SoIC Bulletin

Administration

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Overview

Moore's Law says that computing power doubles every 18 months. Regardless of whether that law is literally correct, it illustrates the rapid changes in information technology that will continue for the foreseeable future. The School of Informatics and Computing prepares students to meet the continuing demand for information technology professionals who know how to grow and adapt to this environment of rapid technological change.

Informatics and Computing is focused on the best applications of technologies, and emphasizes the social and psychological aspects of information technology. Some have called informatics "technology with a human face." Informatics and Computing prepares professionals to use information technology to solve problems in a variety of settings. The degrees emphasize the development of new uses for technologies, always keeping in mind the needs of people and the best and most appropriate uses for technology.

Informatics and Computing students have the following:

- A technical understanding of how computing systems and programs operate
- An ability to adapt/assess and apply new trends in information technology (IT)
- Well-developed problem-solving skills
- Experience working on a team, such as those formed for the senior capstone experience
- Well-developed communications skills to clearly convey solutions and observations to others
- An understanding of social and ethical principles as they relate to IT issues

Degrees from the School of Informatics and Computing are unique because they involve students in learning how information technology relates to a traditional discipline in the sciences, liberal arts, or professions. In the School of Informatics and Computing, a student learns to use technology to solve problems in the chosen area of emphasis and is prepared to use technology to solve problems in a wide variety of career settings.

The undergraduate curriculum looks at information technology from a balanced perspective. It includes a technical core in the areas of mathematical foundations, distributed information, human-computer interaction, social/organization informatics, and new media. In addition to knowledge of core informatics and of informatics in the context of a traditional discipline, students must take a set of general-education courses to ensure that they can communicate clearly in both written and spoken English, read effectively, and reason quantitatively. They must be able to raise and rationally debate ethical concerns suggested by information technologies and their interactions with other people. Students also must have some knowledge of the world; its peoples and their cultural, artistic, and scientific achievements. To this end, the general-education requirement exposes students to the arts and humanities, social and historical studies, and the natural sciences.

The school offers a Bachelor of Science in Informatics degree, four specialized professional master's degrees, a Bachelor of Science in Computer Science degree, the Professional Master's Program in Computer Science, a variety of undergraduate and graduate programs in New Media, and the Undergraduate Program in Health Information Administration. Informatics research is conducted at the Informatics Research Institute, which provides expanded educational opportunities for both undergraduate and graduate students.

Information Technology in Today's Learning

When Indiana University was founded in 1820, only Greek and Latin were taught. The curriculum has obviously changed over time, in response to both intellectual and practical needs. The most recent school to be established at Indiana University, the School of Informatics and Computing, responds to the world's changing needs.

Today, one might say that programming languages and software tools are the Greek and Latin of our times, and no person can be called truly educated without mastery of these "languages." It is not intended to suggest that the classical languages or any natural languages have been supplanted by C++ and Java. Indeed, making available the classical corpus in searchable digital form was one of the first applications of computing to the humanities. The point is to suggest the pervasiveness of information technology in all of civilized life. Much as Greek and Latin opened doors to the scholarship of the nineteenth century, so information technology opens doors to art and science in the twenty-first century.

The development of networks and distributed systems over the past several decades has changed forever the notion of a computer as something that merely "computes." The computer is now an "information processor." Arthur C. Clarke once said that "a sufficiently advanced technology is indistinguishable from magic." Unfortunately, many people see computers and the Internet as magical. The mission of the School of Informatics and Computing is to educate citizens that advanced information technology is indistinguishable (or at least inseparable) from science and the arts.

IU Bloomington

Indiana University Bloomington (IUB) is a residential campus that offers undergraduate, professional, and graduate degrees in more than 70 fields of study. In the fall semester of 2010, the campus had a total enrollment of 42,464, including 31,892 undergraduates and 8,344 students in graduate and professional programs. More than 30 schools and departments at IUB are ranked among the top 10 nationally, with more than 100 ranked in the top 20 in their respective fields.

University Libraries at IUB

The University Libraries at IUB rank fourth in collection size among the Big Ten universities, fifth in the Committee on Institutional Cooperation (CIC), and thirteenth in the nation among major research libraries. The libraries' collections include 7.8 million bound volumes, 4 million microforms, and more than 70,000 current serials.
The Herman B Wells Library houses a core collection especially for undergraduates and extensive graduate research collections—as well as reference services, technical services, government publications, and other essential library services. The Wells Library also is home to the Information Commons, which has more than 350 computer workstations. These facilities are complemented by the 14 campus libraries serving diverse disciplines, such as music, optometry, chemistry, geology, education, business, journalism, and other areas.

University Information Technology Services at IUB

University Information Technology Services (UITS) at IUB supports the application, use, and development of information technology for research, teaching, and learning. UITS makes available more than 1,200 computer workstations, located in 43 Student Technology Centers, for both scheduled instruction and individual study and more than 200 "InfoStations" and other limited-use workstations in locations across campus for access to e-mail and the Web. The Assistive Technology Lab, located in the Wells Library, offers programs and specialized information technology services for students with disabilities. Research computing facilities on campus include two high-performance supercomputers (a 47-processor IBM SP and a 64-processor SGI/Cray Origin2000), a multiterabyte massive data storage system, and a state-of-the-art campus backbone network. Another strength that UITS brings is the Network Operations Centers for both Abilene (Internet 2) and TransPac. More fully described in the next section, they are housed on the IUPUI campus, but scholars and students in Bloomington also benefit from these high-speed communication links.

IUB Hutton Honors College

The School of Informatics and Computing encourages superior students to take advantage of the variety of opportunities offered through the Hutton Honors College and is pleased to help honors students plan their individual programs.

Grants and Scholarships at IUB

The School of Informatics and Computing is developing new sources of funding, and students are encouraged to review the School of Informatics and Computing Web site (http://www.soic.indiana.edu/).

Grants and scholarships also are available through other IU offices, such as the Hutton Honors College. Students are encouraged to consult with the Office of Student Financial Assistance (www.indiana.edu/~sfa) for additional funding opportunities.

IU East

The Bachelor of Science in Informatics is offered on the East campus. Information on the Informatics degree program can be located on the Web at http://www.iue.edu/informatics/.

One School, Multiple Campuses

The School of Informatics spans the IU Bloomington (IUB), Indiana University-Purdue University Indianapolis (IUPUI), IU South Bend (IUSB), IU Kokomo (IUK), IU East (IUEA) and IU Southeast (IUSE) campuses. By combining the strengths of these six campuses, the School of Informatics is able to create a unique environment that enables students to earn degrees with strong information technology components in arts, humanities, science, and the professions. The expert faculty and excellent technological resources foster a synthesis of academic disciplines and cultures. Faculty from varied disciplines share developments in the fast-moving information technology areas through the School of Informatics and its degree programs. The school is actively forging cooperative arrangements with employers in the state and region; and creating internships, cooperative education programs, and opportunities for learning through service.

- IU Bloomington
- IUPUI
- IU East
- IU Kokomo
- IU South Bend
- IU Southeast

IUPUI Indianapolis

IUPUI is an urban campus that combines IU and Purdue programs. In the fall semester of 2009 its schools had a total enrollment of over 30,300, including 22,190 undergraduates and 8,200 students in graduate and professional programs. IUPUI currently ranks among the 10 largest campuses in the nation that offer graduate professional degrees.

IUPUI University Library

The IUPUI University Library is a technology-based learning center that supports teaching and learning in a new Information Commons; at hundreds of workstations in the library; at computers throughout the campus; and in the homes of students, faculty, and staff.

The collection covers a wide range of academic disciplines—from liberal arts to science, engineering, and technology. The collection contains 4,145 subscriptions to electronic and print periodicals, more than 25,000 e-books, more than 1 million print and online volumes, and the Joseph and Matthew Payton Philanthropic Studies Library and Ruth Lilly Special Collections and Archives. The University Library also creates and hosts digital resources about the state of Indiana, including an electronic atlas and image collection.

The University Library information system hosts more than 350 computer workstations, permitting patrons to search for information through an extensive and sophisticated online research system. Word processing and other electronic applications are also available on these machines. The University Library has more than 500 general and graduate study carrels; 40 group-study rooms with seating for approximately 180; and class and meeting rooms, including a 100-seat auditorium.

University Information Technology Services at IUPUI

University Information Technology Services (UITS) at IUPUI supports the application, use, and development of information technology for research, teaching, and

learning. Students have access to more than 500 public workstations on campus. UITS partners with academic schools on campus to provide consulting support in 16 student technology centers and operates another 2 centers as campus-wide resources. The network operations center for Abilene, the high-speed Internet2 backbone network, is located on the IUPUI campus, as is the network operations center for TransPAC, a high-speed network connecting the United States with countries in Asia and the Pacific Rim. The IUPUI campus also is home to the Cisco Networking Academy Training Center and the Cisco Certified Internetwork Expert (CCIE) Practice Lab. One of two such labs in the nation, the CCIE lab provides a testing environment for networking professionals worldwide who are candidates for certification as Cisco Certified Internetwork Experts.

Because Indiana's government, business, industry, finance, health, service, and nonprofit organizations are centered in Indianapolis, the urban environment plays an important role as a learning resource for students enrolled in the informatics programs. Many of the state's communication industries are concentrated in the capital city, and the larger organizations based here have made commitments to improve their communication and business processes through the use of information and information technology. IUPUI has established strong working relationships with both industry and government agencies in communications, information technology, and media arts and sciences.

IUPUI Honors Program

The IUPUI Honors Program offers special opportunities for academically superior students to do honors work or pursue department or general honors degrees. Undergraduates may enroll in independent study, H-Option courses, graduate courses, or designated honors courses. Students should check the Schedule of Classes for course offerings.

Students who have SAT scores of 1100 or above, rank in the top 10 percent of their high school class, or have a 3.30 grade point average are eligible to enroll in honors courses. For additional information on honors degrees, contact the Honors Office, University College 3140, at (317) 274-2660.

Information on the Informatics degree program can be located on the Web at http://informatics.iupui.edu/.

IU Kokomo

The Bachelor of Science in Informatics is offered on the Kokomo campus under the Science, Mathematics, and Informatics Department. Information on the Informatics degree program can be located on the Web at http://www.iuk.edu/sciences/index.php.

IU South Bend

Indiana University South Bend provides all the services and opportunities of a large university combined with the advantages and atmosphere of a small college.

Information on the School of Informatics degree programs offered at the IUSB campus can be located on the Web at https://www.iusb.edu/informatics/.

IU Southeast

The Bachelor of Science in Informatics is offered on the Southeast campus under the Department of Natural Sciences. Information on the Informatics degree program can be located on the Web at http://www.ius.edu/informatics/.

Contact Information

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Disclaimer

While every effort is made to provide accurate and current information, Indiana University reserves the right to change without notice statements in the bulletin series concerning rules, policies, fees, curricula, or other matters.

History

The School of Informatics and Computing offers a new kind of computing education—one where students not only learn how technology works, but also what it can accomplish. Our interdisciplinary approach to research, as well as our innovative curriculum, is designed to instill a new generation of students with the knowledge, imagination, and flexibility to tackle complex issues from global warming to national security. We are training a new kind of thinker, one who is ready to solve the problems of the 21st century.

Computing education has a long and storied history at Indiana University. The Department of Computer Science, founded in 1971, has graduated thousands of students who have gone on to become leaders and innovators in technology development.

The founding of the IU School of Informatics in 2000 added a new dimension to our technology programs. The School of Informatics was the first IT school of its kind—an innovative, interdisciplinary program where technology fuels discoveries in fields as diverse as music and microbiology. We offered the first Ph.D. in Informatics, as well as one of the first master's degrees in cybersecurity.

Recognizing the vital connection between these fields and wanting to provide students with a richer educational experience, the Department of Computer Science and the School of Informatics joined forces in 2005. Now known as the School of Informatics and Computing at IU Bloomington, the school was named one of *Computerworld* magazine's 10 innovative programs that are "IT Schools to Watch" in 2008.

Mission

The Indiana University School of Informatics includes the School of Informatics and Computing at Indiana University Bloomington, the School of Informatics at IUPUI and programs at IU East, IU Kokomo, IU South Bend, and IU Southeast.

The mission of the School is to excel and lead in education, research, and outreach spanning and integrating the full breadth of computing and information technology, including the scientific and technical core, a broad range of applications, and human and societal issues and implications.

The School aims to lead the nation in creating a new, broad and interdisciplinary view of computing and information technology, and uses this viewpoint as the foundation of its main areas of emphasis:

Education and Research

The School offers a broad array of B.S., M.S., and Ph.D. programs in informatics and computer science, and conducts research in a wide range of computing and informatics foundations, applications and implications. This range includes:

- foundational areas including algorithms, data and search, networks and systems, and programming languages
- interdisciplinary applications in areas including artificial intelligence, cognitive science and robotics, complex systems, cyber-infrastructure, digital media, health and life sciences, and security and privacy
- human and societal issues including human computer interaction and social informatics

Economic Development and Entrepreneurship

The School aims to provide talented graduates and professional expertise to a wide range of computing and information technology businesses and occupations, and places special emphasis on partnering with information technology businesses and needs in the state of Indiana. It also emphasizes and supports a culture of entrepreneurship in its students, faculty and alumni.

Diversity

The School aims to provide an environment that involves a diverse array of students, staff and faculty, including women and under-represented minorities, and people with a wide range of intellectual interests and talents. The broad view that the School takes of computing and information technology education and research provides a strong foundation for its diversity goals and being recognized as a national exemplar.

Undergraduate Programs

The School of Informatics and Computing offers a Bachelor of Science in Informatics (INFOBS), a Bachelor of Science in Computer Science (CSCIBS), a Bachelor of Science in Intelligent Systems Engineering (ISENGRBS), and an Accelerated Master's in Computer Science.

The very nature of these degrees, with the changing technologies and applications, requires that the content of each degree be continuously assessed and revised. Therefore, the faculty of the School of Informatics and Computing will periodically review and revise the curricula to ensure that students are prepared to meet contemporary workplace and intellectual demands. Please email the School of Informatics and Computing Student Services Office at soicugrd@indiana.edu or refer to our website at www.soic.indiana.edu/.

Academic counseling for each student in the School of Informatics and Computing is provided by an academic advisor prior to each semester's enrollment. Although academic counseling is intended to provide effective guidance, students are responsible for planning their own programs and for meeting the following degree requirements for graduation. Students are advised to read bulletin descriptions of all courses selected, paying careful attention to conditions concerning awarding of credit.

Admission

Direct Admission

Each year, qualified high school seniors are invited to be directly admitted to the School of Informatics and Computing. To be eligible for Direct Admission, students must have:

- Submitted a complete application to the Office of Admissions by November 1.
- Admitted to Indiana University with either Computer Science B.S., Intelligent Systems Engineering B.S., or Informatics B.S. listed as intended major on your IU Bloomington application.
- Have a minimum SAT score of 1310 (critical reading and math only) or minimum ACT score of 28. Superscores are accepted for both SAT and ACT.
- A 620 minimum math SAT score or 26 math ACT score if your intended major is Intelligent Systems Engineering.
- Have a minimum cumulative GPA of 3.75 on a 4.0 scale. Indiana University Bloomington and School of Informatics and Computing accepts weighted GPAs if provided on your high school transcript. All

GPAs will be converted to a 4.0 scale by the Office of Admissions.

You will receive official notification of your direct admission to the School of Informatics and Computing within four weeks of having been admitted to Indiana University Bloomington.

Standard Admission

Students wishing to major in informatics or computer science must be admitted to Indiana University and first enter the University Division at IUB. Freshmen should begin to satisfy specific degree requirements in the first year. Informatics BS and Computer Science BS majors, after declaring their respective major and completion of the below requirements, will automatically "certify" from University Division in the certification after requirements are completed. For these 2 majors, no application is required and certification is 3 times a year, February (after fall semester), June (after spring semester), and October (after summer sessions).

Students pursuing a Bachelor of Science degree in informatics must satisfy the following requirements:

- Complete 30 credit hours of course work that can count toward a bachelor of science degree in informatics with a minimum cumulative grade point average of 2.0.
- Complete the English composition requirement (ENG-W 131 or equivalent) with a minimum grade of C.
- Complete INFO-I 101, Introduction to Informatics, with a minimum grade of C.

Students pursuing a Bachelor of Science degree in computer science must satisfy the following requirements:

- Complete 30 credit hours of course work that can count toward a bachelor of science degree in computer science with a minimum cumulative grade point average of 2.0.
- Complete the English composition requirement (ENG-W 131 or equivalent) with a minimum grade of C.

Students pursuing a Bachelor of Science degree in intelligent systems engineering must satisfy the following requirements:

- Completion of IU's MATH-M 211 and M 212 with a minimum grade of B.
- Completion of IU's PHYS-P 221 with a minimum grade of B.
- Complete 30 credit hours of course work that can count toward a bachelor of science degree in intelligent systems engineering with a minimum cumulative grade point average of 3.3.
- A demonstrated commitment to course load; students with no W's in course work have stronger applications.

If you meet the above criteria, please contact soicugrd+recruiting@indiana.edu to request an application to be considered for the intelligent systems engineering program.

Contact the Office of Admissions at (812) 855-0661, e-mail iuadmit@indiana.edu, or view the website at www.indiana.edu/~iuadmit/ for complete instructions. For specific information on the School of Informatics and Computing, e-mail soicugrd@indiana.edu@, or view the website at www.soic.indiana.edu/.

Courses

Computer Science

Engineering

Informatics

Information and Library Science

Computer Science

CSCI-A courses are non-major courses and are listed first regardless of the course level.

CSCI-A 110 Introduction to Computers and Computing (3 cr.) CASE N&M P: One year of high school algebra or MATH-M 014. Basic principles of computers and software. Social and lifestyle effects of information technology. Emphasis on problem-solving techniques. Productivity software skills are taught using real-world projects. Lecture and laboratory. Credit given for only one of CSCI-A 106, A 110, or A 111.

CSCI-A 111 A Survey of Computers and Computing (1.5 cr.) P: One year of high school algebra or MATH-M 014, and some prior computing experience. Survey of computing concepts, with emphasis on problem-solving techniques. Experience in a variety of popular applications software for tasks such as word processing, Web browsing, spreadsheet calculations, and databases. Lecture and laboratory. An eight-week course. Credit given for only one of CSCI-A 106, A 110, or A 111.

CSCI-A 112 Programming Concepts (1.5 cr.) P: CSCI-A 110, A 111, or equivalent computing experience. Introduction to programming for users of computer systems. Emphasis on problem-solving techniques. Lecture and laboratory. An eight-week course. Credit not given for both CSCI-A 112 and INFO-I 110.

CSCI-A 113 Data Analysis Using Spreadsheets (1.5 cr.) P: CSCI-A 110, A 111, or equivalent. An introduction to data analysis using spreadsheets, including both scientific and business applications. Elementary statistical concepts and their applications to data analysis. Emphasis on problem-solving techniques. Lecture and laboratory. An eight-week course.

CSCI-A 114 Introduction to Databases (1.5 cr.) P: CSCI-A 110, A 111, or equivalent. Introduction to database design concepts. Entering and modifying data, accessing data using visual tools and SQL, building database applications using forms and application development tools. Emphasis on problem-solving techniques. Lecture and laboratory. An eight-week course. Credit not given for both CSCI-A 114 and INFO-I 111.

CSCI-A 201 Introduction to Programming I (4 cr.) CASE N&M P: Two years of high school mathematics or MATH-M 014. Fundamental programming constructs, including loops, arrays, and files. General problem-solving techniques. Emphasis on modular programming and developing good programming style. Not intended for computer science majors. Credit not given for both CSCI-A 201 and A 597.

CSCI-A 202 Introduction to Programming II (4 cr.) CASE N&M P: CSCI-A 201 or A 304. Advanced programming techniques: user-defined functions and types, recursion vs iteration, parameter-passing mechanisms; Classic abstract data types and algorithms. Programming style. Object-oriented programming. Web programming. May be counted toward computer science major requirements if completed prior to CSCI-C212. Advanced programming techniques: user-defined functions and types, recursion vs iteration, parameter-passing mechanisms; Classic abstract data types and algorithms. Programming style. Object-oriented programming. Web programming. May be counted toward computer science major requirements if completed prior to CSCI-C212. Credit not given for both CSCI-A 202 and A 598.

CSCI-A 216 Digital Multimedia Concepts and Technologies (3 cr.) P: CSCI-A 110, A 111, or equivalent computing experience. **N & M** In-depth introduction to the technologies of digital hardware and software relevant to efficient multimedia communication methods. Lectures focus on computational foundations, underlying concepts, and digital methods. Laboratory provides direct experience with concepts presented in lecture, using latest available digital tools to create direct and Web-based multimedia content. Lecture and laboratory.

CSCI-A 290 Tools for Computing (1-4 cr.) Exploration of topics in computing. Common topics include tools for power users. Prerequisites vary by topic. Lecture and laboratory format. May be repeated for a maximum of 6 credit hours.

CSCI-A 304 Introductory C++ Programming (2 cr.) P: Programming experience. Topics include aspects of C++ that are not object-oriented, basic data structures, standard libraries, and UNIX tools for project management.

CSCI-A 306 Object-Oriented Programming in C++ (2 cr.) P: CSCI-A 201, A 304, A 597, or C 212. Topics include objects, classes, encapsulation, inheritance, polymorphism, templates, and exceptions.

CSCI-A 321 Computing Tools for Scientific Research (4 cr.) CASE N&M P: MATH-M 118 or higher required; MATH-M 211 recommended. Introduction to computer-based tools useful for analysis and understanding of scientific data. Basic methods of computation, data processing, and display in systems such as Matlab combined with elementary practical C/C++ programming. Techniques to support customized scientific research tasks, with particular emphasis on biological, neural, and behavioral sciences. Lecture and laboratory.

CSCI-A 338 Network Technologies and Administration (4 cr.) P: CSCI-A 110, EDUC-W 200, or equivalent computer literacy. Introduction to network principles and current network technology, both hardware and software. Network administration tools and techniques. Laboratory provides practical experience.

CSCI-A 346 User-Interface Programming (3 cr.) P: CSCI-A 202, A 306, A 597, C 212, or equivalent experience. Learn to prototype and build graphical user interfaces for computer applications. Contemporary software design methodology. Students design and implement prototype interfaces to applications provided by the instructor. Extensive use is made of both commercial and experimental software tools.

CSCI-A 348 Mastering the World Wide Web (3-4 cr.) P: Two semesters of programming experience, or equivalent, and some knowledge of operating systems. Project-oriented course leading to ability to maintain a fully functional Web site. Topics include Internet network protocols and Web programming, server administration, protocols, site design, and searching and indexing technologies.

CSCI-B 351 Introduction to Artificial Intelligence (3 cr.) CASE N&M P: CSCI-C 200 or C 211. A survey of techniques for machine intelligence and their relation to human intelligence. Topics include modeling techniques, neural networks, problem-solving methods, heuristics, search, logic, knowledge representation, machine learning, and production systems. Credit not given for both CSCI-B 351 and COGS-Q 351.

CSCI-B 355 Autonomous Robotics (3 cr.) P: Two semesters of computer programming or consent of instructor. Introduction to the design, construction, and control of autonomous mobile robots. This course covers basic mechanics, electronics and programming for robotics, as well as the applications of robots in cognitive science. Credit not given for both CSCI-B 355 and COGS-Q 360.

CSCI-B 363 Bioinformatics Algorithms (4 cr.) P: One programming class or equivalent programming experience in C/C++, Java or Python. The course will introduce algorithms for addressing real-world biological questions. For each topic, we will start with an important biological question and gradually present algorithms to answer this question. The course will also discuss the strategies to formulate an appropriate computation problem from a biological question to motivate algorithmic thinking.

CSCI-B 365 Introduction to Data Analysis and Mining (3 cr.) P: Basic programming skills (CSCI-C 200, C-211 or INFO-I 210). The course objective is to study computational aspects of discovering patterns and relationships in large data. This course is designed to introduce fundamental concepts of data mining and provide hands-on experience in data collection, preprocessing, analysis, clustering and prediction.

CSCI-B 392 Competitive Programming (2 cr.) P: CSCI-C 343 or instructor permission. This course focuses on training students to prepare for programming contests (such as the ACM International Collegiate Programming Contest). The students will learn to design time and space efficient algorithms to solve challenging contest problems, and produce bug-free code under the pressure of time in contest. May be repeated for a maximum of 6 credit hours.

CSCI-B 401 Fundamentals of Computing Theory (3 cr.) CASE N&M P: CSCI-C 241. CSCI-C 212. C: CSCI-C 212. Fundamentals of formal language theory, computation models and computability, the limits of computability and feasibility, and program verification.

CSCI-B 403 Introduction to Algorithm Design and Analysis (3 cr.) CASE N&M P: CSCI-C 241, C 343 and MATH-M 216 or M 212. Algorithm design methodology. General methods for analysis of algorithms. Analysis of

the performance of specific algorithms, such as those for searching and sorting. Credit not given for both CSCI-B 403 and B 503.

CSCI-B 430 Security for Networked Systems (3 cr.) P: INFO-I 230, I 231 and (I 211 or CSCI-C 212). This course is an extensive survey of network security. The course materials cover threats to information confidentiality, integrity, and availability in different internet layers, and defense mechanisms that control these threats. The course also provides a necessary foundation on network security, such as cryptographic, primitives/ protocols, authentication, authorization and access control technologies; and hands-on experiences through programming assignments and course projects. Credit given for only one of CSCI-B 430, INFO-I 430, or I 520.

CSCI-B 433 Systems & Protocol Security & Information Assurance (3 cr.) P: INFO-I 230, I 231 (and I 211 or CSCI-C 212). This class covers the fundamentals of computer security by looking at how things can go wrong, and how people can abuse the system. This is a matter of creative cheating; to find loopholes and exploit them. After students learn how to attack the system, it is possible to propose ways to make the system secure. Students will gain a basic overview of existing security problems and be exposed to methods that can be used to secure against such problems. The course should be taken by any one designing, selecting, or using applications in which security or privacy plays a role. Credit given for only one of CSCI-B 433, INFO-I 433, or I 533.

CSCI-B 441 Digital Design (4 cr.) CASE N&M P: CSCI-C 335. Lab fee. Organization and logic design of digital systems. Course presents a structured design philosophy, emphasizing hardwired and microprogrammed control. Boolean algebra, hardware building blocks, circuit synthesis, microprogramming. In the laboratory, students build, study, and debug a working minicomputer from elementary hardware components. Lecture and laboratory. Credit not given for both CSCI-B 441 and B 541.

CSCI-B 443 Introduction to Computer Architecture (3 cr.) CASE N&M P: CSCI-C 335 and C 343. Principles of processors, control units, and storage systems. Registers, buses, microprogramming, virtual storage. Relationship between computer architecture and system software. Credit not given for both CSCI-B 443 and B 543.

CSCI-B 455 Principles of Machine Learning (3 cr.) P: MATH-M 211 and CSCI-C 211 or previous programming experience. In this course, we explore (machine learning) algorithms that can learn from and make predictions on data. This course introduces the statistical, mathematical, and computational foundations of these frameworks, with a strong focus on understanding the mathematical derivations for the algorithms and simultaneously implementing the algorithms.

CSCI-B 456 Image Processing (3 cr.) P: MATH-M 212 and CSCI-C 212. The course emphasizes the general principle of image processing which includes data structures, algorithms, and analysis and modeling techniques used in modern imaging systems, digital image processing, and low-level computer vision. Topics include image sources, computer representation of images and formats, operations on images, and image analysis.

CSCI-B 457 Introduction to Computer Vision (3 cr.) P: CSCI-B 351 or C 343. In this course, the students will learn fundamental computer vision algorithms as well as basic machine learning frameworks necessary for automated understanding of images and videos. Topics will include object recognition from images, activity/ event recognition from videos, scene segmentation and clustering, motion and tracking, deep learning for images and videos.

CSCI-B 461 Database Concepts (3 cr.) CASE N&M P: CSCI-C 241and C 343. Introduction to database concepts and systems. Topics include database models and systems: hierarchical, network, relational, and object-oriented; database design principles; structures for efficient data access; query languages and processing; database applications development; views; security; concurrency; recovery. Students participate in a project to design, implement, and query a database, using a standard database system. Credit not given for both CSCI-B 461 and B 561.

CSCI-B 481 Interactive Graphics (4 cr.) CASE N&M P: CSCI-C 343 and MATH-M 301 or M 303. Computer graphics techniques. Introduction to graphics hardware and software. Two-dimensional graphics methods, transformations, and interactive methods. Three-dimensional graphics, transformations, viewing geometry, object modeling, and interactive manipulation methods. Basic lighting and shading. Video and animation methods. Credit not given for both CSCI-B 481 and B 581.

CSCI-B 490 Seminar in Computer Science (1-4 cr.) Special topics in computer science. May be repeated for a maximum of 8 credit hours.

CSCI-C 102 Great Ideas in Computing (3 cr.) Survey of great ideas in computing in the modern world. Explores how people use computing tools to realize their ideas. Emphasis on the impact of modern technology and the use of hardware and software to create solutions to everyday problems. Lecture and laboratory.

CSCI-C 200 Introduction to Computers and Programming (4 cr.) P: High school precalculus math. This course is an introduction, broadly, to algorithmic thinking and, specifically, to programming. It teaches the basics of programming using real world applications in natural, physical and social sciences. Students will develop ability to program by identifying problems in real world and then creating a program that solves the problem. Credit given for only one of CSCI-C 200, C 211, H 211 or A 591.

CSCI-C 211 Introduction to Computer Science (4 cr.) CASE N&M P: High school precalculus math. A first course in computer science for those intending to take advanced computer science courses. Introduction to programming and to algorithm design and analysis. Using the Scheme programming language, the course covers several programming paradigms. Lecture and laboratory. Credit given for only one of CSCI-C 211, C 200, H 211 or A 591.

CSCI-H 211 Introduction to Computer Science, Honors (4 cr.) CASE N&M P: High school precalculus

math. Honors version of CSCI-C 211. A first course in computer science for those intending to take advanced computer science courses. Introduction to programming and to algorithm design and analysis. Using the Scheme programming language, the course covers several programming paradigms. Lecture and laboratory. Credit given for only one of CSCI-H 211, C 200, C 211 or A 591.

CSCI-C 212 Introduction to Software Systems (4 cr.) CASE N&M P: CSCI-C 200 or C 211. Design of computer software systems and introduction to programming in the environment of a contemporary operating system. Topics include a modern object-oriented programming language; building and maintaining large projects; and understanding the operating system interface. Lecture and laboratory. Credit given for only one of CSCI-C 212, H 212, A 592 or ENGR-E 111.

CSCI-H 212 Introduction to Software Systems, Honors (4 cr.) CASE N&M P: CSCI-C 200 or C 211. Honors version of CSCI-C 212. Design of computer software systems and introduction to programming in the environment of a contemporary operating system. Topics include a modern object-oriented programming language; building and maintaining large projects; and understanding the operating system interface. Lecture and laboratory. Credit given for only one of CSCI-H 212, C 212, A 592 or ENGR-E 111.

CSCI-C 231 Introduction to Mathematics of Cybersecurity (3 cr.) The goal of this course is for students to be introduced to the basic mathematical tools used in modern cybersecurity. The course covers introductory mathematical material from a number of disparate fields including probability theory, analysis of algorithms, complexity theory, number theory, and group theory. Credit not given for both CSCI-C 231 and INFO-I 231.

CSCI-C 241 Discrete Structures for Computer Science (3 cr.) CASE N&M P: CSCI-C 200 or C 211. MATH-M 211 recommended. Induction and recursive programs, running time, asymptotic notations, combinatorics and discrete probability, trees and lists, the relational data model, graph algorithms, propositional and predicate logic. Credit not given for both CSCI-C 241 and H 241.

CSCI-H 241 Discrete Structures for Computer Science, Honors (3 cr.) CASE N&M P: CSCI-C 200 or C 211. MATH-M 211 recommended. Honors version of CSCI-C 241. Induction and recursive programs, running time, asymptotic notations, combinatorics and discrete probability, trees and lists, the relational data model, graph algorithms, propositional and predicate logic. Credit not given for both CSCI-H 241 and C 241.

CSCI-C 290 Topics in Computer Science (1-3 cr.) P: Prerequisites vary by topic. Exploration of topics in computing and computer science. Common topics include tools for power users. May be repeated for a maximum of 6 credit hours.

CSCI-C 291 System Programming with C and Unix (1.5 cr.) P: CSCI-C 200, C 211, CSCI-A 201, or INFO-I 211. This course provides an introduction to programming in a Unix (Linux) environment using the C language. The key ideas to be discussed are: the Unix shell, file system and basic shell commands; the emacs text editor; and the C programming language.

CSCI-C 295 Leadership and Learning (1-2 cr.) P: CSCI-C 200, C 211, A 201, or INFO-I 210. Students in this course learn and practice how to teach fundamental Computer Science concepts and skills, and investigate strategies to increase K-12 students' interest in CS with different race, gender, age, socioeconomic status, and academic background. Furthermore, this course trains undergraduate instructors in the department to better perform their duties.

CSCI-C 311 Programming Languages (4 cr.) CASE N&M P: CSCI-C 212. C: CSCI-C 241. Systematic approach to programming languages. Relationships among languages, properties and features of languages, and the computer environment necessary to use languages. Lecture and laboratory. Credit given for only one of CSCI-C 311, H 311, A 596 or B 521.

CSCI-H 311 Programming Languages, Honors (4 cr.) CASE N&M P: CSCI-C 212. C: CSCI-C 241. Honors version of CSCI-C 311. Systematic approach to programming languages. Relationships among languages, properties and features of languages, and the computer environment necessary to use languages. Lecture and laboratory. Credit given for only one of CSCI-H 311, C 311, A 596 or B 521.

CSCI-C 322 Object-Oriented Software Methods (4 cr.) P: CSCI-C 212. Design and implementation of complex software systems and applications exploiting the object-oriented paradigm. Selection and effective utilization of object-oriented libraries and interfaces.

CSCI-C 323 Mobile App Development (3 cr.) P: CSCI-C 212. This course focuses on development of mobile applications for modern platforms and introduces common tools and languages used. The course will emphasize the app development cycle: application design, development, testing, publishing and distribution; development tools and emulators/simulators; user interface layout; using sensors including touch, geo-location and orientation; and data management.

CSCI-C 335 Computer Structures (4 cr.) CASE N&M P: CSCI-C 212 and C 291. CSCI-C 241 C: CSCI-C 241. Lab fee. Structure and internal operation of computers. The architecture and assembly language programming of a specific computer are stressed, in addition to general principles of hardware organization and low-level software systems. Lecture and laboratory. Credit not given for both CSCI-C 335 and H 335.

CSCI-H 335 Computer Structures, Honors (4 cr.) CASE N&M P: CSCI-C 212 and C 291. CSCI-C 241. C: CSCI-C 241. Lab fee. Honors version of CSCI-C 335. Structure and internal operation of computers. The architecture and assembly language programming of a specific computer are stressed, in addition to general principles of hardware organization and low-level software systems. Lecture and laboratory. Credit not given for both CSCI-H 335 and C 335.

CSCI-C 343 Data Structures (4 cr.) CASE N&M P: CSCI-C 212. CSCI-C 241. C: CSCI-C 241. Systematic study of data structures encountered in computing problems, structure and use of storage media, methods of

representing structured data, and techniques for operating on data structures. Lecture and laboratory. Credit not given for both CSCI-C 343 and H 343.

CSCI-H 343 Data Structures, Honors (4 cr.) CASE N&M P: CSCI-C 212. CSCI-C 241. C: CSCI-C 241. Honors version of CSCI-C 343. Systematic study of data structures encountered in computing problems, structure and use of storage media, methods of representing structured data, and techniques for operating on data structures. Lecture and laboratory. Credit not given for both CSCI-H 343 and C 343.

CSCI-P 415 Introduction to Verification (3 cr.) CASE N&M P: CSCI-C 311. Tools and techniques for rigorous reasoning about software and digital hardware. Safety, reliability, security, and other design-critical applications. Decision algorithms. Projects involving the use of automated reasoning, such as model checkers, theorem provers, and program transformation. Credit not given for both CSCI-P 415 and P 515.

CSCI-P 423 Compilers (4 cr.) CASE N&M P: CSCI-C 311. Compiler design and construction, including lexical analysis, parsing, code generation, and optimization. Extensive laboratory exercises. Credit not given for both CSCI-P 423 and P 523.

CSCI-P 424 Advanced Functional Programming (3 cr.) P: Experience with functional programming and types, such as taught in CSCI-C 311. This course teaches advanced techniques for functional programming, which can be used to make programs easier to read and compose. These techiniques include equational reasoning, types, monads, and code generation. Some of them are useful even when using a "non-functional" language. Some of them are drawn from cutting-edge research.

CSCI-P 434 Distributed Systems (4 cr.) P: CSCI-C 343. Principles of distributed systems including sytem design, distributed algorithms, consistency and concurrency, and reliability and availability. The role of these foundational issues in distributed file systems, distributed computing, and data-driven systems. Credit not give for both CSCI-P 434 and B 534.

CSCI-P 436 Introduction to Operating Systems (4 cr.) CASE N&M P: CSCI-C 335 and C 343. Organization and construction of computer systems that manage computational resources. Topics include specification and implementation of concurrency, process scheduling, storage anagement, device handlers, mechanisms for event coordination. Lecture and laboratory. Credit given for only one of CSCI-P 436, P 536 or ENGR-E 316.

CSCI-P 438 Introduction to Computer Networks (4 cr.) P: CSCI-C 335. Foundations of computer networks. Networking hardware technology such as Ethernet, ATM, wireless. Networking protocols (TCP/IP), routing, error correcting. Network services such as DNS, Web servers, virtual private networks (VPN), open SSL. Credit given for only one of CSCI-P 438, P 538, or ENGR-E 318.

CSCI-P 442 Digital Systems (4 cr.) CASE N&M P: CSCI-B 441. Lab fee. Elements of computer architecture construction of hardware systems, emphasizing a combination of components to form systems, and applications of general principles of computing to digital implementation. Lecture and laboratory. Credit not given for both CSCI-P 442 and P 542.

CSCI-P 462 Database Application Design and Implementation (3 cr.) P: CSCI-B 461 This course deals with practical issues in the design and implementation of database application systems. Topics include database modeling design, query languages, communication with data, transaction management, concurrency control techniques, security, database design procedures, and some advanced database applications, such as data warehousing, data mining, semi-structured data and semantic web.

CSCI-P 465 Software Engineering for Information Systems I (3 cr.) CASE N&M P: CSCI-C 343. Analysis, design, and implementation of information systems. Project specification. Data modeling. Software design methodologies. Software quality assurance. Supervised team development of a real system for a real client. Credit not given for both CSCI-P 465 and P 565.

CSCI-P 466 Software Engineering for Information Systems II (3 cr.) CASE N&M P: CSCI-C 343. CSCI-B 461. C: CSCI-B 461. Analysis, design, and implementation of information systems. Project specification. Data modeling. Software design methodologies. Software quality assurance. Supervised team development of a real system for a real client. Credit not given for both CSCI-P 466 and P 566.

CSCI-Y 390 Undergraduate Independent Study (1-3 cr.) P: Instructor's permission. Independent research based on existing literature or original work. A report, in the style of a departmental technical report, is required. May be repeated for a maximum of 6 credit hours of any combination of CSCI-Y 390, Y 391, Y 399 and Y 499.

CSCI-Y 391 Undergraduate Independent System Development (1-3 cr.) P: Instructor's permission. The student designs, programs, verifies, and documents a project assignment. Prior to enrolling, the student must arrange for an instructor to supervise the course activity. May be repeated for a maximum of 6 credit hours of any combination of CSCI-Y 390, Y 391, Y 399 and Y 499.

CSCI-Y 395 Career Development for CSCI Majors (1 cr.) Develop skills and knowledge that enable you to successfully pursue your career search, both at the time of graduation and later as you progress through your career. The course covers techniques and strategies which make your job search more efficient and effective. Credit not given for both CSCI-Y 395 and INFO-Y 395.

CSCI-Y 399 Project in Professional Practice (3 cr.) P: CSCI-C 343 and one other computer science major course of 300 level or above and approval of department. The student designs, programs, verifies, and documents a project assignment selected in consultation with an employer and the department. May be repeated for a maximum of 6 credit hours of any combination of CSCI-Y 390, Y 391, Y 399 and Y 499.

CSCI-Y 499 Honors Research (1-12 cr.) P: Approval of departmental honors committee. May be repeated for a maximum of 6 credit hours of any combination of CSCI-Y 390, Y 391, Y 399 and Y 499.

CSCI-H 498 Undergraduate Honors Seminar (1-3 cr.) P: Junior or senior major in computer science or

informatics with a GPA of at least 3.3, or permission of instructor. A survey of faculty research in computer-related fields with different professors discussing their research each week. May be repeated for a maximum of 6 credit hours.

Engineering

ENGR-E 101 Innovation and Design (3 cr.) Innovation and Design provides an introduction to Intelligent Systems Engineering. Students learn about engineering and the focus areas through interactive lectures and hands-on activity quests. Students present each quest with a new media to practice presenting data. Students will learn about professional development and start a digital portfolio.

ENGR-E 110 Engineering Computing Architectures (3 cr.) This course introduces the architecture of computing systems from logic gates through arithmetic logic units, central processing unit, and memory. It proceeds through the integration into a simple, but complete computing device including the necessary software elements.

ENGR-E 111 Software Systems Engineering (4 cr.) This course covers core aspects of the practice of software engineering, from basic programming concepts to design to development, debugging and maintenance. This course will cover software design, considering abstraction, modularity and encapsulation. It will cover requirements and process management, testing and maintenance, common software structures and software development tools. Credit given for only one of ENGR-E 111, CSCI-C 212, H 212 or A 592.

ENGR-E 201 Computer Systems Engineering (3 cr.) P: ENGR-E 110. This course covers modern computing devices, the computing ecosysytem and introductory material in systems programming, computer architecture, operating systems and computer networks. Coursework includes fundamental concepts at the basis of modern computing systems, covering costs in time, space and energy. The curriculum includes basic operational concepts in programming, computer architecture and networking.

ENGR-E 210 Engineering Cyber-Physical Systems (3 cr.) P: ENGR-E 201 and E 221. This course provides an introduction to core topics in cyber-physical systems. These topics include embedded systems, issues of real-time processing, and sensor mechanisms and control algorithms. Students will study applications of these elements in the Internet of Things and Robotics.

ENGR-E 221 Intelligent Systems I (3 cr.) P: MATH-M 211, M 212, PHYS-P 221 and ENGR-E 111. This course introduces important concepts about intelligent systems. It provides a basis in mathematical tools and algorithms used in AI and machine learning. It introduces optimization techniques used in Intelligent Systems II. It will describe many current examples and how they are implemented in cloud systems. The course is based on Python for data analytics.

ENGR-E 222 Intelligent Systems II (3 cr.) P: ENGR-E 221. In this course students will be familiarized with different specific applications and implementations of intelligent systems and their use in desktop and cloud solutions.

ENGR-E 250 Systems, Signals, and Control (3 cr.) P: MATH-M 211 and M 212. Many engineering systems are based on signal processing and this course covers fundamental concepts in signals, systems, and control theory. Basic topics are covered, including continuous and discrete time signals and systems, filtering and sampling, Fourier transforms and its variants, and basic feedback systems.

ENGR-E 299 Engineering Professionalization & Ethics (1 cr.) This course introduces topics in engineering related to professionalism and ethics designed to develop ethical reasoning skills, increase ethical awareness and professionalism, and to analyze ethical dilemmas, specific to engineering. Students will learn ethical principles that can be applied in research, design and development. An eight-week course.

ENGR-E 311 Circuits and Digital Systems (3 cr.) P: ENGR-E 110 and PHYS-P 222. This course will cover elements of circuits, such as the operation of basic circuit elements, fundamental circuit laws, and analytic techniques in both the time domain and the frequency domain. It will also cover the transistor-level design of circuits in the context of modern integrated-circuit technology. Credit given for only one of ENGR-E 111, CSCI-C 212, H 212, or A 592.

ENGR-E 314 Embedded Systems (3 cr.) This course covers Embedded and Real-Time Systems designed for real-time multiprocessing and distributed processing. It discusses theoretical and practical concepts in real-time systems emphasizing both hard and soft real-time distributed multi-processing. Several operating systems (e.g. Xinu, Linux, VxWorks), computer architectures and process scheduling methods will be used to illustrate concepts. Credit not given for both ENGR-E 314 and E 514.

ENGR-E 315 Digital Design with FPGAs (3 cr.) P: ENGR-E 101 and E 221. This course introduces digital design techniques using field programmable gate arrays (FPGAs). It discusses FPGA architecture, digital design flow using FPGAs, and other technologies associated with field programmable gate arrays. The course study will involve extensive lab projects to give students hands-on experience on designing digital systems on FPGA platforms.

ENGR-E 317 High Performance Computing (3 cr.) P: Beginner/intermediate C/C++ experience. Familiarity with Linux/Unix command-line utilities. Students will learn the development, operation, and application of high performance computing systems prepared to address future challenges demanding capability and expertise in HPC. The course is interdisciplinary combining critical elements from hardware technology and architecture, system software and tools, and programming models and application algorithms with the cross-cutting theme of performance management and measurement. Credit not given for both ENGR-E 317 and E 517.

ENGR-E 321 Advanced Cyber-Physical Systems (3 cr.) P: ENGR-E 210 or equivalent. This course is the entry point into the cyber-physical systems specialization. It provides in-depth coverage of core topics in cyber-

physical systems. It will treat issues of data analysis and reactive actuation, as well as power management and mobility. The course will explore formal models for designing and predicting system behavior.

ENGR-E 327 Automated Fabrication Machines (3 cr.) P: ENGR-E 210. This course will engage students in understanding fabrication machines as cyber-physical systems using computer numeric control (CNC), and in understanding how they work by designing, constructing, and programming such devices. This course will provide hands-on experience developing and using 2D and 3D graphics primitives and implementing devices that provide them.

ENGR-E 332 Introduction to Modeling and Simulation (3 cr.) P: MATH-M 211, M 212, M 343, PHYS-P 221, P 222 or equivalent. This course introduces computational modeling and simulation used for solving problems in many engineering fields. Basics of deterministic and stochastic simulation methods are covered. Optimization techniques, use of high-performance computing, and engineering applications of simulations are discussed.

ENGR-E 340 Introduction to Computational Bioengineering (3 cr.) P: ENGR-E 331 and BIOL-L 112 or equivalent. ENGR-E 332 recommended or may be taken concurrently. This course introduces key computational modeling techniques for bioengineering, with a focus on cell population kinetics, cell signaling, receptor trafficking, pharmacokinetics/pharmacodynamics, and compartmental and systems physiology methods. Concepts in control theory and optimization will also be applied to steer the modeled biological systems towards design objectives.

ENGR-E 390 Undergraduate Independent Study (1-3 cr.) P: Instructor's permission. Independent research based on existing literature or original work. A report, in the syle of a departmental technical report, is required. May be repeated for a maximum of 6 credit hours.

ENGR-E 399 Topics in Intelligent Systems Engineering (1-3 cr.) P: Must be a student in the ISE undergraduate program or instructor's permission. Variable topic. Emphasis is on new developments and research in Intelligent Systems Engineering. May be repeated with different topics.

ENGR-E 416 Engineering Cloud Computing (3 cr.) P: Experience with Windows or Linux using Java and scripts. The course covers basic concepts on programming models and tools of cloud computing to support data intensive science applications. Students will get to know the latest research topics of cloud platforms, parallel algorithms, storage and high level language for proficiency with a complex ecosystem of tools that span many disciplines. Credit not given for both ENGR-E 416 and E 516.

ENGR-E 434 Big Data Applications (3 cr.) P: Java and/or Python will be used as programming languages. This is an overview course of Big Data Applications covering a broad range of problems and solutions. It covers cloud computing technologies and includes a project. Algorithms are introduced and illustrated. Credit given for only one of ENGR-E 434, E 534, INFO-I 423, or I 523.

ENGR-E 435 Image Processing (3 cr.) P: Experience with signal processing or machine learning; Linear algebra and Calculus II. The input or output of many engineering tools are images. Therefore, engineers need to know how to process them. Image processing will teach students how to design and implement their own algorithms for automatically detecting, classifying, and analyzing objects in images.

ENGR-E 440 Computational Methods for 3-D Biomaterials (3 cr.) P: ENGR-E 331, E 340 and PHYS-P 222 or equivalent or instructor permission. This computational engineering course teaches key biophysics and numerical concepts needed to simulate 3-D biological tissues, including finite element methods, conservation laws, biotransport, fluid mechanics, and tissue mechanics. The entire course will combine lectures with hands-on lab projects to simulate 3-D biological materials, and prepare students for computational tissue engineering. Credit not given for both ENGR-E 440 and E 540.

ENGR-E 441 Simulating Cancer as an Intelligent System (3 cr.) P: Familiarity with advanced engineering mathematics. This course explores cancer as an adaptive intelligent system, where renegade cells break the rules, reuse the body's natural processes to re-engineer their environments and evade treatments. We will use computational models to explore this system and the potential for future clinicians to plan treatments with data-driven models. Credit not given for both ENGR-E 441 and E 541.

ENGR-E 483 Information Visualization (3 cr.) This course provides students with a working knowledge on how to visualize abstract information and hands-on experience in the application of this knowledge to specific domains, different tasks, and diverse, possibly non-technical users. Credit not given for both ENGR-E 483 and E 583.

ENGR-E 484 Scientific Visualization (3 cr.) This course teaches basic principles of human cognition and perception; techniques and algorithms for designing and critiquing scientific visualizations in different domains (neuro, nano, bio-medicine, IoT, smart cities); hands-on experience using modern tools for designing scientific visualizations that provide novel and/or actionable insights; 3D printing and augmented reality deployment; teamwork/project management expertise. Credit not given for both ENGR-E 484 and E 584.

ENGR-E 490 Engineering Capstone Design I (3 cr.) P: Junior or senior standing. Engineering Capstone Design I is one of two capstone requirements for all Intelligent Systems Engineering students. Students will design engineering projects based on their areas of concentration, which will be supported by dedicated faculty members. Students may choose to conduct advanced research, develop prototypes, design new products or redesign existing products.

ENGR-E 491 Engineering Capstone Design II (3 cr.) P: Junior or senior standing. Engineering Capstone Design II is the second of two capstone requirements for all Intelligent Systems Engineering students. Students will design engineering projects based on their areas of concentration, which will be supported by dedicated faculty members. Students may choose to conduct

advanced research, develop prototypes, design new products or redesign existing products.

Informatics

INFO-I 101 Introduction to Informatics (4 cr.) Problem solving with information technology; introductions to information representation, relational databases, system design, propositional logic, cutting-edge technologies: CPU, operation systems, networks; laboratory emphasizing information technology including Web page design, word processing, databases, using tools available on campus. Credit not given for both INFO-I 101 and H 101.

INFO-H 101 Introduction to Informatics, Honors (4 cr.) Honors version of INFO-I 101. Problem solving with information technology; introductions to information representation, relational databases, system design, propositional logic, cutting-edge technologies: CPU, operation systems, networks; laboratory emphasizing information technology including Web page design, word processing, databases, using tools available on campus. Credit not given for both INFO-H 101 and I 101.

INFO-I 110 Basic Tools of Informatics I—Programming Concepts (1.5 cr.) P: CSCI-A 110, A 111, or equivalent computing experience. Introduction to programming for users of computer systems. Emphasis on problem-solving techniques. An eight-week lecture and laboratory course. Cross-listed with CSCI-A 112. Credit not given for both INFO-I 110 and CSCI-A 112.

INFO-I 111 Basic Tools of Informatics II—Introduction to Databases (1.5 cr.) P: CSCI-A 110, A 111, or equivalent computing experience. Introduction to database design concepts. Entering and modifying data, accessing data using visual tools and SQL, and building database applications using forms and application development tools. Emphasis on problem-solving techniques. An eight-week lecture and laboratory course. Credit not given for both INFO-I 111 and CSCI-A 114.

INFO-I 123 Data Fluency (3 cr.) Data is big. Data is everywhere. How can we possibly be expected to keep up in a world full of data, much of which is data about ourselves? This class provides fundmental skills for the 21st century: understanding data, extracting knowledge from data, generating predictions from data and presenting data.

INFO-I 130 Introduction to Cybersecurity (1 cr.) P: INFO-I 101. C: INFO-I 101. This course introduces students to cybersecurity. The course will primarily focus on introduction to three core areas (technical aspects of security, organizational aspects of security, and legal aspects of security). Through examples of security problems in real life, this course will illuminate fundamental ideas and concepts of information security. An eight-week course.

INFO-I 201 Mathematical Foundations of Informatics (4 cr.) P: INFO-I 101 and MATH-M 118, MATH-A 118, MATH-S 118, or MATH-D 116-117. An introduction to methods of analytical, abstract, and critical thinking; deductive reasoning; and logical and mathematical tools used in information sciences. The topics include propositional and predicate logic, natural deduction proof system, sets, functions and relations, proof methods in mathematics, mathematical induction, and graph theory. Credit not given for both INFO-I 201 and H 201.

INFO-H 201 Mathematical Foundations of Informatics, Honors (4 cr.) P: INFO-I 101, and MATH-M 118, MATH-A 118, or MATH-S 118. Honors version of INFO-I 201. An introduction to methods of analytical, abstract, and critical thinking; deductive reasoning; and logical and mathematical tools used in information sciences. The topics include propositional and predicate logic, natural deduction proof system, sets, functions and relations, proof methods in mathematics, mathematical induction, and graph theory. Credit not given for both INFO-H 201 and I 201.

INFO-I 202 Social Informatics (3 cr.) P: INFO-I 101. Introduction to key social research perspectives and literatures on the use of information and communication technologies. Discusses current topics such as information ethics, relevant legal frameworks, popular and controversial uses of technology (for example, peer-to-peer file sharing), digital divides, and so on. Outlines research methodologies for social informatics. Credit not given for both INFO-I 202 and H 202.

INFO-H 202 Social Informatics, Honors (3 cr.) P: INFO-I 101. Honors version of INFO-I 202. Introduction to key social research perspectives and literatures on the use of information and communication technologies. Discusses current topics such as information ethics, relevant legal frameworks, popular and controversial uses of technology (for example, peer-to-peer file sharing), digital divides, and so on. Outlines research methodologies for social informatics. Credit not given for both INFO-H 202 and I 202.

INFO-I 210 Information Infrastructure I (4 cr.) P: INFO-I 201. The software architecture of information systems. Basic concepts of systems and applications programming. Credit not given for both INFO-I 210 and H 210.

INFO-H 210 Information Infrastructure I, Honors (4 cr.) P: INFO-I 201. Honors version of INFO-I 210. The software architecture of information systems. Basic concepts of systems and applications programming. Credit not given for both INFO-H 210 and I 210.

INFO-I 211 Information Infrastructure II (4 cr.) P: INFO-I 210 or CSCI-C 211. The systems architecture of distributed applications. Advanced programming, including an introduction to the programming of graphical systems. Credit not given for both INFO-I 211 and H 211.

INFO-H 211 Information Infrastructure II, Honors (4 cr.) P: INFO-I 210 or CSCI-C 211. Honors version of INFO-I 211. The systems architecture of distributed applications. Advanced programming, including an introduction to the programming of graphical systems. Credit not given for both INFO-H 211 and I 211.

INFO-I 222 The Information Society (3 cr.) In this course, students will learn to think critically about what it means to live in an "Information Society." From printing press to telephone to computer to the Internet, they will explore the history and social implications of the various information revolutions that shaped contemporary commercial, scientific, organizational, political life.

INFO-I 230 Analytical Foundations of Security (3 cr.) P: INFO-I 130. This course will enable students to reevaluate and conceptualize material learned in discrete courses to consider the topics from their perspective of security. For example, computer system basics such as hardware (CPUs, memory) and software are reconsidered from the perspective of how their interactions create vulnerabilities. Vulnerabilities that combine standard hardware and software configurations will be examined because they illuminate both security and computer networks. Operating systems and file systems are examined from the perspective of access control, permissions, and availability of system services.

INFO-I 231 Introduction to the Mathematics of Cybersecurity (3 cr.) The goal of this course is for students to be introduced to the basic mathematical tools used in modern cybersecurity. The course covers introductory mathematical material from a number of disparate fields including probability theory, analysis of algorithms, complexity theory, number theory, and group theory. Credit not given for both INFO-I 231 and CSCI-C 231.

INFO-I 300 HCI/Interaction Design (3 cr.) P: INFO-I 101 and I 202 or I 222. The analysis of human factors and the design of computer application interfaces. A survey of current HCI designs with an eye toward what future technologies will allow. The course will emphasize learning HCI based on implementation and testing interfaces. Credit not given for both INFO-I 300 and H 300.

INFO-H 300 HCI/Interaction Design, Honors (3 cr.) P: INFO-I 101 and I 202 or I 222. Honors version of INFO-I 300. The analysis of human factors and the design of computer application interfaces. A survey of current HCI designs with an eye toward what future technologies will allow. The course will emphasize learning HCI based on implementation and testing interfaces. Credit not given for both INFO-H 300 and I 300.

INFO-I 303 Organizational Informatics (3 cr.) P: INFO-I 101. Examines the various needs, uses, and consequences of information in organizational contexts. Topics include organizational types and characteristics, functional areas and business processes, information-based products and services, the use of and redefining the role of information technology, the changing character of work life and organizational practices, sociotechnical structures, and the rise and transformation of information-based industries.

INFO-I 308 Information Representation (3 cr.) P: INFO-I 101, I 201 and (I 210 or CSCI-C 211). The basic structure of information representation in digital information systems. Begins with low-level computer representations such as common character and numeric encodings. Introduces formal design and query languages through Entity Relationship Modeling, the Relational Model, XML, and XHTML. Laboratory topics include SQL and XPath querying. Credit not given for both INFO-I 308 and H 308.

INFO-H 308 Information Representation, Honors (3 cr.) P: INFO-I 101, I 201 and (I 210 or CSCI-C 211). Honors version of INFO-I 308. The basic structure of information representation in digital information systems. Begins with low-level computer representations such as common character and numeric encodings. Introduces formal design and query languages through Entity Relationship Modeling, the Relational Model, XML, and XHTML. Laboratory topics include SQL and XPath querying. Credit not given for both INFO-H 308 and I 308.

INFO-I 310 Multimedia Arts and Technology (3 cr.) P: INFO-I 300. The study of the evolution of media arts and underlying principles of communication. Application development paradigms in current practice.

INFO-I 320 Distributed Systems and Collaborative Computing (3 cr.) P: INFO-I 211. An introductory treatment of distributed systems and programming. Topics range from the distributed and object models of computation to advanced concepts such as remote method invocations, object brokers, object services, open systems, and future trends for distributed information systems.

INFO-I 330 Legal and Social Informatics of Security (3 cr.) P: INFO-I 230, or consent of instructor. This course examines that set of ethical and legal problems most tightly bound to the issues of information control. The interaction and technology changes, but the core issues have remained: privacy, intellectual property, Internet law, concepts of jurisdiction, speech anonymity versus accountability, and ethical decision making in the network environment.

INFO-I 356 Globalization, Where We Fit In (3 cr.) Globalization changes how we work, what we buy, and who we know. Globalization involves people working eighty hour weeks in China and receiving free state-of-the-art drugs in Africa. Learn about the past, present and future of globalization, and what it means for you, your job, and your community.

INFO-I 360 Web Design (3 cr.) P: INFO-I 101. Hands-on introduction to the core standards required for professional front-end web design and development (HTML/CSS/Bootstrap). You will create websites, plus learn how web content and style work together, how to make professional choices about web graphics and layout, and how to analyze and critique a website's design and structure.

INFO-I 368 Introduction to Network Science (3 cr.) Friends, computers, the Web, and our brain are examples of networks that pervade our lives. Network science helps us understand complex patterns of connection, interaction, and relationships in many complex systems. Students learn essential concepts and core ideas of network literacy, and basic tools to handle social and information networks.

INFO-I 369 Performance Analytics (3 cr.) P: INFO-I 201 and I 210. INFO-I 368 recommended. This course will review quantitative studies aimed at measuring, predicting and understanding performance in social competitive arenas, ranging from social media to financial markets, from professional sports to scientific and technological innovation.

INFO-I 371 Chemical Informatics I (1 cr.) Presents basic concepts of information representation, storage, and retrieval as they pertain to chemistry. The course is designed to give an overview of the techniques that make modern chemical informatics systems work. Looks at some of the coding techniques that form the basis for

chemical information retrieval by structures, nomenclature, and molecular formulas. Examines various methods of coding for visualization of chemical structures and chemical data. In addition, some of the major algorithms and techniques used in the modern pharmaceutical industry to enhance their research efforts are presented in INFO-I 371.

INFO-I 372 Molecular Modeling (1 cr.) P: CHEM-C 341. Molecular modeling and computational chemistry; application of quantum mechanics and molecular mechanics to drive structural and energetic information about molecules; conformational analysis; quantitative structure activity relationships (QSAR) and related methods for drug design.

INFO-I 390 Undergraduate Independent Study (1-3 cr.) P: Instructor's permission. Independent research based on existing literature or original work. A report, in the style of a departmental technical report, is required. May be repeated for a maximum of 6 credit hours.

INFO-I 391 Internship in Informatics Professional Practice (1-3 cr.) P: Approval of dean and completion of 100- and 200-level requirements in informatics. Students gain professional work experience in an industry or research organization setting, using skills and knowledge acquired in informatics course work. May be repeated for a maximum of 3 credit hours.

INFO-I 399 Current Topics in Informatics (1-3 cr.) Variable topic course. Emphasis is on new developments and research in informatics. May be repeated once with different topic.

INFO-I 400 Topics in Informatics (3 cr.) P: At least junior standing or permission of instructor. Variable topic. Emphasis is on new developments and research in informatics. May be repeated when topic varies.

INFO-H 400 Topics in Informatics, Honors (3 cr.) P: At least junior standing or permission of instructor. Honors version of INFO-I 400. Variable topic. Emphasis is on development and research in informatics. May be repeated when topic varies.

INFO-I 407 Introduction to Health Informatics (3 cr.) P: INFO-I 300. Lab fee. This is a combined advanced undergraduate and graduate course that provides an introduction to health informatics. By the end of the course, students will be able to describe and apply informatics methods that improve health and well being. Credit not given for both INFO-I 407 and H 407.

INFO-H 407 Introduction to Health Informatics, Honors (3 cr.) P: INFO-I 300. Lab fee. Honors version of INFO-I 407. This is a combined advanced undergraduate and graduate course that provides an introduction to health informatics. By the end of the course, student will be able to describe and apply informatics methods that improve health and well being. Credit not given for both INFO-H 407 and I 407.

INFO-I 421 Applications of Data Mining (3 cr.) P: INFO-I 308. The course explores the use of data mining techniques in different settings, including business and scientific domains. The emphasis will be on using techniques instead of developing new techniques or algorithms. Students will select, prepare, visualize, analyze, and present data that leads to the discovery of novel and actionable information.

INFO-I 422 Data Visualization (3 cr.) From dashboards in a car to cutting-edge scientific papers, we extensively use visual representation of data. As our world becomes increasingly connected and digitized and as more decisions are being driven by data, data visualization is becoming a critical skill for every knowledge worker. In this course we will learn fundamentals of data visualization and create visualizations that can provide insights into complex datasets.

INFO-I 423 Big Data Applications and Analytics (3 cr.) The Big Data Applications & Analytics course is an overview course in Data Science and covers the applications and technologies (data analytics and clouds) needed to process the application data. It is organized around rallying cry: Use Clouds running Data Analytics Collaboratively processing Big Data to solve problems in X-Informatics. Credit given for only one of INFO-I 423, I 523, or ENGR-E 534.

INFO-I 424 Big Data Software and Projects (3 cr.) This course studies software HPC-ABDS used in either High Performance Computing or the open source commercial Big Data cloud computing. The student builds analysis systems using this software on clouds and then to use it on a project either chosen by student or selected from list given by instructor. Credit not given for both INFO-I 424 and I 524.

INFO-I 427 Search Informatics (3 cr.) Techniques and tools to automatically crawl, parse, index, store, and search Web information, organizing knowledge that can help meet the needs of organizations, communities and individual users. Social and business impact of search engine technology. As a project, students will build a real search engine and compare it with Google.

INFO-I 430 Security for Networked Systems (3 cr.) P: INFO-I 230, I 231 and (I 211 or C 212). This course is an extensive survey of network security. The course materials cover threats to information confidentiality, integrity, and availability in different Internet layers, and defense mechanisms that control these threats. The course also provides a necessary foundation on network security, such as cryptographic, primitives/ protocols, authentication, authorization and access control technologies; and hands-on experiences through programming assignments and course projects. Credit given for only one of INFO-I 430, I 520, or CSCI-B 430.

INFO-I 433 Systems & Protocol Security & Information Assurance (3 cr.) P: INFO-I 230, I 231 and (I 211 or C 212). This class covers the fundamentals of computer security by looking at how things can go wrong, and how people can abuse the system. This is a matter of creative cheating; to find loopholes and exploit them. After students learn how to attack the system, it is possible to propose ways to make the system secure. Students will gain a basic overview of existing security problems and be exposed to methods that can be used to secure against such problems. The course should be taken by any one designing, selecting, or using applications in which security or privacy plays a role. Credit given for only one of INFO-I 433, I 533, or CSCI-B 433.

INFO-I 435 Management, Access, and Use of Big and Complex Data (3 cr.) Innovation today is emerging from a preponderance of data from sensors, social media, and the Internet. This course covers knowledge representation, data process, and data management for big and complex data. Specific topics include data integration, semantics, and provenance; workflows and pipelines; and distributed noSQL stores. Credit not given for both INFO-I 435 and I 535.

INFO-I 440 Human Robot Interaction (3 cr.) Lab fee. This course surveys the field of human-robot interaction (HRI), which involves understanding how people perceive and respond to robots and creating robots that interact naturally with people. We will discuss the design, evaluation and societal significance of interactive robots from a human-centered perspective through readings, discussion and developing HRI prototypes. Credit given for only one of INFO-I 440, H 440 or I 540.

INFO-H 440 Human Robot Interaction, Honors (3 cr.) Lab fee. This course surveys the field of human-robot interaction (HRI), which involves understanding how people perceive and respond to robots and creating robots that interact naturally with people. We will discuss the design, evaluation and societal significance of interactive robots from a human-centered perspective through readings, discussion and developing HRI prototypes. Credit given for only one of INFO-I 440, H 440 or I 540.

INFO-I 441 Interaction Design Practice (3 cr.) Human-computer interaction design (HCID) describes the way a person or group accomplishes tasks with a computer—what the individual or group does and how the computer responds; what the computer does and how the individual or group responds. This course is organized around a collection of readings and three design projects applying human-computer interaction principles to the design, selection, and evaluation of interactive systems.

INFO-I 453 Computer and Information Ethics (3 cr.) Ethical and professionalization issues that arise in the context of designing and using networked information technologies and information resources. Examines frameworks for making ethical decisions, emergent technologies and their ethical implications, information/computer professionalism. Topics include privacy, intellectual property, cybercrime, games, social justice, and codes of professional ethics.

INFO-I 468 Advanced Network Science (3 cr.) P: INFO-I 368. Friends, computers, the Web, and our brain are examples of networks that pervade our lives. Network science helps us understand complex patterns of connection, interaction, and relationships in many complex systems. Students learn about networks analytic tools, using increasingly complex models and data from social, infrastructure, and information networks.

INFO-I 485 Bioinspired Computing (3 cr.) P: INFO-I 211 or CSCI-C 212. Biological organisms cope with the demands of their environments using solutions quite unlike the traditional human-engineered approaches to problem solving. Biological systems tend to be adaptive, reactive, and distributed. Bio-inspired computing is a field devoted to tackling complex problems using computational methods modeled after design principles encountered in nature. Credit not given for both INFO-I 485 and I 585.

INFO-I 486 Artificial Life (3 cr.) Artificial Life is a broad discipline encompassing the origins, modeling, and synthesis of natural and artificial living entities and systems. Artificial Intelligence, as a discipline, tries to model and understand intelligent systems and behavior, typically at the human level. Credit not given for both INFO-I 486 and I 586.

INFO-I 487 Introduction to Virtual Heritage (3 cr.) This course focuses on how digital technology can represent, restore, disseminate, and help with analysis of artifacts such as vases, furniture, sculpture, monuments, and buildings. Other topics covered include the history and methodologies of Virtual Heritage. Each semester a different case study will provide the focus for the course. Credit not given for both INFO-I 487 and I 587.

INFO-I 488 Advanced Topics in Virtual Heritage (3 cr.) This course teaches students how to create simulations of complex cultural heritage environments such as a room and its furnishings, a building, or a settlement. Also covered are the principles of restorations of art, technologies to disseminate 3D models, and the use of simulations as tools of scientific discovery. Credit not given for both INFO-I 488 and I 588.

INFO-I 490 Professional Practicum/Internship for Undergraduates (0 cr.) P: Approval of the dean. Provides for participation in professional training and internship experience.

INFO-I 491 Capstone Project Internship (1-6 cr.) P: Approval of dean and completion of all required core informatics courses. Students put their informatics education in practice through the development of a substantial project while working in a professional information technology environment. May be repeated for a maximum of 6 credit hours.

INFO-I 492 Senior Thesis (3 cr.) P: Approval of dean and completion of all required core informatics courses. The senior student prepares and presents a thesis: a substantial, typically multichapter paper based on a well-planned research or scholarly project, as determined by the student and a sponsoring faculty member.

INFO-I 493 Senior Thesis (3 cr.) P: Approval of dean and completion of all required core informatics courses. The senior student prepares and presents a thesis: a substantial, typically multichapter paper based on a well-planned research or scholarly project, as determined by the student and a sponsoring faculty member.

INFO-I 494 Design and Development of an Information System (3 cr.) P: Approval of the dean and completion of required core informatics courses. Students work on capstone projects in supervised teams. They select an appropriate project (preferably based on cognate) and then learn to develop a plan that leads to success. Teamwork, communication, and organizational skills are emphasized in a real-world-style environment. Credit not given for both INFO-I 494 and H 494.

INFO-H 494 Design and Development of an Information System, Honors (3 cr.) P: Approval of the dean and completion of required core informatics courses. Honors version of INFO-I 494. Students work on capstone projects in supervised teams. They select an appropriate project (preferably based on cognate) and then learn

to develop a plan that leads to success. Teamwork, communication, and organizational skills are emphasized in a real-world-style environment. Credit not given for both INFO-H 494 and I 494.

INFO-I 495 Design and Development of an Information System (3 cr.) P: Approval of the dean and completion of required core informatics courses. Students work on capstone projects in supervised teams. They select an appropriate project (preferably based on cognate) and then learn to develop a plan that leads to success. Teamwork, communication, and organizational skills are emphasized in a real-world-style environment. Credit not given for both INFO-I 495 and H 495.

INFO-H 495 Design and Development of an Information System, Honors (3 cr.) P: Approval of the dean and completion of required core informatics courses. Honors version of INFO-I 495. Students work on capstone projects in supervised teams. They select an appropriate project (preferably based on cognate) and then learn to develop a plan that leads to success. Teamwork, communication, and organizational skills are emphasized in a real-world-style environment. Credit not given for both INFO-H 495 and I 495.

INFO-H 498 Honors Seminar (1-3 cr.) P: Junior or senior major in INFO with GPA at least 3.3 or permission of instructor. A survey of faculty research in computer related fields with different professors discussing their research each week. May be repeated for a maximum of 6 credit hours.

INFO-I 499 Readings and Research in Informatics (1-3 cr.) P: Consent of instructor and completion of 100- and 200-level requirements in informatics. Independent readings and research related to a topic of special interest to the student. Written report required. May be repeated for a maximum of 6 credit hours for any combination of INFO-I 499 and H 499.

INFO-H 499 Readings and Research in Informatics, Honors (1-3 cr.) P: Consent of instructor and completion of 100- and 200-level requirements in informatics. Honors version of INFO-I 499. Independent readings and research related to a topic of special interest to the student. Written report required. May be repeated for a maximum of 6 credit hours for any combination of INFO-I 499 and H 499.

INFO-T 100 Topics in Informatics Technology (1-3 cr.) Variable topic. The course serves as an introduction to a specific information technology in a hands-on setting. Emphasis is on problem solving techniques using technology. Credit hours may not be applied toward satisfying major requirements in the School of Informatics.

INFO-Y 100 Exploring Informatics and Computer Science (1 cr.) Technology is everywhere and how it relates to the world today is very important to the future. The objective of this course is to offer students an opportunity to explore the many tracks within the fields of Informatics and Computer Science, while also learning about the multiple careers available to students majoring in the fields. Emphasis will be placed on the various ways technology affects the work world and how students can tailor a major to their individual interests. The course will promote a hands-on, interactive and self-reflective course environment. Offered as either a six or eight week course.

INFO-Y 101 Technology Leadership and Innovation (1.5 cr.) This course will focus on developing student leaders by providing resources and tools to empower them in setting goals, teamwork, communication, and decision-making skills. Students will have an opportunity to interact and develop relationships with School of Informatics and Computing faculty, staff, alumni, upper class students, and conduct research.

INFO-Y 102 Technology Leadership and Innovation II (1.5 cr.) P: INFO-Y 101. The focus of this course will be on developing you as a professional and a future leader. Topics addressed will include professional identity development; working in a diverse team; leadership in a global/multinational workforce; the role of social media; and the process and development of professional mentor relationships.

INFO-Y 395 Career Development for Informatics Majors (1 cr.) Helps students develop skills and knowledge to successfully pursue a career search, both at the time of graduation and as they progress through their careers. The course covers techniques and strategies to make the job search more efficient and effective. An eight-week course. Credit not given for both INFO-Y 395 and CSCI-Y 395.

Information and Library Science

ILS-L 150 Information Sources in Telecommunications (1 cr.) Grade S/F. Designed specifically for undergraduates who are premajors or majors in telecommunications and who are required to complete a research project or term paper in R 202 or R 203. Training in use of computerized database systems, as well as selection and use of advanced reference sources.

ILS-L 161 Library Skills and Resources (1 cr.) Designed for undergraduates. Techniques and skills for researching term papers, speeches, and other library projects.

ILS-L 416 Individual in the Information Age (3 cr.) Focuses on emerging information and communication technologies, identifying political, social, and economic trends that have major impact on information sources and access. Students are encouraged to explore individual approaches to the information concepts and issues, understood in a social context.

ILS-Z 115 From James Bond To Zombie Apocalypse and NSA Leaks: Evaluating Information And Intelligence (3 cr.) Using the collection, assessment, analysis, and presentation skills of the intelligence community students will explore important, current policy issues including international relations, privacy, cyber security, war, and humanitarian issues. Students will become familiar with all basic intelligence functions such as the different types of INT: human intelligence, signals intelligence, etc. as well as counterintelligence, hacking, and encryption.

ILS-Z 221 Intelligence Analytics (3 cr.) Intelligence analysis takes information from different sources, considers its deficiencies and biases, combines it with historical, political, technical, social, ideological, economic, and religious knowledge, and uses analytic methods to create background and recommendations for decision makers. Analytic techniques involve qualitative methods

used in business for project management and problem solving.

ILS-Z 311 Spy Tech for Non-Technical Spies (3 cr.) Information is collected by sensors and analyzed by computers for decision making. Satellites and drones are examples of platforms developed for gathering technical information. This course is designed for non-technical students to explore powerful reconnaissance and surveillance technologies as they are used for spying and for business and government functions.

ILS-Z 321 Introduction to Metadata (3 cr.) This course introduces students to principles underlying the development and implementation of metadata schemes and issues of interoperability, standardization, and evaluation of metadata schemes. The course provides extensive opportunities for hands-on application of metadata principles and practices in the development, implementation and evaluation of metadata records.

ILS-Z 331 Strategic Intelligence (3 cr.) This class introduces concepts and methods of identifying, collecting, analyzing, and presenting strategic intelligence from perspectives including competitive and strategic military intelligence, globalized crime, government policy, and natural disasters. We examine disruption, networks, systems theory, asymmetric warfare, organizational structure, and information warfare that have impacted modern strategy and strategic intelligence.

ILS-Z 341 Information Visualization (3 cr.) The visual representation of information requires a deep understanding of human perceptual and cognitive capabilities, computer graphics, interface and interaction design, and creativity. This course provides an overview of state-of-the-art information visualization. Students learn to produce effective temporal, geospatial, topical and network visualization, empowering them to render data into insights.

ILS-Z 351 Moles, Deception, and Counterintelligence (3 cr.) Counterintelligence involves disrupting adversaries' information flow or disseminating disinformation to make them act contrary to their interests. In this class, students explore concepts and techniques of counterintelligence. Assignments allow students to apply course content to real-world threats with a focus on U.S. perspectives in concise papers designed for busy decision-makers.

ILS-Z 362 Communication in Electronic Environments: Online Trolling (3 cr.) This course examines online trolling exploring why people engage in online deviant behaviors, and how others respond to and manage trolls. Conceptualizations and examples of trolling from scholarly literature, popular media, and online communities are critically examined. Assignments allow students to develop informed understandings about trolling and its social impacts.

ILS-Z 399 Topics in Information and Library Science (1-4 cr.) Study of specific topics in information and library science. May be repeated six times (24 credit hours) when topic varies..

ILS-Z 401 Computer-Based Information Tools (1-3 cr.) Graded S/F. This skills-based course introduces basic applications that will be used throughout the student's course work and beyond. Students' experiences in this course should be seen as a basis for further skill development and learning throughout their careers. The course covers computing platforms, access tools, and management tools. Demonstration of skills will be by a mastery test or an assignment in each unit of the course. Z 401 does not count toward graduate degree requirements. Master of Library Science degree students are required to complete ILS-Z 401 within their first 9 credit hours.

Degree Programs

B.S. in Computer Science

B.S. in Informatics

B.S. in Intelligent Systems Engineering

B.A. in Computer Science (offered through the College of Arts and Sciences)

Certificates and Minors

Concurrent/Sequential Baccalaureate Degrees

Bachelor of Science in Computer Science

- Common Ground - General Education Requirements
- Basic Requirements
- SoIC Degree and Major Requirements
- Specializations

Common Ground– General Education Requirements

In summer 2011, Indiana University Bloomington instituted a new campus-wide General Education Program. All IUB undergraduate students who matriculate in or after first summer session 2011 will be required to complete the campus-wide GenEd program prior to graduation. Some courses may overlap and satisfy the Common Ground General Education requirements as well as some additional SoIC General Education requirements needed to complete INFOBS, ISENGRBS, or CSCIBS majors.

The Common Ground

The bulletin with the GenEd requirements, course listings and information can be found at this url: http://bulletins.iu.edu/iub/general-education/2016-2017/index.shtml.

Basic Degree Requirements

Students must successfully complete a minimum of 120 credit hours for the Bachelor of Science degree. Students must complete the specific degree requirements of the School of Informatics and Computing as follows:

- Students must have a minimum cumulative grade point average of 2.0 (C). Any course taken to satisfy the major requirements must be completed with a minimum grade of
  C- unless otherwise specified and the grade point average of all courses taken in the major must be at least 2.0. The major requirements for computer science include core courses, computer science electives, math courses and specialization area courses.
- Students must complete a minimum of 30 credit hours in courses at the 300-400 (junior-senior) level.

- Students must complete at least 12 credit hours of course work in the major field of study on the Bloomington campus.
- Students are expected to complete the requirements for their undergraduate degree within eight years of admission to Indiana University. Students are allowed to continue beyond this time period only at the discretion of the Student Services office.
- Courses that fulfill the requirements for a specialization area may also meet the general education distribution requirements.
- Specialization area courses cannot count as computer science core courses, required math courses or computer science elective courses.
- If specialization area courses are equivalent to computer science major course requirements, students should substitute an alternate course.

SoIC Degree and Major Requirements

**** Equivalent honors versions of regular courses may substitute for all requirements. Please see specific course descriptions, posted in respective bulletin, for prerequisites and other pertinent information. ****

The School of Informatics and Computing student database enables students to check their academic degree information, add/drop minors, add/change specializations/cognates/concentrations and apply to graduate. Students are responsible for these actions.

SoIC Degree Requirements

Intensive Writing (3 cr.)

One intensive writing course at the 200 level or above after completing the English composition requirement. Intensive writing courses at IUB are defined by the College of Arts and Sciences. Students must check the listings for courses at http://college.indiana.edu/undergrad/courses.

Intensive Writing credit will not be awarded for transfer courses and will not be awarded for written work in courses that are not listed as Intensive Writing unless special arrangements have been completed and approved prior to the relevant deadline. All special arrangements must be approved by the director of undergraduate studies in the respective division. The deadline for submitting a proposal to satisfy Intensive Writing by special arrangement is the end of the 2nd week of classes (for regular semester-length courses) and the end of the first week of classes for a summer session course.

Natural Science (12 cr.)

Select twelve credit hours from the following:

- PSY-P 155 Introduction to Psychological and Brain Sciences
- PSY-P 211 Methods of Experimental Psychology
- COGS-Q 370 Experiments and Models in Cognition
- AST (any course)
- BIOL (any course)
- CHEM (any course)
- GEOL (any course)
- PHYS (any course)

General Electives

Remaining credit hours may be used to fulfill minors or pursue personal interests. Students may obtain a maximum of three minors. A maximum of 4 combined HPER-E and SPH-I credit hours and 10 MUS-X credit hours below the 100 level may be used in total hours.

Major Requirements

Students must receive a minimum grade of C- in each course and a major GPA of 2.0 or higher

12 hours in the major must be completed on the Bloomington campus.

Students must complete the following:

Core courses:

- CSCI-C 200 Introduction to Computers and Programming or CSCI-C 211 Introduction to Computer Science
- CSCI-C 212 Introduction to Software Systems
- CSCI-C 241 Discrete Structures for Computer Science
- CSCI-C 343 Data Structures

One approved specialization (see specializations area in bulletin)

45 hours including Core courses and Specialization with the remaining courses drawn from the following list – at least 26 of the 45 hours must be at the 300 level or above.

- CSCI-A 290 Tools for Computing (maximum of 6 total credit hours)
- CSCI-B, C, H, and P courses numbered 200 and above
- CSCI-Y 390* Undergraduate Independent Study
- CSCI-Y 391* Undergraduate Independent System Development
- CSCI-Y 395 Career Development for CSCI Majors
- CSCI-Y 399* Project in Professional Practice
- CSCI-Y 499* Honors Research
- CSCI-H 498 Honors Seminar (at most 1 hour)
- MATH-M 471 Numerical Anaylsis I
- MATH-M 472 Numerical Anaylsis II
- INFO-I 101 Introduction to Informatics (if completed before or concurrently with CSCI-C 212)
- INFO-Y 395 Career Development for Informatics Majors
- INFO-I 494/INFO-I 495 Design and Development of an Information System - authorization required, please see advisor

* Only 6 total hours in these 4 courses

Mathematical Science Requirement:

If used in specialization area (excluding the Security specialization), it may not be used to satisfy this requirement.

- MATH-M 211 Calculus I (or equivalent proficiency)

Select two from the following:

- MATH-M 212 Calculus II
- MATH-M 213 Accelerated Calculus
- MATH-M 3XX (all 300 level courses)
- MATH-M 4XX (all 400 level courses)
- MATH-T 336 Topics in Euclidean Geometry
- MATH-T 403 Modern Algebra for Secondary Teachers

- ECON-E 370 Statistical Analysis for Business and Economics
- LAMP-L 316 Junior Seminar: Analytical Problem Solving
- PHIL-P 251 Intermediate Symbolic Logic
- PHIL-P 350 Logic of Sets
- PHIL-P 352 Logic and Philosophy
- STAT-S 320 Introduction to Statistics **OR** STAT-S 350 Introduction to Statistical Inference

Specialization Area Courses

Students should, in consultation with their academic advisor, choose a specialization area before their junior year. Students must receive a minimum grade of C– in each course. Please consult the specialization section of this bulletin for the list of specialization areas.

Bachelor of Science in Computer Science with Honors

Students must satisfy the requirements for the B.S. in Computer Science degree and the following additional requirements:

- Overall GPA 3.3 or greater
- Computer Science major GPA 3.3 or greater
- Completion of at least 11 hours of CSCI Honors courses (can include CSCI-Y 499).
- At least 29 of the 45 hours required for the major completed at the 300 level or above

Specializations

**** Equivalent honors versions of regular courses may substitute for all requirements. Please see specific course descriptions, posted in respective bulletin, for prerequisites and other pertinent information. ****

Please add or change your specialization through the student database.

Students must receive a minimum grade of C- in each specialization course.

- Artificial Intelligence
- Data Science
- Foundations
- Programming Languages
- Security
- Systems

Artificial Intelligence Specialization

1. Select two courses from the following:
   - CSCI-B 351 Introduction to Artificial Intelligence
   - CSCI-B 365 Introduction to Data Analysis and Mining
   - CSCI-B 455 Principles of Machine Learning
2. Select two courses from the following (if not used above):
   - CSCI-B 351 Introduction to Artificial Intelligence
   - CSCI-B 355 Autonomous Robotics
   - CSCI-B 363 Bioinformatics Algorithms
   - CSCI-B 365 Introduction to Data Analysis and Mining
   - CSCI-B 455 Principles of Machine Learning
   - CSCI-B 456 Image Processing
   - CSCI-B 457 Introduction to Computer Vision
   - STAT-S 320 Introduction to Statistics **OR** STAT-S 350 Introduction to Statistical Inference
3. Select one course from the following:
   - CSCI-B 401 Fundamentals of Computing Theory
   - CSCI-B 403 Introduction to Algorithm Design and Analysis
   - CSCI-P 415 Introduction to Verification

Data Science Specialization

1. Must complete:
   - CSCI-B 461 Database Concepts
   - CSCI-B 403 Introduction to Algorithm Design and Analysis
2. Select one course from the following:
   - CSCI-B 365 Introduction to Data Analysis and Mining
   - CSCI-B 455 Principles of Machine Learning
3. Select one course from the following (if not used above):
   - CSCI-B 351 Introduction to Artificial Intelligence
   - CSCI-B 365 Introduction to Data Analysis and Mining
   - CSCI-B 455 Principles of Machine Learning
   - CSCI-C 311 Programming Languages
   - CSCI-P 434 Distibuted Systems
   - CSCI-P 462 Database Application Design and Implementation
4. Select one course from the following:
   - CSCI-B 401 Fundamentals of Computing Theory
   - CSCI-P 415 Introduction to Verification
   - STAT-S 320 Introduction to Statistics
   - STAT-S 350 Introduction to Statistical Inference

Foundations Specialization

1. CSCI-B 401 Fundamentals of Computing Theory
2. CSCI-B 403 Introduction to Algorithm Design and Analysis
3. Select one course from the following:
   - CSCI-P 415 Introduction to Verification
   - CSCI-B 461 Database Concepts
4. Select two courses from the following (if used in major math requirement, it may not be used to satisfy this requirement):
   - CSCI-C 311 Programming Languages
   - CSCI-B 455 Principles of Machine Learning
   - CSCI-B 504 Introduction to Cryptography **OR** MATH-M 453 Cryptography
   - MATH-M 301 Linear Algebra and Applications **OR** MATH-M 303 Linear Algebra for Undergraduates
   - MATH-M 365 Introduction to Probability and Statistics
   - MATH-M 471 Numerical Analysis I

Programming Languages Specialization

1. CSCI-C 311 Programming Languages
2. CSCI-P 423 Compilers
3. Select two courses from the following:
   - CSCI-C 335 Computer Structures
   - CSCI-P 436 Introduction to Operating Systems
   - CSCI-B 441 Digital Design
   - CSCI-B 461 Database Concepts
   - CSCI-B 490 Seminar in Computer Science (approved topic)
   - CSCI-P 424 Advanced Functional Programming
4. Select one course from the following:
   - CSCI-B 401 Fundamentals of Computing Theory
   - CSCI-B 403 Introduction to Algorithm Design and Analysis
   - CSCI-P 415 Introduction to Verification

Security Specialization

Math courses will also fulfill the Mathematical Science requirement in the major.

1. MATH-M 211 Calculus I
2. MATH-M 212 Calculus II **OR** MATH-M 213 Accelerated Calculus
3. MATH-M 301 Linear Algebra and Applications
4. MATH-M 365 Introduction to Probability and Statistics

Additional requirements:

1. CSCI-B 430 Security for Networked Systems
2. CSCI-B 433 Systems & Protocol Security & Information Assurance
3. CSCI-C 231 Introduction to Mathematics of Cybersecurity
4. CSCI-C 291 System Programming with C and Unix
5. CSCI-C 335 Computer Structures
6. CSCI-P 436 Introduction to Operating Systems
7. CSCI-P 438 Introduction to Computer Networks

Systems Specialization

1. CSCI-C 291 System Programming with C and Unix
2. CSCI-C 335 Computer Structures
3. Select one project course from the following:
   - CSCI-P 436 Introduction to Operating Systems
   - CSCI-P 438 Introduction to Computer Networks
   - CSCI-P 442 Digital Systems
   - CSCI-P 545 Embedded and Real-Time Systems
4. Select one additional systems course from the following (if not used above):
   - CSCI-P 434 Distributed Systems
   - CSCI-P 436 Introduction to Operating Systems
   - CSCI-P 438 Introduction to Computer Networks
   - CSCI-B 441 Digital Design
   - CSCI-P 442 Digital Systems
   - CSCI-B 443 Introduction to Computer Architecture
   - CSCI-B 490 Seminar in Computer Science (approved topic)
   - CSCI-P 545 Embedded and Real-Time Systems
5. Select one course from the following:
   - CSCI-B 401 Fundamentals of Computing Theory
   - CSCI-B 403 Introduction to Algorithm Design and Analysis
   - CSCI-P 415 Introduction to Verification

Bachelor of Science in Informatics

- Common Ground - General Education Requirements
- Basic Requirements
- SoIC Degree and Major Requirements
- Cognates

Common Ground - General Education Requirements

In summer 2011, Indiana University Bloomington instituted a new campus-wide General Education Program. All IUB undergraduate students who matriculate in or after first summer session 2011 will be required to complete the campus-wide GenEd program prior to graduation. Some courses may overlap and satisfy the Common Ground General Education requirements as well as some additional SoIC General Education requirements needed to complete INFOBS, ISENGRBS, or CSCIBS majors. Please be aware that some courses in the INFOBS major require a higher gpa to fulfill a requirement than the same course in the General Education requirement.

The Common Ground

The bulletin with the GenEd requirements, course listings and information can be found at this url: http://bulletins.iu.edu/iub/general-education/2016-2017/index.shtml.

Basic Requirements

Students must successfully complete a minimum of 120 credit hours for the Bachelor of Science degree. Students must complete the specific degree requirements of the School of Informatics and Computing as follows:

- Students must have a minimum cumulative grade point average of 2.0 (C). Any course taken to satisfy the major requirements must be completed with a minimum grade of C- unless otherwise specified and the grade point average of all courses taken in the major must be at least 2.0. The major requirements for informatics include core courses, informatics electives and cognate area courses.
- Students must complete a minimum of 30 credit hours in courses at the 300-400 (junior-senior) level.
- Students must complete at least 12 credit hours of course work in the major field of study on the Bloomington campus.
- Students are expected to complete the requirements for their undergraduate degree within eight years of admission to Indiana University. Students are allowed to continue beyond this time period only at the discretion of the Student Services office.
- Courses that fulfill the requirements for a cognate area may also meet the general education distribution requirements.

- Cognate area courses cannot count as informatics core courses or informatics advanced/elective courses.

SoIC Degree and Major Requirements

**** Equivalent honors versions of regular courses may substitute for all requirements. Please see specific course descriptions, posted in respective bulletin, for prerequisites and other pertinent information. ****

The School of Informatics and Computing student database enables students to check their academic degree information, add/drop minors, add/change specializations/cognates/concentrations and apply to graduate. Students are responsible for these actions.

SoIC Degree Requirements

Intensive Writing (3 cr.)

One intensive writing course at the 200 level or above, with a minimum grade of C, after completing the English composition requirement. Intensive writing courses at IUB are defined by the College of Arts and Sciences. Students must check the listings for courses at http://college.indiana.edu/undergrad/courses.

Intensive Writing credit will not be awarded for transfer courses and will not be awarded for written work in courses that are not listed as Intensive Writing unless special arrangements have been completed and approved prior to the relevant deadline. All special arrangements must be approved by the director of undergraduate studies in the respective division. The deadline for submitting a proposal to satisfy Intensive Writing by special arrangement is the end of the 2nd week of classes (for regular semester-length courses) and the end of the first week of classes for a summer session course.

Math and Statistics (6 cr.)

One of the following Math options with a minimum grade of C:

- MATH-M 118 Finite Mathematics
- MATH-D 116-D 117 Introduction to Finite Mathematics I-II
- MATH-V 118 Finite Math with Applications
- MATH-M 348 Discrete Mathematical Models
- MATH-M 353 Discrete Mathematics
- CSCI-C 241 Discrete Structures for Computer Science

Select one of the following Statistics courses:

- ANTH-A 306 Anthropological Statistics
- CJUS-K 300 Techniques of Data Analysis
- ECON-E 370 Statistical Analysis for Business and Economics
- MATH-M 365 Introduction to Probability and Statistics
- POLS-Y 395 Quantitative Political Analysis
- PSY-K 300 Statistical Techniques
- PSY-K 310 Statistical Techniques
- SOC-S 371 Statistics in Sociology
- SPEA-K 300 Statistical Techniques
- STAT-K 310 Statistical Techniques
- STAT-S 300 Introduction to Applied Statistical Methods
- STAT-S 301 Applied Statistical Methods for Business
- STAT-S 320 Introduction to Statistics

Ethics (3 cr.)

Select one ethics course from the following.

- PHIL-P 140 Introduction to Ethics
- PHIL-P 242 Applied Ethics
- PHIL-P 340 Classics in Ethics
- PHIL-P 342 Problems of Ethics
- REL-R 170 Religion, Ethics, and Public Life
- INFO-I 453 Computer and Information Ethics

Arts and Humanities (6 Cr.)

Above Ethics course does not double-count as Arts and Humanities

Courses cannot double count between this requirement and major or cognate.

These courses may overlap with the Common Ground A&H. Course lists located at http://college.indiana.edu/bulletin-courses/ OR http://bulletins.iu.edu/iub/general-education/2015-2016/requirements/arts-and-humanities.shtml.

Natural and Mathematical Sciences (3 cr.)

Courses cannot double count between this requirement and major or cognate.

One 3 hour course plus one 5 hour course OR three 3 hour courses of N&M, excluding INFO-I 101, Stats and Finite Math. **These courses may overlap with the Common Ground N&M**. Course lists located at http://college.indiana.edu/bulletin-courses/ OR hhttp://bulletins.iu.edu/iub/general-education/2015-2016/requirements/natural-and-mathematical-sciences.shtmll.

General Electives

Remaining credit hours may be used to fulfill minors or pursue personal interests. Students may obtain a maximum of three minors. A maximum of 4 combined HPER-E and SPH-I credit hours and 10 MUS-X credit hours below the 100 level may be used in total hours.

Major Requirements

Students must receive a minimum grade of C- in each course (unless otherwise noted) and a major GPA of 2.0 or higher

12 hours in the major must be completed on the Bloomington campus.

Required Informatics Core Courses

- INFO-I 101 Introduction to Informatics (must complete with a minimum grade of C)
- INFO-I 201 Mathematical Foundations of Informatics
- INFO-I 202 Social Informatics OR INFO-I 222 The Information Society
- INFO-I 210 Information Infrastructure I
- INFO-I 211 Information Infrastructure II
- INFO-I 300 Human-Computer Interaction Design and Programming - **Must be completed on the Indiana University Bloomington campus**

- INFO-I 308 Information Representation - **Must be completed on the Indiana University Bloomington campus**
- INFO-Y 395 Career Development for Informatics Majors **- Must be completed on the Indiana University Bloomington campus**

Advanced Informatics Courses

Select two courses from the following:

* If pursuing a Computer Science Cognate, four courses must be completed if substituting CSCI-C 211/C 212 for INFO-I 210/I 211 in the major.
Advanced informatics courses do not double count as elective courses.

- INFO-I 303 Organizational Informatics
- INFO-I 310 Multimedia Arts and Technology
- INFO-I 320 Distributed Systems and Collaborative Computing
- INFO-I 330 Legal and Social Informatics of Security
- INFO-I 356 Globalization, Where We Fit In
- INFO-I 360 Web Design
- INFO-I 368 Introduction to Network Science
- INFO-I 369 Performanics Analytics
- INFO-I 371 Chemical Informatics
- INFO-I 372 Molecular Modeling
- INFO-I 390 Undergraduate Independent Study (3 credit hour course)
- INFO-I 399 Current Topics in Informatics (3 credit hour course)
- INFO-I 400 Topics in Informatics (3 credit hour course)
- INFO-I 407 Introduction to Health Informatics
- INFO-I 421 Applications of Data Mining
- INFO-I 422 Data Visualization
- INFO-I 423 Big Data Applications and Analytics
- INFO-I 424 Big Data Software and Projects
- INFO-I 427 Search Informatics
- INFO-I 430 Security for Networked Systems
- INFO-I 433 Systems & Protocol Security & Information Assurance
- INFO-I 435 Management, Access, and Use of Big and Complex Data
- INFO-I 440 Human Robot Interaction
- INFO-I 441 Interaction Design Practice
- INFO-I 453 Computer and Information Ethics
- INFO-I 468 Advanced Network Science
- INFO-I 485 Bioinspired Computing
- INFO-I 486 Artificial Life
- INFO-I 487 Introduction to Virtual Heritage
- INFO-I 488 Advanced Topics in Virtual Heritage
- INFO-I 499 (3 credit hour course)
- CSCI-B, C or P 300 level course
- CSCI-B, C or P 400 level course

Informatics Electives

Select two courses from the following:

All courses listed below are subject to the successful completion of prerequisites or approval of the instructor.
Informatics elective courses do not double count as advanced informatics courses.

- INFO-I 303 Organizational Informatics
- INFO-I 310 Multimedia Arts and Technology
- INFO-I 320 Distributed Systems and Collaborative Computing
- INFO-I 330 Legal and Social Informatics of Security
- INFO-I 356 Globalization, Where We Fit In
- INFO-I 360 Web Design
- INFO-I 368 Introduction to Network Science
- INFO-I 369 Performanics Analytics
- INFO-I 371 Chemical Informatics
- INFO-I 372 Molecular Modeling
- INFO-I 390 Undergraduate Independent Study (3 credit hour course)
- INFO-I 399 Current Topics in Informatics (3 credit hour course)
- INFO-I 400 Topics in Informatics (3 credit hour course)
- INFO-I 407 Introduction to Health Informatics
- INFO-I 421 Applications of Data Mining
- INFO-I 422 Data Visualization
- INFO-I 423 Big Data Applications and Analytics
- INFO-I 424 Big Data Software and Projects
- INFO-I 427 Search Informatics
- INFO-I 430 Security for Networked Systems
- INFO-I 433 Systems & Protocol Security & Information Assurance
- INFO-I 435 Management, Access, and Use of Big and Complex Data
- INFO-I 440 Human Robot Interaction
- INFO-I 441 Interaction Design Practice
- INFO-I 453 Computer and Information Ethics
- INFO-I 468 Advanced Network Science
- INFO-I 485 Bioinspired Computing
- INFO-I 486 Artificial Life
- INFO-I 487 Introduction to Virtual Heritage
- INFO-I 488 Advanced Topics in Virtual Heritage
- INFO-I 499 (3 credit hour course)
- BUS-S 305 Technology Infrastructure
- BUS-S 307 Data Management
- BUS-S 308 Business Application Development
- BUS-S 310 Systems Analysis and Project Management
- BUS-S 433 Information Systems Security
- COGS-Q 351 Introduction to Artificial Intelligence and Computer Simulation
- CSCI- Any course at the 300 or 400 level (3 credit hour course)
- MSCH-G 300 Game Production I
- MSCH-G 310 Game Design I: Concepts
- MSCH-G 400 Game Production II
- MSCH-G 410 Games Design II: Systems
- MSCH-G 420 Advanced Game Art I
- MSCH-G 430 Game Art II
- MSCH-G 450 Game Workshop I: Prototype
- MSCH-J 300 Communications Law
- MSCH-J 448 Global Journalism: Issues and Research
- MSCH-L 322 Telecommunications Policymaking
- MSCH-L 425 Telecommunications Regulation
- MSCH-M 421 Economics of Communications Industries

- MSCH-P 351 Video Field and Post Production
- MSCH-P 353 Audio Production
- MSCH-P 354 Program Graphics and Animation
- MSCH-P 356 TV Studio Production
- MSCH-P 369 Sound Design
- MSCH-P 433 Video Documentary
- MSCH-P 434 Documentary Production
- MSCH-P 452 Topical Seminar in Design and Production (Topic: Advanced Video Game Design and Production)
- MSCH-P 454 DVD Authoring
- MSCH-T 427 International Telecommunications
- SOC-S 339 The Sociology of Media
- SPEA-V 369 Managing Information Technology

Capstone
Select one of the following capstone options for a total of 6 hours:

- INFO-I 494/I 495 Design and Development of an Information System - **Must be completed on the Indiana University Bloomington campus**
- INFO-I 491 Capstone Project Internship - **Must be enrolled through Indiana University Bloomington**
- INFO-I 492/I 493 Senior Thesis - **Must be enrolled through Indiana University Bloomington**

Cognate Area Courses

Students should, in consultation with their academic advisor, choose a cognate area before their sophomore year. Students must receive a minimum grade of C- in each course and a cumulative GPA of 2.0 or higher in their cognate area. **Cognate area courses may not double count in any area except the Common Ground General Education requirements .** Please consult the cognate area of this bulletin for the list of cognate areas.

Bachelor of Science in Informatics with Honors

Students must satisfy the requirements for the B.S. in Informatics degree and the following additional requirements:

- Overall GPA 3.3 or greater
- Informatics major GPA 3.5 or greater
- Completion of at least 9 hours of INFO-H courses (excluding capstone) with H-course GPA 3.5 or greater
- Completion of honors capstone course (INFO-H 494/H 495) or capstone thesis (INFO-I 492/I 493)

Cognates

**** Equivalent honors versions of regular courses may substitute for all requirements. Please see specific course descriptions, posted in respective bulletin, for prerequisites and other pertinent information. ****

Please add or change your cognate through the student database.

Students must receive a minimum grade of C- in each cognate course and a cumulative GPA of 2.0 or higher in the cognate. Cognate area courses cannot also count as informatics core courses or informatics advanced/elective courses.

Note: Some cognates complete minor requirements. Please consult the bulletin of the minor's school for the specific requirements of the minor. Students are responsible for adding the minor to their degree record through the School of Informatics and Computing student database.

- Biology
- Business
- Chemistry
- Cognitive Science
- Computer Science
- Economics
- Fine Arts (2 options)
- Geography
- Human-Centered Computing
- Linguistics
- Mathematics
- Medical Sciences
- Music
- Philosophy of Mind and Cognition
- Pre-Health Professions
- Psychology
- Public and Environmental Affairs (5 options)
- Public Health
- Security

Biology Cognate

Required:

- BIOL-L 111 Foundations of Biology: Diversity, Evolution and Ecology
- BIOL-L 112 Foundations of Biology: Biological Mechanisms
- BIOL-L 113 Biology Laboratory
- BIOL-L 211 Molecular Biology
- Two additional courses at 300/400 level (BIOL-L 311, Genetics, is recommended)

Business Cognate

Students may pursue either option of the Business Cognate

Required:

- BUS-K 201 The Computer in Business (minimum grade of C required)

One of the following:

- BUS-A 200 Foundations of Accounting **OR** BUS-A 201 Introduction to Financial Accounting **OR** BUS-A 202 Introduction to Managerial Accounting
- BUS-L 201 Legal Environment of Business **OR** BUS-L 350 Online Law

Select 9 credit hours from the following:

- BUS-F 300 Introduction to Financial Management
- BUS-G 300 Introduction to Managerial Economics and Strategy
- BUS-J 306 Strategic Management and Leadership **OR** BUS-Z 302 Managing and Behavior in Organizations
- BUS-K 315 Business Process Management
- BUS-M 300 Introduction to Marketing
- BUS-P 300 Introduction to Operations Management
- BUS-S 305 Technology Infrastructure
- BUS-S 307 Data Management

- BUS-S 308 Business Application Development
- BUS-W 300 New Venture Management

OR

Required:

- BUS-A 200 Foundations of Accounting **OR** (BUS-A 100 Basics Accounting Skills and BUS-A 201 Introduction to Financial Accounting) **OR** (BUS-A 100 Basic Accounting Skills and BUS-A 202 Introduction to Managerial Accounting)
- BUS-K 201 The Computer in Business (minimum grade of C required)
- BUS-L 201 Legal Environment of Business **OR** BUS-L 350 Online Law

Select 6 credit hours from the following:

- BUS-F 300 Introduction to Financial Management
- BUS-G 300 Introduction to Managerial Economics
- BUS-J 306 Strategic Management and Leadership **OR** BUS-Z 302 Managing and Behavior in Organizations
- BUS-M 300 Introduction to Marketing
- BUS-P 300 Introduction to Operations Management
- BUS-W 300 Small Business Management

Chemistry Cognate

Required:

- CHEM-C 117 Principles of Chemistry and Biochemistry I
- CHEM-C 341 Organic Chemistry I Lectures
- CHEM-C 342 Organic Chemistry II Lectures

Select 6 credits from the following:

- CHEM-A 314 Biological and Environmental Chemical Analysis
- CHEM-C 317 Equilibria and Electrochemistry
- CHEM-C 318 Spectrochemistry and Separation
- CHEM-N 330 Intermediate Inorganic Chemistry
- CHEM-C 360 Introductory Physical Chemistry
- CHEM-C 361 Physical Chemistry of Bulk Matter
- CHEM-C 362 Physical Chemistry of Molecules
- CHEM-C 430 Inorganic Chemistry
- CHEM-C 443 Organic Spectroscopy
- CHEM-C 460 Nuclear Chemistry
- CHEM-C 481 Physical Biochemistry
- CHEM-C 483 Biological Chemistry
- CHEM-C 484 Biomolecules and Catabolism
- CHEM-C 485 Biosynthesis Pathways and Control of Metabolism

Cognitive Science Cognate

Required:

- COGS-Q 240 Philosophical Foundations of the Cognitive and Information Sciences
- COGS-Q 260 Programming for the Cognitive and Information Sciences
- COGS-Q 320 Computation in the Cognitive and Information Sciences
- COGS-Q 370 Experiments and Models in Cognition

Select one course from the following:

- COGS-Q 301 Brain and Cognition
- COGS-Q 351 Introduction to Artificial Intelligence and Computer Simulation
- COGS-Q 360 Autonomous Robotics

Computer Science Cognate

Four, instead of two, Advanced Informatics courses must be completed if substituting CSCI-C 200 **OR** C 211/C 212 for INFO-I 210/I 211 in the major.

Required:

- CSCI-C 200 Introduction to Computers and Programming **OR** CSCI-C 211 Introduction to Computer Science
- CSCI-C 212 Introduction to Software Systems
- CSCI-C 241 Discrete Structures for Computer Science
- CSCI-C 335 Computer Structures **OR** CSCI-C 343 Data Structures
- Select any additional CSCI course at 300/400 level (3 credit hour course)

Economics Cognate

Required:

- MATH-M 119 Brief Survey of Calculus I **OR** MATH-M 211 Calculus I
- ECON-E 201 Introduction to Microeconomics
- ECON-E 202 Introduction to Macroeconomics
- ECON-E 321 Intermediate Microeconomic Theory
- Two additional 300/400 level ECON courses (excluding ECON-E 496 and Y 398). At least one of these courses must be numbered above ECON-E 321 (excluding ECON-E 370)

Fine Arts Cognate

Required:

- SOAD-N 110 Introduction to Studio Art for Nonmajors
- SOAD-S 250 Graphic Design I
- SOAD-S 210 Digital Art: Survey and Practice

Select three courses from one of the following areas:

Option I: Computer Art

- SOAD-S 310 Interactive Multimedia
- SOAD-S 313 3D Computer Graphics
- SOAD-S 410 Advanced Multimedia
- SOAD-S 413 Computer Graphical Environments

Option II: Graphic Design

- SOAD-S 351 Typography I
- SOAD-S 352 Production for the Graphic Designer
- SOAD-S 450 Graphic Design Problem Solving

Students also may consider computer-based courses in printmaking, photography, and video. All courses selected for the cognate must be approved by the School of Fine Arts. Students are cautioned to review prerequisite requirements for upper-level courses.

Geography Cognate

Select one course from the following:

- GEOG-G 107 Physical Systems of the Environment
- GEOG-G 109 Weather and Climate

- GEOG-G 110 Introduction to Human Geography
- GEOG-G 120 Regions of the World

Select four courses from the following:

- GEOG-G 237 Mapping our World
- GEOG-G 250 Computing in the Geospatial Sciences
- GEOG-G 336 Environmental Remote Sensing
- GEOG-G 338 Geographic Information Science
- GEOG-G 436 Advanced Remote Sensing: Digital Image Processing
- GEOG-G 438 Advanced Geographic Information Science
- GEOG-G 488 Applied Spatial Statistics

Human-Centered Computing Cognate

Select 5 courses from the following:

- CSCI-A 216 Digital Multimedia Concepts and Technologies
- INFO-I 303 Organizational Informatics
- INFO-I 310 Multimedia Arts and Technology
- INFO-I 330 Legal and Social Informatics of Security
- INFO-I 360 Web Design
- INFO-I 399 Current Topics in Informatics (approved topic)
- INFO-I 400 Topics in Informatics (approved topic)
- INFO-I 440 Human Robot Interaction
- INFO-I 441 Interaction Design Practice
- INFO-I 453 Computer and Information Ethics
- INFO-I 487 Introduction to Virtual Heritage
- INFO-I 488 Advanced Topics in Virtual Heritage

Linguistics Cognate

Required:

- LING-L 203 Introduction to Linguistic Analysis
- LING-L 306 Phonetics

Select two courses from the following:

- LING-L 307 Phonology
- LING-L 308 Morphology
- LING-L 310 Syntax
- LING-L 325 Semantics
- LING-L 431 Field Methods

Select one course from the following:

- LING-L 445 The Computer and Natural Language
- LING-L 485 Topics in Linguistics
- MATH-M 385 Mathematics from Language
- Any course from outside the Department of Linguistics with sufficient computational content, subject to approval by the Linguistics Undergraduate Advisor.

Mathematics Cognate

Required:

- MATH-M 211 Calculus I
- MATH-M 212 Calculus II

Select one course from the following:

- MATH-M 301 Linear Algebra and Applications
- MATH-M 303 Linear Algebra for Undergraduates

Select two courses from the following:

- MATH-M 343 Introduction to Differential Equations with Applications I
- MATH-M 344 Introduction to Differential Equations with Applications II
- MATH-M 353 Discrete Mathematics
- MATH-M 365 Introduction to Probability and Statistics
- MATH-M 371 Elementary Computational Methods
- MATH-M 447 Mathematical Models and Applications I
- MATH-M 453 Cryptography

Medical Sciences Cognate

Required:

- ANAT-A 215 Basic Human Anatomy
- PHSL-P 215 Basic Human Physiology

Select 6 credit hours from the following:

- ANAT-A 464 Human Tissue Biology
- ANAT-A 480 Human Anatomy for Medical Imaging Evaluation
- MSCI-M 131 Disease and the Human Body **OR** MSCI-M 216 Medical Science of Psychoactive Drugs
- MSCI-M 300 Topics in Medical Sciences
- MSCI-M 450 Undergraduate Research in Biomedical Sciences
- MSCI-M 470 Mechanisms of Human Disease
- MSCI-M 480 Molecular Biology of Cancer: Cell Signaling and Fate
- MSCI-M 485 Physiology of Human Disease
- MSCI-M 490 Special Topics in Biomedical Sciences
- PHSL-P 416 Comparative Animal Physiology
- PHYS-P 314 Introduction to Medical Physics

Music Cognate

Required:

- MUS-Z 361 Introduction to MIDI and Computer Music

Select one of the following sequences:

- MUS-Z 111 Introduction to Music Theory and MUS-Z 211 Music Theory II
- MUS-T 151 Music Theory and Literature I and MUS-T 152 Music Theory and Literature II

Select two additional courses:

- MUS-A 100 Introduction to Personal Recording
- MUS-Z 120 Music in Multimedia
- MUS-Z course at 300/400 level
-

Philosophy of Mind and Cognition Cognate

Required:

- PHIL-P 360 Introduction to Philosophy of Mind
- COGS-Q 240 Philosophical Foundations of the Cognitive and Information Sciences

Select one course from the following:

- PHIL-P 250 Introductory Symbolic Logic
- PHIL-P 251 Intermediate Symbolic Logic
- PHIL-P 352 Logic and Philosophy

Select two courses from the following:

- PHIL-P 211 Modern Philosophy: Descartes through Kant
- PHIL-P 310 Topics in Metaphysics
- PHIL-P 312 Topics in the Theory of Knowledge
- PHIL-P 320 Philosophy of Language
- PHIL-P 366 Philosophy of Action

Pre-Health Professions Cognate

Required:

- BIOL-L 112 Foundations of Biology: Biological Mechanisms
- CHEM-C 117 Principles of Chemistry and Biochemistry I
- CHEM-C 127 Principles of Chemistry and Biochemistry I Lab

Select 7 or more credit hours from the following:

- ANAT-A 215 Basic Human Anatomy
- BIOL-L 113 Biology Laboratory
- BIOL-L 211 Molecular Biology
- CHEM-C 341 Organic Chemistry I Lectures
- CHEM-C 342 Organic Chemistry II Lectures
- CHEM-C 343 Organic Chemistry I Laboratory
- CHEM-N 330 Intermediate Inorganic Chemistry
- PHSL-P 215 Basic Human Physiology
- PHYS-P 201 General Physics I **OR** PHYS-P 221 Physics I

Psychology Cognate

Required:

Select one course (or sequence) from the following:

- PSY-P 101 Introductory Psychology I and PSY-P 102 Introductory Psychology II
- PSY-P 155 Introduction to Psychological and Brain Sciences

Select one course (or approved course) from the following:

- PSY-P 211 Methods of Experimental Psychology
- PSY-K 300 Statistical Techniques
- PSY-K 310 Statistical Techniques
- approved College of Arts and Sciences statistics course

Select three courses from the following:

- PSY-P 325 Psychology of Learning
- PSY-P 329 Sensation and Perception
- PSY-P 330 Perception/Action
- PSY-P 335 Cognitive Psychology
- PSY-P 346 Neuroscience
- PSY-P 349 Cognitive Neuroscience
- PSY-P 350 Human Factors/Ergonomics
- PSY-P 461 Human Memory

Public and Environmental Affairs Cognates

Environmental Management Cognate

Required:

- SPEA-E 272 Introduction to Environmental Sciences
- SPEA-E 363 Environmental Management

Select one course from the following:

- SPEA-E 311 Introduction to Risk Assessment and Risk Communication
- SPEA-E 340 Environmental Economics and Finance
- SPEA-E 476 Environmental Law and Regulation

Select one course from the following:

- SPEA-E 325 Computing for Environmental Scientists
- SPEA-E 419 Applied Remote Sensing of the Environment

Select one course from the following (if not used above):

- SPEA-E 325 Computing for Environmental Scientists
- SPEA-E 355 Introduction to Limnology
- SPEA-E 410 Introduction to Environmental Toxicology
- SPEA-E 411 Introduction to Groundwater Hydrology
- SPEA-E 412 Risk Communication
- SPEA-E 419 Applied Remote Sensing of the Environment
- SPEA-E 422 Urban Forest Management
- SPEA-E 431 Water Supply and Wastewater Treatment
- SPEA-E 440 Wetlands Ecology and Management
- SPEA-E 451 Air Pollution and Control
- SPEA-E 452 Solid and Hazardous Waste Management
- SPEA-E 456 Lake and Watershed Management
- SPEA-E 457 Introduction to Conservation Biology
- SPEA-E 460 Fisheries and Wildlife Management
- SPEA-E 461 Fisheries and Wildlife Management Laboratory

Health Systems Administration Cognate

Required:

- SPEA-H 124 Overview of the U.S. Healthcare System
- SPEA-V 373 Human Resource Management in the Public Sector

Select three courses from the following:

- SPEA-H 352 Healthcare Financial Management I
- SPEA-H 353 Healthcare Financial Management II
- SPEA-H 354 Health Economics
- SPEA-H 401 Strategic Planning in Health Organizations
- SPEA-H 402 Hospital Administration
- SPEA-H 411 Chronic and Long-Term Care Administration

Policy Studies Cognate

Select one course from the following:

- SPEA-V 160 National and International Policy
- SPEA-V 161 Urban Problems and Solutions

Required:

- SPEA-V 348 Management Science
- SPEA-V 370 Research Methods and Statistical Modeling
- SPEA-V 386 Case Studies for Policy Analysis

- SPEA-V 401 Financial and Cost-Benefit Analysis

Public Finance Cognate

Required:

- SPEA-V 246 Elements of Governmental and Nonprofit Financial Accounting Cycle
- SPEA-V 346 Introduction to Government Accounting and Financial Reporting
- SPEA-V 361 Financial Management
- SPEA-V 372 Government Finance and Budgets

Select one course from the following (an alternative course may be chosen in consultation with a SPEA advisor and approval from the Director of Undergraduate Studies in Informatics):

- SPEA-V 401 Financial and Cost-Benefit Analysis
- SPEA-V 441 Topics in Financial Management and Policy

Urban Affairs Cognate

Required:

- SPEA-E 418 Vector-Based Geographic Information Systems OR SPEA-V 450 Contemporary Issues in Public Affairs
- SPEA-V 461 Computer Applications in Public Affairs
- SPEA-V 475 Database Management Systems

Select two courses from the following:

- SPEA-V 340 Urban Government Administration
- SPEA-V 368 Managing Government Operations
- SPEA-V 372 Government Finance and Budgets
- SPEA-V 421 Metropolitan Development

Public Health Cognate

Required:

- SPH-B 366 Community Health
- SPH-B 403 Public Health Program Planning
- SPH-E 311 Introduction to Epidemiology
- SPH-Q 381 Introduction to Biostatistics
- SPH-H 494 Research and Evaluation Methods in Health and Safety

Security Cognate

Required:

- CSCI-C 291 System Programming with C and Unix
- INFO-I 130 Introduction to Cybersecurity
- INFO-I 230 Analytical Foundations of Security
- INFO-I 231 Introduction to the Mathematics of Cybersecurity

Select three courses from the following:

- BUS-S 433 Information Systems Security
- INFO-I 330 Legal and Social Informatics of Security
- INFO-I 369 Performance Analytics
- INFO-I 399 Current Topics in Informatics (approved topic)
- INFO-I 400 Topics in Informatics (approved topic)
- INFO-I 407 Introduction to Health Informatics
- INFO-I 430/CSCI-B 430 Security for Networked Systems
- INFO-I 433/CSCI-B 433 Systems & Protocol Security & Information Assurance
- INFO-I 453 Computer and Information Ethics

Bachelor of Science in Intelligent Systems Engineering

- Common Ground - General Education Requirements
- Basic Requirements
- SoIC Major Requirements
- Concentrations

Common Ground - General Education Requirements

In summer 2011, Indiana University Bloomington instituted a new campus-wide General Education Program. All IUB undergraduate students who matriculate in or after first summer session 2011 will be required to complete the campus-wide GenEd program prior to graduation. Some courses may overlap and satisfy the Common Ground General Education requirements as well as some additional SoIC General Education requirements needed to complete INFOBS, ISENGRBS, or CSCIBS majors.

The Common Ground

The bulletin with the GenEd requirements, course listings and information can be found at this url: http://bulletins.iu.edu/iub/general-education/2016-2017/index.shtml.

Basic Degree Requirements

Please see criteria for applying for the ISE major in the Admissions area of this bulletin.

Students must successfully complete a minimum of 120 credit hours for the Bachelor of Science degree. Students must complete the specific degree requirements of the School of Informatics and Computing as follows:

- Students must have a minimum cumulative grade point average of 2.0 (C). Any course taken to satisfy the major requirements must be completed with a minimum grade of C- unless otherwise specified and the grade point average of all courses taken in the major must be at least 2.0. The major requirements for intelligent systems engineering include math and science foundation courses, engineering core courses, engineering electives, and concentration courses.
- Students must complete a minimum of 30 credit hours in courses at the 300-400 (junior-senior) level.
- Students must complete at least 12 credit hours of course work in the major field of study on the Bloomington campus.
- Students are expected to complete the requirements for their undergraduate degree within eight years of admission to Indiana University. Students are allowed to continue beyond this time period only at the discretion of the Student Services office.
- Courses that fulfill the requirements for a concentration area may also meet the general education distribution requirements.
- Concentration area courses cannot count as engineering core courses, required math courses, or engineering elective courses.

- If concentration area courses are equivalent to intelligent systems major course requirements, student should substitute an alternate course.

SoIC Major Requirements

**** Equivalent honors versions of regular courses may substitute for all requirements. Please see specific course descriptions, posted in respective bulletin, for prerequisites and other pertinent information. ****

The School of Informatics and Computing student database enables students to check their academic degree information, add/drop minors, add/change specializations/cognates/concentrations and apply to graduate. Students are responsible for these actions.

The Intelligent Systems Engineering major and concentration courses are still in the process of being developed and implemented.

Please see criteria for applying for the ISE major in the Admissions area of this bulletin.

Major Requirements

Students must receive a minimum grade of C- in each course and a major GPA of 2.0 or higher

12 hours in the major must be completed on the Bloomington campus.

Students must complete the following:

Natural Science and Mathematics (24 cr.)

1. Must complete:
   - MATH-M 211 Calculus I
   - MATH-M 212 Calculus II
   - MATH-M 343 Introduction to Differential Equations with Applications
   - PHYS-P 221 Physics I
   - PHYS-P 222 Physics II
2. Select 1 course from the following:
   - MATH-M 365 Introduction to Probability and Statistics
   - STAT-S 320 Introduction to Statistics
   - STAT-S 350 Introduction to Statistical Inference

Core courses:

- CSCI-Y 395 Career Development
- ENGR-E 101 Innovation and Design
- ENGR-E 110 Engineering Computing Architectures
- ENGR-E 111 Software Systems Engineering
- ENGR-E 201 Computer Systems Engineering
- ENGR-E 210 Engineering Cyber-Physical Systems
- ENGR-E 221 Intelligent Systems I
- ENGR-E 250 Systems, Signals, and Control
- ENGR-E 299 Engineering Professionalization and Ethics

Each semester Undergraduate Research or Internship will be available.

6 hours of Engineering Electives - Students can choose from any courses in the concentration they have not taken.

Capstone

- ENGR-E 490 Engineering Capstone Design I
- ENGR-E 491 Engineering Capstone Design II

Concentration Area Courses

Students should, in consultation with their academic advisor, choose a concentration area before their junior year. Students must receive a minimum grade of C– in each course. Please consult the concentration area section of this bulletin for the list of concentration areas.

Concentrations

Please add or change your concentration through the student database.

Additional concentrations will be added as the major continues to develop.

Students must receive a minimum grade of C– in each concentration area course.

- Bioengineering
- Nanoscale Systems Engineering

Bioengineering Concentration

* ENGR courses that are not included in the course section of this bulletin as they are still being developed

1. Must complete:
   - BIOL-L 112 Foundations of Biology: Biological Mechanisms
   - BIOL-L 211 Molecular Biology
   - BIOL-L 312 Cell Biology
   - CHEM-C 117 Principles of Chemistry and Biochemistry I
   - CHEM-C 341 Organic Chemistry I Lecture
   - *ENGR-E 331 Advanced Engineering Math
   - ENGR-E 332 Introduction to Modeling and Simulation
2. Must complete:
   - BIOT-T 310 Biotechnology Lecture
   - BIOT-T 315 Biotechnology Laboratory
3. Select 4 courses from the following:
   - *ENGR-E 341 Introduction to Computational Bioengineering
   - *ENGR-E 342 BioSensors and Instrumentation
   - *ENGR-E 424 Wearable Devices
   - *ENGR-E 441 Simulating Cancer as an Intelligent System
   - *ENGR-E 443 Computational Methods for 3-D Biomaterials
   - *ENGR-E 444 Computational Tissue Engineering
   - *ENGR-E 445 Computational Synthetic Biology
   - *ENGR-E 446 Synthetic Biology
   - *ENGR-E 447 High Throughput Systems for Bioengineering
4. Select 2 courses from the following or from the list above (if not used):
   - BIOL-L 313 Cell Biology Laboratory
   - BILO-L 323 Molecular Biology Laboratory
   - BIOL-L 350 Environmental Biology
   - BIOL-L 472 Microbial Ecology
   - BIOL-M 250 Microbiology
   - BIOL-M 350 Microbial Physiology and Biochemistry

- BIOL-M 360 Microbial Physiology Laboratory
- BIOL-M 430 Virology Lecture
- BIOL-M 435 Viral Tissue Culture Laboratory
- BIOT-T 425 Laboratory in Macromolecular Production, Purification, and Characterization
- BIOT-T 440 Structure, Function, and Regulation of Biomolecules
- CHEM-C 383 Human Biochemistry
- PHYS-P 340 Thermodynamics and Statistical Mechanics
- PHYS-P 575 Introduction to Biophysics
- Any ISE course by approval
- Any Math or Science course by approval

Nanoscale Systems Engineering

* ENGR courses that are not included in the course section of this bulletin as they are still being developed

1. Must complete:
   - BIOL-L 112 Foundations of Biology: Biological Mechanisms
   - CHEM-C 117 Principles of Chemistry and Biochemistry I
   - CHEM-C 361 Physical Chemistry of Bulk Matter
   - *ENGR-E 331 Advanced Engineering Math
   - ENGR-E 332 Introduction to Modeling and Simulation
   - PHYS-P 301 Physics III
   - PHYS-P 331 Theory of Electricity and Magnetism I
2. Select 6 courses from the following:
   - CHEM-C 416 Surface Analysis and Surface Chemistry
   - CHEM-C 420 Advanced and Nanoscale Materials
   - ENGR-E 311 Circuits and Digital Systems
   - ENGR-E 321 Advanced Cyber-Physical Systems
   - *ENGR-E 351 Nanoscale Simulation and Engineering Applications
   - *ENGR-E 352 Smart Materials
   - *ENGR-E 353 Engineering Soft Nanodevices
   - *ENGR-E 354 Engineering Nanosensors
3. Select 2 courses from the following or from the list above (if not used):
   - *ENGR-E 325 Robotics I
   - *ENGR-E 326 Robotics II
   - *ENGR-E 341 Introduction to Computational Bioengineering
   - *ENGR-E 357 Rapid Prototyping for Engineers
   - *ENGR-E 424 Wearable Devices
   - ENGR-E 434 Big Data Applications
   - PHYS-P 460 Modern Optics
   - Any ISE course by approval
   - Any Math or Science course by approval

Certificates & Minors

The undergraduate minors or certificate allows a student majoring in another school to get appropriate training in informatics and obtain certification as someone who knows how to apply informatics tools to that subject area. Students may obtain a maximum of three minors.

**** Equivalent honors versions of regular courses may substitute throughout the certificate or minor. ****

Certificate in Informatics

Students must be an IU admitted degree-seeking student and certificate will be awarded concurrently or after an IU degree.

Students may obtain an area certificate in Informatics by successfully completing 8 courses. INFO-I 101 must be completed with a minimum grade of C. A minimum grade of C- in all other courses with an overall certificate GPA of 2.0 is required.

Required Courses:

- INFO-I 101 Introduction to Informatics (minimum grade of C required in this course)
- INFO-I 201 Mathematical Foundations of Informatics
- INFO-I 202 Social Informatics OR INFO-I 222 The Information Society
- INFO-I 210 Information Infrastructure I
- INFO-I 211 Information Infrastructure II
- INFO-I 300 Human-Computer Interaction Design and Programming
- INFO-I 308 Information Representation

In addition, students must take one course from the list of informatics electives (list can be found under the BS Informatics area, SoIC Degree and Major Requirements). CSCI majors may not count upper level CSCI courses in this certificate if used in major requirements.

Minor in Informatics

Students may obtain a minor in Informatics by successfully completing five courses totaling a minimum of 17 credit hours. At least two of the five courses must be at the 300/400 level. INFO-I 101 must be completed with a minimum grade of C. A minimum grade of C- in all other courses with an overall minor GPA of 2.0 is required.

Required Course:

- INFO-I 101 Introduction to Informatics (minimum grade of C required in this course)

A programming course selected from the following:

- INFO-I 210 Information Infrastructure I
- CSCI-A 201 Introduction to Programming I
- CSCI-C 200 Introduction to Computers and Programming or CSCI-C 211 Introduction to Computer Science

Three additional Informatics courses.

- At least two of these courses must be at the 300/400 level. Excludes INFO-I 110, I 111, I 130, T 100, Y 100 and Y 395. Independent study, internship and capstone courses may only be counted with approval of the Director of Undergraduate Studies.

Minor in Human-Centered Computing

Students may obtain a minor in Human-Centered Computing by successfully completing a minimum of 15 credit hours. INFO-I 101 must be completed with a minimum grade of C. A minimum grade of C- in all other courses with an overall minor GPA of 2.0 is required.

The minor introduces students with little or no background in computing to the social, cultural, ethical and organizational dimensions of computing and information technology, as well as the role of design in the creation of new technology.

For Informatics Majors:
Select five courses from the following:

- CSCI-A 216 Digital Multimedia Concepts and Technologies
- INFO-I 303 Organizational Informatics
- INFO-I 310 Multimedia Arts and Technology
- INFO-I 330 Legal and Social Informatics of Security
- INFO-I 360 Web Design
- INFO-I 399 Current Topics in Informatics (approved topic)
- INFO-I 400 Topics in Informatics (approved topic)
- INFO-I 440 Human Robot Interaction
- INFO-I 441 Interaction Design Practice
- INFO-I 453 Computer and Information Ethics
- INFO-I 487 Introduction to Virtual Heritage
- INFO-I 488 Advanced Topics in Virtual Heritage

For non-Informatics Majors:

Required Courses:

- INFO-I 101 Introduction to Informatics (minimum grade of C required in this course) **OR** CSCI-A 110 Introduction to Computers and Computing
- INFO-I 202 Social Informatics OR INFO-I 222 The Information Society
- INFO-I 300 Human-Computer Interaction Design and Programming

Select two courses from the following:

- CSCI-A 216 Digital Multimedia Concepts and Technologies
- INFO-I 303 Organizational Informatics
- INFO-I 310 Multimedia Arts and Technology
- INFO-I 330 Legal and Social Informatics of Security
- INFO-I 360 Web Design
- INFO-I 399 Current Topics in Informatics (approved topic)
- INFO-I 400 Topics in Informatics (approved topic)
- INFO-I 440 Human Robot Interaction
- INFO-I 441 Interaction Design Practice
- INFO-I 453 Computer and Information Ethics
- INFO-I 488 Advanced Topics in Virtual Heritage

Minor in Information Technology

Computer Science majors may not claim this minor.

Students may obtain a minor in Information Technology by successfully completing a minimum of 15 credit hours. A minimum grade of C- in each course and an overall minor GPA of 2.0 is required.

- CSCI-A 338 Network Technologies and Administration
- CSCI-C 200 Introduction to Computers and Programming or CSCI-C 211 Introduction to Computer Science and CSCI-C 212 Introduction to Software Systems
  OR
- CSCI-A 201 Introduction to Programming I and CSCI-A 202 Introduction to Programming II
  OR
- INFO-I 210 Information Infrastructure I and INFO-I 211 Information Infrastructure II

Select one course from the following:

- CSCI-A 216 Digital Multimedia Concepts and Technologies
- CSCI-A 321 Computing Tools for Scientific Research
- CSCI-A 348 Mastering the World Wide Web
- 3 CSCI-A 290 Tools for Computing (if not part of a CSCI-A 202 course - see advisor for this exception)

Minor in Security Informatics

Students may obtain a minor in Security Informatics by successfully completing a minimum of 16 credit hours. A minimum grade of C- in each course and an overall minor GPA of 2.0 is required.

The minor is an appropriate addition for students interested in gaining significant exposure to issues, challenges and techniques relevant to computer based security.

Required Courses:

- CSCI-C 291 System Programming with C and Unix
- INFO-I 130 Introduction to Cybersecurity
- INFO-I 230 Analytical Foundations of Security
- INFO-I 231 Math Foundations of Cybersecurity

Select three courses from the following:

- BUS-S 433 Information Systems Security
- INFO-I 330 Legal and Social Informatics of Security
- INFO-I 369 Performance Analytics
- INFO-I 399 Current Topics in Informatics (approved topic)
- INFO-I 400 Topics in Informatics (approved topic)
- INFO-I 407 Introduction to Health Informatics
- INFO-I 430/CSCI-B 430 Security for Networked Systems
- INFO-I 433/CSCI-B 433 Systems & Protocol Security & Information Assurance
- INFO-I 453 Computer and Information Ethics

Minor in Intelligence Studies (offered through ILS)

Students may obtain a minor in Intelligence Studies by successfully completing a minimum of 15 credit hours. A minimum grade of C+ in all other courses with an overall minor GPA of 2.3 is required. Students in the College of Arts and Sciences must have 9 credit hours in 300/400 level courses.

Intelligence Studies works with information that may not be authoritative or reliable, that may actually be deceptive, and lacks context for purposes of national security or competitive intelligence.

Required Courses:

- ILS-Z 115 Evaluating Intelligence and Information

- ILS-Z 221 Intelligence Analytics

Select one course from the following:

- ILS-Z 399 Topics in Information and Library Science (Topic: Information Visualization)
- INTL-I 210 Diplomacy, Security, Governance

Select two courses from the following:

- ILS-Z 311 Spy Tech for Non-Technical Spies
- ILS-Z 331 Strategic Intelligence
- ILS-Z 351 Moles, Deception, and Counterintelligence
- ILS-Z 399 Topics in Information and Library Science (Topic: Introduction to Metadata)
- INFO-I 453 Computer and Information Ethics

Bachelor of Science in Music - Outside Field

CSCI

A minimum of 27 CSCI hours with a minimum grade of C- in each course and an overall outside field GPA of 2.0 is required.

- CSCI-C 200 Introduction to Computers and Programming or CSCI-C 211 Introduction to Computer Science
- CSCI-C 212 Introduction to Software Systems
- CSCI-C 241 Discrete Structures for CSCI
- CSCI-C 343 Data Structures
- Specialization of choice

INFO

A minimum of 27 INFO hours with a minimum grade of C- (except INFO-I 101 must be a minimum of C) in each course and an overall outside field GPA of 2.0 is required.

- INFO-I 101 Introduction to Informatics (minimum grade of C required in this course)
- INFO-I 201 Mathematical Foundations of Informatics
- INFO-I 202 Social Informatics OR INFO-I 222 The Information Society
- INFO-I 210 Information Infrastructure I
- INFO-I 211 Information Infrastructure II
- INFO-I 300 Human-Computer Interaction Design and Programming
- INFO-I 308 Information Representation
- INFO elective (see list under INFO major)

Outside Minors and Certificates

Students may pursue minors and certificates in other schools. Up to three minors may appear on the student's Indiana University transcript. Some cognates complete minor requirements. Please consult the bulletin of the minor's school for the specific requirements of the minor. The department offering the minor defines the requirements for the minor. Students are required to follow the department's rules regarding grades, prerequisites and course requirements. Students are responsible for adding the minor to their degree record through the School of Informatics and Computing student database.

An exception to the above, if different from the school offering the minor: The School of Informatics and Computing requires a minimum grade of C- in each course (unless otherwise noted as a higher grade) and an overall minor GPA of 2.0.

Certificate in Entrepreneurship

This cross campus certificate consists of fifteen credit hours. Only students outside of the Kelley School of Business will be admitted into the Certificate in Entrepreneurship program. The program consists of three courses from the Kelley School of Business and two courses chosen by the School of Informatics and Computing. This allows for the students to learn the basic issues involved with entrepreneurship as well as specifics relating to entrepreneurship in the field of information technology.

To be considered for the certificate, students must apply online: Certificate Application

A minimum grade of C in all courses with an overall certificate GPA of 2.5 is required.

Kelley School of Business:

Required Courses:

- BUS-W 212 Exploring Entrepreneurship
- BUS-W 300 Small Business Management
- BUS-Z 302 Managing and Behavior in Organizations

School of Informatics and Computing Courses

Select two of the following:

- INFO-I 400 Topics in Informatics (Topic: Design Strategy)
- INFO-I 400 Topics in Informatics (Topic: Technology Entrepreneurship)
- INFO-I 400 Topics in Informatics (Topic: Technology Innovation)

Concurrent/Sequential Baccalaureate Degrees

Concurrent Degree

Students may be permitted to pursue a School of Informatics and Computing degree concurrently with another degree-granting IU-Bloomington school. Check with School of Informatics and Computing academic advisor for more details and approval.

Students concurrently pursuing a Computer Science and Informatics degree may not double-count upper level courses between the CSCI and INFO majors (this includes specializations and cognates).

Sequential Baccalaureate Degree

Students may be permitted to pursue a School of Informatics and Computing degree after completion of a first degree from Indiana University or another university. Students from another university must first be admitted to Indiana University as a degree seeking student. Please see http://www.indiana.edu/~iuadmit/ for admission information.

Students seeking second degree candidacy should review the guidelines available from the School of Informatics and Computing office. After admission to Indiana University, please email soicugrd@indiana.edu for registration approval.

Students with a bachelor's degree who wish to further their education should also consider becoming qualified for admission to a graduate program.

Graduate

Thirty (30) credit hours are required for the M.S. (some majors require more than 30), all of which may be taken in a single department; at least 20 of these credit hours must be earned in the major field. A minimum of 9 credit hours of course work or at least three courses in the major field (excluding thesis) must be numbered 500 or above.

Data Science

How to Apply

We require that you submit your application online. If you need to submit additional materials by mail, send them to the appropriate address below. (International applicants should submit materials to this address, *not* to the Office of International Services).

Data Science Graduate Office
711 N Park Avenue
Bloomington, IN 47408

datasci@indiana.edu

What We Are Looking For

We want to know if your interests and abilities match the program you are applying for and if you seem likely to benefit from an education in the school. If you think it is helpful, you can supplement the required application materials with other information that sheds light on your capabilities. A resume or curruculum vitae is ideal for including citations or links to any published work, hardware artifacts, or software artifacts you have produced.

Items that are important in the evaluation process include:

EDUCATIONAL BACKGROUND

We do not require a bachelor's degree in computer science, informatics, or a related field, but we are looking for background in key areas. You should have basic experience or working knowledge with programming languages such as Python and R before joining the program.

LETTERS OF REFERENCE

Except in special cases, references should be from academic faculty, including at least some in informatics and computing. We ask for three letters but you may submit more. Certificate students need only provide one letter of recommendation.

GRE SCORES

We require GRE scores for all MS applicants and cannot process your application until we receive them. We do not have cut-offs for GRE scores, preferring instead to use the full information available in your application to evaluate. IU's institution code for reporting your GRE score is 1324 and the department code for Data Science processing is 0403 or for Undecided is 0000.

Online MS applicants may apply for a GRE waiver. Please contact the Data Science Graduate Office at datasci@indiana.edu for eligibility requirements.

STATEMENT OF PURPOSE

The most important information to include in your statement of purpose concerns your academic goals. Tell us which research areas you are interested in and which Indiana University faculty you would like to work with. You may also use your statement of purpose to explain any anomalies in your record.

TRANSCRIPTS

You must submit a transcript from each previous undergraduate or graduate institution other than Indiana University that you have attended. We are most interested in the grades you received in courses that are relevant to our graduate programs.

International Applicants

If you are not a citizen or permanent resident of the United States, you must submit the following with your application for admission:

- Financial Documentation. Federal regulations require every admitted international student to demonstrate that the student has current resources available to support himself/herself during their first year of study in the United States. This financial documentation is not part of your application. The Office of International Services strongly recommends that applicants submit their financial documentation using iStart after the application is submitted. By having your financial documentation uploaded into your iStart account, it will expedite the processing of immigration documents in the event you are admitted to our program and accept the offer of admission. Once the application is submitted, the Office of International Services will send you an email with instructions on how to set-up your iStart account and how to submit your Financial Documentation. Immigration documents will not be issued until the required financial documentation is received by the Office of International Services. If you have any questions about how to set-up your iStart account or questions about the required financial documentation, email the Office of International Services, newtoiu@indiana.edu.
- Test of English as a Foreign Language (TOEFL). All applicants who are not native speakers of English or who did not receive an undergraduate or graduate degree from a university in the United States must submit these scores. IU's institution code for reporting TOEFL scores is 1324, and the department code for Data Science processing is 0403 or for Undecided is 0000. We normally expect a minimum TOEFL score of 100 on the internet-based test, 250 on the computer-based test, or approximately 600 on the paper-based test. We may make exceptions when there is other evidence of English ability. Effective August 1, 2016 - IELTS scores are no longer accepted.

Recent Applicants

If you have applied here in the last two years and are applying again, contact us for instructions at datasci@indiana.edu

Deadlines

- **Fall Semester**

- Priority Deadline for Admission and Financial Aid
  - Residential student applications: January 1
  - Online and Certificate student applications: June 1

Admission Status and Notification

We evaluate applications for fall semester after the priority deadlines. We will let you know as soon as we have reached a decision, residential decisions by late February and online/certificate decisions by late June.

Occassionally students who are not admitted contact us for an explanation. Unfortunately, we receive several hundred applications per year, and we do not have the staff to explain admission decisions on a case-by-case basis.

Admissions

- Computer Science
- Data Science
- Informatics
- Information and Library Science
- Admitted Students
- Financial Aid & Scholarships

Admitted Students

Congratulations on your admittance to the School of Informatics and Computing. We're eager for you to join our close-knit community.

We have an orientation for new graduate students each fall, when we'll tell you what you need to know to start off on the right foot.

International students will also attend international orientation, which covers a wide range of topics about studying and living in the United States. IU's Office of International Services can answer any questions you have about visas and other paperwork. This office will be a resource for you throughout your IU career, helping you adjust to U.S. culture, meet your academic goals, complete required paperwork, make good financial choices, and more.

Deferring Admission

You can defer your start date up to one year, but you need to get approval from the program to which you were admitted.

Financial Aid & Scholarships

Tuition & Fees

Indiana University is committed to keeping its degrees affordable for in-state and out-of-state students, both through low costs and generous financial aid.

The Office of Student Financial Assistance has information about current costs of attendance for full-time, domestic graduate students. Costs for international students are slightly different and include mandatory health insurance.

Master's and doctoral students have access to a wide range of financial aid and scholarships from the school, Indiana University, and outside sources such as the federal government.

We offer a variety of assistantships to our Ph.D. students, as well as a limited number of fellowships. In addition, IU offers a number of diversity-building fellowships.

You can learn more about financial aid opportunities from the Office of Student Financial Assistance and the University Graduate School Funding and Fees pages.

International Students

The Office of International Services has information about financial aid and employment for international students. See the information about financial aid for prospective graduate students, employment for F-1 students and J-1 students, and other money matters.

Computer Science

How to Apply

We require that you submit your application online. If you need to submit additional materials by mail, send them to the appropriate address below. (International applicants should submit materials to this address, *not* to the Office of International Services.)

Computer Science Degrees
Graduate Admissions
Computer Science Program
Indiana University
150 S. Woodlawn Avenue
Bloomington, IN 47405-7104

soiccsgr@indiana.edu

What We Are Looking For

We want to know if your interests and abilities match the program you are applying for and if you seem likely to benefit from an education in the school. If you think it is helpful, you can supplement the required application materials with other information that sheds light on your capabilities. A resume or curriculum vitae is ideal for including citations or links to any published work, hardware artifacts, or software artifacts you have produced.

Items that are important in the evaluation process include:

EDUCATIONAL BACKGROUND

We do not require a bachelor's degree in computer science, informatics, or a related field, but we are looking for background in key areas. For example, for computer science degrees, you should have had courses in data structures, machine organization and assembly language, and discrete structures.

LETTERS OF REFERENCE

Except in special cases, references should be from academic faculty, including at least some in informatics and computing. We ask for three letters but you may submit more. If you have experience as a teaching assistant, a letter from your teaching supervisor attesting to your teaching abilities could help your application for aid.

GRE SCORES

We require GRE scores for all applicants and cannot process your application until we receive them. We do not have cut-offs for GRE scores, preferring instead to use the full information available in your application to evaluate. IU's institution code for reporting your GRE scores is 1324 and the department code is 0402 for computer science degrees.

STATEMENT OF PURPOSE

The most important information to include in your statement of purpose concerns your academic goals. Tell us which research areas you are interested in and which Indiana University faculty you would like to work with. You may also use your statement of purpose to explain any anomalies in your record.

TRANSCRIPTS

You must submit a transcript from each previous undergraduate or graduate institution other than Indiana University that you have attended. We are most interested in the grades you received in courses that are relevant to our graduate programs.

Applicants must complete a supplemental form.

International Applicants

If you are not a citizen or permanent resident of the United States, you must submit the following with your application for admission:

- Financial Documentation. Federal regulations require every admitted international student to demonstrate that the student has current resources available to support himself/herself during their first year of study in the United States. This financial documentation is not part of your application. The Office of International Services strongly recommends that applicants submit their financial documentation using iStart after the application is submitted. By having your financial documentation uploaded into your iStart account, it will expedite the processing of immigration documents in the event you are admitted to our program and accept the offer of admission. Once the application is submitted, the Office of International Services will send you an email with instructions on how to set-up your iStart account and how to submit your Financial Documentation. Immigration documents will not be issued until the required financial documentation is received by the Office of International Services. If you have any questions about how to set-up your iStart account or questions about the required financial documentation, email the Office of International Services to newtoiu@indiana.edu .
- Test of English as a Foreign Language (TOEFL) or IELTS scores. All applicants who are not native speakers of English or who did not receive an undergraduate or graduate degree from a university in the United States must submit these scores. IU's institution code for reporting TOEFL scores is 1324, and the department code is 78 for computer science degrees and 99 for informatics degrees. We normally expect a minimum TOEFL score of 100 on the Internet-based test, 250 on the computer-based test, or approximately 600 on the paper-based test, or a score of 6.5 on the IELTS. We may make exceptions when there is other evidence of English ability.

Do not worry if some of your materials, such as your GRE scores or a recommendation letter, have not reached us by the international priority deadline below. We encourage you to get them in as soon as possible, though.

Master's Students Interested in a Ph.D. Program

When applying to one of our Ph.D. programs, current School of Informatics and Computing master's students should contact Graduate Student Services for application procedures. Applicants must fill out the online application for the Ph.D. degree, but other procedures are different. You can reach us by e-mail at soiccsgr@indiana.edu.

Recent Applicants

If you applied here in the last two years and are applying again, contact us for instructions.

Deadlines

- **Fall Semester** Priority Deadline for Admission and Financial Aid
  - PhD student applications: December 1
  - Master's student applications: January 1

Admission Status and Notification

We evaluate applications for fall semester after the priority deadlines. We will let you know as soon as we have reached a decision, generally by March 15.

Occasionally students who are not admitted contact us for an explanation. Unfortunately, we receive several hundred applications per year, and we do not have the staff to explain admission decisions on a case-by-case basis.

Dual Master's Program

Students who are concurrently enrolled in two schools may qualify for two master's degrees under a provision that allows credit earned to satisfy the major requirements of one program to count as elective credit in a second program. Any area of substantial overlap in the two courses of study will be negotiated by the graduate advisor. A student must be formally admitted by both programs. All requirements for both degrees must be met. All course work must be completed within a period of six years.

Information and Library Science

Application Procedures

U.S. Citizen Applicants

Apply online through the ILS website. Check the website for application requirements for your specific program. Contact ilsmain@indiana.edu (ILS Admissions) if you have any questions.

Application to ILS graduate programs includes a minimum of the following (check the website for additional requirements for specific degrees):

1. Completed application forms (online).
2. Three letters of recommendation that address the applicant's academic and professional capabilities. It is the applicant's responsibility to ensure that letters

of recommendation reach the Admissions Office by deadline dates.
3. Current resume or CV
4. A personal essay explaining academic and career objectives (minimum 500 words).
5. Official transcripts from each college attended (except IU transcripts, which the department can obtain from the IU Registrar's online system). From all other colleges and universities, applicants should arrange to have transcripts sent directly to the ILS Admissions Office.
6. Graduate Record Examination (GRE) General Test scores are required of all doctoral program applicants. Master's program applicants whose grade point average (GPA) in undergraduate college course work is below a 3.0 on a 4.0 scale, or whose GPA on course work completed for a previous graduate degree is not 3.2 or higher, must submit GRE scores in support of their applications. GRE minimum scores are 153 verbal, 144 quantitative, and 4.0 analytical writing. GRE scores, if provided, will be taken into account in the competitive admissions process and in the awarding of departmental financial aid. The test must be taken within three years of application. GMAT scores may be submitted for GRE scores for ILS master's degree applicants (minimum of 31 in each area).
7. An application fee. Online applications require payment by credit card.

When the completed application forms are received, an applicant's individual file is established, and documents are added to the file as they are received. Applicants may contact the ILS Office to check on the status of their application. Admission, once granted, remains valid for one year. Applicants may request a deferral of admission via email. Files of admitted students who neither matriculate nor request an extension may be purged soon after the beginning of the semester for which admission was granted.

Application Deadlines

Applications are processed on a rolling basis for master's and specialist programs. Priority deadlines for students not applying for ILS financial aid are May 15 for the fall semester, November 1 for the spring semester, and March 15 for summer session, although applications are accepted beyond these dates.

Applications for Ph.D. students are due January 15.

Applications will not be reviewed until all required documents have been received. Ordinarily, applications for master's and specialist degrees are processed within one month of their completion. Decisions on admission to the doctoral program are usually made by April 15.

The ILS financial aid deadline for all degrees is January 15.

Students must have a completed application on file at ILS by January 15 to be considered for financial aid. For information on financial aid not directly funded by ILS, applicants should contact the Office of Student Financial Assistance (OSFA), 408 N Union, Bloomington, IN 47405, (812) 855-0321 or visit the OSFA website.

International Applicants

Apply online through the ILS website. All supporting material must be sent to the ILS Admissions, 1320 E Tenth Street, Bloomington, IN 47405. Payment of an application fee is required. Questions should be directed to ILS Admissions via ilsmain@indiana.edu.

All international applicants for any ILS degree program must submit a recent official Graduate Record Examination (GRE) General Test score report from the Educational Testing Service. The test must have been taken within three years of application. Scores on all three sections (verbal, quantitative, and analytical) will be considered. GRE minimum scores of 153 verbal, 144 quantitative, and 4.0 analytical writing are required. GMAT scores may be submitted for GRE scores for ILS master's degree applicants (a minimum score of 31 in each area is required).

Students whose first language is not English must submit recent official scores from the Test of English as a Foreign Language (TOEFL). A minimum TOEFL score of 100 (or 600 on the paper test) is required for admission to ILS graduate programs. See the TOEFL website for details.

Students whose first language is not English may be required to also take an IU English Proficiency Test during orientation. The results of this test are used to determine what, if any, remedial English courses must be successfully completed before graduate study begins (or during the first semester).

Additional Bloomington campus information for international applicants can be found on the Office of International Services website.

Informatics

INFORMATICS

Innovation permeates the school. Our rare combination of interdisciplianary programs - including informatics, computer science, data science, library science, information science, and intelligent systems engineering - makes our school one of the largest, broadest, and most accomplished of its kind. Informatics is among the STEM programs in the areas of science, technology, engineering, and math.

WHAT WE ARE LOOKING FOR

We are looking for intelligent, collaborative, and hard-working students! Indiana University's School of Informatics and Computing is a diverse community and students have extraordinary opportunities such as internships, research, cultural programs, and global connections. Employers from a variety of industries hire our graduates as well as provide internships for our students. With a graduate degree in Informatics coupled with your undergraduate degree, you will have a first-rate education that will give you an extra edge in the job market.

EDUCATIONAL BACKGROUND

Our students come from a variety of educational backgrounds - from technology to the sciences and liberal arts. Some of our students have earned a bachelor's degree while others have earned both a bachelor's and a master's degree. Likewise, some of our students enter

the program with no work experience while other students have numerous years of work experience.

APPLICATION TIMELINE

Informatics admits students only in the fall semester. The admissions committee evaluates the application for admission and funding at the same time.

- **Application Deadline for M.S. Applicants: January 1**

APPLICATION REQUIREMENTS

The admissions committee only reviews completed applications. If you have questions about the application process, email infograd@indiana.edu. If you are interested in applying to any of the Informatics programs, we require all applicants to submit the following:

- **Application**

Online Graduate and Professional Admissions Application. The application fee for a domestic applicant is $55.00 and for an international applicant, $65.00.

- **Statement of Purpose**

The admissions committee requires all applicants to submit a Statement of Purpose. You should upload your Statement of Purpose as a PDF file with your online application. Be sure to put your name on your Statement of Purpose. Your statement should be sincere, direct, and most of all, written by you. The admissions committee wants to know about your academic goals, research interests, and abilities. You should explain why you want to be in the program. You may also use your statement to explain any anomalies in your academic record. There is no word limit, but most statements are between 1-3 pages in length. **We do not accept updated versions.**

- **Resume**

Save your resume/CV as a PDF file and upload it with your online application. **We do not accept updated versions.**

- **Official Academic Records: Transcripts and Degree Certifications**

For the admissions process, we can use scanned copies of transcripts and marked as unofficial. Upon admission to the program, you will be required to submit official final transcripts and degree certifications. The registrar or record-keeping official from each institution at which the work was completed will need to send us your official transcripts and degree certifications. Our mailing address is:

Indiana University
Informatics Graduate Programs
Graduate Studies Office
901 E 10th Street, Room 235
Bloomington, IN 47408 USA

- **Letters of Recommendation**

We require three (3) letters of recommendation. Recommendations should be from academic or professional references who can attest to your abilities, accomplishments, strengths, knowledge, experience, and motivation to do graduate work. If you have experience as a teaching assistant, you may want to consider asking your teaching supervisor to write a recommendation on your behalf. On your application, you will need to include your recommender's name, title, address, phone number, and an email address. Once you submit your application, your recommenders will receive an automated recommendation request.

- **GRE Scores**

We require GRE scores for all applicants. GRE scores are good for five (5) years from the date you took the exam. You will need to have your official GRE scores sent directly to Indiana University using our school code - 1324. If you have an ETS score sheet, scan it and send it as an attachment to infograd@indiana.edu. We can use those scores as unofficial scores until the official scores arrive.

- **TOEFL** (for international students)

The TOEFL measures English proficiency. We require all international students who are non-native English speakers to submit TOEFL scores. TOEFL scores are good for two (2) years from the date you took the exam. We expect a minimum score of 100. The TOEFL requirement may be waived, if you earned a degree or are earning a degree from a U.S. university. **NOTE:** Informatics does not accept IELTS scores.

You will need to have your official TOEFL scores sent directly to Indiana University using our school code - 1324. If you have an ETS score sheet, scan it and send it as an attachment to infograd@indiana.edu. We can use those scores as unofficial scores until the official scores arrive.

- **HCI/d Portfolio**

All HCI/d applicants are required to submit a portfolio. Portfolios may include any type of prior work samples such as a thesis, prototypes, writing samples, ethnographic work, photography, etc. These samples do not necessarily need to include only design work samples. Focus on quality, rather than quantity. The portfolio should be a single PDF document/file. You should upload your portfolio as a PDF file with your online application.**We do not accept updated versions.**

- **Financial Documentation**

The financial documentation is not part of your application, however, federal regulations require every admitted international student to demonstrate that the student has current resources available to support himself/herself during their first year of study in the United States. The Office of International Services will issue the immigration documents once they receive the required financial documentation. For a detailed listing of current estimated expenses for study at IU, please visit the Office of International Services. The Office of International Services strongly recommends that applicants submit their financial documentation using iStart after they submit their application. If you have questions about the financial documentation, email the Office of International Services at ois@iu.edu.

APPLICATION REVIEW and NOTIFICATION

The admissions committee will begin reviewing M.S. applicants in January, which will take several weeks. Applicants will receive a decision by mid-March via email.

DECISION DEADLINE FOR ADMITTED STUDENTS - APRIL 15

Admitted students will have until April 15 to accept our offer. This is in the spirit of the Council of Graduate School Resolution. After this date, our offer of acceptance will be withdrawn.

FINANCIAL AWARDS

We offer partial financial aid to M.S. students. We have limited funds to distribute. The number of applications received and the competitiveness of those applications determines the number of financial awards we are able to offer. None of our aid packages provides full tuition or a large stipend. All completed applications are reviewed and considered for financial aid or scholarship. If you are offered admission, your admit letter will detail the financial award, if any.

UNIVERSITY GRADUATE SCHOOL FELLOWSHIPS AND AWARDS

The University Graduate School offers several internal and external fellowships and awards. The application process and deadlines vary by fellowship and award, so be sure to read the requirements carefully. If you are interested in being nominated for an internal fellowship or award, email infograd@indiana.edu to make it clear you are interested in being nominated.

TUITION AND FEES

Indiana University is committed to keeping its degrees affordable for in-state and out-of-state students. We encourage you to review the Office of the Bursar's listing of tuition and fees and mandatory fees. To determine approximate enrollment costs, use the tuition estimator by selecting the term, residency, level, program, and number of hours to estimate the cost of tuition and associated fees. For international students, the Office of International Services outlines the tuition and fees for International students.

QUESTIONS

email infograd@indiana.edu

Courses

Computer Science

Data Science

Engineering

Informatics

Information and Library Science

Computer Science

CSCI-A courses are non-major courses and are listed first regardless of the course level.

CSCI-A 504 Introductory C++ Programming (2 cr.) P: Programming experience. Topics include aspects of C++ that are not object-oriented, basic data structures, standard libraries, and Unix tools for project management. Credit not given for both CSCI-A 504 and either CSCI-A 304, A 597, A 592, C 212 or BUS-K 201.

CSCI-A 506 Object-Oriented Programming in C++ (2 cr.) P: CSCI-A 201, A 304, A 504, or A 597. Topics include objects, classes, encapsulation, inheritance, polymorphism, templates and exceptions. Credit not given for both CSCI-A 506 and either CSCI-A 306, A 202, A 592, A 598 or C 212.

CSCI-A 521 Computing Tools for Scientific Research (3 cr.) C: MATH-M 118 or higher required; MATH-M 211 recommended. Introduction to computer-based tools useful for analysis and understanding of scientific data. Basic methods of computation, data processing, and display systems such at Matlab combined with elementary practical C/C++ programming. Techniques to support customized scientific research tasks, with particular emphasis on biological, neural, and behavioral sciences. Lecture and laboratory.

CSCI-A 538 Network Technologies and Systems Administration (3 cr.) P: CSCI-A 110, EDUC-W 200, or equivalent computer literacy. Introduction to network principles and current network technology, both hardware and software. Network administration tools and techniques. Laboratory provides practical experience. Credit not given for CSCI-A 547 and A 538.

CSCI-A 541 Computing and Technology Bootcamp (3 cr.) P: Basic mathematical and scientific sophistication, on par with basic introductory college level math and science courses. High school level physics is helpful. A high-level introduction to the many information technologies that underlie modern society for students with non-technical backgrounds. Examples include basic ideas in computing, networking, embedded systems, GPS, SCADA , algorithms and machine learning. After completion, students should be able to partake in many high-level discussions with technical leads.

CSCI-A 546 User-Interface Programming (3 cr.) P: CSCI-A 201, A 202, A 306, C 212, A 506, A 597, A 598, or equivalent experience. Learn to prototype and build graphical user interfaces for computer applications. Contemporary software design methodology. Students design and implement prototype interfaces to applications provided by the instructor. Extensive use will be made of both commercial and experimental software tools. Credit not given for both CSCI-A 546 and A 346.

CSCI-A 548 Mastering the World-Wide Web (3 cr.) P: Two semesters of programming experience or equivalent, and some knowledge of operating systems. Project-oriented course leading to ability to maintain a web site with full functionality. Topics include background on internet network protocols and programming, web server administration, advanced web design and authoring, web protocols, interfacing services into the web. Credit not given for both CSCI-A 548 and A 348.

CSCI-A 590 Topics in Programming (1-2 cr.) Eight-week courses designed to provide foundations for using modern programming tools for applications and web development. Lecture and lab. May be repeated for a maximum of 6 credit hours.

CSCI-A 591 Introduction to Computer Science (3 cr.) A first course in computer science for those intending to take advanced computer science courses. Introduction to programming and to algorithm design and analysis. Using the Scheme programming language, the course covers several programming paradigms. Lecture and laboratory.

Credit given for only one of CSCI-A 591, C 200, C 211 or H 211.

CSCI-A 592 Introduction to Software Systems (3 cr.) P: Programming experience. Design of computer software systems and introduction to programming. Topics include the Java programming language and its data structure facilities; building and maintaining large projects; shell tools and system calls. Introduction to object-oriented programming. Lecture and laboratory. Credit given for only one of CSCI-A 592, C 212, H 212 or ENGR-E 111.

CSCI-A 593 Computer Structures (3 cr.) P: CSCI-A 592. Lab fee. Structure and internal operation of computers. The architecture and assembly language programming of a specific computer are stressed, in addition to general principles of hardware organization and low-level software systems. Lecture and laboratory. Credit given for only one of CSCI-A 593, C 335 or H 335. May be applied toward the Ph.D. minor.

CSCI-A 594 Data Structures (3 cr.) P: CSCI-A 592. C: CSCI-C 241 and A 593. Systematic study of data structures encountered in computing problems; structure and use of storage media; methods of representing structured data; and techniques for operating on data structures. Lecture and laboratory. Credit given for only one of CSCI-A 594, C 343 or H 343. May be applied toward the Ph.D. minor.

CSCI-A 595 Fundamentals of Computing Theory (3 cr.) P: CSCI-C 241 C: CSCI-C 212. Fundamentals of formal language theory, computation models and computability, the limits of computability and feasibility, and program verification. Credit not given for both CSCI-A 595 and B 401. May be applied toward the Ph.D. minor, graduate credit available for CS M.S. candidates with special permission.

CSCI-A 596 Programming Languages (3 cr.) P: CSCI-A 593 C: CSCI-A 594. Systematic approach to programming languages. Relationships among languages, properties and features of languages, and the computer environment necessary to use languages. Lecture and laboratory. Credit not given for both CSCI-A 596 and C 311. May be applied toward the Ph.D. minor.

CSCI-A 597 Introduction to Programming I (3 cr.) Fundamental programming constructs, including loops, arrays, classes, and files. General problem-solving techniques. Emphasis on modular programming, user-interface design, and developing good programming style. Credit not given for both CSCI-A 597 and A 201. Not intended for computer science majors.

CSCI-A 598 Introduction to Programming II (3 cr.) P: CSCI-A 597, A 201, A 504, or A 304. Advanced programming techniques: user-defined functions and types, recursion versus iteration, parameter-passing mechanisms. Classic abstract data types and algorithms. Programming style. Object-oriented programming. Credit not given for both CSCI-A 598 and A 202. Not intended for computer science majors.

CSCI-B 501 Theory of Computing (3 cr.) P: CSCI-C 241. Deterministic and nondeterministic automata, regular expressions, pumping lemmas; context-free languages, parsing, pushdown automata, context-sensitive languages, LBA, LR(k) languages, closure and decidability of language classes. Turing machines, random access machines, grammars, general recursive functions, equivalence of computation models, universal machines, relative computing. Unsolvability, semi-recursive sets, Rice's Theorem. Space and time complexity, NP completeness.

CSCI-B 502 Computational Complexity (3 cr.) P: CSCI-B 501. Study of computational complexity classes, their intrinsic properties, and relations between them. Topics include time and space computational complexity. Reducibility and completeness of problems within complexity classes. Complexity of optimization problems. Complexity hierarchies. Relativization of the P =? NP conjecture. Parallel computation models and the class NC.

CSCI-B 503 Algorithms Design and Analysis (3 cr.) P: MATH-M 216 and CSCI-C 343. Models, algorithms, recurrences, summations, growth rates. Probabilistic tools, upper and lower bounds; worst-case and average-case analysis, amortized analysis, dynamization. Comparison-based algorithms: search, selection, sorting, hashing. Information extraction algorithms (graphs, databases). Graphs algorithms: spanning trees, shortest paths, connectivity, depth-first search, breadth-first search. Credit not given for both CSCI-B 503 and B 403.

CSCI-B 504 Introduction to Cryptography (3 cr.) P: Familiar with basic algebra, combinatorics and probability theory. The course provides students with a foundational introduction to cryptography. Students learn the basic primitives used in cryptography such as symmetric encryption, public-key encryption, message authentication codes, digital signatures, cryptographic hashes and related material. Computational aspects of modern cryptography are stressed, as are appropriate security models, and computational security reductions.

CSCI-B 505 Applied Algorithms (3 cr.) The course studies the design, implementation, and analysis of algorithms and data structures as applied to real world problems. The topics include divide-and-conquer, optimization, and randomized algorithms applied to problems such as sorting, searching, and graph analysis. The course teaches trees, hash tables, heaps, and graphs.

CSCI-B 510 Introduction to Applied Logic (3 cr.) Structures: relations between structures, term structures. Description: notation and meaning, substitution operations, first order formulas, database languages, program verification conditions, semantics valuation, normal forms, quantifier reduction, axiomatic theories. Proof: resolution, sequential calculi, natural deduction, automated theorem proving, semantic completeness. Limits of formalization: compactness, undecidability of truth, undecidability of canonical theories, non-formalizability of database theory.

CSCI-B 521 Programming Language Principles (3 cr.) Systematic approach to programming languages. Relationships among languages, properties and features of languages, the computer environment necessary to support language execution. Credit not given for both CSCI-B 521 and either CSCI-C-311 or A 596.

CSCI-B 522 Programming Language Foundations (3 cr.) P: CSCI-C 311 or B 521 and B 510. Introduction to denotational, operational, and axiomatic approaches

to programming language semantics. Semantic analysis of major programming language features. Logics of programs.

CSCI-B 524 Parallelism in Programming Languages and Systems (3 cr.) P: CSCI-P436 or P 536, and either CSCI-C 311 or B 521 or C 343. Fundamentals of parallel computation, with an emphasis on parallel programming methodology and programming languages. Topics include: Parallel algorithms. Major paradigms for parallel software construction: data parallelism, task/thread parallelism and CSP. Compiling programs for parallel computers.

CSCI-B 534 Distributed Systems (3 cr.) P: CSCI-P 436 or P 536. Principles of distributed systems including naming, consistency, concurrency, and security and their role in distributed file systems and file sharing systems. Includes study of and current best practices in distributed computing models: peer-to-peer, grid computing, and distributed object model. Credit not given for both CSCI-B 534 and P 434.

CSCI-B 541 Hardware System Design I (3 cr.) P: CSCI-C 335 and C-343. Lab fee. Structured approach to hardware design, emphasizing hardwired and microprogrammed control. Boolean algebra, hardware building blocks, architecture and control, implementation issues. In the laboratory, students build a working computer using hardware prototyping technologies. Basic training in the use of design and simulation software. Lecture and laboratory. Credit not given for both CSCI-B 541 and B 441.

CSCI-B 543 Computer Architecture (3 cr.) P: CSCI-C 335 and C 343. Fundamentals of computer design, instruction processing and performance analysis. Architecture of single-processor systems, focusing on pipelining, memory and memory hierarchies, and interconnect technology. Exploration of architecture classes such as high-performance multiprocessors, massively parallel computers, embedded systems. Credit not given for both CSCI-B 543 and B 443.

CSCI-B 544 Security for Networked Systems (3 cr.) This course is an extensive survey of system and network security. Course materials cover the threats to information confidentiality, integrity and availability and the defense mechanisms that control such threats. The course provides the foundation for more advanced security courses and hands-on experiences through course projects.

CSCI-B 546 Malware Epidemic: Threat and Defense (3 cr.) P: One semester of programming or equivalent. This course looks at systems and protocols, how to design threat models for them and how to use a large number of current security technologies and concepts to block specific vulnerabilities. Students will use a large number of systems and programming security tools in the laboratories.

CSCI-B 547 Systems and Protocol Security and Information Assurance (3 cr.) P: Some previous programming background and general computer networking and operating systems literacy. This course covers the design and analysis of secure systems, including identifying security goals and risks, threat modeling, defense, integrating different technologies to achieve security goals, developing security protocols and policies, implementing security protocols and secure coding. Some real world scenarios that have many security requirements will be studied.

CSCI-B 548 Privacy in Pervasive Computing (3 cr.) This course prepares graduate students towards a successful research career in wearable and sensor-based computing. This course combines both lectures on the research process and student-led round-table discussions of seminal and influential papers in the field.

CSCI-B 551 Elements of Artificial Intelligence (3 cr.) P: CSCI-C 343 or good knowledge of LISP or Scheme. Introduction to major issues and approaches in artificial intelligence. Principles of reactive, goal-based, and utility-based agents. Problem-solving and search. Knowledge representation and design of representational vocabularies. Inference and theorem proving, reasoning under uncertainty, and planning. Overview of machine learning.

CSCI-B 552 Knowledge Based Artificial Intelligence (3 cr.) P: CSCI-B 551. Knowledge-based methods for artificial intelligence systems: knowledge representation, organization, and application. Typical content includes: Principles of memory organization, indexing and retrieval. Memory-based, analogical, and case-based reasoning. Applications to understanding, explanation, planning, and advisory systems.

CSCI-B 553 Neural and Genetic Approaches to Artificial Intelligence (3 cr.) P: CSCI-B 551. Approaches to the design of intelligent systems inspired by nervous systems, evolution, and animal behavior. Distributed and perceptually grounded representations. Temporal processing. Perception and action. Genetic search. Unsupervised and reinforcement learning. Comparison of symbolic, subsymbolic, and hybrid approaches to intelligence.

CSCI-B 554 Probabilistic Approaches to Artificial Intelligence (3 cr.) P: MATH-M 365, MATH-M 301 and CSCI-B 403. Theory and practice of computational and mathematical foundations of probabilistic models for artificial intelligence and other areas of computing. Topics include: random variables and independence; graphical models including Bayesian and Markov networks; exact and approximate inference algorithms; constrained, unconstrained and stochastic optimization algorithms; parameter and structure estimation; temporal models; applications.

CSCI-B 555 Machine Learning (3 cr.) Theory and practice of constructing algorithms that learn functions and choose optimal decisions from data and knowledge. Topics include: mathematical/probabilistic foundations, MAP classification/regression, linear and logistic regression, neural networks, support vector machines, Bayesian networks, tree models, committee machines, kernel functions, EM, density estimation, accuracy estimation, normalization, model selection.

CSCI-B 557 Music Information Processing: Audio (3 cr.) This course discusses music analysis and processing problems that use sampled audio as the primary data representation. Digital signal processing is discussed, along with filtering and its relationship to Fourier techniques. Applications considered include score following, automatic music transcription and annotation

from audio, musical accompaniment systems, and audio effects.

CSCI-B 561 Advanced Database Concepts (3 cr.) P: CSCI-C 241, C 335, and C 343. Database models and systems: especially relational and object-oriented; relational database design theory; structures for efficient data access; query languages and processing; database applications development; views. Transaction management: concurrency and recovery. Credit not given for both CSCI-B 561 and B 461.

CSCI-B 565 Data Mining (3 cr.) Algorithmic and practical aspects of discovering patterns and relationships in large databases. The course also provides hands-on experience in data analysis, clustering and prediction. Topics include: data preprocessing and exploration, data warehousing, association rule mining, classification and regression, clustering, anomaly detection, human factors and social issues in data mining.

CSCI-B 581 Advanced Computer Graphics (3 cr.) P: CSCI-C 343, MATH-M 301 or M 303 or equivalent experience. Introduction to graphics hardware and software. Two-dimensional graphics methods, transformations, and interactive methods. Three-dimensional graphics, transformations, viewing geometry, object modeling and interactive manipulation methods. Basic lighting and shading. Video and animation methods. Credit not given for both CSCI-B 581 and B 481.

CSCI-B 582 Image Synthesis (3 cr.) P: CSCI-B 581 and MATH-M 215. Raster image display: color theory, gamma correction, and filtering. Advanced shading methods: local illumination models, global illumination models. Surface display, including ray tracing and Z-buffering. Solid modeling; spline surfaces, CSG, superquadrics, and deformations. Scientific visualization: isosurfaces and volume rendering.

CSCI-B 599 Teaching in Computer Science (1 cr.) General principles of teaching and practical experiences that relate to teaching computer science. An important feature of the course is the micro-teaching, in which each participant prepares and delivers short lectures to the seminar participants. Each presentation is followed by critical analysis and discussion.

CSCI-B 603 Advanced Algorithms Analysis (3 cr.) P: CSCI-B 503. Advanced topics in analysis of algorithms, including fast algorithms for classical problems, lower bounds results, and statistical behavior.

CSCI-B 607 Philosophy of Computation (3 cr.) P: Permission of instructor. Critical examination of the conceptual foundations of computing. Several different views assessed with respect to conceptual, explanatory, and empirical criteria. Primary focus on formal symbol manipulation, recursive function theory, effective computability, computational complexity, digitality, and information processing. Some non-standard approaches also considered: connectionism, dynamics, and artificial life.

CSCI-B 609 Topics in Algorithms and Computing Theory (1-6 cr.) P: Permission of instructor. Special topics in algorithms and computing theory. May be repeated 2 times for a maximum of 6 credit hours.

CSCI-B 619 Topics in Applied Logic (1-6 cr.) P: Permission of instructor. Special topics in applied logic.

CSCI-B 621 Advanced Concepts in Programming Languages (3 cr.) P: CSCI-C 311 or B 521. C: CSCI-P 423 or P 523. Discussion of current issues in the design of programming languages. Modularity, abstraction, and static analysis. Applicative and nonapplicative models. Single and multiple processing.

CSCI-B 622 Programming Language Type Systems (3 cr.) P: CSCI-C 311 or B 521. Theoretical foundations and engineering techniques for modern type systems, focusing on polymorphism and subtyping in typed lambda-calculi; applications, including type systems for objects, abstract data types, and modules; issues in type checker implementation and polymorphic type inference.

CSCI-B 629 Topics in Programming Languages (1-6 cr.) P: CSCI-C 311 or B 521 and permission of instructor. Special topics in programming languages. May be repeated 1 time for a maximum of 6 credit hours.

CSCI-B 639 Topics in Software (1-6 cr.) P: Permission of instructor. Special topics in software systems. May be repeated 2 times for a maximum of 12 credit hours.

CSCI-B 644 Very Large Scale Integration (3 cr.) P: CSCI-B 441 or B 541. Basic theory and practice required to convert hardware algorithms and architecture to silicon structures. Use of state-of-the-art design tools for integrated circuits.

CSCI-B 649 Topics in Systems (1-6 cr.) P: Permission of instructor. Special topics in systems. May be repeated 1 time for a maximum of 12 credit hours.

CSCI-B 651 Natural Language Processing (3 cr.) P: CSCI-B 551. CSCI-B 552 or B 553 recommended. Theory and methods for natural language processing. Algorithms for sentence parsing and generation. Context-free and unification grammars. Question-and-answer systems. Analysis of narratives. Finite-state approaches to computational phonology and morphology. Machine translation. Machine learning of natural language. Speech recognition. Neural-network and statistical alternatives to symbolic approaches.

CSCI-B 652 Computer Models of Symbolic Learning (3 cr.) P: CSCI-B 552. Symbolic artificial intelligence methods for learning. Inductive and explanation-based generalization. Failure-driven learning. Case-based learning. Typical content includes: Operationality of explanations and utility of learning. Goal-driven learning. Criteria for when, what, and how to learn. Learning in integrated architectures.

CSCI-B 656 Web Mining (3 cr.) Machine learning techniques to mine the Web and other unstructured/ semistructured, hypertextual, distributed information repositories. Crawling, indexing, ranking and filtering algorithms using text and link analysis. Applications to search, classification, tracking, monitoring, and Web intelligence. Group project on one of the topics covered in class.

CSCI-B 657 Computer Vision (3 cr.) P: CSCI-C 463 or B 551. Concepts and methods of machine vision as a branch of artificial intelligence. Basics of digital image processing. Local and global tools for deriving information

from image data. Model-based object recognition and scene understanding.

CSCI-B 659 Topics in Artificial Intelligence (1-6 cr.) P: Permission of instructor. Special topics in artificial intelligence. May be repeated for a maximum of 12 credit hours.

CSCI-B 661 Database Theory and Systems Design (3 cr.) P: CSCI-B 461 or B 561. Database models: relational, deductive, complex-object, object-oriented. Query languages: relational algebra and calculus, datalog, fixpoint logics, object-oriented query languages. Transaction management theory: concurrency control, recovery, distribution. Post-relational and object-oriented database systems.

CSCI-B 662 Database Systems and Internal Design (3 cr.) P: CSCI-B 561. This course deals with database management systems and their modern applications. We will discuss various issues to be considered and design decisions to be made in these systems. Topics include storage management, access methods, query processing and optimization strategies, concurrently control techniques, data warehousing, data mining, semi-structured data management, etc.

CSCI-B 665 Software Engineering Management I (3 cr.) P: CSCI-B 561 or BUS-S 560. Topics include: the high cost of software, the software life cycle, understanding programming teams, and methodologies for controlling development. Presentation of readings and supervision of programming teams producing software products required.

CSCI-B 666 Software Management Implementation II (1-3 cr.) P: CSCI-B 665. Continuation of projects from CSCI-B 665. Periodic reports and a final paper required. If taken for two or more credits, an additional project or paper is required.

CSCI-B 669 Topics in Database and Information Systems (1-6 cr.) P: Permission of instructor. Special topics in database and information systems. May be repeated for a maximum of 12 credit hours.

CSCI-B 673 Advanced Scientific Computing (3 cr.) P: CSCI-P 573 and MATH-M 471. Multiprocessor organization: vectorization, memory organization, processor topologies and architectures. Models of parallelism. Programming language and systems for scientific and high performance computing. Environments for interactive scientific experiments and databases. Distributed programming tools. Parallelism in scientific problems: Parallel algorithmic techniques, parallel algorithms and models, parallel performance analysis and debugging.

CSCI-B 679 Topics in Scientific Computing (1-6 cr.) P: Permission of instructor. Special topics in scientific computing. May be repeated 1 time for a maximum of 12 credit hours.

CSCI-B 689 Topics in Graphics and Human Computer Interaction (1-6 cr.) P: Permission of instructor. Special topics in graphics and human computer interaction. May be repeated for a maximum of 6 credit hours.

CSCI-C 532 Navy Cyber Operations (3 cr.) P: Students in Navy MSc. Introduce students to basic computing and networking infrastructure, the ubiquity of computing and networks in the modern battlefield, and core principles of cybersecurity. Understanding digital terrain, its relation to traditional battlefields, and intelligence and joint targeting. All previous topics will be combined to discuss CyberOperation Planning, attacking and defending.

CSCI-C 533 Applied Secure Networking Operations and Forensics (3 cr.) P: Students in Navy MSc. Secure network and systems operations, defense and forensics. Students will explore a variety of topics such as threat analysis, victim categorization, and mitigation effectiveness. Students will practice hands¬on design, deployment, and use, of network attack monitoring and mitigation capabilities. Network and systems forensics techniques and tools will be introduced.

CSCI-P 515 Specification and Verification (3 cr.) P: CSCI-C 311. Tools and techniques for rigorous reasoning about software and digital hardware. Safety, reliability, security, and other design-critical applications. Decision algorithms. Projects involving the use of automated reasoning, such as model checkers, theorem provers, and program transformation. Credit not given for both CSCI-P 515 and P 415.

CSCI-P 523 Programming Language Implementation (3 cr.) P: CSCI-B 521 or C 311. Implementation of traditional and nontraditional computer programming languages. Compilation, including lexical analysis, parsing, optimization, code generation, and testing. Run-time support, including run-time libraries, storage management, input-output. Comparison of implementation techniques. Extensive laboratory exercises. Credit not given for both CSCI-P 523 and P 423.

CSCI-P 532 Object-Oriented Software Development (3 cr.) P: Proficiency in Java. This course will help turn motivated students into superior contributors to any small- to mid-sized commercial or open-source software project. It takes a hands-on, learning-by-doing approach. Students are introduced to design patterns, tools, and teamwork strategies from the first assignment to the last project.

CSCI-P 535 Pervasive Computing (3 cr.) P: Object oriented programming. Lab fee. Topics in pervasive computing, such as: sensors, mobility, tangibles, ambient displays, middleware, location and context-awareness. User-centered design methods, such as: requirements gathering, design, prototyping and evaluation. Labs cover current technologies, such as sensors and mobile devices. Lecture and laboratory.

CSCI-P 536 Advanced Operating Systems (3 cr.) P: CSCI-C 335 and C 343. Advanced topics in operating systems, such as: multi-tasking, synchronization mechanisms, distributed system architecture, client-server models, distributed mutual exclusion and concurrency control, agreement protocols, load balancing, failure recovery, fault tolerance, cryptography, multiprocessor operating systems. Credit given for only one of CSCI-P 536, P 436, or ENGR-E 316.

CSCI-P 538 Computer Networks (3 cr.) P: Operating systems or networking course. Layered TCP/IP architecture. LAN technologies (Ethernet, wireless, token ring). Switching. Internet addressing (IPv4, IPv6). Routing protocols. Congestion control (TCP, UDP). Applications (DNS, HTTP, peer-to-peer networks). Selection of topics

including DHCP, ICMP, VPNs, multicast, security. Credit given for only one of CSCI-P 538, P 438, or ENGR-E 318.

CSCI-P 542 Hardware System Design II (3 cr.) P: CSCI-B 541 or B 441. Lab fee. Depending on instructor, a selection of topics in system-level design, such as simulation, logic synthesis, high-level synthesis, codesign, embedded software, verification, test, requirements specification, and others. Projects in system-level design. Computer-aided design tools. Lecture and laboratory. Credit not given for both CSCI-P 542 and P 442.

CSCI-P 545 Embedded and Real-Time Systems (3 cr.) P: Any 400-level "systems" course (middle digit 3 or 4). Design and implementation of purpose-specific, locally distributed software systems. Models and methods for time-critical applications. Real-time operating systems. Testing, validation, and verification. Safety-critical design. Related topics, such as resiliency, synchronization, sensor fusion, etc. Lecture and laboratory.

CSCI-P 556 Applied Machine Learning (3 cr.) The main aim of the course is to provide skills to apply machine learning algorithms on real applications. We will consider fewer learning algorithms and less time on math and theory and instead spend more time on hands-on skills required for algorithms to work on a variety of data sets.

CSCI-P 565 Software Engineering I (3 cr.) P: CSCI-C 343. Analysis design, and implementation of information systems. Project specification. Data modeling. Software design methodologies. Software quality assurance. Supervised team development of a real system for a real client. Credit not give for both CSCI-P 565 and P 465.

CSCI-P 566 Software Engineering II (3 cr.) P: CSCI-C 343, B 461 previously or B 561 concurrently. Analysis, design and implementation of software systems. Requirements specification: data and process modeling. Software design methodologies. Software quality assurance: testing and verification. Software development processes. Credit not given for both CSCI-P 566 and CSCI-P 466.

CSCI-P 573 Scientific Computing (3 cr.) P: MATH-M 303 or M 301, M 343 and CSCI-C 212. For students from all scientific, engineering, and mathematical disciplines, this course provides an overview of computer hardware, software, and numerical methods that are useful on scientific workstations and supercomputers. Topics include high-performance computer architectures, software tools and packages, characteristics of numerical methods in common use, graphical presentation of results, and performance analysis and improvement.

CSCI-P 632 Object-Oriented Software Management (3 cr.) P: Permission of instructor. This course will help turn motivated students into superior managers of any small- to mid-sized commercial or open-source software project. It takes a hands-on, learning-by-doing approach. Students are introduced to the main management concerns of managing smallish design and development teams.

CSCI-Y 790 Graduate Independent Study (1-6 cr.) Independent study under the direction of a faculty member, culminating in a written report. The different depatmental options for independent study are: Research and Reading, Software System Development, Master's Research Project, Master's Software Project, and a University Master's Thesis. May be repeated for a maximum of 9 credit hours.

CSCI-Y 791 Graduate Independent System Development (1-6 cr.) System development culminating in written report and a publicly available system. May be repeated for credit.

CSCI-Y 792 Master's Thesis (1-6 cr.) Readings and research under the supervision of the master's thesis advisor, leading to a thesis at a level admissible as a departmental technical report. May be repeated for a maximum of 6 credit hours of CSCI-Y 792 and Y 793.

CSCI-Y 793 Master's Software Thesis (1-6 cr.) A major software development project, possibly performed jointly with other students, documented in the public domain and with final approval by three graduate faculty. May be repeated for a maximum of 6 credit hours of CSCI-Y 792 and Y 793.

CSCI-Y 798 Professional Practicum/Internship (0-6 cr.) P: Current enrollment in graduate degree program in computer science. Provides for participation in graduate level professional training and internship experience.

CSCI-Y 799 Computer Science Colloquium (1 cr.) A series of talks by researchers in computer science and closely related areas presenting their recent research. A minimum of 75% attendance and course work in the form of a written report based on the talk by any colloquium speaker are required for credit. May be repeated for a maximum of 3 credit hours.

CSCI-Y 890 Thesis Readings and Research (1-12 cr.) Research under the direction of a member of the graduate faculty leading to a Ph.D. dissertation.

CSCI-G 901 Advanced Research (6 cr.) Ph.D. dissertation research after the completion of all course requirements. May be repeated for a maximum of 6 times.

Data Science

DSCI-D 590 Topics in Data Science (3 cr.) P: Must be a student in the Data Science graduate program or instructor's permission. Variable topic. Emphasis on new developments and research in Data Science. May be repeated with different topics 3 times for a maximum of 12 credit hours.

DSCI-D 699 Graduate Independent Study in Data Science (1-6 cr.) P: Must be a student in the Data Science graduate program. Independent Study under the direction of a faculty member, culminating in a written report and/or database development and/or documented laboratory experience. May be repeated 2 times for a maximum of 9 credit hours.

Engineering

ENGR-E 500 Introduction to the Intelligent Systems Engineering Program (1 cr.) This course provides an introduction to Intelligent Systems Engineering and an overview of the various degree specializations that are available. ISE is a set of modern Systems Engineering areas with various interrelations. This course provides a broad introduction and details of faculty research areas.

ENGR-E 501 Introduction to Computer Engineering (3 cr.) This course covers computer engineering and parallel computer architecture for HPC in intelligent systems engineering. Topics include multi-core processors, cache coherence, data centric computing, SIMD, GPU, FPGA, accelerators, and heterogeneous computing architecture. The course will focus on fundamental parallel computer architectures, evaluation and the tradeoffs in design, and their use.

ENGR-E 502 Introduction to Cyber Physical Systems (3 cr.) This covers a broad range of CPS with both uses and component technologies. Robots and Smart systems are covered in some detail. Algorithms, security, control theory, software, device hardware and mechanical construction issues are covered. CPS laboratory experience will be an essential part of course. Current research opportunities are covered.

ENGR-E 503 Introduction to Intelligent Systems (3 cr.) Systems Engineering (SE) can refer to several different concepts, disciplines, and technical skills needed in designing and building systems of systems. This course covers fundamental principle and five use cases with special attention to challenges and opportunities coming from modern computing infrastructure, the internet of things and artificial intelligence.

ENGR-E 504 Introduction to Bioengineering (3 cr.) Bioengineering (BE) and Biomedical Engineering (BME) refer to techniques to manipulate and control living organisms directly or through the development of novel tools. The first half focuses on measurement and the second half on control, with special attention to the enabling role of computation.

ENGR-E 505 Introduction to Nano-Engineering (3 cr.) P: PHYS-P 301 or consent of instructor. Miniaturization of devices and systems to nanoscale boosted in the last couple of decades, enabling unattainable hitherto functionalities and bridging the quantum realm with the mainstream of technological paradigm. Current course provides a broad overview of the scientific background as well as the cutting-edge technological achievements of engineering on nanoscale.

ENGR-E 506 Introduction to Neuro-Engineering (3 cr.) P: One programming course, linear algebra and calculus are required. One AI or Machine Learning course recommended. Understand concepts of neuro-engineering with an applied mathematics focus. Learn the principles of building intelligent machines for neuro-engineering. This is an introductory course to ISE Masters and Ph.D. program in Neuro-Engineering. It will have guest lectures, and the basic material will be interleaved with talks on relevant Bloomington campus research.

ENGR-E 507 Introduction to Environmental Engineering Intelligent Systems (3 cr.) Develop a foundation in Environmental Engineering practices and challenges by exploring how engineered systems promote better predictions about water quality, climate and atmospheric conditions. This course will cover fundamental principles and three use cases to examine unique challenges and opportunities stemming from data analytics, internet of things and modern computing.

ENGR-E 511 Machine Learning for Signal Processing (3 cr.) P: Students should be accustomed to Calculus, Linear Algebra, Probability Theory, CSCI-B 555 and one of the scientific programming languages, MATLAB, Python, or R. The course discusses advanced signal processing topics as an application of machine learning. Hands-on signal processing tasks are introduced and tackled using a problem-solving manner, so students can grasp important machine learning concepts. The course can help students learn to build an intelligent signal processing system in a systematical way.

ENGR-E 512 Advanced Computer Architecture (3 cr.) P: ENGR-E 311, ENGR-E (Engineering Computing Architectures), CSCI-B 543. The course will cover advanced computer architecture topics for data centers regarding multi-core processor hardware, circuit level and micro-architecture level main memory modeling, circuit level and micro-architecture level storage design, GPU architecture, processing-in/near-memory, (convolutional neural network) accelerator design and data center architecture.

ENGR-E 514 Embedded Systems (3 cr.) This course covers Embedded and Real-Time Systems designed for real-time multiprocessing and distributed processing. It discusses theoretical and practical concepts in real-time systems emphasizing both hard and soft real-time distributed multi-processing. Several operating systems (e.g. Xinu, Linux, VxWorks), computer architectures and process scheduling methods will be used to illustrate concepts. Credit not given for both ENGR-E 514 and E 314.

ENGR-E 516 Engineering Cloud Computing (3 cr.) P: Experience with Windows or Linux using Java and scripts. This course covers basic concepts on programming models and tools of cloud computing to support data intensive science applications. Students will get to know the latest research topics of cloud platforms, parallel algorithms, storage and high level language for proficiency with a complex ecosystem of tools that span many disciplines.

ENGR-E 517 High Performance Computing (3 cr.) P: Beginner/intermediate C/C++ experience Familiarity with Linux/Unix command-line utilities. Students will learn about the development, operation, and application of HPC systems prepared to address future challenges demanding capability and expertise. The course combines critical elements from hardware technology and architecture, system software and tools, and programming models and application algorithms with the cross-cutting theme of performance management and measurement. Credit not given for both ENGR-E 517 and E 317.

ENGR-E 522 HPC and Cloud Computing for Large Scale Image Applications (3 cr.) P: ENGR-E 534, SPEA-E 519, GEOG-G 535, or GEOG-538 recommended. Java and Python will be used as programming languages. Understanding of machine learning and/or image processing is helpful. This course describes big data techniques for sensors and remote sensing explaining how one architects analysis systems for sensors and remote imagery. Algorithms, software systems, and storage issues are addressed. The impact of user interfaces is covered. Streaming and batch examples from satellite, internet of things and physics data.

ENGR-E 523 Internet of Things (3 cr.) P: ENGR-E 502 or equivalent. Java, C, and Python will be used as

programming languages. This course covers the Internet of Things (IoT) including the emerging Industrial IoT. Power, security, networking, system architecture from cloud to device are covered. Integration with big data and use cases are discussed. Laboratory sessions are integrated.

ENGR-E 531 Physical Optimization (3 cr.) P: Java and/or Python will be used as programming languages. This course describes applications of optimization based on physical analogies: genetic algorithms, swarm intelligence, simulated and deterministic annealing, neural networks. They are related to statistical physics, variational methods, evolution, information theory, agent-based systems, cellular automata, complex systems and placed in a broad context of physical computation and other optimization approaches.

ENGR-E 532 Systems Engineering (3 cr.) P: ENGR-E 503 or equivalent. Python will be used as programming language. This course covers methodologies and tools used to deal with large complex interactive multi-disciplinary systems of systems and to deliver performance that meet user requirements in an eco-friendly fashion. Students will see several examples and apply SE to an example of their own.

ENGR-E 533 Deep Learning Systems (3 cr.) P: ENGR-E 511. This course teaches the pipeline for building state-of-the-art deep learning-based intelligent systems. It covers general training mechanisms and acceleration options that use GPU computing libraries and parallelization techniques running on high performance computing systems. The course also aims at deploying the networks to the low-powered hardware systems.

ENGR-E 534 Big Data Applications (3 cr.) P: Java and/or Python will be used as programming languages. This is an overview course of Big Data Applications covering a broad range of problems and solutions. It covers cloud computing technologies and includes a project. Algorithms are introduced and illustrated. Credit given for only one of ENGR-E 534, E 434, INFO-I 423, or I 523.

ENGR-E 535 Image Processing for Medical Applications (3 cr.) P: One programming course, linear algebra and calculus are required. Any machine learning or computer vision course would be helpful, but not necessary. Learn how to build intelligent algorithms and software for medical imaging that can help medical doctors to treat their patients and researchers to understand how the body works. Students will be familiarized with algorithmic techniques such as tracking, denoising, warping, segmentation, model fitting, optimization and interactive visualization of medical datasets.

ENGR-E 537 Rapid Prototyping for Engineers (3 cr.) P: Permission of instructor. Protoyping - materialization of concepts - is essential for design and engineering of a product. The course overviews the modern computer aided design (CAD) - computer aided manufacturing (CAM) approach to prototyping. Students will perform a case study practicum, characterizing performance envelope of fused deposition modeling (FDM) 3D printer.

ENGR-E 540 Computational Methods for 3-D Biomaterials (3 cr.) P: ENGR-E 331, E 340 and PHYS-P 222 or equivalent or instructor permission. This computational engineering course teaches key biophysics and numerical concepts needed to simulate 3-D biological tissues, including finite element methods, conservation laws, biotransport, fluid mechanics, and tissue mechanics. The entire course will combine lectures with hands-on lab projects to simulate 3-D biological materials, and prepare students for computational tissue engineering. Credit not given for both ENGR-E 540 and E 440.

ENGR-E 541 Simulating Cancer as an Intelligent System (3 cr.) P: Familiarity with advanced engineering mathematics. This course explores cancer as an adaptive intelligent system, where renegade cells break the rules, reuse the body's natural processes to re-engineer their environments and evade treatments. We will use computational models to explore this system and the potential for future clinicians to plan treatments with data-driven models. Credit not given for both ENGR-E 541 and E 441.

ENGR-E 583 Information Visualization (3 cr.) This course provides students with a working knowledge on how to visualize abstract information and hands-on experience in the application of this knowledge to specific domains, different tasks, and diverse, possibly non-technical users. Credit not given for both ENGR-E 583 and E 483.

ENGR-E 584 Scientific Visualization (3 cr.) Teaches basic principles of human cognition and perception; techniques and algorithms for designing and critiquing scientific visualizations in different domains (neuro, nano, bio-medicine, IoT, smart cities); hands-on experience using modern tools for designing scientific visualizations that provide novel and/or actionable insights; 3D printing and augmented reality deployment; teamwork/project management expertise. Credit not given for both ENGR-E 584 and E 484.

ENGR-E 599 Topics in Intelligent Systems Engineering (1-3 cr.) P: Graduate standing. Variable topic course. Emphasis is on new developments and research in Intelligent Systems Engineering. May be repeated with different topics.

ENGR-E 616 Advanced Cloud Computing (3 cr.) P: ENGR-E 516 or Introduction to Cloud Computing. Java and Python will be used as programming languages. This course describes Cloud 3.0 in which DevOps, Microservices, and Function as a Service is added to basic cloud computing. The discussion is centered around the Apache Big Data Stack and a major student project aimed at demonstrating integration of cloud capabilities.

ENGR-E 621 Software Defined Systems (3 cr.) P: ENGR-E 516, E 616 or Introduction to Cloud Computing recommended. Java and Python will be used as programming languages. This course describes the emerging world of distribute intelligent systems where each system component has internal and external sources of intelligence that are subject to collective control. Examples are given from computers, networks, vehicle systems, digital manufacturing, and robotics. Performance and fault tolerance and system management are discussed.

ENGR-E 623 Applied Streaming Data Systems (3 cr.) P: ENGR-E 502 or equivalent. Java, C, and Python will be used as programming languages. This course covers

the software and algorithm engineering of streaming data systems in the cloud with an emphasis on use in industry and the internet of things.

ENGR-E 687 Graduate Independent Studies in Intelligent Systems Engineering (1-6 cr.) Independent study under the direction of a faculty member, culminating in a written report and/or software development and/or systems/hardware development and/or documented laboratory experience. May be repeated for credit.

ENGR-E 890 Thesis Readings and Research (1-6 cr.) P: Graduate standing or department approval. Research under the direction of a member of the graduate faculty leading to a Ph.D. dissertation. May be repeated for a maximum of 6 times or 36 credit hours.

ENGR-G 901 Advanced Research (6 cr.) Ph.D. dissertaion research after the completion of all course requirements. May be repeated for a maximum of 6 times.

Informatics

INFO-I 500 Fundamental Computer Concepts for Informatics (3 cr.) An introduction to fundamental principles of computer concepts for Informatics study, including an overview of computer architecture, computer algorithms, fundamentals of operating systems, data structure, file organization and database concepts. INFO-I 500 is expected to impart the required level of competency in computer science. This course may be waived in lieu of six undergraduate credit hours of computer science or informatics coursework, covering areas of programming, discrete structures, and data structures.

INFO-I 501 Introduction to Informatics (3 cr.) P: Calculus I or Linear Algebra I and introductory undergraduate statistics or probability course. This course serves as an intensive introduction to the most central technical tools of Informatics, most importantly, Probability and Statistics, Linear Algebra and Numerical Optimization. The course weaves in computation, using R, as a uniting theme, while including numerous examples and applications of the techniques presented.

INFO-I 502 Human-Centered Research Methods in Informatics (3 cr.) This course surveys a broad range of research methods employed in Informatics, exploring their meta-theoretical underpinnings and exemplifying their application to specific research questions. This course is intended for students in Informatics graduate programs, especially Ph.D. students, who need a grounding in research methods.

INFO-I 504 Social Dimensions of Science Informatics (3 cr.) Examines ethical, legal, and social issues surrounding contemporary research and practice in science informatics. Topics include the nature of science and technology, the ramifications of recent advances in science informatics, and relevant science policy and research ethics. General knowledge of science informatics is assumed.

INFO-I 506 Globalization and Information (3 cr.) Explores the processes that promote and impede movement of human action and informational activities to the most general levels, e.g., the level of the world as a whole. Surveys diverse theories of globalization to identify the best approaches for professional informatics career planning and making information globally accessible.

INFO-I 507 Introduction to Health Informatics (3 cr.) Lab fee. This is a combined advanced undergraduate and graduate course that provides an introduction to health informatics. By the end of the course, students will be able to describe and apply informatics methods that improve health and well being.

INFO-I 519 Introduction to Bioinformatics (3 cr.) P: One semester programming course or equivalent. Sequence alignment and assembly; RNA structure, protein and molecular modeling; genomics and protenomics; gene prediction; phylogenic analysis; information and machine learning; visual and graphical analysis bioinformatics; worldwide biologic databases; experimental design and data collection techniques; scientific and statistical data analysis; database and data mining methods; and network and Internet methods.

INFO-I 520 Security for Networked Systems (3 cr.) This course is an extensive survey of system and network security. Course materials cover the threats to information confidentiality, integrity and availability and the defense mechanisms that control such threats. The course provides the foundation for more advanced security courses and hands-on experiences through course projects. Credit not given for both INFO-I 520 and I 430.

INFO-I 521 Malware Epidemic: Threat and Defense (3 cr.) P: One semester programming course or equivalent. This course is designed to be research and hands-on oriented. Students are required to read and present research papers that reflect the state of the art in malware-related research and participate in course projects that expose them to the cutting-edge technologies on malware defense.

INFO-I 523 Big Data Applications and Analytics (3 cr.) The Big Data Applications & Analytics course is an overview course in Data Science and covers the applications and technologies (data analytics and clouds) needed to process the application data. It is organized around rallying cry: Use Clouds running Data Analytics Collaboratively processing Big Data to solve problems in X-Informatics. Credit given for only one of INFO-I 523, I 423, or ENGR-E 534.

INFO-I 524 Big Data Software and Projects (3 cr.) This course studies software HPC-ABDS used in either High Performance Computing or the open source commercial Big Data cloud computing. The student builds analysis systems using this software on clouds and then to use it on a project either chosen by student or selected from list given by instructor. Credit not given for both INFO-I 524 and I 424.

INFO-I 525 Organizational Informatics and Economics of Security (3 cr.) Security technologies make explicit organizational choices that allocate power. Security implementations allocate risk, determine authority, reify or alter relationships, and determine trust extended to organizational participants. The course begins with an introduction to relevant definitions (security, privacy, trust) and then moves to a series of timely case studies of security technologies.

INFO-I 526 Applied Machine Learning (3 cr.) The main aim of the course is to provide skills to apply machine learning algorithms on real applications. We will consider fewer learning algorithms and less time on math and theory and instead spend more time on hands-on skills required for algorithms to work on a variety of data sets.

INFO-I 527 Mobile and Pervasive Design (3 cr.) Lab fee. The aim of this course is to provide students with the ability to design and implement novel interactions with mobile and pervasive technologies. We will discuss interaction paradigms and explore different technologies. Students will design, build, implement and refine mobile and pervasive computing applications for their domain of interest.

INFO-I 528 Participatory Design (3 cr.) Participatory Design is a design approach that democratizes the design process by involving end-users. This course has two objectives: we will survey PD's emergence in the creation of computing systems; we will also explore what participation means in technology design today, in contexts such as international development, citizen science, etc.

INFO-I 529 Machine Learning in Bioinformatics (3 cr.) P: INFO-I 519 or equivalent knowledge. The course covers advanced topics in Bioinformatics with a focus on machine learning. The course will review existing techniques such as hidden Markov models, artificial neural networks, decision trees, stochastic grammars, and kernel methods. Examine application of these techniques to current bioinformatics problems including: genome annotation and comparison, gene finding, RNA secondary structure prediction, protein structure prediction, gene expression analysis, proteonmics, and integrative functional genomics.

INFO-I 530 Field Deployments (3 cr.) The aim of this course is to provide students with the ability to design, facilitate and analyze in situ user studies with pervasive systems. We will discuss study designs based on the type of systems, in situ evaluation methods, and how to analyze the study data.

INFO-I 531 Seminar in Health Informatics (1-3 cr.) Variable topic. Emphasis is on advanced topics and research in health informatics. May be repeated with different topics, subject to approval of the Dean.

INFO-I 532 Seminar in Bioinformatics (1-3 cr.) Variable topic. Emphasis is on advanced topics and research in bioinformatics. May be repeated with different topics, subject to approval of the Dean.

INFO-I 533 Systems and Protocol Security and Information Assurance (3 cr.) This course looks at systems and protocols, how to design threat models for them and how to use a large number of current security technologies and concepts to block specific vulnerabilities. Students will use a large number of systems and programming security tools in the laboratories. Credit not given for both f INFO-I 533 and I 433.

INFO-I 534 Seminar in Human-Computer Interaction (1-3 cr.) Variable topic. Emphasis is on advanced topics and research in human-computer interaction. May be repeated once with a different topic, subject to approval of the program director.

INFO-I 535 Management, Access, and Use of Big and Complex Data (3 cr.) Innovation today is emerging from a preponderance of data from sensors, social media, and the Internet. This course covers knowledge representation, data process, and data management for big and complex data. Specific topics include data integration, semantics, and provenance; workflows and pipelines; and distributed noSQL stores. Credit not given for both INFO-I 535 and I 435.

INFO-I 536 Foundational Mathematics of Cybersecurity (3 cr.) Students will learn mathematical tools necessary to understand modern cyber security. The course will cover introductory mathematical material from a number of disparate fields including probability theory, computational theory, complexity theory, group theory, and information theory.

INFO-I 537 Legal and Social Informatics of Security (3 cr.) Security technologies make explicit organizational choices that allocate power. Security implementations allocate risk, determine authority, reify or alter relationships, and determine trust extended to organizational participants. The course begins with an introduction to relevant definitions (security, privacy, trust) and then moves to a series of timely case studies of security technologies. This course may be taken as an alternative INFO-I 525. The course also requires a project, including a work plan, a timeline, peer evaluations, and professional presentations.

INFO-I 538 Introduction to Cryptography (3 cr.) This class considers issues of network security, treating in depth the topics covered in INFO-I 536. In particular, the class involves adversarial modeling, a detailed treatment of security primitives, and methods for analysis of security. It spans the ethics and technology of security, with examples drawn both from deployed and proposed protocols. Topics to be covered include studies of rational and malicious cheating, symmetric and asymmetric cryptography, security reductions and heuristics.

INFO-I 539 Cryptographic Protocols (3 cr.) This class will cover current and timely topics in the field of Security Informatics. Topics will vary from year to year. Examples of topics that could have been covered in recent years include phishing and cyberfraud, trusted computing basis, electronic voting, and digital rights management systems.

INFO-I 540 Human Robot Interaction (3 cr.) Lab fee. This course surveys the field of human-robot interaction (HRI), which involves understanding how people perceive and respond to robots and creating robots that interact naturally with people. We will discuss the design, evaluation and societal significance of interactive robots from a human-centered perspective through readings, discussion and developing HRI prototypes. Credit given for only one of INFO-I 540, I 440 or H 440.

INFO-I 541 Interaction Design Practice (3-6 cr.) Human-Computer Interaction Design (HCID) describes the way a person or group accomplishes tasks with a computer—what the individual or group does and how the computer responds; what the computer does and how the individual or group responds. Sometimes known as "interface design," HCID becomes increasingly important as computing intelligence and connectivity spread ubiquitously to home, work, and play environments. This course will be organized around a collection of readings

and three design projects concerned with applying human-computer interaction principles to the design, selection, and evaluation of interactive systems.

INFO-I 542 Foundations of HCI (3 cr.) "Foundations of HCI" offers a survey overview of the field of Human-Computer Interaction Design. It introduces the main themes of HCI set generally in a historical context. Themes include interaction design, cognitive modeling, distributed cognition, computer-supported cooperative work, data visualization, ubiquitous computing, affective computing, and domestic computing, among others.

INFO-I 543 Interaction Design Methods (3 cr.) Students will learn basic concepts and methods for usability studies and evaluation of interactive systems as well as apply those methods to actual system design evaluations. This course is not only for understanding the basics and traditional approaches in this area, but also for exploring new ways of evaluating the usability of state-of-the-art technology-based systems such as systems in ubiquitous computing, CSCW, tangible and social computing areas.

INFO-I 544 Experience Design (3 cr.) Accompanying its move from workplace productivity into culture-at-large, HCI is increasingly concerned with designing engaging user experiences. "Experience Design" is an interdisciplinary course that brings anthropological, philosophical, design, and technological perspectives together to explore novel ways to research, design, and evaluate qualities of user experience.

INFO-I 545 Music Information Representation, Search, and Retrieval (3 cr.) A comprehensive, comparative study of computer-based representation schemes for music, including those oriented toward music notation, music performance, and music analysis. Overview of musical metadata. Techniques and tools for search and retrieval of music information. Credit not given for both INFO-I 545 and MUS-N 564.

INFO-I 546 Music Information Processing: Symbolic (3 cr.) This course deals with both methodology and specific applications that attempt to algorithmically annotate, understand, recognize, and categorize music in symbolic (score like) form. Particular applications will include key finding, harmonic analysis, note spelling, rhythm recognition, meter induction, piano fingering, and various classification problems such as genre or composer identification. The methodology we will employ will be probabilistic and will include ideas from Machine Learning such as optimal classifiers, hidden Markov models, and Bayesian networks. Students will have computing assignments, present papers, and be expected to implement solutions to problems using a high-level language such as R or Matlab.

INFO-I 547 Music Information Processing: Audio (3 cr.) This course deals with various music analysis and processing problems that use sampled audio as the primary data representation. We discuss digital signal processing, including filtering and its relationship to Fourier techniques. Topics include synthesis, effects processing, score following, and blind music recognition, and accompaniment systems.

INFO-I 548 Introduction to Music Informatics (3 cr.) History, issues, and applications in music information technology. Survey of various types of musical information. Introduction to digital musical media, including data standards and processing; database structure and organization standards and processing; database structure and organization of audio-, score-, and text file objects; and discussion of copyright issues.

INFO-I 549 Advanced Prototyping (3 cr.) P: INFO-I 540 or permission of instructor. Prototyping is the activity of exploring a design space and developing design ideas. The course will cover issues surrounding the construction of prototypes (e.g., breadth, depth, look, interaction, low/high, vertical/horizontal, etc.). Students will practice manipulating different prototyping materials, both physical and digital, and learn about different prototype evaluation techniques.

INFO-I 552 Ind Study in Bioinformatics (1-3 cr.) P: Permission of instructor and completion of at least one 500-level informatics course. Independent readings and research under the direction of a faculty member culminating in a written report. May be repeated for a maximum of 3 times and 9 credit hours.

INFO-I 553 Ind Study in Chem Informatics (1-3 cr.) P: Permission of instructor and completion of at least one 500-level informatics course. Independent readings and research under the direction of a faculty member, culminating in a written report. May be repeated for a maximum of 3 times and 9 credit hours.

INFO-I 554 Ind St Human Computer Interaction (1-3 cr.) P: Permission of instructor and completion of at least one 500-level informatics course. Independent readings and research under the direction of a faculty member, culminating in a written report. May be repeated for a maximum of 3 times and 9 credit hours.

INFO-I 561 Meaning and Form in HCI (3 cr.) P: INFO-I 541. This course is a continuation of Human-Computer Interaction Design I, emphasizing the justification of design effectiveness.

INFO-I 571 Introducing Cheminformatics (3 cr.) Overview of chemical informatics techniques, including chemical structure coding, chemical data representation, chemical database and search systems, molecular visualization and modeling techniques, and the development of chemical informatics software.

INFO-I 572 Computational Chemistry and Molecular Modeling (3 cr.) This course has two main objectives. 1) To give you a thorough introduction to computational chemisty and modern methods of electronic structure theory that form the basis of molecular modeling today. Mainly, we will concentrate on quantum mechanical methods and pay special attention to Density Functional Theory. Instead of digging deep into the mathematics of quantum chemistry, we will concentrate on practical aspects and examine in detail how computational chemistry can be used to explain chemical reactions and electronic properties. 2) To get your ‘Hands Dirty’ and conduct real and original research designed to allow you to see the knowledge obrained from the first part of the course in action and apply a wide range of state-of-the-art methods to solve a specific chemcial research problem at a high level of scientific rigor.

INFO-I 573 Programming for Chemical & Life Science Informatics (3 cr.) Students will receive a thorough

understanding of software development for chem- and bioinformatics, and broaden experience of working in a scientific computing group. Topics include programming for the web, depiction of chemical and biological structures in 2D and 3D, science informatics tool kits, software APIS, AI and machine-learning algorithm development, high performance computing, database management, managing a small software development group, and design and usability of science informatics software.

INFO-I 585 Bioinspired Computing (3 cr.) Biologically-inspired computing is an interdisciplinary field devoted to computational methods modeled after natural design principles. The goal is to produce informatics tools with enhanced robustness, scalability, flexibility and natural human-machine interaction. Topics include: Self-organization, Evolutionary Systems, Cellular Automata, Boolean Networks, L-Systems, Collective and Swarm Behavior, Artificial Immune Systems, Complex Networks. Credit not given for both INFO-I 585 and I 485.

INFO-I 586 Artificial Life (3 cr.) Artificial life is a broad discipline encompassing the origins, modeling, and synthesis of natural and artificial living entities and systems. Artificial intelligence, as a discipline, tries to model and understand intelligent systems and behavior, typically at the human level. Credit not given for both INFO-I 586 and I 486.

INFO-I 587 Introduction to Virtual Heritage (3 cr.) This course focuses on how digital technology can represent, restore, disseminate, and help with analysis of artifacts such as vases, furniture, sculpture, monuments, and buildings. Other topics covered include the history and methodologies of Virtual Heritage. Each semester a different case study will provide the focus for the course. Credit not given for both INFO-I 587 and I 487.

INFO-I 588 Advanced Topics in Virtual Heritage (3 cr.) This course teaches students how to create simulations of complex cultural heritage environments such as a room and its furnishings, a building, or a settlement. Also covered are the principles of restorations of art, technologies to disseminate 3D models, and the use of simulations as tools of scientific discovery. Credit not given for both INFO-I 588 and I 488.

INFO-I 590 Topics in Informatics (3 cr.) Variable topic. Emphasis is on new developments and research in informatics. May be repeated with different topics, subject to approval of the Dean.

INFO-I 591 Graduate Internship (0-6 cr.) P: Approval required. Students gain professional work experience in an industry or research organization setting, using skills and knowledge acquired in Informatics course work. May be repeated for a maximum of 6 credit hours.

INFO-I 601 Introduction to Complex Systems (3 cr.) The course will cover fractals, emergent behavior, chaos theory, cooperative phenomena, and complex networks. Students will learn how to think differently about complexitalities, finding ways to understand their complexity and addressing the problems they pose.

INFO-I 602 Music Info Processing: Audio (3 cr.) This course deals with various music analysis and processing problems that use sampled audio as the primary data representation. Digital signal processing including filtering and its relationship to Fourier techniques. Focus on applications including score following, automatic music transcription and annotation from audio,musical accompaniment systems, as well as some useful audio effects.

INFO-I 604 Human Computer Interaction Design Theory (3 cr.) The course will explore, analyze, and criticize underlying assumptions and the rational behind some of the most influential theoretical attempts in HC and related fields. The purpose of the course is to make students aware of how theories can influence practice and to develop critical thinking around the role, purpose, and function for theories.

INFO-I 605 Social Foundations of Informatics (3 cr.) Topics include the economics of information businesses and information societies, legal and regulatory factors that shape information and information technology use, the relationship between organization cultures and their use of information and information technology, and ownership of intellectual property.

INFO-I 606 Network Science (3 cr.) P: Requires strong working knowledge of mathematics and programming, specifically, proficiency in the topics such as probability, statistics, linear algebra, data structures, and algorithms. Python is the main programming language. This course teaches the fundamental theories, algorithms, and key applications of network science across social and biological systems.

INFO-I 609 Advanced Seminar I in Informatics (3 cr.) Contemporary Informatics approaches and related theories. This Ph.D. seminar will be held as reading and discussion courses, divided into sections. This means that the courses will to a large extent be self- and/or group-study oriented with support from faculty.

INFO-I 611 Mathematical and Logical Foundations of Informatics (3 cr.) P: Basic discrete mathematics equivalent to MATH-M 118, or consent of instructor. An introduction to mathematical methods for information modeling, analysis, and manipulation. The topics include proof methods in mathematics, models or computation, counting techniques and discrete probability, optimization, statistical inference and ore advanced topics that include but are not limited to Markov chains and random walks, random graphs, and Fourier analysis.

INFO-I 617 Informatics in Life Sciences and Chemistry (3 cr.) Introduces the fundamental notions in genome and proteome informatics and chemical informatics focusing on the design and organizing issues in information systems used in those areas. The course is designed for students with no biology or chemistry background, but some knowledge in informatics, who want to learn basic topics in bioinformatics and chemical informatics.

INFO-I 619 Structural Bioinformatics (3 cr.) The course will cover informatics approaches, based on the sequence and 3D structure of biological macromolecules, whose objective is to improve our understanding of the function of these molecules.

INFO-I 621 Computational Techniques in Comparative Genomics (3 cr.) Summarizes computational techniques for comparing genomes on the DNA and protein sequence levels. Topics include state of the art computational

techniques and their applications: understanding of hereditary diseases and cancer, genetic mobile elements, genome rearrangements, genome evolution, and the identification of potential drug targets in microbial genomes.

INFO-I 651 Ethnography of Information (3 cr.) Introduces ethnography as a social science methodology and way of knowing with which to study information and its social contexts. Places ethnography in the Informatics knowledge base. Trains students in the use of a broad range of ethnographic techniques relevant to study of automated information technology in use. Designed to be open to students from other programs with sufficient methodological and substantive background.

INFO-I 667 Seminar in Health Informatics I (3 cr.) P: INFO-I 531. Advanced graduate seminar in health informatics, designed to complement INFO-I 531. This seminar is intended for graduate students enrolled in the Health Informatics track in the Informatics Doctoral Program.

INFO-I 690 Topics in Informatics (1-3 cr.) Variable topic. Emphasis on new developments and research in informatics. Course is intended for Ph.D. students in the school of Informatics. May be repeated with different topics, subject to approval of the Dean.

INFO-I 692 Thesis/Project Bioinformatics (1-6 cr.) P: Graduate standing and approval of the Dean. The student prepares and presents thesis or project in an area of bioinformatics. The product is substantial, typically a multi-chapter paper or carefully designed and evaluated application, based on well-planned research or scholarly project. Details are worked out between student and sponsoring faculty member. May be repeated for a maximum of 6 credit hours.

INFO-I 694 Thesis/Project in Human-Computer Interaction (1-6 cr.) P: Graduate standing and approval of the Dean. The student prepares and presents a thesis or project in an area of human-computer interaction. The product is substantial, typically multi-chapter paper, or a carefully designed and evaluated application, based on well-planned research or scholarly project. Details are worked out between the student and sponsoring faculty member. May be repeated for a maximum of 6 credit hours.

INFO-I 698 Research in Informatics (1-30 cr.) Research not dissertation related under the direction of a member of the graduate faculty. May be repeated for a maximum of 30 credit hours.

INFO-I 699 Independent Study in Informatics (1-3-12 cr.) Independent readings and research for Ph.D. students under the direction of a faculty member, culminating in a written report. May be repeated for a maximum of 12 credit hours.

INFO-I 709 Advanced Seminar II in Informatics (3 cr.) Topic: Contemporary Informatics approaches and related theories. This Ph.D. seminar will be held as reading and discussion courses, divided into sections. This means that the courses will to a large extent be self- and/or group-study oriented with support from faculty. More advanced readings and discussion than INFO-I 609.

INFO-I 790 Informatics Research Rotation (3 cr.) Working with faculty to investigate research opportunities. May be repeated for a maximum of 6 credit hours.

INFO-I 798 Professional Practicum/Internship (0 cr.) P: Current enrollment in the graduate degree program in Informatics. Participation in graduate level professional training and internship experience.

INFO-I 890 Thesis Readings and Research (1-12-30 cr.) Research under the direction of a member of the graduate faculty leading to a Ph.D. dissertation. May be repeated for a maximum of 30 credit hours.

INFO-G 599 Thesis Research (0 cr.) Master's students who have enrolled in 30 or more hours of graduate course work applicable to the degree and who have completed all other requirements of the degree except the thesis of final project of performance may enroll in INFO-G 599. Requires section authorization.

INFO-G 901 Advanced Research (6 cr.) Ph.D. dissertation research after the completion of all course requirements. May be repeated for a maximum of 6 times.

Information and Library Science

ILS-Z 501 User Services and Tools (3 cr.) This course introduces students to the basic information sources and services among different types of libraries and information centers, including academic, public, special, and school media.

ILS-Z 502 Collection Development and Management (3 cr.) Theoretical and pragmatic aspects of the selection, evaluation, and management of collections in all types of libraries. Acquisitions, publishers, and publishing, policy making, and intellectual freedom and censorship are also covered.

ILS-Z 503 Representation and Organization (3 cr.) Introduces students to various disciplines' approaches to the understanding, organization, representation (summarizing), and use of knowledge and information. This survey looks for commonality among the approaches taken in information science, cognitive psychology, semiotics, and artificial intelligence, among others. The goal is to identify criteria for evaluation and improvement of ways to organize and represent information for future retrieval. Information systems currently used in libraries and information centers will be studied as examples. Emphasis in the course is on concepts and ideas, with appropriate attention to terminology and technology.

ILS-Z 504 Cataloging (3 cr.) Historical development and principles essential to the understanding of the conceptual foundations of providing bibliographic access and control of materials and information. Discussion and examples in the application of AACR2r will be presented to illustrate and reflect current practice. Emphasis is on monographic publications.

ILS-Z 505 Evaluation of Resources and Services (3 cr.) P: 9 credit hours for the MLS program. Examines the applied evaluation of library resources and services, including collections, document delivery, technical services, reference services, and overall library performance. Emphasis is placed on the available methods and methodological issues. The checklist method, availability studies, document delivery tests, use

studies, applied bibliometrics, and the use of automation are covered.

ILS-Z 506 Introduction to Research (3 cr.) P: 9 credit hours for the MLS program. The research process, including concepts, design, conduct, and evaluation. Principles and characteristics of approaches and methodologies relevant to research in the field. Examples of data sources and introduction to methods of statistical description and analysis; ethical issues.

ILS-Z 510 Introduction to Information Studies (3 cr.) Information science students are introduced to the dynamic and shifting information professions, complex organizations, and emerging careers in the field. Issues in information management, user- oriented systems design, socio-technical concepts, and usability are major themes for the course.

ILS-Z 511 Database Design (3 cr.) Concerned with a comprehensive view of the processes involved in developing formal access to information from a user-centered point of view. Considers various database models such as flat file, hierarchical, relational, and hypertext in terms of text, sound, numeric, image, and geographic data. Students will design and implement databases using several commercial database management systems.

ILS-Z 512 Information Systems Design (3 cr.) P: ILS-Z 515 and Z 532. Students identify, design, and implement a significant information design project, such as the redesign of a complex Web site for a local business, library, or nonprofit. Principles and practices of project management are discussed in the context of team-based web site redesign.

ILS-Z 513 Organizational Informatics (3 cr.) Introduces information, technology, and social behavior in the organizational context. Concepts of organization theory, organization behavior, knowledge and information management, and organizational intelligence provide a critical foundation for managing information, people, and information and communication technologies in rapidly changing and dynamic environments.

ILS-Z 514 Social Aspects of Information Technology (3 cr.) The objective of this course is to help students think critically and constructively about information & communication technology and its relationship to work, leisure, and society at large. This course covers a series of concepts and analytical devices as well as empirical case studies related to social consequences of information & communication technologies when it is shaped and used by individuals, public agencies, and businesses.

ILS-Z 515 Information Architecture (3 cr.) Effective information system design integrates knowledge of formal structures with understanding of social, technological, and cognitive environments. Drawing from a range of disciplines, this course investigates how people represent, organize, retrieve, and use information to inform the construction of information architectures that facilitate user understanding and navigation in conceptual space.

ILS-Z 516 Human-Computer Interaction (3 cr.) Examines the human factors associated with information technology and seeks to provide students with knowledge of the variables likely to influence the perceived usability, and hence the acceptability, of any information technology. In so doing it will enable students to progress further towards specialist's work in the important field of human-computer interaction.

ILS-Z 517 Web Programming (3 cr.) The main focus of this course is to instruct students to develop and implement dynamic and interactive web applications. In order to do so, students will learn the basics of an open source programming language both through lectures and hands-on exercises in the lab.

ILS-Z 518 Communication in Electronic Environments (3 cr.) Examines conceptual perspectives on information in organizations, covering topics such as types of information, information activities, organizational culture and information technology, communication as information flow, obtaining and using information from the environment, managing information in specialized extended communities, and ethical and quality issues. Focus varies by type of community studied.

ILS-Z 519 Information Analytics (3 cr.) P: 6 ILS graduate credit hours. Theoretical and practical exploration of issues surrounding contemporary information systems. A specific focus will be on evaluating information systems from the user perspective. This approach will cut across disciplinary frameworks: behavioral, cognitive, and social sciences. It will also cover multiple research methods: online surveys, sense-making, critical incident, and network analysis.

ILS-Z 520 Information Seeking and Use (3 cr.) P: 6 ILS graduate credit hours. This course introduces students to the concepts of information analysis from a human perspective, focusing particularly on the theoretical models and practical techniques that underpin the field. Sociological and psychological perspectives will be examined in order to develop an approach to the assessment of users' information needs.

ILS-Z 521 Humanities Information (3 cr.) P: ILS-Z 501 or permission of instructor. Introduction to information sources and services in the disciplines of performing arts, music, fine arts, literature, language, philosophy, and religion. In addition, the course addresses information needs and behavior patterns of users seeking these types of information.

ILS-Z 522 Social Science Information (3 cr.) P: ILS-Z 501 or permission of instructor. Study of the core information tools in the fields of anthropology, economics, history, political science, psychology, and sociology. Includes key bibliographic databases and electronic network tools. Evaluation of research dealing with information channels in these fields.

ILS-Z 523 Science and Technology Information (3 cr.) P: ILS-Z 501. C: ILS-Z 501. General materials, reference books, periodicals, government documents, non-book media in the individual literature of individual disciplines; patents and report literature. Examination of production, publication, distribution, and forms of scientific and technical literature.

ILS-Z 524 Adult Readers Advisory (3 cr.) A review and discussion of trends reflected in subject content and use of book and nonbook materials for patrons in secondary

school and public libraries in relation to changing adult needs and the role of libraries in meeting such needs.

ILS-Z 525 Government Information (3 cr.) P: ILS-Z 501. Survey of government information dissemination in all formats and at all levels of government. Consideration of government information policy. Primary emphasis given to U.S. government information but with some consideration given to state and local publications in the United States, and those of international organizations.

ILS-Z 526 Business Information (3 cr.) P: ILS-Z 501 or permission of instructor. Introduction to basic business materials. Includes resources, research methods, current developments, automated systems, and databases.

ILS-Z 531 Subject Access Systems (3 cr.) P: ILS-Z 503. Principles, development, characteristics, and internal structures of subject access systems. Evaluation of the strengths and weaknesses of the major classification schemes and current subject heading systems.

ILS-Z 532 Information Architecture for the Web (3 cr.) Focuses on Web site development. Students study information architecture as an approach for site organization and design, and learn about project management for complex web development tasks. In lab sessions, students work with advanced markup languages and scripting and develop sites, typically for real clients.

ILS-Z 533 Online Searching (3 cr.) Principles, methods, and techniques of advanced online information retrieval (IR). Characteristics of, and search strategies for, the use of bibliographic, referral, citation, fact, numeric, and full text databases and search systems. Considers standards, use of communications software, front-ends and micro-based IR systems, and creation of in- house databases.

ILS-Z 534 Search (3 cr.) The success of commercial search engines shows that Information Retrieval is a key in helping users find the information they seek. This course provides an introduction to information retrieval theories and concepts underlying all search applications. We investigate techniques used in modern search engines and demonstrate their significance by experiment.

ILS-Z 541 Information Policy (3 cr.) Data creation, publication, dissemination, and use occur in a complex social context. Legal and regulatory structures continue to evolve to control these processes. This course explores international and U.S. principles, laws, and regulations affecting the information industry. Focus varies with the topic; for example, copyright of electronic information sources or transborder data flow. May be repeated for credit when topic varies.

ILS-Z 542 International Information Issues (3 cr.) Comparison of information policies, information standards, and library systems as they affect commercial, scholarly, scientific, and political information contexts.

ILS-Z 543 Computer-Mediated Communication (3 cr.) Computer-mediated communication (CMC) is human-to-human interaction via computer networks such as the Internet. This course examines potentials and constraints of several types of CMC, and considers how content and dynamics are influenced by the systems' technical properties and the cultures that have grown up around their use.

ILS-Z 544 Gender and Computerization (3 cr.) This course explores the relationship between information communication technologies (ICTs) and the gender of the people who design, use, administer, and make policy concerning computer systems and computer networks such as the Internet.

ILS-Z 550 Perspectives on Librarianship (3 cr.) Overview of the library as a social institution, historically, currently, and for the future, within social, economic, political, and cultural contexts. Focuses on both the institution (whether academic, public, school, or special library settings) and the materials in the many formats (including the evolution of communication media) and their users to create an understanding of the role and importance of libraries.

ILS-Z 551 Management for Information Professionals (3 cr.) Introduction to management in libraries and other information centers. Covers topics such as teamwork, communication, leadership, motivation, planning and decision-making, budgeting, organizing and human resources, ethics, and diversity.

ILS-Z 552 Academic Library Management (3 cr.) Background and current trends in the management of academic libraries.

ILS-Z 553 Public Library Management (3 cr.) Background and current trends in the management of public libraries.

ILS-Z 554 Library Systems (3 cr.) Principles for the design, selection, implementation, and management of automated systems of all types in libraries, including systems for technical services processing, reference and user services, and management. Focus is on present and future applications of technology in libraries, their technical features, and their implications for library services and management. When possible, some practical experience with a particular application will be provided.

ILS-Z 555 Strategic Intelligence (3 cr.) Introduces different concepts of strategic intelligence, and different contexts in which these are applied; the idea of intelligence is not restricted to national security, or corporate competition: it can apply at the level of the individual citizen, company, community, or country.

ILS-Z 556 Systems Analysis and Design (3 cr.) This course introduces the basic concepts underlying systems analysis and design, focusing on contextual inquiry/ design and data modeling, as well as the application of those analysis techniques in the analysis and design of organizational information systems.

ILS-Z 561 User Interface Design for Information Systems (3 cr.) This course focuses on established principles and methods to design effective interfaces for information systems, emphasizing document retrieval, filtering, visualization, correlation, analysis, and research.

ILS-Z 571 Materials for Youth (3 cr.) Evaluation and use of books, magazines, recordings, films, radio and television broadcasts, and other sources of information and recreation.

ILS-Z 572 Youth Services (3 cr.) P: ILS-Z 571 or permission of instructor. C: ILS-Z 571. This course emphasizes the history, philosophy, and description

of children and young adult library services. It takes a holistic look at the role of the youth services librarian from planning and evaluation to specific services and programs, and examines the current and future outlook for this type of librarianship. Emphasis is on the public library, but cooperation with appropriate services and programs such as school media centers is also discussed.

ILS-Z 573 Education of Information Users (3 cr.) Reviews important educational theories for application to secondary school, college, and university settings which provide training and education programs to teach students skills leading to information literacy. Standards from AASL and ACRL are applied to instructional design and practice including lecture, collaboration with faculty, and evaluation of online tutorials.

ILS-Z 574 Information Inquiry for School Teachers (3 cr.) This course is intended to be an opportunity for teachers and future teachers (including school library media specialists as teachers) to practice methods in critically thinking about information/media, and to use that process as a means to teach their students to be critical reviewers and communicators as well.

ILS-Z 580 History of Libraries (3 cr.) Development of libraries and information services from earliest times to the present, with emphasis on the library in relation to social, economic, cultural, and political trends.

ILS-Z 581 Archives and Records Management (3 cr.) Introduces basic theories, methods, and significant problems in archives and records management. The course also discusses how archivists are responding to the challenge of managing and preserving electronic records.

ILS-Z 582 Preservation (3 cr.) Examines causes of library and archival materials deterioration. Develops conceptual framework and management perspective for preservation programs using technical standards, program development tools, scientific and administrative research reports, and advocacy literature. Explores the new information technologies and media as both preservation tools and challenges.

ILS-Z 583 Rare Book Librarianship (3 cr.) P: Authorization required. Introduction to the development, organization, and operation of rare book libraries and special collections. Includes an overview of the fundamentals of book collecting, both private and institutional, the antiquarian book trade and auction market, and the profession and practice of rare book librarianship.

ILS-Z 584 Manuscripts (3 cr.) P: Authorization required. Introduction to the nature, functions, and methodology of the organization and administration of archives and manuscript collections. The course will consist of lectures, discussions, field trips, and special projects.

ILS-Z 585 Records Management (3 cr.) Records management is the management of documentary information for the purposes of supporting the goals and strategy of an organization. This requires understanding of business processes as well as statutes, regulations, the litigation process, disaster recovery and business continuity, and storage architecture.

ILS-Z 586 Digital Curation (3 cr.) Preserving and providing long-term access to digital materials over time is a Grand Challenge. They require constant and ongoing maintenance. This course provides an overview of research, policy and current practices in curating and preserving digital data, gives students practical experience, working with digital materials, and creating digital curation plans.

ILS-Z 601 Directed Readings (1-6 cr.) P: Permission of instructor. Readings and study in any area of library or information science having an extensive literature. A student may enroll for this course twice in the same semester under different instructors. Normally Z 601 is completed under the direction of a full-time faculty member. Readings done under Z 601 shall not duplicate the content of any course now in the curriculum of Information and Library Science.

ILS-Z 602 Directed Research (1-3 cr.) P: Permission of instructor. Individual research in a problem in the field of library and information science.

ILS-Z 603 Workshop in Library and Information Science (1-3 cr.) P: Permission of instructor. Group study of specific problems in the library and information field. Generally includes a hands-on element. May be repeated for a maximum of 6 credit hours.

ILS-Z 604 Topics in Library and Information Science (1-4 cr.) P: Permission of instructor. Study of specific topics in librarianship and information science. May be repeated with different topics.

ILS-Z 605 Internship in Library and Information Science (2-6 cr.) P: Permission of faculty advisor. Supervised internship in an information management environment. Professionals in library and information management mentor each graduate student. Sixty on-site hours must be completed for each credit earned. Students document their experiences through journals, abstracts of related publications, and a final presentation. Normally, at least 18 credits must be completed before enrollment. Guidelines and placement sites are available on the ILS Web site. Graded on S/F basis.

ILS-Z 621 Audio and Video Sources (3 cr.) P: ILS-Z 501 or permission of instructor. User-focused approach to decision making in the digital audio and video information environment. Emphasizes collection development in support of user services, including access to remote collections and evaluation of multimedia materials and delivery mechanisms, and issues related to emerging technologies. Scope includes adult and young adult audiences.

ILS-Z 622 Resources and Services for People with Disabilities (3 cr.) P: ILS-Z 501 or permission of instructor. Access to information is essential for sustained independence of people with disabilities. This course studies materials, services, and assistive technologies to support this access.

ILS-Z 623 Genealogy and Local History (3 cr.) P: ILS-Z 501. Focuses on developing collections and providing reference services in genealogy and local history.

ILS-Z 629 Topics in Information Sources and Services (3 cr.) The purpose of this course is to provide the opportunity for greater in-depth study of

the information and literature sources related to area studies, specific academic disciplines, and/or specific library patron audiences. Examples include Slavic materials, Latin American bibliography, and international legal bibliography. Depending on the potential market, the demand for knowledge concerning the specific information, literature, and material, and the expertise of available faculty, there is a wide range of possible topics.

ILS-Z 631 Advanced Cataloging (3 cr.) P: ILS-Z 504. Provides extensive background in description and access for electronic and non-book resources.

ILS-Z 632 Technical Services (3 cr.) P: ILS-Z 551, Z 552 or Z 553. Principles of organization and function of library technical services, including acquisition, cataloging, serials, circulation. Special emphasis on research and development in library systems and technology. Includes file organization, documentation system development, analysis, and evaluation for manual, mechanical, and automated applications.

ILS-Z 633 Indexing (3 cr.) P: ILS-Z 504 or Z 515. Theoretical concepts of subject indexing and thesaurus construction for information retrieval. Examines alternative approaches to traditional indexing techniques. Evaluation and use of appropriate computer software.

ILS-Z 634 Metadata (3 cr.) P: ILS-Z 503 or Z 515. Metadata is essential in designing and developing effective knowledge systems; it facilitates resource discovery, database documentation, and recording digital documents' textual and conceptual histories. This course introduces principles supporting the development and implementation of metadata schemes, focusing on issues of interoperability, internal and external standardization, and evaluation.

ILS-Z 635 Ontologies (3 cr.) P: ILS-Z 634 and authorization required. An ontology is a common semantic conceptualization of reality that is shared by members of a knowledge domain; it supports exchange of knowledge among participants. This course explores formal specifications for ontology construction among systems applications and software agents.

ILS-Z 636 Data Semantics (3 cr.) Explores the technologies of the Semantic Web by examining the application of technologies to WWW information delivery and the principles of formal logic and computation guiding their developments.

ILS-Z 637 Information Visualization (3 cr.) Introduces information visualization, highlighting processes which produce effective visualizations. Topics include perceptual basis of information visualization, data analysis to extract relationships, and interaction techniques.

ILS-Z 638 Big Data Analytics for Web and Text (3 cr.) P: Students should have some basic programming skills. Introduces fundamentals of big data analysis, focusing on its theoretical methodological aspects, including numerical and textual processing, statistical analysis, machine learning, and data retrieval, representation, semantics, and data storage. Open source data-operation frameworks and tools (R, Hadoop, NoSQL) are introduced and demonstrated that students use with real-world data sets.

ILS-Z 639 Social Media Mining (3 cr.) P: Basic Unix Skills. This course provides a graduate-level introduction to social media mining and methods. The course provides hands-on experience mining social data for social meaning extraction (focus on sentiment analysis) using automated methods and machine learning technologies. We will read, discuss, and critique claims and findings from contemporary research related to SMM.

ILS-Z 640 Seminar in Intellectual Freedom (3 cr.) P: 9 ILS graduate credit hours or permission of instructor. Beginning with a history of and alternative philosophical justifications for censorship, the student is introduced to constraints, obligations, and problems relating to intellectual freedom.

ILS-Z 641 Computer-Mediated Discourse Analysis (3 cr.) Computer-mediated discourse analysis (CMDA), applies theories from linguistic discourse analysis, pragmatics, ethnomethodology, and semiotics in the analysis of discourse-language and language use in computer-mediated communication. This course provides hands-on experience in applying empirical analytical methods, and in interpreting the results.

ILS-Z 642 Content Analysis for the Web (3 cr.) Application of Content Analysis methods to web documents, interactivity features, and links.

ILS-Z 643 The Information Industry (1-3 cr.) This course examines various aspects of the information industry: products, producers, suppliers, trends, and market opportunities. Focus varies with the topic; for example, structural market characteristics, or technical developments and their impact.

ILS-Z 644 Information Networks (3 cr.) In this course we will survey historical and theoretical foundations of network studies, introduce basic concepts in network theory, discuss metrics and models, use software tools to experiment with real-world network data, and study specific applications of network approaches in different information related phenomena. Students will learn how to gather and analyze network data and interpret the results. NodeXL, Pajek and Network Workbench will be used for data gathering and analysis.

ILS-Z 645 The Social and Organizational Informatics of Big Data (3 cr.) This course surveys organizational, legal, political, and social issues surrounding the creation, dissemination and use of big data from the perspective of social and organizational informatics. It focuses on ways in which the integration of big data is changing structure, culture, and work practices in private and public sector organizations.

ILS-Z 650 Library Philanthropy Fundraising (3 cr.) Introduces the role of private giving in support of libraries. Examines personal and corporate philanthropy and their applicability in libraries and information centers.

ILS-Z 651 Art Librarianship (3 cr.) P: FINA-A 575 or permission of instructor. Academic art library administration, collection development, reference services, technical services operations, facilities, and slide and photograph/picture collections will be emphasized.

ILS-Z 652 Digital Libraries (3 cr.) P: ILS-Z 532 and authorization required. Examines the design and operation of digital libraries and related electronic publishing

practices from a socio- technical perspective. Students develop understanding of major issues, concepts, and trends, enabling them to understand the socio- technical character of digital libraries that can and will be effectively supported and used by various groups.

ILS-Z 653 Health Sciences Librarianship (3 cr.) P: ILS-Z 501. C: ILS-Z 501. Health sciences library administration, materials organization, and information services. Emphasis on National Library of Medicine classification, subject headings, printed indexes, and online databases.

ILS-Z 654 Law Librarianship (3 cr.) P: ILS-Z 501 or permission of instructor. An introduction to basic legal materials and law librarianship. Primary and secondary resources; indexes; digests and citators; specialized research methods; current developments in automated legal research. History of law libraries in the U.S., their organization and administration. The role of law librarians in law schools and law firms.

ILS-Z 655 Music Librarianship (3 cr.) P: MUS-M 539. Academic music library administration, collection development, technical services operations, record and performing ensemble collections, and reference services will be emphasized.

ILS-Z 656 Digital Publishing Standards and Systems (3 cr.) This course will teach students to design and publish documents on the Web and for common eBook platforms such as iBook and Kindle. We will learn about XML-based document formats (such as TEI, DocBook, Office Open XML) and eXtensible Stylesheet Language Transformations (XSLT), a special-purpose programming language for transforming XML documents into other XML and non-XML formats. We will also learn to develop publications in common eBook formats, including ePub (iBook, etc.), AZW (Amazon Kindle), and KF8/AZW3 (Amazon Kindle).

ILS-Z 657 Digital Humanities (3 cr.) This course is an introduction to the use of information technology in literary and humanistic study. We will survey the field of digital humanities, or humanities computing as it is sometimes called, from electronic scholarly editing, to the computational analysis of style, theme, and structure, to considerations of the cultural impact of information technology on scholarly discourse, publishing, and the academy. We will also study several specific technologies in detail, including eXtensible Markup Language (XML) and the Text Encoding Initiative. Students will be expected to generate critical work on subjects related to digital humanities and to perform some hands-on exercises using technologies common in digital humanities research.

ILS-Z 661 Concepts and Contemporary Issues in Human-Computer Interaction (3 cr.) Examines and assesses theoretical approaches developed specifically for understanding the use, informing the design, and assessing the value of information technologies. The course also considers contemporary issues surrounding the situated use of information technologies, such as emotional, embodiment, interpersonal, and social aspects of interaction.

ILS-Z 662 Interface Design for Collaborative Information Spaces (3 cr.) Provides an overview of two-dimensional and three- dimensional interface design. Topics covered include task and user analysis, interface goals and design methods, and empirical evaluation.

ILS-Z 671 School Media (3 cr.) P: ILS-Z 501 and Z 571 or permission of instructor. C: ILS-Z 501 and Z 571. Establishes the professional teaching and administrative role of the certified school library media specialist in K-12 settings. Situations are examined that pertain specifically to policy development, budgeting, collection development, instructional design, support staff training, facility design, district supervision, and information networking within the modern school corporation. Students make site visits to leading school information centers, conferences, and media fairs.

ILS-Z 672 Seminar on Literature for Youth (3 cr.) P: ILS-Z 571 or permission of instructor. An advanced seminar, addressing such topics as: images of minority groups, societal problems (e.g., poverty and family patterns), or informational needs and materials including access and availability of print, nonprint, and computer resources. May be repeated twice for credit when topic varies.

ILS-Z 680 The Book to 1450 (3 cr.) P: Authorization required. Covers the introduction and development of writing and the history of the manuscript and printed book, from their beginnings to approximately the year 1450. Although there will be some coverage of the non-Western book, the emphasis will be on the history of the book in the West.

ILS-Z 681 The Book 1450 to the Present (3 cr.) P: Authorization required. A survey of the book from 1450 to the present, with emphasis on the development of the book in the West. Focuses on the physical aspects of the book from the mid-fifteenth through the twentieth centuries, and on some of the many roles of the book in society during this period; also increases awareness of current scholarly trends in the history of the book.

ILS-Z 683 Reference Sources for Rare Books (3 cr.) P: ILS-Z 501 or Z 684. Introduces and evaluates reference sources that are useful in working with rare books in many fields.

ILS-Z 684 Descriptive Bibliography (3 cr.) P: Authorization required. The development of the practice of printing, typefounding, and papermaking; the principles and practice of the bibliographical description of printed books, with emphasis on the period to 1880.

ILS-Z 685 Building Trustworthy Digital Repositories: Theory and Practice (3 cr.) Addresses the major issues and challenges facing the archival/records management professions in their quest to manage electronic records. Students will study and evaluate the impact automation has had on archival theory and practice, analyzing various models and strategies archivists have developed to manage electronic records.

ILS-Z 690 Capstone in Information Architecture (3 cr.) The capstone course integrates within a single project the theoretical and practical components of the Information Architecture Certificate program. Working with one of the program co-directors, who serves as the student's project advisor, the student will determine both the scope and extent of the project. The student will publicly present and defend the capstone project upon completion.

ILS-Z 701 Introduction to Doctoral Research in Information Science (6 cr.) Role and function of research in society; history of library and information science scholarship; current need for research in LIS; critical analysis of present state of knowledge in the field; relevant research methodologies; barriers to individual initiatives in research.

ILS-Z 702 Doctoral Research Practicum I (2 cr.) P: ILS-Z 701. Student acquires practical hands-on experience with the research process through involvement in a ILS faculty member's research project.

ILS-Z 703 Doctoral Research Practicum II (2 cr.) P: ILS-Z 701 and Z 702. Student acquires practical, hands-on experience with the research process through involvement in a ILS faculty member's research project. The ILS-Z 703 research project should differ substantially from the ILS-Z 702 project with which the student was involved.

ILS-Z 706 Introduction to Research (3 cr.) The research process, including concepts, design, conduct, and evaluation. Principles and characteristics of approaches and methodologies relevant to research in the field. Examples of data sources and introduction to methods of statistical description and analysis; ethical issues.

ILS-Z 710 Doctoral Research Practicum III (3 cr.) P: ILS-Z 701, Z 702 and Z 703. The student applies methods of research under the supervision of a ILS faculty member. The research project may originate with the student or may be one on which the faculty member seeks student assistance.

ILS-Z 763 Research Problems and Methods in Information Science (3 cr.) P: Permission of instructor. Study of current problems and methodological approaches in information science research.

ILS-Z 764 Seminar in Information Science (3 cr.) P: Permission of instructor. A doctoral seminar in IS introduces students to topic areas within the domain of information science (e.g., social informatics, scientometrics, information retrieval, representation and organization of resources, philosophy of information, human computer interaction, visualization). It is a reading-and-writing intensive experience and emphasizes depth over breadth.

ILS-Z 765 Doctoral Research in Information Science (1-6 cr.) Independent research or study. A student may enroll for this course more than once in one semester under different instructors.

ILS-Z 790 Dissertation Proposal in Information Science (3 cr.) P: Must have successfully completed the qualifying exam. Contact PhD Recorder for permission to register. Doctoral students develop their plans for theses subject to criticism by other doctoral students and faculty.

ILS-Z 799 Ph.D. Thesis (arr. cr.) P: Must have been admitted to candidacy. Contact PhD Recorder for permission to register. See advisor for more information.

ILS-G 901 Advanced Research (6 cr.) P: Must have 90 credit hours. Contact PhD Recorder for permission to register. Please see advisor for more information on Advanced Research. May be repeated six times (36 credit hours).

ILS-Z 646 Seminar in Documents and Documentation (3 cr.) This seminar explores epistemological and genre assumptions of modern documentation and the different events and genre modes by which "information" in many various forms is produced through presentations of "fact." It involves an historical and social survey of the various types of collections of documents and their construction and use.

Bulletins

The Graduate Certificate in Data Science (GCDS) encompasses a broad range of courses on topics such as cloud computing, health and medicine, high-performance computing, and data analysis. This professional certificate allows students the opportunity to tailor their curriculum to suit their interests.

Students must complete 12 graduate credit hours. Courses must be selected from the approved list of graduate courses listed within the master's curriculum; any four courses may be taken for the certificate. Students are encouraged to consult a faculty advisor for course recommendations, etc.

Coursework must be completed within two (2) years of entering the certificate program. No credits my be transferred from another graduate or undergraduate program in order to satisfy the requirements for 12 credit hours of coursework.

Master of Science in Informatics

The Master of Science in Informatics (MS INFO) is designed for students who are contemplating entering a specific track in the Ph.D. Informatics program and have a specific faculty member who is recommending them to apply to the MS Informatics program. By starting off in the MS Informatics, the student is introduced to the subject matter which will help them decide if the Ph.D. Informatics program is right for them. If it is the right program, the student can complete the MS Informatics degree (2 year program) and then apply to the Ph.D. Informatics program. Students may be able to transfer 30 credits of graduate work towards the Ph.D. degree. In special circumstances, after completing the first year of the MS Informatics program, a faculty member may recommend that the student apply to the Ph.D. Informatics program. When this happens, student who complete 1 year of the MS Informatics program may be able to transfer some of those credits to the Ph.D. Informatics program.

CURRICULUM

The Master of Science in Informatics (MS INFO) is a 36 credit degree program. Each MS Informatics student will be assigned a faculty advisor who will guide the student in the selection of courses. Students should be able to complete the degree in four semesters of full-time graduate work.

Infomatics courses approved by advisor and Director of Graduate Studies, Informatics (27 cr.)

Electives - any approved graduate level course within or outside the School of Informatics and Computing (9 cr.)

Degree Programs

- Data Science Certificate

- M.S. and Accelerated Master's Program in Computer Science
- M.S. in Bioinformatics
- M.S. in Data Science
- M.S. in Human-Computer Interaction Design
- M.S. in Informatics
- M.S. in Security Informatics
- Master of Information Science (MIS) and Accelerated MIS
- Master of Library Science (MLS) and Accelerated MLS
- Master of Information Science (MIS) and Master of Library Science (MLS) Dual Degree
- ILS Specializations
- ILS Dual Degrees and Certificates
- Ph.D. in Computer Science (offered through the University Graduate School)
- Ph.D. in Informatics (offered through the University Graduate School)
- Ph.D in Information Science (offered through the University Graduate School)
- Ph.D in Intelligent Systems Engineering (offered through the University Graduate School)

Accelerated Master's Program in Computer Science

The Accelerated Master's Program combines the Computer Science B.S. and M.S. degrees to enable highly focused and motivated students to organize their studies so as to earn the two degrees in five years from the time of matriculation to the university.

The program's overall course requirements add up to as much as nine fewer credit hours than the sum total of the B.S. and M.S. degrees taken individually.

Admission and Status

- For admission to the Accelerated Master's Program, students must have completed at least 26 CSCI major hours towards a Computer Science B.S. degree. Students must have earned a major GPA of at least 3.0 at the time of admission to the program.
- Students in the program are normally classified as undergraduates until the end of the first semester in which 120 or more hours of credit toward graduation have been earned. Students in good standing, defined as a major GPA of at least 3.0, must submit the standard application to the University Graduate School by January 1 prior to the academic year they want to transition to graduate status. If the transition to graduate status is delayed beyond this time, Accelerated Master's status will normally revert to undergraduate B.S. status. Students are advised to check on the effect that transition to graduate status may have on existing undergraduate funding; the possibility of graduate funding is conditional upon transition to graduate status. Those not in good standing at any time are dropped from the program and reclassified as undergraduate B.S. students.
- Students in the Accelerated Master's Program must complete at least 15 hours of coursework while registered in graduate status. Normally, this would encompass no fewer than two semesters.
- Students need to begin graduate level courses in their senior year, while in undergraduate status, otherwise the program may not be completed in five years. Students should consult with the undergraduate advisor regarding appropriate graduate level courses. Permission to enroll in graduate level courses must be obtained from the course instructor or your advisor.
- The B.S. and M.S. degrees must be taken simultaneously. The student must graduate with both degrees at the same time and apply to graduate for both degrees with the undergraduate recorder.

Academic Requirements

- A minimum of 141 credit hours
- Major GPA of at least 3.0; Cumulative GPA for graduate courses of at least 3.0
- All Computer Science B.S. degree requirements
- At least 21 Computer Science credit hours beyond the requirements for the B.S. degree at 500 level or above. This may not include CSCI-Y 890. At least 15 credit hours need to be CSCI courses for majors, and the remaining 6 credit hours may be any CSCI, ILS, INFO, STAT, or MATH courses at 500 level or above. At most 6 combined credit hours may be CSCI-Y 790, Y 791, Y 792, Y 793 or Y 798.

Computer Science

- M.S. in Computer Science
- Accelerated Master's Program in Computer Science

About the Program

What imagination makes possible, computer science makes real.

Robots were once science fiction. Today, they build cars, take photos on Mars, disarm bombs, and vacuum our living rooms. While there may be no limit to what technology can accomplish—from space travel to curing cancer—none of it is possible without key breakthroughs in computing theory, programming, artificial intelligence, data analysis, and systems and application design.

As a graduate student in computer science, you'll develop a deep understanding of computing theory and applications that will serve as a springboard to new discoveries. Our cross-disciplinary approach to computer science exposes you not only to the latest research in high-performance computing, data and search, artificial intelligence, and computer security—but also gives you the opportunity to apply those insights to real-world problems such as controlling pandemic disease and tracking the effects of climate change on polar ice.

Major research concentrations on campus include:

- Formal methods for system design, hardware, and robotics
- Foundations: Theory of computing, algorithms, and applied logic
- High-performance computing
- Cybersecurity
- Graphics and visualization
- Programming languages and compilers
- Artificial intelligence and cognitive science
- Distributed and parallel systems
- Database and information systems
- Computer networks and security

Degrees

M.S. in Computer Science

- A two-year, multidisciplinary program that provides broad insights in computing theory, data and search, networks, systems, applications and programming, and their practical applications in solving problems

Accelerated Master's Program in Computer Science

- A five-year combined B.S. and M.S. in computer science for highly focused students who want a head start on their careers

Ph.D. in Computer Science

(See University Graduate School Bulletin, http://www.indiana.edu/~bulletin/iu/gradschool/2013-2014/index.shtml**)**

M.S. in Computer Science

M.S. Requirements

The Master of Science in Computer Science program includes a minimum of 30 credit hours in the following four categories.

Foundations (3 cr.)

Complete one course from the following:

- CSCI-B 501 Theory of Computing
- CSCI-B 503 Algorithms Design and Analysis

Systems (3 cr.)

Complete:

- CSCI-P 536 Advanced Operating Systems

Computer Science Courses (15 cr.)

Complete any CSCI courses 500 level and above. (This does not include INFO, ILS, etc. courses.)

- This may include a maximum of 3 credit hours of independent study (CSCI-Y 790, Y 791, Y 792 and Y 793).
- This may not include CSCI-Y 798 Professional Practicum Internship.

Creativity Requirement (9 cr.)

Complete any SoIC or STATS courses 500 level and above. (This includes CSCI, INFO and ILS courses.)

- This may include a maximum of 6 credit hours of CSCI-Y 798 Professional Practicum Internship. One credit hour is awarded for each 160 hours of work is given. (For example, someone working 10 hours per week for a 16-week semester would receive 1 credit hour.) The credits are rounded down to the nearest whole number, if the number of hours does not divide evenly by 160.

- This may include a maximum of 6 credit hours of independent study (CSCI-Y 790, Y 791, Y 792 and Y 793). Students who wish to complete a master's thesis must take 6 credit hours of CSCI-Y 792 and complete the formal master's thesis as prescribed by the University Graduate School.

M.S. in Bioinformatics

M.S. Requirements

The M.S. in Bioinformatics is a two-year professional program that emphasizes computation and informatics but also integrates knowledge from biology, statistics, and related areas. It prepares students to pursue a bioinformatics career or admission to a Ph.D. program.

PREREQUISITES

Our M.S. students are expected—but not required—to have at least introductory knowledge of both informatics and biology, including:

- Approximately 6 credit hours of undergraduate course work in biology, covering molecular biology, genetics, and evolution
- Approximately 6 credit hours of undergraduate course work in computer science or informatics, covering programming, discrete structures, and data structures

If you have not completed these prerequisites, you will be required to take one or two appropriate 500-level background classes suggested by the program directorate.

COURSES

Students are required to complete 30 credit hours of graduate-level course work, including the following courses:

- INFO-I 519 Introduction to Bioinformatics (3 cr.)
- INFO-I 529 Machine Learning in Bioinformatics (3 cr.)

Other courses can be selected from a wide range of bioinformatics-related course offerings in computer science, informatics, biology, statistics, mathematics, or chemistry. Students will be advised on their individual study plans by the program directorate.

Students must also complete a yearlong, 6 credit hour capstone research project in their second year, including an oral presentation to the public and submission of a written report. These projects are typically supervised by one of the core bioinformatics faculty members, but we encourage students to work with a supervisor in a related discipline—such as biology, computer science, chemistry, or medical sciences—and choose a co-supervisor among the bioinformatics core faculty.

All other courses can be selected from topics and seminars in bioinformatics and courses in related disciplines.

Master of Data Science

The M.S. in Data Science (MSDS) is a two-year program offering multidisciplinary coursework in computer science, information science, informatics, statistics, engineering, and other disciplines. It prepares students to pursue a data science related career or admission to a Ph.D. program. In addition, MSDS students may select to specialize in the Computational and Analytical Data Science track.

Curriculum

Students are required to complete 30 credit hours of graduate-level coursework for this degree. Individual program choices will vary. Students pursuing the program will develop expertise in four areas (15 credit hours):

Statistics

Select one course from the following:

- SPEA-V 506 Statitical Analysis for Effective Decision-making
- STAT-S 520 Introduction to Statistics
  - Higher level Statistics course may be taken with approval

Machine Learning, Data Mining, Text Mining

Select two courses from the following:

- CSCI-B 505 Applied Algorithms
- CSCI-B 551 Elements of Artificial Intelligence
- CSCI-B 555 Machine Learning
- CSCI-B 565 Data Mining
- CSCI-B 657 Computer Vision
- ILS-Z 534 Search
- INFO-I 526/CSCI-P 556 Applied Machine Learning
- INFO-I 590 Topic: Applied Data Mining
- INFO-I 606 Network Science

Data Engineering and Stewardship

Select one course from the following:

- ENGR-E 516 Engineering Cloud Computing
- ENGR-E 517 High Performance Computing
- INFO-I 523 Big Data Applications and Analytics
- INFO-I 524 Big Data Software and Projects
- INFO-I 535/CSCI-B 669 Management, Access, and Use of Big and Complex Data

Visualization and Storytelling

Select one course from the following:

- ENGR-E 583/ILS-Z 637 Information Visualization
- ENGR-E 584 Scientific Visualization
- INFO-I 590 Topic: Data Visualization
- INFO-I 590 Topic: Data and Society

The remaining 15 credit hours can be selected from courses above or additional data science-related course offerings. In consultation with a Data Science faculty advisor, students may choose to pursue an independent study or relevant internship opportunity that blends the learning in data science to a major project or a custom specialization. Be creative in your course strategies.

MS in Data Science - Computational and Analytical Track

Students with a strong computer science background wishing to drive deeper into the mechanics of data science methodologies may wish to pursue a more rigorous curriculum. For those pursuing the Computational and Analytics (C&A) track, students must pursue more technical and theoretical coursework in four areas (15 credit hours):

Data Systems Foundation

Required

- CSCI-B 561 Advanced Database Concepts

Algorithmic Foundation

Select one course from the following:

- CSCI-B 503 Algorithms Design and Analysis
- CSCI-B 505 Applied Algorithms

Data Analytics Foundation

Required

- STAT-S 520 Introduction to Statistics

Select one course from the following:

- CSCI-B 555 Machine Learning
- CSCI-B 565 Data Mining

Big Data Infrastructure

Select one course from the following:

- INFO-I 535/CSCI-B 669 Management, Access and Use of Big and Complex Data
- ENGR-E 516 Engineering Cloud Computing

The remaining 15 credit hours can be selected from a wide range of data science-related course offerings. A course in data ethics or a major project is highly encouraged. Students can be advised on their individual study plans with the assistance of a Computational & Analytical faculty advisor.

M.S. in Human-Computer Interaction (design emphasis)

M.S. Requirements

The Master of Science in HCI (design emphasis) is an intensive, two-year program that teaches students to shape new media, interactive tools, artifacts, and systems in ways that enhance usability, augment learning, facilitate communication, and enrich the lives of the people using them. The program culminates in a one-semester 6 credit hour capstone project.

Download the HCID MS Program handbook here:https://www.soic.indiana.edu/doc/graduate/graduate-forms/HCID-Program-Handbook-2017.pdf

CURRICULUM

A total of 36 credit hours is required for this degree. There are some required courses and there are some elective courses.

Year 1 Fall

- INFO-I 541 Interaction Design Practice (6 cr.)
- INFO-I 542 Foundations of HCI (3 cr.)

Year 1 Spring

- INFO-I 543 Interaction Design Methods (3 cr.)
- INFO-I 544 Experience Design (3 cr.)
- INFO-I 561 Meaning and Form in HCI (3 cr.)

Year 2 Fall

- INFO-I 549 Advanced Prototyping (3 cr.)

Recommended Electives* (select two):

- INFO-I 604 Human Computer Interaction Design Theory (3 cr.)
- INFO-I 590 Topic: Rapid Design for Slow Change (3 cr.)
- FINA-S 552 Graphic Design (3 cr.) or similar course

Year 2 Spring

- INFO-I 694 Thesis/Project in Human-Computer Interaction (6 cr.)

Recommended Electives* (select one):

- INFO-I 590 Topic: TBA (3 cr.)
- INFO-I 590 Topic: Interaction Culture (3 cr.)

***Electives and Recommended Electives**

The recommended electives detailed above are the elective classes that students most typically select and the classes which they can select without additional approval from the program director. It is possible for students to tailor their particular program by selecting with approval of the director alternative graudate classes from within the University. Independent Study or Internship credits are sometimes possible as an additonal alternative, as described in the HCI/d MS Handbook. Electives can be from any school at Indiana University with courses related to the student's area of concentration, including other areas in Informatics and Computing and ILS.

M.S. in Security Informatics

M.S. Requirements

The M.S. in Security Informatics (MSSI) offers an interdisciplinary focus that combines coursework in mathematics, protocol analysis, and system and network security, with business and economics, social engineering, human-computer interaction, and other disciplines.
In addition, MSSI students choose a concentration in financial risk, psychology, organizational theory or a particular focus area is computer science like embedded systems.

CURRICULUM

A total of 36 credit hours is required for this degree. Individual program choices will vary. The program can be understood as consisting of four elements:

1. Security foundations
2. Professional practice
3. Computing networks
4. Concentrations in an area of interest

Courses

- INFO-I 591 Graduate Internship (6 cr.)

Required Security Informatics Courses (12 cr.)

- INFO-I 520 Security for Networked Systems (3 cr.)
- INFO-I 525 Organizational Informatics and Economic Security (3 cr.)
- INFO-I 533 Systems and Protocol Security and Information Assurance (3 cr.)
- INFO-I 536 Foundational Mathematics of Cybersecurity (3 cr.)

Computer Networking Electives (9 - 12 cr.)

Electives or Concentration (6 - 9 cr.)

Concentration electives (9 cr.)
Concentration electives can be from any school or college at Indiana University with courses related to the student's area of interest. The Kelley School of Business teaches graduate courses on management of technology and information systems in organizations. The School of Public and Environmental Affairs teaches courses on risk behavior, policy, and decision-making. The Department of Telecommunications also offers courses in information economics, media studies, and information policy.

Suggested courses and concentrations:

- Complex Systems
  - ILS-Z 604 Topic: Information Networks (3 cr.)
  - INFO-I 586 Artificial Life (3 cr.)
  - INFO-I 590 Topic: The Simplicity of Complexity (3 cr.)
  - INFO-I 601 Introduction to Complex Systems (3 cr.)
- Embedded Systems Concentration
  - CSCI-B 441 Digital Design (4 cr.)
  - CSCI-C 335 Computer Structures (4 cr.)
  - CSCI-P 415 Introduction to Verification (3 cr.)
  - CSCI-P 442 Digital Systems (4 cr.)
  - CSCI-P 545 Embedded and Real-Time Systems (3 cr.)
- Social Informatics
  - INFO-I 504 Social Dimensions of Science Informatics (3 cr.)
  - INFO-I 506 Globalization and Information (3 cr.)
  - INFO-I 651 Ethnography of Information (3 cr.)
- Music Informatics
  - INFO-I 545 Music Information Representation, Search and Retrieval (3 cr.)
  - INFO-I 547 Music Information Processing: Audio (3 cr.)
  - MUS-K 503 Electronic Studio Resources 1 (3 cr.)
- Business Concentration
  - BUS-F 421 Derivative Securities and Corporate Risk Management (3 cr.)
  - BUS-F 525 Corporate Financial Risk Management (1.5 cr.)
  - BUS-K 490 Independent Study in Decision Sciences (1–3 cr.)
  - SPEA-V 541 Benefit-Cost Analysis of Public and Environmental Policies (3 cr.)
- SPEA Concentration
  - SPEA-E 560 Environmental Risk Analysis (3 cr.)
  - SPEA-V 507 Data Analysis and Modeling for Public Affairs (3 cr.)
  - SPEA-V 673 Public Policy Analysis and Management Science/Operations Research (3 cr.)
- Criminal Justice Concentration
  - CJUS-P 430 Law and the Legal System (3 cr.)

    - CJUS-P 595 Data Analysis in Criminal Justice I (3 cr.)
    - CJUS-P 596 Data Analysis in Criminal Justice II (3 cr.)
- Psychology Concentration
    - PSY-P 533 Introduction to Bayesian Data Analysis I (3 cr.)
    - PSY-P 647 Decision Making under Uncertainty (3 cr.)
    - PSY-P 651 Perception/Action (3 cr.)
    - PSY-P 654 Multivariate Analysis (3 cr.)
    - PSY-P 820 Social Perception (3 cr.)
- Information and Library Science Concentration
    - ILS-Z 514 Social Aspects of Information Technology (3 cr.)
    - ILS-Z 532 Information Architecture for the Web (3 cr.)
    - ILS-Z 636 Semantic Web (3 cr.)
    - ILS-Z 642 Content Analysis for the Web (3 cr.)
    - ILS-Z 643 The Information Industry (1–3 cr.)
    - ILS-Z 671 School Media (3 cr.)
    - ILS-Z 680 The Book to 1450 (3 cr.)
- Telecommunications Concentration
    - TEL-T 504 Introduction to Telecommunications Policy Studies (3 cr.)
    - TEL-T 512 Communication and Politics (3 cr.)
    - TEL-T 532 Economics of the Media Industries (3 cr.)
    - TEL-T 575 Directed Group New Media Design Project (3 cr.)
    - TEL-T 610 The Networked Society (3 cr.)
    - TEL-T 650 Telecommunications and the Constitution (3 cr.)

Concentrations can also be regional or cultural. Indiana University is home to exemplary centers and institutes for geographical and regional studies. Any of the cultural and regional studies can be combined with the study of network security; given the inherently global nature of the challenges. Some examples include:

- African Studies Program
- Center for Languages of the Central Asian Region
- Center for Latin American and Caribbean Studies
- Center for the Study of Global Change
- East Asian Studies Center
- European Union Center
- India Studies Program
- Inner Asian and Uralic National Resource Center
- Jewish Studies Program
- Middle Eastern and Islamic Studies Program
- Russian and East European Institute
- West European Studies

Master of Information Science (MIS)

Goals and Objectives of the Master of Information Science Program The Master of Information Science (MIS) program is an interdisciplinary professional program designed to prepare students for lifelong careers in designing, managing, and consulting about information and communication technologies (ICT) and services in public, corporate, and nonprofit settings. The program couples best-practices training in the management and use of ICT with exposure to current information management and systems research; there is a strong emphasis on essential career development skills including written and oral communication, team building, analysis, and critical thinking that are necessary for assuming management positions in business, nonprofit, academic, and government organizations.

ILS has identified the following primary goals and objectives for the MIS program. Upon completion of this program, graduates will be prepared to:

Demonstrate understanding of research necessary for careers as information professionals

- Apply appropriate strategies, tools and technologies to represent, organize, and manage data and information
- Apply appropriate theories and empirical evidence for effective leadership, management, and collaboration
- Use critical thinking to evaluate information, technology, and services problems and challenges
- Synthesize and interpret relevant research findings for use in ICT project management

Adopt socio-technical and user-centered approaches to studying and working with information and communication technologies (ICT)

- Understand the management and organizational structures of information organizations
- Utilize effectively the theoretical and practical bases of information organization, architecture, storage, retrieval, and delivery systems
- Apply techniques from human-computer interaction, systems analysis, programming and database design, to analyze user needs and information systems in social and organizational settings
- Develop innovative solutions to address information, technology, and services problems and challenges

Work effectively within and across a variety of information settings and contexts

- Communicate effectively, orally and in writing, with a variety of audiences
- Identify information and technical resources that will support an organization's activities
- Analyze, evaluate, and manage ICT to support organizational activities and work practices
- Demonstrate knowledge of relevant concepts and theories of organizational behavior for managing people, information, and technology in public and private sector organizations

Participate successfully and responsibility in the information professions

- Explain socio-economic, cultural, policy, and ethical issues involved in the design, development, management, and use of ICT
- Engage in life-long learning, making effective use of the range of information resources (research and

popular writings, professional organizations) that support information work

MIS DEGREE REQUIREMENTS

The MIS program helps to educate a distinctive information professional, one whose expertise includes understanding the human side of information and information technologies and applying this understanding to practical problems. The curriculum has been designed to provide a sound conceptual foundation for developing leadership-oriented careers and enabling students to develop expertise in one or more specific areas. A candidate for the Master of Information Science degree must complete 42 credit hours of graduate course work; at least 36 credit hours must be taken in the IU Department of Information and Library Science.

A maximum of 6 graduate credit hours from outside the IU Department of Information and Library Science may, in certain circumstances and with approval (using the "Outside Course Approval Form"), be applied to the MIS degree. These 6 credit hours may be taken at Indiana University, or at another university. Outside courses are warranted only when they are relevant to the student's career objectives and will contribute more to the enrichment of their programs than would additional ILS courses. Ordinarily, permission for such outside course work must be obtained before enrolling in the course. The course must be completed with a grade of B or higher, must not be applied to another degree (except in the case of a recognized dual-degree program), and must be taken within the five-year time frame allowed for completion of the degree.

MIS Requirements: (36 cr.)

Foundation Courses (18 cr.)

- ILS-Z 510 Introduction to Information Studies (3 cr.) * Must be fulfilled before you complete 18 credit hours
- ILS-Z 511 Database Design (3 cr.)
- ILS-Z 515 Information Architecture (3 cr.)
- ILS-Z 516 Human-Computer Interaction (3 cr.)
- Programming Requirement (e.g. ILS-Z 517, Z 656, approved Z 603)

Complete one course from the following:

- ILS-Z 513 Organizational Informatics (3 cr.)
- ILS-Z 556 Systems Analysis and Design (3 cr.)

Electives (18 cr.)

Technology Literacy Requirement Basic digital literacy is essential to your success as an information professional.

You are expected to have basic technology skills upon entering the MIS degree program - or to acquire those skills in your first semester. The following list includes technologies with which you should be competent. These are IT Training courses offered at no cost by University Information Technology Services (UITS) - descriptions and links to all of the courses below can be found at this website.

Standard productivity tools, such as Microsoft Office (Word, Excel, PowerPoint) or open source alternatives

- Word 2013: The Essentials
- PowerPoint 2013: The Basics
- Excel 2013: The Basics

Basic Unix commands, including copying, moving, and deleting files and directories; and editing text files with vi, emacs, or pico

- Unix: The Basics
- vi: Unix Text Editing
- Common communications and file transfer tools such as ssh, sftp, and scp

Basic HTML and CSS for creating web pages and other digital content

- HTML5 and CSS: The Basics
- Cascading Style Sheets: The Basics
- Cascading Style Sheets: Layout & Design
- CSS3: An Overview
- Dreamweaver CS6: The Basics
- Bibliographic management tools
- Zotero
- EndNote: The Basics

Indiana University's University Information Technologies Services (UITS) offers many excellent training opportunities, including instructor-led workshops and self-paced online courses. As an IU student, you can take advantage of these training opportunities at no additional charge.

You can also develop required skills through many free online training opportunities, such as those offered by Codecademy.

Accelerated Master of Information Science

The accelerated program allows you to take 12 graduate-level credits during your senior year in the Department of Information and Library Science concurrently with your remaining undergraduate requirements. With this approach, once you complete your undergraduate degree, you will only need 24 credits to earn a master's degree, which can be completed in one year.

Students apply for the program during their junior year and are eligible for ILS courses during their senior year. Students complete 12 credits of graduate coursework during their senior year amd 6 more graduate credits the summer after graduation. Summer work can either be graduate coursework or an internship. Students can complete the Accelerated Master's degree by taking 9 credits of coursework in each of the next two semesters.

The requirements for the degree are the same as the regular MIS or MLS degree, and no courses taken at the undergraduate or graduate level are allowed to count towards both an undergraduate and a graduate degree.

Master of Library Science

Goals and Objectives for the Master of Library Science Program The Master of Library Science (MLS) is a 36 credit hour program accredited by the American Library Association. The program is innovatively designed to meet the new challenges of our profession. Students in the program are introduced to the roles and functions of libraries in contemporary society. They become familiar

with key policy issues and technological trends, and with how these issues and trends affect libraries and information centers of all kinds. Students learn to manage and evaluate collections, respond to the information needs of patrons, and to use technology to improve access to information. Students who complete the program are prepared for careers in library administration, public services, technical services, reference services, and collection development at public, school, academic, and special libraries.

ILS has identified the following primary goals and objectives for the MLS program. Upon completion of the MLS program, graduates will be prepared to:

Approach Professional Issues with Understanding

- Understand the social, political, ethical, and legal aspects of information creation, access, ownership, service, and communication
- Anticipate emerging trends and respond proactively

Assist and Educate Users

- Analyze and identify the information needs of diverse communities of users
- Educate users and potential users to locate, use, and evaluate information resources and tools
- Analyze and evaluate information systems and services in a variety of settings

Develop and Manage Collections of Information Resources

- Design and apply policies and procedures that support the selection and acquisition of information resources for particular communities of users
- Manage, evaluate, and preserve physical and virtual collections of information resources
- Uphold ethical and legal standards in acquiring, leasing, preserving, and providing access to information resources

Represent and Organize Information Resources

- Understand and apply principles of representation and organization

Manage and Lead libraries and Other Information Organizations

- Perform basic managerial functions, including planning, budgeting, and performance evaluation
- Communicate effectively to a variety of audiences
- Apply theories of organizational behavior and structure

Use Research Effectively

- Design, conduct, interpret, and take action based upon research and evaluation

Deploy Information Technologies in Effective and Innovative Ways

- Implement and evaluate information and communication technologies for efficiency, usability and value to users

MLS DEGREE REQUIREMENTS

The Master of Library Science degree requires 36 credit hours of graduate course work in Information and Library Science and a digital literacy requirement (see below). The ILS website provides information about dual degree requirements and transfer credit.

MLS Foundation Requirements: (15 cr.)

- ILS-Z 501 User Services and Tools (3 cr.)
- ILS-Z 503 Representation and Organization (3 cr.)
- ILS-Z 550 Persepectives in Librarianship (3 cr.)
- ILS-Z 605 Internship in Library and Information Science (3 cr.)*
    - * Must complete 18 ILS credits before taking and approval form is required

Complete one course from the following:

- ILS-Z 511 Database Design (3 cr.)
- ILS-Z 512 Information Systems Design (3 cr.)
- ILS-Z 516 Human-Computer Interaction (3 cr.)
- ILS-Z 517 Web Programming (3 cr.)
- ILS-Z 532 Information Architecture for the Web (3 cr.)
- ILS-Z 534 Search (3 cr.)
- ILS-Z 554 Library Systems (3 cr.)
- ILS-Z 556 Systems Analysis and Design (3 cr.)
- ILS-Z 634 Metadata (3 cr.)
- ILS-Z 636 Data Semantics (3 cr.)
- ILS-Z 637 Information Visualization (3 cr.)
- ILS-Z 652 Digital Libraries (3 cr.)
- ILS-Z 656 Digital Publishing Standards and Systems (3 cr.)
- ILS-Z 661 Concepts and Contemporary Issues in Human-Computer Interaction (3 cr.)

Electives (21 cr.)

MLS electives must be ILS courses. Choose from:

- Any 500/600 level ILS course
- ILS-Z 601 Directed Readings (1-6 cr.)
- ILS-Z 602 Directed Research (1-6 cr.)
- ILS-Z 603 Workshop in Library and Information Science (1-3 cr., often 1.5 cr.)
    - These workshops focus on practical, professional skills. You can count up to 6 credits of Z 603 toward your degree.
- ILS-Z 604 Topics in Library and Information Science (3 cr.) (professional issue topic)
- ILS-Z 629 Topics in Information Sources and Services (3 cr.) (professional issue topic)

Digital Literacy Requirement Basic digital literacy is essential to your success as an information and library professional. This is as true for youth services and reference librarians as it is for metadata and digital collections librarians.

You are expected to have basic technology skills upon entering the MLS degree program - or to acquire those skills in your first semester. The following list includes technologies with which you should be competent. These are IT Training courses offered at no cost by University Information Technology Services (UITS) - descriptions

and links to all of the courses below can be found at this website.

Standard productivity tools, such as Microsoft Office (Word, Excel, PowerPoint) or open source alternatives

- Word 2013: The Essentials
- PowerPoint 2013: The Basics
- Excel 2013: The Basics

Basic Unix commands, including copying, moving, and deleting files and directories; and editing text files with vi, emacs, or pico

- Unix: The Basics
- vi: Unix Text Editing
- Common communications and file transfer tools such as ssh, sftp and scp

Basic HTML and CSS for creating web pages and other digital content

- HTML5 and CSS: The Basics
- Cascading Style Sheets: The Basics
- Cascading Style Sheets: Layout & Design
- CSS3: An Overview
- Dreamweaver CS6: The Basics
- Bibliographic management tools
- Zotero
- EndNote: The Basics

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You can also develop required skills through many free online training opportunities, such as those offered by Codecademy.

Accelerated Master of Library Science

The accelerated program allows you to take 12 graduate-level credits during your senior year in the Department of Information and Library Science concurrently with your remaining undergraduate requirements. With this approach, once you complete your undergraduate degree, you will only need 24 credits to earn a master's degree, which can be completed in one year.

Students apply for the program during their junior year and are eligible for ILS courses during their senior year. Students complete 12 credits of graduate coursework during their senior year and 6 more graduate credits the summer after graduation. Summer work can either be graduate coursework or an internship. Students can complete the Accelerated Master's degree by taking 9 credits of coursework in each of the next two semesters.

The requirements for the degree are the same as the regular MIS or MLS degree, and no courses taken at the undergraduate or graduate level are allowed to count towards both an undergraduate and a graduate degree.

MIS and MLS Dual Degree

CURRICULUM

A total of 54 credit hours is required for this degree.

If a course fulfills requirements for both the MIS foundation and the MLS foundation, the course is allowed to fulfill both requirements, but students must take additional electives to fulfill the required number of credit hours.

MIS Foundation Requirements (18 cr.)

- ILS-Z 510 Introduction to Information Studies (3 cr.) * Must be fulfilled before you complete 18 credit hours
- ILS-Z 511 Database Design (3 cr.)
- ILS-Z 515 Information Architecture (3 cr.)
- ILS-Z 516 Human-Computer Interaction (3 cr.)
- Programming Requirement (e.g. ILS-Z 517, Z 656, approved Z 603)

Complete one course from the following:

- ILS-Z 513 Organizational Informatics (3 cr.)
- ILS-Z 556 Systems Analysis and Design (3 cr.)

MLS Foundation Requirements (15 cr.)

- ILS-Z 501 User Services and Tools (3 cr.)
- ILS-Z 503 Representation and Organization (3 cr.)
- ILS-Z 550 Perspectives on Librarianship (3 cr.)
- ILS-Z 605 Internships in Library and Information Science (3 cr.)*
  - * Must complete 18 ILS credits before taking and approval form is required.

Complete one course from the following:

- ILS-Z 511 Database Design (3 cr.)
- ILS-Z 512 Information Systems Design (3 cr.)
- ILS-Z 516 Human-Computer Interaction (3 cr.)
- ILS-Z 517 Web Programming (3 cr.)
- ILS-Z 532 Information Architecture for the Web (3 cr.)
- ILS-Z 534 Search (3 cr.)
- ILS-Z 554 Library Systems (3 cr.)
- ILS-Z 556 Systems Analysis and Design (3 cr.)
- ILS-Z 634 Metadata (3 cr.)
- ILS-Z 636 Data Semantics (3 cr.)
- ILS-Z 637 Information Visualization (3 cr.)
- ILS-Z 652 Digital Libraries (3 cr.)
- ILS-Z 656 Digital Publishing Standards and Systems (3 cr.)
- ILS-Z 661 Concepts and Contemporary Issues in Human-Computer Interaction (3 cr.)

Electives (21 cr.)

MLS electives must be ILS courses. Choose from:

- Any 500/600 level ILS course
- ILS-Z 601 Directed Readings (1-6 cr.)
- ILS-Z 602 Directed Research (1-6 cr.)
- ILS-Z 603 Workshop in Library and Information Science (1-3 cr., often 1.5 cr.)
  - These workshops focus on practical, professional skills. You can count up to 6 credits of Z 603 toward your degree.
- ILS-Z 604 Topics in Library and Information Science (3 cr.) (professional issue topic)

- ILS-Z 629 Topics in Information Sources and Services (3 cr.) (professional issue topic)

ILS Specializations

Specializations In addition to the MIS/MLS, ILS offers two kinds of joint program options. Specializations within a master's program are reflected on the student's transcript; 14 specializations are available in the MLS, MIS or both.

All specializations with the MIS must complete the MIS Foundation requirements (18 cr.) and all specializations with the MLS must complete the MLS Foundation requirements (15 cr.) plus the specialization requirements in order to earn a degree.

If a course fulfills requirements for both the MLS or MIS foundation and a specialization or dual degree, the course is allowed to fulfill both requirements, but students must take additional electives to fulfill the required number of credit hours towards the dual degree or specialization.

MIS with Data Science Specialization

Specialization Requirements (18 cr.)

- ILS-Z 605 Internship in Library and Information Science (3 cr.)

Choose 9 credits from the following:

- CSCI-B 555 Machine Learning (3 cr.)
- CSCI-B 649 Topic: Cloud Computing (3 cr.) or ENGR-E 516 Cloud Computing (3 cr.)
- CSCI-B 669 Topic: Scientific Data Management (3 cr.)
- INFO-I 573 Programming for Science Informatics (3 cr.)
- STAT-S 520 Intro to Statistics (3 cr.)
- STAT-S 670 Exploratory Data Analysis (3 cr.)

Specialization Electives (6 cr.)
Choose 6 credits from the following:

- ILS-Z 503 Representation and Organization (3 cr.)
- ILS-Z 512 Information Systems Design (3 cr.)
- ILS-Z 532 Information Architecture for the Web (3 cr.)
- ILS-Z 534 Search (3 cr.)
- ILS-Z 603 Workshop in Library and Information Science (1-3 cr.); must be approved by your specialization advisor
- ILS-Z 604 Topic: Information Networks (3 cr.)
- ILS-Z 604 Topic: Scholarly Communication (3 cr.)
- ILS-Z 604 Topic: Social and Organizational Informatics of Big Data (3 cr.)
- ILS-Z 634 Metadata (3 cr.)
- ILS-Z 636 Data Semantics (3 cr.)
- ILS-Z 637 Information Visualization (3 cr.)
- ILS-Z 643 The Information Industry (1 - 3 cr.)
- ILS-Z 661 Concepts and Contemporary Issues in Human-Computer Interaction (3 cr.)

MIS with Digital Curation Specialization

Specialization Requirements (18 cr.)
Required (15 cr.)

- ILS-Z 586 Digital Curation (3 cr.)
- ILS-Z 634 Metadata (3 cr.)
- ILS-Z 652 Digital Libraries (3 cr.)
- ILS-Z 685 Building Trustworthy Digital Repositories (3 cr.)
- ILS-Z 690 Capstone in Information Architecture (3 cr.)

Choose 9 credits from the following:

- ILS-Z 603 Workshop in Library and Information Science (1-3 cr.); must be approved by your specialization advisor
- ILS-Z 604 Topic: Big Data Analytics for Web and Text (3 cr.)
- ILS-Z 604 Topic: Information Ethics (3 cr.)
- ILS-Z 604 Topic: Scholarly Communication (3 cr.)
- ILS-Z 635 Ontologies (3 cr.)
- ILS-Z 636 Data Semantics (3 cr.)
- ILS-Z 637 Information Visualization (3 cr.)
- ILS-Z 640 Seminar in Intellectual Freedom (3 cr.)
- ILS-Z 656 Digital Publishing Standards and Systems (3 cr.)
- INFO-I 523 Big Data Applications and Analytics (3 cr.)
- INFO-I 524 Big Data Software and Projects (3 cr.)
- INFO-I 587 Introduction to Virtual Heritage (3 cr.)
- INFO-I 588 Advanced Topics in Virtual Heritage (3 cr.)

MIS with Digital Humanities Specialization

Specialization requirements (18 cr.)

- ILS-Z 657 Digital Humanities (3 cr.)
- Capstone Project (3 - 6 cr.)
  - ILS-Z 601 Directed Readings (Capstone Project) (1.5 - 3 cr.) - Semester 1
  - ILS-Z 602 Directed Research (Capstone Project) (1.5 - 3 cr.) - Semester 2

Specialization Electives (9 - 12 cr.)
Choose 9 - 12 credits from the following or approved by the specialization advisor. Classes taken outside ILS must be approved by completing the Outside Course Approval Form. A maximum of 6 credits outside of ILS may be approved.

- ILS-Z 541 Information Policy (3 cr.)
- ILS-Z 543 Computer-Mediated Communicaton (3 cr.)
- ILS-Z 544 Gender and Computerization (3 cr.)
- ILS-Z 584 Manuscripts (3 cr.)
- ILS-Z 603 Workshop in Library and Information Science (1-3 cr.); approved by your specialization advisor
- ILS-Z 604 Topic: Big Data Analytics for Web and Text (3 cr.)
- ILS-Z 604 Topic: Information Ethics (3 cr.)
- ILS-Z 604 Topic: Scholarly Communications (3 cr.)
- ILS-Z 634 Metadata (3 cr.)
- ILS-Z 635 Ontologies (3 cr.)
- ILS-Z 637 Information Visualization (3 cr.)
- ILS-Z 640 Seminar in Intellectual Freedom (3 cr.)
- ILS-Z 642 Content Analysis for the Web (3 cr.)
- ILS-Z 652 Digital Libraries (3 cr.)
- ILS-Z 656 Digital Publishing Standards and Systems (3 cr.)

- ILS-Z 680 The Book to 1450 (3 cr.)
- ILS-Z 681 The Book 1450 to the Present (3 cr.)
- ILS-Z 684 Descriptive Bibliography (3 cr.)

Outside course example

- INFO-I 587 Introduction to Virtual Heritage (3 cr.)
- INFO-I 588 Advanced Topics in Virtual Heritage (3 cr.)

MIS with Digital Libraries Specialization

Specialization Requirements (18 cr.)

- ILS-Z 605 Internship in Library and Information Science (3 cr.)
- ILS-Z 634 Metadata (3 cr.)
- ILS-Z 652 Digital Libraries (3 cr.)

Choose 9 credits from the following:

- ILS-Z 502 Collection Development and Management (3 cr.)
- ILS-Z 504 Cataloging (3 cr.)
- ILS-Z 511 Database Design (3 cr.)
- ILS-Z 516 Human-Computer Interaction (3 cr.)
- ILS-Z 517 Web Programming (3 cr.)
- ILS-Z 532 Information Architecture for the Web (3 cr.)
- ILS-Z 534 Search (3 cr.)
- ILS-Z 603 Workshop in Library and Information Science (1 -3 cr.): Choose a workshop in Digitizing, Encoded Archival Description (EAD), Metadata Object Description Schema (MODS), XML, or anther topic approved by your specialization advisor.
- ILS-Z 604 Topics in Library and Information Science (1 - 4 cr.) Choose a course in Digital Curation, Metadata and Semantics, Scholarly Communication, or another topic approved by your specialization advisor
- ILS-Z 633 Indexing (3 cr.)
- ILS-Z 635 Ontologies (3 cr.)
- ILS-Z 636 Data Semantics (3 cr.)
- ILS-Z 637 Information Visualization (3 cr.)
- ILS-Z 656 Information Technology Standardization (3 cr.)
- ILS-Z 657 Digital Humanities (3 cr.)
- Other courses approved by your specialization advisor

MIS with Information Architecture Specialization

Specialization Requirements (18 cr.)

- ILS-Z 690 Capstone in Information Architecture (3 cr.)

Choose 15 credits from the following:

- ILS-Z 503 Representation and Organization (3 cr.)
- ILS-Z 512 Information Systems Design (3 cr.)
- ILS-Z 519 Evaluation of Information Systems (3 cr.)
- ILS-Z 520 Information Seeking and Use (3 cr.)
- ILS-Z 532 Information Architecture for the Web (3 cr.)
- ILS-Z 534 Search (3 cr.)
- ILS-Z 603 Workshop in Library and Information Science (1 - 3 cr.); approved by your specialization advisor
- ILS-Z 633 Indexing (3 cr.)
- ILS-Z 634 Metadata (3 cr.)
- ILS-Z 635 Ontologies (3 cr.)
- ILS-Z 636 Semantic Web (3 cr.)
- ILS-Z 637 Information Visualization (3 cr.)
- ILS-Z 643 The Information Industry (1 - 3 cr.)
- ILS-Z 661 Concepts and Contemporary Issues in Human-Computer Interaction (3 cr.)
- Other SoIC courses: up to 9 cr. approved by your specialization advisor

MIS with Information Technology Leadership Specialization

Specialization Requirements (18 cr.)

- ILS-Z 555 Strategic Intelligence (3 cr.) (or the approved INFO-I 399 version)
- ILS-Z 556 Systems Analysis and Design (3 cr.) or ILS-Z 513 Organizational Informatics (3 cr.) or INFO-I 303 Organizational Informatics (3 cr.) - whichever not taken with the M.I.S. Foundation requirements
- ILS-Z 605 Internship in Library and Information Science (2 - 6 cr.) or ILS-Z 690 Capstone in Information Architecture (3 cr.)
- ILS-Z 643 The Information Industry (1 - 3 cr.) or ILS-Z 512 Information Systems Design (3 cr.)

Choose 6 credits from the following:

- ILS-Z 514 Social Aspects of Information Technology (3 cr.)
- ILS-Z 518 Communication in Electronic Environments (3 cr.)
- ILS-Z 534 Search (3 cr.)
- ILS-Z 541 Information Policy (3 cr.)
- ILS-Z 542 International Information Issues (3 cr.)
- ILS-Z 551 Management for Information Professionals (3 cr.)
- ILS-Z 604 Topic: Data Analytics and Text Mining (3 cr.)
- ILS-Z 640 Topic: Information Ethics (3 cr.)
- ILS-Z 637 Information Visualization (3 cr.)

MLS with Archives and Records Management Specialization

Specialization Requirements (18 cr.)

- ILS-Z 581 Archives and Records Management (3 cr.)
- ILS-Z 605 Internship in Library and Information Science (3 cr.)

Choose 12 credits from the following:

- ILS-Z 511 Database Design (3 cr.)
- ILS-Z 513 Organizational Informatics (3 cr.)
- ILS-Z 519 Information Analytics (3 cr.)
- ILS-Z 556 Systems Analysis and Design (3 cr.)
- ILS-Z 582 Preservation (3 cr.)
- ILS-Z 584 Manuscripts (3 cr.)
- ILS-Z 585 Records Management (3 cr.)
- ILS-Z 586 Digital Curation (3 cr.)

- ILS-Z 603 Workshop in Library and Information Science (1 - 3 cr.) Choose a workshop in Encoded Archival Description (EAD), Metadata Object Description Schema (MODS), Processing Manuscript Collections, XML, or another topic approved by the specialization advisor
- ILS-Z 604 Topics in Library and Information Science (1 - 4 cr.) Choose a course in Advanced Archival Appraisal, Audio Preservation: Principles and Practices, Clarification and Business Processes, Evaluation and Audit, Introduction to Moving Image Preservation, Oral History, or another topic approved by the specialization advisor
- ILS-Z 634 Metadata (3 cr.)
- ILS-Z 652 Digital Libraries (3 cr.)
- ILS-Z 685 Electronic Records Management (3 cr.)
- Other courses approved by the specialization advisor

MLS with Art Librarianship Specialization

Specialization Requirements (18 cr.)

- ILS-Z 521 Humanities Information (3 cr.)
- ILS-Z 605 Intership in Library and Information Science (4 cr.) Consult your specialization advisor to find an internship
- ILS-Z 651 Art Librarianship (3 cr.)
- ILS-Z 680 The Book to 1450 (3 cr.)

Specialization Electives (6 cr.)
Choose from information and library science courses. Consult your specialization advisor for recommended electives

MLS with Children's and Young Adult Services Specialization

Specialization Requirements (18 cr.)

- ILS-Z 571 Materials for Youth (3 cr.)
- ILS-Z 572 Youth Services (3 cr.)
- ILS-Z 672 Seminar on Literature for Youth (3 cr.)
- 3 cr. approved by your specialization advisor

Choose 6 credits from the following:

- ILS-Z 532 Information Architecture for the Web (3 cr.)
- ILS-Z 541 Information Policy (3 cr.)
- ILS-Z 603 Workshop in Library and Information Science (1 - 3 cr.) Choose a workshop in Electronic Materials for Children, Emergent Literacy, Public Library Programming, Storytelling, or another topic approved by your specialization advisor
- ILS-Z 604 Topics in Library and Information Science (1 - 4 cr.) Choose Storytelling or another topic approved by your specialization advisor
- ILS-Z 605 Internship in Library and Information Science (2 - 6 cr.)
- ILS-Z 621 Audio and Video Sources (3 cr.)
- ILS-Z 622 Resources and Services for People with Disabilities (3 cr.)
- ILS-Z 640 Seminar in Intellectual Freedom (3 cr.)
- ILS-Z 672 Seminar on Literature for Youth (3 cr.)
- Other courses approved by your specialization advisor

MLS with Data Science Specialization

Specialization Requirements (18 cr.)

- ILS-Z 517 Web Programming (3 cr.)
- ILS-Z 605 Internship in Library and Information Science (3 cr.)

Choose 9 credits from the following:

- CSCI-B 555 Machine Learning (3 cr.)
- CSCI-B 649 Topic: Cloud Computing (3 cr.) or ENGR-E 516 Cloud Computing (3 cr.)
- CSCI-B 669 Topic: Scientific Data Management and Preservation (3 cr.)
- INFO-I 573 Programming for Science Informatics (3 cr.)
- STAT-S 520 Intro to Statistics (3 cr.)
- STAT-S 670 Exploratory Data Analysis (3 cr.)

Specialization Electives (3 cr.)
Choose 1 from the following:

- ILS-Z 511 Database Design (3 cr.)
- ILS-Z 512 Information Systems Design (3 cr.)
- ILS-Z 515 Information Architecture (3 cr.)
- ILS-Z 532 Information Architecture for the Web (3 cr.)
- ILS-Z 534 Search (3 cr.)
- ILS-Z 603 Workshop in Library and Information Science (1 - 3 cr.) must be approved by your specialization advisor
- ILS-Z 604 Topic: Information Networks (3 cr.)
- ILS-Z 604 Topic: Scholarly Communication (3 cr.)
- ILS-Z 604 Topic: Social and Organizational Informatics of Big Data (3 cr.)
- ILS-Z 634 Metadata (3 cr.)
- ILS-Z 636 Data Semantics (3 cr.)
- ILS-Z 637 Information Visualization (3 cr.)
- ILS-Z 643 The Information Industry (3 cr.)
- ILS-Z 661 Concepts and Contemporary Issues in Human-Computer Interaction (3 cr.)

MLS with Digital Curation Specialization

Specialization Requirements (18 cr.)

- ILS-Z 586 Digital Curation (3 cr.)
- ILS-Z 634 Metadata (3 cr.)
- ILS-Z 652 Digital Libraries (3 cr.)
- ILS-Z 685 Building Trustworthy Digital Repositories (3 cr.)
- ILS-Z 690 Capstone in Information Architecture (3 cr.)

Choose 3 credits from the following:

- ILS-Z 603 Workshop in Library and Information Science (3 cr.) approved by your specialization advisor
- ILS-Z 604 Topic: Big Data Analytics for Web and Text (3 cr.)
- ILS-Z 604 Topic: Information Ethics (3 cr.)
- ILS-Z 604 Topic: Scholarly Communication (3 cr.)
- ILS-Z 635 Ontologies (3 cr.)
- ILS-Z 636 Data Semantics (3 cr.)
- ILS-Z 637 Information Visualization (3 cr.)

- ILS-Z 640 Seminar in Intellectual Freedom (3 cr.)
- ILS-Z 656 Digital Publishing Standards and Systems (3 cr.)
- INFO-I 523 Big Data Applications and Analytics (3 cr.)
- INFO-I 524 Big Data Software and Projects (3 cr.)
- INFO-I 587 Introduction to Virtual Heritage (3 cr.)
- INFO-I 588 Advanced Topics in Virtual Heritage (3 cr.)

MLS with Digital Humanities Specialization

Specialization Requirements (18 cr.)

Choose 6 - 9 credits from the following:

- Capstone project (3 - 6 cr.)
  - ILS-Z 601 Directed Readings (1.5 - 3.0 cr.) Semester 1
  - ILS-Z 602 Directed Research (1.5 - 3.0 cr.) Semester 2
- ILS-Z 657 Digital Humanities (3 cr.)

Choose 9 - 12 credits from the following or approved by your specialization advisor; maximum of 6 credits outside of ILS courses

- ILS-Z 541 Information Policy (3 cr.)
- ILS-Z 543 Computer-Mediated Communication (3 cr.)
- ILS-Z 544 Gender and Computerization (3 cr.)
- ILS-Z 584 Manuscripts (3 cr.)
- ILS-Z 603 Workshop in Library and Information Science (1 - 3 cr.) approved by your specialization advisor
- ILS-Z 604 Topic: Big Data Analytics for Web and Text (3 cr.)
- ILS-Z 604 Topic: Information Ethics (3 cr.)
- ILS-Z 604 Topic: Scholarly Communications (3 cr.)
- ILS-Z 634 Medadata (3 cr.)
- ILS-Z 635 Ontologies (3 cr.)
- ILS-Z 637 Information Visualization (3 cr.)
- ILS-Z 640 Seminar in Intellectual Freedom (3 cr.)
- ILS-Z 642 Content Analysis for the Web (3 cr.)
- ILS-Z 652 Digital Libraries (3 cr.)
- ILS-Z 656 Digital Publishing Standards and Systems (3 cr.)
- ILS-Z 680 The Book to 1450 (3 cr.)
- ILS-Z 681 The Book 1450 to the Present (3 cr.)
- ILS-Z 684 Descriptive Bibliography (3 cr.)

Outside course example:

- INFO-I 587 Introduction to Virtual Heritage (3 cr.)
- INFO-I 588 Advanced Topics in Virtual Heritage (3 cr.)

MLS with Digital Libraries Specialization

Specialization Requirements (18 cr.)

- ILS-Z 605 Internship in Library and Information Science (3 cr.)
- ILS-Z 634 Metadata (3 cr.)
- ILS-Z 652 Digital Libraries (3 cr.)

Choose 9 credits from the following:

- ILS-Z 502 Collection Development and Management (3 cr.)
- ILS-Z 504 Cataloging (3 cr.)
- ILS-Z 511 Database Design (3 cr.)
- ILS-Z 516 Human-Computer Interaction (3 cr.)
- ILS-Z 517 Web Programming (3 cr.)
- ILS-Z 532 Information Architecture for the Web (3 cr.)
- ILS-Z 534 Search (3 cr.)
- ILS-Z 603 Workshop in Library and Information Science (1 - 3 cr.) Choose a workshop in Digitizing, Encoded Archival Description (EAD), Metadata Object Description Schema (MODS), XML, or another topic approved by your specialization advisor
- ILS-Z 604 Topics in Library and Information Science (1 - 4 cr.) Choose a topic in Digital Curation, Metadata and Semantics, Scholarly Communication, or another topic approved by your specialization advisor
- ILS-Z 633 Indexing (3 cr.)
- ILS-Z 635 Ontologies (3 cr.)
- ILS-Z 636 Data Semantics (3 cr.)
- ILS-Z 637 Information Visualization (3 cr.)
- ILS-Z 656 Digital Publishing Standards and Systems (3 cr.)
- ILS-Z 657 Digital Humanities (3 cr.)
- Other courses approved by your specialization advisor

MLS with Information Architecture Specialization

Specialization Requirement (18 cr.)

- ILS-Z 690 Capstone in Information Architecture (3 cr.)

Choose 15 credits from the following:

- ILS-Z 512 Information System Design (3 cr.)
- ILS-Z 515 Information Architecture (3 cr.)
- ILS-Z 516 Human-Computer Interaction (3 cr.)
- ILS-Z 520 Information Seeking and Use (3 cr.)
- ILS-Z 532 Information Architecture for the Web (3 cr.)
- ILS-Z 534 Search (3 cr.)
- ILS-Z 603 Workshop in Library and Information Science (1 -3 cr.) approved by your specialization advisor
- ILS-Z 633 Indexing (3 cr.)
- ILS-Z 634 Metadata (3 cr.)
- ILS-Z 635 Ontologies (3 cr.)
- ILS-Z 636 Data Semantics (3 cr.)
- ILS-Z 637 Information Visualization (3 cr.)
- ILS-Z 643 The Information Industry (3 cr.)
- ILS-Z 661 Concepts and Contemporary Issues in Human-Computer Interaction (3 cr.)
- Other SoIC courses approved by your specialization advisor

MLS with Music Librarianship Specialization

Specialization Requirements (18 cr.)

- MUS-M 539 Introduction to Music Bibliography (3 cr.)

- ILS-Z 504 Cataloging (3 cr.)
- ILS-Z 605 Internship in Library and Information Science (6 cr.) One of two areas related to music librarianship, such as music cataloging, music collection development, music reference, or music technology. Internships must be approved by your specialization advisor. MUS-M 539 and ILS-Z 504 are prerequisites
- ILS-Z 655 Music Librarianship (3 cr.) MUS-M 539 and ILS-Z 504 are prerequisites or corequisites
- Electives (3 cr.) Choose from information and library science courses. Consult your specialization advisor for recommended electives

MLS with Rare Books and Manuscripts Specialization

Specialization Requirement (18 cr.)

- ILS-Z 583 Rare Book Librarianship (3 cr.)
- ILS-Z 605 Internship in Library and Information Science (3 cr.) Related to rare books and manuscripts

Choose 12 credits from the following:

- ILS-Z 580 History of Libraries (3 cr.)
- ILS-Z 582 Preservation (3 cr.)
- ILS-Z 584 Manuscripts (3 cr.)
- ILS-Z 629 Topics in Information Sources and Services (3 cr.)
- ILS-Z 652 Digital Libraries (3 cr.)
- ILS-Z 680 The Book to 1450 (3 cr.)
- ILS-Z 681 The Book 1450 to the Present (3 cr.)
- ILS-Z 684 Descriptive Bibliography (3 cr.)
- Other courses approved by your specialization advisor

Requirements for the specializations do sometimes change. Please visit the ILS website for the most recent requirements.

ILS Dual Degree and Certificates

Dual Degrees

Dual master's degree programs are available with other units on campus; 14 options are offered with the MLS, MIS or both programs. Admission to a dual degree program requires separate admission to both ILS and to the department or school responsible for the other degree. Both degrees must be awarded simultaneously.

All dual degrees with the MIS must complete the MIS Foundation Requirement (18 cr.), and all dual degrees with the MLS must complete the MLS Foundation Requirement (15 cr.) plus the dual degree requirements in order to earn a degree. Please see the University Graduate School bulletin (all MA degrees), the School of Public and Environmental Affairs (MPA), or the Maurer School of Law (JD) for the dual departments' requirements.

If a course fulfills requirements for both the MLS core and a specialization or dual degree, the course is allowed to fulfill both requirements, but students must take additional electives to fulfill the required number of credit hours towards the dual degree or specialization.

MIS and Central Eurasian Studies (MA)

- MIS Electives (12 cr.)
  - Choose from information and library science courses.
- MA Requirements (24 cr.)
  - The Department of Central Eurasian Studies provides information about the M.A. requirements.

MIS and Folklore Ethnomusicololgy (MA)

- MIS Electives (12 cr.)
  - Choose from information and library science courses.
- MA Requirements (21 cr.)
  - The Department of Folklore and Ethnomusicology provides information about the M.A. requirements.

MIS and Latin American and Caribbean Studies (MA)

- MIS Additional Requirements (9 cr.)
  - ILS-Z 533 Online Searching
  - ILS-Z 605 Internship in Library and Information Science (under the supervision of the Latin American bibliographer) or an equivalent experience
  - ILS-Z 629 Topics in Information Sources and Services - topic: Latin American bibliography. Alternatively, you may elect to take an ILS advanced reference course (Z 521, Z 522, Z 523, Z 525, or Z 526) and do a course project involving Latin American materials.
- MIS Electives (3 cr.)
  - Choose from information and library science courses.
- MA Requirements (24 cr.)
  - The Center for Latin American and Caribbean Studies provides information about the M.A. requirements.

MIS and Public Affairs (MPA)

- MIS Electives (12 cr.)
  - Choose from information and library science courses.
- MPA Requirements (36 cr.)
  - Contact SPEA for information about the M.P.A. requirements.

MIS and Russian and East European Studies (MA)

- MIS Electives (12 cr.)
  - Choose from information and library science courses.
- MA Requirements (24 cr.)
  - The Russian and East European Institute provides information about the M.A. requirements.

MLS and African American and African Diaspora Studies (MA)

- MLS Additional Requirements (3 cr.)
  - ILS-Z 521 Humanities Information or Z 522 Social Science Information.
- MLS Electives (12 cr.)
  - Choose from information and library science courses.
- MA Requirements (28 cr.)
  - The Department of African American and African Diaspora Studies provides information about the M.A. requirements.

MLS and African Studies (MA)

- MLS Additional Requirements (3 cr.)
  - ILS-Z 521 Humanities Information or Z 522 Social Science Information.
- MLS Electives (12 cr.)
  - Choose from information and library science courses.
- MA Requirements (26 cr.)
  - The African Studies Program provides information about the M.A. requirements.

MLS and Central Eurasian Studies (MA)

- MLS Electives (15 cr.)
  - Choose from information and library science courses.
- MA Requirements (24 cr.)
  - The Department of Central Eurasian Studies provides information about the M.A. requirements.

MLS and Comparative Literature (MA)

- MLS Electives (15 cr.)
  - Choose from information and library science courses.
- MA Requirements (20 cr.)
  - The Department of Comparative Literature provides information about the M.A. requirements.

MLS and English (MA)

- MLS Additional Requirement (3 cr.)
  - ILS-Z 521 Humanities Information
- MLS Electives (12 cr.)
  - Choose from information and library science courses.
- MA Requirements (24 cr.)
  - Learn about the M.A. in English requirements in the University Graduate School Bulletin.

MLS and Folklore and Ethnomusicology (MA)

- MLS Electives (15 cr.)
  - Choose from information and library science courses.
- MA Requirements (21 cr.)
  - The Department of Folklore and Ethnomusicology provides information about the M.A. requirements.

MLS and History (MA)

- MLS Additional Requirements (9 cr.)
  - ILS-Z 521 Humanities Information or Z 522 Social Science Information
  - ILS-Z 581 Archives and Records Management of Z 584 Manuscripts
  - ILS-Z 605 Internship in Library and Information Science
- MLS Electives (6 cr.)
  - Choose from information and library science courses.

MA Requirements (26 cr.)
- The Department of History provides information about the M.A. requirements.

MLS and History of Art (MA)

- MLS Additional Requirements (9 cr.)
  - ILS-Z 521 Humanities Information
  - ILS-Z 605 Internship in Library and Information Science
  - ILS-Z 651 Art Librarianship
- MLS Electives (6 cr.)
  - Choose one of these courses:
    - ILS-Z 532 Information Architecture for the Web
    - ILS-Z 533 Online Searching
    - ILS-Z 633 Indexing
    - ILS-Z 652 Digital Libraries
- MA Requirements (32 cr.)
  - The Department of Art History provides information about the M.A. requirements.

MLS and History and Philosophy of Science (MA)

- MLS Additional Requirements (9 cr.)
  - ILS-Z 523 Science and Technology Information
  - ILS-Z 581 Archives and Records Management or Z 584 Manuscripts
  - ILS-Z 605 Internship in Library and Information Science
- MLS Electives (6 cr.)
  - Choose from information and library science courses.
- MA Requirements (21 cr.)
  - The Department of History and Philosophy of Science provides the information about the M.A. requirements.

MLS and Latin American and Caribbean Studies (MA)

- MLS Additional Requirements (9 cr.)
  - ILS-Z 533 Online Searching

    - ILS-Z 605 Internship in Library and Information Science (under the supervision of the Latin American bibliographer) or an equivalent experience
    - ILS-Z 629 Topics in Information Sources and Services - topic: Latin American Bibliography. Alternatively, you may elect to take an ILS advanced course (ILS-Z 521, Z 522, Z 523, Z 525 or Z 526) and do a course project involving Latin American materials.
- MLS Electives (6 cr.)
    - Choose from information and library science courses.
- MA Requirements (24 cr.)
    - The Center for Latin American and Caribbean Studies provides information about the M.A. requirements.

MLS and Law (JD)

- MLS Additional Requirements (6 cr.)
    - ILS-Z 525 Government Information
    - ILS-Z 654 Law Librarianship
- MLS Electives (9 cr.)
    - Choose from information and library science courses. ILS-Z 533 Online Searching and Z 640 Seminar in Intellectual Freedom are particularly appropriate.
- JD Requirements (79 cr.)
    - The IU Maurer School of Law provides information about the J.D. requirements.

MLS and Musicology (MA)

- MLS Additional Requirements (12 cr.)
    - ILS-Z 504 Cataloging
    - Two 3 cr. of ILS-Z 605 internships in one or two areas related to music librarianship, such as music cataloging, music collection development, music reference, or music technology. The director of the Music Librarianship Specialization must approve the internships. MUS-M 539 and ILS-Z 504 are prerequisites.
    - ILS-Z 655 Music Librarianship: you must take MUS-M 539 and ILS-Z 504 before or with this course.
- MLS Electives (3 cr.)
    - Choose from information and library science courses.
- MA Requirements (30 cr.)
    - The Jacobs School of Music provides information about the M.A. requirements.

MLS and Public Affairs (MPA)

- MLS Electives (15 cr.)
    - Choose from information and library science courses.
- MPA Requirements (36 cr.)
    - Contact SPEA for information about the M.P.A. requirements.

MLS and Russian and East European Studies (MA)

- MLS Electives (15 cr.)
    - Choose from information and library science courses. The Russian and East European Institute counts ILS-Z 605 and Z 629 toward the M.A., allowing an additional 6 cr. of ILS courses in your program.
- MA Requirement (24 cr.)
    - The Russian and East European Institute provides information about the M.A. requirements.

Requirements for dual degrees do sometimes change. Please visit the ILS website for the most recent requirements.

State Certification The state of Indiana certifies librarians for positions in public libraries and school media centers. Each of these certifications can be completed within the MLS program. The ILS website has details on certification requirements.

Graduate Certificate in Information Architecture (18 cr.)
The professional role of the information architect encompasses project management and the organization of work flows within a team-based approach to the design of information structures. Coursework must be completed within three (3) years of entering the certificate program. No credits may be transferred from another graduate or undergraduate program. More information about the Graduate Certificate in Information Architecture is available on the ILS website.

Specialist in Library and Information Science (30 cr.)
The Specialist degree requires 30 cr. of graduate coursework, of which at least 15 cr. must be taken in ILS. The additional 15 cr. may be taken in another school or department of Indiana University. The program should be planned in consultation with the ILS advisor to meet the student's academic and professional goals.

Student Organizations & Services

The following student groups are available for students to participate in:

- CS - Computer Science Club
- ICCA - Informatics and Computing Consulting Association
- ICSA - Informatics and Computing Student Association
- INgineering Club
- Informatics and Computing Entrepreneurs Club
- National Society of Black Engineers - IU Chapter
- SoIC Summer Camp Counselors
- STARS Ambassadors
- uWIC - Undergraduate Women in Informatics and Computing

Other information on Student Groups may be found at https://www.soic.indiana.edu/student-life/student-organizations.html.

Academic Integrity

Academic integrity requires that students take credit only for their own ideas and efforts. Misconduct, including cheating, fabrication, plagiarism, interference, or facilitating academic dishonesty, is prohibited because it undermines the bonds of trust and cooperation among members of this community and between us and those who may depend on our knowledge and integrity. Complete details are contained in the Indiana University

Academic Misconduct

Cheating

Cheating is dishonesty of any kind with respect to course assignments, alteration of records, or examinations. It is the student's responsibility not only to abstain from cheating, but also to avoid the appearance of cheating and to guard against making it possible for others to cheat. Any student who helps another student cheat is as guilty of cheating as the student assisted. The student also should do everything possible to induce respect for the examining process and for honesty in the performance of assigned tasks in or out of class.

Plagiarism

Plagiarism is assuming credit for someone else's work, words, or ideas—whether or not the ideas are expressed in the borrower's own words. Honesty requires that any ideas or materials taken from another source for either written or oral use must be fully acknowledged. Plagiarism includes language or ideas taken from isolated formulas, sentences, or paragraphs; entire articles copied from books, periodicals, or speeches; the writings or created works of other students; and materials assembled or collected by others in projects or collections without acknowledgment.

A faculty member who has evidence that a student is guilty of cheating or plagiarism will initiate the process of determining the student's guilt or innocence. No penalty will be imposed until the student has been informed of the charge and of the evidence on which it is based, and has been given an opportunity to present a defense. If the faculty member finds the student guilty, the faculty member assesses a penalty within the course and promptly reports the case in writing to the dean of the school or comparable head of the academic unit. The report should include the names of any other students who may be involved in the incident and recommendations for further action. The dean, in consultation with the faculty member if the latter so desires, will initiate any further disciplinary proceedings and inform the faculty member of any action taken. In every case, a record of the offenses remains on file.
For further regulations, please refer to the *IU Code of Student Rights, Responsibilities, and Conduct*.

Academic Standing

Students are considered to be in good standing during any semester in which their academic grade point average is at least 3.0 (B) for both their last semester's course work and for the cumulative average of all course work completed. Only courses with grades of C (2.0) or above may be counted toward degree requirements. However, grades below C are used in computing the cumulative grade point average, even if a course is repeated and a higher grade is earned.

Academic Probation

Students are placed on probation following a semester in which their graduate cumulative or semester grade point average falls below 3.0. Students on probation are required to attain an average of at least 3.0 for all graduate course work completed by the end of the next semester of full-time enrollment or its equivalent (9 credit hours). Failure to do so is cause for dismissal.

Course Waivers

Requests for waiver of specific courses or requirements on the basis of previous course work are to be submitted in writing to the dean.

Credit Earned in Non-Degree Status

Not more than 9 hours of graduate credit completed as a non-degree student may be credited toward a School of Informatics graduate degree. Deficiency courses do not apply to the 9 credit hours.

Degree Conferral

For all students seeking a master's degree, an application for the degree must be filed with the School of Informatics at least 60 days before the date anticipated for degree conferral. All degree requirements must be completed at least 30 days prior to the date of expected degree conferral, including submission of the bound copies of the master's thesis (if required for degree).

Grading System

The official grading system is as follows:

Grade	Quality of Achieveme	Points Per Credit Hour		Grade	Quality of Achieveme	Points Per Credit Hour
A+	Highest passing grade	4.0		D-	Lowest passing grade	0.7
A		4.0		P	Passing	-
A-		3.7		S	Satisfactory	-
B+		3.3		F	Failure	0.0
B		3.0		W	Withdrawn	-
B-		2.7		I	Incomplete	-
C+		2.3		R	Deferred Grade	-
C		2.0		NC	No Credit	-
C-		1.7		NR	No grade received	-
D+		1.3		NY	Signifies enrollment in a special program for which credit earned will be recorded when completed.	

A minimum of a B (3.0) average in graduate work is required for continuance in graduate study. Courses completed with grades below C (2.0) are not counted toward degree requirements, but such grades will be counted in calculating a student's grade point average. Note that no work may be transferred from another institution unless the grade is B (3.0) or higher.

Incomplete Grades

A grade of Incomplete may be given only if the completed portion of a student's work is of passing quality. It is the responsibility of the student to satisfy the requirements of that course within one calendar year from the date on which the Incomplete is recorded. The student is expected to finish all necessary work in time for the instructor to assign a regular grade before the expiration of this time period. If the student is unable to do so, it is the student's responsibility to notify the instructor of the course and the graduate advisor within the year to request an extension of time. Every overdue Incomplete will be changed to a grade of F after one calendar year.

A student who has received a grade of Incomplete (I) should not register for the course a second time, but should arrange with the instructor to have the Incomplete (I) changed to a letter grade upon completion of all requirements.

Withdrawals

Because deadlines for withdrawal from courses may vary by campus and/or school, students should check with the current campus *Schedule of Classes* to verify deadlines and procedures.

Graduate

For forms, please visit the School of Informatics and Computing website.
Please note, this is for the Master's degree(s) only. The Ph.D. degrees are offered through the University Graduate School.

- Academic Integrity
- Academic Standing
- Course Waivers
- Credit Earned in Non-Degree Status
- Degree Conferral
- Grading System
- Intercampus Transfer
- Student Grievance
- Time Requirements
- Transfer of Credit

Intercampus Transfer

Students enrolled in the School of Informatics at any campus of Indiana University may transfer to the School of Informatics on another campus, provided they are in good standing.

Student Grievance

All academic personnel (faculty, part-time instructors, and advisors) are expected to conform to the Code of Student Rights, Responsibilities and Conduct. Students who feel that they have been treated unfairly by a faculty member may lodge a complaint by following these steps:

1. Discuss the matter with the faculty member or instructor.
2. If step 1 fails to resolve the situation, discuss the matter with the chairperson of the department or the coordinator of the program in which the faculty member is employed. The departmental chairperson will discuss it with the faculty member and seek some resolution.
3. If step 2 fails, the student may discuss the matter or file a written, signed complaint with the dean. Anonymous complaints will not be entertained. A copy of any written complaint will be forwarded to the faculty member, who may respond in writing.
4. When warranted, the dean may refer a written complaint and the faculty member's response to the Faculty Affairs Committee for further investigation and review.
5. The Faculty Affairs Committee will evaluate the complaint on the basis of university policy and may recommend to the dean that the instructor be sanctioned. If the committee finds the complaint to be unfounded, a letter to that effect may be placed in the student's file.

Time Requirements

All requirements for the M.S. degrees must be met within five consecutive calendar years from the date of completion of the first credited (i.e., nondeficiency) course.

Revalidation of Courses

Normally, a course may not be counted toward degree requirements if it has been completed more than five years prior to the awarding of the degree for master's students. The advisor may recommend to the dean that course work taken prior to the deadline be revalidated if it can be demonstrated that the knowledge contained in the course(s) remains current. Currency of knowledge may be demonstrated by (a) passing an examination specifically on the material covered by the course; (b) passing a more advanced course in the same subject area; (c) passing a comprehensive examination in which the student demonstrates substantial knowledge of the content of the course; or (d) publishing scholarly research demonstrating knowledge of the content of the course.

Courses taken while an undergraduate and counted toward the requirements of a baccalaureate degree may not also be counted toward a graduate degree.

Transfer of Credit

A maximum of 8 credit hours (9 credit hours at IUPUI) of graduate course work with grades of B (3.0) or higher may be transferred from other accredited colleges and universities and applied to the School of Informatics degree programs. The transfer must be approved by the dean and is not an automatic occurrence. (See Revalidation of Courses for more information.)

Undergraduate

Absences

From Final Examinations: Students are required to adhere to the policies regarding final examinations, as published in the Enrollment and Student Academic

Information Bulletin or the Registration Guide and Academic Information.

From Scheduled Classes: Illness is usually the only acceptable excuse for absence from class. Other absences must be explained to the satisfaction of the instructor, who will decide whether omitted work may be made up.

Dean's List
The School of Informatics and Computing recognizes exceptional academic performance in baccalaureate degree programs. The Dean's List contains the names of students who have achieved a semester grade point average of 3.7 or higher during any semester in which the student completes 12 or more graded credit hours.

Degree Application
Candidates for graduation must file an application through the student database (https://cid.indiana.edu/SiS/student.cfm) by September 15 for December graduation and by February 15 for May or August graduation to be included in the graduation ceremony program. **To receive your diploma, you must apply to graduate**.

Dismissal
Students will be dismissed if their semester grade point average is below 2.0, their cumulative grade point average is below 2.0 and they have had a previous probation or academic warning. Students will be notified in writing that they have been dismissed and will be withdrawn from classes for which they have registered.

Degrees Awarded with Distinction
The School of Informatics and Computing awards bachelor's degrees with three levels of distinction with the following cumlative grade point average: Distinction (3.7); High Distinction (3.8); and Highest Distinction (3.9). Students must have taken 60 graded credit hours at Indiana University.

The level of distinction is printed on both the final transcript and the diploma.

Academic Regulations

- Absences
- Academic Probation
- Academic Standing
- Dean's List
- Degree Application
- Degrees Awarded with Distinction
- Dismissal
- Readmission
- Semester Load
- Statute of Limitations

Academic Probation
Students will be placed on academic probation if their semester grade point average is below 2.0. Students will be instructed to complete an academic self-assessment, schedule an appointment at the Student Academic Center and to meet with their School of Informatics and Computing advisor. Students that have had one previous semester of probation and this probation results in the cumulative grade point average to be below 2.0, will be dismissed.

Readmission
Dismissed students must petition the dean of the School of Informatics and Computing for readmission. A Petition for Readmission must be filed by July 15 for fall, November 15 for spring, and April 15 for summer readmission. A student who has been dismissed is eligible to return to school after being out of school for one regular semester (summer sessions do not count) and having petitioned successfully. A third dismissal is final. Dismissed students whose petitions are denied will not be allowed to register.

Semester Load
A typical full-time academic load is 12 to 18 credit hours per semester, with the average load being approximately 15 credit hours. Students who expect to carry more than 19 credit hours a semester should have a cumulative grade point average of at least 3.0 (B) and have approval from an academic advisor or dean.

Academic Standing
A student is in good academic standing for an Indiana University bachelor's degree when his or her semester grade point average is a minimum of 2.0 (C) for the last semester's course work and when his or her cumulative grade point average is at least 2.0 (C).

Class Standing
Class standing is based on the number of credit hours completed:

- Freshman, fewer than 30 credits
- Sophomore, 30 to 59 credits
- Junior, 60 to 89 credits
- Senior, 90 or more credits

Statute of Limitations
Candidates for the bachelor's degree in the School of Informatics and Computing have the right to complete the degree requirements specified by the bulletin in effect at the time they entered Indiana University, provided that the required courses are available and that no more than eight calendar years have elapsed since the date of entry.

Change of Grade
A student desiring a change of grade should discuss the situation with the instructor. A change of grade must be justified. If the instructor agrees, the faculty member will file a Grade Change Authorization Form. If the instructor and student do not agree on a changed grade, or if the instructor cannot be located, the student should discuss the matter with the chairperson or director of the department offering the course. Appeals unresolved at this level may be referred to the academic deans. Appeals of grades or requests for other actions will not be considered after one calendar year from the end of the semester in which the course in question was taken.

Extended-X Option
The School of Informatics and Computing does not recognize Extended-X grades for internal purposes and degree requirements. Grades of FX calculate as grades of F (D-X grades as grades of D-, DX grades as grades of D, etc.). This calculation will apply to all categories of academic standing (good standing, probation, and dismissal); class rank; and all grade point

average requirements in the degree, including cumulative, semester, and major concentrations.

For transcript purposes, a student may exercise this option for no more than 3 courses, totaling no more than 10 credit hours. A student may use the Extended-X option on the transcript only once for a given course.

Only courses attempted during or after the fall 2001 term will be eligible for replacement under the Extended-X policy. The following grades cannot be replaced under the Extended-X policy: S, P, W, I, R, NC.

Grade Point Average

The cumulative grade point average is computed by dividing the total number of grade points earned by the total number of credit hours completed in which grades of A through F are assigned. Credit earned at another institution may be applied toward degree requirements, but the grades earned at other institutions will not be calculated in the Indiana University cumulative grade point average.

Incomplete Courses

A temporary grade of Incomplete (I) on the transcript indicates that the course work is mostly completed, generally 75 to 80 percent, and of passing quality.

It is the student's responsibility to contact the instructor to have a grade of Incomplete assigned. The instructor specifies the work to be done to remove the grade of Incomplete and the period of time allowed for completion. If the student fails to remove the Incomplete within one calendar year, the Office of the Registrar will change the grade to an F. The dean (or instructor) authorizes adjustments of this period in exceptional circumstances. A student who has received a grade of Incomplete should not register for the course a second time but should arrange with the instructor to have the grade changed to a letter grade upon completion of requirements, provided that it is done within the year.

Grading Policies

The School of Informatics and Computing follows the official grading system of Indiana University, which is as follows:

A+	= 4.00	C+	= 2.30
A	= 4.00	C	= 2.00
A-	= 3.70	C-	= 1.70
B+	= 3.30	D+	= 1.30
B	= 3.00	D	= 1.00
B-	= 2.70	D-	= 0.70
		F	= 0.00

The following grades carry no grade points: I (Incomplete), NC (No Credit), NR (No Report Filed by Instructor), P (Passing), R (Deferred), S (Satisfactory), W (Withdrawal).

- Change of Grade
- Extended-X Option
- Grade Point Average
- Incomplete Courses
- Pass/Fail Option
- R Grade
- Withdrawals

Pass/Fail Option

Students in the School of Informatics and Computing may elect to take a maximum of 12 credit hours total under the Pass/Fail option. The procedure for declaring this option can be found in the Enrollment and Student Academic Information Bulletin. Special regulations affecting the Pass/Fail option for School of Informatics and Computing students are as follows:

- Only one course per semester or one course per summer session can be taken under the Pass/Fail option.
- School of Informatics and Computing students may take only university elective courses or general elective courses on a Pass/Fail basis. The Pass/Fail option may not be used for any course that satisfies the requirements for a minor or certificate.
- A grade of P is not counted in the grade point average; a grade of F is included. Grades of P cannot be changed to any other letter grade.
- Pass/Fail forms are availble from your advisor.

R Grade

The R grade (Deferred) on the final report indicates that the nature of the course is such that the work of the student can be evaluated only after two or more terms. Courses in which an R grade is assigned will be announced as deferred grade courses in the online enrollment system.

Withdrawals

A grade of W (Withdrawal) is given automatically to the student who withdraws from courses during the automatic withdrawal period as specified in the Enrollment and Student Academic Information Bulletin. After the automatic withdrawal period, a student may withdraw only with the permission of the dean. This approval is given only for urgent reasons related to extended illness or equivalent distress. The desire to avoid a low grade is not an acceptable reason for withdrawal from a course.

A grade of W does not affect the overall grade point average. A grade of F will be recorded on the official transcript if a student stops attending but does not officially withdraw from class. Students who alter their schedules, whether at their own initiative or by departmental directive, must follow withdrawal procedures. Students who do not assume this responsibility are jeopardizing their records because they will incur a failing grade in a course not properly dropped and will not receive credit for work done in a course not properly added.

Students who wish to cancel their Bloomington campus registrations for a future semester must notify the Office of the Registrar in writing prior to the first day of classes.

Students who are forced to discontinue all studies during the semester (even if enrolled in only one course) and withdraw from the university must contact the Student Advocates Office in Eigenmann Hall West 229 to complete the withdrawal process.

At IUB, if a student withdraws after the first week of classes, the courses in which the student was enrolled will be retained on the student's record with a grade of W or F (as appropriate) and a notation of the date of withdrawal. To qualify for a grade of W after the deadline, a student must be passing the course(s) on the date of withdrawal.

If the student is failing, the grade on the date of withdrawal will be F.

Academic Misconduct

Cheating

Cheating is dishonesty of any kind with respect to course assignments, alteration of records, or examinations. It is the student's responsibility not only to abstain from cheating, but also to avoid the appearance of cheating and to guard against making it possible for others to cheat. Any student who helps another student cheat is as guilty of cheating as the student assisted. The student also should do everything possible to induce respect for the examining process and for honesty in the performance of assigned tasks in or out of class.

Plagiarism

Plagiarism is assuming credit for someone else's work, words, or ideas—whether or not the ideas are expressed in the borrower's own words. Honesty requires that any ideas or materials taken from another source for either written or oral use must be fully acknowledged. Plagiarism includes language or ideas taken from isolated formulas, sentences, or paragraphs; entire articles copied from books, periodicals, or speeches; the writings or created works of other students; and materials assembled or collected by others in projects or collections without acknowledgment.

A faculty member who has evidence that a student is guilty of cheating or plagiarism will initiate the process of determining the student's guilt or innocence. No penalty will be imposed until the student has been informed of the charge and of the evidence on which it is based, and has been given an opportunity to present a defense. If the faculty member finds the student guilty, the faculty member assesses a penalty within the course and promptly reports the case in writing to the dean of the school or comparable head of the academic unit. The report should include the names of any other students who may be involved in the incident and recommendations for further action. The dean, in consultation with the faculty member if the latter so desires, will initiate any further disciplinary proceedings and inform the faculty member of any action taken. In every case, a record of the offenses remains on file.
For further regulations, please refer to the *IU Code of Student Rights, Responsibilities, and Conduct*.

Student Grievance Procedures

All academic personnel (faculty, part-time instructors, and advisors) are expected to conform to the Code of Student Rights, Responsibilities and Conduct. Students who feel that they have been treated unfairly by a faculty member may lodge a complaint by following these steps:

1. Discuss the matter with the faculty member or instructor.
2. If step 1 fails to resolve the situation, discuss the matter with the chairperson of the department or the coordinator of the program in which the faculty member is employed. The departmental chairperson will discuss it with the faculty member and seek some resolution.
3. If step 2 fails, the student may discuss the matter or file a written, signed complaint with the dean. Anonymous complaints will not be entertained. A copy of any written complaint will be forwarded to the faculty member, who may respond in writing.
4. When warranted, the dean may refer a written complaint and the faculty member's response to the Faculty Affairs Committee for further investigation and review.
5. The Faculty Affairs Committee will evaluate the complaint on the basis of university policy and may recommend to the dean that the instructor be sanctioned. If the committee finds the complaint to be unfounded, a letter to that effect may be placed in the student's file.

Academic Policies and Procedures

Academic policies and procedures have been developed and approved by faculty to govern and facilitate student academic progress. These policies and procedures exist for undergraduate and graduate students.

Core Faculty

- Acharya, Raj, Ph.D. *(University of Minnesota/Mayo Medical School, 1984), Dean; Rudy Professor of Engineering, Computer Science and Informatics*
- Ahn, Yong-Yeol, Ph.D. *(KAIST, 2008)*, *Assistant Professor of Informatics and Computing*
- Bardzell, Jeffrey, Ph.D. *(Indiana University, 2004), Professor of Informatics*
- Bardzell, Shaowen, Ph.D. *(Indiana University, 2004), Associate Professor of Informatics*
- Beer, Randall, Ph.D. *(Case Western Reserve University, 1989), Professor of Cognitive Science, Computer Science and Informatics*
- Blanco Rodrigues, Saul, Ph.D. *(Cornell University, 2011), Visiting Assistant Professor of Computer Science*
- Blevis, Eli, Ph.D. *(Queen's University at Kingston, 1990), Professor of Informatics and Cognitive Science*
- Bolin, Maria, Ph.D. *(Karolinska Instituet, Stockholm, 1995), Associate Professor of Intelligent Systems Engineering*
- Bollen, Johan, Ph.D. (University of Brussels, 2001), *Associate Professor of Informatics*
- Bondesson Bolin, Maria, Ph.D. *(Karolinska Institute [Sweden], 1995), Associate Professor of Intelligent Systems Engineering*
- Börner, Katy, Ph.D. *(University of Kaiserslautern [Germany], 1997), Victor H. Yngve Distinguished Professor of Information Science; Adjunct Professor Intelligent Systems Engineering and Statistics; Director, Cyberinfrastructure for Network Science (CNS) Center*
- Bramley, Randall, Ph.D. *(University of Illinois at Urbana-Champaign, 1989), Professor of Computer Science*
- Brendel, Volker, Ph.D. *(Weizmann Institute of Science, Israel, 1986), Professor of Biology and Computer Science*
- Brown, Geoffrey, Ph.D. *(University of Texas at Austin, 1987), Professor of Computer Science*
- Camp, L. Jean, Ph.D. *(Carnegie Mellon University, 1996), Professor of Informatics and Computer*

Science; Adjunct Professor of Telecommunications; Associate Director, Center for Applied Cybersecurity Research

- Clawson, James, Ph.D. *(Georgia Institute of Technology, 2012), Assistant Professor of Informatics*
- Connelly, Kay, Ph.D. *(University of Illinois, 2003), Professor of Computer Science; Associate Director of the Center for Applied Cybersecurity Research; Director of Proactive Health*
- Crandall, David, Ph.D. *(Cornell University, 2008), Associate Professor of Informatics*
- Dalkilic, Mehmet, Ph.D. *(Indiana University, 2000), Associate Professor of Informatics and Computer Science; Coordinator Life Sciences; Associate Center For Genomics and Bioinformatics*
- Day, Ronald E., Ph.D. *(State University of New York– Binghamton, 1990), Chair of Information and Library Science; Professor of Information and Library Science*
- DeDeo, Simon, Ph.D. *(Princeton University, 2006), Assistant Professor of Informatics*
- Ding, Ying, Ph.D. *(Nanyang Technological University [Singapore], 2001), Professor of Informatics*
- Donaldson, Devan, Ph.D. *(University of Michigan, 2015), Assistant Professor of Information Science*
- Ekbia, Hamid, Ph.D. *(Indiana University, 2003), Professor of Information Science*
- Ensmenger, Nathan, Ph.D. *(University of Pennsylvania, 2001), Associate Chair of Informatics, Associate Professor of Informatics*
- Ergun, Funda, Ph.D. *(Cornell University, 1998), Professor of Computer Science*
- Fichman, Pnina, Ph.D. *(University of North Carolina at Chapel Hill, 2003), Professor of Library and Information Science; Director of Rob Kling Center for Social Informatics (RKCSI)*
- Fish, Allison, Ph.D. *(University of California-Irvine, 2010), Assistant Professor of Informatics*
- Flammini, Alessandro, Ph.D. *(International School for Advanced Studies, 1996), Professor of Informatics; Adjunct Professor of Physics; Affiliated Researcher in the Biocomplexity Institute; Director of CNeTS*
- Fortunato, Santo, Ph.D. *(University of Bielefeld Germany, 2000), Professor of Informatics*
- Fox, Geoffrey C., Ph.D. *(Cambridge University [United Kingdom], 1967), Distinguished Scientist, Community Grids Laboratory; Distinguished Professor of Computer Science, Physics and Informatics; Chair of Intelligent Systems Engineering*
- Friedman, Daniel P., Ph.D. *(The University of Texas at Austin, 1973), Professor of Computer Science*
- Frischer, Bernard, Ph.D. *(University of Heidelberg, Germany, 1975), Professor of Informatics*
- Garyfallidis, Eleftherios, Ph. D. *(University of Cambridge, 2012), Assistant Professor of* Intelligent Systems Engineering
- Glazier, James, Ph.D. *(University of Chicago, 1989), Director of Biocomplexity Institute Biophysics; Professor of Intelligent Systems Engineering*
- Groth, Dennis, Ph.D. *(Indiana University, 2002), Associate Professor of Informatics, Computer Science and Cognitive Science; Vice Provost for Undergraduate Education*
- Gumennik, Alexander, Ph.D. *(Hebrew University of Jerusalem, 2010), Assistant Professor of Intelligent Systems Engineering*
- Guo, Feng, Ph.D. *(Pennsylvania State University, 2015), Assistant Professor of Intelligent Systems Engineering*
- Haghverdi, Esfandiar, Ph.D. *(University of Ottawa, 2000), Executive Associate Dean for Academic Affairs*; *Professor of Computer Science; Adjunct Professor of Mathematics*
- Hahn, Matthew, Ph.D. *(Duke University, 2003), Professor of Informatics and Biology*
- Hara, Noriko, Ph.D. *(Indiana University, 2000), Director, ILS Graduate Program; Associate Professor of Information Science*
- Henry, Ryan, Ph.D. *(University of Waterloo, 2014), Assistant Professor of Computer Science*
- Herring, Susan C., Ph.D. *(University of California, Berkeley, 1991), Professor of Information Science; Adjunct Professor of Linguistics*
- Hill, Raquel, Ph.D. *(Harvard University, 2002) Associate Professor of Computer Science and Informatics*
- Hofstadter, Douglas, Ph.D. *(University of Oregon, 1975), Distinguished Professor; College Professor of Cognitive Science and Computer Science; Adjunct Professor of Comparative Literature; Director, Center for Research on Concepts and Cognition*
- Huang, Yan, Ph.D. *(University of Virginia, 2012), Assistant Professor of Computer Science*
- Izquierdo, Edwardo, Ph.D. *(University of Sussex, UK, 2008), Assistant Professor of Cognitive Science and Informatics*
- Jadhao, Vikram, Ph.D. *(University of Illinois at Urbana-Champaign, 2010),* Assistant Professor of *Intelligent Systems Engineering*
- Jiang, Lei, Ph.D. *(University of Pittsburgh, 2014), Assistant Professor of Intelligent Systems Engineering*
- Kapadia, Apu, Ph.D. *(University of Illinois at Urbana-Champaign, 2005), Associate Professor of Computer Science and Informatics*
- Kim, Minje, Ph.D. *(University of Illinois at Urbana-Champaign, 2016), Assistant Professor of Intelligent Systems Engineering*
- Leake, David, Ph.D. *(Yale University, 1990), Executive Associate Dean, School of Informatics and Computing; Professor of Computer Science*
- Leivant, Daniel, Ph.D. *(University of Amsterdam [Netherlands], 1975), Professor of Computer Science; Adjunct Professor of Philosophy and Mathematics*
- Lewis, Greg, Ph.D. *(University of Illinois at Chicago, 2011), Assistant Professor of Intelligent Systems Engineering*
- Liu, Lantao, Ph.D. *(Texas A&M, 2013), Assistant Professor of Intelligent Systems Engineering*
- Liu, Xiaohong, Ph.D. *(Syracuse University, 2010), Associate Professor of Library and Information Science*

- Lukefahr, Andrew, Ph.D. *(University of Michigan-Ann Arbor, 2016), Assistant Professor of Computer Science*
- Macklin, Paul, Ph.D. *(University of California-Irvine, 2007), Associate Professor of Intelligent Systems Engineering*
- McRobbie, Michael A., Ph.D. *(Australian National University, 1979), President of Indiana University; Professor of Computer Technology, Purdue School of Engineering and Technology, Computer Science, Informatics and Philosophy; Adjunct Professor of Information Science and Cognitive Science*
- Medina, Eden Miller, Ph.D. *(Massachusetts Institute of Technology, 2005), Associate Professor of Informatics; Adjunct Associate Professor of History; Director of Rob Kling Center for Social Informatics*
- Menczer, Filippo, Ph.D. *(University of California at San Diego, 1998), Professor of Informatics, Computer Science and Cognitive Science; Adjunct Professor of Physics*
- Milojevi#, Staša, Ph.D. *(University of California, Los Angeles, 2009), Associate Professor of Informatics*
- Montoya, Rob, Ph.D. *(University of California, Los Angeles, 2017), Assistant Professor of Information and Library Science*
- Myers, Steven, Ph.D. *(University of Toronto [Canada], 2004), Associate Professor of Informatics and Computer Science; Research Affiliate, Center for Applied Cybersecurity Research*
- Natarajan, Sriraam, Ph.D. *(Oregon State University, 2007), Associate Professor of Informatics*
- Newton, Ryan, Ph.D. *(Massachusetts Institute of Technology, 2009), Associate Professor of Computer Science*
- Nippert-Eng, Christena, Ph.D. *(State University of New York at Stony Brook, 1994), Professor of Informatics*
- Paolillo, John, Ph.D. *(Stanford University, 1992), Associate Professor of Informatics and Information Science; Adjunct Associate Professor of Linguistics*
- Patil, Sameer, Ph.D. *(University of California-Irvine, 2009), Assistant Professor of Informatics*
- Plale, Beth, Ph.D. *(State University of New York at Binghamton, 1998),* Professor of Informatics and *Computer Science;*
- Purdom, Paul W., Ph.D. *(California Institute of Technology, 1966), Professor of Computer Science*
- Qian, Feng, Ph.D. *(University of Michigan, 2012), Assistant Professor of Computer Science*
- Qiu, Judy, Ph.D. *(Syracuse University, 2005), Associate Professor of Intelligent Systems Engineering*
- Radicchi, Filippo, Ph.D. *(Jacobs University [Germany], 2007), Associate Professor of Informatics*
- Radivojac, Predrag, Ph.D. *(Temple University 2003), Professor of Computer Sicence and Informatics*
- Raphael, Christopher, Ph.D. *(Brown University, 1991), Professor of Informatics and Cognitive Science; Adjunct Professor of Music Theory*
- Rawlins, Gregory J.E., Ph.D. *(University of Waterloo [Canada], 1987), Associate Professor of Computer Science and Informatics*
- Riddell, Allen, Ph.D. *(Duke University, 2013), Assistant Professor of Information and Library Science*
- Rocha, Luis Mateus, Ph.D. *(State University of New York at Binghamton, 1997), Professor of Informatics, Computer Science and Cognitive Science*
- Rosenbaum, Howard S., Ph.D. *(Syracuse University, 1996), Director, Master of Information Science; Professor of Information Science*
- Roth, Eatai, Ph.D. *(Johns Hopkins University, 2012), Assistant Professor of Intelligent Systems Engineering*
- Ryoo, Michael, Ph.D. *(University of Texas at Austin, 2008), Assistant Professor of Informatics*
- Sabanovic, Selma, Ph.D. *(Rensselaer Polytechnic Institute, 2007), Associate Professor of Informatics*
- Sabry, Amr, Ph.D. *(Rice University, 1994), Chair of Computer Science, Professor of Computer Science*
- Sahinalp, S. Cenk, Ph.D. *(University of Maryland at College Park, 1997), Professor of Computer Science*; *Co-Director of CGB Bioinformatics*
- Shan, Chung-Chein (Ken), Ph.D. *(Harvard University, 2005), Assistant Professor of Computer Science*
- Shih, Patrick C., Ph.D. *(University of California-Irvine, 2011), Assistant Professor of Informatics*
- Siegel, Martin A., Ph.D. *(University of Illinois, 1973), Professor of Informatics, Cognitive Science and Instructional Systems Technology*
- Siek, Jeremy, Ph.D. *(Indiana University, 2005), Associate Professor*
- Siek, Katie, Ph.D. *(Indiana University, 2006), Associate Professor of Informatics*
- Sterling, Thomas, Ph.D. (*Massachusetts Institute of Technology,* 1984), *Professor of Intelligent Systems Engineering; Diector of the Center for Research in Extreme Scale Technologies*
- Stolterman, Erik, Ph.D. *(Umea University [Sweden], 1991), Senior Executive Associate Dean; Professor of Informatics*
- Su, Norman, Ph.D. *(University of California-Irvine, 2009), Assistant Professor of Informatics*
- Sugimoto, Cassidy, Ph.D. *(University of North Carolina at Chapel Hill, 2010), Associate Professor of Informatics*
- Swany, Martin, Ph.D. *(University of California, Santa Barbara, 2003), Professor of Intelligent Systems Engineering; Deputy Director of the Center for Research in Extreme Scale Technologies*
- Tang, Haixu, Ph.D. *(Shanghai Institute of Biochemistry [China], 1998), Professor of Informatics and Computer Science; Affiliated Researcher in the Center for Genomics and Bioinformatics*
- Tobin-Hochstadt, Sam, Ph.D. *(Northeastern University, 2010), Assistant Professor*
- Todd, Peter M., Ph.D. *(Stanford University, 1992), Professor of Informatics, Cognitive Science and Psychological and Brain Sciences*
- Van Gucht, Dirk, Ph.D. *(Vanderbilt University, 1985), Professor of Computer Science*
- Walsh, John A., Ph.D. *(Indiana University, 2000), Associate Professor of Information and Library Science; Adjunct Associate Professor of English*

- Wang, XiaoFeng, Ph.D. *(Carnegie Mellon University, 2004), Professor of Informatics and Computer Science; Affiliated Researcher in the Center for Applied Cybersecurity Research*
- Wild, David, Ph.D. *(Sheffield University [United Kingdom], 1994), Director of Data Science; Associate Professor of Informatics*
- Williamson, Donald, Ph.D. *(Ohio State University, 2016), Acting Assistant Professor of Computer Science*
- Yaroslavtsev, Grigory, Ph. D *(Pennsylvania State Univeristy, 2014), Assistant Professor of Computer Science*
- Ye, Yuzhen, Ph.D. *(Shanghai Institute of Biochemistry, China, 2001), Associate Professor of Informatics and Computer Science*
- Zhang, Qin, Ph.D. *(Hong Kong University of Science and Technology, China, 2010) Assistant Professor of Computer Science*
- Zhou, Yuan, Ph.D. *(Carnegie Mellon University, 2014), Assistant Professor of Computer Science*

Emerti Faculty

- Abrera, Josefa B., Ph.D. *(Indiana University, 1970), Associate Professor Emerita of Information and Library Science*
- Armstrong, Marian L., A.M. *(Indiana University, 1958), Assistant Professor Emerita of Information and Library Science*
- Callison, Daniel, Ed.D. *(Indiana University, 1982), Professor Emeritus of Information and Library Science*
- Cronin, Blaise, Ph.D. *(The Queen's University of Belfast, 1983), D.S.Sc. (The Queen's University of Belfast, 1998), D.Litt. (h.c.), Queen Margaret University College, Edinburgh, 1997, Emeritus Rudy Professor of Information and Library Science*
- Dunn, J. Michael, Ph.D. *(University of Pittsburgh, 1966), Former Dean, School of Informatics; Emeritus Oscar R. Ewing Professor of Philosophy; Emeritus Professor of Informatics and Computer Science; Founding Member, Cognitive Science Program*
- Dybvig, R. Kent, Ph.D *(Universtiy of North Carolina at Chapel Hill, 1987), Professor Emeritus of Computer Science*
- Fitzgibbons, Shirley A., Ph.D. *(Rutgers University, 1976), Associate Professor Emerita of Information and Library Science*
- Gannon, Dennis, Ph.D. *(University of California, Davis, 1974; University of Illinois, 1980), Professor Emeritus of Computer Science*
- Gasser, Michael E., Ph.D. *(University of California at Los Angeles, 1988), Associate Professor Emeritus of Computer Science and Cognitive Science; Adjunct Associate Professor Emeritus of Linguistics*
- Hagstrom, Stanley A., Ph.D. *(Iowa State University, 1957), Professor Emeritus of Physics and Computer Science*
- Hanson, Andrew J., Ph.D. *(Massachusetts Institute of Technology, 1971), Professor Emeritus of Computer Science*
- Harter, Stephen P., Ph.D. *(University of Chicago, 1974), Professor Emeritus of Information and Library Science*
- Haynes, Christopher T., Ph.D. *(University of Iowa, 1982), Associate Professor Emeritus of Computer Science and Informatics*
- Jacob, Elin K., Ph.D. *(University of North Carolina at Chapel Hill, 1994), Associate Professor of Library and Information Science*
- Johnson, Steven D., Ph.D. *(Indiana University, 1983), Professor Emeritus of Computer Science*
- Kaser, David, Ph.D. *(University of Michigan, 1956), Distinguished Professor Emeritus of Information and Library Science*
- Mills, Jonathan W., Ph.D. *(Arizona State University, 1988), Associate Professor Emeritus of Computer Science*
- Nisonger, Thomas E., Ph.D. *(Columbia University, 1976), Professor Emeritus of Information and Library Science*
- Ogan, Christine, Ph.D. *(University of North Carolina, 1976), Professor Emeritus of Informatics and Journalism*
- Preer, Jean, Ph.D. *(George Washington University, 1980), Professor Emeritia*
- Prosser, Franklin, Ph.D. *(Pennsylvania State University, 1961), Professor Emeritus of Computer Science*
- Robbin, Alice R., Ph.D. *(University of Wisconsin—Madison, 1984), Associate Professor of Library and Information Science*
- Robertson, Edward L., Ph.D. *(University of Wisconsin - Madison, 1970), Professor Emeritus of Computer Science and Informatics*
- Schnabel, Robert, Ph.D. *(Cornell University, 1977), Former Dean, School of Informatics and Computing; Professor of Computer Science and Informatics*
- Shaw, Debora, Ph.D. *(Indiana University, 1983), Professor Emeritus of Library and Information Science*
- Springer, George, Ph.D. *(Harvard, 1949), Professor Emeritus of Computer Science and Mathematics*
- White, Herbert S., M.S.L.S. *(Syracuse University,1950), Distinguished Professor Emeritus of Information and Library Science*
- Wiggins, Gary D., Ph.D. *(Indiana University, 1985), Director of Chemical Informatics Program; Interim Director of Bioinformatics Program; Professor Emeritus of Informatics*
- Winkel, David E., Ph.D. *(Iowa State University, 1957), Professor Emeritus of Computer Science*
- Wise, David S., Ph.D. *(University of Wisconsin—Madison, 1971), Professor Emeritus of Computer Science*

Faculty

Lecturers

- Bhutta, Adeel, M.S. *(University of Central Florida, 2006), Lecturer of Computer Science*
- Choksy, Carol E.B., Ph.D. *(University of Chicago, 1987), Lecturer of Information and Library Science*
- Demarest, Bradford, Ph.D *(Indiana University, 2016), Lecturer of Informatics*

- Duncan, John, Ph.D. *(Indiana University, 2011), Senior Lecturer of Informatics*
- Francisco, Matthew, Ph.D. *(Rensselaer Polytechnic Institute, 2010), Lecturer of Informatics*
- German, Dan-Adrian, M.S. *(Indiana University, 1994), Senior Lecturer of Computer Science*
- Hmeljak, Mitja, Ph.D. *(Indiana University, 2010), Lecturer*
- Hottell, Mathew, M.S. *(Indiana University, 2003), Senior Lecturer of Informatics; Director of Serve IT*
- Lee, Erika, M.A. *(Indiana University, 2004), Lecturer of Informatics*
- Logan, Paul, M.S. *(Indiana University, 2015), Lecturer of Informatics*
- Onesti, Nina, M.S. *(Indiana University, 2008), Senior Lecturer of Informatics*
- Pierz, Dan, M.A. *(Indiana University, 2009), Lecturer of Informatics*
- Pope, Charles E., B.S. *(Ambassador University, 1993), CSCI A110 Course Coordinator; Assoicate Chair of Computer Science; Senior Lecturer of Computer Science*
- Richert, Daniel, M.S. *(Indiana University, 2012), Senior Lecturer of Informatics*
- Somogyi, Endre, Ph.D. *(Indiana University, 2014), Lecturer of Computer Science*
- Stark, Roderick, M.S. *(Indiana University, 1986), Lecturer of Informatics*
- Terrell, Jennifer, Ph.D. *(Indiana University, 2015), Lecturer of Informatics*
- Wennstrom, Erik, Ph.D. *(Indiana University, 2012), Lecturer of Computer Science*
- Whitmer, Jeffrey M., M.A. *(Indiana University, 1986), Senior Lecturer of Computer Science*

Special Faculty

- Anderson, Matthew, Ph.D. *(University of Texas-Austin, 2004), Assistant Research Scientist in Intelligent Systems Engineering*
- Asher, Andrew, Ph.D. *(University of Illinois at Urbana-Champaign, 2008), Information and Library Science*
- Bantin,Philip C., M.L.S. *(University of Wisconsin-Madison, 1976), Adjunct Instructor, Information and Library Science*
- Barnas, Martina, Ph.D. *(Ohio State University), Assistant Dean of Research*
- Beggs, John, Ph.D. *(Yale University, 1998), Adjunct Associate Professor of Informatics*
- Brodowicz, Maciej, Ph.D. *(University of Houston, 1998), Assistant Research Scientist in Intelligent Systems Engineering*
- Buckley, Keith A., M.L.S. *(Indiana University, 1980), Adjunct Assistant Instructor, Information and Library Science*
- Byrd, Donald, Ph.D. *(Indiana University, 1984), Adjunct Associate Professor of Informatics and Computing*
- Callas, Jon, B.S. *(University of Maryland at College Park, 1980), Chief Technical Officer and Co-founder, Silent Circle, Adjunct Professor of Informatics*
- Cate, Fred, JD. *(Stanford University, 1987), Adjunct Professor of Informatics and Computing*
- Chen, Miao, Ph.D. *(Syracuse University, 2013), Adjunct Instructor, Information and Library Science*
- Cherbas, Peter, Ph.D. *(Harvard University, 1973), Professor of Biology; Senior Fellow, Institute for Molecular and Cellular Biology; Adjunct Professor of Computer Science*
- Cheun, Wookjin, M.L.S. *(Indiana University), Adjunct Associate Professor, Information and Library Science*
- Courtney, Angela, M.L.I.S. *(University of Texas at Austin, 1995), Adjunct Assistant Professor, Information and Library Science*
- Cox, Steven, *Adjunct Instructor,* Information and Library Science
- D'Allessandro, Luke, Ph.D. *(University of Rochester, 2014),* Assistant Research Scientist in Intelligent Systems Engineering
- Davis, Charles H., Ph.D.*(Indiana University, 1969), Senior Fellow & Adjunct Professor, Information and Library Science*
- Dekydtspotter, Lori Lynn *(MLS, Indiana University, 1999), Adjunct Instructor, Information and Library Science*
- Doman, Thompson, Ph.D. *(University of Louisville, 1990), Adjunct Associate Professor of Informatics and Computing*
- Dowell, Erika, M.L.S., *(Indiana University, 2000), Adjunct Instructor, Information and Library Science*
- Duffy-Backs, Dana, M.L.S. *(Indiana University, 1994) Adjunct Instructor, Information and Library Science*
- Fariss, Linda K., J.D. *(Indiana University, 1988), Associate Director and Adjunct Instructor, Law Library, IU Bloomington, Lecture in Law (part time), School of Law and Adjunct Associate Professor, Information and Library Science*
- Gens, John S., Ph.D. *(Washington University in St. Louis),* Assistant Research Scientist in Intelligent Systems Engineering
- Gifford, Erik, B.S. *(Keuka College, 2015), CAD Systems Administrator at GW Lisk, Adjunct Associate Professor of Informatics*
- Gilbert, Kevin, Ph.D. *(Massachusetts Institute of Technology, 1974), Adjunct Lecturer of Informatics and Computing*
- Guha, Rajarshi, Ph.D. *(Penn State University, 2005), Adjunct Assistant Professor of Informatics and Computing*
- Gyssens, Marc, Ph.D. *(University of Antwerp [Belgium], 1985), Adjunct Professor of Informatics and Computing*
- Hagar, Amit, Ph.D. *(University of British Columbia [Vancouver, Canada], 2004), Professor of History and Philosophy of Science, Adjunct Profressor of Intelligent Systems Engineering*
- Hardesty, Juliet, M.I.S. *(Indiana University, 2006), Adjunct Instructor, Information and Library Science*
- Helling, William, Ph.D. *(University of Kansas, 1986), M.I.S., (Indiana University, 1998), Adjunct Instructor, Information and Library Science*
- Himebaugh, Bryce, B.S. *(University of Evansville, 1993), Clinical Assistant Professor of Computer Science*

- Huang, Chunfeng, Ph.D. *(Texas A&M University, 2001), Associate Professor of Statistics, Adjunct Associate Professor of Computer Science*
- Isaacson, Eric, Ph.D. *(Indiana University, 1992), Adjunct Associate Professor of Informatics and Computing*
- Jones, Christine, M.L.S. *(Indiana Unversity, 2003), Adjunct Instructor, Information and Library Science*
- Kissel, Ezra, Ph.D. *(University of Delaware, 2012),* Assistant Research Scientist in Intelligent Systems Engineering
- Kouper, Inna, Ph.D. *(Assistant Research Scientist in Informatics*
- Kuebler, Sandra, Ph.D. *(University of Tubinger, 2003), Adjunct Associate Professor of Informatics and Computing*
- LaMacchia, Brian, Ph.D. *(MIT, 1996), Director of Security & Crypto, Microsoft Research, Adjunct Associate Professor of Informatics*
- Laherty, Jennifer, M.L.S. *(Indiana University, 1996), Information and Library Science*
- Lajiness, Michael, *Adjunct Professor of Informatics and Computing*
- Ledbetter, Krista, M.L.S. *(Indiana University, 2005), Adjunct Instructor,* Information and Library Science
- Lynch, Michael, Ph.D. *(University of Minnesota, 1977), Adjunct Professor of Informatics and Computing*
- Malbasa, Velijko, Ph.D. *(University of Novi Sad [Yugoslavia], 1985), Visiting Professor in Computer Science*
- McDonald, Courtney, M.L.S. *(Indiana University, 2000), Information and Library Science*
- McDonald, Daniel, Ph.D. *(Carnegie Mellon University), Assistant Professor of Statistics, Adjunct Assistant Professor of Computer Science*
- Minter, Catherine, M.Sc. in I.L.S. *(Aberystwyth University, 2007), Adjunct Instructor,* Information and Library Science
- Mitchell, C. Thomas, Ph.D. *(University of Reading UK, 1987), Associate Professor of Apparel Merchandising and Interior Design, Adjunct Associate Professor of Informatics*
- Morrison, Andrew, M.L.S. *(Indiana University, 1991), Adjunct Professor,* Information and Library Science
- Moss, Lawrence, Ph.D. *(University of California at Los Angeles, 1984), Professor of Mathematics; Adjunct Associated Professor of Computer Science, Linguistics, and Philosophy; Adjunct Assistant Professor of Informatics and Computing; Director of Logic Program, College of Arts and Sciences*
- Ortiz, Gerardo, Ph.D. *(Ecole Polytech, 1992), Adjunct Professor of Informatics and Computing*
- Pantaloni, Nazareth, Ph.D. *(Villanova University, 2010), Adjunct Instructor, Information and Library Science*
- Park, Taemin, Ph.D. *(Indiana Univeristy, 1992), Coordinator for Bibliographic and Electronic Access Courses, Adjunct Professor of Information and Library Science*
- Ponella, Phillip, M.L.S. *(Souther Connecticut State University, 1994), Director, William and Gayle Cook Music Library, Indiana University, and Adjunct Instructor, Information and Library Science*
- Porges, Stephen, Ph.D. *(Michigan State University, 1970), Distinguished University Scientist at Kinsey Institute, Adjunct Professor in Intelligent Systems Engineering*
- Roberts, Michele, M.S. *(Indiana State, 1977), Director of Computing Outreach Education*
- Rogers, Yvonne, Ph.D. *(University of Wales, 1988), Adjunct Professor of Informatics and Computing*
- Schopf, Jennifer, Ph.D. *(University of California, San Diego, 1999), Director of International Networking, Indiana University, Adjunct Associate Professor of Informatics*
- Silver, Joel, M.L.S. *(Indiana University, 1986), Director of Rare Books and Manuscripts Librarianship Specialization, Director of Lilly Library, Indiana University, Adjunct Professor, Information and Library Science*
- Sluka, James P., Ph.D. *(California Institute of Technology), Research Scientist at the Biocomplexity Institute, Senior Scientist in Intelligent Systems Engineering*
- Sporns, Olaf, Ph.D. *(Rockefeller University, 1990), Adjunct Professor of Informatics*
- Stamm, Sidney, Ph.D. *(Indiana University), Associate Professor of Computer Science and Software Engineering, Rose-Hulman Institute of Technology, Principal Security and Privacy Engineer Mozilla, Adjunct Associate Professor of Computer Science*
- Stirling, B. Kyle, M.A. *(University of Florida, 1987), Adjunct Lecturer of Informatics; Associate Director for Data Science Strategic and Industry Initiatives*
- Trosset, Michael, Ph.D. *(University of California-Berkeley, 1983), Adjunct Professor of Informatics and* Computing
- Van den Bussche, Jan, *Professor of Computer Science, Universiteit Hasselt, Belgium, Adjunct Professor of Computer Science*
- Vespignani, Alex, Ph.D. *(University of Rome, 1994), Sternberg Family Distinguished University Professor, Northeastern University, Adjunct Professor Informatics*
- VonLaszewski, Gregor, Ph.D. *(Syracuse University, 1996), Assistant Director of the Digital Science Center, Adjunct in Intelligent Systems Engineering*
- Wallace, Steven, *Adjunct Lecturer of Informatics and Computing*
- Warren, Lamara, Ph.D. *(Indiana University, 2010), Assistant Dean for Diversity*
- Williams, Cherry, M.L.I.S. *(University of California, Los Angeles, 2005), Curator of Manuscripts, The Lilly Library, Indiana University, Adjunct Instructor,* Information and Library Science
- Winterman, Brian, M.L.S. *(Indiana University, 2003), Information Fluency and Assessment Librarian, Indiana University, and Adjunct Instructor,* Information and Library Science
- Yaeger, Larry, M.S. *(PolyTechnic Institute of New York, 1974), Google, Adjunct Professor of Informatics*
- Yu, Chen, Ph.D. *(Princeton University, 2002), Adjunct Associate Professor of Informatics and Computing*

- Zhang, Hui, Ph.D. *(University of California, Berkeley, 1993), Professor of Computer Science, Carnegie Mellon University, Adjunct Professor of Informatics*