

# Information Systems

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## Information Systems

Information systems are computer systems that support the operations, management, and decision-making in organizations. Information systems are now an integral part of the work environment of every organization and play a critical role in the running of organizations. They are the heart of our Internet-based economy. Information systems enable people to access the information they need, collaborate, make decisions, and perform their jobs and personal activities effectively.

The field of Information Systems (IS) aims to bridge the fields of computer science and business. It resides at the interaction of these two fields. IS professionals serve as the critical link between the technical areas and other areas of an organization.

NJIT's IS professors are experts in the field and are very student focused. NJIT's IS graduates place among the highest-paying and most plentiful jobs nationally. NJIT's very active Career Services Division promotes many co-op and internship opportunities with major local companies. This is fostered by our location within Northern New Jersey's high concentration of business and industry, and NJIT is just ½ hour from midtown Manhattan by train. We welcome both part-time and full-time students, and offer relatively low tuition rates for the region.

## Master of Science in Information Systems (MSIS)

The MSIS is a STEM\* degree that prepares people to become business and systems analysts, data scientists, systems and application designers, and designers of user interfaces and user experience. The curriculum core focuses on business mining and analytics, systems design that both extracts and utilizes this business data, and the techniques that assure the effectiveness of the user interface for such systems. Four electives provide broad flexibility to develop expertise in related analytics, design, business and computing areas of interest to the student.

## Admission Requirements

(The program is offered both on-campus and online.)

The field of IS is broadly interdisciplinary. Applicants with degrees in any field are therefore welcome to apply for the MSIS program. A series of "bridge courses" are used to develop the required skills of incoming students who may not have been exposed to some parts of the IS curriculum.

## Ph.D. in Information Systems (IS PhD)

The Information Systems (IS) PhD program is a STEM\* degree designed to produce scholars with a commanding knowledge of both theory and practice of IS for complex applications and environments. The program encourages an interdisciplinary approach to the exploration of information systems, and the evaluation of its effectiveness and consequences.

IS PhD dissertations must make a substantial scientific contribution to their particular area of research. PhD students can do research in two research tracks: Information Integration and Informatics (III), i.e., information science and data intensive research, and Human-Centered Computing (HCC).

## Entrance Requirements

- Applicants from varying academic backgrounds may apply. Applicants without sufficient computing or mathematics/statistics background, however, will be assigned additional foundation coursework.
- Typically applicants are required to have a Master's degree with a demonstrated record of academic achievement and show promise of being able to excel in the program, but we make exceptions for outstanding students with a Bachelor's degree.
- GPA should be 3.5 or better on a 4.0 scale.
- To ensure that each student finds a dissertation advisor and committee with proper expertise, after receiving an application, the PhD director will inform those who pass the first round of screening to contact and secure a faculty advocate with the proper expertise to assess and foster their research interests. Applicants should explore faculty web sites ([is.njit.edu](http://is.njit.edu) (<http://is.njit.edu>), **look for those listed among our core faculty—assistant professors, associate professors and professors**) and are encouraged to consult with the PhD director regarding research interests and contacting faculty.

## Application Materials

The IS PhD application requires several items in addition those required by NJIT. Therefore applicants must submit both (1) department-specific materials and (2) general NJIT-required materials. For complete details see: [is.njit.edu/academics](http://is.njit.edu/academics) (<http://is.njit.edu/academics/>).

## Financial Support and Application Deadlines

Application deadlines are as follows:

- For Fall semester:
  - For those seeking financial support: December 15
  - For those not seeking financial support: February 15
- For Spring semester:
  - For those seeking financial support: September 1
  - For those not seeking financial support: October 1

## Part-Time Students

The IS PhD program welcomes part-time students, under the following conditions. Part-time students should arrange their work schedules to participate in research group meetings, seminars and other research activities as often as possible. These activities often take place during the day. Part-time students are required to obtain a leave from work obligations for at least one year in order to focus on their research proposition and dissertation research on a full-time basis.

## Distance Students

The IS PhD is an on-campus program; we cannot accommodate distance learning students.

## Business and Information Systems (MS BIS)

The M.S. in Business and Information Systems is a STEM\* degree that teaches students concepts in both business and information systems. The focus of the degree is on the application of computing and information systems in business, government, and non-profit organizations. Besides learning about information systems topics such as databases, application development tools, web design, software use and evaluation, management information and decision support systems, students will learn business topics such as accounting, management, marketing, finance, and business operations.

Technology and science are dramatically changing our economy and our society. This is creating new business opportunities and needs, with an increasing push for computing employees to be more involved in designing and evaluating business information systems for both small companies as well as major corporations. Information systems employees must have a solid understanding of business fundamentals to succeed. Specifically designed to address this issue, the M.S. in Business and Information Systems is primarily for students who want to prepare for careers where they will do requirements analysis and application systems design and development, as well as use, analyze and evaluate computing applications and systems in a business environment. The U.S. Bureau of Labor Statistics points to very strong need for managers with technical skills well into the next decade.

## Admission Requirements

(The program is offered both on-campus and online.)

The field of IS is broadly interdisciplinary. Applicants with degrees in any field are therefore welcome to apply for the MSBIS program. A series of "bridge courses" are used to develop the required skills of incoming students who may not have been exposed to some parts of the IS curriculum.

*\*Science, Technology, Engineering, and Mathematics*

## NJIT Faculty

### B

Bieber, Michael P., Professor

### D

Deek, Fadi P., Distinguished Professor

### E

Egan, Richard W., Senior University Lecturer

### H

Hiltz, S. Roxanne, Distinguished Professor Emeritus

### J

Jones, Quentin, Associate Professor

### L

Lee, Michael, Assistant Professor

Lin, Lin, Senior University Lecturer

**S**

Scher, Julian M., Associate Professor Emeritus

**T**

Tremaine, Marilyn M., Professor Emeritus

Turoff, Murray, Distinguished Professor Emeritus

**W**

Williams, Keith A., University Lecturer

Wohn, Donghee Yvette, Assistant Professor

Wu, Yi-Fang, Brook, Associate Professor

**X**

Xu, Songhua, Assistant Professor

**Programs**

- Business and Information Systems - M.S. (<http://catalog.njit.edu/graduate/computing-sciences/information-systems/business-information-systems-ms/>)
- Information Systems - M.S. (<http://catalog.njit.edu/graduate/computing-sciences/informatics/ms/>)
- Information Systems - Ph.D. (<http://catalog.njit.edu/graduate/computing-sciences/information-systems/phd/>)

**Programs**

- Business and Information Systems Implementation (<http://catalog.njit.edu/graduate/computing-sciences/information-systems/business-information-systems-cert/>)
- Data Mining (<http://catalog.njit.edu/graduate/computing-sciences/information-systems/data-mining-cert/>)
- Data Visualization (<http://catalog.njit.edu/graduate/computing-sciences/information-systems/data-visualization-cert/>)
- IT Administration (<http://catalog.njit.edu/graduate/computing-sciences/information-technology/it-administration-cert/>)
- Information Security (<http://catalog.njit.edu/graduate/computing-sciences/information-systems/information-security-cert/>)
- Network Security and Information Assurance (<http://catalog.njit.edu/graduate/computing-sciences/information-systems/network-security-information-systems-cert/>)
- Software Engineering, Analysis, and Design (<http://catalog.njit.edu/graduate/computing-sciences/information-systems/software-engr-analysis-design-cert/>)
- Web Systems Development (<http://catalog.njit.edu/graduate/computing-sciences/information-systems/web-systems-development-cert/>)

**Information Systems Courses****IS 513. Programming Foundations for IS. 3 credits, 3 contact hours.**

This course is an introduction to the Java programming language teaching the foundations of writing, testing and debugging of programs. The course has three major parts. The first part teaches fundamental programming techniques that use primitive data types, variables, assignments expressions and operators, control statements, arrays and files I/O. The second part covers testing and debugging, and teaches students how to write programs that work reliably. The third part introduces object-oriented programming.

**IS 531. Database Fundamentals. 3 credits, 3 contact hours.**

This course gives students extensive, pragmatic experience in designing, building, querying, updating, maintaining and managing relational databases, using the Structured Query Language (SQL). We will start our journey by analyzing what database is and why it is superior to other data management methods. We will then conduct logical and physical database design. SQL will be extensively covered, and students will design and implement sophisticated SQL queries invoking self-joins, outer joins, correlated subqueries and related concepts. Hands-on experience will be gained by working with actual databases using industry-standard database management systems such as Oracle.

**IS 565. Aspects Of Information Systems. 3 credits, 3 contact hours.**

Methods and models of supporting the management process; ethical issues pertaining to the construction, deployment, and impact of information systems on organizations and society; description, analysis, and design of information systems to assist problem solving and decision-making in a business environment.

**IS 590. Graduate Co-op Work Experience I. 1 credit, 1 contact hour.**

Prerequisite: students must have the approval of the co-op advisor for the Informatics department. Provides on-the-job reinforcement and application of concepts presented in the graduate IS curriculum. Work assignments are identified by the co-op office and developed and approved by the Informatics department in conjunction with the student and employer. Students must submit, for Informatics department approval, a proposal detailing the nature of the intended work. A report at the conclusion of each semester's work experience is required. Credits for this course may not be applied toward degree requirements for either the bachelor's or master's in IS.

**IS 591. Graduate Co-op Work Experience II. 1 credit, 1 contact hour.**

Prerequisite: students must have the approval of the co-op advisor for the IS department. Provides on-the-job reinforcement and application of concepts presented in the graduate IS curriculum. Work assignments are identified by the co-op office and developed and approved by the Informatics department in conjunction with the student and employer. Students must submit, for Informatics department approval, a proposal detailing the nature of the intended work. A report at the conclusion of the semester work experience is required. Credits for this course may not be applied toward degree requirements for either the bachelor's or master's in IS.

**IS 592. Graduate Co-op Work Experience III. 1 credit, 1 contact hour.**

Prerequisites: graduate standing, and acceptance by the Informatics department and the Division of Career Development Services. Students must have the approval of the co-op advisor for the Informatics department. Provides on-the-job reinforcement and application of concepts presented in the graduate IS curriculum. Work assignments are identified by the co-op office and developed and approved by the Informatics department in conjunction with the student and employer. Students must submit, for IS department approval, a proposal detailing the nature of the intended work. A report at the conclusion of the semester work experience is required. Credits for this course may not be applied toward degree requirements for either the bachelor's or master's in IS.

**IS 593. Graduate Co-op Work Experience IV. 0 credits, 0 contact hours.**

Prerequisite: One immediately prior 3-credit registration for graduate co-op work experience with the same employer. Requires approval of departmental co-op advisor and the Division of Career Development Services. Must have accompanying registration in a minimum of 3 credits of course work.

**IS 601. Web Systems Development. 3 credits, 3 contact hours.**

Prerequisites: NONE Students will gain experience in open source web development through an intensive hands-on project, applying real-world problem-solving skills to meeting information systems requirements. Students will learn Web development principles, as well as professionally relevant skills including industry standards, conventions, and procedures within large-scale programming projects. Also covered are the communication tools, technologies, and practices that individuals use to coordinate and collaborate within the open source software development community.

**IS 612. Emergency Management Informatics. 3 credits, 3 contact hours.**

This course covers core aspects of Emergency Management (EM) as they relate to information systems and usage of associated technologies. EM theory identifies four critical areas: 1) understanding & mitigating risk, 2) planning & preparedness, 3) reaction & response, 4) recovery & normalization. The role of informatics for each critical area will vary and is the basis for discussions and assignments. This course also focuses on innovative information systems approaches to EM in each area. Within the EM domain, business continuity (information processing and sharing during crisis situations), cyberterrorism, and international response are covered.

**IS 613. Design of Emergency Management Information Systems. 3 credits, 0 contact hours.**

This course is concerned with the development of requirements, the design of the human interaction, and the supporting functionality of any Information System related to the complete preparedness lifecycle for emergency, disaster, and crisis situations for government bodies, non-profit, and/or private organizations that are concerned with business continuity. It also focuses on organizational behavior and its effects on the functionality of the system and the design of the human interface.

**IS 614. Command and Control Systems. 3 credits, 3 contact hours.**

This course investigates the relevance and applicability of using of Command and Control (C2) models in organizational responses to both normal emergencies and catastrophic events. C2 refers to how leadership, authority, decision-making and coordination are assured within an organization, including distributed and virtual organizations. The course examines the functionality and properties of C2 systems in terms of matching requirements for these systems to the behavior of individuals, groups, and organizations during emergency conditions. It will address integrating systems and technologies within organizational emergency operations functions and processes to include business continuity and disaster response.

**IS 616. Learning Methodologies and Training Technologies. 3 credits, 3 contact hours.**

This course provides an overview of learning methodologies and training technologies, with an emphasis on emergency management. It reviews theories and develops skills for the planning, evaluation and selection of traditional and new technology-driven learning and training methods. Course participants will review relevant research and learn how to choose the most effective training methodologies, technologies and content resources appropriate to the needs of different audiences.

**IS 631. Enterprise Database Management. 3 credits, 3 contact hours.**

Prerequisites: IS 601 This course provides an understanding of the issues as well as hands-on experience in managing database systems as an essential organizational resource. Students will obtain a conceptual foundation of database design and explore the implications for organizational database usage. Students also will gain experience with enterprise database management systems, such as Oracle. This course introduces the design and management of enterprise-wide database systems. Topics include: (1) data modeling and database design; (2) database implementation with SQL; (3) database access standards for enterprise database systems; (4) multidimensional databases, online analytic processing (OLAP) and data warehousing, customer relationship management (CRM); and (5) web-based enterprise database systems.

**IS 634. Information Retrieval. 3 credits, 3 contact hours.**

Prerequisite: IS 601 Modern information retrieval systems, such as web search engines, empower users to easily access information on the web. The course covers the concepts and principles of information retrieval systems design, including web crawling, automatic indexing, vector space modeling, retrieval algorithms, digital libraries, text mining, information extraction, and document warehousing. These techniques are essential for building web systems, text databases, document processing systems, and other advanced information management systems.

**IS 650. Data Visualization and Interpretation. 3 credits, 3 contact hours.**

The course will focus on training students in data visualization techniques and relevant tools. They will learn theoretical aspects of visualization design, and gain practical experience in interpreting data as well as critiquing and comparing visualization techniques. They will develop interactive visualization interfaces as part of a class project. Students will also gain a broad understanding of how visualization can enhance data interpretation and play a key role in the data science pipeline. Finally, recent advances will be presented in the areas of information visualization, visual analytics, and human-data interaction.

**IS 654. Visual Informatics for Social Network and Mobile Flow. 3 credits, 3 contact hours.**

Prerequisite: IS 665 or equivalent. Nowadays, computational scientists are using network and flow to explore and analyze relationships among spatial objects. In the meantime, more and more virtual networks, such as Facebook and Twitter, have spatial characteristics which bring researchers opportunity to study spatial pattern of virtual network elements such as information diffusion and human behavior across space. This course will focus on substantive themes within network and flow. Visual informatics will be covered in this course followed by several case studies.

**IS 657. Spatiotemporal Urban Analytics. 3 credits, 3 contact hours.**

Prerequisite: IS 665 or equivalent. This course teaches essential concepts and skills needed to efficiently develop spatiotemporal thinking, create a spatiotemporal model, and visualize/model the urban spatiotemporal relationships in the open source environment. Students will learn about big data analytic skills that integrate large open source data and traditional data by investigating the relationship between virtual and physical worlds in the built environment.

**IS 661. User Experience Design. 3 credits, 3 contact hours.**

This is a foundation course on the design of digital products. User eXperience Design (UXD) isn't just about making interfaces usable. It is about designing and building relevant and successful products. Effective UXD requires a mix of Interaction Design (ID) methods and processes. This course takes you through the process of creating compelling interaction designs for digital products from the idea stage into creating a simple and intuitive user experience blueprint. You will 'learn by doing' in a team environment, enabling you to practice the techniques with coaching from instructors. The course will demystify Lean UX; Agile UX; Human Computer Interaction (HCI); Design Audits and Claims analysis; Persona construction; Storyboarding; ID scenarios; ID Frameworks; Role of user-research in UXD; and Design Patterns.

**IS 663. System Analysis and Design. 3 credits, 3 contact hours.**

Pre or Corequisite: IS 601 This course develops the skills necessary to analyze, design and manage the development of effective enterprise-scale information systems solutions incorporating contemporary methods and effective organizational and global project management practices. It focuses on technical business systems analysis and design techniques, and covers key software engineering principles, methods and frameworks, including process models, agile and lean principles, project and risk management, estimation, requirements elicitation and analysis, modeling, system and software architecture, design patterns, and quality systems. Students will actively participate in discussions, review selected articles, participate in team exercises and collaborate on projects involving analysis and prototyping of applications addressing real-world problems and integrating current and emerging technologies.

**IS 664. Customer Discovery. 3 credits, 3 contact hours.**

'Customer Discovery' is the term used by lean startup companies to describe the process of directly engaging with customers to explore potential new markets. Such evidence-based entrepreneurship guides the potential for new product ideas early in the development process. Similarly, high-tech innovators in new media, web, software apps, social networking, wearable computing, and mobile devices need to determine early on if their proposed solutions address real user needs. They do this by understanding potential user's practice, preferences and mental models. As a result, knowledge of a basic set of qualitative customer discovery methods is essential for both the lean startup entrepreneur and those engaged in interaction design innovation. This course teaches these methods through hands-on team projects. Students will design and run interview and diary studies, thinking out-loud protocols and focus groups, and analyze and report on findings. Students will explore over the course of the semester a problem domain and gain understanding of customer needs that will serve as a foundation for high-tech, innovative product design.

**IS 665. Data Analytics for Info System. 3 credits, 3 contact hours.**

Prerequisite: IS 601 This course gives a graduate level introduction to data analysis, probability and statistics from an information systems perspective, including many of the techniques that are most relevant to the profession of Data Scientist for business, data and web analytics, as well as current data sets. We will learn and conduct Python, MATLAB and R based manipulation of data. Course topics include the rudiments of probability and random variables, estimation, special distribution and sampling, Markov processes, hypothesis testing, graphics and visualization.

**IS 676. Requirement Engineering. 3 credits, 3 contact hours.**

Prerequisites or Corequisites: IS 663 or CS 673 or equivalent project experience in the field. Requirements engineering is one of the all-important beginning stages of the systems development life cycle. Revealing and understanding the system's requirements is a crucial component of success for developing new computing systems or adjusting existing applications. This course covers the theory, principles, and practical application of the methodologies and tools for requirements engineering. The focus is development of large software systems and the integration of multiple systems into a comprehensive, domain dependent solution. All aspects of requirements engineering including the knowledge and skills needed to elicit and analyze requirements, translate these requirements into technical specifications, verify that the requirements accurately capture the system requirements, and manage software requirements through the system development cycle will be covered. Students will actively participate in discussions, labs and exercises, and prepare operational requirements and technical specifications for real-world problems. We will spend a considerable amount of time interacting and learning through discussion of assigned readings and other material.

**IS 677. Information System Principles. 3 credits, 3 contact hours.**

This course introduces the field of Information Systems; the study of how people and organizations should use information technologies effectively. We examine the major areas in the field, analyzing the major issues, trends and problems. We survey the role of information systems in organizations and how these systems support organizational objectives and organizational structure, as well as providing competitive business advantages. We discuss basic concepts such as the systems point of view, the organization of a system, the nature of information and information flows, as well as how people process information and related cognitive concepts. We also examine various types of information system applications such as e-commerce, supply chain, decision support, and enterprise systems. And, finally, we also consider critical ethics issues including privacy, personalization and security.

**IS 678. IT Service Management. 3 credits, 3 contact hours.**

The course does not have prerequisites but it is not recommended during the first semester of graduate study without prior professional work experience in the computing field. This course introduces IT service management, a set of specialized organizational capabilities for enabling value for customers in the form of IT services. ITIL, a globally recognized framework of best practices for IT service management is covered in some detail, along with other approaches for IT service management. The course presents ITIL key concepts, the ITIL service value system, the service value chain, the four dimensions of service management, ITIL guiding principles and ITIL management practices. ITIL is presented in the context of a specific organizational services domain.

**IS 680. Information Systems Auditing. 3 credits, 3 contact hours.**

Due to the dynamic nature of information technology, the need arises continually to redefine audit, control and security requirements and processes. Topics include the IS audit process, IT infrastructure and operations, information protection, disaster recovery and business continuity, IT service delivery and support, business application systems, and project management. Students gain practical experience with each by working through a series of sample Certified Information Systems Audit (CISA) exam questions.

**IS 681. Computer Security Auditing. 3 credits, 3 contact hours.**

This course reflects the current emphasis on information security and security management in Fortune 500 corporations. Students will delve into information protection concepts, privacy impact analysis, computer crime, legal issues, controls and auditing systems, and firewall configuration. Students will have the opportunity to learn and perform evaluations on security infrastructures in a controlled environment in class labs by completing realistic security auditing projects and using vulnerability assessment tools to assess risks and evaluate security controls on networked infrastructures.

**IS 682. Forensic Auditing for Computing Security. 3 credits, 3 contact hours.**

A computer forensics audit is the proper identification and collection of computer evidence. Computers are involved in security violations through crime or violations of policy, or being targeted by an attack. This course deals with the preservation, identification, extraction, documentation, reporting, acquisition, analysis and interpretation of computer data. Topics covered include evidence handling, chain of custody, collection, preservation, identification and recovery of computer data. In this hands-on course, you will conduct several labs where you will be taught to analyze, review and extract information from computer hard drives, and determine what and how the information could have been compromised. Computer Forensics Audit professionals become experts in e-discovery and preserving sensitive evidential matter.

**IS 683. Web Systems Development. 3 credits, 3 contact hours.**

Students will gain experience in open source web development through an intensive hands-on project, applying real-world problem-solving skills to meeting information systems requirements. Students will learn Web development principles, as well as professionally relevant skills including industry standards, conventions, and procedures within large-scale programming projects. Also covered are the communication tools, technologies, and practices that individuals use to coordinate and collaborate within the open source software development community.

**IS 684. Business Process Innovation. 3 credits, 3 contact hours.**

Prerequisites: IS 663 or CS 673 This course adopts a balanced approach to business process innovation (BPI) that includes both incremental improvement and re-engineering. It specifically examines the concept of a service-oriented architecture (SOA) and the use of web services as a way to enable scalable and adaptive business processes. Students will learn how to develop process maps using the Business Process Modeling Notation (BPMN) and design process improvements to achieve efficiency, effectiveness, compliance and agility objectives. The focus of the course is on ways in which information technology can be used to manage, transform and improve business processes.

**IS 685. Enterprise Architecture and Integration. 3 credits, 3 contact hours.**

Prerequisites: None, but recommend completion of IS 663 or CS 673. The Enterprise Architecture (EA) describes an organization's IT strategy and operational structure. IS and IT professionals utilize the EA to analyze, design and integrate the (often heterogeneous) IT infrastructure and applications to most effectively support the enterprise and respond to risks. Students learn to develop an EA analysis which reflects its business strategies, capabilities, processes, and systems, metrics, information resources, and networking infrastructure. This enables students to determine the impact of IT solutions, by learning to deconstruct, analyze and configure IT systems in alignment with enterprise-wide business strategies. The course covers the industry standard The Open Group Architecture Framework (TOGAF) enterprise architecture framework and focuses on Enterprise Application Integration (EAI).

**IS 686. Pervasive Computing: An HCI Perspective. 3 credits, 3 contact hours.**

This course examines Pervasive/Ubiquitous Computing, the trend toward increasingly ubiquitous connected computing devices in the environment - a trend being brought about by a convergence of advanced electronic, and particularly, wireless technologies and the internet. We do this from a Human Computer Interaction perspective looking at the current and future design of various systems.

**IS 687. Transaction Mining and Fraud Detection. 3 credits, 3 contact hours.**

Prerequisite: IS 665 Increasingly, all of our transactions are electronic. We use debit and credit cards (electronic transactions) instead of checks and cash at banks, restaurants, stores, and many other businesses. Evaluation of transactions to find risk includes detection of terrorists and money launderers. Every financial institution is legally required to monitor transactions to detect organized crime and terrorism. Mining transaction streams to find good or bad customers is a rapidly growing area of employment for IS graduates. This course will present methods that are being used to analyze and mine transactional data and the business applications of these methods.

**IS 688. Web Mining. 3 credits, 3 contact hours.**

Prerequisite: IS 665. Web mining aims to discover useful information and knowledge from the Web hyperlink structure, page contents and usage logs. It has direct applications in e-commerce, Web analytics, information retrieval/filtering, personalization, and recommender systems. Employees knowledgeable about Web mining techniques and their applications are highly sought by major Web companies such as Google, Amazon, Yahoo, MSN and others who need to understand user behavior and utilize discovered patterns from terabytes of user profile data to design more intelligent applications. The primary focus of this course is on Web usage mining and its applications to business intelligence and biomedical domains. We learn techniques from machine learning, data mining, text mining, and databases to extract useful knowledge from the Web and other unstructured/semistructured, hypertextual, distributed information repositories. This data could be used for site management, automatic personalization, recommendation, and user profiling. Topics covered include crawling, indexing, ranking and filtering algorithms using text and link analysis, applications to search, classification, tracking, monitoring, and Web intelligence. Programming assignments give hands-on experience. A group project highlights class topics.

**IS 690. Web Services and Middleware. 3 credits, 3 contact hours.**

Prerequisite: IS 601 Web services enable integration of web-based applications and feature sets to any other web-based system in a modular way. Middleware is a set of functionality positioned in between and enabling interoperability among different, distributed enterprise and other computing applications. This course provides an introduction to web services and middleware in the context of digital libraries - large scale multimedia information repositories. Students will gain hands on experience in developing their own web services managing a complex distributed computing platform.

**IS 698. Special topics in Information Systems. 3 credits, 3 contact hours.**

Special area course given when suitable interest develops. Advance notice of forthcoming topics will be given.

**IS 700B. Master's Project. 3 credits, 3 contact hours.**

Approval of the project advisor is required for registration. Experimental and/or theoretical investigation of a relevant topic in information systems. A written report must be submitted to the project advisor. The student cannot register in IS 700B more than once and the incomplete (I) grade is not allowed. Master's students registering for the first time in Master's Project must take simultaneously the INTD 799 (Responsible Contact of Research) course.

**IS 700C. Master's Project. 6 credits, 6 contact hours.**

An approved project involving design, implementation, and analysis, or theoretical investigation, under the guidance of a faculty member. Students are strongly advised to work with the faculty member to develop a project proposal during the semester prior to conducting the master's project. Approval to register for the project must be obtained from the faculty member advising the project.

**IS 701B. Master's Thesis. 3 credits, 3 contact hours.**

Approval of the thesis advisor is required for registration. Experimental and/or theoretical investigation of a relevant topic in information systems that can lead to a quality publication. A written thesis must be defended and approved by a committee of at least three faculty members. The student is expected to defend the thesis upon accrual of six thesis credits. Additional registration in IS 701B, beyond six credits, is required every semester until successful thesis defense (six credits count toward degree requirements and time limits apply). Master's students registering for the first time in Master's Thesis must take simultaneously the INTD 799 (Responsible Contact of Research) course.

**IS 701C. Master's Thesis. 6 credits, 6 contact hours.**

Approval of the thesis advisor is required for registration. Experimental and/or theoretical investigation of a relevant topic in information systems that can lead to a quality publication. A written thesis must be defended and approved by a committee of at least three faculty members. The student must continue registering for three thesis credits (IS 701B) each semester until successful thesis defense (six credits count toward degree requirements and time limits apply).

**IS 725. Independent Study in Information Systems. 3 credits, 3 contact hours.**

Approvals of the academic advisor and course instructor are required for registration. Students working on their PhD dissertation or MS thesis cannot normally register for this course with their respective dissertation/thesis advisor. This special course covers areas of study in which one or more students may be interested but there is not sufficiently broad interest to warrant a regular course offering. Students may not register for this course more than once.

**IS 726. Independent Study II. 3 credits, 3 contact hours.**

Approvals of the academic advisor and course instructor are required for registration. Students working on their PhD dissertation or MS thesis cannot normally register for this course with their respective dissertation/thesis advisor. This special course covers areas of study in which one or more students may be interested but there is not sufficiently broad interest to warrant a regular course offering. Students may not register for this course more than once. Students should only register for IS 726 if they have taken IS 725 in a prior semester.

**IS 727. Independent Research III. 3 credits, 1 contact hour.****IS 735. Social Media. 3 credits, 3 contact hours.**

Prerequisite: IS 665 or MATH 661, or a graduate course in statistics or course in quantitative research methods. Seminar style course that covers design and impact of computer-based systems for human communication, including email and IM, discussion boards, Computer-Supported Cooperative Work (CSCW), Group Decision Support Systems (GDSS), and Social Networking Systems. Topics include alternative design structures, impacts of primarily text-based group communication, and recent empirical studies of virtual teams, online communities, and systems used for social networking, including 3-D worlds such as Second Life and "micro blogging" systems such as Twitter.

**IS 764. Research Methods for Human-Centered Computing and Design. 3 credits, 3 contact hours.**

Prerequisites: None. This introductory seminar in human centered computing and design provides a survey of the methodological literature on qualitative research methods paired with appropriate article-length exemplars. We cover a variety of different research strategies including design science, action research, case study, qualitative data collection and analysis techniques, and scenario-based design. This course develops skills in designing and evaluating systems using qualitative methods. We also discuss writing and reviewing academic articles and research proposals. The course utilizes information systems as the primary domain but could be extended for students in other disciplines.

**IS 765. Quantitative Methods in Information Systems Research. 3 credits, 3 contact hours.**

Prerequisite: MATH 661 or equivalent. This course is a practical and project-oriented introduction to quantitative and qualitative methods in information systems (IS) research that use human subjects. The focus of the course is on developing researchers' capability to select and implement appropriate data collection and statistical analysis procedures for a variety of research questions and to interpret the results of these procedures.

**IS 766. Philosophy of Information Science. 3 credits, 3 contact hours.**

This seminar explores central issues in contemporary philosophy of science. We consider "scientific" progress in the computing sciences with a focus on information systems and human computer interaction theory. We discuss topics such as confirmation and disconfirmation of theories; falsifiability and pseudo-science; introduction; probability; and statistical inference, prediction, explanation and empirical equivalence. We read key works by philosophers such as Popper and Kuhn. We examine the notion of "design science" and contrast it with "natural science", and examine whether social science research should strive to emulate natural science methods. Readings will be tied into research within information systems and the computing sciences in general, looking at how scientific theories are tested or confirmed.

**IS 776. IS Research Study. 3 credits, 3 contact hours.**

Prerequisite: Restricted to students in the doctoral program in Information Systems. The IS Research Study serves as the Information Systems PhD qualifying exam and demonstrates research readiness. Each student works with a faculty member to identify the topic of a research study, and then takes the lead in designing and conducting the study, and analyzing the results.

**IS 785. Special Topics. 3 credits, 3 contact hours.**

These seminars examine a special interest area of Information Systems in depth. Each seminar emphasizes recent work in the area selected.

**IS 786. Special Topics. 3 credits, 3 contact hours.**

These seminars examine a special interest area of Information Systems in depth. Each seminar emphasizes recent work in the area selected.

**IS 790. Doct Dissertation & Res. 0 credits, 0 contact hours.**

For PhD students who have completed the qualifying exam. Research and writing are carried out under the supervision of a designed graduate faculty member. The completed dissertation should be a substantial contribution to the knowledge of the topic under research, and of sufficient merit to warrant publication in a leading scientific or technical journal.

**IS 790A. Doct Dissertation & Res. 1 credit, 1 contact hour.**

Co-requisite: IS 791. Approval of the dissertation advisor is required for registration. Experimental and/or theoretical investigation of a relevant topic in information systems. For PhD students who have successfully defended their dissertation proposal. The student must register in IS 790A every semester until successful dissertation defense. A written dissertation must be defended and approved by a committee of at least five members. Students enrolled in the PhD program before 2015 Fall must accumulate a minimum number of credits in Doctoral Dissertation Research and Pre-Doctoral Research (see graduate catalog for program-specific details; the same requirement may apply to joint PhD programs with other universities).



**IS 790B. Doct Dissertation & Res. 3 credits, 3 contact hours.**

Co-requisite: IS 791. Since the IS 790A course should normally be taken instead, approvals of academic and dissertation advisors are required for registration. Experimental and/or theoretical investigation of a relevant topic in information systems. For PhD students who have successfully defended their dissertation proposal. Students enrolled in the PhD program before 2015 Fall must accumulate a minimum number of credits in Doctoral Dissertation Research and Pre-Doctoral Research (see graduate catalog for program-specific details; the same requirement may apply to joint programs with other universities).

**IS 790C. Doct Dissertation & Res. 6 credits, 6 contact hours.**

Co-requisite: IS 791. Since the IS 790A course should normally be taken instead, approvals of academic and dissertation advisors are required for registration. For PhD students who have successfully defended their dissertation proposal. Experimental and/or theoretical investigation of a relevant topic in information systems. Students enrolled in the PhD program before 2015 Fall must accumulate a minimum number of credits in Doctoral Dissertation Research and Pre-Doctoral Research (see graduate catalog for program-specific details; the same requirement may apply to some joint programs with other universities).

**IS 790D. Doct Dissertation & Res. 9 credits, 3 contact hours.**

For PhD students who have completed the qualifying exam. Research and writing are carried out under the supervision of a designed graduate faculty member. The completed dissertation should be a substantial contribution to the knowledge of the topic under research, and of sufficient merit to warrant publication in a leading scientific or technical journal.

**IS 790E. Doct Dissertation & Res. 12 credits, 3 contact hours.**

For PhD students who have completed the qualifying exam. Research and writing are carried out under the supervision of a designed graduate faculty member. The completed dissertation should be a substantial contribution to the knowledge of the topic under research, and of sufficient merit to warrant publication in a leading scientific or technical journal.

**IS 790F. Doct Dissertation & Res. 15 credits, 3 contact hours.**

For PhD students who have completed the qualifying exam. Research and writing are carried out under the supervision of a designed graduate faculty member. The completed dissertation should be a substantial contribution to the knowledge of the topic under research, and of sufficient merit to warrant publication in a leading scientific or technical journal.

**IS 791. Doctoral Seminar. 0 credits, 0 contact hours.**

A seminar in which faculty, students, and invited speakers will present summaries of advanced topics in information systems. In the course students and faculty will discuss research procedures, dissertation organization, and content. Students engaged in research will present their own problems and research progress for discussion and criticism.

**IS 792. Pre-Doctoral Research. 3 credits, 3 contact hours.**

Co-requisite: IS 791. Approval of the dissertation advisor is required for registration. Preliminary experimental and/or theoretical investigation of a relevant topic in information systems. For students who have passed the qualifying examination but have not defended the dissertation proposal. Permission is needed of the academic advisor as well for students who have completed the required coursework but have not passed the qualifying examination.