

The Major in Information Systems

Faculty Program Director: Randy S. Weinberg

Office: Porter Hall 222

<http://www.cmu.edu/information-systems/>

Information Systems (IS), found within the Dietrich College of Humanities and Social Sciences, is an internationally recognized undergraduate major for students who want to design and implement effective solutions to meet organizational, societal and management needs for information and decision support.

In today's complex, interconnected world, the effective creation, distribution, and use of information via technology is central to daily life. Computer based information systems facilitate, enable and often define the relationships between corporations and consumers, buyers and suppliers, businesses of all sizes, social networks, and citizens and their governments. Understanding these relationships and effectively addressing the collection, flow, and distribution of information is vital to running a modern organization, enterprise or government agency.

Information Systems involves the effective design, delivery, use and impact of information and communications technologies in organizations and society. The importance of information technology and information systems to organizations and the need for well-educated professionals in the field is the basis for the Information Systems curriculum at Carnegie Mellon. Whether implementing applications, providing management or decision support, managing complex systems projects, or helping organizations design business processes or cope with rapid change, IS professionals fill an essential need across all sectors of society.

Information systems students at Carnegie Mellon learn to use, manage and deploy information technologies to address real problems or opportunities. They develop a solid foundation in computing, communications, as well as software development principles, languages, and methods. Since Information Systems generally operate within organizations, IS students study social sciences and organizational theory. IS students learn how to right-size information technology solutions to meet real-world economic and organizational constraints. Information Systems students also learn, through hands-on experience, the importance of professional communications, problem analysis, critical thinking and teamwork. Building on the multi-disciplinary strengths of the university and the Dietrich College of Humanities and Social Sciences, graduates in Information Systems are ideally suited to take a leading role in shaping our information-based future.

The flexible nature of the program encourages students to explore their own interests through program electives, study in a contemporary content area or through optional second majors and minors.

IS students are well prepared to pursue graduate work in a wide range of fields. For students interested in master's degree-level graduate work at Carnegie Mellon, there are many possibilities, including accelerated Masters degree programs in Information Systems Management, Human Computer Interaction, Information Security Policy and Management, Engineering Technology and Innovation Management, and Business Administration.

IS graduates continue to be in high demand in the information-age workplace. There has been a strong job market for IS students in recent years, and national trends indicate that this is likely to continue. IS majors often take jobs in consulting companies, major software firms, large corporations, and start-up companies. Internship opportunities closely parallel the job market.

In addition to the Dietrich College General Education Requirements and basic prerequisites in Mathematics, Statistics and Computer Science, IS students must complete the Professional Core, the Disciplinary Core and a focused Content Area. In the Professional Core (consisting of six courses), students learn the basic skills necessary to analyze, design, implement and test high-quality, cost effective information systems. Two of the Professional Core courses are project-based experiences in which small teams of students develop and deliver solutions to real information problems.

In the Disciplinary Core (consisting of three courses), students study key areas fundamental to understanding and solving problems in information systems: professional communications; quantitative analysis and research methods; and organizations, policy, and social science.

IS students also complete three courses within one Content Area. The content areas are designed to provide students an opportunity to gain additional depth in a focused area. Currently, twelve content areas are available: (1) Business / Enterprise Systems, (2) Computing and Information Systems & Technology, (3) Social and Global Systems, (4) Quantitative Analysis, (5) Game Design, (6) Animation and Special Effects, (7) Media Design, (8) Learning Media, (9) Sound Design, (10) Innovation and Entrepreneurship, (11) Intelligent Environments, (12) Physical Computing. Content areas (5) through (12) are offered through CMU's Integrative

Design, Arts, and Technology (IDeATe) (<http://www.cmu.edu/ideate>) initiative combining arts and technology.

Study Abroad Options in Information Systems

Given the importance of globalization, we encourage students to consider expanding their international experience by spending a semester studying abroad. The IS program is very flexible in allowing students to pursue these opportunities. With careful planning, study abroad is possible during most semesters. Students interested in study abroad should talk with the IS Academic Advisor to help plan an appropriate course of study. With prior approval, study abroad courses may be applied to major requirements.

Information Systems as Additional Major or Minor

Information Systems is not available as either an additional major or minor.

Curriculum

The Information Systems major is offered only as a Bachelor of Science (B.S.) degree. In addition to major requirements outlined below, all Information Systems students must fulfill the General Education requirements for the Dietrich College of Humanities and Social Sciences. A total of 360 units is required for the degree.

Requirements are subject to revision. Advisor approval is required for each student's major curriculum plan. Any proposed course substitutions to courses required for the IS major must be approved in advance by the IS Academic Advisor.

Prerequisites

Information Systems requires completion of prerequisite courses in Mathematics, Statistics and Computer Science. All prerequisites must be successfully completed prior to the start of Fall semester, junior year.

Mathematics and Statistics

Complete one of the following calculus sequences:

		Units
21-111	Differential Calculus	10
21-112	Integral Calculus	10

OR

		Units
21-120	Differential and Integral Calculus	10
21-256	Multivariate Analysis (Required for advanced business courses)	9

OR

		Units
21-120	Differential and Integral Calculus	10
21-122	Integration and Approximation (Required for advanced computer science courses)	10

AND also complete:

		Units
36-201	Statistical Reasoning and Practice	9

Computer Science

Three Computer Science courses are required. To maintain normal progress toward the Information Systems degree, students must complete 15-121 Introduction to Data Structures prior to the start of Spring Semester, sophomore year.

Students entering the program as freshmen will have the option to complete a Computer Science Placement Test. Depending on appropriate Advanced Placement credit and/or results of the Computer Science Placement Test, entering students may place directly into 15-112 or 15-121. 15-110 is taken as the first Computer Science prerequisite unless a student places

directly into 15-112 or 15-121. Most students entering the program will begin the sequence with 15-110.

		Units
15-110	Principles of Computing	10
15-112	Fundamentals of Programming and Computer Science	12
15-121	Introduction to Data Structures	10

Note: Students cannot receive credit for both 15-104 Introduction to Computing for Creative Practice and 15-110 Principles of Computing.

Professional Core

The Professional Core consists of six courses (five core courses and one core elective).

Complete all five of these courses:

		Units
67-250	The Information Systems Milieux (Spring Semester Only)	9
67-262	Database Design and Development (Offered Annually)	9
67-272	Application Design and Development (Offered Annually)	9
67-373	Software Development Project (Spring Semester Only)	12
67-475	Innovation in Information Systems (Fall Semester Only)	12

Note: Students transferring into Information Systems as sophomores or juniors substitute 67-344 Organizational Intelligence in the Information Age (or other pre-approved courses) 67-250 The Information Systems Milieux.

Professional Core Elective

Plus, complete 6 to 12 units chosen from the following options:

		Units
19-402	Telecommunications Technology, Policy & Management	12
19-403	Policies of Wireless Systems	12
67-240	Mobile Web Design & Development	9
67-279	Introduction to Geographical Information Systems	6
67-306	Special Topics: Management of Computer and Information Systems	6
67-308	Innovation Studio: Health Care Information Systems	9
67-319-67-331	Global Technology Consulting Groundwork - Technology Consulting in the Global Community (these two courses are taken sequentially)	6
67-324	Accelerating Innovation and Entrepreneurship	9
67-327	Web Application Security	6
67-328	Mobile to Cloud: Building Distributed Applications	9
67-329	Contemporary Themes in Global Systems	9
67-344	Organizational Intelligence in the Information Age	9
67-353	IT & Environmental Sustainability	6
67-364	Practical Data Science	9
67-442	Mobile Application Development in iOS	9
88-223	Decision Analysis	9
88-275	Bubbles: Big Data for Human Minds	9

OR Any Computer Science course above 15-121 with prerequisite of 15-112 or higher.

OR Any Human-Computer Interaction course (05-xxx).

OR other *pre-approved* 67-3xx or 67-4xx which may be offered from time to time. Students wishing to apply such courses to their Professional Core requirement must complete a course substitution application through the IS Academic Advisor.

OR other *pre-approved* courses offered by the Engineering & Public Policy Department (19-xxx).

NOTE: 67-1xx and 67-2xx courses may not be applied to this requirement.

Disciplinary Core

Complete one course (9 units) from each of the three Disciplinary Core categories.

Professional Communications

Information systems professionals communicate with a wide range of people in most organizations and often facilitate communications between diverse groups of stakeholders. Consequently, the most successful professionals typically are those with strong communication skills. These courses help students see that the structure and presentation of information affects how well (and how easily) it can be understood and used.

Complete one course (9 units). It is recommended that this requirement be completed by the end of junior year:

		Units
05-341	Organizational Communication	9
36-315	Statistical Graphics and Visualization	9
51-261	Communication Design Fundamentals: Design for Interactions for Communications	9
or 51-262	Communication Design Fundamentals: Design for Interactions for Communications	
70-321	Negotiation and Conflict Resolution	9
70-340	Business Communications	9
70-341	Organizational Communication	9
70-342	Managing Across Cultures	9
76-270	Writing for the Professions	9
76-272	Language in Design	9
88/70/85-341	Organizational Communication	9

Quantitative Analysis and Research Methods

This area focuses on decision making and data analysis — essential to development of useful information systems. This area exposes students to analytic methods in the social sciences and quantitative methods for approaching complex methods.

Complete one course (9 units). It is recommended that this requirement be completed in the sophomore year:

		Units
21-257	Models and Methods for Optimization	9
21-325	Probability	9
36-202	Methods for Statistics and Data Science	9
36/70-208	Regression Analysis	9
36-217	Probability Theory and Random Processes	9
36-225	Introduction to Probability Theory	9
36-303	Sampling, Survey and Society	9
36-309	Experimental Design for Behavioral and Social Sciences	9
67-364	Practical Data Science	9
80-305	Choices, Decisions, and Games	9
80-405	Game Theory	9
88-223	Decision Analysis	9
88-251	Empirical Research Methods	9
88-275	Bubbles: Big Data for Human Minds	9

Organizations, Policy, and Social Science

The focus of this area is on how organizations function in modern social and economic environments. Students will develop a greater understanding of how social policy and technology influence organizations and how they operate.

Complete one course (9 units):

		Units
08-200/19-211	Ethics and Policy Issues in Computing	9
15-390/70-421	Entrepreneurship for Computer Science	9
19-402	Telecommunications Technology, Policy & Management	12
19-403	Policies of Wireless Systems	12
19-411	Global Competitiveness: Firms, Nations and Technological Change	9
67-308	Innovation Studio: Health Care Information Systems	9
67-321	Social Informatics	6

67-344	Organizational Intelligence in the Information Age	9
67-353	IT & Environmental Sustainability	6
70-311	Organizational Behavior	9
70-318	Managing Effective Work Teams	9
70-332	Business, Society and Ethics	9
70/85/88-341	Organizational Communication	9
70-342	Managing Across Cultures	9
70-414	Entrepreneurship for Engineers	9
70-415	Introduction to Entrepreneurship	9
70-416	New Venture Creation	9
70-420	Entrepreneurship for Scientists	9
70-437	Organizational Learning and Strategic Management	9
80-341	Computers, Society and Ethics	9
88-223	Decision Analysis	9
88-260	Organizations	9
88-275	Bubbles: Big Data for Human Minds	9

Content Area

Complete a minimum of 27 units from one of the Content Areas below. No Content Area course may also be used to fulfill a Disciplinary Core or Professional Core requirement.

Business/Enterprise Systems

This content area broadens a student's knowledge in the business, economics and policy aspects of large scale information systems.

		Units
19-402	Telecommunications Technology, Policy & Management	12
19-403	Policies of Wireless Systems	12
19-411	Global Competitiveness: Firms, Nations and Technological Change	9
67-240	Mobile Web Design & Development	9
67-306	Special Topics: Management of Computer and Information Systems	6
67-308	Innovation Studio: Health Care Information Systems	9
67-319-67-331	Global Technology Consulting Groundwork - Technology Consulting in the Global Community (these two courses are taken sequentially)	6
67-324	Accelerating Innovation and Entrepreneurship	9
67-328	Mobile to Cloud: Building Distributed Applications	9
67-330	Technology Consulting in the Community	9
67-344	Organizational Intelligence in the Information Age	9
67-353	IT & Environmental Sustainability	6
67-442	Mobile Application Development in iOS	9
70-318	Managing Effective Work Teams	9
70-332	Business, Society and Ethics	9
70-366	Intellectual Property and E-Commerce	6
70-371	Operations Management	9
70-414	Entrepreneurship for Engineers	9
or 70-415	Introduction to Entrepreneurship	
or 70-420	Entrepreneurship for Scientists	
or 70-421	Entrepreneurship for Computer Scientists	
70-437	Organizational Learning and Strategic Management	9
70-438	Commercialization and Innovation	9
70-443	Digital Marketing and Social Media Strategy	9
70-449	Social, Economic and Information Networks	9
70-455	Modern Data Management	9
70-460	Mathematical Models for Consulting	9
70/73-465	Technology Strategy	9
70-471	Supply Chain Management	9
73-359	Benefit-Cost Analysis	9
73-469	Global Electronic Markets: Economics and the Internet	9

76-391	Document & Information Design	12
76-487	Web Design	12

Computing and Information Systems & Technology

This content area allows students to focus on current and emerging technologies.

		Units
05-391	Designing Human Centered Software	12
05-410	User-Centered Research and Evaluation	12
05-430	Programming Usable Interfaces	15
05-431	Software Structures for User Interfaces	15
05-432	Personalized Online Learning	12
05-433	Programming Usable Interfaces OR Software Structures for Usable Interfaces	6
05-499	Special Topics in HCI	Var.
16-311	Introduction to Robotics	12
16-362	Mobile Robot Programming Laboratory	12
19-411	Global Competitiveness: Firms, Nations and Technological Change	9
60-415	Advanced ETB: Animation	10
67-240	Mobile Web Design & Development	9
67-327	Web Application Security	6
67-328	Mobile to Cloud: Building Distributed Applications	9
67-364	Practical Data Science	9
67-442	Mobile Application Development in iOS	9

Any 15-xxx course above 15-121 with prerequisite of 15-112 or higher

Social and Global Systems

This content area exposes students to key themes in globalization and global systems . management, policy, international business, and technology.

		Units
19-402	Telecommunications Technology, Policy & Management	12
19-403	Policies of Wireless Systems	12
19-411	Global Competitiveness: Firms, Nations and Technological Change	9
67-319-67-331	Global Technology Consulting Groundwork - Technology Consulting in the Global Community (these two courses are taken sequentially)	6
67-321	Social Informatics	6
67-329	Contemporary Themes in Global Systems	9
67-330	Technology Consulting in the Community	9
67-353	IT & Environmental Sustainability	6
70-342	Managing Across Cultures	9
70-365	International Trade and International Law	9
70-430	International Management	9
70-480	International Marketing	9
73-372	International Money and Finance	9
76-318	Communicating in the Global Marketplace	9
76-386	Language & Culture	9
79-318	Sustainable Social Change: History and Practice	9
79-381	Energy and Empire: How Fossil Fuels Changed the World	9
88-371	Entrepreneurship, Regulation and Technological Change	9
88-384	Conflict and Conflict Resolution in International Relations	9
88-411	Rise of the Asian Economies	9

Additionally, other *pre-approved* courses offered by the Engineering & Public Policy Department (19-xxx) may be used to fulfill the Social and Global Systems Content Area.

Quantitative Analysis

Students will learn to apply analytic and quantitative methods for approaching complex, ambiguous problems.

		Units
21-257	Models and Methods for Optimization	9
21-292	Operations Research I	9
36/70-208	Regression Analysis	9
36-217	Probability Theory and Random Processes	9
or 36-225	Introduction to Probability Theory	
36-303	Sampling, Survey and Society	9
36-309	Experimental Design for Behavioral and Social Sciences	9
36-350	Statistical Computing	9
36-401	Modern Regression	9
36-410	Introduction to Probability Modeling	9
or 36-46x	Topics in Statistics	
67-364	Practical Data Science	9
70-460	Mathematical Models for Consulting	9
70-462	Stochastic Modeling and Simulations	9
73-274	Econometrics I	9
73-374	Econometrics II	9
88-223	Decision Analysis	9
88-251	Empirical Research Methods	9

Integrative Design, Arts, and Technology (IDeATe) Content Areas:

An IDeATe content area consists of a minimum of 27 units which may include one Portal Course (other than 15-104 Introduction to Computing for Creative Practice) plus 2 courses from one of the areas below.

Game Design (IDeATe)

In this content area, students will learn both theory and skill in the key areas of games: dramatic narrative and character development, visual and sound synthesis, special effects and performance capture, programming and engine development, interface and interaction architecture development, game assessment and redesign. Please visit the Game Design website (<http://www.cmu.edu/ideate/concentrations-and-minors/game-design.html>) for information about available courses.

Animation and Special Effects (IDeATe)

The interconnected components of performance capture, rendering, 3D and 2D animation, and special effects will be covered in this content area. Course information can be found at the Animation and Special Effects website (<http://www.cmu.edu/ideate/concentrations-and-minors/animation-and-special-effects.html>).

Media Design (IDeATe)

The digital mediation of experiences content area explores the interconnected development of technology and content in new media systems and the meaning that arises from the resulting forms. Students learn to design mediated experiences across different platforms, from mobile to large-scale installations. Course information can be found on the Media Design website (<http://www.cmu.edu/ideate/concentrations-and-minors/media-design.html>).

Learning Media (IDeATe)

Students in this content area will combine their diverse skills for the design of effective new media systems for learning; from games for learning to tangible learning tool kits and remote learning systems. They will leverage new technologies, media arts knowledge, and learning science principles to create engaging experiences with measurable real world impact. For course information, please visit the Learning Media website (<http://www.cmu.edu/ideate/concentrations-and-minors/learning-media.html>).

Sound Design (IDeATe)

This content area will explore the processes and products of digital sound and music. Students will receive basic training in key areas: principles of computer music, hybrid instrument building, concepts in sound design. 62-150 IDeATe: Introduction to Media Synthesis and Analysis (10 units) is the required portal course for this content area and will serve as one of the courses for this content area. Course information can be found at the Sound Design website. (<http://www.cmu.edu/ideate/concentrations-and-minors/sound-design.html>)

innovation and Entrepreneurship (IDeATe)

Students in this content area will develop the knowledge and skills to lead and innovate in creative industries. Their interdisciplinary, hands-on coursework will emphasize the conceptualization of innovative products and

the structuring of innovation processes. Courses and additional information can be found at the Innovation and Entrepreneurship website (<http://www.cmu.edu/ideate/concentrations-and-minors/entrepreneurship-for-creative-industries.html>).

Intelligent Environments (IDeATe)

The focus of this content area is on spaces that support efficiency and high quality of experience, addressing both the integrated development of such environments and the resulting experience.

The required portal course for this content area is 62-150 IDeATe: Introduction to Media Synthesis and Analysis (10 units) or 16-223/60-223 IDeATe: Introduction to Physical Computing (10 units) and will serve as one of the courses for this content area. Course information can be found at the Intelligent Environments website (<http://www.cmu.edu/ideate/concentrations-and-minors/intelligent-environments.html>).

Physical Computing (IDeATe)

The barriers between computing devices and their users have slowly dissolved. The physical world is becoming a key interface for computing and the internet of things is becoming the next generation of connectivity. Students in this content area will explore the technical, experiential, and semantic issues of this evolution. Course information can be found on the Physical Computing website (<http://www.cmu.edu/ideate/concentrations-and-minors/physical-computing.html>).

Sample Curriculum

Freshman		Sophomore	
Fall	Spring	Fall	Spring
67-100 Information Systems Freshman Workshop	67-250 The Information Systems Milieux	67-262 Database Design and Development	67-272 Application Design and Development
15-110 Principles of Computing	15-112 Fundamentals of Programming and Computer Science	15-121 Introduction to Data Structures	Disciplinary Core Course
21-111 Differential Calculus	21-112 Integral Calculus	Disciplinary Core Course	Elective Course
36-201 Statistical Reasoning and Practice	76-101 Interpretation and Argument	Elective Course	Elective Course
Freshman Seminar	79-104 Global Histories	Elective Course	Elective Course
99-101 Computing @ Carnegie Mellon			
Elective Course			

Junior		Senior	
Fall	Spring	Fall	Spring
Professional Core Elective Course	67-373 Software Development Project	67-475 Innovation in Information Systems	Content Area Course
Disciplinary Core Course	Content Area Course	Content Area Course	Elective Course
Elective Course	Elective Course	Elective Course	Elective Course
Elective Course	Elective Course	Elective Course	Elective Course
Elective Course	Elective Course	Elective Course	Elective Course

Academic Policies

Transfer into Information Systems

Most IS students are admitted directly into Information Systems as incoming freshmen. Only Information Systems major students are permitted to enroll in the Professional Core courses (67-250 and above), and IS students have enrollment priority in IS electives.

Students in high academic standing may apply to be admitted to the Information Systems major as transfer students. Transfers into Information Systems will always be subject to availability of space in the major. Applications will be considered based on the following criteria:

- Strong record of academic performance at Carnegie Mellon (minimum QPA of 3.4)
- Relevance and clarity of personal statement
- Interview with IS Academic Advisor. Current Dietrich students must also interview with their Academic Advisory Center (AAC) advisor while non-Dietrich students will only be required to meet with the IS Academic Advisor.
- Relevance of courses completed to date
- Completion of 15-112 Fundamentals of Programming and Computer Science with final grade of 'A' or 'B'

Application materials must be submitted no later than the last day of classes of the fall or spring semester. Current Dietrich students will submit materials to the Academic Advisory Center while non-Dietrich students will submit all materials directly to Information Systems in PH 222.

Students accepted as transfers to the IS program would normally be expected to complete the usual prerequisites and begin the Professional Core courses during the next available semester.

Students interested in applying for transfer to the Information Systems major should contact the IS Academic Advisor for information regarding availability, application procedures and deadlines. Potential applicants to the IS major should be working toward a sensible alternative major, so that their success at Carnegie Mellon is not predicated on admission to the IS program.

Double Counting of Courses

"Double Counting" refers to instances when a course taken to fulfill one requirement counts simultaneously toward a requirement in another major or minor program. Double Counting is permitted in the Dietrich College on a very limited basis. Information Systems students may double count no more than two courses used to fulfill any Information Systems major requirement (beyond the Dietrich College General Education requirements and Prerequisite courses) with any combination of dual degrees, additional majors, minors or graduate degree programs. Only one course may double count with any minor. No course can count for more than one requirement within the major. Students must also adhere to any policy restrictions on double counting enforced by the academic department of the student's additional major or minor.

Course Repeats

Per university policy, when a course is repeated, all grades will be recorded on the official academic transcript and will be calculated in the student's QPA. This is the case regardless if the first grade for the course is a passing or failing grade.

Undergraduate students who wish to repeat a course already passed must obtain approval from the student's Dean or Department Head. When a student takes a course s/he has already passed, only one set of units will count towards graduation requirements.

Faculty

C.F. LARRY HEIMANN, Teaching Professor – Ph.D., Washington University (St. Louis); Carnegie Mellon, 1998–.

JOSEPH S. MERTZ, Teaching Professor (joint Appointment with Heinz College) – Ph.D., Carnegie Mellon University; Carnegie Mellon, 1997–.

SARA MOUSSAWI, Assistant Teaching Professor – Ph.D., City University of New York; Carnegie Mellon, 2016–.

JERIA QUESENBERY, Associate Teaching Professor – Ph.D., Pennsylvania State University; Carnegie Mellon, 2007–.

RAJA SOORIAMURTHI, Teaching Professor – Ph.D., Indiana University; Carnegie Mellon, 2007–.

RANDY S. WEINBERG, Teaching Professor; Program Director, Information Systems – Ph.D., University of Minnesota; Carnegie Mellon, 1998–.

CHADI AOUN, Associate Teaching Professor – Carnegie Mellon - Qatar - Ph.D., University of New South Wales; Carnegie Mellon, 2015–.

ANIS CHARFI, Associate Teaching Professor – Carnegie Mellon - Qatar - Dr.Ing., Technische Universität Darmstadt; Carnegie Mellon, 2015–.

DIVAKARAN LIGINLAL, Teaching Professor – Carnegie Mellon - Qatar - Ph.D., University of Arizona - Tucson; Carnegie Mellon, 2009–.

SELMA LIMAM MANSAR, Teaching Professor – Carnegie Mellon - Qatar - Ph.D., National Polytechnic Institute of Grenoble; Carnegie Mellon, 2007–.

DANIEL PHELPS, Associate Teaching Professor – Carnegie Mellon - Qatar - Ph.D., Florida State University; Carnegie Mellon, 2007–.