COMPUTER SCIENCE AND SOFTWARE ENGINEERING

Chair: Daniela Rosca, Department of Computer Science and Software Engineering

UNIX Administrator and Teacher: Joseph Chung

Bachelor of Science with a Major in Computer Science

The Computer Science curriculum provides a solid foundation in the computing sciences, preparing students for employment in industry or for graduate school. Software design and development is emphasized along with foundational computing concepts. The higher-level courses enable students to explore a variety of topics, such as databases, networks, artificial intelligence, scripting languages, game programming, UNIX administration, and computer security.

The B.S. in Computer Science, which is accredited by the Computing Accreditation Commission of ABET (http://www.abet.org), is recommended especially for students who plan to attend graduate school in computer science or who plan to specialize in scientific computing. The educational objectives of the BS in Computer Science are to enable graduates, within a few years after graduation, to:

• Work as effective team members or team leaders in the development of computer and software systems covering a wide range of business, educational and scientific applications.
• Enter professional careers in positions including computer programmer, software tester, systems analyst, network administrator, software systems designer, database manager, computer systems integrator, software security analyst, and game developer.
• Undertake graduate studies and develop the knowledge and expertise to complete advanced studies or do research in computer science, engineering, and other scientific fields.
• Work in teams, communicating effectively with technical and non-technical team members, clients, and customers, while meeting the social and ethical responsibilities of their profession.
• Explore, synthesize, and implement ideas in their areas of interest and activity.
• Adapt to new technologies and methodologies with the skills required to react to a changing world.

Students interested in Computer Science but looking for a more flexible curriculum may choose to pursue the non-ABET-accredited B.A. in Computer Science. This program requires fewer math and science credits, which allows students to take additional coursework or a minor in other academic areas.

Bachelor of Science in Software Engineering

The undergraduate Software Engineering curriculum, which is accredited by the Engineering Accreditation Commission of ABET (http://www.abet.org) is designed to give students a broad background in both computer and engineering science with a heavy emphasis on those aspects of software engineering that will enable graduates to efficiently participate in the design, development, and deployment of large software systems. Because of the sequential nature of the courses and the number of requirements for engineering majors, careful planning is necessary to complete the curriculum in four years.

The educational objectives of the BS in Software Engineering program are to prepare software engineering graduates to do the following things within the first few years after graduation from the program:

• Obtain employment in organizations that develop or acquire software and/or enter graduate school;
• Make strong contributions to teams that are responsible for the specification, design, construction, testing, deployment, maintenance, or use of software systems;
• Develop experience in additional areas of professional specialty that, when combined with their BSSE education, will continue the path toward lifelong learning;
• Use their engineering, communications, interpersonal, and business skills to advance their careers in a business, government, or academic environment;
• Critically assess their engineering capabilities and acquire the additional knowledge and skills they need to maintain currency within their evolving work environment;
• Assist their employers’ organizations in achieving their business goals.

Programs

Majors

• B.S. in Computer Science (http://catalog.monmouth.edu/undergraduate-catalog/science/computer-science-software-engineering/computer-science-bs)
• B.A. in Computer Science (http://catalog.monmouth.edu/undergraduate-catalog/science/computer-science-software-engineering/computer-science-ba)
• B.S. in Software Engineering (http://catalog.monmouth.edu/undergraduate-catalog/science/computer-science-software-engineering/software-engineering-bs)

Minor

• Computer Science (http://catalog.monmouth.edu/undergraduate-catalog/science/computer-science-software-engineering/computer-science-minor)
• Information Technology (http://catalog.monmouth.edu/undergraduate-catalog/science/computer-science-software-engineering/information-technology-minor)

Certificate

• Information Technology (http://catalog.monmouth.edu/undergraduate-catalog/science/computer-science-software-engineering/information-technology-certificate)

Faculty

Eugenio Cesario, Associate Professor. M.A., Ph.D., University of Calabria, Italy. Research interests fall in the broad areas of data analytics and parallel/distributed data mining, and include urban computing, energy-aware cloud computing, Cloud-grid services architectures, and Knowledge Discovery applications. Most recently, he has been focusing his research on crime data analysis and mobility pattern discovery.
Courses

**CS-102  Introduction to Computing and Problem Solving**  
Credits: 4  
Term Offered: All Terms  
Course Type(s): TL  
Introduces a broad overview of computing topics, designed to provide students with awareness of the computing field's many aspects. Topics include fundamentals of computer architecture, operating systems, applications, networks and problem-solving. Computing topics are demonstrated and presented using computing applications including word processors, spreadsheets, databases, presentation software, and Web page development software. Introduces social and ethical issues related to computing and explores the local and global impact of computing on individuals, organizations and society. It also gives students their initial exposure to group project work.

**CS-104  Introduction to Problem Solving and Software Development**  
Credits: 3  
Term Offered: All Terms  
Course Type(s): TL  
Introduces a broad overview of problem solving, computing topics, and fundamental concepts and methodologies of software development designed to provide students with awareness of the computing field's many aspects. Topics include fundamentals of computer architecture, operating systems, applications, problem-solving. It emphasizes the main phases of the software development lifecycle, such as requirements, design, implementation, testing, project planning. Also, it stresses the difference between the software product and process. Introduces social and ethical issues related to computing and explores the local and global impact of computing on individuals, organizations and society. It also gives students their initial exposure to group project work.

**CS-105  Introduction to Computer Science I**  
Credits: 3  
Prerequisite(s): CS-104  
Co-requisite(s): CS-175L  
Term Offered: All Terms  
Course Type(s): TL  
Introduces a broad overview of computing topics, designed to provide students with awareness of the computing field's many aspects. Topics include fundamentals of computer architecture, operating systems, applications, networks and problem-solving. Computing topics are demonstrated and presented using computing applications including word processors, spreadsheets, databases, presentation software, and Web page development software. Introduces social and ethical issues related to computing and explores the local and global impact of computing on individuals, organizations and society. It also gives students their initial exposure to group project work.

**CS-175L  Introduction to Computer Science I lab**  
Credits: 1  
Prerequisite(s): CS-104  
Co-requisite(s): CS-175  
Term Offered: All Terms  
Course Type(s): None  
Introduces the basic concepts of program development in a modern object-oriented language; problem-solving methods and algorithm development; basic primitive and object data types; language syntax; style and documentation; and coding and testing of programs

**CS-175  Introduction to Computer Science I**  
Credits: 3  
Prerequisite(s): CS-104  
Co-requisite(s): CS-175L  
Term Offered: All Terms  
Course Type(s): None  
Introduces the basic concepts of program development in a modern object-oriented language; problem-solving methods and algorithm development; basic primitive and object data types; language syntax; style and documentation; and coding and testing of programs

**CS-176  Introduction to Computer Science II**  
Credits: 3  
Prerequisite(s): CS-175 and CS-175L, both passed with a grade of C or higher  
Co-requisite(s): CS-176L  
Term Offered: All Terms  
Course Type(s): None  
Continuation in depth and breadth of problem solving and algorithm development, using the same modern object-oriented language as in CS-175. More advanced object-oriented design. Introduction to polymorphism, inheritance, and interfaces.
CS-176L  Introduction to Computer Science II Lab  Credits: 1
Prerequisite(s): CS-175 and CS-175L, both passed with a grade of C or higher
Co-requisite(s): CS-176
Term Offered: All Terms
Course Type(s): None
Introduction to advanced concepts of programming and program development in a modern Software Development Environment with debugger and source code control.

CS-199  Independent Study in Computer Science  Credits: 1-3
Term Offered: All Terms
Course Type(s): None
Independent study in a computer science topic not substantially treated in a regular course; for students with superior ability. One-hour consultation per week. Prior permission of the directing professor and department chair is required to take this course.

CS-202  Discrete Mathematics and Applications  Credits: 4
Prerequisite(s): CS-175 and MA-109
Term Offered: All Terms
Course Type(s): None
Covers the basic concepts, methods, structures, and models from discrete mathematics used throughout computer science. Topics addresses include: logic and mathematical reasoning, functions, sets, summations, asymptotic notation, algorithms and complexity, number theory, cryptography, matrix algebra, induction and recursion, counting techniques, combinatorial objects, discrete structures, discrete probability theory, relations, and graph theory and graph algorithms.

CS-205  Data Structures and Algorithms  Credits: 3
Prerequisite(s): MA-130, CS-176, and CS-176L, all passed with a grade of C or higher
Co-requisite(s): CS-205L
Term Offered: All Terms
Course Type(s): None
Introduction to the design, implementation, and use of fundamental data structures (lists, stacks, queues, trees); extensions of these structures and associated algorithms; informal complexity analysis.

CS-205L  Data Structures and Algorithms Lab  Credits: 1
Prerequisite(s): MA-130, CS-176, and CS-176L, all passed with a grade of C or higher
Co-requisite(s): CS-205
Term Offered: All Terms
Course Type(s): None
Introductions to the basic concepts of programming and program development in a modern Software Development Environment with debugger and source code control.

CS-212  Networking Fundamentals I  Credits: 3
Term Offered: Spring Term
Course Type(s): None
Prepares students with knowledge and skills required to successfully install, operate, and troubleshoot a small branch office network. Includes topics on networking fundamentals; connecting to a WAN; basic security and wireless concepts; routing and switching fundamentals; the TCP/IP and OSI models; IP addressing; WAN technologies; operating and configuring IOS devices; configuring RIPv2, static and default routing; implementing NAT and DHCP; and configuring simple networks.

CS-222  Networking Fundamentals II  Credits: 3
Prerequisite(s): CS-212
Term Offered: All Terms
Course Type(s): None
Prepares students with knowledge and skills required to successfully install, operate, and troubleshoot a small to medium size enterprise branch network. Covers topics on VLSM and IPv6 addressing; extending switched networks with VLANs; configuring, verifying and troubleshooting VLANs; the VTP, RSTR, OSPF and EIGRP protocols; determining IP routes; managing IP traffic with access lists; NAT and DHCP; establishing point-to-point connections; and establishing Frame Relay connections.

CS-250  Android Application Development  Credits: 3
Prerequisite(s): CS-175 and CS-176
Term Offered: Spring Term
Course Type(s): None
Introduces students to writing applications for Android mobile devices. It familiarizes students with the development software for creating Android apps, programming logic used in the apps, and Java code that puts the software design and logic into the practice using an Android emulator.

CS-275  Introduction to an Algorithmic Language  Credits: 3
Term Offered: All Terms
Course Type(s): None
A thorough overview of the syntax of an algorithmic language and stress on the concepts of structured programming. Four hours per week.

CS-286  Computer Architecture I  Credits: 3
Prerequisite(s): CS-176 or CS-275 passed with a grade of C or higher
Term Offered: All Terms
Course Type(s): None

CS-288  Cooperative Education: Computer Science  Credits: 3
Prerequisite(s): CS-205 passed with a grade of C or higher, Junior standing, and thirty or more credits with at least fifteen taken at Monmouth University.
Term Offered: All Terms
Course Type(s): EX2
Provides an opportunity for students who are engaged in a computer science-related work experience. Fifteen to twenty hours of work experience per week. May be repeated for credit. Departmental approval is required to take this course.

CS-289  Internship in Computer Science  Credits: 3
Term Offered: Summer Term
Course Type(s): EX1
Supervised practical experience in Computer Science. Repeatable for credit. Sophomore standing, departmental approval, and placement are required to take this course.

CS-298  Special Topics in Computer Science (200 Level)  Credits: 1-3
Term Offered: All Terms
Course Type(s): None
An intensive study of a particular subject or problem in computer science to be announced prior to registration. May be conducted on either a lecture-discussion or a seminar basis. Three or four hours per week. If a prerequisite is required it will be announced in the course schedule.
CS-299  Independent Study in Computer Science  Credits: 3
Term Offered: Spring Term
Course Type(s): None
Independent study in a computer science topic not substantially treated in a regular course; for students with superior ability. One-hour consultation per week. Prior permission of the directing professor and department chair is required to take this course.

CS-302  Designing and Implementing Routing in Enterprise Networks  Credits: 3
Prerequisite(s): CS-212 and CS-222, both passed with a grade of C or higher
Term Offered: All Terms
Course Type(s): None
Prepares students with knowledge and skills necessary to use advanced IP addressing and routing in implementing scalable and secure routers connected to LANs and WANs. Also covers configuration of secure routing solutions to support branch offices and mobile workers.

CS-306  Computer Algorithms II  Credits: 4
Prerequisite(s): CS-205 passed with a grade of C or higher
Term Offered: All Terms
Course Type(s): None
Continuation in depth and breadth of the design, implementation, and use of data types (list, binary search tree, tree, hash table, graph); intermediate algorithm design; complexity analysis. Four hours per week.

CS-310  Advanced Object-Oriented Programming and Design  Credits: 3
Term Offered: All Terms
Course Type(s): WT
Object-oriented programming and design, using a language different from that used on CS 176. Use of classes, inheritance, polymorphism, and libraries. Topics will include flexible system design for such requirements as globalization. This is a writing-intensive course.

CS-312  Designing and Implementing Switching in Enterprise Networks  Credits: 3
Prerequisite(s): CS-302 passed with a grade of C or higher
Term Offered: All Terms
Course Type(s): None
Prepares students with knowledge and skills necessary to plan, configure, and verify the implementation of complex enterprise switching solutions using Enterprise Architecture. Also covers secure integration of VLANs, WLANs, and voice and video into campus networks.

CS-315  Theory of Computing  Credits: 3
Prerequisite(s): CS-176 or CS-275 passed with a grade of C or higher and either CS-202 or MA-120 or MA-130 passed with a grade of C or higher
Term Offered: All Terms
Course Type(s): None
An introduction to phrase structure languages and their relation to automata, computability, and program verification.

CS-316  Implementing Network Security  Credits: 3
Prerequisite(s): CS-212 and CS-222 both passed with a grade of C or higher
Term Offered: All Terms
Course Type(s): None
Prepares students with knowledge and skills required to secure networks. Includes topics on core security technologies, the installation, troubleshooting and monitoring of network devices to maintain integrity, confidentiality and availability of data and devices, and competency in the technologies that use their security structures. A hands-on career oriented course, with an emphasis on practical experience, to help students develop specialized security skills, along with critical thinking and complex problem solving skills.

CS-320  IP Telephony Design and Implementation  Credits: 3
Prerequisite(s): CS-212 and CS-222 both passed with a grade of C or higher
Term Offered: Fall Term
Course Type(s): None
Prepares students with knowledge of how to implement and support data and voice integration solutions at the network-access level. Topics covered include basic IP Telephony operation, router configuration, support, troubleshooting, and integration with an existing PSTN network.

CS-322  Network Troubleshooting  Credits: 3
Prerequisite(s): CS-312 passed with a grade of C or higher
Term Offered: All Terms
Course Type(s): None
Prepares students with knowledge and skills necessary to plan and perform regular maintenance on complex enterprise routed and switched networks and use technology-based practices to perform network troubleshooting.

CS-324  Computer Architecture II  Credits: 3
Prerequisite(s): CS-286 passed with a grade of C or higher
Term Offered: All Terms
Course Type(s): None
Boolean algebra, combinational and sequential circuit devices are presented in lectures and laboratory. Computer hardware organization. Memory and CPU design. CPU control with microcode. Four hours per week.

CS-325  Software Engineering Concepts  Credits: 3
Prerequisite(s): CS-205 passed with a grade of C or higher; and EN-101 and EN-102 or permission of the instructor
Term Offered: Fall Term
Course Type(s): WT
Overview of software engineering concepts, analysis/design techniques, Unified Modeling Language (UML), software documentation, and group development of software.

CS-330  Administrating Unified Communication Manager  Credits: 3
Prerequisite(s): CS-212 and CS-222 both passed with a grade of C or higher
Term Offered: All Terms
Course Type(s): None
Prepares students with knowledge of deploying a Unified Communications Manager to support single site and multi-site deployment models.
CS-335 Programming Language Concepts  Credits: 3
Prerequisite(s): CS-205 passed with a grade of C or higher
Term Offered: Fall Term
Course Type(s): None
Design, evaluation, and implementation of programming languages.
Discussion of imperative, applicative, object-oriented and concurrent
languages. Four hours per week.

CS-337 Enterprise Mobile Apps Design and Development  Credits: 3
Prerequisite(s): CS-205 passed with a minimum grade of C or higher
Term Offered: Fall Term
Course Type(s): None
Presents methodologies to build enterprise mobile apps on iPad tablets
and iPhone smartphones using iOS. The course will cover technologies
to use in the design and development of apps on mobile devices and
integration of these apps with corporate data sources, sensor devices
and cloud computing services. Also listed as SE-337.

CS-350 Research in Computer Science  Credits: 1-4
Prerequisite(s): CS-306 passed with a grade of C or higher, a minimum
of fifteen credits at Monmouth University and a minimum GPA of 3.25
Term Offered: All Terms
Course Type(s): EX5
Original research work, associated with an external constituent and/or
organization, planned and carried out with assistance of faculty research
advisor. Research conducted by the student will be shared with the
external constituency and submitted for outside publication and review.
Number of credits arranged with advisor. Limited to Computer Science
students with approval of chair, program director, or advisor.

CS-360 Introduction to Game Development  Credits: 3
Prerequisite(s): CS-205 passed with a grade of C or higher
Term Offered: Fall Term
Course Type(s): None
An introduction to the creation of computer/video games and the
different elements of games, including computer graphics, animation,
artificial intelligence, algorithms, data structures, networking, software
development cycles and human-computer interaction. Also listed as
SE-360.

CS-370 Program Development Under Unix  Credits: 3
Prerequisite(s): CS-176 or CS-275 passed with a grade of C or higher
Term Offered: Fall Term
Course Type(s): None
Introduction to the use of the UNIX operating system and its utilities
for incremental and distributed program development, maintenance,
and debugging. The course covers the UNIX shell, utilities, and program
development tools that are used for large projects involving multiple
developers on multiple machines. Three hours per week.

CS-371 Scripting Languages  Credits: 3
Prerequisite(s): CS-176 or equivalent
Term Offered: All Terms
Course Type(s): None
An introduction to programming using widely-used, dynamically-typed,
interpreted programming languages, which are sometimes called
"scripting" languages. Covers general-purpose scripting languages,
such as Perl and Python that are used to develop a wide range of
applications. Scripting languages, such as PHP, that are used primarily in
web development, will not be covered in this course.

CS-375 File Management  Credits: 4
Prerequisite(s): CS-205 passed with a grade of C or higher
Term Offered: Fall Term
Course Type(s): None
Overview of files, records and files, blocking and buffering, secondary
storage devices; sequential file organization, external sort/merge
algorithms; random access; relative file organization; tree-structured
file organization; search trees, indexed sequential file organization; list-
structured file organization; multiple-key file organization. Four hours per
week.

CS-388 Cooperative Education: Computer Science  Credits: 3
Prerequisite(s): CS-205 passed with a grade of C or higher, Junior
standing and thirty or more earned credits with at least fifteen taken at
Monmouth University
Term Offered: All Terms
Course Type(s): EX2
Provides an opportunity for students who are engaged in a computer
science-related experience. Fifteen to twenty hours of work experience
per week. This course may be repeated for credit. Departmental approval
is required to take this course.

CS-389 Internship in Computer Science  Credits: 3
Term Offered: Summer Term
Course Type(s): EX1
Supervised practical experience in Computer Science. Repeatable for
credit. Junior standing, departmental approval, and placement are
required to take this course.

CS-398 Special Topics in Computer Science (300 Level)  Credits: 1-3
Prerequisite(s): CS-176 or CS-275 passed with a grade of C or higher
Term Offered: All Terms
Course Type(s): None
An intensive study of a particular subject or problem in computer science
to be announced prior to registration. May be conducted on either a
lecture-discussion or a seminar basis. Three or four hours per week. If a
prerequisite is required it will be announced in the course schedule.

CS-399 Independent Study in Computer Science  Credits: 3
Term Offered: All Terms
Course Type(s): None
Independent study in a computer science topic not substantially
covered in a regular course; for students with superior ability. One-hour
consultation per week. Prior permission of the directing professor and
department chair is required to take this course.

CS-414 Computer Networks  Credits: 4
Prerequisite(s): CS-286 passed with a grade of C or higher
Term Offered: All Terms
Course Type(s): None
Provides introduction to computer-networking concepts, technologies,
and services, including basic communications theory, analog and digital
devices, Public Switched Telephone Network, data networks, LANs,
wireless services, data protocols, the Internet, multi-media, and B-ISDN.

CS-418 Compiler Construction  Credits: 3
Prerequisite(s): CS-205 passed with a grade of C or higher
Term Offered: All Terms
Course Type(s): None
The principles and practices of incorporating the theory of finite
automata and context-free languages, the maintenance and use of
semantic information, and the generation and optimization of code to
produce a compiler. Four hours per week.
CS-420  Survey of Artificial Intelligence Concepts and Practices  Credits: 3
Prerequisite(s): CS-205 and MA-130 both passed with a grade of C or higher
Term Offered: All Terms
Course Type(s): None
Introduction of fundamental concepts and practices of artificial intelligence, covering search techniques, constraint satisfaction, knowledge representation, machine learning, planning, and natural language processing. The course will provide experience in the implementation of techniques from these areas. Three hours per week.

CS-432  Database Systems  Credits: 3
Prerequisite(s): CS-205 passed with a grade of C or higher
Term Offered: Fall Term
Course Type(s): None
Overview of database system concepts; data modeling; ER and UML diagrams; relational database schema definition; database design; query languages; introduction to NoSQL and comparison between relational and non-relational databases; hand-on experience of SQL, Oracle, and NoSQL.

CS-435  Systems Programming  Credits: 3
Prerequisite(s): CS-205 and CS-286 both passed with a grade of C or higher and Senior standing
Term Offered: Fall Term
Course Type(s): None
Introduction to the implementation of basic system software: text editors, assemblers, loaders, and macro processors, with emphasis on software methodology for creating and maintaining large programs. The language of instruction will be C, which will be briefly introduced. Four hours per week.

CS-438  Operating Systems Analysis  Credits: 3
Prerequisite(s): CS-286 and CS-205 both passed with a grade of C or higher
Term Offered: All Terms
Course Type(s): None
Management of memory, processes, files, and devices. OS design principles and performance measures. Multiprogramming, multiprocessing, concurrency, deadlock, virtual machines. Competitive and cooperating processes. Programs will be written in C or in Java. Three hours per week.

CS-445  Computer Graphics  Credits: 3
Prerequisite(s): CS-205 passed with a grade of C or higher
Term Offered: All Terms
Course Type(s): None
Drawing lines and curves, area filling, fractals, three dimensional viewing, clipping, ray-tracing, shading, hidden line and surface removal. Four hours per week.

CS-461  Simulation and Modeling  Credits: 3
Prerequisite(s): CS-205 passed with a grade of C or higher
Term Offered: All Terms
Course Type(s): None
An introduction to the use of discrete event simulation and other modeling methods and tools to predict the performance of computer systems and communications networks.

CS-471  System Administration  Credits: 3
Prerequisite(s): CS-370 or CS-371 passed with a grade of C or higher
Term Offered: Spring Term
Course Type(s): None
Fundamental topics in system administration, focused primarily on UNIX administration with added coverage of Microsoft Windows NT descendant systems. The course is a hands-on introduction to installing and maintaining modern, multi-user, production UNIX-like operating systems and the essential services that are hosted on these systems.

CS-488  Cooperative Education: Computer Science  Credits: 3
Prerequisite(s): CS-205 passed with a grade of C or higher
Term Offered: All Terms
Course Type(s): EX2
Provides an opportunity for students who are engaged in a computer science-related experience. Fifteen to twenty hours of work experience per week. May be repeated for credit. Departmental approval is required to take this course. Junior standing, thirty or more earned credits with at least fifteen taken at Monmouth University and CS-205 passed with a grade of C or higher are required to take this course.

CS-489  Internship in Computer Science  Credits: 1-3
Term Offered: All Terms
Course Type(s): EX1
Supervised practical experience in Computer Science. Repeatable for credit. Junior standing, departmental approval, and placement are required to take this course.

CS-490  Senior Project  Credits: 4
Prerequisite(s): CS-325 and CS-432 both passed with a grade of C or higher
Term Offered: Spring Term
Course Type(s): RD
Affords the student an opportunity to integrate topics and techniques from previous coursework in a capstone project. The project will combine investigation into computer science literature and actual implementation, either in an area of current research or an application area of interest to industry. Implementation might involve collaboration with other students. The project will be presented formally, both orally and in written form. This course satisfies the reasoned oral discourse requirement for computer science students.

CS-492A  Computer Science Senior Project A  Credits: 3
Prerequisite(s): CS-325 and CS-432, both passed with a grade of C or higher
Term Offered: All Terms
Course Type(s): RD
Affords the student an opportunity to integrate topics and techniques from previous coursework in a capstone project. The project will combine investigation into computer science literature and actual implementation, either in an area of current research or an application area of interest to industry. Implementation might involve collaboration with other students. The project will be presented formally both orally and in written form. This course satisfies the reasoned oral discourse requirement for computer science students.
CS-492B  Computer Science Senior Project B  Credits: 3
Prerequisite(s): CS-492A
Term Offered: All Terms
Course Type(s): RD
Affords the student an opportunity to integrate topics and techniques from previous coursework in a capstone project. The project will combine investigation into computer science literature and actual implementation, either in an area of current research or an application area of interest to industry. Implementation might involve collaboration with other students. The project will be presented formally both orally and in written form. This course satisfies the reasoned oral discourse requirement for computer science students.

CS-498  Special Topics in Computer Science (400 Level)  Credits: 1-3
Term Offered: All Terms
Course Type(s): None
An intensive study of a particular subject or problem in computer science to be announced prior to registration. May be conducted on either a lecture-discussion or a seminar basis. Three or four hours per week. If a prerequisite is required it will be announced in the course schedule.

CS-499  Independent Study in Computer Science  Credits: 1-4
Term Offered: All Terms
Course Type(s): None
Independent study in a computer science topic not substantially treated in a regular course; for students with superior ability. One-hour consultation per week. Prior permission of the directing professor and department chair is required to take this course.

IT-100  Information Technology  Credits: 3
Term Offered: All Terms
Course Type(s): TL
Introduction to computer-based information management concepts that provide an integrated approach to personal computer software in a Windows environment. These include, word processing, spreadsheet, database, presentation graphics, and electronic communication applications; information retrieval from the Internet and online library resources; fundamental computer literacy; and the ethical and societal implications of computer technology. Hands-on experience with a microcomputer on a networked system is provided. Not open to students who have completed CS-102 or IT-102 or IT-150.

IT-102  Information Technology for Scientists  Credits: 3
Term Offered: All Terms
Course Type(s): TL
Introduction to computer-based information management that provides an integrated approach to personal computer software in a Windows environment, which includes word processing, spreadsheet, mathematics, database, presentation graphics, Internet and electronic communication applications. Emphasizes scientific applications, technical report preparation and presentation. Hands-on experience with a microcomputer on a networked system is provided.

IT-103  Applied Information Technology  Credits: 3
Term Offered: Fall Term
Course Type(s): TL
Applies the principles and tools of information technology toward a deeper understanding of their impact on scientific, social and ethical issues via a central theme for the semester such as (but not limited to) climate change, big data, health-care cost analysis and others. This course will use software such as spreadsheets, databases, modeling, simulation, data analysis, software, electronic-communication applications; information retrieval from the internet and on-line library resources; social media, intranet and extranet systems to help students emerge with thematic materials in a way that deepens their understanding of associated topics.

IT-150  Information Technology for Business  Credits: 3
Term Offered: All Terms
Course Type(s): TL
Introduction to computer-based information business management that provides an integrated approach to personal computer software in a Windows environment. This includes fundamental technology literacy; operating systems, word processing, spreadsheet, database, presentation graphics, and electronic communication applications; computer and network security; troubleshooting; information retrieval from the Internet and on-line library resources; intranet and extranet systems; and the ethical, societal, legal, and economic implications of computer technology. Hands-on experience with a microcomputer on a networked system is provided.

IT-200  Advanced Information Technology  Credits: 3
Prerequisite(s): IT-100 or IT-102; or CS-102 or IT-150
Term Offered: All Terms
Course Type(s): None
Advanced concepts and techniques in computer-based information management are provided through an integrated approach to personal computer hardware and software in a Windows environment. These include: hardware and software considerations; societal and ethical considerations; the program development life cycle; creating tables; merging documents and desktop publishing in word processing; creating templates, workbooks with multiple worksheets, and creating a data map in electronic spreadsheets; creating custom reports and an application system using macros in database management; and using embedded visuals in presentation graphics applications. Hands-on experience with a microcomputer on a networked system is provided.

IT-250  Internet and Network Technology  Credits: 3
Prerequisite(s): IT-200 or CS-175 or permission of the instructor
Term Offered: All Terms
Course Type(s): None
Introduction to integrated application software used for authoring and publishing Web sites in a Windows environment. Applications include markup programming and Internet scripting languages used to create Web pages. Network technologies and the fundamental concepts involved in creating a network and in facilitating network operation will also be introduced. Concepts include: protocols, networking media, and architectures. Hands-on experience with a microcomputer on a networked system is provided.

IT-298  Special Topics in Information Technology (200 Level)  Credits: 3
Prerequisite(s): IT-100 and as announced in the course schedule
Term Offered: Fall Term
Course Type(s): None
Topics of current interest in Information Technology.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Term Offered</th>
<th>Prerequisite(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IT-300</td>
<td>Windows Applications: Program Design and Implementation</td>
<td>3</td>
<td>All Terms</td>
<td>IT-250 or permission of the department</td>
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<td></td>
<td>Prerequisite(s): IT-250 or permission of the department</td>
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<td>Term Offered: All Terms</td>
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<td>Course Type(s): None</td>
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<td>Course Type(s): None</td>
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<td></td>
<td>Program development life cycle, core programming concepts,</td>
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<td></td>
<td>Program development life cycle, core programming concepts, and software</td>
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<td></td>
<td>and software design and methodologies used to create</td>
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<td></td>
<td>design and methodologies used to create Windows applications with Visual Basic.</td>
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<td></td>
<td>Windows applications with Visual Basic. Practical problems</td>
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<td>Practical problems are used to illustrate application-building techniques used</td>
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<td>are used to illustrate application-building techniques</td>
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<td>in a variety of applications, including Windows desktop application and</td>
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<td>used in the design and development of apps on</td>
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<td>applications targeted for the Internet and intranets. Topics include</td>
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<td>mobile devices and technologies used in professional Web</td>
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<td>designing customized user interfaces, building dialog boxes, adding</td>
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<td>site development are introduced through the case study and</td>
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<td>drag-and-drop functionality to applications, and creating</td>
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<td>lecture approach. Topics include the application of</td>
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<td>customized database management and reporting applications. Hands-on</td>
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<td></td>
<td>advance scripting languages and software applications for</td>
<td></td>
<td></td>
<td>experience with a microcomputer on a networked system is provided.</td>
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<td></td>
<td>interactive controls, cascading style sheets, dynamic</td>
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<td>page layout, special effects, document formatting and</td>
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<td>transformation.</td>
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<td>IT-398</td>
<td>Special Topics in Information Technology (300 Level)</td>
<td>3</td>
<td>Fall Term</td>
<td>IT-100 and as announced in the course schedule</td>
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<td></td>
<td>Prerequisite(s): IT-100 and as announced in the course</td>
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<td>Term Offered: Fall Term</td>
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<td></td>
<td>schedule</td>
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<td>Course Type(s): None</td>
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<td>Topics of current interest in Information Technology.</td>
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<td>Topics of current interest in Information Technology.</td>
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<td>IT-399</td>
<td>Independent Study in Information Technology</td>
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<td>All Terms</td>
<td>All Terms</td>
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<td>Prerequisite(s): None</td>
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<td>Course Type(s): None</td>
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<td>Term Offered: All Terms</td>
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<td>Reading and research on a selected topic under the direction of a faculty</td>
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<td>Course Type(s): None</td>
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<td>member. Prior permission of the directing professor and department chair is</td>
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<td>required to take this course.</td>
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<td>IT-405</td>
<td>Advanced Internet Technology</td>
<td>3</td>
<td>All Terms</td>
<td>IT-250 and IT-300</td>
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<td></td>
<td>Prerequisite(s): IT-250 and IT-300</td>
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<td>Term Offered: All Terms</td>
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<td>Course Type(s): None</td>
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<td>Course Type(s): None</td>
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<td>The most current tools and technologies used in professional Web site</td>
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<td>development are introduced through the case study and lecture approach. Topics</td>
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<td>include the application of advance scripting languages and software applications</td>
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<td>for interactive controls, cascading style sheets, dynamic page layout, special</td>
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<td>effects, document formatting and transformation.</td>
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<tr>
<td>IT-450</td>
<td>Information Systems Project Management</td>
<td>3</td>
<td>All Terms</td>
<td>IT-250 or permission of the department</td>
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<td>Prerequisite(s): IT-250 or permission of the department</td>
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<td>Term Offered: All Terms</td>
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<td>Course Type(s): EX5</td>
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<td>The tools and skills of the systems analyst needed in information systems</td>
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<td>project management are introduced through the case study and experiential</td>
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<td>approach. Project management software will be used within an integrated-software</td>
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<td>environment-systems framework; students will complete two information technology</td>
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<td>projects in Web and database design for external clients.</td>
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<td>IT-498</td>
<td>Special Topics in Information Technology (400 Level)</td>
<td>3</td>
<td>Fall Term</td>
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<td>Prerequisite(s): IT-100 and as announced in the course</td>
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<td>Term Offered: Fall Term</td>
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<td>schedule</td>
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<td>Topics of current interest in Information Technology.</td>
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<td>Topics of current interest in Information Technology.</td>
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<tr>
<td>SE-104</td>
<td>Introduction to Software Engineering</td>
<td>3</td>
<td>Spring Term</td>
<td>Spring Term</td>
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<td></td>
<td>Prerequisite(s): None</td>
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<td>Course Type(s): None</td>
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<td>Introduction to the methods and tools for software development. Topics</td>
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<td>include the personal software process, requirements engineering, software</td>
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<td>design, testing methods, project management, and other management techniques.</td>
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<tr>
<td>SE-199</td>
<td>Independent Study in Software Engineering</td>
<td>3</td>
<td>Summer Term</td>
<td>Summer Term</td>
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<td></td>
<td>Prerequisite(s): None</td>
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<td>Course Type(s): None</td>
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<td>Independent Study of a particular subject or problem in software engineering</td>
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<td>under the guidance of a software engineering faculty member. Prior permission</td>
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<td>of the directing professor and department chair is required to take this course.</td>
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<tr>
<td>SE-205</td>
<td>Requirements Engineering and Specifications</td>
<td>3</td>
<td>Fall Term</td>
<td>SE-104 and CS-175</td>
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<tr>
<td></td>
<td>Prerequisite(s): SE-104, CS-176 or CS-275; EN-101 and EN-102</td>
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<td>Term Offered: Fall Term</td>
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<td>Course Type(s): None</td>
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<td>Prior permission of the instructor</td>
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<td>Term Offered: Spring Term</td>
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<td>Course Type(s): WT</td>
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<td>Design process notations, methods, paradigms, and tools. System architecture</td>
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<td>tradeoff analysis; component and subcomponent specification. Generic (domain)</td>
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<td>design; architectural styles, frameworks, and patterns. Test and integration</td>
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<td>plan documents. Architecture standards; design tools.</td>
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<tr>
<td>SE-207</td>
<td>Software Design and Architecture</td>
<td>3</td>
<td>All Terms</td>
<td>SE-104, CS-176 or CS-275; EN-101 and EN-102 or permission of the instructor</td>
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<td></td>
<td>Prerequisite(s): SE-104, CS-176 or CS-275; EN-101 and EN-102</td>
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<td>Term Offered: All Terms</td>
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<td>Course Type(s): None</td>
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<td>Prior permission of the instructor</td>
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<td>Design process notations, methods, paradigms, and tools. System architecture</td>
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<td>tradeoff analysis; component and subcomponent specification. Generic (domain)</td>
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<td>design; architectural styles, frameworks, and patterns. Test and integration</td>
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<td>plan documents. Architecture standards; design tools.</td>
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<td>SE-299</td>
<td>Independent Study in Software Engineering</td>
<td>3</td>
<td>All Terms</td>
<td>All Terms</td>
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<td>Prerequisite(s): None</td>
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<td>Course Type(s): None</td>
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<td>Independent Study of a particular subject or problem in software engineering</td>
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<td>under the guidance of a software engineering faculty member. Prior permission</td>
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<td>of the directing professor and department chair is required to take this course.</td>
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<tr>
<td>SE-306</td>
<td>Formal Methods in Software Engineering</td>
<td>3</td>
<td>Fall Term</td>
<td>MA-120 or MA-130</td>
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<tr>
<td></td>
<td>Prerequisite(s): MA-120 or MA-130</td>
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<td>Term Offered: Fall Term</td>
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<td>Course Type(s): None</td>
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<td>Covers a variety of formal methods and applies them to software-specification</td>
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<td>development. Assumes a firm grounding in mathematical logic, knowledge of</td>
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<td>proof techniques, and skill in the translation of problems expressed in English</td>
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<td>into predicate logic.</td>
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<tr>
<td>SE-312</td>
<td>Software Verification, Validation, and Maintenance</td>
<td>3</td>
<td>Fall Term</td>
<td>SE-104 and CS-176 or CS-275</td>
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<td>Prerequisite(s): SE-104 and CS-176 or CS-275</td>
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<td>Term Offered: Fall Term</td>
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<td>Course Type(s): None</td>
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<td>Covers inspections of requirements, design and code, as well as testing, the</td>
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<td>handling of change requests, software evolution, code comprehension, and change</td>
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<td>management.</td>
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<tr>
<td>SE-337</td>
<td>Enterprise Mobile Apps Design and Development</td>
<td>3</td>
<td>Fall Term</td>
<td>CS-205 passed with a grade of C or higher and CS-337</td>
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<td></td>
<td>Prerequisite(s): CS-205 passed with a grade of C or higher and CS-337</td>
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<td>Term Offered: Fall Term</td>
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<td>Course Type(s): None</td>
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<td>Presents methodologies to build enterprise mobile apps on iPad tablets and</td>
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<td>iPhone smartphones using iOS. The course will cover technologies to use in the</td>
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<td>design and development of apps on mobile devices and integration of these apps</td>
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<td>with corporate data sources, sensor devices and cloud computing services. Also</td>
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<td>listed as CS-337.</td>
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</table>
SE-351 Microprocessor Laboratory  
Prerequisite(s): MA-120 or MA-130  
Term Offered: Fall Term  
Course Type(s): None  
Introduces the student to microprocessor-based, hardware-interface design. Provides practice in developing software that drives the interfaces between a microprocessor and the outside world. Topics include: logic circuit analysis and synthesis, digital hardware components, microprocessor system architecture, and assembly and C/C++ language programming of input/output device drivers.

SE-352 Embedded and Real-Time Software  
Prerequisite(s): SE-351  
Term Offered: Spring Term  
Course Type(s): None  
Familiarizes students with the fundamental issues related to embedded and real-time software systems and gives them an opportunity to become familiar with a commercially available system for developing and testing embedded and real-time software. Topics include: definition of embedded systems, process concurrency, interprocess communications, synchronization, and process scheduling.

SE-353 Comparative Languages  
Prerequisite(s): CS-176 or CS-275  
Term Offered: Fall Term  
Course Type(s): None  
Begins with a history of the development of programming languages that provides the background necessary to understand programming-language design and evaluation. This is followed by an introduction to the basic programming language constructs and then critically comparing their implementation in some of the most common languages. Included is a discussion of the advantages and disadvantages of modern programming languages for a variety of applications. Some of the languages discussed are LISP, C, Small Talk, C++, Java, Ada, PL/1, and Prolog.

SE-356 Internet Technologies for Software Engineers  
Prerequisite(s): CS-102 and CS-176 or CS-275  
Term Offered: Spring Term  
Course Type(s): None  
Provides an intensive look at the leading-edge technologies that are used to build Internet applications, what they do, and how they do it. Topics covered will include: hyper-text markup language, cascading style sheets, scripting languages, active server pages, Pert/CGI, and the extensible markup language.

SE-357 Engineering Web-based Systems  
Prerequisite(s): SE-205 and SE-207  
Term Offered: Spring Term  
Course Type(s): None  
A practical introduction to the principles, methods, and tools required to create high-quality software applications for the distributed, client-server context of the Web. Emphasis is on architectural designs, and language and data access methods that are common in Web-based systems.

SE-360 Introduction to Game Development  
Prerequisite(s): CS-205 passed with a grade of C or higher  
Term Offered: Fall Term  
Course Type(s): None  
An introduction to the creation of computer/video games and the different elements of games, including computer graphics, animation, artificial intelligence, algorithms, data structures, networking, software development cycles and human-computer interaction. Also listed as CS-360.
SE-485A  Software Practicum  Credits: 3
Prerequisite(s): CS-205, SE-205, SE-207, and SE-312
Term Offered: Fall Term
Course Type(s): EX5, RD
Team work on substantial software projects submitted by corporate sponsors. Interim progress reports required, with a final formal defense and presentation to corporate staff, faculty, and other students in the course. At the end of SE-485A, students must submit their software engineering portfolio for review by the Software Engineering faculty.

SE-485B  Software Practicum  Credits: 3
Prerequisite(s): SE-485A
Term Offered: Spring Term
Course Type(s): EX5, RD
Team work on substantial software projects submitted by corporate sponsors. Interim progress reports required, with a final formal defense and presentation to corporate staff, faculty, and other students in the course. At the end of SE-485B, students must submit their software engineering portfolio for review by the Software Engineering faculty.

SE-498  Special Topics in Software Engineering  Credits: 3
Term Offered: Fall Term
Course Type(s): None
A 400-level intensive study of a particular subject or problem in software engineering to be announced prior to registration. May be conducted on either a lecture-discussion or a seminar basis. Three or four hours per week. If a prerequisite is required it will be announced in the course schedule.

SE-499  Independent Study in Software Engineering  Credits: 1-3
Term Offered: Spring Term
Course Type(s): None
Independent Study of a particular subject or problem in software engineering under the guidance of a software engineering faculty member. Prior permission of the directing professor and department chair is required to take this course.