

## Computer & Information Sciences

College of Science, Engineering & Technology  
Department of Computer & Information Sciences  
273 Wissink Hall • 507-389-2968  
Web site: [www.cset.mnsu.edu/cis](http://www.cset.mnsu.edu/cis)

Chair: Colin Wightman

Gregg Asher, Cyrus Azarbod, Rebecca Bates, Steven Case, Lee Cornell, Cesar Guerra-Salcedo, David Haglin, Allan Hart, Dean Kelley, Ann Quade, Richard Roiger, Hamed Sallam, Julio Sanchez, Susan Schilling, James Slack, Mahbubur Syed, Leon Tietz, Christophe Veltsos, Michael Wells

Bachelor's degree programs offered by the Department of Computer and Information Sciences prepare computer and information scientists for positions in computer-related fields. The department offers majors in Computer Science (CS), Computer Information Science (CIS), Management Information Systems (MIS), and three minors.

MIS Note: Management Information Systems (MIS) is a cross-disciplinary field of study which combines the technical aspects from computer science with the resource management techniques from business. To reflect the cross-disciplinary nature of this field, there are two MIS programs at MSU: one is offered in the Department of Computer and Information Sciences; the other offered in the Department of Management. Students who have an interest and an aptitude for the technical aspects of MIS should consider the MIS major in the Department of Computer and Information Sciences. This program has about two-thirds courses in the Department of Computer and Information Sciences and one-third Business courses. Students who have an interest and an aptitude for the resource management component of MIS should consider the Management major, MIS option in the Department of Management. This program has about two-thirds courses in the College of Business and one-third Computer and Information Sciences courses.

Admission to Major is granted by the department. Admission to the Major is required before the student is permitted to take 300- and 400-level courses. Requirements are:

- A minimum of 32 earned semester credits
- Completion of MATH 121 with a grade of C or better
- Completion of ENG 101 with a grade of C or better
- Completion of COMS 110 with a grade of B or better
- Completion of COMS 211 and COMS 212 with a grade of C or better and a GPA of 2.5 in these courses (or their equivalents).

### COMPUTER SCIENCE BS

Required General Education (7 credits):

- ENG 101 Composition (4)  
SPEE 100 Fund. of Speech Communication (3)

Required Support Courses (7 credits):

- ENG 271 Technical Communication (4)  
Choose one of the following Speech courses:  
101, 102, 202, 203, 315, 325, 333, or 403.

Required for Major (Core, 51 credits):

- COMS 211 Fundamentals of Computer Science I (4)  
COMS 212 Fundamentals of Computer Science II (4)  
COMS 310 Data Structures and Algorithms (4)  
COMS 320 Machine Structures and Programming (4)  
COMS 370 Concepts of Programming Languages (4)  
COMS 410 Abstract Machines and Grammars (4)  
COMS 460 Operating Systems (4)  
MATH 121 Calculus I (4)  
MATH 122 Calculus II (4)  
MATH 247 Linear Algebra I (4)  
STAT 354 Concepts of Probability and Statistics (3)  
MATH 375 Introduction to Discrete Mathematics (4)

Choose one of the following courses:

- COMS 360 Systems Programming (4)

- COMS 362 Introduction to Data Communication and Networking (4)  
COMS 420 Computer Organization II (4)  
COMS 470 Compiler Construction (4)

Required Electives (COMS, 8 credits)\*:

Choose an additional eight credits of coursework from the following courses:

- COMS 201 Introduction to Assistive Technology (2)  
COMS 202 Computers in Society (4)  
COMS 230 Applied Expert Systems (4)  
COMS 340 Database Management Systems I (4)  
COMS 350 Operations Research I (4)  
COMS 360# Systems Programming (4)  
COMS 361 Windows Programming (4)  
COMS 362# Introduction to Data Communication and Networking (4)  
COMS 371 Applications Programming (4)  
COMS 380 Systems Analysis and Design (4)  
COMS 411 Parallel and Distributed Processing (4)  
COMS 412 Graphics (4)  
COMS 420# Advanced Computer Organization (4)  
COMS 430 Artificial Intelligence (4)  
COMS 432 Robotics (4)  
COMS 440 Database Management Systems II (4)  
COMS 450 Operations Research II (4)  
COMS 460 Operating Systems (4)  
COMS 462 Communication Protocols (4)  
COMS 463 Client Server and Web Applications (4)  
COMS 464 Mobile Applications (4)  
COMS 465 Distributed Processing (4)  
COMS 470# Compiler Construction (4)  
COMS 480 Software Engineering (4)  
COMS 481 Rapid Application Development (4)  
COMS 495 Seminar in Computer Science (1)  
COMS 496 Selected Topics in Computer Science (1-4)  
COMS 497 Internship (4)  
COMS 499 Individual Study (1-2)

\* minimum of 4 credits of required electives must be of 400-level

# can only be selected as a required elective if NOT chosen under required for major courses

The following courses are not to be used in this major: 100, 101, 160, 171, 200, 272, 490, 491, 492, 493.

Required Electives (Science, 12 credits):

Choose one of the following sequences:

- BIOL 105 General Biology I (4)\*  
BIOL 106 General Biology II (4) OR  
CHEM 201 General Chemistry I (5)\*  
CHEM 202 General Chemistry II (5) OR  
GEOL 121 Physical Geology (4)\*  
GEOL 122 Earth History (4)\* OR  
PHYS 221 General Physics I (5)\*  
PHYS 222 General Physics II (5) AND

Any class numbered 200 or above in Astronomy, Biology, Chemistry, Geology, or Physics or one class from another sequence listed above.

\* May be used to fulfill General Education requirements.

Required Minor: Yes. Any. Note that the Mathematics requirements specified above fulfill the requirements for a mathematics minor.

### COMPUTER INFORMATION SCIENCE BS

Required General Education (10 credits):

- ENG 101 Composition (4)  
SPEE 100 Fund. of Speech Communication (3)  
STAT 154 Elementary Statistics (3)

Required Support Courses (11 credits):

ENG 271 Technical Communication (4)  
 MATH 121 Calculus I (4)  
 MATH 180 Mathematics for Computer Science (4)

Choose one of the following Speech courses:  
 101, 102, 202, 203, 315, 325, 333, or 403.

Required for Major (Core, 34 credits):

COMS 211 Fundamentals of Computer Science I (4)  
 COMS 212 Fundamentals of Computer Science II (4)  
 COMS 310 Data Structures and Algorithms (4)  
 COMS 320 Machine Structures and Programming (4)  
 COMS 340 Database Management Systems I (4)  
 COMS 362 Introduction to Data Communication and Networking (4)  
 COMS 380 Systems Analysis and Design (4)  
 COMS 497 Internship (6)

Required Electives (12 credits):

At least eight credits of these electives must be 400-level classes

Choose one or more of the following Category I Courses:

COMS 371 Applications Programming (4)  
 COMS 412 Graphics (4)  
 COMS 430 Artificial Intelligence (4)  
 COMS 432 Robotics (4)  
 COMS 462 Communications Protocols (4)  
 COMS 463 Client Server and Web Applications (4)  
 COMS 464 Mobile Applications (4)  
 COMS 465 Distributed Processing (4)  
 COMS 470 Compiler (4)  
 COMS 480 Software Engineering (4)

Then choose additional credits of COMS electives from the COMS courses not used above or from the following list:

COMS 201 Introduction to Assistive Technology (2)  
 COMS 202 Computers in Society (4)  
 COMS 230 Applied Expert Systems (4)  
 COMS 350 Operations Research I (4)  
 COMS 360 Systems Programming (4)  
 COMS 361 Windows Programming (4)  
 COMS 370 Concepts of Programming Languages (4)  
 COMS 410 Abstract Machines and Grammars (4)  
 COMS 411 Parallel and Distributed Processing (4)  
 COMS 420 Advanced Computer Organization (4)  
 COMS 440 Database Management Systems II (4)  
 COMS 450 Operations Research II (4)  
 COMS 460 Operating Systems (4)  
 COMS 481 Rapid Application Development (4)  
 COMS 495 Seminar in Computer Science (1)  
 COMS 496 Selected Topics in Computer Science (1-4)  
 COMS 499 Individual Study (1-2)

The following courses are not to be used in this major: 100, 101, 160, 171, 200, 272, 490, 491, 492, 493.

Required Minor: Yes. Any.

## MANAGEMENT INFORMATION SYSTEMS BS

Required General Education (10 credits):

ENG 101 Composition (4)  
 SPEE 100 Fund. of Speech Communication (3)  
 STAT 154 Elementary Statistics (3)

Required Support Courses (11 credits):

ENG 271 Technical Communication (4)  
 MATH 121 Calculus I (4)  
 MATH 180 Mathematics for Computer Science (4)

Choose one of the following Speech courses:

101, 102, 202, 203, 315, 325, 333, or 403

Required for Major (Core, 68 credits):

COMS 211 Fundamentals of Computer Science I (4)  
 COMS 212 Fundamentals of Computer Science II (4)

COMS 310 Data Structures and Algorithms (4)  
 COMS 340 Database Management Systems I (4)  
 COMS 362 Introduction to Data Communication and Networking (4)  
 COMS 371 Applications Programming (4)  
 COMS 380 Systems Analysis and Design (4)  
 COMS 480 Software Engineering (4)  
 COMS 497 Internship (6)  
 ACCT 200 Financial Accounting (3)  
 ACCT 210 Managerial Accounting (3)  
 BLAW 371 Computer and Technology Law (3)  
 FINA 362 Business Finance (3)  
 IBUS 380 Principles of International Business (3)  
 MGMT 330 Principles of Management (3)  
 MGMT 346 Production and Operations Management (3)  
 MGMT 458 Corporate Information Systems (3)  
 MRKT 310 Principles of Marketing (3)

Choose one of the following courses:

MGMT 472 Information Technology Project Management (3)  
 MGMT 473 Introduction to E-Commerce (3)  
 MGMT 476 Decision Support Systems (3)  
 MGMT 477 Computer Performance Modeling (3)

Required Electives (8 credits):\*

Choose eight credits from the following courses:

COMS 201 Introduction to Assistive Technology (2)  
 COMS 202 Computers in Society (4)  
 COMS 230 Applied Expert Systems (4)  
 COMS 320 Machine Structures and Programming (4)  
 COMS 350 Operations Research I (4)  
 COMS 360 Systems Programming (4)  
 COMS 361 Windows Programming (4)  
 COMS 370 Concepts of Programming Languages (4)  
 COMS 411 Parallel and Distributed Processing (4)  
 COMS 412 Graphics (4)  
 COMS 420 Advanced Computer Organization (4)  
 COMS 430 Artificial Intelligence (4)  
 COMS 432 Robotics (4)  
 COMS 440 Data Management Systems II (4)  
 COMS 450 Operations Research II (4)  
 COMS 460 Operating Systems (4)  
 COMS 462 Communications Protocols (4)  
 COMS 463 Client Server and Web Applications (4)  
 COMS 464 Mobile Applications (4)  
 COMS 465 Distributed Processing (4)  
 COMS 470 Compiler Construction (4)  
 COMS 481 Rapid Application Development (4)  
 COMS 495 Seminar in Computer Science (1)  
 COMS 496 Selected Topics in Computer Science (1-4)  
 COMS 499 Individual Study (1-2)

\*Minimum of 4 credits of required electives must be of 400-level

The following courses are not to be used in this major: 100, 101, 160, 171, 200, 272, 490, 491, 492, 493.

Required Minor: None.

## COMPUTER SCIENCE MINOR

Required for Minor (Core, 20 credits):

COMS 211 Fundamentals of Computer Science I (4)  
 COMS 212 Fundamentals of Computer Science II (4)  
 COMS 310 Data Structures and Algorithms (4)  
 COMS 320 Machine Structures and Programming

Choose one of the following courses:

COMS 360 Systems Programming (4)  
 COMS 362 Introduction to Data Communication and Networking (4)  
 COMS 420 Computer Organization II (4)  
 COMS 460 Operating Systems (4)

## COMPUTER INFORMATION SCIENCE MINOR

Required for Minor (Core, 20 credits):

COMS 211 Fundamentals of Computer Science I (4)

COMS 212 Fundamentals of Computer Science II (4)

Choose three of the following courses:

COMS 310 Data Structures and Algorithms (4)

COMS 320 Machine Structures and Programming

COMS 340 Database Management Systems I (4)

COMS 362 Introduction to Data Communication and Networking (4)

COMS 380 Systems Analysis and Design (4)

## COMPUTER TECHNOLOGY MINOR

Required for Minor (Core, 20 credits):

COMS 110 Foundation of Computer Science (4)

COMS 202 Computers in Society (4)

COMS 211 Fundamentals of Computer Science I (4)

COMS 321 Micro Configuration and Maintenance (4)

Choose one of the following courses:

COMS 212 Fundamentals of Computer Science II (4)

COMS 230 Intelligent Systems (4)

ENG 271 Technical Communication (4)

## POLICIES/INFORMATION

**GPA Policy.** A GPA of 2.5 or higher in courses required for a major or minor in the Department of Computer and Information Sciences is required for graduation. This GPA requirement is calculated and must be maintained for each of the following areas: 1) for the combined Required General Education and Required Support Courses, or their substitutions, if any; 2) for the Required for Major and Required Electives courses including Category I courses, if any. When pursuing the Management Information Systems major, this second requirement must be maintained in the COMS component of the major as well as in the overall major. It is recommended that students who cannot maintain a GPA of 3.0 in required 100 and 200 level courses see their advisor for a program review.

Refer to the College regarding required advising for students on academic probation.

**Grading Policy.** All coursework applied towards the major or minor, including required general education and support courses, must be taken for a letter grade except for courses offered only as P/N.

A minimum grade of C is required in all courses which are to be applied towards a departmental major or minor program, including those required courses which are in supporting areas (such as ENG 271). In addition, a minimum grade of C is required for all prerequisite courses. Grades of D are not accepted by the department.

Any student who receives a D or F in a COMS class, or who drops a COMS class after the first two weeks of the semester, will have a hold for COMS classes put his/her registration. In other words, he/she will not be able to register for future COMS courses until the hold is released.

To have the hold released, the student must meet with his/her advisor and present the advisor with an appeal form. This form will be available from the Office of Computer Science (273 Wissink Hall).

This hold policy does NOT apply to students who are taking 100-level COMS courses.

**Administrative Drop Policy.** Students enrolled in COMS 110 who do not attend class the first meeting of a once-a-week class or do not attend by the first meeting of class will be automatically dropped from the course by the end of the first week of the current semester. If you are not able to attend the first class session as listed above and do not wish to be dropped, you will need to submit a written request to the department PRIOR to the first day of the course at the following address: ad-computer@mnsu.edu. For assistance with the process, call the Office of Computer Science at 507-389-2968.

**Incomplete Policy.** An incomplete grade for a course will generally be given only under two conditions. The first condition is illness — a doctor's written

recommendation must be supplied. The second condition arises when a death in the student's family has caused the student to be away from the campus for an extended period of time. The student must have a satisfactory grade (C or better) in the course at the time of the onset of the condition.

**Internship Policy.** The Department of Computer and Information Sciences continuously strives for improvements in the academic program. Course-work, coupled with extensive laboratory experience, play an important part in the student's educational program. However, application of the concepts discussed in class to on-the-job situations is equally important. As a result, the department requires an internship for all CIS and MIS majors.

COMS 100, 101, 160, 171, 492, and 493 do not count toward a major or minor in the computer and information sciences.

**Residency:** At least 50 percent of the computer and information sciences credits required for a major or minor from this department must be earned at Minnesota State University, Mankato.

## COURSE DESCRIPTIONS

### COMS 100 (4) Introduction to Computer Science

This course provides a basic foundation in computer concepts and literacy. Topics include the development of computers, hardware, software, and their social implications. The course includes a hands-on lab which introduces students to various systems and applications software including graphical user interfaces, word processing, drawing and painting programs, electronic mail, the Internet, spreadsheets, databases, and presentation software. This course cannot be counted toward any major or minor offered by the Computer and Information Sciences department.

GE-13 F, S

### COMS 101 (3) Introduction to Microcomputers

An introductory course in personal computer use for business majors. Provides an understanding of what personal computers are, how they are controlled, and their usefulness in the business world. Assignments include work on word processing, spreadsheets, presentation packages, communications, an introduction to web pages, and graphics. This course cannot be counted toward any other major or minor offered by the Computer and Information Sciences department.

F, S

### COMS 110 (4) Foundation of Computer Science

This course provides a comprehensive introduction to the foundations of computer science. The topics covered include algorithms, pseudocode, computer theory, computer hardware, computer software, and the related social issues. Lab work develops familiarity with both hardware and software. The course is intended to provide knowledge and skills applicable to all disciplines while providing a broad introduction to the field of computer science.

Pre: MATH 112 (College Algebra)

GE-13 F, S

### COMS 160 (1) Introduction to Selected Operating Systems

This course is intended to provide the student with hands-on experience with a particular operating system. This experience would include terminal operation methods; and the creation, manipulation and editing of files. The course may be repeated for different operating systems.

Variable

### COMS 171 (2) Introduction to C++ Programming

This course provides an introduction to programming using C++. Emphasis on structured programming concepts, with a brief discussion of object-oriented programming. Control structures, expressions, input/output, arrays, and functions.

F, S

### COMS 200 (4) Microcomputer Applications

Using both a lecture and lab environment, this course seeks to provide students with additional personal computer experience on both IBM and Macintosh platforms in these areas: operating systems, graphics, WWW page

development, telecommunications, utility software, networking, file transfer, presentation software.

Pre: COMS 100, 110, or 101 or consent of instructor Variable

#### COMS 201 (2) Introduction to Assistive Technology

This course introduces students to assistive technology and its applicability to people with various disabilities. Hardware and software demonstrations with an emphasis placed on inexpensive and readily available solutions. Extensive use of the Internet will be employed to keep current with latest technology and to facilitate a continuing dialogue with instructor.

Variable

CD-Related

#### COMS 202 (4) Computers in Society

This course seeks to confront participants with complex social and ethical issues associated with computers. Through thoughtful questions, informative readings, and the analysis of dichotomous viewpoints, courses participants will gain insight into the complexity of technology-related issues discussed as well as the lack of simplistic solutions to the problems.

F, S

GE-1C

#### COMS 211 (4) Fundamentals of Computer Science I

This is the first course in a two-course sequence for students who are planning to major or minor in computer science. The course emphasizes concepts needed for continuing study in computer science, the use of abstraction in program design, and advanced problem-solving skills. Programming in a high-level language is a focal point of the course. Prerequisite: A grade of A or B in COMS 110.

Coreq.: MATH 121 (Calculus I) F, S

#### COMS 212 (4) Fundamentals of Computer Science II

This course is a continuation of 211. The course introduces students to object-oriented concepts and programming techniques. It also covers essential data structures such as linked lists, stacks, and queues, and trees. The student will be expected to produce larger applications, utilizing multiple compilation units.

Prerequisite: COMS 211 F, S

#### COMS 230 (4) Intelligent Systems

This course offers a hands-on approach to non-algorithmic problem solving. The course covers fundamental material on data mining and knowledge discovery. Several data mining methods including decision tree algorithms, association rule generators and neural networks are detailed. Rule-based systems and intelligent agents are introduced as methods for building decision-making models. Students learn how to apply data-mining tools to real-world problems.

Pre: COMS 100, 101, or 110 Variable

#### COMS 260 (4) Assembly Language Programming

Assembly language programming techniques. Machine level data representations, instructions, and addressing modes. Accessing operating system facilities using assembly language, writing and using macros.

Pre: COMS 212 F, S Variable

#### COMS 270 (1-4) Introduction to Selected Programming Language

This course provides an overview of a selected high-level programming language. Special features of the language will be emphasized, along with its control structures, input/output, storage structures, and abstraction mechanisms. May be repeated for different languages.

Pre: COMS 211 Variable

#### COMS 271 (4) C++ Programming

This course is intended to provide an overview of object-oriented programming using C++. The coverage of material ranges from traditional structured programming features of C++ such as functions, pointers, and arrays to object-oriented features such as classes, inheritance, and polymorphism. The course also includes real-world application examples.

Variable

#### COMS 272 (4) Fortran Programming

To learn the algorithmic programming language FORTRAN to solve scientific, engineering and mathematical problems.

Pre: COMS 100 or 211 Variable

#### COMS 296 (1-2) Introduction to Selected Topics

Special topics not covered in other 100- and 200-level courses. May be repeated for each new topic. Does not apply towards major.

#### COMS 310 (4) Data Structures & Algorithms

Study of trees, hashing, and graph algorithms. Analysis of algorithms, memory management, and proof techniques.

Pre: COMS 212, MATH 180 or 121 F, S

#### COMS 320 (4) Machine Structures and Programming

Introduction to computer hardware and its design including Boolean logic, basic digital circuits, number representations and digital arithmetic, instruction set design, digital storage, performance metrics, processor datapath and control, pipelining, memory hierarchy, busses and I/O interfacing, parallel processors.

Pre: COMS 212, MATH 180 or 121 F, S

#### COMS 321 (4) Micro Configuration & Maintenance

Provides a working knowledge and hands-on experience with configuring, upgrading, optimizing, troubleshooting and repairing personal computer hardware, networks and system software. Preventative maintenance and emergency recovery techniques.

Pre: Jr/Sr status or consent Variable

#### COMS 340 (4) Database Management Systems I

Introduction to the concept of database systems; database models; database management systems; file organization; design of databases using data modeling and normalization; conversion of data model into relational, network, and hierarchical data models; extensive coverage of SQL and implementation of an application using a relational database in a team environment.

Pre: COMS 212 F, S

#### COMS 350 (4) Operations Research I

A first course in decision theory and linear programming. Topics covered include problem modeling, decision analysis, forecasting, inventory systems, and linear programming, including the SIMPLEX method, duality, sensitivity analysis, and various applications such as the transportation problem, network flow problems, and project management.

Pre: COMS 212, MATH 180 or 121, and STAT 154 Variable

#### COMS 360 (4) Systems Programming

Machine level I/O and operating system file processing. Structure of systems programs including assemblers, linkers, and object oriented utilities and interfaces. Writing utility programs and extensions to an operating system.

Pre: COMS 212 Variable

#### COMS 361 (4) Windows Programming

This course addresses programming Microsoft Windows 95 to Windows XP. Course approach is at the API level and uses Visual C++. The course covers topics such as: event-driven paradigm, API programming, application and graphics support services, drawing geometrical figures, bitmapped graphics, and DirectX fundamentals.

Pre: COMS 212 Variable

#### COMS 362 (4) Introduction to Data Communication and Networking

This course covers basic concepts related to data communication and networking. Topics addressed will include the OSI model, the Internet model, network management, network protocols and data security.

Pre: COMS 212 F, S

#### COMS 370 (4) Concepts of Programming Language



A comparative approach to general concepts of current higher-level programming languages. Various programming language paradigms will be covered, including imperative, object-oriented, functional, and logical.

Pre: COMS 310 S

### COMS 371 (4) Applications Programming

This is a course in application program development designed to simulate large scale development. Students will be introduced to the programming language, COBOL, but the emphasis of the course will be on principles of application programming such as, control breaks, table manipulations, file manipulations, sorting, interactive programming, sub-programming, index-sequential file handling, structure charts, and program documentation.

Pre: COMS 212

### COMS 380 (4) Systems Analysis & Design

This course explores both structured as well as object oriented systems analysis and design. Use of upper and lower CASE tools are employed in the analysis, design and implementation of a team oriented term project.

Pre: COMS 212 F, S

### COMS 410 (4) Abstract Machines and Grammars

This course studies the computational ability of a variety of computational models including finite state machines, regular expressions, context-free grammars, and Turing machines. For each model, the student will develop, study and apply techniques for determining those languages which are computable using the particular model.

Pre: MATH 375 F

### COMS 412 (4) Graphics

Concepts and algorithms used in computer graphics, including polygonal and curved images in both 2 and 3 dimensions, representation of solid objects, and color and illumination models.

Pre: COMS 310, MATH 247 On Demand

### COMS 420 (4) Advanced Computer Organization

Advanced topics in computer architecture including a major emphasis on measuring and improving computer performance. Topics include advances in pipelining and analysis and optimization of storage systems and networks, multiprocessor challenges and trends.

Pre: COMS 320 Variable

### COMS 430 (4) Artificial Intelligence

Artificial intelligence problem solving techniques including predicate logic and the resolution principle, artificial intelligence programming languages, machine learning, neural network models and object oriented methods are discussed.

Pre: COMS 230 or COMS 212 S

### COMS 432 (4) Robotics

Current practice and future directions in robotics including robot anatomy, kinematics, sensors, sensor interfacing and fusion, mobile robotics, real-time programming, vision and image processing algorithms, subsumption architecture.

Pre: COMS 260 or 320 S

### COMS 440 (4) Database Management Systems II

Extensive coverage of query processing and optimization; concurrency control and recovery, and security and integrity in centralized/distributed environments. Team-oriented projects in a heterogeneous client server environment.

Pre: COMS 212 F, S

### COMS 450 (4) Operations Research II

A second course in operations research for majors and non-majors. Topics include computer simulation, game theory, stochastic processes, queuing theory, Markov processes, and reliability. Simulation topics include Monte Carlo methods, discrete and continuous simulations, simulation languages and packages.

Pre: COMS 350 and STAT 354 Variable

### COMS 460 (4) Operating Systems

This course covers basic operating systems concepts including processes, interprocess communication, interprocess synchronization, deadlock, memory allocation, segmentation, paging, resource allocation, scheduling, performance evaluation, file systems, storage, devices, protection, security, privacy and distributed systems.

Pre: COMS 320 F

### COMS 462 (4) Communication Protocols

Advanced coverage of data communication and networking protocols with an emphasis on protocol design and implementation. Topics addressed will include data transmission methods, error detection and recovery, flow control, routing, data throughput, and performance analysis of existing and emerging Internet protocols.

Pre: COMS 362 Variable

### COMS 463 (4) Client/Server and Web Applications

Introduction to distributed and client/server systems. Network operating systems to support C/S. Database servers. Client server and the Internet. Distributed objects. Web-based application development on PC and UNIX platforms. The principal functions of web servers and how they handle clients. CGI, ASP, JSP, JDBC, JavaBeans, Active-X, Servlets.

Pre: COMS 362. FS

### COMS 464 (4) Mobile Applications and Networks

This course provides an understanding of existing and emerging mobile and wireless data networks, with an emphasis on digital data communications. Students will gain an understanding of the unique considerations that must be given to network protocols for wireless and mobile communication as well as their applications.

Pre: COMS 362, COMS 310 Variable

### COMS 465 (4) Parallel and Distributed Processing

This course offers an introduction to technical issues related to parallel and distributed systems. Topics addressed included parallel and distributed programming languages, parallel algorithm design and analysis, and parallel and distributed architectures. The course includes practical parallel programming experiences.

Pre: COMS 362 Variable

### COMS 470 (4) Compiler Construction

Principles and techniques of compiler construction. Development of efficient parsers and scanners; manual and automatic approaches. Optimization techniques and code generation.

Pre: COMS 370 Variable

### COMS 480 (4) Software Engineering

This is a course in software engineering that introduces the student to all important aspects of the discipline. The main purpose of this course is to simulate the engineering of a software product, from gathering requirements through implementation and maintenance. The course emphasizes a traditional development methodology. Students will be introduced to Visual Basic and Microsoft Project, but the emphasis of the course will be on principles of software engineering including project planning, requirements gathering, size and cost estimation, analysis, design, coding, testing, and implementation.

Pre: COMS 380 F, S

### COMS 481 (4) Rapid Application Development

In-depth understanding of low and high CASE tools and rapid application development. CASE tools will range from the traditional software development life cycle to object-oriented client/server environments. Extensive team-oriented applications will be developed using tools such as SYNON, OBSYDIAN, Power Builder, and MSSQL server.

Pre: COMS 340 Variable

### COMS 491 (1-6) In-Service in Computer Science

This course is designed to meet the needs of kindergarten through twelfth

grade practicing teaching majors who wish to enhance their technology-related skills and knowledge. Both lab and lecture activities are used to provide participants guided experiences with current applications of technology.

Pre: Consent Variable

#### COMS 492 (3) Computers in the Classroom

Using both a lecture and lab format, this course provides students with a foundation for developing computer-delivered instruction within the classroom by examining the hardware and software which are part of emerging technologies, and the research issues associated with the developing effective instruction using the computer.

Pre: Senior status Variable

#### COMS 493 (3) Computer-Based Instructional Systems

This course provides participants with opportunities to develop, implement, and assess formative and summative evaluation instruments; identify researchable issues in computer-delivered instruction; develop computer-delivered instruction using a sophisticated authoring tool.

Pre: Senior status Variable

#### COMS 495 (1) Seminar in Computer Science

Provides Computer Science majors and minors an opportunity to explore a topic not normally covered in the curriculum, in a small-group setting.

Pre: Consent F, S

#### COMS 496 (1-4) Selected Topics in Computer Science

Special topics not covered in other courses. May be repeated for credit on each new topic.

Pre: Consent Variable

#### COMS 497 (1-12) Internship

This course is designed to provide students with an opportunity to utilize their training in a real-world business environment. Participants work under the guidance and direction of a full-time staff member. (At most 6 hours toward a major in this department.)

Pre: Permanent admission to the CS, CIS, or MIS major, completion of four courses from COMS 310, 320, 340, 362, 380, and consent. F, S

#### COMS 499 (1-2) Individual Study

Problems on an individual basis.

Pre: Consent F, S