



**INDIANA UNIVERSITY SOUTH BEND
COLLEGE OF LIBERAL ARTS AND SCIENCES**

DEPARTMENT OF COMPUTER AND INFORMATION SCIENCES

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INTRODUCTION

The department began offering degrees in computer science in 1983. Today we have over 200 declared majors in computer science. We offer a Bachelor of Science degree, an Associate of Science degree, two certificate programs, a minor in computer science, and a minor in cognitive psychology. Recently, through our joint partnership with the School of Business and Economics, we developed a new Master of Science degree in Management of Information Technology. In addition, our Master of Science in Applied Mathematics and Computer Science has been approved by the Indiana Higher Education Commission and we hope to begin accepting students for the Fall of 2002.

MESSAGE FROM THE FACULTY

Our mission is to provide the highest quality education in the most enjoyable and friendly atmosphere possible. In pursuing this mission we work hard to attract the best and most qualified faculty to our program. We also work hard to build and maintain up-to-date computer laboratories. These play an essential role in our programs. Through our internship program as well as our faculty consulting and volunteering, we interact regularly with our local industry so that we continually exchange ideas to the mutual benefit of both the business community and the university. Our goal is to bridge the gap between theories and concepts presented in the classroom and real life business and industry needs and practices.

We have charted a course to develop many exciting and challenging projects over the next five years. Some of these are given below:

- Ž Continue to refine our joint masters program with School of Business and Economics (MS-MIT).
- Ž Implement and refine our joint masters program with Mathematics (M.S. in Applied Mathematics and Computer Science).
- Ž Develop a masters program in computer science.
- Ž Develop a bachelors program in Informatics.
- Ž Prepare for accreditation of our B.S. in Computer Science by the Computer Science Accreditation Board (CSAB). Accreditation will externally validate the quality that already exists in our programs.

In addition to the above, we plan to continue to

- Ž improve our teaching and research environment for our students and faculty, and aggressively recruit the best and brightest to our department.
- Ž improve our laboratories.
- Ž expand our community outreach program.
- Ž mentor our students, and support their learning, research and creative activities.

If you are considering majoring in computer science, we would be pleased to hear from you.

COMPUTER SCIENCE FACULTY

FULL TIME FACULTY

Bolotin-Schwartz, Ruth, Ph.D. in Business Administration with a double major in Computer Information Systems and Operations Research (Temple University), M.S. degree in Computer Science (University of California, Los Angeles), BA degree in Liberal Arts with a major in mathematics (Northwestern University). Teaching and research interests: Curriculum development, database systems, enterprise resource planning, and programming languages.

Hakimzadeh, Hossein, Ph.D. in Computer Science (North Dakota State University, 1993). Research interests: database management systems; operating systems; distributed systems, object-oriented software engineering.

Knight, William, Ph.D. in Mathematics (University of California, Berkeley, 1969), M.Sc. in Statistics (Pennsylvania State University, 1977), M.Sc. in Computer Science (University of Illinois, Urbana, 1986). Research interests: analysis of algorithms; data structures.

Russo, John, Ph.D. in Mathematics (Florida State University, 1965). Research interests: program efficiency; software engineering.

Scheessele, Mike, ABD in Quantitative and Mathematical Psychology (Purdue University). Research interests: Cognitive science and artificial intelligence, especially psychologically plausible artificial vision and problem-solving systems. Additional interests include software engineering, information systems, and information assurance and security issues.

Surma, Dave, Ph.D. in Computer Science and Engineering (University of Notre Dame 1998). Research interests: Parallel and Distributed Computing, Multimedia applications, Computer Architectures, High-Performance Networks, and Software tools for parallel and distributed computing systems.

Vrajitoru, Dana, D.Sci. in Computer Science (University of Neuchâtel, 1997). Research interests: genetic algorithms; scientific visualization; parallel computation; information retrieval; artificial intelligence.

Wolfer, James, Ph.D. in Computer Science (Illinois Institute of Technology, 1993). Research interests: harnessing the power of naturally inspired computation to solve real-world problems, visualization in science and medicine, cognitive science and computer science education.

PART TIME ASSOCIATE FACULTY

James Champaigne
Matt Holloway
Rebecca Hartman
Judith Hoffacker
Lou Landman
John Madigan
Roberta Ritschard
Kurt Traxler
Bill Wolf

OVERVIEW OF THE DEPARTMENT

The IUSB Computer Science program has eight full-time faculty members and a number of part-time instructors. It offers a full range of courses in computer science and information technology. Currently, the department offers a Bachelor of Science degree in computer science, a two-year Associate of Science degree in computer science, two Certificates in Computer Programming, a minor in computer science, and a minor in cognitive science (offered jointly with the Psychology and Philosophy departments). Students in the Division of Arts may earn a Complementary Major in computer science. Finally, the department offers courses to support the Master of Science degree in Management of Information Technologies given by the Division of Business and Economics. Any student who wishes to major in computer science should contact the associate chair of Computer Science as soon as possible. An appointment can be made by calling 237-6521.

EQUAL OPPORTUNITY

The department recruits majors without regard to race, sex, religion, nationality, or physical disability, and seeks to provide every student equal access to all its facilities and degree programs. Indeed, we welcome diversity among our students as a positive factor in learning.

FURTHER INFORMATION

Members of the department are happy to answer questions about our programs at any time. Drop by the department or give us a call at (219) 237-6521. Alternatively, you may browse our department's web site at <http://www.cs.iusb.edu>

COMPUTER SCIENCE PROGRAMS

Currently, IUSB offers a Master of Science degree, a Bachelor of Science degree and a two-year Associate of Science degree in computer science. Students majoring in computer science at IUSB will take a course of study modeled after the recommendations of the Association for Computing Machinery. C++ is the principal programming language at IUSB, but Scheme, Java, Visual BASIC, and other languages are offered.

All computer science majors must complete a core curriculum of courses that build an overall understanding of the computer, computing environments, and theoretical and ethical issues important in the computer related professions.

Computer Science students work in a variety of computing environments at IUSB. In the first two courses (C101 and C201) students work on DOS/Windows based microcomputers. Many subsequent courses involve working in a UNIX environment available in departmental laboratories. The departmental UNIX machines are also available over phone lines for students who wish to have remote access. The IUSB campus is an Internet site, so students have access to electronic mail and the World Wide Web.

BACHELOR OF SCIENCE IN COMPUTER SCIENCE

The degree requires a total of **122** credit hours including the following:

<p>Area 1 (English Composition) W131, or equivalent.</p>	
<p>Area 2 (Foreign Language) Six credit hours in a single foreign language, or equivalent (e.g., 3 years of a single foreign language in high school with at least a C average).</p>	
<p>Area 3 (Foreign Language/Business) Completion of <i>one</i> of the following three options: a) Six credit hours at the second year level in a foreign language; OR b) Six credit hours at the first year level in a second foreign language; OR c) Five courses in Business and Economics, including Accounting A201, A202 (or A311, A312), and courses from at least two other departments in Business and Economics. K201 and E270 are excluded from the list of five courses. Economics courses fulfill this requirement and requirement 5a below simultaneously.</p>	
<p>Area 4 (Arts and Humanities) One course from each of the following three areas, plus a fourth course in any one area. a) Fine Arts; Music M174; Communication Arts (except S160). b) English (except W131); Foreign Languages (only advanced courses of a literary nature). c) History, Philosophy, Religious Studies.</p>	

<p>Area 5 (Social and Behavioral Sciences) Four courses from the following areas, to include at most two in any one area. a) Economics; Geography; Political Science. b) Psychology. c) Sociology/Anthropology; Linguistics.</p>	
<p>Area 6 (Natural Sciences) Thirteen credit hours in courses selected from chemistry, physics, geology, biology, and astronomy. At least two disciplines must be selected. At least one of the courses must have a laboratory component. Physics P303 is recommended.</p>	
<p>Area 7 (Mathematics) Thirteen credit hours of Mathematics to be satisfied by taking M215, M216, and M301.</p>	
<p>Area 8 (Computing) Forty-four credit hours in computer science, to be satisfied with the following courses: Core: C101, C201, C243, C251, C308, C311, C335, C435, C455, and Electives: at least three additional computer science courses at or above the 300 level. Possible choices for these three courses include the internship course (Y398), computer hardware and digital design (C421), compiler design (C431), information organization and retrieval (C441), database systems (C442), artificial intelligence (C463), computer networks (B438), graphics (C481), advanced PC techniques (C490), and Object Oriented Programming in Java (C490). Math Electives: The mathematics courses M447, M448, M471, and M472 may be counted here as computer science courses.</p>	

**A POSSIBLE PROGRAM FOR COMPUTER SCIENCE
MAJORS**

	<u>FALL</u>	<u>SPRING</u>
1st. YEAR	C101 (4) M215 (5) W131 Eng. Comp. (3) Foreign Language (3)	C201 (4) M216 (5) Arts & Humanities (3) Foreign Language (3)
2nd. YEAR	C243 (4) M301 (3) P281 (3) Physics Social Science (3) Foreign Language (3)	C335 (4) C308 (4) P303 (3) Physics Foreign Language (3)
3rd. YEAR	C251 (3) C311 (4) Arts & Humanities (3) Natural Science (3) Social Science (3)	C455 (4) C.S. Elective Natural Science (5) Social Science (3)
4th. YEAR	C.S. Elective C.S. Elective Arts & Humanities (3) Social Science (3) Elective (3) Elective (3)	C435 (4) Arts & Humanities (3) Elective (3) Elective (3)

ASSOCIATE OF SCIENCE IN COMPUTER SCIENCE

This degree requires a total of 61 credit hours. These are broken into Concentration Requirements and General Requirements.

Concentration Requirements: C101, C201, C243, and at least three more courses in computer science above the level of C201. (The word "course" here means at least 3 credit hours) A minimum of 21 credit hours total are required.

Basic requirements: English Composition W131 or equivalent (3 credit hours); arts and humanities (6 credit hours); social and behavioral sciences (6 credit hours); natural sciences (8 credit hours); foreign language (6 credit hours); and Mathematics M119 or M215 (3 or 5 credit hours).

**A POSSIBLE PROGRAM FOR THE ASSOCIATE OF
SCIENCE IN COMPUTER SCIENCE**

	<u>FALL</u>	<u>SPRING</u>
1st. YEAR	C101 (4) M215 (5) W131 (3) English Composition M174 (3) Music for the Listener	C201 (4) A100 (3) Astronomy E104 (3) Economics H105 (3) History P103 (3) Psychology
2nd. YEAR	C243 (4) C335 (4) P281 (3) Physics Foreign Language (3)	C308 (4) C.S. Elective (3-4) P303 (3) Physics Foreign Language (3)

CERTIFICATES IN PROGRAMMING

The department offers two separate certificate programs: a Certificate in Computer Programming and a Certificate in Advanced Computer Programming. These certificates are intended primarily for students who are seeking or already hold a degree in some other subject but who wish to acquire some of the skills practiced by well-trained professional programmers.

Certificate in Computer Programming	Certificate in Advanced Computer Programming
<p>This certificate requires completion of the following three 4-credit courses at IUSB with a grade of C or better:</p> <p>C101 Computer Programming I C201 Computer Programming II C243 Introduction to Data Structures</p>	<p>This certificate requires completion of the following six courses with a grade of C or better. At least five of these courses must be taken at IUSB.</p> <p>C101 Computer Programming I C201 Computer Programming II C243 Introduction to Data Structures C308 System Analysis and Design C335 Computer Structures One elective chosen from the following (C251, C311, C421, C441, C442, C481, C490, B424, B438)</p> <p>A student may earn the first Certificate and then later complete three additional courses to earn the Advanced Certificate.</p>

In addition, the student must take and pass W031 Pre-Composition with a grade of C or better, or else score at a non-remedial level (i.e., at a level that would permit them to take W131 English Composition) on the IUSB placement exam in Composition.

Note: The college of LAS does not allow a student to obtain a certificate and an A.S. or B.S. degree in computer science in the same semester.

MINOR IN COMPUTER SCIENCE

This requires a minimum of 21 credit hours of computer science consisting of six courses, to include C101, C201, C243, and three more courses in computer science above the level of C201.

MINOR IN COGNITIVE SCIENCE

This consists of at least 15 credit hours of courses chosen from the following:

Computer Science:	C101, C201, C243, C251, C463
Mathematics:	M343, M344, M360, M366, M447
Philosophy:	X100, X200, X220, P250, P312, P313, P320, P360, P366, P383
Psychology:	P325, P326, P329, P335, P390, P423, P438, P459, P495
Cognitive Science:	P200(Phil), P390(Phil)

The Cognitive Science courses may be used in the cognitive science minor when offered with the subtitle "Introduction to Cognitive Science". When so offered, the course content will be interdisciplinary, drawing from some or all of these areas: philosophy, psychology, computer science, linguistics, neuroscience, anthropology, and/or mathematics. The primary goal of the course is to survey cognitive science as a whole and to demonstrate both its unity and its eclectic nature. A seminar format will be used.

In addition, the following conditions must be met:

1. One of the Cognitive Science courses must be included in the program.
2. At least 3 credit hours from each of the areas of computer science, philosophy, and psychology must be included in the program. Students majoring in computer science must take an additional course in one of the other areas (none of the courses listed in Computer Science can count toward both a major and a minor).

A minor program in Cognitive Science requires approval by the Cognitive Science Committee. In particular, courses marked with an asterisk in the above list have greatly varying content, so their acceptability in a minor program will be determined by the committee. Credit cannot be earned for both C297 and C463 when the former is offered under the title "Introduction to Artificial Intelligence". Also, credit cannot be earned for both X355 and X410. Courses not listed above may be included with permission of the committee. Such courses are not restricted to the areas of computer science, psychology, and philosophy; they may also be appropriate courses from anthropology, linguistics, or neuroscience.

COMPLEMENTARY MAJOR IN COMPUTER SCIENCE

Students with majors in the Division of Arts may earn a Complementary Major in computer science. Students must complete at least 30 credit hours in computer science, to be satisfied with C101, C201, C243 and other courses above the level of C201.

MASTER OF SCIENCE IN APPLIED MATHEMATICS AND COMPUTER SCIENCE

This graduate degree is offered jointly with the Department of Mathematical Sciences at IUSB. The goal of this program is to address the needs of people who already have work experience in technical or quantitative fields, people with undergraduate degrees in science or business, or people who simply wish to increase their level of skills and expertise in computing and applied mathematics.

Prospective students would begin with a flexible core curriculum in both computer science and applied mathematics, and then proceed to specialize in their desired fields. We anticipate that students with the proper background could complete the 36 credit program in two years. In addition students would be able to tailor a program to their needs with the help of an advisor. The emphasis throughout the curriculum would be on the real-world problems and applications likely to be encountered in business and industry.

ADMISSION REQUIREMENT

Candidates for admission to the program are required to hold a baccalaureate degree from an accredited institution with a minimum GPA of 3.0 and promising application materials. An applicant whose past academic record is not sufficiently strong (low GPA, undergraduate degree completed too long ago and work experience not in the field) could qualify for admission by scoring 600 or higher on at least one GRE. Although no specific undergraduate field of study is required, students with satisfactory competence in undergraduate study of basic computer and mathematics subjects would be encouraged to apply. Generally, these would be graduates with undergraduate degrees in mathematics, computer science, chemistry, physics, biological sciences, engineering, secondary mathematics education, business, economics, and other technical fields. Students who do not have appropriate background in computer science and/or in mathematics are also welcome, and they would be allowed to take the necessary pre-requisite course work. In addition to the above, applicants whose native language is not English should

submit proof of such proficiency (TOEFL) by the time they apply for admission. A minimum TOEFL score of 550 is required.

DEGREE REQUIREMENT

The program will be tailored to individual student needs, and will consist of 36 credit hours, including 30-33 hours of course work and 3-6 hours of a thesis or graduate project. A student will choose to specialize either in computer science or in applied mathematics. The core courses for each of those disciplines are as follows.

Ž *Computer Science Core:* Algorithm Design and Analysis, Networks and Distributed Computing, Advanced Database Concepts, Advanced Computer Graphics.

Ž *Applied Mathematics Core:* Statistical Design of Experiments, Analysis of Numerical Methods, Forecasting, Simulation Modeling.

A student will also take at least 3 courses in the complementary discipline. Courses will be designed with industrial practice in mind, and the problems and examples students encounter in the classroom will be like those they can expect to encounter in their professional lives. Students requiring additional background will be allowed to take up to 9 hours of undergraduate 400 level course work. Both full-time and part-time study will be possible.

THESIS

Students will be required to complete a thesis or project. The project should involve a substantial level and amount of work which reflect what a student learned in coursework, it should have applications to industry or business, and it should have strong academic merit. In preparation for the project, a student should identify to the program's graduate studies director a project committee. The committee will consist of a faculty member in the student's discipline to serve as project advisor, a faculty member in the other discipline, and a third person who may be faculty from within or outside of the department, or who may be an appropriate individual in business or industry. The student should submit a project proposal to the committee for approval. The project itself should be reported in a thesis format, and defended before the committee. Copies of the final version of the thesis will be archived in the department and library. Note that there will be no comprehensive exams; in particular, a student finishes the program by finishing a project.

COURSES OFFERED FOR GRADUATE CREDIT

Students must first choose a concentration in either Computer Science or Applied Mathematics. The core courses for each concentration are shown in Table A.

Table A - Core Requirements	
For students specializing in Computer Science	For students specializing in Mathematics
B503 - Algorithms Design and Analysis B538 - Networks and Distributed Computing B561 - Advanced Database Concepts B581 - Advanced Computer Graphics	M562 - Statistical Design of Experiments M571 - Analysis of Numerical Methods M5xx - Forecasting M5xx - Simulation Modeling

In addition to the core, students will be allowed to take at most 3 courses from the following list (Table - B) to prepare for advanced level courses.

Table B - Preparatory Courses	
Computer Science	B403 - Analysis of Algorithms (same as C455) P423 - Assemblers and Compilers I (same as C431) P436 - Operating Systems I (same as C435) B438 - Computer Networks B441 - Computer Organization (same as C421) C441 - Information Organization and Retrieval B461 - Database Systems (same as C442) C463 - Artificial Intelligence B481 - Interactive Computer Graphics C490 - Seminar in Computer Science C490 - PC Techniques
Mathematics	M471 - Numerical Analysis I M472 - Numerical Analysis II M447 - Mathematical Modeling I M448 - Mathematical Modeling II

ADVANCED COURSES

Students will be required to select their advanced courses from Table C below according to their needs and interests.

Table C - Advanced Courses	
Course Titles	
Computer Science	B503 - Algorithms Design and Analysis P536 - Advanced Operating Systems B538 - Networks and Distributed Computing B541 - Hardware System Design I B551 - Elements of Artificial Intelligence B561 - Advanced Database Concepts B565 - Software Engineering I B581 - Advanced Computer Graphics B582 - Image Synthesis B651 - Natural Language Processing B661 - Database Theory and Systems Design B665 - Software Engineering Management Y790 - Graduate Independent Study - Thesis
Mathematics	M546 - Control Theory M562 - Statistical Design of Experiments M569 - Statistical Decision Theory M571-572 - Analysis of Numerical Methods I,II M5xx - Operations Research M5xx - Transform Methods M5xx - Simulation Modeling M5xx - Forecasting M5xx - Sampling

SAMPLE CURRICULA FOR MS IN APPLIED MATH AND CS

Although some students will need prerequisite courses, the following two tables represent a typical two year schedule for a student specializing in computer science or mathematics.

Table D - For a student specializing in Computer Science	
1 st . Year	2 nd . Year
Fall M471 - Numerical Methods (3) B565 - Software Engineering I (3) B503 - Algorithms Design and Analysis (3)	Fall B581 - Advanced Computer Graphics (3) B551 - Elements of Artificial Intelligence (3) M5xx - Simulation Modeling (3)
Spring B561 - Advanced Database Concepts (3) B538 - Networks & Distributed Computing (3) M562 - Statistical Design of Experiments (3)	Spring B661 - Database Theory & Sys. Design (3) B582 - Image Synthesis (3) Y790 - Grad. Independent Study - Thesis (3)

MASTER OF SCIENCE IN MANAGEMENT OF INFORMATION TECHNOLOGIES

This graduate degree is given by the Division of Business and Economics. It requires between 21 and 63 credit hours, depending on the undergraduate background of the student entering the degree program. Highly qualified students may apply for exemption for various courses listed below. For students with no background in business or computer science, the curriculum is as follows:

Phase 1: Mathematics and Statistics Core (2 courses)
 Statistical Applications
 Mathematics Tools in Business

Phase 2: Basic Business Core (9 courses)
 Survey of Financial Accounting & Reporting
 Management Information Systems
 Survey of Economics
 Organizational Behavior
 Legal/Ethical Environment of Business
 Management of Marketing
 Financial Management
 Production Management
 Managerial Decision-Making Models

Phase 3: Basic Applied Computing Core (4 courses, to include the first three of the following)
 Object Oriented Programming
 Database Management Systems
 Telecommunications and Computer Networking
 Web Site Development Techniques
 Enterprise Resource Planning

Phase 4: Advanced Business Core (4 courses)
Management of IT Projects
Decision Support Systems
Electronic Commerce
Business Process Re-engineering Using IT

Phase 5: Capstone Project Core (2 courses)
Seminar in Management of Information Technologies I
Seminar in Management of Information Technologies II

Admission into the program requires a bachelor's degree from an accredited college or university, a satisfactory score on the GMAT exam, satisfactory undergraduate academic performance, and letters of recommendation. Experience in the workplace is strongly recommended.

Students interested in this degree program should contact the Division of Business and Economics or the IUSB Office of Graduate Programs.

COURSE DESCRIPTIONS

UNDERGRADUATE NON-MAJOR COURSES

A106 Introduction to Computing (3 cr.)

Fundamentals of computer hardware and software; use of packaged programs in areas such as word processing, spreadsheets, database management, communications, graphics; the role and impact of computers in society. Course is designed for people with little or no computer experience. One class per week is spent in the microcomputer teaching laboratory. *This course is not intended for computer science majors.*

A107 Programming Within Applications (3 cr.)

UNDER CONSTRUCTION

P: A106 or equivalent.

A150 Understanding Operating Systems (1 cr.)

UNDER CONSTRUCTION

P: A106 or equivalent. Study of the basic concepts of operating systems, understanding the role of operating systems in providing a virtual machine interface. Understanding the relationship between the hardware and operating system. Survey of the user level operating system facilities and commands. *This course is not intended for computer science majors.*

A201 - Introduction to Programming I (4 cr.)

UNDER CONSTRUCTION

R: M014, A106. Fundamental programming constructs, including loops, arrays, classes, and files. General problem-solving techniques. Emphasis on modular programming, user-interface design, and developing good programming style. Not intended for computer science majors. (VB or Java). *This course is not intended for computer science majors.*

A247 Network Technologies and Administration (3 cr.)

UNDER CONSTRUCTION

P: A106, or equivalent computer literacy. Introduction to network principles and current network technology, both hardware and software. Network administration tools and techniques. Laboratory provides practical experience. *This course is not intended for computer science majors.*

A340 Introduction to Web Programming (3 cr.)

UNDER CONSTRUCTION

P: C101. An introduction to programming web documents, including HTML, JavaScript and Perl. Creation of a simple web site, including a home page with dynamic elements, using both client-side and server-side techniques. *This course is not intended for computer science majors.*

UNDERGRADUATE CS-MAJOR COURSES

C101 Computer Programming I (4 cr.)

P: M014 or equivalent. Fundamental concepts of algorithm development, modularity and program design, computer programming. The programming language used will be C++. [An exemption exam is available to students who already have some knowledge of C++.]

C151 Multiuser Operating Systems (2 cr.)

UNDER CONSTRUCTION

R: C101. Survey of the operating system facilities and commands. Installation and maintenance of operating systems such as Linux. Understanding process management, file systems, memory and virtual memory management issues. Understanding networking and its role in modern computing environment. Operating system security. Writing shell scripts and batch files.

C201 Computer Programming II (4 cr.)

P: C101. Fundamental concepts of computer science, including top-down design, data structures, structured control flow, modular programming, recursion and standard algorithms. Programming language concepts are illustrated with C++.

C243 Introduction to Data Structures (4 cr.)

P: C201, C: C151. Abstract data types; implementations using various data structures and algorithms; elementary algorithm analysis; space/time trade-offs; sorting and searching; object oriented design and programming; software engineering principles.

C251 Foundations of Digital Computing (3 cr.)

P: C243; (M215 or M119). Mathematical foundations of computing, including mathematical induction, propositional logic, proofs of correctness. Finite graph theory and algorithms. Complexity classes and NP-completeness.

C297 Sophomore Topics in Computer Science (2-3 crs.)

Contents and prerequisites vary from year to year. (This course may count towards a minor or Associate of Science, but not a bachelor's degree.)

C308 System Analysis and Design (4 cr.)

P: C243. The software development life cycle structured top-down and bottom-down design; data flow diagramming; entity relationship modeling; study of computer aided software engineering; I/O design and validation; file and database design; design of user interfaces; comparison of structured vs. object oriented design. A team project will be completed.

C311 Organization of Programming Languages (4 cr.)

P: C243 and C335. Design and implementation of programming languages: syntax; semantics; comparison of programming paradigms such as imperative, functional, logic, and object oriented.

Implementation of concepts such as binding, scope, parameter passing, looping, branching, subprograms, tasks and concurrency, heap management, exception handling, templates, inheritance, overloading.

C335 Computer Structures (4 cr.)

P: C201. Computer architecture and machine language; internal data representation; assembly systems; program segmentation and linking; I/O devices; serial communication. Projects to illustrate basic machine structure and programming techniques.

Y398 Internship - Professional Practice (3 cr.)

P: C308, C335, and one additional course in computer science above the level of C243. Enrollment requires that the student be accepted as a temporary employee of an organization or business. The work must offer the student challenging computer experience in a closely supervised position. The student will report weekly to the faculty member in charge. Prior approval of the position is required. The course can be taken twice for a total of 6 credits, but only 3 credits can be used to satisfy the requirements for computing electives.

C421 Computer Organization (3 cr.)

P: Physics P303, C243, C335. Principles of logic design; addressing; central processing units; microprogrammed versus hardwired control; input-output organization, interrupts; other topics chosen by the instructor.

B424 Parallel and Distributed Programming (3 cr.)

UNDER CONSTRUCTION

P: C243, M301. Overview of parallel computers, shared memory, message passing, MIMD and SIMD classifications. Understanding and use of message passing and synchronization facilities such as MPI. Study of parallel programming models such as master-slave, client-server, task-farming, divide-and-conquer and pipelining. Performance analysis of parallel systems, execution time, time complexity, load balancing and scalability.

C431 Assemblers and Compilers I (3 cr.)

P: C311. Analysis and implementation of a compiler for a high level programming language. Relationship between regular languages, finite automata, lexical analysis, and scanner generators such as lex. Relationship between context-free grammars, stack machines, parsers, and parser generators such as yacc and lgen. Symbol tables and semantic analysis for translating declarations, expressions, assignments, I/O, control structures, and subroutines. Large programming project.

C435 Operating Systems I (4 cr.)

P: C251, C308, and C335. R: C311. Design and implementation of operating systems: the process model, process synchronization, semaphores, deadlock management, multi-tasking, multi-threading, interprocess communication, process scheduling, memory management, paging, segmentation, virtual memory management, file system design and implementation, I/O device drivers, interrupt handlers and spoolers. Students will complete the design and implementation of a simulated multi-tasking operating system.

B438 Computer Networks (3 cr.)

P: C243 and C335. Fundamental concepts and technologies used in design of computer networks. Architecture and design philosophy of Internet and basic performance issues. Low-level technologies like Ethernet and wireless. Packet switching and virtual circuits. Core protocols of the Internet, such as TCP and IP. Error control, congestion control, and routing.

C441 Information Organization & Retrieval (3 cr.)

P: C243. Fundamental structures and algorithms for the management of secondary storage devices: persistence; sharability; file and database organization; fields; records; transactions; hardware concepts of storage devices; sequential, random, indexed, hashed, and B-tree files; operations on files; search; sort; performance issues.

C442 Database Systems (3 cr.)

P: C308. The fundamental concepts, theory, and practices in the design and implementation of database management systems: data independence; data modeling; entity relationship modeling; functional dependencies; normalization; relational, hierarchical, network, and object oriented data models; relational algebra; relational calculus; data definition and manipulation languages; recovery; concurrency; security; integrity of data.

C455 Analysis of Algorithms (4 cr.)

P: C251 and M216. R: M301. Mathematical analysis of time and space requirements for algorithms, using combinatorics, recurrence relations, and elementary probability theory. Turing machines and decidability.

C463 Artificial Intelligence (3 cr.)

P: C251. R: C311. Techniques and principles of artificial intelligence and implementations of some of these techniques. Various formalisms for representing knowledge, and relationships of this to such tasks as inference, game playing, and machine learning.

B481 Interactive Computer Graphics (3 cr.)

P: C243, Math M301. An introduction to interactive programming: design and implementation of graphical user interfaces (GUI). Fundamentals of modern interactive graphics: hardware, software, data structures, mathematical manipulation of graphical objects, algorithms for two- and three-dimensional graphics. No prior background in graphics is needed, although a good background in C++ programming and data structures is required. Some familiarity with computer architecture is assumed.

C490 Seminar in Computer Science (1-3 cr.)

P: Varies. Special topics in computer science.

P = Prerequisite

R = Recommended

C = Co-requisite

MS-MIT COURSES

A505 Object Oriented Programming (4 cr.)

P: BUSB A504 Management Information Systems.

Fundamental concepts of software engineering, algorithm development, computer programming, objects, and data structuring. Emphasis on understanding how software is developed, writing small programs and learning to read code with understanding. Will include a weekly closed laboratory session for most of the course.

A510 Database Management Systems (3 cr.)

P: A505. Fundamental concepts and practices in design and implementation of database management systems. Topics include data modeling, functional dependencies, normalization, relational, hierarchical, network and object oriented data models, relational algebra, relational calculus, data definition and manipulation languages, SQL, recovery, concurrency, security, distribution and integrity of data.

A515 Telecommunications and Computer Networks (4 cr.)

P: A505. Fundamental concepts and technologies used in design of computer networks and the Internet. The architecture of the Internet and performance issues. Low-level technologies ranging from Ethernet to wireless will be compared. Packet switching and virtual circuits. Core protocols of the Internet: TCP (Transport Control Protocol) and IP (Internet Protocol). Ongoing and future changes in the Internet.

MS-AM/CS COURSES

Courses Offered for Graduate Credit In Computer Science
(Starting Fall 2002)

Preparatory Courses

B441 - Computer Organization (3 cr.) (Same as C421)

P: Physics P303, C243, C335. Principles of logic design; addressing; central processing units; microprogrammed versus hardwired control; input-output organization, interrupts; other topics chosen by the instructor.

P423 - Assemblers and Compilers I (3 cr.) (Same as C431)

P: C311. Analysis and implementation of a compiler for a high level programming language. Relationship between regular languages, finite automata, lexical analysis, and scanner generators such as lex. Relationship between context-free grammars, stack machines, parsers, and parse generators such as yacc and lgen. Symbol tables and semantic analysis for translating declarations, expressions, assignments, I/O, control structures, and subroutines. Large programming project.

P436 - Operating Systems and Computer Architecture (4 cr.) (Same as C435)

P: C251, C308, C335. Design and implementation of operating systems: the process model, process synchronization, semaphores, deadlock management, multi-tasking, multi-threading, interprocess communication, process scheduling, memory management, paging, segmentation, virtual memory management, file system design and implementation, I/O device drivers, interrupt handlers and spoolers. Students will complete the design and implementation of a simulated multi-tasking operating system.

B438 - Computer Networks (3 cr.)

P: C243, C335. Theory and practice of data communication between computing devices. Topics include network architecture and

topology, wide-area networks, local-area networks, and ISO network layers.

C441 - Information Organization & Retrieval (3 cr.)

P: C243. Fundamental structures and algorithms for the management of secondary storage devices: persistence; shareability; file and database organization; fields; records; transactions; hardware concepts of storage devices; sequential, random, indexed, hashed, and B-tree files; operations on files; search; sort; performance issues.

B461 - Database Systems (3 cr.) (Same as C442)

P: C308. The fundamental concepts, theory, and practices in the design and implementation of database management systems: data independence; data modeling; entity relationship modeling; functional dependencies; normalization; relational, hierarchical, network, and object oriented data models; relational algebra; relational calculus; data definition and manipulation languages; recovery; concurrency; security; integrity of data.

B403 - Analysis of Algorithms (4 cr.) (Same as C455)

P: C251, M216 (Calculus II). Mathematical analysis of time and space requirements for algorithms, using combinatorics, recurrence relations, and elementary probability theory. Turing machines and decidability.

C463 - Artificial Intelligence (3 cr.)

P: C251, C311. Techniques and principles of artificial intelligence and implementations of some of these techniques. Various formalisms for representing knowledge, and relationships of this to such tasks as inference, game playing, and planning. Machine learning.

B481 - Interactive Computer Graphics (3 cr.)

P: C243, M301 (Applied Linear Algebra). An introduction to interactive programming: design and implementation of graphical user interfaces (GUI). Fundamentals of modern interactive graphics: hardware, software, data structures, mathematical manipulation of graphical objects, algorithms for two- and three-dimensional

graphics. No prior background in graphics is needed, although a good background in C++ programming and data structures is required. Some familiarity with computer architecture is assumed.

Advanced Courses

B503 Algorithms Design and Analysis (3 cr.)

P: C455. Models, algorithms, recurrences, summations, growth rates. Probabilistic tools, upper and lower bounds; worst-case and average-case analysis, amortized analysis, dynamization. Comparison-based algorithms: search, selection, sorting, hashing. Information extraction algorithms (graphs, databases). Graphs algorithms: spanning trees, shortest paths, connectivity, depth-first search, breadth-first search.

P536 Advanced Operating Systems (3 cr.)

P: C435. Advanced topics in operating systems, such as: multi-tasking, synchronization mechanisms, distributed system architecture, client-server models, distributed mutual exclusion and concurrency control, agreement protocols, load balancing, failure recovery, fault tolerance, cryptography, multiprocessor operating systems.

B538 Networks and Distributed Computing (3 cr.)

Basic concepts and technologies of computer networks. Protocols and protocol stacks. Client-server models. Distributed object technology. High-performance and high-bandwidth techniques. Distributed operating systems.

B541 Hardware System Design I (3 cr.)

Structured approach to hardware design, emphasizing hardwired and microprogrammed control. Boolean algebra, hardware building blocks, architecture and control, implementation issues. In the laboratory, students build a working computer using hardware prototyping technologies. Basic training in the use of design and simulation software. Lecture and laboratory. Credit not given for both B541 and C421.

B551 Elements of Artificial Intelligence (3 cr.)

Introduction to major issues and approaches in artificial intelligence. Principles of reactive, goal-based, and utility-based agents. Problem-solving and search. Knowledge representation and design of representational vocabularies. Inference and theorem proving, reasoning under uncertainty, and planning. Overview of machine learning.

B561 Advanced Database Concepts (3 cr.)

P: C442. Database models and systems: specially relational and object-oriented; relational database design theory; structures for efficient data access; query languages and processing; database applications development; views. Transaction management: concurrency and recovery.

P565 Software Engineering I (3 cr.)

P: C308. Analysis, design and implementation of software systems. Requirements specification: data and process modeling. Software design methodologies. Software quality assurance: testing and verification. Software development processes.

B581 Advanced Computer Graphics (3 cr.)

P: M301. Introduction to graphics hardware and software. Two-dimensional graphics methods, transformations, and interactive methods. Three-dimensional graphics, transformations, viewing geometry, object modeling and interactive manipulation methods. Basic lighting and shading. Video and animation methods. Credit not given for both B581 and C481.

B582 Image Synthesis (3 cr.)

P: B581. Raster image display: color theory, gamma correction, and filtering. Advanced shading methods: local illumination models, global illumination models. Surface display, including ray tracing and Z-buffering. Solid modeling; spline surfaces, CSG, superquadrics, and deformations. Scientific visualization: isosurfaces and volume rendering.

B651 Natural Language Processing (3 cr.)

Theory and methods for natural language processing. Algorithms for sentence parsing and generation. Context-free and unification grammars. Question-and-answer systems. Analysis of narratives. Finite-state approaches to computational phonology and morphology. Machine translation. Machine learning of natural language. Speech recognition. Neural-network and statistical alternatives to symbolic approaches.

B661 Database Theory and Systems Design (3 cr.)

P: B561. Database models: relational, deductive, complex-object, object-oriented. Query languages: relational algebra and calculus, datalog, fixpoint logics, object-oriented query languages. Transaction management theory: concurrency control, recovery, distribution. Post-relational and object-oriented database systems.

Y790 Graduate Independent Study (1-6 cr.)

Independent study under the direction of a faculty member, culminating in a written report. May be repeated for credit. R grade not allowed. The different departmental options for independent study are: Research and Reading, Software System Development, Master's Research Project, Master's Software Project, and a University Master's Thesis.

Courses Offered for Graduate Credit In Mathematics

(Starting Fall 2002)

Consult with the department of Mathematical Sciences for the most up to date version.

Preparatory Courses

M447-M448 Mathematical Models and Applications I-II (3 - 3)

P: M301 (Applied Linear Algebra);

Formation and study of mathematical models used in the biological, social, and management sciences. Mathematical topics include linear programming, games, graphs, Markov, and Poisson processes, mathematical programming, queues, and equations of growth. Suitable for secondary school teachers.

M471-M472 Numerical Analysis I-II (3 - 3)

P: (for M471) M301 (Applied Linear Algebra), M311 (Calculus III), C201.

P: (for M472) M471 and M343 (Intro. to Differential Equations with Applications I);

Numerical solutions of nonlinear equations; interpolation, including finite difference and splines; approximation, using various Hilbert spaces; numerical differentiation and integration; direct methods for linear systems; iterative techniques in matrix algebra. Numerical solutions of nonlinear systems; solution of ordinary differential equations: initial-value problems, boundary-value problems; computation of eigenvalues and eigenvectors; introduction of numerical solutions for partial differential equations.

Advanced Courses

M546 Control Theory (3 cr.)

Examples of control problems; control and observability of discrete and continuous systems; optimal control, the maximum principle; state-space and frequency domain approaches; stochastic control.

M562 Statistical Design of Experiments (3 cr.)

Fundamentals, completely randomized design, randomized complete blocks. Latin squares, multi-classification, factorial, nested factorial, incomplete blocks, fractional replications, confounding, general mixed factorial, split-plot and optimum design. Use of existing statistical computing packages.

M569 Statistical Decision Theory (3 cr.)

Foundation of statistical analysis, Bayesian and decision theoretic formulation of problems; construction of utility functions and quantifications of prior information; methods of Bayesian decision and inference, with applications; empirical Bayes; combination of evidence; game theory and minimax rules, Bayesian design and sequential analysis. Comparison of statistical paradigms.

M571-M572 Analysis of Numerical Methods I,II (3 cr.)

Solution of systems of linear equations, elimination and iterative methods, error analyses, eigenvalue problems; numerical methods for integral equations and ordinary differential equations; finite difference, finite element, and Galerkin methods for partial differential equations; stability of methods.

M5xx Sampling (3 cr.)

Survey designs, simple random, stratified, and systematic samples, systems of sampling, methods of estimation, ratio and regression estimates, costs. Other topics as time permits.

M5xx Transform Methods (3 cr.)

Basic transform methods in problem solving; Laplace transforms, Fourier transforms, other integral transforms, inversion of transforms; introduction to wavelets and their applications.

M5xx Operations Research (3 cr.)

Introduction to the methods of operations research. Linear programming, dynamic programming, integer programming, network problems, queuing theory, scheduling.

M5xx Simulation Modeling (3 cr.)

Basic simulation modeling, discrete, continuous, and mixed simulation, Monte Carlo simulation.

M5xx Forecasting (3 cr.)

Forecasting systems, regression models, stochastic forecasting, time series, smoothing approach to prediction, model selection, seasonal adjustment.

**MATHEMATICS REQUIREMENT FOR
BS IN COMPUTER SCIENCE****M215 Analytic Geometry and Calculus I (5 cr.)**

P: M115 or M125-M126 or Level VI). Functions, limits, continuity, differentiation and its applications, indefinite and definite integrals.

M216 Analytic Geometry and Calculus II (5 cr.)

P: M215. Techniques and applications of integration, sequences and series, Taylor polynomials and Taylor series, other topics as time allows.

M301 Applied Linear Algebra (3-4 cr.)

P: M215 or M120 with consent of instructor. Systems of linear equations, the vector space \mathbb{R}_n , abstract vector spaces, linear dependence, bases, linear transformations, matrices, eigenvalues and eigenvectors, applications. Credit not given for both M301 and M303.

COURSES IN COGNITIVE SCIENCE**X355 Special Topics in the Philosophy of Science (3 cr.)**

P: Junior standing, 1 or more courses approved for the cognitive science minor. This course may be used in the cognitive science minor when offered with the sub-title "Introduction to Cognitive Science". When so offered, the course content will be interdisciplinary, drawing from some or all of the areas: philosophy, psychology, computer science, linguistics, neuroscience, anthropology, mathematics. The primary goal of the course is to survey cognitive science as a whole and to demonstrate both its unity and its eclectic nature. A seminar format will be used. This course may also be offered under the number X410 Topics in the History of Science.

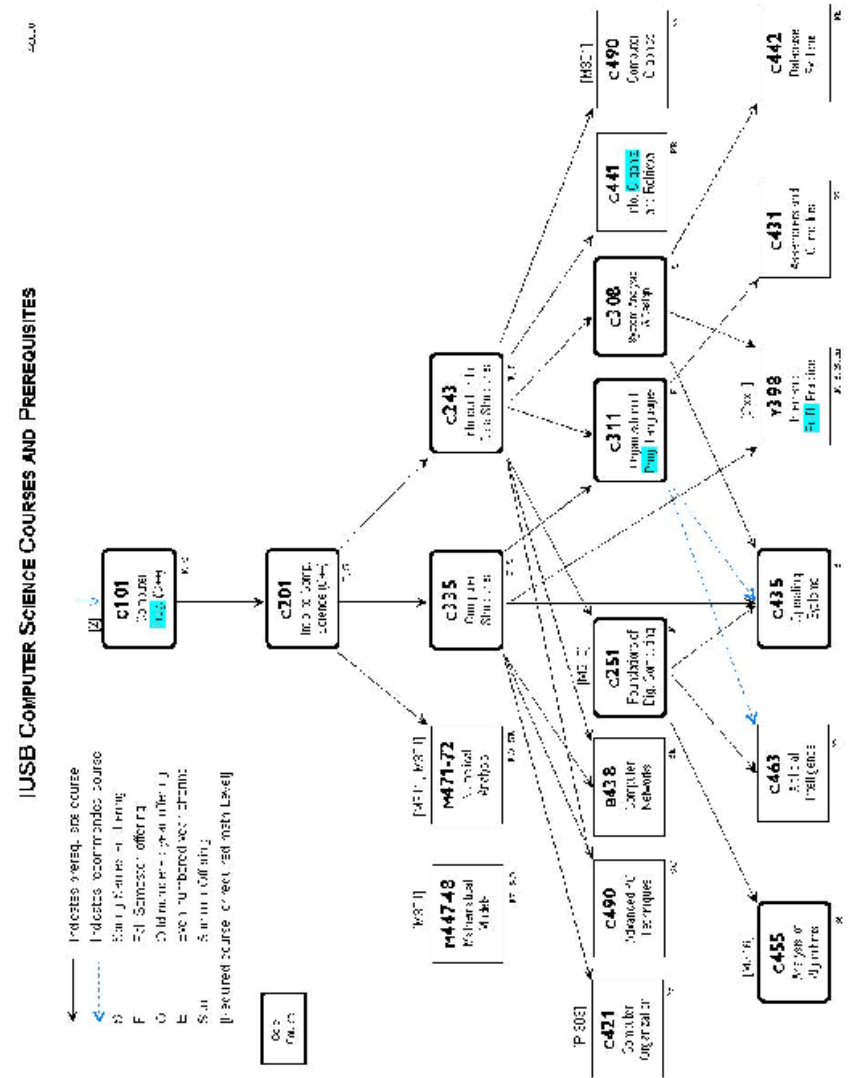
SCHEDULING OF COURSES

To help students make long-range curriculum plans, the Department attempts to offer courses in predictable fashion. Courses are offered both in the daytime and in the evenings (5:30 p.m. or later). A course that is offered in the evening in one term will normally be offered during the day in the next term in which it is scheduled, and conversely. If a course has more than one section in a given term, both daytime and evening sections are almost always scheduled. The following tables may be useful in predicting future course offerings.

COMPUTER SCIENCE COURSES	
Course Number	Usual Semesters Offered
A106	All*
C101	Fa, Sp*
C201	Fa, Sp*
C243	Fa, Sp
C251	Fa
C308	Sp
C311	Fa
C335	Fa, Sp
C421	as offered
C431	as offered
C435	Sp
B438	Sp of even numbered years
C441	as offered
C442	Fa of even numbered years
C455	Sp
C463	as offered
C481	as offered
C490 Advanced PC	Sp of odd numbered years
C490 Java	as offered

* = multisectioned Fall and Spring,
Sp = Spring, Fa = Fall

PREREQUISITE HIERARCHY CHART for Undergraduate Computer Science Courses



**APPENDIX - A
THE MATHEMATICS PLACEMENT EXAM**

Students who have not taken an IUSB mathematics course must take the placement exam before registering for computer science courses, (exception is computer science A106). This exam is designed to help IUSB students determine the level at which they should begin their studies. Contact the Academic Resource Center for testing (Northside 166).

Students from other IU campuses will be required to take the IUSB math placement exam if they have not satisfied the IUSB prerequisites for a particular course even though they may have met the prerequisites for the course at another IU campus. For example, M014 is the prerequisite for M119 at I.U. Bloomington, but M014 does not fulfill the prerequisite requirements for this course at IUSB. Students having mathematics credits from another college may obtain a placement examination waiver from the Chairman of the Department of Mathematical Sciences, if it can be determined that the transferred credits satisfy the stated IUSB prerequisites for a given course.

The placement exam consists of five parts:

- Part A: Arithmetic
- Part B: Algebra I
- Part C: Algebra II
- Part D: Algebra II
- Part E: Algebra II and Trigonometry

The test will place you at one of the following levels:

Level	Course(s) you are eligible to enroll in
Level I	M004 Introduction to Algebra.
Level II	M014 Basic Algebra.
Level III	M107 College Algebra, C101.
Level IV	M115, M125.
Level V	M119 or M126. Students at this level can move to level 4 by completing M126 or M115. (M119 is also sufficient if the student has had trigonometry.)
Level VI	Students at this level have a solid mathematics back-ground and can enroll in M215. Level 4 students can also enroll in M118 or M119 if these courses better fit their needs.

**APPENDIX - B
REMEDIAL MATHEMATICS COURSES**

M004 Introduction to Algebra (3cr.)

P: Level I on the mathematics placement examination. Designed for remediation of advanced arithmetic and beginning algebra skills. Arithmetic of fractions and signed numbers. Beginning equations in one variable. S/F grading. Credit may not be used toward a degree.

M014 Basic Algebra (4 cr.)

P: M004, or level II on the mathematics placement examination. Designed to provide algebraic skills needed for future mathematics courses. Algebraic fractions, exponents, linear equations, quadratic equations, inequalities, factoring, elementary graphs. S/F grading. Credit may not be used toward a degree.

NOTE:

Remedial courses are counted when computing a student's credit hour load in any semester, but they do not count toward graduation in any curriculum at Indiana University.

**APPENDIX - C
PREREQUISITE COURSES IN MATHEMATICS**

Computer science students who have not taken adequate mathematics courses in highschool may need to enroll in the following courses prior to enrolling in M215 (Calculus I).

M107 College Algebra (3cr.)

P: M014, or level III on the mathematics placement examination.

M115 Pre-Calculus and Trigonometry (5 cr.)

P: M107 or equivalent or level IV on the mathematics placement examination. Designed to prepare students for higher numbered mathematics and computer science courses, including calculus (M215). Graphing equations in two variables; functions and their graphs; linear, quadratic, polynomial, and rational functions; exponential and logarithmic functions; trigonometric and inverse trigonometric functions. Does not satisfy Arts and Sciences general-education requirements. Equivalent to M125/M126. Credit not given for both M115 and M125/M126.

M119 Brief Survey of Calculus I (3 cr.)

P: M115, or M125, or Level V on the Mathematics Placement Examination. Introduction to calculus. Primarily for students from business and the social sciences. Note: Credit not given for both M119 and M215.

M125 Pre-Calculus Mathematics (3 cr.)

P: M107 or equivalent or level IV on the mathematics placement examination. Designed to prepare students for higher numbered mathematics and computer science courses including calculus (M119) Graphing equations in two variables; functions and their graphs; linear, quadratic, polynomial, and rational functions; exponential and logarithmic functions. Does not satisfy the Arts and Sciences general-education requirements. Credit not given for both M125 and M115.

M126 Trigonometric Functions (2 cr.)

P: M125 or equivalent or level V on the mathematics placement examination. Designed to develop the properties of the trigonometric and inverse trigonometric functions and to prepare for a course in calculus (M215). Does not satisfy Art and Sciences general-education requirements. Credit not given for both M126 and M115.

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