COMPUTER SCIENCE (CS)

NOTE: All prerequisites for Computer Science (CS) courses must be completed with a grade of "C-" or better.

Computer Science (CS) Courses

CS 1023. Cultural Implications of the Information Society. (3-0) 3 Credit Hours.
This course offers an examination of the modern information society and the influences of technological advances on society and culture. The emphasis is on information and its management from ethical, social, and legal perspectives. Students will make extensive use of the World Wide Web. Generally offered: Fall, Spring. Course Fees: LRS1 $45; STSI $21.

CS 1033. Microcomputer Applications. (3-0) 3 Credit Hours.
Study of the uses of the computer and the organization and visualization of data. Topics will be selected from library searching, networking, e-mail, spreadsheets, databases, authoring packages, multimedia and hypertext applications, presentation graphics, and legal/ethical issues. May not be applied toward a major in computer science. (Formerly CS 2083. Credit cannot be earned for both CS 1033 and CS 2083.) Generally offered: Spring. Course Fees: IUCS $45; LRS1 $45; STSI $21.

CS 1063. Introduction to Computer Programming I. (3-0) 3 Credit Hours.
Prerequisite: MAT 1073 or the equivalent. An introduction to computer programming using a modern object-oriented computer language. Topics include assignment, decisions, loops, methods and arrays using objects. Generally offered: Fall, Spring, Summer. Course Fees: IUCS $45; LRS1 $45; STSI $21.

CS 1083. Programming I for Computer Scientists. (3-0) 3 Credit Hours. (TCCN = COSC 1336)
Prerequisite: MAT 1073 or the equivalent. An introduction to computer programming emphasizing structured programming, problem solving, and algorithmic thinking. Topics include assignment, decisions, loops, methods, arrays, and use of objects. Students intending to major or minor in Computer Science should take this course instead of CS 1063. Course Fees: IUCS $45; LRS1 $45; STSI $21.

CS 1093. Programming for Data Science. (3-0) 3 Credit Hours.
Prerequisite: MAT 1073 or the equivalent. An introduction to computer programming emphasizing structured programming, problem solving, and algorithmic thinking. Topics include assignment, decisions, loops, functions, arrays/lists, and use of objects and math/stat packages. Course Fees: IUCS $45; LRS1 $45; STSI $21.

CS 1153. Game Programming. (3-0) 3 Credit Hours.
Prerequisite: Computer literacy. Introduction to game design and programming. Common practices used in the video game industry today will also be introduced. Students will learn the basics of creating a PC game through lecture material, hands-on laboratories, and a final project in which the students will build a simple game. Generally offered: Fall. Course Fees: IUCS $45; LRS1 $45; STSI $21.

CS 1173. Data Analysis and Visualization. (3-0) 3 Credit Hours.
Prerequisite: MAT 1023. Introduction to computation for data analysis and visualization in a programming language such as MATLAB or R. Programming concepts including functions, scripting, loops and logic, handling of vectors and structured data are explored in the context of working with and plotting real data. May be applied toward the Mathematics Core Curriculum requirement. (Formerly titled “Computation for Scientists and Engineers.”) Generally offered: Fall, Spring, Summer. Course Fees: DL01 $75; IUCS $45; LRC1 $12; LRS1 $45; STSI $21.

CS 1714. Computer Programming II. (4-0) 4 Credit Hours. (TCCN = COSC 1437)
Prerequisite: CS 1083. Extended programming concepts including multidimensional arrays, pointers, dynamic memory allocation/deallocation and recursion. Problem solving methods, algorithm development and implementation. The course includes 3 hours of lecture and a mandatory 1-hour recitation per week. (Formerly CS 1711/1713. Credit cannot be earned for both CS 1714 and CS 1711/1713.) Course Fees: IUCS $60; LRS1 $60; STSI $28.

CS 1793. Data Computation. (3-0) 3 Credit Hours.
Prerequisite: CS 1093. Extended programming concepts including multidimensional arrays, references, dynamic memory allocation/deallocation, list-like structures and recursion. Problem solving methods, algorithm development and implementation. Course Fees: IUCS $45; LRS1 $45; STSI $21.

CS 2073. Computer Programming with Engineering Applications. (3-0) 3 Credit Hours. (TCCN = ENGR 2304)
Prerequisites: MAT 1214 and completion of or concurrent enrollment in MAT 1224. Algorithmic approaches to problem solving and computer program design for engineers. Engineering and mathematically-oriented problem sets will be emphasized, including nonnumeric applications. Searching, sorting, linked lists, and data typing will be introduced. May not be applied toward a major in computer science. Generally offered: Fall, Spring. Course Fees: IUCS $45; LRS1 $45; STSI $21.

CS 2124. Data Structures. (4-0) 4 Credit Hours.
Prerequisites: CS 1714 and completion of or concurrent enrollment in MAT 1214. Abstract data structures (stacks, queues, lists, trees), recursion, sorting, and searching. Implementation of data structures using explicit memory management, and introduction to abstract data type design and encapsulation. The course includes 3 hours of lecture and a mandatory 1-hour recitation per week. (Formerly CS 2123 and CS 2121/2123. Credit cannot be earned for both CS 2124 and CS 1723 or CS 2121/2123.) Course Fees: IUCS $60; LRS1 $60; STSI $28.

CS 2173. Programming Fundamentals and Data Structures. (3-0) 3 Credit Hours.
Prerequisite: Consent of instructor. This course is a bridge course for non-Computer Science students. It cannot be applied to the undergraduate degrees in computer science. Topics include programming fundamentals and basic data structures such as arrays, stack, linked-lists, trees, graphs. Only one of the following may be applied towards a degree: CS 2173, CS 2193, or CS 2124 (previously CS 2121/2123). Course Fees: IUCS $45; LRS1 $45; STSI $21.

CS 2193. Data Organization. (3-0) 3 Credit Hours.
Prerequisites: CS 1793 and MAT 1214. Abstract data structures (stacks, queues, lists, trees), recursion, sorting, and searching. Implementation of data structures using explicit memory management, and introduction to abstract data type design and encapsulation. Only one of the following may be applied towards a degree: CS 2173, CS 2193, or CS 2124 (previously CS 2121/2123). Course Fees: IUCS $45; LRS1 $45; STSI $21.

CS 2233. Discrete Mathematical Structures. (3-0) 3 Credit Hours. (TCCN = MATH 2305)
Prerequisites: CS 1083 and MAT 1093. Survey and development of theoretical tools suitable for describing algorithmic applications. Propositional and predicate calculus, proofs, induction, order notation, recurrences and discrete structures. (Formerly 3233. Credit cannot be earned for both CS 2233 and CS 3233.) Generally offered: Fall, Spring, Summer. Course Fees: IUCS $45; LRS1 $45; STSI $21.
CS 3113. Principles of Cyber Security. (3-0) 3 Credit Hours.
Prerequisite: CS 2124. An introductory course in Cyber Security including an examination of the fundamental principles underlying cyber security, how these principles interrelate and how they are typically employed to secure computer systems and networks. The course will also examine how failures in fundamental security design principles can lead to system vulnerabilities that can be exploited and will also examine the legal issues governing cyber law and cyber operations. (Formerly CS 2433. Credit cannot be earned for both CS 3113 and CS 2433.) Differential Tuition: $150. Course Fees: DL01 $75; IUCS $45.

CS 3333. Mathematical Foundations of Computer Science. (3-0) 3 Credit Hours.

CS 3343. Analysis of Algorithms. (3-0) 3 Credit Hours.
Prerequisites: CS 2124, CS 2233, and CS 3333. Analysis of the performance of algorithms; discussion of programming techniques and data structures used in the writing of effective algorithms. Generally offered: Fall, Spring. Differential Tuition: $150. Course Fee: IUCS $45.

CS 3424. Systems Programming. (4-0) 4 Credit Hours.
Prerequisite: CS 2124. A study of systems-level programming in a specific system (at present, Unix). Focus on concepts and tools to support the construction of systems programs. The course includes 3 hours of lecture and a mandatory 1-hour recitation per week. (Formerly CS 2413 and CS 3421/3423. Credit cannot be earned for both CS 3424 and CS 2413 or CS 3421/3423.) Differential Tuition: $200. Course Fee: IUCS $60.

CS 3433. Computer and Information Security. (3-0) 3 Credit Hours.
Prerequisites: CS 3424 and consent of instructor. An introduction to the protection of computer systems and networks. Topics will include authentication, access controls, malicious software, formal security methods, firewalls, intrusion detection, cryptography and information hiding, risk management, computer forensics, and ethics. Generally offered: Fall. Differential Tuition: $150. Course Fee: IUCS $45.

CS 3443. Application Programming. (3-0) 3 Credit Hours.

CS 3523. Windows Systems Programming. (3-0) 3 Credit Hours.
Prerequisite: CS 2124. A study of systems-level programming in the Windows Operating System. Focus on concepts and tools to support the construction of Windows systems programs. Learn and use tools like Powershell, Python and command prompt. Understand in detail how the registry works, how to audit and log system changes, how to create new users, how to manipulate access control lists, etc. Differential Tuition: $150. Course Fee: IUCS $45.

CS 3723. Programming Languages. (3-0) 3 Credit Hours.
Prerequisites: CS 2233 and CS 3443. An introduction to high-level procedural, functional, and object-oriented programming languages, their theoretical foundations, organization, and implementation. Topics include formal syntax, compilers and interpreters, type systems, scoping and activation records, control structures, and data abstraction. Generally offered: Fall, Spring. Differential Tuition: $150. Course Fee: IUCS $45.

CS 3733. Operating Systems. (3-0) 3 Credit Hours.
Prerequisites: CS 3424, CS 3443, and CS 3844. An introduction to the functions and major techniques of a modern multiprogramming operating system. Includes exposure to the fundamentals of processor management, process synchronization, memory management, and peripheral management. Generally offered: Fall, Spring. Differential Tuition: $150. Course Fee: IUCS $45.

CS 3743. Database Systems. (3-0) 3 Credit Hours.
Prerequisites: CS 2233 and CS 3424. Study of fundamentals of database systems. Topics include basic concepts, various data models, database design, storage systems, indexing and hashing, database application design and implementation, and commercially available database systems. Differential Tuition: $150. Course Fee: IUCS $45.

CS 3753. Data Science. (3-0) 3 Credit Hours.
Prerequisites: CS 2124, CS 2233, and CS 3333. Study of fundamental methods and models of data science. Topics include data management, Extract-Transform-Loading methods, machine learning models, and data visualization. Use of a specialized programming language is emphasized. Differential Tuition: $150. Course Fee: IUCS $45.

CS 3773. Software Engineering. (3-0) 3 Credit Hours.
Prerequisite: CS 3443. Introduction to different aspects of software engineering with the concentration on processes, methods, and tools for developing reliable software-centered systems. Study of software development process models, project management, a variety of modeling notations, requirement analysis, architecture design methods, and testing techniques. Generally offered: Fall, Spring. Differential Tuition: $150. Course Fee: IUCS $45.

CS 3793. Artificial Intelligence. (3-0) 3 Credit Hours.
Prerequisites: CS 3343 and CS 3424. Discussion of theorem-proving by machine; includes computational linguistics, psychological modeling, and computer games. Differential Tuition: $150. Course Fee: IUCS $45.

CS 3844. Computer Organization. (4-0) 4 Credit Hours.
Prerequisite: CS 2124. Organization of a computer system is introduced at block diagram level. Programming in assembly language and understanding the macroarchitecture of a computer is emphasized. Fundamentals of digital systems are introduced and the designs of various components used are investigated. The course includes 3 hours of lecture and a mandatory 1-hour recitation per week. (Formerly CS 2733 and CS 3841/3843. Credit cannot be earned for both CS 3844 and CS 2733 or CS 3841/3843.) Differential Tuition: $200. Course Fees: IUCS $60.

CS 3853. Computer Architecture. (3-0) 3 Credit Hours.
Prerequisites: CS 3424 and CS 3844. Instruction set architecture, datapath and control unit design, advanced computer arithmetic, pipelining, memory hierarchy and I/O subsystem, performance issues. (Formerly CS 4753. Credit cannot be earned for both CS 3853 and CS 4753.) Generally offered: Fall, Spring. Differential Tuition: $150. Course Fee: IUCS $45.

CS 3873. Computer Networks. (3-0) 3 Credit Hours.
Prerequisites: CS 3424 and CS 3443. Network architecture, TCP/IP protocol suite, routing, data-link layer protocols, medium access control protocols, error detection and recovery, local area networks, wireless and mobile networks. (Formerly CS 4873. Credit cannot be earned for both CS 3873 and CS 4873.) Generally offered: Spring. Differential Tuition: $150. Course Fee: IUCS $45.
CS 4223. Bioinformatics and Big Data. (3-0) 3 Credit Hours.
Prerequisite: CS 3343 or consent of instructor. Hands-on introduction to large-scale analysis of heterogeneous data with emphasis on integrating information and tools from publicly available biological databases to address complex problems. Differential Tuition: $150. Course Fee: IUCS $45.

CS 4233. Computational Biology and Bioinformatics. (3-0) 3 Credit Hours.
Prerequisite: CS 3343. Study of algorithmic and statistical techniques in modeling and analyzing large-scale biological data such as DNA sequences, gene expression, and gene networks. Topics include fast string matching, sequence alignment, frequent pattern mining, clustering, classification, and significance testing. Differential Tuition: $150. Course Fee: IUCS $45.

CS 4243. Large-Scale Data Management. (3-0) 3 Credit Hours.
Prerequisites: CS 3424 and CS 3443. Modern big data systems managing the three Vs of big data (variety, volume, and velocity). Topics include, but not limited to classic data management (overview), web search, information retrieval, map/reduce, data integration, natural language processing at scale. Differential Tuition: $150. Course Fee: IUCS $45.

CS 4253. Machine Learning. (3-0) 3 Credit Hours.
Prerequisite: CS 3343. Study of fundamental concepts and methods of machine learning. Topics include unsupervised learning, supervised learning, reinforcement learning and other advanced topics selected by instructor. Differential Tuition: $150. Course Fee: IUCS $45.

CS 4263. Deep Learning. (3-0) 3 Credit Hours.
Prerequisite: One of the following: CS 3753, CS 3793, CS 4233, CS 4253. Study of advanced techniques for learning models. Algorithmic and hands-on introduction to deep neural networks and adversarial learning. Topics include convolutional models, generative networks, neural network vulnerabilities, and attention models, with applications in natural language understanding and computer vision. Differential Tuition: $150. Course Fee: IUCS $45.

CS 4313. Automata, Computability, and Formal Languages. (3-0) 3 Credit Hours.
Prerequisite: CS 3343. Discussion of abstract machines (finite state automata, pushdown automata, and Turing machines), formal grammars (regular, context-free, and type 0), and the relationship among them. Differential Tuition: $150. Course Fee: IUCS $45.

CS 4353. Unix and Network Security. (3-0) 3 Credit Hours.
Prerequisite: CS 3433. A technical survey of the fundamentals of computer and information security. Issues include cryptography, authentication, attack techniques at both the OS and network level, defense techniques, intrusion detection, scan techniques and detection, forensics, denial of service techniques and defenses, libpcap, libdnet and libnet programming. Generally offered: Spring. Differential Tuition: $150. Course Fee: IUCS $45.

CS 4363. Cryptography. (3-0) 3 Credit Hours.
Prerequisites: CS 3343, and CS 3113 or CS 3433. A course in pure and applied cryptography, with emphasis on theory. Topics may include conventional and public-key cryptosystems, signatures, pseudo-random sequences, hash functions, key management, and threshold schemes. Differential Tuition: $150. Course Fee: IUCS $45.

CS 4373. Data Mining. (3-0) 3 Credit Hours.
Prerequisite: CS 3343 or consent of instructor. Principles, techniques, systems and evaluation of data mining. Topics may include data preprocessing, frequent pattern mining, association mining, classification and prediction, cluster analysis, and advanced topics such as mining streams, time-Series, texts, and graphs. Differential Tuition: $150. Course Fee: IUCS $45.

CS 4383. Computer Graphics. (3-0) 3 Credit Hours.
Prerequisites: CS 2124 and CS 3433. An introduction to two- and three-dimensional generative computer graphics. Display devices, data structures, mathematical transformations, and algorithms used in picture generation, manipulation, and display. Differential Tuition: $150. Course Fee: IUCS $45.

CS 4393. User Interfaces. (3-0) 3 Credit Hours.

CS 4413. Web Technologies. (3-0) 3 Credit Hours.

CS 4423. Game Development. (3-0) 3 Credit Hours.
Prerequisite: CS 3443. A study of the major topics in game development, such as game mechanics, rendering, scripting, user interfaces, animation, asset management, and physics, with a focus on team-based development practices. By the end of the course, students will have developed a full game with a group and several mini-games individually. Differential Tuition: $150. Course Fee: IUCS $45.

CS 4453. Penetration Testing. (3-0) 3 Credit Hours.
Prerequisite: CS 3873. Introduction to the principles and techniques associated with the cyber security practice known as penetration testing or ethical hacking. The course covers planning, reconnaissance, scanning, exploitation, post-exploitation, and result reporting. Students learn how to use penetration testing tools, how to discover system vulnerabilities and how to avoid exploitation of vulnerabilities. Differential Tuition: $150. Course Fee: IUCS $45.

CS 4463. Steganography. (3-0) 3 Credit Hours.
Prerequisite: CS 3424. Steganography literally means "covered writing" and is the science of hiding secret data within innocuous data. This course covers a broad set of background topics including data compression, encryption, hashing, number theory, and human perception. Then we delve into the aspects and techniques for data hiding using image and audio files for data hiding. This includes bitmaps, jpegs, and wave files. We also explore steganalysis—the detection of hidden data—in the various file types. We also discuss the use of steganography in practice, particularly use by malware. There is a course project where a team of students develop and test their own steganography program. Differential Tuition: $150. Course Fee: IUCS $45.
CS 4473. Cryptocurrencies and Bitcoins. (3-0) 3 Credit Hours. 
Prerequisite: CS 3113. This course introduces the concept of public
permissionless blockchains and discusses the various applications that
it enables. It specifically focuses on the cryptocurrency application of
such distributed systems, with an emphasis on Bitcoins. This course
will cover the following topics: blockchain fundamentals, operation of
the Bitcoin cryptocurrency, Bitcoin security, user privacy and anonymity
in Bitcoin, Bitcoin as a distributed application platform, Bitcoin and
cryptocurrency regulation, future of Bitcoins and cryptocurrencies,
Ethereum and Smart Contracts. Differential Tuition: $150. Course Fee:
IUCS $45.

CS 4483. Cyber Security Foundations and Practice. (3-0) 3 Credit Hours. 
Prerequisite: CS 3113. Advanced study of fundamental cyber security
and privacy technologies and their applications in modern and emerging
cyber systems such as social media, cloud computing, internet of things,
cyber-physical systems and cryptocurrencies. Differential Tuition: $150.
Course Fee: IUCS $45.

CS 4493. Advanced Topics in Cyber Security. (3-0) 3 Credit Hours. 
Prerequisite: Consent of instructor. Advanced topics in an area of
systems and cloud. May be repeated for credit when topics vary.

CS 4593. Topics in Computer Science. (3-0) 3 Credit Hours. 
Prerequisite: Consent of instructor. Advanced topics in an area of
computer science. May be repeated for credit when topics vary. Generally

CS 4613. Senior Design I. (3-0) 3 Credit Hours. 
Prerequisites: CS 3443 and CS 3773. Students will self-organize into
teams, prepare/propose project scope, gather requirements, produce
specifications, analyze security and other risk factors, and present their
designs. Industrial collaboration and/or faculty sponsorship of these
projects is encouraged. Not more than a total of 6 semester credit hours
of Internship, Independent Study, Senior Design, and Senior Thesis
courses may count toward the Bachelor of Science degree in Computer

CS 4623. Senior Design II. (3-0) 3 Credit Hours. 
Prerequisite: CS 4613. Students continue the development of an
instructor-approved design project, testing of the design project,
and present their findings, along with social and ethical impact
considerations. Students who own their intellectual property are required
to compete in CITE. Industrial collaboration and/or faculty sponsorship of
these projects is encouraged. Not more than a total of 6 semester credit
hours of Internship, Independent Study, Senior Design, and Senior Thesis
courses may count toward the Bachelor of Science degree in Computer

CS 4633. Simulation Techniques. (3-0) 3 Credit Hours. 
Prerequisite: CS 3343. Design, execution, and analysis of simulation
models, discrete event simulation techniques, input and output analysis,
random numbers, and simulation tools and languages. Differential
Tuition: $150. Course Fee: IUCS $45.

CS 4643. Cellular and Mobile Technologies. (3-0) 3 Credit Hours. 
Prerequisite: CS 3733. A study of cellular and mobile infrastructure,
networks, and applications. Focus on concepts and tools related to the
major cellular and mobile protocols. Differential Tuition: $150. Course
Fee: IUCS $45.

CS 4653. Software and Malware Reverse Engineering. (3-0) 3 Credit Hours. 
Prerequisites: CS 3844, and CS 3113 or CS 3433. An introduction to
the basic procedures to reverse engineering of software, hardware and

CS 4663. Distributed and Cloud Systems Security. (3-0) 3 Credit Hours. 
Prerequisite: CS 3733. A study of the uses and security issues of
virtualization, distributed systems and cloud systems. Differential Tuition:
$150. Course Fee: IUCS $45.

CS 4673. Cyber Operations. (3-0) 3 Credit Hours. 
Prerequisite: CS 3113 or CS 3433. A study of both offensive and defensive
cyber operations, risk management, social engineering, perception
management, and the international legal issues and considerations
surrounding cyber operations, conflict, and war. Differential Tuition: $150.
Course Fee: IUCS $45.

CS 4683. Secure Software Development and Analysis. (3-0) 3 Credit Hours. 
Prerequisite: CS 3443. Analysis of software for vulnerabilities.
Development of robust, secure software. Topics include source and
binary code analysis, static and dynamic code analysis techniques,
testing methodologies, secure programming principles and practices.

CS 4713. Compiler Construction. (3-0) 3 Credit Hours. 
Prerequisites: CS 3723 and CS 3844. An introduction to implementation
of translators. Topics include formal grammars, scanners, parsing
techniques, syntax-directed translation, symbol table management, code
generation, and code optimization. (Formerly titled "Compiler Writing")

CS 4723. Software Validation and Quality Assurance. (3-0) 3 Credit Hours. 
Prerequisite: CS 3773. Study of software validation techniques.
Introduction to static analysis and software testing approaches
(functional testing, structural testing, integration testing and regression
testing). Overview of test planning and test case design. Review of topics
Course Fee: IUCS $45.

CS 4743. Enterprise Software Engineering. (3-0) 3 Credit Hours. 
Prerequisites: CS 3743 and CS 3773. Providing a hands-on introduction
to principles and best practices for the development of enterprise-
level software systems. Topics include architectural patterns,
database models, remote deployment and execution, and concurrency
management. (Formerly titled "Applied Software Engineering")

CS 4773. Object-Oriented Systems. (3-0) 3 Credit Hours. 
Prerequisite: CS 3773. An introduction of principles and methodologies
of good software design. Study of object-oriented concepts and
techniques, encapsulation, inheritance mechanisms, polymorphism, and
programming in one or more object-oriented languages. Examination of
design patterns that provide reusable solutions to problems in object-

CS 4783. Advanced Software Engineering. (3-0) 3 Credit Hours. 
Prerequisites: CS 3743 and CS 3773. Application of software engineering
principles to develop a working, security-hardened software product as a
team project. Real-world case studies and perspectives will accompany
lecture to provide students with an industry-level viewpoint. Differential
Tuition: $150. Course Fee: IUCS $45.
Thesis courses may count toward the Bachelor of Science degree in credit hours of Internship, Independent Study, Senior Design, and Senior I (special exceptions are possible). Not more than a total of 6 semester Science undergraduate research symposium. Faculty sponsorship of the series of assignments. The student also prepares a presentation of Prerequisite: Consent of Instructor. The student writes the thesis through $150. Course Fee: IUCS $45.

CS 4883. Embedded Systems. (3-0) 3 Credit Hours.
Prerequisite: CS 3844. Concepts and design principles of embedded systems. Microprocessor and hardware architecture, sensors and actuators, basic feedback control theory. Real-time scheduling, programming in embedded systems. Differential Tuition: $150. Course Fee: IUCS $45.

CS 4843. Cloud Computing. (3-0) 3 Credit Hours.
Prerequisite: CS 3424. The general trend of modern computing in cloud. Cloud computing paradigm and associate key technologies. Programming in cloud environment (e.g., Hadoop, MapReduce, and OpenStack APIs). Privacy and security in Cloud. Differential Tuition: $150. Course Fee: IUCS $45.

CS 4853. Advanced Systems Programming. (3-0) 3 Credit Hours.

CS 4863. Distributed Computing and Systems. (3-0) 3 Credit Hours.
Prerequisite: CS 3733. A distributed system comprises computer working together as a single unit. These systems are essential to the understanding of present and future computer applications. This course will include the following topics: concurrent processing, threads, network programming, distributed file systems, remote procedure calls, distributed objects, client-server models, and Internet protocols. Differential Tuition: $150. Course Fee: IUCS $45.

CS 4883. Senior Thesis I. (3-0) 3 Credit Hours.
Prerequisite: Consent of Instructor. The student learns how to conduct independent research. He/she selects a thesis topic, conducts a literature review, plans and executes an experiment, and gathers and analyzes data. Faculty sponsorship of the thesis is required and a faculty member should agree to sponsor the student before Senior Thesis I begins. Not more than a total of 6 semester credit hours of Internship, Independent Study, Senior Design; and Senior Thesis courses may count toward the Bachelor of Science degree in Computer Science. Differential Tuition: $150. Course Fee: IUCS $45.

CS 4893. Senior Thesis II. (3-0) 3 Credit Hours.
Prerequisite: Consent of Instructor. The student writes the thesis through a series of assignments. The student also prepares a presentation of his/her research and presents the thesis to the public during a Computer Science undergraduate research symposium. Faculty sponsorship of the thesis is required and should be the same faculty member from Thesis I (special exceptions are possible). Not more than a total of 6 semester credit hours of Internship, Independent Study, Senior Design, and Senior Thesis courses may count toward the Bachelor of Science degree in Computer Science. Differential Tuition: $150. Course Fee: IUCS $45.

CS 4911. Independent Study. (0-0) 1 Credit Hour.
Prerequisites: Permission in writing (form available) from the instructor, the student's advisor, the Department Chair, and the Dean of the College in which the course is offered. Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but not more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree. Differential Tuition: $50. Course Fee: IUCS $15.

CS 4912. Independent Study. (0-0) 2 Credit Hours.
Prerequisites: Permission in writing (form available) from the instructor, the student's advisor, and the Dean of the College in which the course is offered. Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but not more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree. Differential Tuition: $100. Course Fee: IUCS $30.

CS 4913. Independent Study. (0-0) 3 Credit Hours.
Prerequisites: Permission in writing (form available) from the instructor, the student’s advisor, the Department Chair, and the Dean of the College in which the course is offered. Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but not more than 6 semester credit hours, regardless of discipline, will apply to a bachelor’s degree. Generally offered: Fall, Spring, Summer. Differential Tuition: $150. Course Fee: IUCS $45.

CS 4933. Internship in Computer Science. (0-0) 3 Credit Hours.
Prerequisites: Junior or senior standing, an overall 2.5 grade point average, and permission in writing from the instructor, the Department Chair, and the Dean of the College of Sciences. The opportunity for a semester-long work experience in a private business or public agency in a computer science-related position. Not more than 3 semester credit hours of CS 4933, and not more than a total of 6 semester credit hours of CS 4933 and independent study courses may count toward the Bachelor of Science degree in Computer Science. The grade report for this course is either "CR" (satisfactory participation in the internship) or "NC" (unsatisfactory participation in the internship). Generally offered: Fall, Summer. Differential Tuition: $150. Course Fee: IUCS $45.

CS 4953. Special Studies in Computer Science. (3-0) 3 Credit Hours.
Prerequisite: Consent of instructor. An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. Special Studies may be repeated for credit when topics vary, but not more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree. Generally offered: Summer. Differential Tuition: $150. Course Fee: IUCS $45.

CS 4963. Advanced Topics in Systems and Cloud. (3-0) 3 Credit Hours.
Prerequisite: Consent of instructor. Advanced topics in an area of systems and cloud. May be repeated for credit when topics vary. Differential Tuition: $150. Course Fee: IUCS $45.

CS 4973. Advanced Topics in Data Science. (3-0) 3 Credit Hours.
Prerequisite: Consent of instructor. Advanced topics in an area of data science. May be repeated for credit when topics vary. Differential Tuition: $150. Course Fee: IUCS $45.

CS 4993. Honors Research. (0-0) 3 Credit Hours.
Prerequisites: Enrollment limited to candidates for College Honors during their last two semesters; approval by the College Honors Committee. Supervised research and preparation of an honors thesis. May be repeated once with approval. Differential Tuition: $150. Course Fee: IUCS $45.