Department of Computer Science

The Department of Computer Science offers a Bachelor of Science degree in Computer Science and a Minor in Computer Science. The Department also offers the Certificate in Pathogenic Outbreak Investigations in collaboration with the Department of Biology and the Department Information Systems and Cyber Security in the College of Business. The certificate is located in the Department Information Systems and Cyber Security (http://catalog.utsa.edu/undergraduate/business/informationsystems/cybersecurity/#certificatestext).

Admission Policy

The goal of the Department of Computer Science is to provide undergraduate students a program of study with the highest possible standards. To achieve this goal, the admission policy of the Department of Computer Science is designed to identify those students most likely to succeed in their undergraduate computer science education. All applicants for admission to the Department of Computer Science will be admitted to the Department as pre-computer science (PCS) students. In order to declare Computer Science as a major, a PCS student must satisfy the following criteria.

- Completion with a grade of "C-" or better of MAT 1214 Calculus I
- Completion with a grade of "C-" or better of CS 1713 Introduction to Computer Programming II and CS 1711 Introduction to Computer Programming II Recitation

A PCS student who fails to complete the criteria to change the major to CS within two years from the date of admission to the Department of Computer Science will be changed from PCS to undeclared (UND) in the University student record system. The student must choose a major other than computer science. A computer science minor is, however, available to all UTSA students who seek to complement a different academic major with a strong foundation in computer science.

Bachelor of Science Degree in Computer Science

The Bachelor of Science degree in Computer Science is designed to prepare students with a strong technical emphasis on modern computing and systems. The degree program offers students the opportunity to prepare for advanced graduate study and for careers in high-technology companies, business, government, and teaching. The department offers concentrations in Computer and Information Security and Software Engineering.

The Bachelor of Science degree in Computer Science requires a minimum of 120 semester credit hours, including the Core Curriculum requirements. Thirty-nine of the total semester credit hours required for the degree must be at the upper-division level.

All majors in computer science are required to complete all required and elective computer science courses with a grade of "C-" or better.

All candidates seeking this degree must fulfill the Core Curriculum requirements and the degree requirements, which are listed below.

Core Curriculum Requirements (42 semester credit hours)

Students seeking the Bachelor of Science degree in Computer Science must fulfill University Core Curriculum requirements in the same manner as other students. The course listed below will satisfy both degree requirements and Core Curriculum requirements; however, if this course is taken to satisfy both requirements, then students may need to take an additional course in order to meet the minimum number of semester credit hours required for this degree. For a complete listing of courses that satisfy the Core Curriculum requirements, see below.

MAT 1214 may be used to satisfy the core requirement in Mathematics as well as a major requirement.

Core Curriculum Component Area Requirements (http://catalog.utsa.edu/undergraduate/bachelorsdegeregulations/degreerequirements/corecurriculumcomponentarearequirements)

Gateway Courses

Students pursuing the Bachelor of Science degree in Computer Science must successfully complete each of the following Gateway Courses with a grade of "C-" or better in no more than two attempts. A student who is unable to successfully complete these courses within two attempts, including dropping a course with a grade of "W" or taking an equivalent course at another institution, will be required to change his or her major.

Degree Requirements

A. Required courses (this also satisfies the 3 hours of Core Curriculum requirements for Mathematics):

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>CS 1713</td>
<td>Introduction to Computer Programming II</td>
<td>3</td>
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<tr>
<td>CS 1711</td>
<td>Introduction to Computer Programming II</td>
<td>4</td>
</tr>
<tr>
<td>&amp; CS 1711</td>
<td>and Introduction to Computer Programming II Recitation</td>
<td></td>
</tr>
<tr>
<td>CS 2123</td>
<td>Data Structures</td>
<td>4</td>
</tr>
<tr>
<td>&amp; CS 2121</td>
<td>and Data Structures Recitation</td>
<td></td>
</tr>
<tr>
<td>CS 2233</td>
<td>Discrete Mathematical Structures</td>
<td>3</td>
</tr>
<tr>
<td>CS 3333</td>
<td>Mathematical Foundations of Computer Science</td>
<td>3</td>
</tr>
<tr>
<td>&amp; CS 3341</td>
<td>and Analysis of Algorithms Recitation</td>
<td></td>
</tr>
<tr>
<td>CS 3423</td>
<td>Systems Programming</td>
<td>4</td>
</tr>
<tr>
<td>&amp; CS 3421</td>
<td>and Systems Programming Recitation</td>
<td></td>
</tr>
<tr>
<td>CS 3443</td>
<td>Application Programming</td>
<td>3</td>
</tr>
<tr>
<td>CS 3723</td>
<td>Programming Languages</td>
<td>3</td>
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<tr>
<td>&amp; CS 3731</td>
<td>and Operating Systems Recitation</td>
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<tr>
<td>CS 3843</td>
<td>Computer Organization</td>
<td>4</td>
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<tr>
<td>&amp; CS 3841</td>
<td>and Computer Organization Recitation</td>
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</tr>
<tr>
<td>CS 3853</td>
<td>Computer Architecture</td>
<td>4</td>
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<tr>
<td>&amp; CS 3851</td>
<td>and Computer Architecture Recitation</td>
<td></td>
</tr>
<tr>
<td>MAT 1214</td>
<td>Calculus I (The student who is not prepared for MAT 1093 Precalculus.)</td>
<td>4</td>
</tr>
</tbody>
</table>

The University of Texas at San Antonio
MAT 1224  Calculus II  4

B. Upper-Division computer science courses

With prior written approval of the Undergraduate Advisor of Record, students may take upper-division MAT or STA courses to satisfy up to 6 hours of this requirement. A student with a cumulative grade point average of 3.0 or better may enroll in graduate courses and apply the credits earned toward satisfying this requirement. Enrollment in graduate courses requires prior written approvals as described in chapter 1 (Bachelor’s Degree Regulations) of this catalog.

C. Free electives

Electives  6

Total Credit Hours  81

Concentration in Computer and Information Security

All candidates for the Concentration in Computer and Information Security must fulfill the Core Curriculum requirements and the Computer Science degree requirements including, as part of the upper-division computer science electives in item B in the degree requirements, the following three courses:

CS 3433  Principles of Computer and Information Security  3
CS 4353  Unix and Network Security  3
CS 4363  Cryptography  3

Total Credit Hours  9

Concentration in Software Engineering

All candidates for the Concentration in Software Engineering must fulfill the Core Curriculum requirements and the Computer Science degree requirements including, as part of the upper-division computer science electives in item B in the degree requirements, the following course:

CS 3773  Software Engineering  3

Select two of the following:  6
CS 4393  User Interfaces
CS 4723  Software Validation and Quality Assurance
CS 4733  Project Management
CS 4743  Applied Software Engineering
CS 4773  Object-Oriented Systems

Total Credit Hours  9

Course Sequence Guide for B.S. Degree in Computer Science

This course sequence guide is designed to assist students in completing their UTSA undergraduate Computer Science degree requirements. This is merely a guide and students must satisfy other requirements of this catalog and meet with their academic advisor for individualized degree plans. Progress within this guide depends upon such factors as course availability, individual student academic preparation, student time management, work obligations, and individual financial considerations. Students may choose to take courses during Summer terms to reduce course loads during long semesters.

B.S. in Computer Science – Recommended Four-Year Academic Plan

First Year

Fall
AIS 1203  Academic Inquiry and Scholarship (core)  3
CS 1063  Introduction to Computer Programming I  3
MAT 1214  Calculus I (core and major)  4
WRC 1013  Freshman Composition I (Q) (core)  3
Creative Arts core  3

Spring
CS 1713  Introduction to Computer Programming II  4
& CS 1711  3
MAT 1224  Calculus II  4
POL 1133 or 1213  Texas Politics and Society (core)  3
WRC 1023  Freshman Composition II (Q) (core)  3

Second Year

Fall
CS 2123  Data Structures  4
& CS 2121  3
POL 1013  Introduction to American Politics (core)  3
Free elective  3
Life & Physical Sciences core  3
Social & Behavioral Sciences core  3

Spring
CS 2233  Discrete Mathematical Structures  3
CS 3333  Mathematical Foundations of Computer Science  3
CS 3443  Application Programming  3
Life & Physical Sciences core  3
Free elective  3

Third Year

Fall
CS 3423  Systems Programming  4
& CS 3421  3
CS 3723  Programming Languages  3
CS 3843  Computer Organization  4
& CS 3841  3
Upper-division CS elective  3

Spring
CS 3343  Analysis of Algorithms  4
& CS 3341  4
CS 3733  Operating Systems  4
& CS 3731  4
CS 3853  Computer Architecture  4
& CS 3851  4
Upper-division CS elective  3

Fourth Year

Fall
American History core  3
Component Area Option core  3
include assignment, decisions, loops, methods and arrays using objects.

programming using a modern object-oriented computer language. Topics
Prerequisite: MAT 1073 or the equivalent. An introduction to computer
Hours. (TCCN = COSC 1336)

COSC 2436)

CS 2073. Computer Programming with Engineering Applications. (3-0) 3 Credit Hours.
Prerequisite: MAT 1214 and completion of or concurrent enrollment in
Programing 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 Core Curriculum requirement in the
Component Area Option. (Formerly titled “Computation for Scientists and
Engineers.”).

CS 1173. Data Analysis and Visualization using MATLAB. (3-0) 3 Credit Hours.
Prerequisite: MAT 1023. Introduction to computation for data analysis and visualization using MATLAB. 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 Core Curriculum requirement in the
Component Area Option. (Formerly titled “Computation for Scientists and
Engineers.”).

CS 2111. Introduction to Computer Programming II Recitation. (1-0) 1 Credit Hour. (TCCN = COSC 1437)
Prerequisite: CS 1063. Concurrent enrollment in CS 1713 is required. Recitation to accompany CS 1713. (Formerly titled “Introduction to Computer Science Recitation.”).

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.

CS 1173. Data Analysis and Visualization using MATLAB. (3-0) 3 Credit Hours.
Prerequisite: CS 2073. Concurrent enrollment in CS 2083 is required. Recitation to accompany CS 2083. (Formerly titled “Introduction to
Computer Science Recitation.”).

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.

CS 2121. Data Structures Recitation. (1-0) 1 Credit Hour. (TCCN = COSC 2436)
Prerequisites: CS 1171 and CS 1713. Concurrent enrollment in CS 2123 is required. Recitation to accompany CS 2123. (Formerly titled “Introduction to
Computer Science.”).

CS 1143. Web Design. (3-0) 3 Credit Hours.
Prerequisite: Computer literacy. Introduction to the process of planning, designing, and building a Web site. Concepts required to design and build interactive Web sites, including page design using XHTML, tables, CSS, and JavaScript. Design tools will be used to design and maintain Web sites.

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.

To declare a Minor in Computer Science, obtain advice, or seek approval of substitutions for course requirements, students should consult with their academic advisor.

## Minor in Computer Science

All students pursuing the Minor in Computer Science must complete 20 semester credit hours.

### A. Required courses

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### B. CS core courses or approved CS electives

Select 9 hours of additional CS core courses or approved CS electives, at least 6 hours of which must be at the upper-division level.

Total Credit Hours: 20

Note: Some courses are only offered once a year; Fall or Spring. Check with the Department of Computer Science for scheduling of courses.

### Computer Science (CS) Courses

**CS 1023. Cultural Implications of the Information Society. (3-0) 3 Credit Hours. (TCCN = COSC 1300)**

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. May be applied toward the core curriculum requirement in World Society and Issues.

**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.).

**CS 1063. Introduction to Computer Programming I. (3-0) 3 Credit Hours. (TCCN = COSC 1336)**

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.

**CS 1073. Introductory Computer Programming for Scientific Applications. (3-0) 3 Credit Hours.**
Prerequisite: MAT 1073 or the equivalent. Introductory programming. Data representation, problem-solving methods, algorithm development and implementation, arrays and list structures, searching and sorting. May not be applied toward a major in computer science.

**CS 1143. Web Design. (3-0) 3 Credit Hours.**
Prerequisite: Computer literacy. Introduction to the process of planning, designing, and building a Web site. Concepts required to design and build interactive Web sites, including page design using XHTML, tables, CSS, and JavaScript. Design tools will be used to design and maintain Web sites.

**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.

**CS 1173. Data Analysis and Visualization using MATLAB. (3-0) 3 Credit Hours.**
Prerequisite: CS 2073. Concurrent enrollment in CS 2083 is required. Recitation to accompany CS 2083. (Formerly titled “Introduction to Computer Science Recitation.”).

**CS 1711. Introduction to Computer Programming II Recitation. (1-0) 1 Credit Hour. (TCCN = COSC 1437)**
Prerequisite: CS 1063. Concurrent enrollment in CS 1713 is required. Recitation to accompany CS 1713. (Formerly titled “Introduction to Computer Science Recitation.”).

**CS 1713. Introduction to Computer Programming II. (3-0) 3 Credit Hours. (TCCN = COSC 1437)**
Prerequisite: CS 1063. Concurrent enrollment in CS 1711 is required. Extended programming concepts including multidimensional arrays, pointers, dynamic memory allocation/deallocation and recursion. Problem solving methods, algorithm development and implementation. (Formerly titled “Introduction to Computer Science.”).

**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.

**CS 2121. Data Structures Recitation. (1-0) 1 Credit Hour. (TCCN = COSC 2436)**
Prerequisites: CS 1171 and CS 1713. Concurrent enrollment in CS 2123 is required. Recitation to accompany CS 2123. (Formerly titled “Introduction to
Computer Science.”).

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</tbody>
</table>

Total Credit Hours: 120.0

1 CS 3773 must be taken for Software Engineering concentration.

The University of Texas at San Antonio
CS 2123. Data Structures. (3-0) 3 Credit Hours. (TCCN = COSC 2436)
Prerequisites: CS 1711 and CS 1713. Concurrent enrollment in CS 2121 is required. 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. (Formerly CS 1723. Credit cannot be earned for both CS 2123 and CS 1723.)

CS 2153. Game Design. (3-0) 3 Credit Hours.
Prerequisites: CS 1153. This course builds upon the lessons learned in CS 1153 Game Programming to examine in more detail the design and development of electronic games. The fundamentals of game design and development of electronic games. The fundamentals of game design will be examined in detail and the students will be responsible for building a game using a popular game engine.

CS 2233. Discrete Mathematical Structures. (3-0) 3 Credit Hours. (TCCN = MATH 2405)
Prerequisites: CS 1711, CS 1713, and MAT 1214. 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.)

CS 3333. Mathematical Foundations of Computer Science. (3-0) 3 Credit Hours.
Prerequisites: CS 1711, CS 1713, and MAT 1224. Survey and development of mathematical and statistical tools suitable for describing algorithmic applications. Vectors, matrices, combinatorics, probability and statistical models.

CS 3341. Analysis of Algorithms Recitation. (1-0) 1 Credit Hour.
Prerequisites: CS 2121, CS 2123, CS 2233, and CS 3333. Concurrent enrollment in CS 3343 is required. Recitation to accompany CS 3343.

CS 3343. Analysis of Algorithms. (3-0) 3 Credit Hours.
Prerequisites: CS 2121, CS 2123, CS 2233, and CS 3333. Concurrent enrollment in CS 3341 is required. Analysis of the performance of algorithms; discussion of programming techniques and data structures used in the writing of effective algorithms.

CS 3421. Systems Programming Recitation. (1-0) 1 Credit Hour.
Prerequisites: CS 2121 and CS 2123. Concurrent enrollment in CS 3423 is required. Recitation to accompany CS 3423. (Formerly CS 2411. Credit cannot be earned for both CS 3421 and CS 2411.)

CS 3423. Systems Programming. (3-0) 3 Credit Hours.
Prerequisites: CS 2121 and CS 2123. Concurrent enrollment in CS 3421 is required. 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. (Formerly CS 2413. Credit cannot be earned for both CS 3423 and CS 2413.)

CS 3433. Principles of Computer and Information Security. (3-0) 3 Credit Hours.
Prerequisites: CS 3421 and CS 3423. 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.

CS 3443. Application Programming. (3-0) 3 Credit Hours.
Prerequisites: CS 2121 and CS 2123. Advanced application development in a current object-oriented language. Introduction to the software life cycle, best programming practices, and modern development tools.

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.

CS 3731. Operating Systems Recitation. (1-0) 1 Credit Hour.
Prerequisites: CS 3421, CS 3423, CS 3443, CS 3841, and CS 3843. Concurrent enrollment in CS 3733 is required. Recitation to accompany CS 3733.

CS 3733. Operating Systems. (3-0) 3 Credit Hours.
Prerequisites: CS 3421, CS 3423, CS 3443, CS 3841, and CS 3843. Concurrent enrollment in CS 3731 is required. 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.

CS 3743. Introduction to Database Systems. (3-0) 3 Credit Hours.
Prerequisites: CS 2233, CS 3421, and CS 3423. 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.

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.

CS 3793. Introduction to Artificial Intelligence. (3-0) 3 Credit Hours.
Prerequisites: CS 3341 and CS 3343. Discussion of theorem-proving by machine; includes computational linguistics, psychological modeling, and computer games.

CS 3841. Computer Organization Recitation. (1-0) 1 Credit Hour.
Prerequisites: CS 2121 and CS 2123. Concurrent enrollment in CS 3843 is required. Recitation to accompany CS 3843. (Formerly CS 2731. Credit cannot be earned for both CS 3841 and CS 2731.)

CS 3843. Computer Organization. (3-0) 3 Credit Hours.
Prerequisites: CS 2121 and CS 2123. Concurrent enrollment in CS 3841 is required. 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. (Formerly CS 2733. Credit cannot be earned for both CS 3843 and CS 2733.)

CS 3851. Computer Architecture Recitation. (1-0) 1 Credit Hour.
Prerequisites: CS 3421, CS 3423, CS 3841, and CS 3843. Concurrent enrollment in CS 3853 is required. Recitation to accompany CS 3853. (Formerly CS 4751. Credit cannot be earned for both CS 3851 and CS 4751.)

CS 3853. Computer Architecture. (3-0) 3 Credit Hours.
Prerequisites: CS 3421, CS 3423, CS 3841, and CS 3843. Concurrent enrollment in CS 3851 is required. 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.)
CS 3873. Computer Networks. (3-0) 3 Credit Hours.
Prerequisites: CS 3841 and CS 3843. 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.)

CS 4313. Automata, Computability, and Formal Languages. (3-0) 3 Credit Hours.
Prerequisites: CS 3341 and 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.

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.

CS 4363. Cryptography. (3-0) 3 Credit Hours.
Prerequisites: CS 3341, CS 3343, and 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.

CS 4383. Computer Graphics. (3-0) 3 Credit Hours.
Prerequisites: CS 2121, CS 2123, CS 3341, and CS 3343. 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.

CS 4393. User Interfaces. (3-0) 3 Credit Hours.
Prerequisite: CS 3443. Study of advanced user interface issues. User interface design, human factors, usability, GUI programming models, and the psychological aspects of human-computer interaction.

CS 4413. Web Technologies. (3-0) 3 Credit Hours.
Prerequisites: CS 3421 and CS 3423. Fundamentals of Web and component technology: markup languages, layout design, client and server side programming, database and Web integration.

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.

CS 4633. Simulation. (3-0) 3 Credit Hours.
Prerequisites: CS 3341 and CS 3343. Design, execution, and analysis of simulation models, discrete event simulation techniques, input and output analysis, random numbers, and simulation tools and languages.

CS 4713. Compiler Construction. (3-0) 3 Credit Hours.
Prerequisites: CS 3341, CS 3343, CS 3841, and CS 3843. 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 3443. 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 in quality assurance.

CS 4733. Project Management. (3-0) 3 Credit Hours.
Prerequisite: CS 3443. Introduction to principles and best practices for software project management. Topics include software process models, capability maturity model, metrics, cost estimation, software project planning, risk management, software configuration management, people management, and software management CASE tools.

CS 4743. Applied Software Engineering. (3-0) 3 Credit Hours.
Prerequisite: CS 3443. Introduction to principles and best practices for the development of software systems. Application of software engineering knowledge of process models, methods, and tools to the design, implementation, and testing of team-based software products.

CS 4773. Object-Oriented Systems. (3-0) 3 Credit Hours.
Prerequisite: CS 3443. 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-oriented design.

CS 4823. Introduction to Parallel Programming. (3-0) 3 Credit Hours.
Prerequisites: CS 3341, CS 3343, CS 3421, and CS 3423. Parallel programming concepts (partitioning, synchronization and communication, programming models-shared memory based and message based), programming tools and languages, performance issues.

CS 4833. Embedded Systems. (3-0) 3 Credit Hours.
Prerequisites: CS 3341, CS 3343, CS 3731, CS 3733, CS 3851, and CS 3853. 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.

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.

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).

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.

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.