

# Computer Science (CSci)

<http://www.cs.und.edu>

Desell, Grant, Hu, Kerlin, Kim, Liu, Marsh (Chair), Reza and Stokke

The underlying goal of the Department of Computer Science is to provide up-to-date, quality instruction in its undergraduate and graduate programs. In support of this goal, a curriculum has been developed which encourages a formal, abstract, theoretical approach to the study of computer science while providing students with experience on state-of-the-art equipment. The degree programs are designed to provide a background of professional education for careers in business, science, government, and industry, and to furnish a strong foundation for graduate study in computer science.

The department offers a Bachelor of Science in Computer Science through the John D. Odegard School of Aerospace Sciences and a Bachelor of Arts with a Major in Computer Science through the College of Arts and Sciences. A minor in computer science is also available.

The B.S. program provides the strongest mathematical and scientific background. It is recommended for students who intend to pursue graduate studies or to seek employment involving technical or scientific applications of computing. The B.S. degree is accredited by the Computing Accreditation Commission of ABET, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012, telephone: 410-347-7700.

The B.A. program offers more flexibility with fewer requirements relating to science and mathematics, but with additional requirements for courses in the humanities. This degree program is recommended for students pursuing a broader-based liberal arts education.

Optional specializations in Network and Operating Systems Analysis, Software Engineering, Game Development and Computer Animation, and Information Technology are available in conjunction with the degree programs.

In addition to the majors and minor, several courses are offered to provide basic knowledge of computer technology and programming for students wishing to use the computer as a tool in other disciplines.

The B.A. and B.S. degrees are conferred upon students who successfully complete the requirements specified below with a minimum cumulative and institutional grade point average of 2.0, a minimum grade point average of 2.2 for all Computer Science courses used to fulfill the major requirements, and grades of 'C' or higher in all required Computer Science prerequisite courses.

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## College of Engineering and Mines

### B.S. in Computer Science

Required 125 credits (36 of which must be numbered 300 or above, and 60 of which must be from a 4-year institution) including:

I. Essential Studies Requirements (see University ES listing).

II. Requirements of the Odegard School of Aerospace Sciences. See College listing.

III. Courses from computer science as follows:

CSCI 160	Computer Science I *	4
CSCI 161	Computer Science II *	4
CSCI 230	Systems Programming *	3
CSCI 242	Algorithms and Data Structures *	3
CSCI 289	Social Implications of Computer Technology	3
CSCI 363	User Interface Design	3
CSCI 365	Organization of Programming Languages *	3
CSCI 370	Computer Architecture *	4
CSCI 435	Formal Languages and Automata	3
CSCI 451	Operating Systems I	3

CSCI 492	Senior Project I	2
CSCI 493	Senior Project II	2
CSCI 494	Special Projects in Computer Science (Co-Req CSCI 493)	1
CSCI Electives **		12
Total Credits		50

\* Grade of 'C' or higher required.

\*\* A combined total of 6 credits from CSCI 260 Advanced Programming Languages, CSCI 297 Experiential Learning, CSCI 299 Topics in Computer Science, CSCI 397 Cooperative Education or CSCI 494 Special Projects in Computer Science may be applied toward these electives. The remaining electives must be UND Computer Science courses numbered 300 or above.

IV. Courses from other departments as follows:

COMM 110	Fundamentals of Public Speaking	3
EE 201	Introduction to Digital Electronics	2
EE 202		
MATH 208	Discrete Mathematics	3
MATH 165 & MATH 166	Calculus I and Calculus II	8
Approved math elective		2-3
Approved probability/statistics elective		3
Approved 2-semester laboratory science sequence		8
2 approved courses in science		6-8
Total Credits		35-38

## College of Arts and Sciences

### B.A. with Major in Computer Science

Required 125 hours (36 of which must be numbered 300 or above, and 60 of which must be from a 4-year institution) including:

I. Essential Studies Requirements (see University ES listing).

II. College of Arts and Sciences Requirements. See College listing.

III. Courses from Computer Science as follows:

CSCI 160	Computer Science I *	4
CSCI 161	Computer Science II *	4
CSCI 230	Systems Programming *	3
CSCI 242	Algorithms and Data Structures *	3
CSCI 365	Organization of Programming Languages *	3
CSCI 370	Computer Architecture *	4
CSCI 435	Formal Languages and Automata	3
CSCI 451	Operating Systems I	3
CSCI 465	Principles of Translation	3
CSCI 492	Senior Project I	2
CSCI 493	Senior Project II	2
CSCI Electives **		12
Total Credits		46

\* Grade of 'C' or higher required.

\*\* Electives may be selected from CSCI 260 Advanced Programming Languages (at most 3 hours), CSCI 289 Social Implications of Computer Technology, CSCI 297 Experiential Learning, CSCI 299 Topics in Computer Science or CSCI 397 Cooperative Education (at most 3 hours) and any other UND Computer Science courses numbered 300 or above.

IV. Courses from other departments as follows:

Level II proficiency in a language other than English (Level IV recommended)		
ENGL 209	Introduction to Linguistics	3

EE 201	Introduction to Digital Electronics	2
EE 202		1
MATH 208	Discrete Mathematics	3
ECON 210	Introduction to Business and Economic Statistics	3
Select one of the following:		3
PHIL 110	Introduction to Logic	
PHIL 221	Symbolic Logic	
Total Credits		15

## Minor in Computer Science

20 credit hours from Computer Science including:

Select one of the following:		4
CSCI 160	Computer Science I	
CSCI 130	Introduction to Scientific Programming	
CSCI 161	Computer Science II	4
CSCI electives		12
Total Credits		20

\* All 12 credit hours of Computer Science electives must be 200 level or above.

## Optional Specializations

A student's coursework in either the B.S. program, the B.A. program, or the Minor program above may be designed to complete one or more of the following specializations. Each specialization completed will be noted on the student's academic record.

### I. System and Programming Security

Coursework must include:

CSCI 327	Data Communications	3
CSCI 389	Computer and Network Security	3
MATH 425	Cryptological Mathematics	3
CSCI 455	Database Management Systems	3
Select two of the following:		6
CSCI 384	Artificial Intelligence	
CSCI 427	Advanced Data Communications	
CSCI 457	Electronic Commerce Systems	
Total Credits		18

### II. Software Engineering

Coursework must include:

CSCI 260	Advanced Programming Languages	3
CSCI 364	Concurrent and Distributed Programming	3
CSCI 463	Software Engineering	3
Program Specific Elective:		3
CSCI 363	User Interface Design (B.A. Students)	
CSCI 465	Principles of Translation (B.S. Students)	
Select one of the following:		1
CSCI 297	Experiential Learning	
CSCI 397	Cooperative Education	
CSCI 491	Seminars in Computer Science	
CSCI 494	Special Projects in Computer Science	
Select one of the following:		3
CSCI 562	Formal Specification Methods	
CSCI 565	Advanced Software Engineering	
Total Credits		16

### III. Information Technology

Coursework must include:

CSCI 389	Computer and Network Security	3
CSCI 455	Database Management Systems	3
CSCI 457	Electronic Commerce Systems	3
Select one of the following:		1
CSCI 297	Experiential Learning	
CSCI 397	Cooperative Education	
CSCI 491	Seminars in Computer Science	
CSCI 494	Special Projects in Computer Science	
Select two of the following:		6
CSCI 260	Advanced Programming Languages	
CSCI 327	Data Communications	
CSCI 399	Topics in Computer Science	
CSCI 513	Advanced Database Systems	
Total Credits		16

A student's coursework in the B.S. program may be designed to complete the following specialization. This specialization will be noted on the student's academic record.

### IV. Game Development and Computer Animation

Elective coursework must include:

CSCI 384	Artificial Intelligence	3
CSCI 463	Software Engineering	3
CSCI 446	Computer Graphics I	3
CSCI 448	Computer Graphics II	3
ART 110	Introduction to the Visual Arts	3
ART 112	Basic Design	3
PHYS 251	University Physics I	4
PHYS 252	University Physics II	4
MATH 207	Introduction to Linear Algebra	2
Total Credits		28

## Courses

### CSCI 101. Introduction to Computers. 3 Credits.

An overview of the fundamental concepts and applications of computer science. Topics include data storage, hardware, operating systems, and programming principles. Corequisite: CSCI 101T is recommended. F,S,SS.

### CSCI 101T. Software Applications Tutorial. 1 Credit.

An introductory tutorial course to complement CSCI 101. Activities will include hands-on experience with operating systems and application software (including word processors, spreadsheets, and databases). Corequisite: CSCI 101 is recommended. On demand.

### CSCI 120. Computer Programming I. 4 Credits.

An introduction to computer programming in a high-level language, with emphasis on problem solving and logical thinking. Students learn to design, implement, test, and debug programs for small-scale problems using elementary data types and control structures. Includes laboratory. On demand.

### CSCI 130. Introduction to Scientific Programming. 4 Credits.

An introduction to scientific computing, with problem solving, algorithm development, and structured programming in a high-level language with an engineering and mathematical focus. Emphasis on learning how to design, code, debug, and document programs, using techniques of good programming style. Includes laboratory. F,S,SS.

### CSCI 150. Introduction to Computer Science. 3 Credits.

This is an introductory course for prospective computer science majors as well as offering an introduction to computing for non-computer science majors. Students will receive a broad introduction to the discipline of computer science without the immersion into a programming language. Students will learn to write interactive Web-based programs. No previous computing or programming experience is assumed. On demand.

**CSCI 160. Computer Science I. 4 Credits.**

An introduction to computer science, with problem solving, algorithm development, and structured programming in a high-level language. Emphasis on learning how to design, code, debug, and document programs, using techniques of good programming style. Includes laboratory. F,S,SS.

**CSCI 160L. Computer Prog I Lab.****CSCI 161. Computer Science II. 4 Credits.**

A broadening of foundations for computer science with advanced concepts in computer programming. Includes an introduction to data structures, analysis of algorithms, and the theory of computation. Includes laboratory. Prerequisites: CSCI 130 or CSCI 160, and MATH 103 or MATH 107; concurrent enrollment in MATH 208 is recommended. F,S,SS.

**CSCI 161L. Computer Prog II Lab.****CSCI 170. Computer Programming II. 4 Credits.**

Advanced techniques in computer programming using a high-level language. Topics include the use of recursion, pointers, and fundamental data structures in developing small to medium-scale programs. Includes laboratory. Prerequisite: CSCI 120. On demand.

**CSCI 199. Topics in Computing. 1-3 Credits.**

Selected introductory-level topics in computing for students of all majors. Course may be repeated to 6 credits with different topics. Repeatable to 6 credits. On demand.

**CSCI 230. Systems Programming. 3 Credits.**

Focus on low level programming. Topics covered include pointers, memory management, code optimization, compiling and linking, and library management. Prerequisite: CSCI 161. S.

**CSCI 242. Algorithms and Data Structures. 3 Credits.**

Object-oriented implementations of complex data structures including lists, sets, trees, and graphs. Time and space analysis and classification of algorithms using upper bounds (big Oh), lower bounds (big Omega), and exact bounds (big Theta). Techniques for analysis of recursive algorithms including use of the "Master Theorem" for divide-and-conquer recurrences. Prerequisites: CSCI 161 and MATH 208. F,S.

**CSCI 260. Advanced Programming Languages. 3 Credits.**

Programming in a specific high-level language for students who are already proficient at programming in another high-level language. Course may be repeated for different languages. A student may not receive credit for both CSCI 260 and a 100-level programming course in the same language. Prerequisite: CSCI 161 or consent of instructor. Repeatable. F.

**CSCI 289. Social Implications of Computer Technology. 3 Credits.**

An introduction to the effects of computer technology on society and individuals and to ethical problems faced by computer professionals. Topics covered include privacy, the nature of work, centralization versus decentralization and the need for human factors analysis in the development of a new computer system. F.

**CSCI 290. Cyber-Security and Information Assurance. 3 Credits.**

An introduction covering the breadth of essential Cyber-Security and Information Assurance topics. Students will hone skills in observation, deduction, analysis, logical reasoning and critical thinking as they gain experience with non-technical and lightly technical aspects of Cyber-Security and Information Assurance through practical and real-world examples. S.

**CSCI 297. Experiential Learning. 1-3 Credits.**

A practical experience in which students offer their proficiency in computing as a resource or service for others. The experience may involve software development, software consulting and assistance, system administration, or instruction. Prerequisite: CSCI 161. Repeatable to 6 credits. S/U grading. F.

**CSCI 299. Topics in Computer Science. 1-3 Credits.**

Selected intermediate-level topics in computer science for students with some experience or previous coursework in computing. Course may be repeated up to 6 credits with different topics. Repeatable to 6 credits. On demand.

**CSCI 327. Data Communications. 3 Credits.**

An introduction to the concepts of data transmission, communication hardware and protocols, communication software and the design, performance and management of computer networks. Prerequisites: CSCI 230 and MATH 208. F.

**CSCI 363. User Interface Design. 3 Credits.**

A study of the design and implementation of user interfaces for software applications. Students will apply principles of interface design to build applications using a toolkit of graphical interface components. Required coursework includes a team project. Prerequisite: CSCI 161. F.

**CSCI 364. Concurrent and Distributed Programming. 3 Credits.**

This course focuses on concurrent object oriented programming and modern distributed/parallel programming models (such as OpenMP, CUDA, OpenCL and Actors). Students will utilize various high performance distributed computing technology. Topics covered will include shared and distributed memory systems, sockets, threads, and message passing. Prerequisites: CSCI 242 and CSCI 230. S, even years.

**CSCI 365. Organization of Programming Languages. 3 Credits.**

Compile and run time requirements of programming languages, parameter passing and value binding techniques. Vector and stack processing. Prerequisite: CSCI 242. S.

**CSCI 370. Computer Architecture. 4 Credits.**

Computer structure, machine presentation of numbers and characters, instruction codes and assembly systems. Introduction to hardware methodologies and software extensions to hardware in computers. Some topics on hardware and software selection will be discussed. Prerequisites: CSCI 230, EE 201, and EE 202. S.

**CSCI 384. Artificial Intelligence. 3 Credits.**

A survey of the applications and techniques of artificial intelligence. Topics include problem solving paradigms, tree searching, rule-based systems, theorem proving, knowledge representation, natural language processing, image processing, and computer learning. Prerequisite: CSCI 242. S.

**CSCI 389. Computer and Network Security. 3 Credits.**

This course introduces techniques for achieving security in multi-user standalone computer systems and distributed computer systems. Coverage includes host-based security topics (cryptography, intrusion detection, secure operating systems), network-based security topics (authentication and identification schemes, denial-of-service attacks, worms, firewalls), risk assessment and security policies. Prerequisite: CSCI 161. S.

**CSCI 397. Cooperative Education. 1-2 Credits.**

A practical work experience with an employer closely associated with the student's academic area. Arranged by mutual agreement among student, department, employer, and the UND Cooperative Education office. Repeatable to 6 credits. Prerequisites: Declared Computer Science major with 15 completed credits in CSCI including CSCI 161. Repeatable to 6 credits. S/U grading. F,S,SS.

**CSCI 399. Topics in Computer Science. 1-3 Credits.**

Selected topics in Computer Science which allow students to study specialized subjects. Repeatable to 12 credits. Prerequisite: Consent of instructor. Repeatable to 12 credits. On demand.

**CSCI 427. Advanced Data Communications. 3 Credits.**

Analysis of existing and future data communications technologies and protocols, including the modeling of realistic networked environments and the analysis of their performance. Prerequisites: CSCI 327. S, even years.

**CSCI 435. Formal Languages and Automata. 3 Credits.**

A study of automata, grammars, and Turing machines as specifications for formal languages. Computation is defined in terms of deciding properties of formal languages, and the fundamental results of computability and decidability are derived. Prerequisites: CSCI 242 and minimum second semester junior standing. F.

**CSCI 445. Mathematical Modeling and Simulation. 3 Credits.**

A study of various mathematical applications for digital computers, including the modeling, simulation and interpretation of the solution of complex systems. Prerequisites: CSCI 161 or CSCI 170, and MATH 166 and a statistics course. F, even years.

**CSCI 446. Computer Graphics I. 3 Credits.**

Introduction to computer graphics. Topics include display technology, light and color, 2D and 3D representations, image processing, ray-tracing, and computer animation. Prerequisites: CSCI 242, CSCI 363, and MATH 166. F, odd years.

**CSCI 448. Computer Graphics II. 3 Credits.**

A continuation of CSCI 446, topics covered include: history of games, game taxonomies, game design theory, computer game development, physics engines and AI engines. Prerequisite: CSCI 446. S, even years.

**CSCI 451. Operating Systems I. 3 Credits.**

Introduction to operating system theory and fundamentals. Topics include: multiprogramming, CPU scheduling, memory management methods, file systems, interprocess communication, and a survey of modern operating systems. Prerequisites: CSCI 242 and CSCI 370. F.

**CSCI 452. Operating Systems II. 3 Credits.**

A study of the implementation of operating systems and parts of operating systems, and development of system software. Prerequisites: CSCI 451. On demand.

**CSCI 455. Database Management Systems. 3 Credits.**

Database concepts, database administration, database design, and database performance, including the partial design of a DBMS application. Prerequisite: CSCI 242. S.

**CSCI 457. Electronic Commerce Systems. 3 Credits.**

A study of electronic commerce system architecture and electronic commerce content design and implementation. Topics include Internet basics, business issues, Web markup languages, static and dynamic Web programming, e-commerce content design and construction, and databases and host languages with embedded SQL such as JDBC. Prerequisite: CSCI 260. S, odd years.

**CSCI 463. Software Engineering. 3 Credits.**

This course teaches software engineering principles and techniques used in the specification, design, implementation, verification and maintenance of large-scale software systems. Major software development methodologies are reviewed. As development team members, students participate in a group project involving the production or revision of a complex software product. Prerequisites: CSCI 242 and CSCI 363. S.

**CSCI 465. Principles of Translation. 3 Credits.**

Techniques for automatic translation of high-level languages to executable code. Prerequisites: CSCI 365 and CSCI 370. F, odd years.

**CSCI 491. Seminars in Computer Science. 1 Credit.**

A course for advanced students. Repeatable to 3 credits. Prerequisite: Consent of instructor. Repeatable to 3 credits. S/U grading. F,S.

**CSCI 492. Senior Project I. 2 Credits.**

The first course in a two-semester sequence in which computer science majors undertake a culminating research or software development project. The course requires written documents, oral presentations, and peer review for the initial phases of the project, including a project proposal, a review of previous work, and a complete software design or research plan. Prerequisites: CSCI 242 and at least second-semester junior standing. Corequisites: Concurrent enrollment in CSCI 494 with student's CSCI capstone project adviser is recommended. F.

**CSCI 493. Senior Project II. 2 Credits.**

The second course in a two-semester sequence in which computer science majors undertake a culminating research or software development project. The course requires written documents and oral presentations/demonstrations for both a preliminary and a final review of the completed project. Student must be concurrently enrolled in at least 1 credit of CSCI 494 with their CSCI capstone project advisor. Prerequisite: CSCI 492. Corequisite: CSCI 494. S.

**CSCI 494. Special Projects in Computer Science. 1-3 Credits.**

A course for advanced students. 1-3 credits varying with the choice of project. May be repeated (6 credits maximum). Prerequisite: Consent of instructor. Repeatable to 6 credits. F,S.