

CS

BACHELOR OF SCIENCE

IN

COMPUTER SCIENCE

- **COMPUTER SCIENCE**
- **NETWORK & SECURITY**
- **INFORMATION TECHNOLOGY**
- **CYBERSECURITY**
- **DATA SCIENCE**

DEPARTMENT OF COMPUTER SCIENCE

The goal of the Department of Computer Science is to provide individuals with a broad-based theoretical and practical understanding of Computer Science. Students who complete the program are prepared to pursue graduate study or to assume positions which include software engineering, technical programming, and the application of computers and related technologies to problems in industry such as computer security, network design and management, and Web design.

The curriculum offered by the Department of Computer Science is designed to serve these purposes:

1. To offer an undergraduate major program in computer science for individuals who wish to pursue a career in this field;
2. To prepare students for graduate work in computer science;
3. To offer a minor in computer science for those who feel the need for a less extensive concentration in computing;
4. To serve students in other academic disciplines by offering instruction in computer applications that are useful in these disciplines.

The Department offers an undergraduate major with five choices of concentration. In each concentration, students are guided through a carefully selected sequence of courses designed to provide a thorough grounding in practical aspects of the field. Students will also acquire sufficient theoretical background to enable them to keep up with the rapid changes in computer technology and methodology. Students should consult a Department advisor to determine which concentration and electives to choose.

Declaration of Major

To declare a major in Computer Science, a student must fill out the 'Declaration of Major Form,' available in the Computer Science Department office.

A student must complete the major requirements in effect when admitted (or re-admitted) to the University. Upon declaring the major, a student must choose a concentration. If the student later wishes to change concentrations, he/she must notify the Department advisor.

Conditions for Graduation with a Bachelor of Science Degree in Computer Science

1. Declaration of major
2. Meet major requirements as follows:

48 credit hours of computer science course work, including 24 credit hours of CS core courses, plus an additional 24 credit hours of CS course work as required in the chosen concentration: Computer Science, Computer Networks and Security, Information Technology, Cybersecurity, Data Science.

No grade lower than a 'C' will be accepted in the major or minor.

Core Courses (Required of all CS majors), 24 credit hours

CS 200 Programming Fundamentals	4cr
CS 201 Discrete Structures	3cr
CS 207 Object Oriented Programming and Data Structures	5cr
CS 301 Computer Organization	3cr
CS 308 Operating Systems	3cr
CS 319 WIP: Fundamentals of Software Engineering (ELE-DS)	3cr
CS 324 Introduction to Design of Algorithms	3cr

NO SUBSTITUTIONS ARE ALLOWED FOR CORE COURSES.

3. Completion of all University and College of Arts & Sciences requirements for graduation as listed in the University catalog.

REGISTRATION FOR COMPUTER SCIENCE COURSES

Students may register online for Computer Science courses for which prerequisites have been met during advance and late registration. Prerequisites will be checked and enforced. If a prerequisite was taken elsewhere, special permission will be required before the student can register. **It is important that transfer students who have not had their courses evaluated by the CS program advisor do so prior to registering.**

Note that a student may advance register for a course while enrolled in the prerequisite course at NEIU, but must complete the prerequisite with a 'C' or better to remain registered. If the prerequisite course is not successfully completed the student must withdraw from any course(s) for which it is a prerequisite.

GENERAL INFORMATION

Computer Science electives, as well as requests for substitutions of required courses, must be approved by the Computer Science Department. Approval for substitutions must be in writing from the Department chair. Substitutions are allowed only under special circumstances as determined by the Department chair.

Students who intend to pursue a Master's degree in Computer Science should plan on completing Calculus II and are advised to take a course in Linear Algebra. Requirements of graduate programs in computer science vary. Students should check with a graduate school advisor at the prospective school. Students planning to apply for Northeastern Illinois University's M.S. in Computer Science should have a minimum GPA of 3.00/4.00 in all major courses and an overall minimum GPA of 2.75/4.00. Courses used to fulfill the undergraduate degree cannot be used toward the graduate degree.

Transfer students should have their transferred computer science courses evaluated by the Computer Science advisor for possible acceptance as soon as possible after receiving the University transfer evaluation. Transfer students who have fulfilled the math requirement for CS-200/201 at another school should have that math course evaluated by the CS advisor as soon as possible. Acceptance of a course by the University does not guarantee major equivalency. Transfer courses equivalent to CS courses in the selected concentration may be accepted as part of the major requirements if a grade of 'C' or better was earned; however, transfer students must complete a minimum of 24 credit hours of CS 300-level course work at Northeastern Illinois University and meet all major course requirements in the selected concentration.

NOTE: Introductory courses completed at other schools are not equivalent to CS-200 *Programming Fundamentals* or CS-207 *Object Oriented Programming and Data Structures* unless they cover the same material taught at NEIU. The Computer Science Department administers placement tests to determine whether a transferred course can be accepted into the major as an equivalent course.

A transfer student should declare a major in computer science during his/her first term in order to plan a program with the Computer Science advisor.

MINOR IN COMPUTER SCIENCE

A student may complete a minor in Computer Science by selecting courses totaling at least 18 credit hours from those offered by the Computer Science Department. A minor includes CS-200 Programming Fundamentals, CS-201 Discrete Structures, and at least 6 hours in 300-level courses. The additional courses can be 100, 200 or 300-level. No grade lower than a 'C' will be accepted in the minor. Specific courses should be chosen with the Computer Science advisor to best enhance the student's major. Transfer students must complete a minimum of 9 hours toward the CS minor at Northeastern Illinois University.

A student should obtain approval for courses from the Department advisor or chair before beginning his/her program of study. Deadlines and requirements for filing for graduation are published in the schedule of classes. It is the student's responsibility to complete all requirements and forms by the proper time.

GRADUATION INSTRUCTIONS FOR COMPUTER SCIENCE MAJORS/MINORS

In order to file for graduation you must:

1. Be an officially declared CS major or minor with all required forms (Declaration of Major; CS New Major Questionnaire; Declaration of Minor, if pursuing a minor) processed.
2. Obtain an application for graduation from the Office of Enrollment Services.
3. Obtain an Academic Course Record form for the major from the CS Department office, and an Academic Course Record form for the minor from your minor department, if you have a minor.
4. Make an appointment with the Computer Science advisor.
5. If you have a minor, complete the Academic Course Record form for your minor and have it approved by the advisor in your minor department.
6. Turn in the originals of the Application for Graduation and Academic Course Record forms for the major (and minor, if applicable) at the Enrollment Services counter, D-101.

FILING DEADLINES FOR GRADUATION ARE GENERALLY:

May	Previous August 1 - September 15
August	Previous November 1 - January 15
December	Previous April 1 - May 15

FOR EXACT DEADLINES CONTACT THE OFFICE OF ENROLLMENT SERVICES.

FOR FURTHER INFORMATION PLEASE CONTACT:

Department of Computer Science
Northeastern Illinois University
5500 N. St. Louis Avenue
Chicago, Illinois 60625
Telephone: (773)442-4720
Department Office: COBT

Computer Science Concentration

This concentration is designed primarily for the student intending to pursue an advanced degree in Computer Science; however, it is appropriate for any student whose goal is to understand the fundamentals of Computer Science.

Core Courses (Required of all CS majors): **24 cr.**

CS-200	Programming Fundamentals	4 cr.
CS-201	Discrete Structures	3 cr.
CS-207	Object Oriented Programming and Data Structures	5 cr.
CS-301	Computer Organization	3 cr.
CS-308	Operating Systems	3 cr.
CS-319	WIP: Fundamentals of Software Engineering (ELE-DS)	3 cr.
CS-324	Introduction to the Design of Algorithms	3 cr.

Required Courses for the Computer Science Concentration: **9 cr.**

CS-325	Theory of Computation.....	3 cr.
CS-335	Artificial Intelligence.....	3 cr.
CS-355*	Cryptography.....	3 cr.

*Required of students admitted/re-admitted in catalog term Fall 2019 or later. Students admitted/re-admitted before Fall 2019 can substitute a course from list below.

Three courses chosen from the following (each course is 3 cr.): **9 cr.**

CS 307	Programming Language
CS-315	Data Base Management
CS-331	Computer Networks
CS-334	Open Source Systems
CS-340	Computer Graphics
CS-341	Parallel Computing and Distributed Systems
CS-342	Human Computer Interaction (ELE-X)
CS-343	Natural Language Processing

Two CS 300-level electives, approved by the CS Department..... **6 cr.**

Total: 48 cr.

Computer Science Concentration

The major in Computer Science is planned as part of a four-year degree. A student interested in pursuing the Computer Science Concentration must take **MATH 187 *Calculus I*** and **MATH-202 *Calculus II***. Check with the Math Department for placement information and prerequisites. It is recommended that a student complete MATH-202 before taking CS-325 *Theory of Computation*; however, a student need not complete MATH-202 before starting the major. A student in the Computer Science concentration may start the major after completing College Algebra.

A Computer Science major in the Computer Science concentration will generally take at least six terms and should be started in the sophomore or junior year.

Students must complete the prerequisite course(s) with a grade of 'C' or better before taking the next course. The order in which courses may be chosen is listed below. Students are advised to take no more than three Computer Science courses in one semester.

Group one	CS-200	Programming Fundamentals
	CS-201	Discrete Structures
Group two	CS-207	Object Oriented Programming and Data Structures
	CS-301	Computer Organization
	CS-308	Operating Systems
	CS-319	WIP:Fundamentals of Software Engineering (ELE-DS)
Group four	CS-324	Introduction to the Design of Algorithms
	CS-325	Theory of Computation
	CS-335	Artificial Intelligence
Group five	CS-355	Cryptography
	Three courses chosen from list on p. 4*	
	Two CS 300-level electives, approved by the CS Department*	

*May also be taken in groups one through four on the condition that all prerequisites for the chosen courses are met.

Check the rotation plan on page 10 to find out when courses are offered.

Computer Networks and Security Concentration

This concentration is designed to prepare the student for employment in a computer security related field.

Core Courses (Required of all CS majors): **24 cr.**

CS-200	Programming Fundamentals	4 cr.
CS-201	Discrete Structures	3 cr.
CS-207	Object Oriented Programming and Data Structures	5 cr.
CS-301	Computer Organization	3 cr.
CS-308	Operating Systems	3 cr.
CS-319	WIP: Fundamentals of Software Engineering (ELE-DS)	3 cr.
CS-324	Introduction to the Design of Algorithms	3 cr.

Required courses for the Computer Networks and Security Concentration: **9 cr.**

CS-331	Computer Networks.....	3 cr.
CS-355	Cryptography.....	3 cr.
CS-360	Cybersecurity.....	3 cr.

Three courses chosen from the following (each course is 3 cr.): **9 cr.**

CS-315	Data Base Management
CS-323	Cyberlaw (ELE-X)
CS-334	Open Source Systems
CS-335	Artificial Intelligence
CS-341	Parallel Computing and Distributed Systems
CS-345	Network Security
CS-361	Secure Programming and Testing

Two CS 300-level electives, approved by the CS Department..... **6 cr.**

Total: **48 cr.**

Computer Networks and Security Concentration

The major in Computer Science is planned as part of a four-year degree. A student interested in pursuing the Computer Networks and Security concentration must take College Algebra.

A Computer Science major with an emphasis in Computer Networks and Security will generally take at least six terms and should be started in the sophomore or junior year.

Students must complete prerequisite course(s) with a grade of 'C' or better before taking the next course. The order in which courses may be chosen is listed below. Students are advised to take no more than three computer science courses in one semester.

Group one	CS-200 CS-201	Programming Fundamentals Discrete Structures
Group two	CS-207 CS-301	Object Oriented Programming and Data Structures Computer Organization
Group three	CS-308 CS-331	Operating Systems Computer Networks
Group four	CS-319 CS-324 CS-360	WIP: Fundamentals of Software Engineering (ELE-DS) Introduction to the Design of Algorithms Cyber Security
Group five	CS-355	Cryptography
		Three courses chosen from list on p. 6*
		Two CS 300-level electives, approved by the CS Department*

*May also be taken in groups one through four on the condition that all prerequisites for the chosen courses are met.

Check the rotation plan on page 10 to find out when courses are offered.

Information Technology Concentration

This concentration is designed to prepare the student for employment involving Web development and computer network design and maintenance.

Core Courses (Required of all CS majors): **24 cr.**

CS-200	Programming Fundamentals	4 cr.
CS-201	Discrete Structures	3 cr.
CS-207	Object Oriented Programming and Data Structures	5 cr.
CS-301	Computer Organization	3 cr.
CS-308	Operating Systems	3 cr.
CS-319	WIP: Fundamentals of Software Engineering (ELE-DS)	3 cr.
CS-324	Introduction to the Design of Algorithms	3 cr.

Required courses for the Information Technology concentration: **9 cr.**

CS-315	Data Base Management.....	3 cr.
CS-331	Computer Networks.....	3 cr.
CS-339	Fundamentals of IT Project Management.....	3 cr.

Three courses chosen from the following (each course is 3 cr.): **9 cr.**

CS-300	Client Side Web Development
CS-317	Event Driven Programming
CS-321	Server Side Web Development
CS-334	Open Source Systems
CS-335	Artificial Intelligence
CS-342	Human Computer Interaction (ELE-X)
CS-347	Mobile Application Development
CS-360	Cyber Security

Two CS 300-level electives, approved by the CS Department..... **6 cr.**

Total: 48 cr.

Information Technology Concentration

This concentration is designed to prepare the student for employment involving Web development and computer network design and maintenance.

Core Courses (Required of all CS majors): **24 cr.**

CS-200	Programming Fundamentals	4 cr.
CS-201	Discrete Structures	3 cr.
CS-207	Object Oriented Programming and Data Structures	5 cr.
CS-301	Computer Organization	3 cr.
CS-308	Operating Systems	3 cr.
CS-319	WIP: Fundamentals of Software Engineering (ELE-DS)	3 cr.
CS-324	Introduction to the Design of Algorithms	3 cr.

Required courses for the Information Technology concentration: **9 cr.**

CS-315	Data Base Management.....	3 cr.
CS-331	Computer Networks.....	3 cr.
CS-339	Fundamentals of IT Project Management.....	3 cr.

Three courses chosen from the following (each course is 3 cr.): **9 cr.**

CS-300	Client Side Web Development
CS-317	Event Driven Programming
CS-321	Server Side Web Development
CS-334	Open Source Systems
CS-335	Artificial Intelligence
CS-342	Human Computer Interaction (ELE-X)
CS-347	Mobile Application Development
CS-360	Cyber Security

Two CS 300-level electives, approved by the CS Department..... **6 cr.**

Total: 48 cr.

Cybersecurity Concentration

This concentration is designed to prepare students for employment involving network and information security, digital forensic, and security requirements analysis and design.

Core Courses (Required of all CS majors): **24 cr.**

CS-200	Programming Fundamentals	4 cr.
CS-201	Discrete Structures	3 cr.
CS-207	Object Oriented Programming and Data Structures	5 cr.
CS-301	Computer Organization	3 cr.
CS-308	Operating Systems	3 cr.
CS-319	WIP: Fundamentals of Software Engineering (ELE-DS)	3 cr.
CS-324	Introduction to the Design of Algorithms	3 cr.

Required courses for the Cybersecurity concentration: **9 cr.**

CS-331	Computer Networks.....	3 cr.
CS-355	Cryptography.....	3 cr.
CS-360	Cybersecurity.....	3 cr.

Three courses chosen from the following (each course is 3 cr.): **9 cr.**

CS-260	Computer Security	
CS-315	Data Base Management	
CS-323	Cyberlaw (ELE-X)	
CS-343	Introduction to Natural Language Processing	
CS-345	Network Security	
CS-349	Internet of Things	
CS-351	Data Wrangling for Data Analysis	
CS-362	Digital Forensics	

Two CS 300-level electives, approved by the CS Department..... **6 cr.**

Total: 48 cr.

Cybersecurity

The major in Computer Science is planned as part of a four-year degree. A student interested in pursuing the Cybersecurity concentration must take College Algebra.

A Computer Science major with an emphasis in Cybersecurity will generally take at least six terms and should be started in the sophomore or junior year.

Students must complete prerequisite course(s) with a grade of 'C' or better before taking the next course. The order in which courses may be chosen is listed below. Students are advised to take no more than three computer science courses in one semester.

Group one	CS-200 CS-201	Programming Fundamentals Discrete Structures
Group two	CS-207 CS-301	Object Oriented Programming and Data Structures Computer Organization
Group three	CS-308 CS-331	Operating Systems Computer Networks
Group four	CS-319 CS-324 CS-360	WIP: Fundamentals of Software Engineering (ELE-DS) Introduction to the Design of Algorithms Cyber Security
Group five	CS-355	Cryptography
	Three courses chosen from list on p. 11*	
	Two CS 300-level electives, approved by the CS Department*	

*May also be taken in groups one through four on the condition that all prerequisites for the chosen courses are met.

Check the rotation plan on page 10 to find out when courses are offered.

Data Science

The concentration is designed to prepare students for employment involving data analysis, research and also prepares students to conduct academic research.

Core Courses (Required of all CS majors): **24 cr.**

CS-200	Programming Fundamentals	4 cr.
CS-201	Discrete Structures	3 cr.
CS-207	Object Oriented Programming and Data Structures	5 cr.
CS-301	Computer Organization	3 cr.
CS-308	Operating Systems	3 cr.
CS-319	WIP: Fundamentals of Software Engineering (ELE-DS)	.. 3 cr.
CS-324	Introduction to the Design of Algorithms	3 cr.

Required courses for the Data Science concentration: **9 cr.**

CS-315	Data Base Management	3 cr.
CS-322	Applied Research and Data Analysis	3 cr.
CS-351	Data Wrangling for Data Analysis	3 cr.

Three courses chosen from the following (each course is 3 cr.): **9 cr.**

CS-327	Computational Methods in Biology
CS-329	Decision Theory
CS-335	Artificial Intelligence
CS-342	Introduction to Human Computer Interaction (ELE-X)
CS-343	Introduction to Natural Language Processing
CS-349	Introduction to Internet of Things
GES-372	GIS Across Disciplines
MATH-275	Applied and Computational Statistics
MATH-305	Probability and Statistics
MATH-307	Introduction to Stochastic Processes
MATH-365	Statistical Computer and Data Analysis Packages
ECON-220	Business and Economic Statistics I
ECON-318	Introduction to Econometrics and Forecasting
ECON-343	Macroeconomic Data Analysis
ECON-346	Applied Economic Statistics Using R
MNGT-351	Data Visualization and Management
MNGT-352	Model-based Decision Making
MNGT-353	Supply Chain Analytics
MNGT-368	Business Statistics

MNGT-377 Production/Operations Management
MNGT-379 Business Analytics
MKTG-353 Marketing Research

Two CS 300-level electives, approved by the CS Department..... **6 cr.**

Total: 48 cr.

Data Science

The major in Computer Science is planned as part of a four-year degree. A student interested in pursuing the Data Science concentration must take College Algebra.

A Computer Science major with an emphasis in Data Science will generally take at least six terms and should be started in the sophomore or junior year.

Students must complete prerequisite course(s) with a grade of 'C' or better before taking the next course. The order in which courses may be chosen is listed below. Students are advised to take no more than three computer science courses in one semester.

Group one	CS-200 CS-201	Programming Fundamentals Discrete Structures
Group two	CS-207 CS-301	Object Oriented Programming and Data Structures Computer Organization
Group three	CS-308 CS-315	Operating Systems Modern Database Management
Group four	CS-319 CS-324 CS-322	WIP: Fundamentals of Software Engineering (ELE-DS) Introduction to the Design of Algorithms Applied Research and Data Analysis
Group five	CS-351	Data Wrangling for Data Analysis
		Three courses chosen from list on p. 11*
		Two CS 300-level electives, approved by the CS Department*

*May also be taken in groups one through four on the condition that all prerequisites for the chosen courses are met.

Check the rotation plan on page 10 to find out when courses are offered.

COURSE ROTATION PLAN

Northeastern Illinois University is on a semester system. The fall term begins late August, the spring term begins in January and the summer term begins late May. Listed below is the rotation plan for undergraduate Computer Science courses. Students should take this plan into consideration when outlining their major programs. Students should note that most courses will be offered either day or evening, but not both, in a semester.

D refers to courses offered between 8:00 a.m. and 4:00 p.m. Monday through Friday. E refers to courses offered between 4:15 p.m. and 10:00 p.m. Monday through Friday or Saturday between 8:00 a.m. and 2:00 p.m. (later in the summer). X indicates that no section will be offered that semester.

The rotation plan will be adhered to as closely as possible; however, changes may be made due to unforeseen circumstances. Courses with low enrollments may be canceled after Advance Registration or during Change of Registration. Courses might be scheduled more frequently when required.

Courses that are not listed here have an irregular rotation plan.

	FALL	SPRING	SUMMER
CS-100 Computers and Society	D&E	D&E	D or E
CS-101 Creative Problem Solving	D or E	D or E	X
CS-108 Computer Science for All	D or E	D or E	X
CS-109 FYE: The Info Age: Its Impact on Chicago Culture	D	D	
CS-200 Programming Fundamentals	D&E	D&E	D or E
CS-201 Discrete Structures	D&E	D&E	D or E
CS-207 Object Oriented Programming and Data Science	D&E	D&E	D or E
CS-300 Client Side Web Development	D&E	D&E	D or E
CS-301 Computer Organization with Assembly	D or E	D&E	D or E
CS-302 Systems Programming	Not offered on regular basis		
CS-304 Data Structures	D&E	D&E	D or E
CS-307 Programming Languages	Not offered on regular basis		
CS-308 Operating Systems	D or E	E	D or E
CS-315 Data Base Management	E	D or E	X
CS-317 Event-Driven Programming	X	E	X
CS-319 WIP:Fundamentals of Software Engineering(ELE-DS)E		D or E	X
CS-321 Server-Side Web Development	D or E	E	X
CS-323 Cyberlaw (ELE-X)	E	E	X
CS-324 Introduction to the Design of Algorithms	D or E	E	D or E
CS-325 Theory of Computation	E	X	X
CS-331 Computer Networks	E	E	D or E
CS-334 Open Source Systems	X	D or E	X
CS-335 Artificial Intelligence	D or E	D or E	X
CS-336 History of Computing	Not offered on regular basis.		
CS-338 Science, Women, and Technology (ELE-X)	Not offered on regular basis.		
CS-339 Fundamentals of IT Project Management	E (or Sat)	E (or Sat)	X
CS-340 Computer Graphics	Not offered on regular basis.		
CS-341 Parallel Computing and Distributed Systems	TBD		
CS-342 Introduction to Human Computer Interaction (ELE-X)	D or E	D or E	X
CS-343 Natural Language Processing	TBD		
CS-344 Introduction to Systems Administration	TBD		
CS-345 Network Security	E	X	X
CS-347 Mobile Application Development	D or E	D or E	X
CS-349 Internet of Things	TBD		
CS-355 Cryptography	X	E	X
CS-360 Cyber Security	X	E	X
CS-361 Secure Programming and Testing	TBD		

CS COURSE OFFERINGS

CS-100. Computers And Society. 3 Hours.

This course provides an introduction to the history of computing and how computers have affected society. Furthermore, it covers the basic computer skills needed to be truly computer literate in modern society. Topics include, but are not limited to the history of computing, the social context of computing, ethical issues in computing, computer security and privacy, the impact of the Internet and the World Wide Web, an introduction to computer architecture and operating systems, and basic computer programs utilized for school, work, and home.

CS-101. Creative Problem Solving. 3 Hours.

The goal of this course is to focus on the skills required to analyze a problem and create a step-by-step (algorithmic) solution to that problem. Basic computation using arithmetic, relational, and logical operators will be covered as well as an in-depth treatment of decision and repetition control structures to create algorithms based on mathematical concepts such as summation, averages, exponentiation, prime and perfect numbers, algebraic and geometric sequences, etc.

Prerequisite: [MATH-092](#) with a minimum grade of C.

CS-108. Computer Science For All. 3 Hours.

Computer science has revolutionized many disciplines and it is no longer only for computer scientists. By studying computer science students will use computational thinking and apply programming to real world scenarios and interdisciplinary examples from science, math and teacher education. Robots and web and mobile-based coding platforms will be used to expose students to coding through different technologies. Students will learn computer science concepts such as algorithms, loops, and conditionals. Each week students will engage in hands-on computational thinking or coding exercises. Finally, students will complete a project using coding to demonstrate

scientific, mathematical, or concepts from other disciplines.

Prerequisites: [ENGL-101](#) and Accuplacer College Level Math 020 - 120 (or Accuplacer Adv. Algebra & Func 237 - 300 or NEIU Math Placement Result 30 - 45).

CS-109. First Year Experience: The Information Age: Its Impact On Chicago's Culture. 3 Hours.

The 21st century has seen the genesis of the Information Age. Advances in computer technology have made immediate access to information and sophisticated processing of information commonplace in business, science, medicine, education, various professional areas and many aspects of personal life. This course focuses on how this has impacted Chicago's culture and its diverse communities. This course fulfills the First Year Experience (FYE) requirement. FYE-109 courses are intended for Freshmen only. Students may not take more than one FYE-109 course.

CS-200. Programming Fundamentals. 4 Hours.

This course serves as an introduction to principles of computer programming. It covers fundamental concepts including input/output, data types, arithmetic, relational and logical operators, branching, looping, arrays, classes and objects, wrapper classes and strings. Programming projects involving these concepts will be assigned for interactive applications, numeric computations, and analysis of data.

Prerequisite: [MATH-173](#) with a minimum grade of C.

CS-201. Discrete Structures. 3 Hours.

Introduction to the fundamental number theoretic, logical, algorithmic, combinatoric, and computational concepts from discrete structures and their applications to computer science. This course involves no programming.

Prerequisite: [MATH-173](#) with a minimum grade of C or [MATH-104](#) with a minimum grade of C.

CS-203. Introduction To Problem Solving & Computational Thinking. 2 Hours.

The goal of this course is to focus on the skills required to analyze a problem and create a step-by-step solution to that problem using the Bransford's IDEAL problem-solving approach (Identify the problem, Define the problem, Examine the options, Act on a plan, look at the consequences) and hone their problem-solving skills by applying the IDEAL approach to a variety of problems in a wide range of domains. Students integrate computational thinking into the IDEAL and Duke's 7 steps problem-solving approaches, recognize patterns in the problems they are solving (similarities and differences), identify abstractions, decompose a problem, and convert a real-world problem to its computational equivalent problem.

Corequisite: [CS-200](#).

CS-207. Object-Oriented Programming And Data Structures. 5 Hours.

This course provides an in-depth study of object-oriented programming and abstract data structures implementation

and application. It covers inheritance and polymorphism, abstract classes and interfaces, exception handling, file operations, stacks, queues, lists, trees, heaps, and graphs. Additional topics include recursion, searching, and sorting algorithms.

Prerequisite: CS-200 with a minimum grade of C.

CS-260. Computer Security. 3 Hours.

This course serves as an introduction to computer security. It covers the basic components of modern computers, and the fundamental concepts of security including assets, threats, adversaries, cryptosystems, confidentiality, integrity, availability, assurance, authenticity, anonymity, privacy, and security principles. Building upon these fundamental concepts, this course also covers user authentication, security management and risk assessment, implementation of security plans to keep systems secure, and physical and infrastructure security. Finally, the course introduces human resources security, and legal and ethical aspects of security practices.

Prerequisite: CS-200 with a minimum grade of C.

CS-300. Client Side Web Development. 3 Hours.

The course discusses web site design issues and the requirements of e-commerce. Furthermore, it covers the creation of web pages. Hands-on development and group projects are an essential part of this course.

Prerequisite: CS-200 with a minimum grade of C.

CS-301. Computer Organization. 3 Hours.

Representation of data, machine arithmetic, processor and memory organizations, instruction execution, assembly and machine languages, addressing mechanisms, and implementation of high level language constructs. Students

will gain a vision of levels of abstraction in hardware and software, the nature of the Von Neumann machine and the nature of high level languages.

Prerequisite: CS-200 with a minimum grade of C and CS-201 with a minimum grade of C.

CS-302. Systems Programming. 3 Hours.

Introduction to systems programming, including use and implementation of assembler, macros, loaders, compilers, and operating systems.

Prerequisite: CS-207 with a minimum grade of C and CS-308 with a minimum grade of C.

CS-304. Data Structures. 3 Hours.

This course provides experience implementing and manipulating basic data structures, as well as analyzing their applications in Computer Science. Topics covered will include: Stacks, Queues, Linked Lists, Binary Tree Structures, Heaps, Graphs, and Sorting Algorithms.

Prerequisite: CS-201 with a minimum grade of C and CS-207 with a minimum grade of C.

CS-305. Computer Logic And Circuitry. 3 Hours.

Introduction to logical design of computers and some of their applications. Included are Boolean algebra, switching theory, number systems, numerical codes, and computer organization. Engineering problems are de-emphasized. Computer word organization, languages and use of computers for simple problems will be explained. **Prerequisite:** CS-200 with a minimum grade of C.

CS-307. Programming Languages. 3 Hours.

This course provides an introduction to the fundamental concepts of programming languages their structural definition and run time implementation. It equips the students with the tools necessary for the critical evaluation of existing programming languages, and the learning of new ones. In addition, it prepares students for the study of computer design.

Prerequisite: CS-207 with a minimum grade of C or CS-424 with a minimum grade of C.

CS-308. Operating Systems. 3 Hours.

A general overview of the ideas underlying operating systems. Included are traditional topics such as file systems, CPU scheduling, memory management and device scheduling, along with the topics of more current interest such as deadlock handling, process synchronization and distributed systems. No single operating system is studied; examples are drawn from many sources.

Prerequisite: CS-207 with a minimum grade of C and CS-301 with a minimum grade of C.

CS-309. Compiler Theory. 3 Hours.

Introduction to basic structure and components of a compiler. Finite automata, lexical analysis, regular grammar, context free grammar, top-down and bottom-up parsing techniques.

Prerequisite: CS-207 with a minimum grade of C.

CS-310. Algorithmic Thinking In Problem Solving. 1 Hour.

In this course, students focus on learning advanced problem-solving strategies and apply them to more challenging problems in computer science and business. Students synthesize information that they have learned across different computer science courses, in particular data structures, to solve complex problems efficiently and communicate solutions to teammates and industry professionals. The course provides practice on problems drawn from different domains, characterized by incomplete, vague, and possibly inconsistent specifications. Emphasis is on problems that have practical and real-world relevance.

Prerequisite: CS-203 with a minimum grade of C.

Corequisite: CS-207.

CS-311. Modern Computer Architecture. 3 Hours.

This course is intended for those students who wish to understand the architecture and operation of computer systems. Methods for interconnecting processors, memories and I/O devices are discussed. The addressing modes and instruction techniques for manipulation of more complex data structures such as queues, lists and trees are covered.

Prerequisite: (CS-207 with a minimum grade of C or CS-406 with a minimum grade of C) and CS-301 with a minimum grade of C.

CS-314. Independent Study In Computer Science. 3 Hours.

An opportunity for an individual research or applications project under the direction of an advisor knowledgeable in the field of endeavor. The project will be designed by the student and his/her project advisor, and must be approved by the chairperson of the Department of Computer Science before the project itself is undertaken.

CS-315. Modern Database Management. 3 Hours.

Theoretical foundations and state-of-the-art data base management systems. The relational, hierarchical and network approaches to data base management systems and representative systems are described. User interfaces are emphasized.

Prerequisite: CS-200 with a minimum grade of C.

CS-317. Event-Driven Programming. 3 Hours.

This course serves as an introduction to techniques and tools for the design of graphical user interfaces and event-driven applications. Topics covered include layering, domain logics, form and control basics, custom control, database mapping, and application embedded support. Students will be expected to apply these concepts in programming projects.

Prerequisite: CS-207 with a minimum grade of C.

CS-319. Writing Intensive Program: Fundamentals Of Software Engineering. 3 Hours.

This course serves as an introduction to the life cycle of the software development process. Topics covered include each phase of the cycle, and techniques and paradigms that result in the successful realization of each stage. Students will be expected to apply these concepts in a large-scale project.

Prerequisite: CS-207 with a minimum grade of C and ENGL-101 with a minimum grade of C.

CS-320. Object-Oriented Programming. 3 Hours.

This course provides an introduction to Object-Oriented Design (OOD) and Object-Oriented Programming (OOP), which is a highly used contemporary programming paradigm. The three main features of OOD, namely encapsulation, polymorphism and inheritance are discussed. The student must implement these concepts in a project.

Prerequisite: CS-304 with a minimum grade of C.

CS-321. Server Side Web Development. 3 Hours.

This course is an introduction to techniques and tools for designing server side web applications. Topics covered include web application flow, object oriented programming, design of classes, dynamic content, scripting languages, implicit objects and database accessing. Students will be expected to apply these concepts in the development of a website.

Prerequisite: CS-207 with a minimum grade of C and CS-300 with a minimum grade of C.

CS-322. Statistical Computer Program Packages. 3 Hours.

This course provides an in depth study of modern statistical data analysis using as the Binomial and Normal distribution, the Linear Regression model, Analysis of Variance, Nonparametric methods and Computer Random Sampling techniques using MINITAB and GPSS. In addition, students will become experienced in the actual implementation of these statistical models with data sets using such statistical software packages as MINITAB, SPSS, BMDP and SAS.

Prerequisite: CS-200 with a minimum grade of C and MATH-275 with a minimum grade of C.

CS-323. Cyberlaw. 3 Hours.

This course presents an introduction to the legal issues relating to the use of computers and the Internet. Topics covered include privacy, freedom of speech, intellectual property in cyberspace, encryption and interception of communication, computer crime, professional ethics and codes of conduct and work related ethical and legal issues.

CS-324. Introduction To The Design Of Algorithms. 3 Hours.

Methods for analyzing algorithms are discussed including an introduction to asymptotic notation. Several

approaches to designing algorithms are covered using theory, examples and problems. Those approaches include divide-and-conquer, dynamic programming, the greedy approach backtracking and branch-and-bound. Different approaches are applied to the same problem to illuminate the relative advantages.

Prerequisite: CS-201 with a minimum grade of C and CS-207 with a minimum grade of C.

CS-325. Theory Of Computation. 3 Hours.

This course discusses several models of computation, including finite automata, pushdown automata and deterministic and nondeterministic Turing machines. The notions of undecidability, computational complexity, intractability and NP completeness are also discussed. The course is mainly theoretical in nature, but some applications, such as finite state systems and parsing, will be discussed.

Prerequisite: CS-201 with a minimum grade of C and CS-207 with a minimum grade of C or (CS-424 with a minimum grade of C).

CS-326. Numerical Methods Using Fortran Programming. 3 Hours.

An introduction to structured Fortran programming, Computational errors, Solving nonlinear equations, Solving sets of Equations, Determinants and matrix inversions, Interpolating polynomials.

Prerequisite: MATH-106 with a minimum grade of C or MATH-185 with a minimum grade of C.

CS-327. Computational Methods In Biology. 3 Hours.

Bioinformatics is the discipline that applies mathematics, statistics, computer science, chemistry, and biology to solving problems in biology using biological data sets. The problems investigated are usually at the molecular level. These problems include sequence alignment, genome assembly, models of evolution and phylogenetic trees, analyzing gene expression data, and gene linkage analysis. One of the most important statistical tools used in bioinformatics is the Bayesian network. This course introduces the techniques used in bioinformatics, in particular Bayesian networks, and provides solutions to several bioinformatics problems.

Prerequisite: (CS-201 with a minimum grade of C or MATH-251 with a minimum grade of C) and (BIO-100 with a minimum grade of C or BIO-201 with a minimum grade of C) and CS-200 with a minimum grade of C.

CS-329. Decision Theory. 3 Hours.

This course covers probabilistic networks, influence diagrams, and decision trees, and their application to making decisions in the face of uncertainty. It addresses modeling one-time decisions and also modeling repeatable decisions as done by an expert system. An expert system is a system that makes the judgments and decisions of an expert. Classical examples of expert systems are systems that make financial decisions and ones that perform medical diagnosis. This course will concentrate more of the latter. Methods for building expert systems and for doing inference with them will be covered.

Prerequisite: CS-201 with a minimum grade of C and CS-207 with a minimum grade of C.

CS-331. Computer Networks. 3 Hours.

This course covers concepts in data communications, emphasizing protocols. An overview of all protocol layers will be covered, with emphasis on OSI and TCP/IP.

Prerequisite: CS-207 with a minimum grade of C or CS-406 with a minimum grade of C or CS-424 with a minimum grade of C.

CS-334. Open Source Systems. 3 Hours.

This course is an introduction to the open source domain, including the Linux operating system and other technologies. Topics covered include open source licensing, Linux administration and characteristics of open source applications. Students will be expected to understand the main concepts, and become capable of researching available resources and participating in open source communities.

Prerequisite: CS-308 with a minimum grade of C.

CS-335. Artificial Intelligence. 3 Hours.

This course covers strong artificial intelligence methods, which have resulted in the development of systems that solve open problems in specialized domains. Such methods include 1) AI models based on logical reasoning, in particular decision trees and learning decision trees, rule-based expert systems, semantics nets, and frames; 2) AI models based on probabilistic reasoning, in particular Bayesian networks and learning Bayesian networks, influence diagrams, and class probability trees; and 3) AI models based on emergent intelligence, in particular evolutionary computation and swarm intelligence. Lastly, the course discusses an important endeavor in AI, namely language processing.

Prerequisite: CS-207 with a minimum grade of C or CS-407 with a minimum grade of C or (CS-424 with a minimum grade of C and CS-400 with a minimum grade of C).

CS-336. History Of Computing. 3 Hours.

This course discusses the history of computing beginning with the earliest computational devices and continuing to current technologies. The history of computing is much more than the study of computers. It also involves the study of how computing is done and approached and how it has evolved over time. This course covers the following aspects of computing history: technology, both hardware and software; business history; and sociological impacts and key turning points. Within those aspects, trends and evolution are covered as well.

CS-338. Science, Women, And Technology. 3 Hours.

This course includes an overview of the women who have made major contributions to computing from Grace Hopper to Ellen Spertus. Furthermore, it provides a life-course analysis of women in computing from an early childhood interest, through university, to graduate school and finally into the work place. This analysis will provide the seed for research topics. Each student will choose a research topic, conduct the research, and present the results to the class.

CS-339. Fundamentals Of Information Technology Project Management. 3 Hours.

An Information System is a well-coordinated collection of technological and human resources that gathers and transforms data into information that enables decision making and process improvement within organizations. Information Technology Project Management is the application of knowledge, skills, tools, and techniques to project activities in order to meet project requirements. This course serves as an introduction to these concepts. Students will be expected to apply these tools and techniques in a group based project.

Prerequisite: CS-207 with a minimum grade of C.

Corequisite: CS-319.

CS-340. Fundamentals Of Computer Graphics. 3 Hours.

This course provides a unified introduction to computer graphics and computer vision for students with an interest in imaging or digital visual arts. Topics covered include the fundamentals of display hardware and applications, interactive techniques and color models, 3D viewing pipeline, 3D polygon rendering (clipping, scan conversion, and visibility algorithms), illumination models, transparency, and ray-tracing. The student must write programs using these methodologies.

Prerequisite: CS-207 with a minimum grade of C.

CS-341. Parallel Computing And Distributed Systems. 3 Hours.

This course works on the fundamental concepts of building systems that work across multiple computing platforms. The course includes topics of distributed operating systems and network protocols for process communication, synchronization, scheduling, and exception and deadlock resolution; understanding of client-server, web-based collaborative systems; parallel computing; concurrency issues; and APIs for distributed application development. Several distributed computing environments are discussed and used in developing experimental projects in a cluster of networked computers. Building systems using cloud-based and service-oriented architectures may also be included.

Prerequisite: CS-308 with a minimum grade of C and CS-304 with a minimum grade of C.

CS-342. Introduction To Human Computer Interaction. 3 Hours.

A good understanding of how a system/device interacts with its users is what differentiates a product that is technically sound from a usable one. HCI is the science that explores these interactions. HCI is at the intersection of many disciplines including cognitive psychology, linguistics, design and engineering. HCI considerations are increasingly cited as key factors in product design. In this course we will explore the science behind HCI and we will put parts of it into practice.

CS-343. Introduction To Natural Language Processing. 3 Hours.

Computers have tried to understand humans since the beginning. Today, with social media, globalization and the

widespread use of computing devices the task of understanding is facing new challenges. In this course the students will learn the core techniques used by computers to understand and generate language, as well as state of the art research in the field.

Prerequisite: [CS-207](#) with a minimum grade of C.

CS-345. Network Security. 3 Hours.

This course discusses the principles and practice of network security applications and standards that are widely used on the internet and on corporate networks. Building upon a review of networking and cryptographic algorithms, topics covered include network access control, network attacks and countermeasures, Internet security protocols, intrusion detection systems, firewalls and intrusion prevention systems, tunneling and virtual private networks, proxy firewalls and servers, anonymizing proxies, and cloud computing security.

Prerequisite: [CS-331](#) with a minimum grade of C.

CS-346. Interdisciplinary Seminar In STEM. 2 Hours.

This course uses a hands-on approach to modern inquiry-based research problems and techniques in the physical and computational sciences. The course is structured around a series of modular problem-based exercises, covering topics from the fields of Chemistry, Computer Science, Earth Science, Mathematics and Physics, and is designed to provide the content and pedagogical background for students to be successful peer leaders. The cross-disciplinary modules will draw connections between scientific disciplines, and showcase common research tools and techniques used in the sciences. The workshop will also incorporate discussions on a range of topics, from scientific ethics, scientific methodology and error analysis.

Prerequisite: [MATH-185](#) with a minimum grade of C.

CS-347. Mobile Application Development. 3 Hours.

This course covers programming applications for mobile platforms. Students will learn about mobile application environments and platforms and how to design and develop applications to account for the limited screen size, memory, and access to the internet. Students will incorporate graphics, networking, security, media to create new, real world, practical applications. Development, design, implementation, testing, debugging, and maintaining these applications will also be covered. Students will use a variety of programming languages to create these applications.

Prerequisite: [CS-207](#) with a minimum grade of C and [CS-300](#) with a minimum grade of C.

CS-348. Computer Ethics And Public Policy. 3 Hours.

This course discusses ethical and social issues related to the development and use of computer technology. The course provides students with historical and philosophical context to understand the evolution of ethics and its intersection with the use of technology as well as touching on major ethical issues currently affecting the use of computer technology. Topics involve ethics, public policy, privacy, responsibility and legal considerations.

CS-349. Introduction To The Internet Of Things. 3 Hours.

Internet of Things (IoT) is an emerging technology that actively brings informative and interactive dimensions to the spaces we live and work in. IoT is about creating a fully integrated Internet that includes both cyber elements and physical devices, where the interactions and interconnections between them build smart spaces and trigger applications in many areas (e.g., home automation, transportation, healthcare). This course introduces the fundamentals of IoT, ad-hoc systems, and sensor networks. The topics covered include the different architectures and platforms, communication modules and protocols, hardware accessories and devices, application models and IoT programmability. The course then focuses on the different challenges, limitations, security threats and attacks, and privacy and security measures and protocols.

Prerequisite: [CS-200](#) with a minimum grade of C and [CS-331](#) with a minimum grade of C.

CS-351. Data Wrangling For Data Analysis. 3 Hours.

Data is messy, comes from different sources and it is seldom complete. This course provides an in-depth study of how to prepare data coming from various sources, in different formats, with noisy information, in order to perform meaningful and sound analyses. Contents include grouping data, visualizing data, and aggregating data from the web and other sources.

Prerequisite: [MATH-173](#) with a minimum grade of C.

CS-355. Cryptography. 3 Hours.

This course covers cryptography and a wide range of cryptographic applications. Theory discussed includes the design and analysis of cryptographic algorithms such as private key and public key cryptosystems used to secure data transmission and electronic system communications. Cryptographic applications such as digital signatures, entity identification, key exchange and e-commerce transactions are discussed.

Prerequisite: [CS-324](#) with a minimum grade of C or ([CS-400](#) with a minimum grade of C and [CS-404](#) with a minimum grade of C).

CS-359. Machine Learning. 3 Hours.

This course provides an introduction to machine learning and its underlying fundamental statistical concepts. Building upon basic probability theory and linear algebra, the course addresses several concepts essential to the understanding of machine learning, including approximation, generalization, overfitting, underfitting, and linear and nonlinear systems. Several supervised and unsupervised learning algorithms are covered and used to solve real-world problems. The course will also introduce neural networks, ensemble learning, and active learning. Hands-on projects and in-class laboratories of the application of machine learning to the broad field of computer science and related fields will be given.

Prerequisite: [CS-207](#) with a minimum grade of C.

CS-360. CyberSecurity. 3 Hours.

This course covers a wide range of advanced security concepts, tools, and models. Topics covered include denial of service attacks, web security and client- and server-side attacks, email security, database security, payment system security, and digital-rights management. Building upon the introduced security fundamental concepts, advanced enterprise security topics such as cryptocurrency, static and dynamic malware analysis, security auditing architecture and trails, incident response, and threat intelligence frameworks will be introduced. Hand-on experience will be provided through several laboratory sessions and projects.

Prerequisite: [CS-355](#) with a minimum grade of C and [CS-331](#) with a minimum grade of C.

CS-361. Secure Programming And Testing. 3 Hours.

This course details how to design, build, and test programs in order to make them more secure. The course will discuss the following topics: concepts of secure programming (including risk management), techniques and tools used to build secure systems, techniques to test for security in programs and systems, specific vulnerabilities to avoid (and how to do so), and how to test for those vulnerabilities. Specific common classes of programming-induced vulnerabilities will be included such as buffer overflows, race conditions, off-by-one errors, integer overflow, and improper use of randomness functions.

Prerequisite: [CS-331](#) with a minimum grade of C.

CS-362. Digital Forensics. 3 Hours.

Digital forensic science concerns the acquisition, recovery, and investigation of digital data. This course provides an introduction to computer components, storage devices, and file systems. Topics covered include forensic algorithms, operating systems artifacts analysis, files analysis, network attacks and forensics, Internet artifacts with emphasis on browser and mail applications, and memory forensics. Students will use tools and create scripts for digital forensic investigation.

Prerequisite: [CS-207](#) with a minimum grade of C and [CS-260](#) with a minimum grade of C.

CS-390. Supervised Field Study I. 3 Hours.

(Internship) The student completes a computer programming project for an institution at the institution site. The institution defines the project which must be approved by the Department of Computer Science for the purpose of satisfying the course requirement. The project should take approximately 168 hours to complete. NOTE: [CS-390](#) is repeatable for a maximum of 9 credit hours.

CS-391. Supervised Field Study II. 6 Hours.

(Internship) Same as [CS-390](#) except that project should take approximately 336 hours to complete.

CS-392. Supervised Field Study III. 9 Hours.

(Internship) Same as [CS-390](#) except that project should take approximately 504 hours to complete.

DEPARTMENT FACULTY

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