COMPUTER SCIENCE (CS)

Undergraduate students may choose from one of three degree options: the B.S. in computer science, which is intended for students interested in the design and implementation of software systems, the B.S. in information technology, which focuses on the application of existing computing technologies to meet the information needs of organizations and individual computer users, or the B.S. in and analytics and data science. Students may choose between two options within the B.S. in analytics and data science major. The analytics option, which emphasizes the application of data science in business and industry or the data science option, which focuses on the theoretical and computational underpinnings of modern data science.

https://ceps.unh.edu/computer-science/

**Programs**

- Analytics and Data Science Major: Analytics Option (B.S.) (http://catalog.unh.edu/undergraduate/engineering-physical-sciences/programs-study/computer-science/analytics-data-science-major-analytics-option-bs)
- Analytics and Data Science Major: Data Science Option (B.S.) (http://catalog.unh.edu/undergraduate/engineering-physical-sciences/programs-study/computer-science/analytics-data-science-major-data-science-option-bs)
- Analytics Minor (http://catalog.unh.edu/undergraduate/engineering-physical-sciences/programs-study/computer-science/analytics-minor)
- Computer Programming Cognate (http://catalog.unh.edu/undergraduate/engineering-physical-sciences/programs-study/computer-science/computer-programming-cognate)
- Computer Science Major (B.S.) (http://catalog.unh.edu/undergraduate/engineering-physical-sciences/programs-study/computer-science/computer-science-major-bs)
- Computer Science Major: Algorithms Option (B.A.) (http://catalog.unh.edu/undergraduate/engineering-physical-sciences/programs-study/computer-science/computer-science-major-algorithms-option-ba)
- Computer Science Major: Cybersecurity Option (B.A.) (http://catalog.unh.edu/undergraduate/engineering-physical-sciences/programs-study/computer-science/computer-science-major-cybersecurity-option-ba)
- Computer Science Major: Systems Option (B.A.) (http://catalog.unh.edu/undergraduate/engineering-physical-sciences/programs-study/computer-science/computer-science-major-systems-option-ba)
- Computer Science Minor (http://catalog.unh.edu/undergraduate/engineering-physical-sciences/programs-study/computer-science/computer-science-minor)
- Data Science Minor (http://catalog.unh.edu/undergraduate/engineering-physical-sciences/programs-study/computer-science/data-science-minor)
- Information Technology Cognate (http://catalog.unh.edu/undergraduate/engineering-physical-sciences/programs-study/computer-science/information-technology-cognate)
- Information Technology Major (B.S.) (http://catalog.unh.edu/undergraduate/engineering-physical-sciences/programs-study/computer-science/information-technology-major-bs)
- Information Technology Minor (http://catalog.unh.edu/undergraduate/engineering-physical-sciences/programs-study/computer-science/information-technology-minor)

**Courses**

**Analytics (DATA)**

DATA 557 - Introduction to Data Science and Analytics
 Credits: 4

An introduction to data science and analytics. The landscape of analytics, including an overview of industries and sectors using analytics or expected to use analytics in the near future. Data generation, data management, data cleaning, and data preparation. Ethical use of data. Focus on visual and exploratory analysis. Project-based, with an emphasis on collaborative, experiential learning. Programming and statistical software will be used, but previous experience is not required. 

Attributes: Environment, Tech Society (Disc)

DATA 674 - Predictive and Prescriptive Analytics I
 Credits: 4

A first course in predictive and prescriptive analytics. Supervised learning models including linear models and CART models. Model assessment and scoring methods, including cross-validation. Regularization and model tuning. Unsupervised learning models including k-means clustering. Project-based, with an emphasis on collaborative, experiential learning. Statistical software will be used and programming required. Prereq: MATH 425, COMP 490, DATA 557, or permission of the instructor.

DATA 675 - Predictive and Prescriptive Analytics II
 Credits: 4

A second course in predictive and prescriptive analytics. Time series analysis and model ensembles. Bootstrapping, simulation, optimization. Monte Carlo methods. Project-based, with an emphasis on collaborative experiential learning. Statistical software will be used and programming required. Prereq: DATA 674 or permission of the instructor.

DATA 690 - Internship Experience
 Credits: 3

A field-based learning experience via placement in a business, non-profit, or government organization using analytics. Under the guidance of a faculty advisor and workplace supervisor, students gain practical experience solving problems and improving operational processes using analytics. Prereq: UMST 599: Internship and Career Planning Seminar.
DATA 750 - Neural Networks  
Credits: 4  
Artificial neural networks power the recent advances in computer vision, speech recognition, and machine translation. This is a first course on neural networks with a focus on applications in computer vision and natural language processing. Topics will include generic feedforward neural networks, convolutional neural networks for computer vision tasks, and recurrent neural networks with application to natural language processing, with other topics to be selected based on the interests of the instructor and the class. Prereq: MATH 425, MATH 545 or MATH 645, COMP 490, or permission of the instructor. Also listed as COMP 750.  
Equivalent(s): DATA 751

DATA 757 - Big Data  
Credits: 4  
A first course in large-scale analytics and data science. Characteristics of big data and the emerging software stack for working with massive datasets, including Hadoop and MapReduce. Algorithms for extracting information from massive datasets. A first course in linear algebra is not a prerequisite, but is recommended. Prereq: MATH 425, DATA 557, or instructor permission.

DATA 790 - Capstone Project  
Credits: 4  
Under direction of a faculty mentor, students work in teams to find solutions to complex real-world problems using analytics. Projects may come from internal or external sources. Students define the problem, obtain the necessary data, develop suitable models and solutions, and present their results. Prereq: Senior standing in Analytics B.S. program.

DATA 796 - Data Analytics Lab Independent Study  
Credits: 4  
This class is a student independent study centered around a faculty-facilitated but student-directed analytic project. The class requires competency in two areas for successful completion: Data collection/cleaning and data mining/analysis. Students will be responsible to apply modern analytical tools and techniques such as predictive modeling, segmentation, network analysis and others to real world problems and data. They will be required to present their findings during the course and at its completion as well as write a formal report of methods and findings with modern data visualizations synthesized throughout.

Computer Science (CS)

CS 400 - Introduction to Computing  
Credits: 1  
Initial exploration of computing, including comparison of the various subfields. A wide range of issues, including fundamental concepts, selected current topics and the role of both computing and computing professionals in organizations and in society are also discussed. Cr/F.

CS 401 - Computers and Their Applications  
Credits: 4  
Use of computers to manage and analyze information across a variety of settings and disciplines. Introduces major categories of computer software, including word processing, spreadsheets and database systems. Covers basic computer concepts and the computer's role in today's society. Significant hands-on work required outside of the class. Not open to CS majors. CEPS students should check with their major department for approval.  
Attributes: Environment,TechSociety(Disc)  
Equivalent(s): CIE 530, CS 401H, CS 495, DCE 491, DCE 492, INCO 495

CS 401H - Honors/Computers & Their Appl  
Credits: 4  
Use of computers to manage and analyze information across a variety of settings and disciplines. Introduces major categories of computer software, including word processing, spreadsheets and database systems. Covers basic computer concepts and the computer's role in today's society. Significant hands-on work required outside of the class. Not open to CS majors. CEPS students should check with their major department for approval.  
Attributes: Environment,TechSociety(Disc)  
Equivalent(s): CIS 411, CS 401, DCE 491, DCE 492

CS 404 - Do-It-Yourself Internet  
Credits: 4  
The objective of this course is to demystify the design process that leads to the evolution of the Internet. In doing so, we investigate the ways that technology changes to meet the needs of society, how society changes in response to these new technologies and how these societal changes create pressures that produce needs for new technologies.  
Attributes: Environment,TechSociety(Disc)

CS 405 - Introduction to Applications Programming  
Credits: 4  
Introduces the concepts and techniques of computer programming. Particular emphasis on computer programming as a problem-solving technique for business applications. The basic software development process (modeling, algorithm design, programming, testing and debugging) is illustrated. CEPS students should check with their major department for approval. Not open to CS and IT majors.

CS 408 - Living in a Networked World: The Good, the Bad, and the Ugly  
Credits: 4  
The objective of this course is to explore the implications of living in a networked world. The course surveys the fundamental technologies and practices that make up the Internet and then ask the student to examine the ramifications of using the technologies. Users of the technologies should understand the technology in order to make educated decisions about how to use it safely and effectively. Students have the opportunity to self-publish by using various current technologies including blogs, discussion boards, email and creating web pages using xhtml.  
Attributes: Environment,TechSociety(Disc)

CS 410 - Introduction to Scientific Programming  
Credits: 4  
Introduces the concepts and techniques of computer programming. Particular emphasis on computer programming as a problem-solving technique in science and engineering applications. Either the C language or Python is taught and used for assignments. Good programming style is stressed. Significant out-of-class programming required. Not open to students who have completed CS 407, 415, or the equivalent.  
Equivalent(s): CS 410C, CS 411, CS 412, CS 415, CS 416

CS 410C - Introduction to Scientific Programming/C  
Credits: 4  
Introduces the concepts and techniques of computer programming. Particular emphasis on computer programming as a problem-solving technique in science and engineering applications. Good programming style is stressed. Significant out-of-class programming required. Not open to students who have completed CS 415 or equivalent.  
Equivalent(s): CS 410, CS 415
CS 410P - Introduction to Scientific Programming/Python  
Credits: 4  
Introduces the concepts and techniques of computer programming.  
Particular emphasis on computer programming as a problem-solving  
technique in science and engineering applications. Good programming  
style is stressed. Significant out-of-class programming required. Not open  
to students who have completed CS 415 or the equivalent.  
Equivalent(s): CS 410, CS 415

CS 414 - From Problems to Algorithms to Programs  
Credits: 4  
This course is an introduction to the design and implementation of  
computer programs. The basic software development process (modeling,  
algorithm design, programming, testing and debugging) is illustrated  
through problem examples. Programming techniques are introduced to  
allow students to implement and evaluate solutions as programs.  
Attributes: Quantitative Reasoning(Disc)

CS 415 - Introduction to Computer Science I  
Credits: 4  
Theory and practice of computer science. Algorithm development and  
analysis; data abstraction techniques; elementary data structures;  
dynamic memory manipulation; debugging; and program design issues.  
Computer systems and applications. Intended for CS majors.  
Equivalent(s): COMP 425

CS 416 - Introduction to Computer Science II  
Credits: 4  
Theory and practice of computer science. Algorithm development and  
analysis; data abstraction techniques; elementary data structures;  
dynamic memory manipulation; debugging; and program design issues.  
Computer systems and applications. Intended for CS majors. Prereq:  
CS 415.  
Equivalent(s): COMP 425, CS 412, CS 512

CS 417 - From Programs to Computer Science  
Credits: 4  
Accelerated coverage of programming techniques for students with  
experience equivalent to CS410 or CS 414. Covers basic algorithm  
analysis. Topics include basics of classes, inheritance, and data  
abstraction; linear data structures (vectors, lists, stacks and queues);  
trees and simple graphs; hash tables; sorting and searching; recursion;  
and basic graph traversal algorithms. Numerous labs and programming  
assignments build skills in planning, problem solving, and debugging: this  
is a hands on course. Prereq: CS 410 or CS 414 or equivalent.

CS 501 - Professional Ethics and Communication in Technology-related  
Fields  
Credits: 4  
A mixed lecture/seminar course intended to improve both reasoning and  
ability to communicate effectively in front of an audience. Students learn  
basic forms of ethical argument, they read about ethical situations in  
which technology and technology professions play a key role, and they  
participate in student-led discussions about the reading. Students also  
make oral presentations about both ethical and technical topics, and  
evaluate each other's presentations in order to improve their sense for  
what makes a good presentation. Prereq: ENGL 401.  
Attributes: Environment, TechSociety(Disc); Inquiry (Discovery)

CS 515 - Data Structures and Introduction to Algorithms  
Credits: 4  
Reviews basic data structures; advanced data structures such as graphs,  
B-trees, and AVL trees; abstract data structure design and programming  
techniques; use of data abstraction language. Introduction to algorithm  
analysis. Prereq: CS 416 or CS 417.  
Equivalent(s): COMP 525, CS 612

CS 520 - Assembly Language Programming and Machine Organization  
Credits: 4  
Assembly language programming and machine organization: program  
data representation; registers, instructions, and addressing modes;  
assemblers and linkers. Impact of hardware on software and software on  
hardware. Prereq: CS 416 or CS 417.  
Equivalent(s): CS 611

CS 580 - Introduction to Topics in Computing  
Credits: 1-2  
Introductory material not normally covered in regular course offerings,  
but of value to students prior to internships or senior-level courses.  
Repeat Rule: May be repeated for a maximum of 6 credits.

CS #595 - Professional Ethics and Communication in Computer Science  
Credits: 2  
A seminar course intended to improve both reasoning and ability to  
communicate effectively in front of an audience. Students learn  
basic forms of ethical argument, they read about ethical situations in  
which technology and technology professions play a key role, and they  
participate in student-led discussions about the reading. Students also  
make oral presentations about both ethical and technical topics, and  
evaluate each others' presentations in order to improve their sense for  
what makes a good presentation.

CS 619 - Introduction to Object-Oriented Design and Development  
Credits: 4  
Principles of problem analysis and software design applied to the  
development cycle of a software system (i.e. from system requirements  
specification to design, implementation, and system test). Design  
and implementation using object-oriented principles, patterns, and  
tools. Experience in understanding and debugging software systems.  
Experience in working in groups. Prereq: CS 515.  
Equivalent(s): CS 516

CS 620 - Operating System Fundamentals  
Credits: 4  
Introduces operating system concepts and design. Process and memory  
management; scheduling; file systems; storage devices; inter-process  
communication. Prereq: CS 520.  
Equivalent(s): CS 610

CS 659 - Introduction to the Theory of Computation  
Credits: 4  
Review of sets, relations, and languages. Induction and diagonalization.  
Finite automata, context-free languages, pushdown automata. Basic  
complexity theory. Prereq: MATH 531.

CS 671 - Programming Language Concepts and Features  
Credits: 4  
Explores the main features of modern, high-level, general purpose  
programming languages from the user (programmer) point of view. Provides students with an opportunity to use non-imperative  
programming paradigms, such as object-oriented, functional, and logical,  
and to learn how specific features of such languages can be used  
efficiently in solving programming problems. Prereq: CS 520.
CS 696 - Independent Study
Credits: 1-6
Individual projects developed and conducted under the supervision of a faculty member. Prereq: permission of faculty supervisor and department chairperson. May be repeated for credit.
Equivalent(s): CS 696W

CS 696W - Independent Study
Credits: 1-6
Individual projects developed and conducted under the supervision of a faculty member. Prereq: permission of faculty supervisor and department chairperson.
Attributes: Writing Intensive Course
Repeat Rule: May be repeated for a maximum of 8 credits. May be repeated up to 1 time.
Equivalent(s): CS 696

CS 699 - Internship
Credits: 1
Provides the opportunity to apply academic experience in settings associated with future professional employment. A written proposal for the internship must be approved by the instructor. The proposal must specify what the student will learn from the internship, why the student is properly prepared for the internship and what supervision is available during the internship. A mid-semester report and final report are required. Prereq: permission. Only open to Computer Science majors. Cr/F.
Repeat Rule: May be repeated for a maximum of 4 credits. May be repeated up to 3 times.
Equivalent(s): CS 600

CS 712 - Compiler Design
Credits: 4
Formal languages and formal techniques for syntax analysis and parsing; organization of the compiler and its data structures; code generation. LL and LR parsing; automatic generation of scanners and parsers from high level descriptions. Implementation of features from imperative and object-oriented languages. Students required to design and implement a compiler for a simple language. Prereq: CS 520.

CS #720 - Operating System Programming
Credits: 4
Detailed discussion of operating system concepts and features. Practical examples and exercises that utilize advanced operating system features, including inter-process communication, synchronization, client-server communication, shared memory, threads, remote procedure calls, and device-level I/O. Discussion of POSIX 1003.1 Part I Standards. Prereq: CS 520 and CS 619.

CS 723 - Performance Evaluation of Computer Systems
Credits: 4
Introduces the main concepts, techniques, and tools needed to evaluate the performance of computer systems under various configurations and workloads. The techniques allow one to perform capacity planning based on quality of service requirements of users and workload characteristics. Course is mainly based on the use of analytic queuing network models of computers systems. The performance techniques are applied to study the performance of centralized, distributed, parallel, and client/server systems. The course also discusses performance measuring tools for operating systems such as Unix and Windows NT. Prereq: CS 620 and (MATH 539 or MATH 644).

CS 725 - Computer Networks
Credits: 4
Introduction to fundamental concepts of computer networks and exploration of widely-used networking technologies. Topics include principles of congestion and error control; network routing; local, wireless and access networks; application protocol design; and network programming. In-depth discussion of the Internet suite of protocols. Prereq: CS 520.
Equivalent(s): IT 725

CS 727 - Computer Security
Credits: 4
Introductory course in the mechanism and implementation of techniques in computer security. Various fundamental security topics include cryptography, passwords, access control, protocols, software vulnerabilities and malware detection. Prereq: CS 520.

CS 730 - Introduction to Artificial Intelligence
Credits: 4
In-depth introduction to artificial intelligence, concentrating on aspects of intelligent problem-solving. Topics include situated agents, advanced search techniques, knowledge representation, logical reasoning techniques, reasoning under uncertainty, advanced planning and control, and learning. Prereq: CS 515.

CS 730W - Introduction to Artificial Intelligence
Credits: 4
In-depth introduction to artificial intelligence, concentrating on aspects of intelligent problem-solving. Topics include situated agents, advanced search techniques, knowledge representation, logical reasoning techniques, reasoning under uncertainty, advanced planning and control, and learning. Prereq: CS 671. Writing intensive.
Attributes: Writing Intensive Course

CS 733 - Mobile Robotics
Credits: 4
An introduction to the foundational theory and practices in mobile robotics. Topics include Kinematics of wheeled mobile robots, Sensors for mobile robots, Robot navigation and perception, Robot vision, Localization and mapping of mobile robots. Hands-on experience directed towards implementation with a real robot. Prereq: Programming course of Permission of instructor.

CS 735 - Introduction to Parallel and Distributed Programming
Credits: 4
Programming with multiple processes and threads on distributed and parallel computer systems. Introduces programming tools and techniques for building applications on such platforms. Course requirements consist primarily of programming assignments. Prereq: CS 520.
Equivalent(s): CS 735W

CS 745 - Formal Specifications and Verification of Software Systems
Credits: 4
Course focuses on the formal specification and verification of reactive systems, most notably concurrent and distributed systems. Topics relevant to these systems, such as non-determinism, safety and liveness properties, asynchronous communication or compositional reasoning, are discussed. We rely on a notation (TLA+, the Temporal Logic of Actions) and a support tool (TLC, the TLA+ Model Checker). Prereq: CS 520 and CS 659.
CS 750 - Machine Learning  
Credits: 4  
An introduction to fundamental concepts and common methods in machine learning. In addition to theoretical topics, the course involves hands-on experience in making predictions using synthetic and real-world datasets. Prereq: MATH 539 or MATH 644, and Programming course or Permission of instructor.

CS 753 - Information Retrieval  
Credits: 4  
Fundamental algorithms and techniques for text processing and text-based information retrieval systems. Topics include how to build an end-to-end information retrieval system, such as a Web search engine. Prereq: CS 515.  
Equivalent(s): MATH 753

CS 757 - Mathematical Optimization for Applications  
Credits: 4  
This course introduces the foundations of mathematical optimization and reinforces them via applications. The content includes convex optimization, first and second-order methods, constrained problems, duality, linear and quadratic programming, as well as discrete and non-convex optimization. Applications will focus on machine learning methods but also include problems from engineering and operations research. Prereq: MATH 426; Programming proficiency in MATLAB, R, Java, C, Python, or equivalent.  
Equivalent(s): MATH 757

CS 758 - Algorithms  
Credits: 4  
An introduction to important concepts in the design and analysis of algorithms and data structures, including implementation, complexity analysis, and proofs of correctness. Prereq: CS 515 and CS 659.

CS 760W - Introduction to Human-Computer Interaction  
Credits: 4  
Human-computer interaction is a discipline concerned with the design, evaluation, and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them. Prereq: CS 619 and CS 620. Writing intensive.  
Attributes: Writing Intensive Course  
Equivalent(s): CS 760

CS #767 - Interactive Data Visualization  
Credits: 4  
Detailed discussion of how an understanding of human perception can help us design better interactive displays of data. Topics include color, space perception, object perception and interactive techniques. Students write interactive programs, give presentations and undertake a project designing and evaluating a novel display technique. Prereq: instructor’s permission.  
Equivalent(s): CS 767W

CS 767W - Interactive Data Visualization  
Credits: 4  
Detailed discussion of how an understanding of human perception can help us design better interactive displays of data. Topics include color, space perception, object perception and interactive techniques. Students write interactive programs, give presentations and undertake a project designing and evaluating a novel display technique. Prereq: instructor’s permission. Writing intensive.  
Attributes: Writing Intensive Course  
Equivalent(s): CS #767

CS 770 - Computer Graphics  
Credits: 4  
Input-output and representation of pictures from hardware and software points of view; interactive techniques and their applications; three-dimensional image synthesis techniques and their applications. Prereq: CS 671.  
Equivalent(s): CS 770W

CS 771 - Web Programming Paradigms  
Credits: 4  
In this course you will learn languages to program the Web. Languages integrated into browsers, like JavaScript, and languages invoked on the server, like Ruby. You will also learn about frameworks, like Rails, and various techniques used to support the programming process. In addition, you will learn languages you will need to create, modify, and process Web documents. Although we will learn how to read and write in these languages, our primary goal will be an understanding of how the design of these multi-paradigm dynamic languages support the process of developing Web applications. Prereq: CS 671.  
Equivalent(s): IT 771

CS 775 - Database Systems  
Credits: 4  
Introduction to database management systems — design, implementation, and usage — with focus on the relational model. Data description, manipulation, and query language in the context of MySQL. Schema design and normalization; indexes, transaction processing. Web access of databases (PHP); overview of XML and noSQL systems. No credit if credit earned for IT 775. Prereq: CS 515.  
Equivalent(s): IT 775

CS 780 - Topics  
Credits: 1-4  
Material not normally covered in regular course offerings. May be repeated for credit.

CS 791 - Senior Project I  
Credits: 2  
The principal goal of CS 791 is to develop precise functional specifications for the senior projects as well as a complete software design specification. The course will review and expand upon design concepts presented in previous courses, including UML, and CRC approach, and design patterns. Students apply these concepts to the design of their own senior projects. A significant component of the design includes specifications of the testing methodology to be used. Prereq: CS 619. Computer Science and CS: Bioinformatics majors only.

CS 792 - Senior Project II  
Credits: 2  
Continuation of CS 791: Senior Project I. Students complete the project by implementing their design. Students work in teams. Successful completion of this course fulfills the Capstone Experience requirement for Computer Science majors. Prereq: CS 791. Writing intensive.  
Attributes: Writing Intensive Course

CS 799 - Thesis  
Credits: 4  
Students work under the direction of a faculty sponsor to plan and carry out independent research resulting in a written thesis. Required for honors-in-major. Prereq: Permission.  
Attributes: Writing Intensive Course  
Repeat Rule: May be repeated for a maximum of 8 credits.
Information Technology (IT)

IT 403 - Introduction to Internet Technologies
Credits: 4
Introductory course exploring the fundamentals of Internet communications with an emphasis on the World Wide Web. Students develop an understanding of the Internet's underlying technologies and learn how to utilize them as contributing members of the Web community. Students become proficient with creating and publishing Web pages using HTML and CSS. No prior knowledge or experience is assumed. No credit if credit earned for CIS 405. (Note CIS 405 is offered at UNH Manchester, and is not related to CS 405 at UNH Durham.)
Equivalent(s): CIS 405, CIS 410F, CIS 495, CS 403

IT 502 - Intermediate Web Design
Credits: 4
An intermediate level exploration of the theory and practice of Web design. Students learn the fundamentals of design theory applicable to the World Wide Web and examine tools and techniques for applying that knowledge to their projects. Additional topics include information architecture, usability, accessibility, optimization, typography, and market visibility. Working knowledge of XHTML and CSS required. Prereq: CS 403.
Equivalent(s): CS 502

IT 505 - Database Programming
Credits: 4
Introduces database programming in the microcomputer environment. Students use a procedural programming language such as Visual Basic to manipulate data managed by a database management system. Emphasis is on the relational database model. Topics include connections, queries (including use of SQL), relations, constraints, transaction processing, concurrency issues, exception handling, and report generation. Prereq: a programming course. Computer Science majors not allowed.
Equivalent(s): COMP 520, CS 505

IT 520 - Computer Architecture
Credits: 4
Fundamentals of computer organization, including binary systems, data representation (and compression), machine language, program execution, memory and process issues. Operating systems and networking basics. Not open to CS majors. Prereq: a programming course.

IT 600 - Internship
Credits: 1
Provides opportunity to apply academic experience in settings associated with future professional employment. A written proposal for the internship must be approved by the instructor. The proposal must specify what the student will learn from the internship, why the student is properly prepared for the internship, and what supervision will be available during the internship. A mid-semester report and a final report are required. Prereq: permission; majors only Cr/F.
Repeat Rule: May be repeated for a maximum of 4 credits.

IT 604 - Server-side Web Development
Credits: 4
An intermediate-level examination of the theory and practice of developing server-side applications for the World Wide Web. Students will learn practical techniques for designing and implementing data-driven Web sites through the use of server-side processing. Working knowledge of HTML, CSS, and some programming language is required. Prereq: IT 403 and a programming course.
Equivalent(s): CS 504
**IT 699 - Internship**  
**Credits:** 1  
Provides the opportunity to apply academic experience in settings associated with future professional employment. A written proposal for the internship must be approved by the instructor. The proposal must specify what the student will learn from the internship, why the student is properly prepared for the internship and what supervision is available during the internship. A mid-semester report and final report are required. Students may receive compensation for their internship work. Prereq: permission. Information Technology majors only. Cr/F.  
**Repeat Rule:** May be repeated for a maximum of 4 credits. May be repeated up to 3 times.  
**Equivalent(s):** IT 600

**IT 704 - Advanced Web Development**  
**Credits:** 4  
An advanced exploration of various topics in Web development. Topics covered each semester will be chosen to reflect the current state of stable and accepted Web technologies, with a decided emphasis on open-source solutions. Both client-side and server-side technologies are likely to be included, with particular attention given to concepts and techniques used to facilitate efficient Web development. Prereq: IT 604.

**IT 705 - Project Management for Information Technology**  
**Credits:** 4  
This course focuses on a core set of project management essentials that can affect the bottom line of project technical and business performance. These are termed "best practices," and those addressed are: formal risk management, agreement on interfaces, metrics based scheduling/tracking, frequent binary completion milestones, incremental development, people aware management style, and change management. The emphasis is on information technology projects; however, the basic principles are pertinent to a wider class of project domains. Prereq: Senior standing in IT or permission.  
**Attributes:** Writing Intensive Course

**IT 710 - Senior Project**  
**Credits:** 4  
Students are organized into teams and work on a specific IT project. Utilizing the skills and concepts learned in IT 705 (as well as other previous academic and field experience), each team works with one or more stakeholders to provide all necessary project elements - from initial specification through design and development to delivery. Teams are expected to provide both interim and final written and/or oral reports for the project. Prereq: IT 705; Information Technology majors only.

**IT 725 - Network Technology**  
**Credits:** 4  
Introduction to fundamental concepts of computer networks and exploration of widely-used networking technologies. Topics include principles of congestion and error control; network routing; local, wireless and access networks; application protocol design; and network programming. In-depth discussion of the Internet suite of protocols. Prereq: IT 520.  
**Equivalent(s):** CS 725

**IT 775 - Database Technology**  
**Credits:** 4  
Topics include database architecture, schema design and definition, entity-relationship diagrams, data retrieval and update, and indexing performance. Architectures for single-user, multi-user, client-server, and web access are introduced. The relational data model is emphasized but alternative database models, such as semi-structured and object models, are introduced. Database administration topics include examination of metadata information, data integrity, and management of users and privileges, performance tuning, transactions, isolation levels, and security. Ethics of data protection are introduced. Students develop skill in SQL. Not open to CS majors. No credit if credit earned for CS 775. Prereq: IT 505.  
**Equivalent(s):** CS 775

**IT 780 - Topics in Information Technology**  
**Credits:** 4  
Material not normally covered in course offerings.  
**Repeat Rule:** May be repeated for a maximum of 8 credits.

**Faculty**  
https://ceps.unh.edu/directory/all