CS 00100:　　　　　Computer Science Learning Community　　　　　1 s.h.
One semester requirement for all students who enter the major.

CS 01101:　　　　　Computer Science Principles　　　　　3 s.h.
This course introduces students to the foundational concepts of computer science and challenges them to explore how computing and technology can impact the world. More than a traditional introduction to programming, it is a rigorous, engaging, and approachable course that explores many of the foundational ideas of computing so all students understand how these concepts are transforming the world we live in. Topics covered include creativity and innovation, abstraction, data and Information (e.g., the role of data analytics), algorithms, programming, the Internet and the global impact of computing. This course is designed to map to the relatively new high school Advance Placement course and exam.

CS 01102:　　　　　Introduction To Programming　　　　　3 s.h.
This course acquaints students with the logical structure of a computer, the algorithmic formulation of problems, and a modern high-level programming language. Extensive programming experience is included in the course. Proficiency equivalent to Basic Algebra II (MATH01.195) is expected for this course.

CS 01104:　　　　　Introduction to Programming and Problem Solving　　　　　3 s.h.
This course emphasizes algorithmic solutions of problems. The syntax of the programming language is also studied, as well as the writing of structured code. Proficiency equivalent to Basic Algebra II.

CS 01105:　　　　　Web Literacy　　　　　3 s.h.
This is an introductory course on the world wide web, exposing how it works, and showing students how to use it appropriately. This course teaches students to create and modify basic web pages with markup languages and style directives, and how to embed non-text information such as video, images, and sound. The principles of publishing websites on the Internet and the process by which a page is delivered to end users will also be covered.

CS 01110:　　　　　Computing Environments　　　　　3 s.h.
Students will be exposed to a variety of computing environments. The course will include extensive hands-on of a variety of software applications. Topics covered will include user tools, user programming techniques, application packages, and networking communications. Students will gain an understanding of the principles of computing which will enable them to adapt to future technological developments. A solid and fundamental understanding of computers and current operating systems, word processing and spreadsheet software are essential to this course.

CS 01190:　　　　　Introduction To Computer Game Modeling　　　　　3 s.h.
This is an introductory computer games modeling course which examines the basics of computer game design and visual effects. Students will use graphics software modeling packages to create characters and visual effects, and to develop a computer game idea, including storyline and plots. Elementary programming techniques may also be taught.

CS 01205:　　　　　Computer Laboratory Techniques　　　　　3 s.h.
Prerequisite(s): CS 04113 or CS 04103; and Sophomore Standing
A practical introduction to the hardware, software and networks used by the Computer Science Department. A foundation in programming using the language or languages required for intermediate and advanced computer science courses will be included.

CS 01211:　　　　　Principles Of Information Security　　　　　3 s.h.
Students will be exposed to the spectrum of security activities, methods, technologies, and threats. This course will cover a range of key topics in the area of information and computer security including inspection and protection of information assets, detection of and reaction to security threats, taxonomy of security threats, and concentrating on issues in computer and operating systems security, principles of network security, and basics of cryptography.

CS 01295:　　　　　Special Topics in Computer Science　　　　　.5 to 3 s.h.
Restricted to CS Majors and Minors
Specific topical outline to be covered will vary depending upon the topic chosen for the course and will be clearly stated on the course syllabus.

CS 01395:　　　　　Topics In Computer Science　　　　　1 to 4 s.h.

Prerequisites: CS 04222 or CS 04225

This course enables the faculty to offer courses in advanced topics which are not offered on a regular basis. Prerequisites will vary according to the specific topic being studied.

CS 01400:   Independent Study   1 to 4 s.h.

CS 01541:   Bioinformatics - Advanced Computational Aspects   3 s.h.

matriculation in the MS Computer Science program or MS Bioinformatics or permission of the program coordinator

This course introduces the advanced student to the computer hardware, software, algorithms and statistical packages that are used in computational aspects of bioinformatics. Hardware topics include multiprocessor clusters, high performance computing, and parallelism. Software topics include message passing and shared memory styles of parallel/concurrent programming languages, databases, available software packages, and visualization techniques for large data sets. Algorithms and statistical packages include those for the study of molecular biology, evolution, structural biology, and biological networks. Students will design and carry out an independent research project using and developing appropriate bioinformatics algorithms, software and/or hardware. Undergraduate preparation in Calculus, Statistics (preferably Biostatistics), and Introduction to Computer Programming is strongly suggested.

CS 02421:   Big Data Tools and Techniques   3 s.h.

Pre-requisites: CS 10337 or MIS 02337 or CS 04430 or (CS 10338 and CS 10339)

Big data refers to the large, diverse sets of information that grow at ever-increasing rates. It encompasses the volume of information, the velocity or speed at which it is created and collected, and the variety or scope of the data points being covered. Big data often comes from multiple sources and arrives in multiple formats. This course discusses various tools for loading, storing, visualizing and analyzing Big-Data sets.

CS 02570:   Information Visualization   3 s.h.

Prerequisite(s): matriculation in the MS Computer Science program OR the MS Data Science program OR the COGS in Computational Data Science program OR permission of the program coordinator

This is a graduate level course in Information Visualization. Topics covered include graphics programming, information visualization general principles, visualization techniques for 1-dimensional, 2-dimensional, and N-dimensional information, graph visualization, visualization techniques for image and digital libraries, as well as for the World Wide Web, interactivity, theories behind information visualization, and focus+context techniques. This course also includes the implementation of techniques presented in lecture. Students are encouraged to devise new techniques, implement them, and determine their effectiveness. Students will be required to complete in-depth assignments, read, summarize, and present recent journal papers from the information visualization literature, and prepare term papers with regard to an information visualization research topic. Students will also be required to specify, design, implement, and document a semester-long software project related to information visualization.

CS 04103:   Computer Science And Programming   4 s.h.

Prerequisites: MATH 01122 OR MATH 01130 OR CS 01104

This course emphasizes programming methodology, algorithms and simple data structures. Topics to be covered include top down design of functions and classes, basic data abstraction and encapsulation, control structures, file i/o, user defined classes and object-oriented principles.

CS 04110:   Introduction To Programming Using Robots   3 s.h.

This course teaches fundamental programming skills centered in the context of robot programming. Students will program small robots to perform a variety of tasks. In addition to learning a sophisticated programming language, students will gain skills in design techniques and experience working in teams to build complex systems.

CS 04113:   Introduction To Object Oriented Programming   4 s.h.

Prerequisite: MATH 01122 or MATH 01130

This course introduces the fundamental concepts of programming from an object-oriented perspective. Topics are drawn from classes and objects, abstraction, encapsulation, data types, calling methods and passing parameters decisions, loops, arrays and collections, documentation, testing and debugging, exceptions, design issues, inheritance and polymorphic variables and methods. The course emphasizes modern software engineering and design. Students are expected to be sufficiently proficient in mathematics such that they are ready to take Calculus I (MATH 01130).

CS 04114:   Object Oriented Programming And Data Abstraction   3 s.h.
Prerequisites: CS 04113 or (CS 04103 and CS 04112)
Objects and data abstraction continues from Introduction to Object-Oriented Programming to the methodology of programming from an object-oriented perspective. Through the study of object design, this course introduces software engineering and focuses on file I/O, function prototypes, exception handling, decoupling strategies, and other advanced topics.

CS 04171:   Creating Android Applications   3 s.h.
Prerequisite(s): None
This course is designed for students who want to start developing mobile applications on Android platforms and understand the basic concepts of Computer Science. The course will start with the basics of Android programming by covering the most recent version of Android and understanding its development framework. Students will then learn to develop feature-rich Android applications using the MIT App Inventor Integrated Development Environment and learn the basic "Big Ideas" of Computer Science such as, algorithmic thinking, abstractions, logic, flow control, and data representation, storage and manipulation.

CS 04210:   Advanced Programming Workshop   2 s.h.
Prerequisites: CS 04103 OR CS 04113 Minimum Grade of C-
Programming languages, integrated development environments, application programming interfaces, software packages, and libraries are examples of programming technologies. This project intensive course, which is part of B.A. in Computing and Informatics program, explores a specified programming technology at an advanced level.

CS 04222:   Data Structures And Algorithms   4 s.h.
Prerequisite(s): CS 04.114 (C- or better) and MATH 03.160 or MATH 03.150; Corequisite: CS 01205
This course features programs of realistic complexity. The programs utilize data structures (string, lists, graphs, stacks, trees) and algorithms (searching, sorting, etc.) for manipulating these data structures. The course emphasizes interactive design and includes the use of microcomputer systems and direct access data files.

CS 04225:   Principles of Data Structures   3 s.h.
Prerequisites: CS 04103 or CS 04113 Minimum Grade of C-
The course features programs of realistic complexity. The programs utilize data structures (strings, lists, graphs, stacks) and algorithms (searching, sorting, etc.) for manipulating these data structures. The course emphasizes interactive design and includes the use of microcomputer systems and direct access data files.

CS 04301:   Bioinformatics - Computational Aspects   3 s.h.
Prerequisite(s): (CS 01104 or CS 04103) and CS 01205 and BINF 07250
This course introduces the student to the computer hardware, software, algorithms and statistical packages that are used in computational aspects of bioinformatics. Hardware topics include multiprocessor clusters, high performance computing, and parallelism. Software topics include message passing and shared memory styles of parallel/concurrent programming languages, databases, available software packages, and visualization techniques for large data sets. Algorithms and statistical packages include those for the study of molecular biology, evolution, structural biology, and biological networks.

CS 04305:   Web Programming   3 s.h.
Prerequisites: CS 01205 and CS 04222
This course introduces the student to some of the underlying software components of the World Wide Web as it currently exists. Topics include markup languages, scripting languages, programming languages such as Java, and other software components of the Web.

CS 04315:   Programming Languages   3 s.h.
Prerequisites: (CS 04222 or CS 04225) and (CS 06205 or ECE 09241)
A study of the fundamental principles underlying the design of programming languages. Students will study two or more languages from contrasting programming paradigms such as Functional, Object-Oriented, Logical, or Concurrent.

CS 04350:   Blockchain Programming   3 s.h.
Prerequisite(s): (CS 10250 OR CS 07350) AND (CS 01104 OR cs 04113)

This course covers the computer science techniques to architect a collection of data into a blockchain data model. Students will configure how each block stores data, learn how blocks are validated in order to add new ones to the chain; and create methods to validate the chain integrity. Students will also create a back-end API web service and migrate their private blockchain to the web service they created, learn how to post blocks to the blockchain via a web client and learn how to validate blockchain health.

CS 04372:   Advanced Android Programming   3 s.h.
Prerequisite(s): CS 10271 or CS 04225 or CS 04222
This course is designed to extend the material presented in Introduction to Android Programming (CS 04.371). This course covers advanced and custom Android user interface development, localization and resource management, the Android network API, location aware applications, data storage, testing and performance tuning, and publishing and selling Android applications. Students will gain a deeper understanding of Android application development and have an exciting opportunity to write feature-rich Android applications.

CS 04376:   Advanced iOS Application Programming   3 s.h.
Prerequisites: CS 04375or permission of the instructor.
This course is designed to extend the material presented in Introduction to iOS Programming (CS 04.375). This course covers advanced and custom iOS user interface development, localization, and resource management, the iOS network API, location aware applications, data storage, testing, and performance tuning, and publishing and selling iOS applications. Students will gain a deeper understanding of iOS application development and have an exciting opportunity to write feature-rich iOS applications.

CS 04380:   Object Oriented Design   3 s.h.
Prerequisite: CS 04222
This course will introduce important concepts, such as inheritance and polymorphism, which are crucial tools needed for crafting object-oriented solutions to real-world problems. Design patterns that commonly occur in design situations will be covered. A formal notation for describing and evaluating object-oriented designs such as the Unified Modeling Language (UML) will be taught. Students will apply the concepts to design and implement object-oriented solutions to one or more reasonably sized real-world problems.

CS 04390:   Operating Systems   3 s.h.
Prerequisites: CS 04222 and CS 06205
The course concentrates on the design and functions of the operating systems of multi-user computers. Its topics include time sharing methods of memory allocation and protection, files, CPU scheduling, input-output management, interrupt handling, deadlocking and recovery and design principles. The course discusses one or more operating systems for small computers, such as UNIX.

CS 04391:   Parallel and Concurrent Programming   3 s.h.
Prerequisites: CS 04390 (can be taken concurrently)
Concurrency and parallelism are both used with respect to multithreaded programming. This course will cover techniques on improving performance and/or responsiveness based on topics in parallel programming and concurrent programming. Such topics may include optimizing the underlying parallel resources of a particular machine (such as multiple cores), machine clustering, synchronization mechanisms (such as locking), responses to simultaneous occurring events, processes and multithreading, context switching, race conditions or shared-memory multiprocessors.

CS 04392:   System Programming And Operating System Internals   3 s.h.
Prerequisites: CS 04390 and CS 01205
This course examines the system kernel of a modern operating system including the file structure and implementation, the process structure and process scheduling, memory management policies, and the I/O subsystem. This course also covers the system call interface to the system kernel and various inter-process communication schemes.

CS 04394:   Distributed Systems   3 s.h.
Prerequisites: (CS 06205 and CS 04222) or (ECE 09242 and CS 04225)
This course will introduce students to the Distributed System, a network of (possibly autonomous) computers that cooperatively solve single problems or facilitate parallel execution of related tasks. Key topics of study include Distributed Systems Architecture,

Distributed Resource Management, and Accessing Distributed Resources. Students will participate in algorithm, process and system design for distributed systems.

CS 04400:   Computer Science - Senior Project   3 s.h.
Prerequisite(s): CS 01205 and CS 07340 and CS 07321
This is an advanced programming course in which students work on large-scale individual or team programming projects and make a formal presentation on their work. The course discusses program development, methodologies and strategies.

CS 04401:   Compiler Design   3 s.h.
Prerequisites: CS 04315 and CS 07210
This course presents theory of compiler design, syntax-directed translation, and code generation. Students design a compiler for a subset of a high-level programming language.

CS 04430:   Database Systems: Theory And Programming   3 s.h.
Prerequisites: CS 04222
This course focuses on the design of DBMS and their use to create databases. The course covers both the theoretical concepts and the implementation aspects of database systems with a special emphasis on relational database systems, SQL, programming (in a modern programming language such as C++ or Java) using a real database Application Programming Interface (such as JDBC or ODBC)

CS 04440:   Data Warehousing   3 s.h.
Prerequisites: MIS 02337 OR CS 10337 OR CS 04430
This course teaches Data Warehousing and its applications to Data Analytics and Knowledge Discovery. Topics include requirements gathering for data warehousing, data warehouse architecture, dimensional model design for data warehousing, physical database design for data warehousing, extracting, transforming, and loading strategies, introduction to Knowledge Discovery, design and development of analytics applications, expansion and support of a data warehouse.

CS 04471:   Topics in Mobile Programming   3 s.h.
Prerequisite(s): Permission of the instructor or sufficient programming background
Students will explore topics in mobile application development. This course covers the various mobile operating systems, mobile development tools, and all that is needed to create mobile applications, using programming languages appropriate for the mobile platform being studied. Students will gain an advanced understanding of mobile application development and have an exciting opportunity to write and publish feature-rich mobile applications.

CS 04623:   Advanced Software Engineering   3 s.h.
Prerequisite: CS 04524 Agile Software Engineering plus Matriculation in the MS Computer Science program OR the COG in Software
Engineering program OR permission of the program coordinator
Students will apply their knowledge from Agile Software Engineering to explore in greater depth advanced theory and practice of software engineering techniques. Emphasis will be placed on new and emerging methodologies like SAFE, Lean, Kanban. Students will be expected to compare and contrast various methodologies and techniques and complete in-depth assignments involving conference or journal papers from the software engineering literature.

CS 06205:   Computer Organization   3 s.h.
Prerequisite(s): Minimum Requirement C- for each of the following: (CS 04113 or CS 04103) and (MATH 03160 or MATH 03150) and
Sophomore Standing
This course provides an introduction to computer organization. Students are exposed to the register level architecture of a modern computer and its assembly language. The topics include machine level data representation, von Neumann architecture and instruction execution cycle, memory hierarchy, I/O and interrupts, instruction sets and types, addressing modes, instruction formats and translation.

CS 06310:   Principles Of Digital Computers   3 s.h.
Prerequisite: CS 06205

This course provides an introduction to the fundamentals of computer hardware systems. The topics include digital logic, combinational circuits, sequential circuits, memory system structure, bus and interconnection structure, computer arithmetic and the ALU unit, I/O system structure, hardwired control unit, microprogrammed control unit, and alternative computer architectures. This course is not open to students who have taken CS06.370 Digital Design and Lab.

CS 06311:   Digital Computer Laboratory   1 s.h.

Corequisites: CS 06310 Prerequisites: CS 06205

This lab course provides the student with hands-on experience in the design and implementation of digital components. State-of-the-art systems are used to design, test, and implement digital circuits: Combinational circuits, sequential circuits, registers, counters, datapath, arithmetic/logic units, control units, and CPU design. This course is taken concurrently with Principles of Digital Computers.

CS 06390:   Introduction To Systems Simulation And Modeling   3 s.h.

Prerequisite(s): (CS 04222 or CS 04225) and (MATH 01210 or (ENGR 01202 and MATH01235))

The students in this course will understand the fundamentals of and have practical experience with system modeling and simulation. Course topics include the Monte Carlo simulation technique, discrete event simulation algorithms and tools, and principles of mathematical modeling, queuing theory, input modeling, output analysis, and verification and validation of a simulation model. The students in this course will learn to use a commercial simulation software tool and will conduct a simulation study in an engineering field.

CS 06410:   Data Communications And Networking   3 s.h.

Prerequisites: CS 04222

Students in this upper-division course will study the principles of data communications and important network architectures and protocols. Its topics include: the advantages of networking, major network architectures, protocol reference models and stacks, the Data Link Layer, the Network Layer, the Transport Layer, and the Internet. Additional topics may include: local, metropolitan and wide area networks; wireless, telephone and cellular networks; network security; and network programming. Students complete a networking team project.

CS 06412:   Advanced Computer Architecture   3 s.h.

Prerequisites: CS 06310

This is an advanced course in computer architecture designed to expand the knowledge gained by students in the Principles of Digital Computers course. The topics include various performance enhancement techniques such as DMA, I/O processor, cache memory, multiport memories, RISC, pipelining, and various advanced architectures such as high-level language architecture, data-flow architecture, and multiprocessor and multi-computer architectures. This course also allows detailed examination of one or two contemporary computers.

CS 06415:   Wireless Networks, Protocols And Applications   3 s.h.

Prerequisites: CS 06410

This course prepares students to understand wireless networks systems, and the underlying communications technologies that make them possible. The course covers descriptive material on wireless communications technologies, and important deployed and proposed wireless networks and systems. Wireless system performance and Quality of Service capabilities are addressed. Students will prepare and deliver technical presentations on state-of-the-art topics in wireless networks and systems.

CS 06416:   Tcp/Ip And Internet Protocols And Technologies   3 s.h.

Prerequisites: CS 06410

This is an advanced computer networking course that will expand students knowledge received in the Data Communications and Networking course. This course will examine operation of the TCP/IP protocol as well as design and architecture of the Internet. This course will cover such topics as: Medium access protocols, address resolution protocols, Internet Protocol (IP), Quality of Service, Transport Protocol, and congestion control mechanisms. This course will also include selected topics on network security and network management. Students will prepare and deliver technical presentations on state-of-the-art research topics in the Internet.

CS 06417:   Principles of Network Security   3 s.h.

Prerequisites: CS 01210 or CS 06410 and CS 07351
This course examines the fundamentals of network security. The material covered in this course includes such topics as cryptographic systems necessary for network security, public key infrastructure, principles of data integrity, authentication, and key management, Internet architecture and TCP/ICP protocol suite, application layer security, secure sockets layer and transport layer security protocols, IPSec, distributed and cloud security, wireless and mobile security, network security techniques and components, network-based vulnerability detection and penetration testing, defense in depth, and others. Students will prepare and deliver technical presentations on state-of-the-art research topics in the network security.

CS 06420:   Embedded Systems Programming   3 s.h.
Prerequisites: (CS 04390 and CS 06310 and CS 06311) or (CS 04390 and ECE 09241 and ECE 09242)
Embedded software is used in almost every electronic device. This course deals with software issues that arise in embedded systems programming. Important concepts covered in this course will include device programming interfaces, device drivers, multi-tasking with real-time constraints, task synchronization, device testing and debugging, and embedded software development tools such as emulators and in-circuit debuggers. These concepts will be applied to design and implement embedded software for one or more modest-sized embedded systems.

CS 06440:   Cloud Computing and the Internet Things   3 s.h.
Prerequisite(s): (CS 01210 or CS 06410) and (CS 04225 or CS 04222)
This course exposes students to the variety, complexity, and capabilities of modern cloud platforms and investigates Embedded Systems and the Internet of Things (IoT) techniques, and architectures. The topics covered in the course include cloud infrastructure components, essential characteristics of cloud platforms, security implication of cloud resources, typical instruction sets and architectures of embedded systems, IoT system architectures, IoT networking and security, MQTT and REST protocols, cyber considerations and issues related to embedded systems and IoT devices, hands-on experience in using Amazon and Microsoft cloud(AWS and Azure) to visualize live data streams of IoT devices as well as other topics. Coursework will include student presentations and a term project that will provide exposure to scientific research in cloud computing and IoT.

CS 06447:   Introduction to IoT Upper Stack   3 s.h.
Prerequisite(s): CS 06440 OR ECE 09475
The Internet of Things is often characterized by a lower stack which involves connected device hardware and software and an upper stack which contains the cloud platform and applications. A communications layer connects the upper and lower stack. This course will explore the upper stack in depth, covering such topics as IoT security, cryptography, game theory foundations, credential management for connected devices, data wrangling/cleansing and overviews of machine learning and visualization.

CS 06470:   Cyber Operations   3 s.h.
Prerequisite(s): CS 06417 and CS 01205
This course exposes students to the principals and practice of the cyber operations and will introduce a high-level overview of the different phases of cyber operations and required critical skills. The topics covered in the course include offensive cyber operations, software reverse engineering, detecting software vulnerabilities, identifying command and control operations, implementing exploits for discovered vulnerabilities as well as other topics through hands-on experiences and technical presentations.

CS 07210:   Foundations Of Computer Science   3 s.h.
Prerequisites: C- or better in (MATH 03160 or MATH 03150) and one of the following: CS 01102, CS 04103, CS 01104 or CS 04113
This course provides an introduction to the theoretical foundations of computer science, including finite automata, context-free grammars, Turing machines, and formal logic.

CS 07310:   Robotics   3 s.h.
Prerequisites: (CS 04222 and MATH 01210) or (CS 04225 and ENGR 01202 and MATH 01236)
This course provides an introduction to the fundamentals of robotics. Students will study robot manipulators and mobile robots, robot sensors, and robot cognition. Students will also gain experience programming in small groups, and programming in a domain where noisy and imprecise data is commonplace.

CS 07320:   Software Engineering Laboratory   1 s.h.

This lab is designed for students who are not taking CS 07321 Software Engineering I yet wish to learn how to use software development tools. The course will cover selected topics in software engineering models and methods as well as software design notations. Any prerequisite software engineering knowledge will not be expected of students and will be included in this course.

CS 07321:   Software Engineering I   4 s.h.
Prerequisites: (CS04.222 or CS 04.225) and (CMS 04.205 or ENGR 01.202) and (WA 01.302 or ENGR 01.201)
An introduction to the discipline of Software Engineering. Students will explore the major phases of the Software Lifecycle, including analysis, specification, design, implementation, and testing. Techniques for creating documentation and using software development tools will be presented. Students will gain experience in these areas by working in teams to develop a software system. Proficiency in programming is expected of the students entering this course.

CS 07322:   Software Engineering II   3 s.h.
Prerequisites: CS 07321
Students will apply their knowledge from Software Engineering to develop an advanced software system, working in teams, The project will be taken through each of the major software development phrases and student teams will create appropriate deliverables for each phase. Advanced modern software engineering topics such as critical systems, real-time systems, formal specification and validation, and project management will be covered.

CS 07340:   Design And Analysis Of Algorithms   3 s.h.
Prerequisites: CS 04222 and CS 07210
In this course, students will learn to design and analyze efficient algorithms for sorting, searching, graphs, sets, matrices, and other applications. Students will also learn to recognize and prove NP-Completeness.

CS 07350:   Computer Cryptography   3 s.h.
Prerequisites: CS 07210 and CS 04222
This course introduces students to the principles and practices which are required for secure communication: cryptography, cryptanalysis, authentication, integrity, and digital certificates. Mathematical tools and algorithms are used to build and analyze secure cryptographic systems with computers. Social, political, and ethical aspects of cryptography are also covered.

CS 07351:   Cyber Security: Fundamentals, Principles and Applications   3 s.h.
Prerequisites: (MATH 03150 or MATH 03160) and CS 06205
This course exposes students to the security fundamental principles and will introduce a wide range of security activities, methodologies, and procedures. The topics covered in the course include fundamental concepts of computer security, principles of cryptography, software security and trusted systems, isolation and virtualization, host-based vulnerability detection, security architecture, Windows and Linux system administration, access control and least privilege, legal and ethics as well as other topics.

CS 07353:   Security of Mobile Devices   3 s.h.
Prerequisites: CS 04222, CS 06205
This course focuses on the technical and logistical principles of securing mobile devices. Current operating systems, applications and networks will be addressed. Social and ethical implications will also be explored throughout the course. Both hands-on experience and scenario-based analysis will be emphasized in the course.

CS 07355:   Cybersecurity Management, Policy and Risk   3 s.h.
This course covers cybersecurity planning and management, security risk analysis, policy, legal, ethics and compliance issues and security program management from a technical cybersecurity perspective at the undergraduate level. Course is cross-listed with MIS 02318 - Information Systems Risk Management. Students cannot receive credit for both.

CS 07360:   Introduction To Computer Graphics   3 s.h.
Prerequisites: (MATH 01210 or MATH 01235) and CS 07340
This junior/senior level course covers such topics as fundamentals of graphics devices; use of graphics language/packages; windowing and clipping; geometrical transformation in 2- and 3-D; raster display algorithms; hidden line and surface elimination; animation.

CS 07370:   Introduction To Information Visualization   3 s.h.

Prerequisites: CS 04.222 OR CS 04.225 OR MIS 02.337 OR MIS 02.338 OR CS 10.337

This is a junior/senior level course that introduces basic elements of Information Visualization, which is concerned with the creation of visual representation of Big Data abstract phenomena for which there may not be a natural physical reality, such as stock market movements, social relationships, gene expression levels, manufacturing production monitoring, survey data from political polls, or supermarket purchases. Students will be exposed to techniques covering the five main phases of developing information visualization tools: representation, presentation, interaction, perception and interpretation, and evaluation. Students will be required to develop a large project related to information visualization.

CS 07380:   Introduction To Computer Animation   3 s.h.

Prerequisites: (MATH 01210 or MATH 01236) and (PHYS02200 or PHYS 00220)

This is a junior/senior level course that takes a look at Computer Animation from a programmer's perspective. It will investigate the theory, algorithms, and techniques for describing and programming motion for virtual 3D worlds. Approaches that will be explored include keyframing systems, kinematics, motion of articulated figures, and procedural and behavioral systems. This course includes the implementation of techniques presented in lecture. Students are encouraged to devise new techniques, implement them, and determine their effectiveness. Students will be required to implement and document a large software project related to computer animation.

CS 07390:   Introduction To Computer Game Design And Development   3 s.h.

Prerequisites: (CS 04222 or CS 04225) and (Math 01210 or MATH 01235)

This is a junior/senior level course that introduces the technology, science, and art involved in the creation of computer games. Games will be examined in a systems context to understand gaming and game design fundamentals. The theory and practice of developing computer games will be investigated from a blend of technical, aesthetic, and cultural perspectives. Extensive study of past and current computer games will be used to illustrate course concepts. Group game development and implementation projects will culminate in classroom presentation and evaluation.

CS 07422:   Theory Of Computing   3 s.h.

Prerequisites: CS 04222 and MATH 01131 and CS 07210

This is an advanced course in the theoretical foundations of computer science, building on the introduction provided in the Foundations of Computer Science course. It studies models of computers, such as finite automata and Turing machines, formal languages, and computability, as well as the fundamentals of complexity theory and NP-completeness.

CS 07430:   Human-Computer Interaction   3 s.h.

Prerequisites: CS 04222 or CS 04225

This course teaches the fundamental concepts of Human Computer Interaction (HCI) and user-centered design. Students will learn how to create effective interfaces to both software and hardware systems that are both effective and usable.

Students will study modeling, user testing, user interaction analysis techniques, and prototyping. Team projects are required.

CS 07450:   Artificial Intelligence (Ai)   3 s.h.

Prerequisite(s): CS 04222 or CS 07210 and CS 01205 and MATH 01131

AI studies methods for programming "intelligent" behavior in computers. Students study the data representation methods and algorithms used in AI, and survey research areas such as puzzle solving, game-playing, natural language processing, expert systems, and learning. This is a mathematically and programming intensive course. In addition to readings, discussion, and problem solving in AI, students will be expected to do significant programming tasks in languages that may be new to them.

CS 07455:   Machine Learning   3 s.h.

Prerequisites: MATH 01210 or MATH 01235 and STAT 02290 or ECE 09363

The use of computational approaches to extract information from vast amounts of data and make intelligent decision based on that information constitutes the foundation of machine learning, a field that has made a dramatic impact on our daily lives. From weather prediction to medical diagnosis, end-user recommendations to smart homes, autonomous vehicles to speech identification, machine learning is now everywhere. This course introduces concepts, issues, and algorithms in machine learning and pattern recognition, and will discuss both theoretical and practical aspects. Main topics of the course will include basic learning theory, convex and evolutionary optimization techniques, supervised, unsupervised and semi-supervised learning, ensemble systems, model selection and combination, feature selection and performance evaluation techniques. The class will

feature assignments and projects that allow students to implement various traditional and emerging machine learning algorithms, and evaluate them on real-world applications.

CS 07459:   Models of Deep Learning   3 s.h.
Prerequisite(s): STAT 02290 and MATH 01210
This course provides an in-depth, hands-on introduction to deep learning/neural network programming. This course will highlight many practical computational, algorithmic and data issues related to designing, training and deploying deep learning models. Prior programming knowledge is expected.

CS 07460:   Computer Vision   3 s.h.
Prerequisites: CS 04222, MATH 01210, and STAT 02290
This course examines the fundamental issues in computer vision and major approaches that address them. The topics include image formation, image filtering and transforms, image features, mathematical morphology, segmentation, camera calibration, stereopsis, dynamic vision, object recognition and computer architectures for vision.

CS 07480:   Introduction to Data Mining   3 s.h.
Prerequisites: (CS 04222 and NEUR 01450) and (STAT 02260 or STAT 00290 or STAT 02280 or STAT 02284)
This course teaches the fundamental concepts of Data Mining. Students will learn how to program systems to gather and analyze large data sets to discover important patterns.

CS 07485:   Web and Text Mining   3 s.h.
Prerequisites: CS 04225 or CS 04222
This course teaches methods of mining large amounts of text. Students will be introduced to methods for obtaining, exploring, and preprocessing large amounts of text. Tools for natural language processing, topic modeling, sentiment analysis and Bayesian classifiers will be introduced. Business and biomedical applications of text mining will be discussed.

CS 07523:   Advanced Software Engineering   3 s.h.
Prerequisites: Acceptance into the Computer Science MS or BS/MS program
Students will apply their knowledge from Software Engineering to develop an advanced software system, working in teams. The project will be taken through each of the major software development phases, and student teams will create appropriate deliverables for each phase. Advanced modern software engineering topics such as critical systems, real-time systems, formal specification and validation, and project management will be covered. Students will be required to complete in-depth assignments involving conference or journal papers from the software engineering literature.

CS 07540:   Advanced Design And Analysis Of Algorithms   3 s.h.
Prerequisite(s): Matriculation in the MS Computer Science program OR the MS Data Science program OR permission of the program coordinator
Students in this course will study efficient algorithms for sorting, searching, graphs, sets, matrices, and other applications, and will learn to design and analyze new algorithms. Students will also learn to recognize and prove NP-Completeness.

CS 07556:   Machine Learning I   3 s.h.
Prerequisite(s): matriculation in the MS Computer Science program OR permission of the program coordinator
This course introduces students to machine learning tasks at the graduate level including classification, regression, learning with unlabeled data), common machine learning approaches, and mathematics required to understand advanced topics in machine learning. Students will be exposed to topics such as data Issues in machine learning, Information-based learning (Decision Tree), Similarity-based learning (k-nearest neighbor), Probabilistic-based learning (naïve Bayes, Maximum A Posteriori, Bayesian Network), Linear Models (Perceptron, Linear Regression, Logistic Regression), Support Vector Machine, Neural Network, Performance measure and evaluation, Descriptive Statistics and Result Visualization, Learning with unlabeled data (clustering), Mathematics for Advanced Topics in Machine Learning (Topics in Probability, Linear Algebra, and Optimization).

CS 07570:   Information Visualization   3 s.h.
This is a graduate level course in Information Visualization. Topics covered include graphics programming, information visualization general principles, visualization techniques for 1-dimensional, 2-dimensional, and N-dimensional information, graph visualization, visualization techniques for image and digital libraries, as well as for the World Wide Web, interactivity, theories behind

information visualization, and focus+context techniques. This course also includes the implementation of techniques presented in lecture. Students are encouraged to devise new techniques, implement them, and determine their effectiveness. Students will be required to complete in-depth assignments, read, summarize, and present recent journal papers from the information visualization literature, and prepare term papers with regard to an information visualization research topic. Students will also be required to specify, design, implement, and document a semester-long software project related to information visualization.

CS 07655: Natural Language Processing 3 s.h.
Prerequisite: CS 07540 Advanced Design and Analysis of Algorithms plus matriculation in the MS Computer Science program OR permission of the program coordinator
This course presents methods for allowing computers to understand and generate sentences in human languages (such as English) and prepares the student to do research in natural language processing. Topics include syntax, semantics, pragmatics, and knowledge representation.

CS 10200: Fundamentals of Network Security 3 s.h.
Prerequisite: CS 01210
This course introduces network security focusing on the overall processes with an emphasis on hands-on skills in the following areas: security policy design and management; security technologies, products and solutions; firewall and secure router design, installation, configuration, and maintenance; AAA implementation, and VPN implementation using routers.

CS 10250: Cryptography and Blockchain Essentials 3 s.h.
This introduction to the basic theory and practice of cryptographic techniques used in computer security will explore the inner workings of cryptographic techniques and how to use them correctly. It will include consensus algorithms (such as Proof of Work and Byzantine Consensus) and their role in blockchains and cryptocurrencies, cryptographic tools employed in cryptocurrencies (including digital signatures algorithm and zero knowledge proofs) and trusted hardware in blockchain-based systems.

CS 10271: Introduction to Android Programming 3 s.h.
Prerequisite(s): CS 04113 or CS 04171 or CS 04103 or CS 01104 or CS 01102
This course is targeted for students who want to start writing mobile applications on Android platforms. Android has become a formidable mobile operating system, and this course will provide hands-on learning on writing Android applications. The course will start with the basics of Android programming by covering the most recent version of Android and understanding its development framework. Students will then learn both the fundamentals and the nuts and bolts of Android application development and have an exciting opportunity to write feature-rich Android applications. Students also need a solid foundation in the Java Programming Language, and in particular, should be comfortable with writing functions, arrays, and class objects.

CS 10275: Introduction to iOS Application Programming 3 s.h.
Prerequisite(s): CS 04113 or CS 04171 or CS 04103 or CS 01104 or CS 01102
This course is targeted for students who wanted to start writing mobile applications on iOS platforms. iOS has become a formidable mobile operating system, and the courses will provide hands-on learning on writing iOS applications. The course will start with the basics of iOS programming by covering the most recent version of iOS and understanding its development framework. Students will then learn both the fundamentals and the nuts and bolts of iOS application development and have an exciting opportunity to write feature-rich iOS applications.

CS 10310: Introduction to Web Development 3 s.h.
Prerequisites: (MIS 02337 or CS 10377) or (CS 10338 and CS 10339) or CS 04430 and (CS 04114 or CS 04210) and (CS 04222 or CS 04225)
This course, which is part of the BA in Computing and Informatics, teaches students the basic techniques of web site development, including some of the tools, languages, and platforms that are commonly used for web sites. This course does not count as a restricted elective for the BS in Computer Science.

CS 10337: Applied Database Technologies Applied Database Technologies 3 s.h.
Prerequisite(s): Must be enrolled in the BA in Computing & Informatics Major or the CUGS in MIS; May not be enrolled as the following classifications: Freshman or Sophomore

This course covers the practical aspects of relational database systems, including database modeling using ER and EER diagrams, physical database design, the relational database query language SQL, normal forms, database integrity and transaction management. Includes a project involving an RDBMS.

CS 10338: SQL In-depth   1 s.h.

This course provides comprehensive coverage of the relational database query language SQL. The course covers core SQL commands to define, manipulate, aggregate, and join data. Students will write advanced SQL queries (e.g., aggregate queries and subqueries), learn both Data Manipulation Language (DML) and Data Definition Language (DDL), and create database constraints.

CS 10339: Database Modeling and Design   2 s.h.

Prerequisite: CS 10338

This course covers the practical aspects of relational database systems, including database modeling using ER and EER diagrams, physical database design, normal forms, database integrity and transaction management. It assumes a strong working knowledge of SQL including Data Manipulation Language (DML) and Data Definition Language (DDL).

CS 10340: Systems Administration   3 s.h.

Prerequisites: CS 01211 AND CS 01210 OR permission of the instructor.

This course is designed to introduce students to the universal principles of systems administration that apply to all platforms and the major operating system families: Linus/Unix and Windows. The students will have hands on experience with the installation, configuration, administration, and management of core servers and core server operating systems.

CS 10342: Web Server Platforms   3 s.h.

Prerequisites: CS 10.310 OR permission of the instructor.

This course is designed to prepare students to install, configure, and maintain Web Servers. Students will learn about the installation, access control, security, performance, managing, and troubleshooting of web server hardware, software, and services.

CS 10344: Concepts of Computing Technologies   3 s.h.

Prerequisites: CS 01210or CS 06410; and CS 01211 or CS 07351

This course, which is part of the B.A. in Computing and Informatics program, examines the role, proper architecture, and potential contributions of Information technologies and systems – what they are, how they should be configured, and how they affect users of the technologies. This course covers a range of topics such as architectural planning, system and network administration, identity and authentication systems, change and problem administration, configuration of computing systems, data center and facilities management, capacity planning, document and content control, maintaining servers for system availability and uptime, systems monitoring and performances tuning, as well disaster recovery and system continuity.

CS 10430: Computing and Informatics Capstone Experience   3 s.h.

Prerequisites: CS 10310 AND CMS 04205

This course is designed to introduce students to all aspects of software production from the early stages of system specification through to systems maintenance. This course provides an - exposure to the software development process by which user needs are translated into a tangible software product.

CS 99210: Introductory Learning Assistant Experience in Computer Science   1 s.h.

Prerequisite: Permission of Supervising Instructor

The course is designed to provide students with an introductory experience in applied pedagogy associated with collegiate-level Learning Assistant (LA) Models while deepening their mastery of computing fundamentals. Students will review and prepare for practicum in a computing related course with exposure to LA skills and strategies. Students will utilize learned LA skills and fundamental computing knowledge to facilitate in-class active and collaborative learning exercises in small student groups. This course is recommended for all students interested in developing depth of their computing knowledge with some specific pedagogical methods while also enhancing their communication and interpersonal skills via student mentorship and staff collaboration.

CS 99300:   Computer Field Experience   3 to 12 s.h.
Prerequisite(s): Permission of instructor and CS 04222 or CS 04225
Students are assigned projects in a professional environment.

CS 99310:   Advanced Learning Assistant Seminar in Computer Science   3 s.h.
Prerequisite: Permission of Instructor
This course is designed to provide students with more advanced experience in applied pedagogy associated with collegiate-level Learning Assistant (LA) Models while further deepening their mastery of computing fundamentals. Students will focus on the implementation of LA skills and strategies while completing their practicum in a computing related course. Students will apply learned LA skills and computing knowledge in areas of assessment, design, development, and facilitation of in-class active and collaborative learning activities and exercises. This course is recommended for all students interested in continuing their development of some specific computing pedagogical methods, communication techniques, and interpersonal skills via student mentorship and staff collaboration.

CS 99390:   Computer Science Research I   1 to 3 s.h.
Prerequisite(s): permission of instructor and enrollment in the Computer Science or Computing and Informatics major.
This course will allow students to do real-world computer science research by applying what they've learned in the regular computer science curriculum to complex research problems. Research will be guided by a faculty member of the Computer Science department and requires the permission of an undergraduate Computer Science faculty member.

CS 99490:   Computer Science Research II   3 s.h.
Prerequisite(s): CS 99390
This course will leverage the research skills and results from Computer Science Research I so students are capable of performing high-level undergraduate computer science research to address complex research problems. Research will be guided by a faculty member of the Computer Science department and requires the permission of an undergraduate Computer Science faculty member.

CST 01110:   Information Technology Foundations   3 s.h.
This course focuses on the essential IT skills and knowledge needed for tasks commonly performed by advanced end-users and entry-level IT professionals alike. It focuses on the knowledge and skills required to identify and explain the basics of computing, IT infrastructure, application and software, software development, database fundamentals, and security. This course directly maps to CompTIA Information Technology Fundamentals Plus (ITF+) Certification.

CST 01111:   Computer Hardware and Operations   3 s.h.
This course provides students with an in-depth knowledge of the internal operations of personal computers and the software it relies on. It focuses on understanding the relationship between various computer parts and peripherals, troubleshooting problems, customer service skills, and safety practices. This course directly maps to the CompTIA A+ Certification.

CST 02110:   Implementations of SQL I Implementations of SQL I   3 s.h.
This course examines ANSI-standard SQL and its variations as implemented by the major relational database providers,
e.g., Oracle, Azure (Microsoft SQL Server), MySQL. It focuses on the SELECT clause including inner and outer joins, aggregation, correlated and regular subqueries, modeling basics, and SQL functions across implementations.

CST 02210:   Implementations of SQL II   3 s.h.
Prerequisite(s): CST 02110
This course builds on the fundamentals of SQL and introduces relational data manipulation and definition languages (DML and DDL), the use of metadata such as dictionary and schema objects, indexes and query optimization.

CST 02220:   Database Administration I   3 s.h.
Prerequisite(s): CST 02210
This course introduces the principles of database administration including the role of a DBA, database implementation and configuration options, and tradeoffs between various database configurations.

CST 02230:   Database Development   3 s.h.

Prerequisite(s): CST 02210
This course goes over key principles in database development including data modeling, normalization, and NoSQL databases.

CST 02250:   Database Security   3 s.h.
Prerequisite(s): CST 02220
This course is a comprehensive survey of database security techniques. It will describe several types of attack such as inference attacks or injection attacks. It will also discuss key database countermeasures such as intrinsic database security, roles, password management techniques, row-level security, encryption, securing connections, views as a security tool. Finally it will expose students to security logs and audit trails.

CST 02320:   Database Administration II   3 s.h.
Prerequisite(s): CST 02220
This advanced course in database administration will cover such topics as replication, data migration, transactions, as well as backup and recovery techniques.

CST 02330:   Database Programming   3 s.h.
Prerequisite(s): CST 02210
This course covers database programming techniques, whether at the database layer (e.g., triggers, functions and procedures) or at the business tier layer in the form of transmissible data formats to webserver software or client services

CST 02400:   Database Warehouse Principles   3 s.h.
Prerequisite(s): CST 02330
This course covers many of the principles of data warehousing, including batch data vs streaming data, data analytics core concepts and analytics techniques, data visualization (e.g., visualization, reporting, business intelligence (BI)), b. basic chart types such as bar charts and pie charts, and data processing such as ETL tools.

CST 03201:   Security+   3 s.h.
This course examines various IT security topics such as cryptography and access control, as well as topics in the business-related IT subfields of risk management and disaster recovery. It focuses on the following domains – threats, attacks, and vulnerabilities; architecture and design; implementation, operation, and incident response; and governance, risk, and compliance. This class directly maps to CompTIA Security Plus (Sec+) Certification.

CST 03215:   Penetration Testing Fundamentals   3 s.h.
Prerequisite(s): CST 09210
The purpose of this course is to give students of all backgrounds and experience levels a well-researched and engaging introduction to the realm of penetration testing. With real-world examples that reflect today's most important and relevant security topics, this course addresses how and why people attack computers and networks, so that students can be armed with the knowledge and techniques to successfully combat hackers. Because the world of information security changes so quickly and is often the subject of much hype, this course also aims to provide a clear differentiation between hacking myths and hacking facts. Many hands-on exercises are included, which allow students to practice skills as they are learned.

CST 03252:   Foundations of Computer Forensics   3 s.h.
This interdisciplinary course focuses on the legal and technical principles of digital forensics. Analysis of complex legal issues and current trends in high technology crime will be followed by exploration of formal methodologies and best practices for the forensically sound acquisition and analysis of digital evidence. Social and ethical impacts will also be explored throughout the course as it relates to high technology crime. Hands-on scenario based activities will provide students with opportunities to develop the legal understanding and technical skills that will serve as a foundation to pursue careers in computer forensics in law enforcement and the private sector.

CST 03253:   Applications for Computer Forensics   3 s.h.
Prerequisite(s): CST 03252
This course covers the active use of EnCase Forensic software. It focuses on Digital forensic and EnCase Forensic concepts and methodology such as: the proper handling and acquisition of digital evidence using EnCase; basic computer functionality as well as that of various computer file systems; examining various artifacts using EnCase Forensic, including the Windows registry,

Windows artifacts, email, and Internet history; and creating and exporting an examination report using EnCase Forensic. This course directly maps to the EnCASE Certified Examiner Preparation (EnCE) Certification.

CST 03270:   Introduction to Intrusion Detection   3 s.h.
This course introduces Splunk and how to use fields; get statistics from your data; and create reports, dashboards, lookups, and alerts. Scenario-based examples and hands-on challenges will enable you to create robust searches, reports, and charts. It also introduces Splunk's datasets features and Pivot interface. This course directly maps to Splunk Fundamentals 1 and 2 Certifications.

CST 03315:   Advanced Penetration Testing   3 s.h.
Prerequisite(s): CST 03215
This course covers penetration testing tools and techniques via hands-on experience. This course trains not only the skills but also the mindset required to be a successful penetration tester. The course focuses on proper planning, scoping, and recon, and then dives deep into scanning, target exploitation, password attacks, and wireless and web apps with detailed hands-on exercises. This course directly maps to the Offense Security Certified Professional (OSCP) Certification.

CST 03352:   Digital Incident Handling   3 s.h.
This course is a method-driven program that uses a holistic approach to cover vast concepts concerning organizational incident handling and response, from preparing and planning the incident handling response process to recovering organizational assets after a security incident. The course focuses on all the stages involved in incident handling and the response process. This course directly maps to the EC-Council Certified Incident Handler (ECIH) Certification.

CST 03370:   IDS/IPS Administration   3 s.h.
This course is designed to introduce concepts for system administrators who are responsible for managing the Splunk Enterprise environment. The course provides the fundamental knowledge of Splunk license manager, indexers, and search heads. It covers the configuration, management, and monitoring of core Splunk Enterprise components. This course directly maps to Splunk Enterprise System Administration Certification.

CST 03372:   Knowledge Management in IDS/IPS   3 s.h.
Prerequisite(s): CST 03270
This course focuses on additional Splunk search commands as well as advanced use of knowledge objects. Major topics include advanced statistics and eval commands, advanced lookup topics, advanced alert actions, using regex and erex to extract fields, using spath to work with self-referencing data, creating nested macros and macros with event types, and accelerating reports and data models. This course directly maps to Splunk Fundamentals 3 Certification.

CST 03410:   Cyber Defense   3 s.h.
This course covers the most up-to-date core security analyst skills and upcoming job skills used by threat intelligence analysts, application security analysts, etc. Not only does it focus on the knowledge and skills required to proactively capture, monitor, and respond to network traffic findings, but it also emphasizes software and application security, automation, threat hunting, and IT regulatory compliance, which affects the daily work of security analysts. This course directly maps to the CompTIA Cyber Security Analyst Plus (CySA+) Certification.

CST 03418:   Advanced Topics in Ethical Hacking   3 s.h.
Prerequisite(s): CST 03218
The course covers the methodologies and tools required to assess the security posture of an organization by identifying vulnerabilities in the network and system infrastructure to determine if unauthorized access is possible. It focuses on the most advanced tools and techniques used by black and grey hat hackers alike to break into an organization to assess, document, and remediate vulnerabilities from a vendor-neutral perspective. This course directly maps to the EC-Council Certified Ethical Hacker (CEH) certification.

CST 03452:   Advanced Digital Forensics Investigation   3 s.h.
Prerequisite(s): CST 03252
This course provides a firm grasp of digital forensics, presenting a detailed and methodological approach to digital forensics and evidence analysis that also pivots around Dark Web, IoT, and Cloud Forensics. The tools and techniques covered in this course will

prepare the learner for conducting digital investigations using groundbreaking digital forensics technologies. This course directly maps to the EC-Council Certified Hacking Forensics Investigator (CHFI) Certification.

CST 03472:   IDS/IPS for Cloud   3 s.h.
Prerequisite(s): CST 03270
This course prepares administrators to manage users and get data in Splunk Cloud. Topics include data inputs and forwarder configuration, data management, user accounts, and basic monitoring and problem isolation. The focus of this class is the knowledge, best practices, and configuration details for Splunk Cloud. This course directly maps to Splunk Cloud Administration Certification.

CST 06220:   Linux/Unix Essentials   3 s.h.
This course is designed to give students an introduction to Linux/Unix like Operating Systems. Since this course serves as an introduction, no prior experience with Linux/Unix like Operating Systems is required. This course will show students how to connect to a Linux/Unix like Operating System and engage with it via the command line. Students will learn about the Linux/Unix hierarchical file structure, basic protection and permission features, and file editing operations from the command line. Students will also learn how to use streams, pipes, and redirects with typical Linux/Unix like programs such as awk, grep and sort. The experience is then capped by creating automated systems using a shell programming language such as bash.

CST 06225:   Linux/Unix Administration   3 s.h.
Prerequisite(s): CST 06220
This is an intermediate course that requires pre-existing work with a Linux/Unix like Operating System. This course focuses on the administrator role of a system and the tools needed to perform common administration tasks. Students will learn how to navigate a package manager, configure a boot manager, and monitor tasks. In depth use of regular expressions will be taught so students can process logs and enforce appropriate resource usage. In depth discussion on the relationships between users, groups and services will be addressed as well as the security principles that follow.

CST 06230:   Microcomputer Operating Systems I: Workstation   3 s.h.
This course is designed to give students an introduction to the Windows environment as a client in the client-server model. Topics include the installation of a Windows environment, network customization, securing file systems and setting up local and network printing. Operating System hardening concepts are then addressed by way of the dispatch of administrator and group accounts, customization via registry editing, and introducing peer-to-peer communication. No experience with the Windows Workstation is needed prior to joining this course.

CST 06235:   Microcomputer Operating Systems II: Server Systems   3 s.h.
Prerequisite(s): CST 06230
Students in this course will gain an in-depth experience working with Windows server systems in the client-server model. Instruction begins with the installation and customization of a Windows Server Operating System. Focus is then given to customization of the network environment by using user, group, and network resource management tools along with environment and application group policies. Server protocols such as the Dynamic Host Control Protocol will be addressed as well as implementing a Domain Name System. Students will then learn how to perform customization via remote access and how to perform remote deployment.

CST 06240:   Linux Systems and Services   3 s.h.
Prerequisite(s): CST 06220 and CST 09210
Linux System and Services is an in-depth course requiring pre-existing experience with the Linux Operating System. Students will learn how to employ a system administrator role to manage user and group accounts to perform monitoring actions. Students will also learn about localization, internationalization, and character encoding. Exercises related to system time via timestamps, job scheduling with cron, and logging will also be used. Finally, students will be able to setup and configure commonly used services on Linux systems such as print, email, and databases.

CST 06340:   Introduction to Azure Cloud Services   3 s.h.
This is an introductory course to the Azure Cloud services system. Students need no prior experience with Azure systems to enroll in this course. Students will gain an introduction to cloud computing concepts and terminology as well as how to setup an account

and manage it through the Azure website interface. Students will then be able to setup a small Azure project using the Azure sandbox. Important alerts and monitors will also be set up so students can monitor billing usage.

CST 06343: Azure Management Tools and Security 3 s.h.
Prerequisite(s): CST 06340
This is an intermediate course using the Azure Cloud services system. Students will learn about the difference services that the Azure system offers as well as the deployment mechanisms used for the services. Users will be able to setup monitoring systems, gain exposure to the security mechanisms in place and configure event detection. Students may also gain exposure to network principles used in cloud computing such as Firewalls and security groups.

CST 06440: Azure Services and Lifecycles 3 s.h.
Prerequisite(s): CST 06340
This course is an advanced course on using the Azure Cloud services system. Students will learn, from a business perspective, about cloud governance and deployment strategies. Students will also learn about regulatory and compliance standards as well as migration plans for already implemented systems. Students will partake in a project that involves cloud management, documentation, security audits, and "cloud spend" reports to assess deployment solutions.

CST 09210: Introduction To Computer Networks And Data Communications 3 s.h.
This course examines the basics of data communication and computer networks and covers such topics as IT system components, layered network architectures, introduction to internetworking, the Internet, IP protocols, basics of TCP and UDP transmission protocols, standard network applications and basics of network security, network utility software, network traffic analysis, network mapping techniques, and configuring local area networks in a popular operating system.

CST 09290: Intermediate Networking 3 s.h.
Prerequisite(s): CST 09210
This course will examine more advanced topics in data communication and computer networks and will cover such topics such as wide area network, multi-media communication, security, wireless technology, network routing, and switching configuration tools.

CST 09310: Network Support and Troubleshooting 3 s.h.
Prerequisite(s): CST 09210
This course focuses on the technical skills needed to securely establish, maintain and troubleshoot the essential networks that businesses rely on. Areas of focus includes network architecture, performance monitoring, wireless technology and network security.

CST 09320: Network Architectures, Models, and Protocols 3 s.h.
Prerequisite(s): CST 09290
The course focuses on introduction to Cisco network architectures, models, protocols, and networking elements that connect users, devices, applications and data through the internet and across modern computer networks - including IP addressing and Ethernet fundamentals. By the end of the course, students can build simple local area networks (LANs) that integrate IP addressing schemes.

CST 09325: Network Communication and Configuration 3 s.h.
Prerequisite(s): CST 09320
The course focuses on Cisco network architectures, models, protocols, and networking elements that connect users, devices, applications and data through the internet and across modern computer networks - including IP addressing and Ethernet fundamentals. Students will build simple local area networks (LANs) that integrate foundational network security, and perform basic configurations for routers and switches.

CST 09430: Switching, Routing and Wireless Essentials 3 s.h.
Prerequisite(s): CST 09325
This course focuses on switching technologies and router operations that support small-to-medium business networks and includes wireless local area networks (WLANs) and security concepts. Students learn key switching and routing concepts. They can perform basic network configuration and troubleshooting, identify, and mitigate LAN security threats, and configure and

secure a basic WLAN. Students are required to have successfully completed the Introduction and intermediate to Cisco Networks courses prior to beginning the Switching, Routing and Wireless Essentials (SRWE) course.

CST 09435:   Enterprise Networking, Security, and Automation   3 s.h.
Prerequisite(s): CST 09430
This course focuses on the architectures and network considerations related to designing, securing, operating, and troubleshooting enterprise networks. This course covers wide area network (WAN) technologies and quality of service (QoS) mechanisms used for secure remote access. This course also introduces software-defined networking, virtualization, and automation concepts that support the digitalization of networks. Students gain skills to configure and troubleshoot enterprise networks, and learn to identify and protect against cybersecurity threats. They are introduced to network management tools and learn key concepts of software-defined networking, including controller-based architectures and how application programming interfaces (APIs) enable network automation.