Department of Computer Science

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General Statement: The Department of Computer Science offers a B.S. degree in Computer Science (CS). The CS program provides the CS majors with a broad-based knowledge in various contemporary computer science fields such as Programming Languages, Computer Architectures and Operating Systems, Algorithms, Database Systems, Computer Communications and Networks, Cyber-Security, Artificial Intelligence and Robotics, Computer Vision and Graphics, Bioinformatics and High-Performance Computing, and Software Engineering. The CS program also offers a concentration in Bioinformatics under the B.S. degree.

The mission of the Department of Computer Science, commensurate with the mission of the University and the College of Engineering, is to provide quality Computer Science education, to pursue theoretical and applied research in the critical areas of computer science, and to engage in service to its constituents.

The Program Educational Objectives of the Computer Science Undergraduate Program describe the career and professional accomplishments that the Program is preparing graduates to achieve in three to five years after graduation. These objectives are:

1. Graduates are employed within the discipline or closely related fields or pursue graduate education.
2. Graduates demonstrate professional growth evidenced by measurable development activities and leadership roles.

The Computer Science **Student Outcomes** require that the graduating students demonstrate the following:

1. Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.
2. Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.
3. Communicate effectively in a variety of professional contexts.
4. Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.
5. Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.
6. Apply computer science theory and software development fundamentals to produce computing-based solutions

Program Requirements

A minimum of 120 semester credit hours are required for completion of the BS degree in Computer Science. The distribution of these credits is outlined below.

Orientation and General Computer Science	2
Communication	9
Humanities / Fine Arts	9
Social / Behavioral Sciences	6
History	6
Natural Sciences	12
Mathematics	18
CS Core courses	37
Computer Science Electives	12
Technical Electives	9
Total	120

Orientation and General Computer Science (2):

1. UNIV 1000 Service to Leadership (1)
2. COMP 1500 Introduction to Computer Science (1)

Communication (9):

1. ENGL 1010 Freshman English I (3)
2. ENGL 1020 Freshman English II (3)
3. COMM 2200 Public Speaking (3)

Humanities/Fine Arts (9):

1. Humanities/ Fine Arts Elective I (3)
2. Humanities/ Fine Arts Elective II (3)
3. Humanities/ Fine Arts Elective III (3)

Humanities/Fine Arts Electives must be chosen from the General Education list of Humanities and Fine Arts courses approved by the University. One Humanities/Fine Arts Elective must be chosen from ENGL 2120, 2310, 2012, 2013, 2210, 2320, 2022, or 2023.

Social/Behavioral Sciences (6):

1. Social Behavioral Science Elective I (3)
2. Social Behavioral Science Elective II (3)

Social Behavioral Science Electives must be chosen from the General Education list of Social and Behavioral Science courses approved by the University.

History (6):

1. HIST 2010 American History I (3)
2. HIST 2020 American History II (3)
3. HIST 2050 World History I (3)
4. HIST 2060 World History II (3)
5. HIST 2700 African American Experience (3)
6. HIST 2030 History of Tennessee (3)

Natural Sciences (12):

Natural Sciences must be chosen from: PHYS 2110 (3) & 2111 (1) (or PHYS 2010 (3) & 2011 (1)), PHYS 2120 (3) & 2121 (1) (or PHYS 2020 (3) & 2021 (1)), CHEM 1110 (3) & 1111 (1), CHEM 1120 (3) & 1121 (1), BIOL 1110 (3) & 1111 (1), or BIOL 1120 (3) &1121 (1).

Mathematics (18):

1. MATH 1910 Calculus & Analytic Geometry (4)
2. MATH 1920 Calculus II (4)
3. MATH 3100 Probability and Statistics ***or*** (3)
   MATH 2050 Probability and Statistics ***or***
   STAT 3110 Probability and Statistics or Equivalent
4. COMP 3010 Discrete Mathematics (4)
5. MATH Elective (3)

(must be 2000 or higher level with approval of academic advisor. MATH 2500, 3130, 4500, 4724, 4750, and 4900 are not accepted)

Computer Science (Core 37):

1.	COMP 2140	Computer Programming I	(4)
2.	COMP 2240	Computer Programming II	(4)
3.	COMP 2400	Computer Organization	(3)
4.	COMP 3050	Programming Languages	(3)
5.	COMP 3040	Data Structures	(3)
6.	COMP 3190	Ethics and Professionalism in Computing	(2)
7.	COMP 3300	Software Engineering	(3)
8.	COMP 3310	Data Communication and Computer Networks	(3)
9.	COMP 3560	Introduction to Theory of Computing	(3)
10.	COMP 4100	Operating Systems	(3)
11.	COMP 4500	Senior Project I	(2)
12.	COMP 4510	Senior Project II	(1)
13.	COMP 4700	Algorithms	(3)

Computer Science Electives (12):

1. COMP 3110 or 3120 or 3130 or 3140 or 3150 or 3160 (not more than two of those courses are allowed).
2. COMP 1210 and COMP 3000 may not be chosen as Computer Science elective course.

Technical Electives (9):

Technical Electives may be chosen from Computer Science, Engineering, Mathematics, Natural Sciences, and Business Information Systems.

1. They can be chosen at any level from Computer Science or Business Information Systems.
2. They can be also chosen at any level courses from the departments other than Computer Science in the College of Engineering.
3. They can be any level Natural Science courses.
4. They can be any level Math courses at the 2000 level or above. Math 1115 may also be accepted.
5. Astronomy – any level.
6. Any other courses need to be approved by the Departmental Curriculum Committee.

a. Students may not count both BISI 2150 and COMP 1210.

Important Rules for Elective Courses: All of the elective courses must be chosen in such a way that the total credits at the 3000-4000 levels must be at least 42 credits.

Suggested Four Year Plan
Bachelor of Science in Computer Science

FRESHMAN YEAR

FALL SEMESTER	HR.	SPRING SEMESTER	HR.
ENGL 1010	3	ENGL 1020	3
MATH 1910	4	MATH 1920	4
Humanities/Fine Arts (1)	3	Social/Behav. Sci.(2)	3
COMP1500	1	COMP 2240	4
COMP 2140	4		
UNIV 1000	1		
	16		14

SOPHOMORE YEAR

FALL SEMESTER	HR.	SPRING SEMESTER	HR.
Humanities/Fine Arts (1)	3	COMP 3040	3
COMM 2200	3	COMP 3010	4
Natural Science (3)	4	Natural Science (3)	4
COMP 2400	3	History (4)	3
COMP 3190	2	Social/Behav. Sci.(2)	3
	15		17

JUNIOR YEAR

FALL SEMESTER	HR.	SPRING SEMESTER	HR.
COMP Sci. Elective (5)	3	COMP 3300	3
COMP 3050	3	COMP 3310	3
Natural Science (2)	4	COMP 3560	3
Humanities/Fine Arts (1)	3	MATH Elective (6)	3
History (4)	3	Technical Elective (7)	3
	16		15

SENIOR YEAR

FALL SEMESTER	HR.	SPRING SEMESTER	HR.
COMP 4100	3	COMP 4510	1
COMP 4500	2	COMP Sci. Elective (5)	3
COMP 4700	3	COMP Sci. Elective (5)	3
COMP Sci. Elective (5)	3	Technical Elective (7)	3
Technical Elective (7)	3	MATH 2050 or MATH 3100 or STAT 3110	3
	14		13

Suggested Four Year Plan
Bachelor of Science in Computer Science
with Concentration in Bioinformatics

FRESHMAN YEAR

FALL SEMESTER	HR.	SPRING SEMESTER	HR.
ENGL 1010	3	ENGL 1020	3
MATH 1910	4	MATH 1920	4
Humanities/Fine Arts (1)	3	Social/Behav. Sci.(2)	3
COMP1500	1	COMP 2240	4
COMP 2140	4	Humanities/Fine Arts (1)	3
UNIV 1000	1		
	16		17

SOPHOMORE YEAR

FALL SEMESTER	HR.	SPRING SEMESTER	HR.
Humanities/Fine Arts (1)	3	COMP 3040	3
COMM 2200	3	COMP 3010	4
BIOL 1110/1111	4	Natural Science (3)	4
COMP 2400	3	History (4)	3
COMP 3190	2	Social/Behav. Sci.(2)	3
	15		17

JUNIOR YEAR

FALL SEMESTER	HR.	SPRING SEMESTER	HR.
COMP 3112/3113	4	COMP 3300	3
COMP 3050	3	COMP 3310	3

BIOL 4110/4111	4	COMP 3560	3
Humanities/Fine Arts (1)	3	COMP Sci. Elective (5)	3
		COMP 3710	3
	14		15

SENIOR YEAR

FALL SEMESTER	HR.	SPRING SEMESTER	HR.
COMP 4100	3	COMP 4510 (8)	1
COMP 4500 (8)	2	Technical Elective (7)	3
COMP 4700	3	Technical Elective (7)	3
COMP 4820	3	Technical Elective (7)	3
MATH Elective (6)	3	MATH 2050 or MATH 3100 or STAT 3110	3
	14		13

Suggested Four Year Plan
Bachelor of Science in Computer Science
with Concentration in Cybersecurity and Networking

FRESHMAN YEAR

FALL SEMESTER	HR.	SPRING SEMESTER	HR.
ENGL 1010	3	ENGL 1020	3
MATH 1910	4	MATH 1920	4
Humanities/Fine Arts (1)	3	Social/Behav. Sci.(2)	3
COMP1500	1	COMP 2240	4
COMP 2140	4		
UNIV 1000	1		
	16		14

SOPHOMORE YEAR

FALL SEMESTER	HR.	SPRING SEMESTER	HR.
Humanities/Fine Arts (1)	3	COMP 3190	2
COMM 2200	3	COMP 3010	4
Natural Science (3)	4	Natural Science (3)	4
COMP 2400	3	History (4)	3
COMP 3040	3	Social/Behav. Sci.(2)	3
	16		16

JUNIOR YEAR

FALL SEMESTER	HR.	SPRING SEMESTER	HR.
COMP Sci. Elective (5)	3	COMP 3300	3
COMP 3050	3	COMP 3560	3
Natural Science (3)	4	COMP 4720	3
History (4)	3	COMP 4750	3
COMP 3310	3	MATH 2050 or MATH 3100 or STAT 3110	3
	16		15

SENIOR YEAR

FALL SEMESTER	HR.	SPRING SEMESTER	HR.
COMP 4100	3	COMP 4510 (9)	1
COMP 4500 (9)	2	COMP 4760	3
COMP 4700	3	Humanities/Fine Arts (1)	3
COMP 4770 or 4780	3	Technical Elective (7)	3
Technical Elective (7)	3	MATH Elective (6)	3
	14		13

Suggested Four Year Plan
Bachelor of Science in Computer Science
with Concentration in Data Science

FRESHMAN YEAR

FALL SEMESTER	HR.	SPRING SEMESTER	HR.
ENGL 1010	3	ENGL 1020	3
MATH 1910	4	MATH 1920	4
Humanities/Fine Arts (1)	3	Social/Behav. Sci.(2)	3
COMP1500	1	COMP 2240	4
COMP 2140	4		
UNIV 1000	1		
	16		14

SOPHOMORE YEAR

FALL SEMESTER	HR.	SPRING SEMESTER	HR.
Humanities/Fine Arts (1)	3	COMP 3190	2
COMM 2200	3	COMP 3010	4
Natural Science (3)	4	COMP 3710	3
COMP 2400	3	Natural Science (3)	4
COMP 3040	3	Social/Behav. Sci.(2)	3
	16		16

JUNIOR YEAR

FALL SEMESTER	HR.	SPRING SEMESTER	HR.
COMP 3140	3	COMP 3300	3
COMP 3050	3	COMP 3310	3
Natural Science (3)	4	COMP 3560	3
History (4)	3	COMP 4750	3
MATH 2050 or MATH 3100 or STAT 3110	3	History (4)	3
	16		15

SENIOR YEAR

FALL SEMESTER	HR.	SPRING SEMESTER	HR.
COMP 4100	3	COMP 4510 (10)	1
COMP 4500 (10)	2	COMP 4840	3
COMP 4700	3	COMP 4850	3
COMP 3800	3	Technical Elective (7)	3
COMP 4830	3	Humanities/Fine Arts (1)	3
	14		13

Notes:

(1) Humanities/Fine Arts Electives must be chosen from the General Education list of Humanities and Fine Arts courses approved by the University. One Humanities/ Fine Arts Elective must be chosen from ENGL 2120, 2310, 2012, 2013, 2210, 2320, 2022, or 2023.
(2) Social and Behavioral Sciences Electives must be chosen from the General Education list of Social and Behavioral Science course approved by the University.
(3) Natural Sciences must be chosen from: PHYS 2110 & 2111 (or PHYS 2010 & 2011), PHYS 2120 & 2121 (or PHYS 2020 & 2021), CHEM 1110 & 1111, CHEM 1120 & 1121, or BIOL 1120 & 1121.
(4) History must be from the General Education list of History courses approved by the University. They are currently HIST 2010, HIST 2020, HIST 2030, HIST 2050, HIST 2060, and HIST 2700.
(5) At least one of COMP 3110 or 3120 or 3130 or 3140 or 3150 or 3160 must be taken (not more than two of those courses are allowed). COMP 1210 and COMP 3000 may not be chosen as a Computer Science Elective course.
(6) MATH Elective must be 2000 or higher level with approval of academic advisor. MATH 2500, 3130, 4500, 4724, 4750, 4900 are not accepted.
(7) Technical Electives may be chosen from Computer Science, Engineering, Mathematics, Natural Sciences, and Business Information Systems.
    a. They can be chosen at any level from Computer Science or Business Information Systems.
    b. They can be also chosen at any level courses from the departments other than Computer Science in the College of Engineering.
    c. They can be any level Natural Science courses.
    d. They can be any level Math courses at the 2000 level or above. Math 1115 may also be accepted.
    e. Any other courses need to be approved by the Departmental Curriculum Committee.
(8) Students may not count both BISI 2150 and COMP 1210.Students in Bioinformatics Concentration are required to complete a Bioinformatics related research project for COMP 4500 Senior Project I and COMP 4510 Senior Project II courses.
(9) Students in Cybersecurity and Networking Concentration are required to complete a Cybersecurity or Networking related research project for COMP 4500 Senior Project I and COMP 4510 Senior Project II courses.
(10) Students in Data Science Concentration are required to complete a Data Science related research project for COMP 4500 Senior Project I and COMP 4510 Senior Project II courses.

Important: All of the elective courses must be chosen in such a way that the total credits at the 3000-4000 level must be at least 42 credits.

Course Descriptions

COMP 1210 Introduction to Computing (3). This course is for non-CS majors. The purpose is to introduce students to computer hardware and use. Topics covered include: Computer hardware, operating systems and some of the commonly used application software such as a word Processor, an Internet browser, an email manager, a presentation manager and a spreadsheet processor. Course includes hands-on work with computers. Not open to CS majors.

COMP 1500 Introduction to Computer Science (1). The purpose is to introduce students to essentials of computer hardware and software, concept of operating systems and problem modeling and solving. Topics to be offered are number representations, computer memory and data storage methods, basic digital logic, problem modeling and solving, introduction to algorithm development, basic programming skills, basics of computer operating systems, and current issues relating computing to society presented.

COMP 2140 Computer Programming I (4). This course is designed to introduce programming fundamentals. Students will learn to write programs involving variable storage, formatted input/output, control structures, program repetition, logical operations, functions, file interaction, elementary data types including array and string, and aggregated data types defined by struct. Students are required to use computer labs.

COMP 2240 Computer Programming II (4). This course will continue to develop programming skills and focus on Object Oriented design. Topics include constructors, destructors, operator overloading, inheritance and polymorphism, exception handling, and multi-dimensional arrays of aggregated data. Students are required to use computer lab. Prerequisite: COMP 2140 or equivalent.

COMP 2400 Computer Organization (3). This course introduces the structures and working principles of the different hardware units of a computer. Computer systems organization, the digital logic level (gates and circuits, memory), micro-architecture level (data path, microinstructions), instruction set architecture level (instruction format, addressing), basics of assembly language, and parallel computer architectures are discussed. Prerequisites: COMP 1500 or one semester of programming.

COMP 2600 Assembly Language (3). This course introduces low level programming through an assembly programming language. Topics include: quick review of main memory and CPU, use of memory, data types, data processing, addressing, compilation and linking processes. Prerequisite: COMP 2400.

COMP 2630 Selected Programming Languages (3). his course provides a broad introduction to a selected programming language. The focus is on emerging and state-of-the-art languages. The language selected may vary per offering. Prerequisite: None.

COMP 3000 Computer Programming for non-CS majors (3). This course is a computer programming for non-CS majors. Topics covered include: Introduction to computer hardware, problem solving and algorithm development, and implementation of-algorithms using an object-oriented programming language. Schedule will include two (2) lecture hours and one (1) lab hour.

COMP 3030 Windows Programming (3). This course introduces basics of windows programming, web programming and data driven programming using an event driven paradigm. Topics discussed include: language facilities for event driven programming, .NET frame class hierarchy, delegate, events and event handling, graphic user interface, graphics device context, I/O with files and database and web applications. Prerequisite: COMP 2240 or equivalent.

COMP 3040 Data Structures (3). This course introduces elementary and abstract data structures. Topics discussed are: array and linked list, hash table, binary search tree, heap, stack, FIFO queue, dynamic dictionary, priority queues, graph, and some sorting and searching algorithms and their implementations. Prerequisite: COMP 2240.

COMP 3050 Programming Languages (3). This course exposes students to various programming languages, their structures and characteristics. The course provides an overview of key concepts used in developing modern programming languages. Programming language principles and paradigms will be introduced by highlighting several programming languages (such as Lisp/Prolog, Python, and Java) so that students will be able to choose an appropriate programming language to solve a particular problem. The course will increase the capacity to use existing languages and learn new languages. Prerequisite: COMP 2240 or equivalent.

COMP 3110 Java Programming (3). Object-oriented programming concepts including classes, interfaces, inheritance, and polymorphism are emphasized using Java programming language. An overview of more advanced programming concepts including database connectivity, multi-threading, and networking is given. Students are expected to work in teams to design and implement a software system as a semester project. Prerequisite: COMP 2140 or equivalent or approval of the instructor.

COMP 3112/3113 Introduction to Bioinformatics (4). Bioinformatics is an interdisciplinary field in which biology and computer science merge. This course is designed to introduce students with basic concepts, methods and tools to analyze biological problems, prepare students with skills necessary to communicate across the fields of computer science and biology. Topics include (but not limited to) biological sequence and literature databases, strategies to search these databases to solve significant biological problems, principle and algorithms used in analysis of sequence problems. Prerequisite: BIOL 1110/1111 and COMP 2140.

COMP 3120 C++ Programming (3). This course will provide a broad introduction to C++ programming language and focus on object-oriented design. It will start the syntax of C++ for elementary language structures and data types such as operators, conditions, loops, strings and array. The main topics include pointers, destructors, operator over-loading, inheritance and polymorphism, exception handling, multi-dimensional arrays and dynamic memory allocation. Students are required to use computer lab. Prerequisite: COMP 2140 or equivalent.

COMP 3130 C Programming (3). This course provides a broad introduction to the C programming language. The course aims to teach the syntax and use of major constructs of the C language and will focus on problem solving and algorithm implementation using a universal subset of the C programming language. Some of these constructs include: conditional statements, loops, functions, operators, unions, arrays, pointers, strings, structures, and file I/O, problem-solving and algorithm design. Students are expected to learn how to program through hands-on exercises and project. Prerequisite: Comp 2140 or Equivalent.

COMP 3140 Python Programming (3). This course will introduce the fundamental techniques of programming using Python. Topics covered include the basics and syntax of the language, introduction to object-oriented programming, and data and information processing. The course aims at expose the students to algorithmic and procedural problem-solving using Python. This course is intended for persons with a prior background in any programming language. Prerequisite: COMP 2140 or equivalent.

COMP 3150 COBOL Programming (3). This course provides a broad introduction to the programming concepts and to the widely used business language, Common Business-Oriented Language (COBOL). The course aims to teach the syntax and use of major constructs of the COBOL language and will focus on problem solving and algorithm implementation using a universal subset of the COBOL Programming Language. Prerequisite: Comp 2140 or equivalent.

COMP 3160 C# Programming (3). This course will continue to develop programming skills and focus on object-oriented design using C# programming language. Topics include constructors, destructors, operator overloading, inheritance, polymorphism, exception handling, multi-dimensional arrays, pointers and dynamic memory allocation. Students will learn C# syntax and its features through those topics. Prerequisite: Comp 2140 or equivalent.

COMP 3170 Applied Operating Systems (1-3). This course is designed for presenting advanced features of some commonly used operating systems and their uses. It can be taken more than one time, provided each time a different operating system is taught. Examples of operating systems to be offered are Mac OS, LINUX, and Solaris. Prerequisite: COMP 2400.

COMP 3185/86/87/88 Cooperative Education (3). This course is to provide students with the opportunity applying the knowledge, skills and abilities gained in classrooms and labs in Computer Science into real-world work. Students undertake learning projects in governmental, business, industry, or university settings. Formal proposals, project objectives, and learning plans must be reviewed and approved by faculty advisor. Student activities and progress are monitored, evaluated and graded by an assigned faculty. Prerequisite: Approved by the Department Chair.

COMP 3190 Ethics and Professionalism in Computing (2). This course presents the important topics of communications and ethics for computer professionals. Topics discussed include: Introduction and definitions, ethics for computing professionals and computer users, computer and Internet crime~~,~~ privacy, freedom of expression, intellectual property, security, and the Software Engineering Code of Ethics and Professional Practice.

COMP 3010 Discrete Mathematics (4). This course presents discrete mathematical structures needed for computer science. Topics include: logic and methods of proof, structures of sets and functions, fundamentals of algorithms, relations, permutations and combinations, discrete probability, graphs and trees and their applications, introduction to mathematical structures such as modular arithmetic, groups, ring, and field. Prerequisite: Math 1910 or COMP 2140 or equivalent.

COMP 3230 Information Systems Analysis (3). This course provides a comprehensive discussion of analysis and design of information systems. It discusses information systems from multiple perspectives including system specifications, logical and physical design, database selection, integration, performance, prototyping, and deployment. Prerequisite: COMP 2240.

COMP 3300 Software Engineering (3). A practical understanding of all phases of software development including system design and analysis is provided. The software life cycle including software specification, design, implementation, verification, and evolution is investigated in detail. Students are expected to work in teams to design, analyze, and partially implement a large-scale software system as semester project. Prerequisite: COMP 2240 or equivalent.

COMP 3310 Data Communications and Computer Networks (3). This course presents basic concepts of data communications and computer networks. Topics include: Definitions, signals, encoding and modulation, analog and digital data transmission and transmission media, error detection and control, types of networks, structure of an open network model, data link and data link protocols, Internet protocol, routing and routing algorithms, and security issues. Prerequisite: COMP 2400.

COMP 3410 Advanced Computer Organization (3). This course focuses on advanced computer organization and architecture. Topics include RISC and CISC architectures, 1-bus and multi-bus processor design, pipelining, microprogramming, memory system, and performance measures. Students will work in teams on design projects. Prerequisite: COMP 2400.

COMP 3500 Digital Logic Design (3). A comprehensive introduction to the digital logic design theory, techniques, simulations, and practical applications. The course covers combinational and sequential logic networks, network reduction, adders, multipliers, decoders, multiplexers, shifters, counters, latches and flip-flops, finite-state machines, and arithmetic logic units. Students are expected to work in laboratory in teams to design and implement some logic networks. Prerequisite: COMP 2400 or equivalent.

COMP 3560 Introduction to Theory of Computing (3). This course presents various models of computation and the relationships between these models and corresponding languages. Topics include: finite automata and regular languages, pushdown automata and context-free languages, Turing machines, complexity and limits of algorithmic computation, new computation paradigms. These topics are used as a basis for exploring computability, complexity, and more advanced areas of theory. Prerequisite: COMP 3010.

COMP 3650 Microprocessors (3). This course presents the architecture and instruction sets of different microprocessors and microcontrollers, and the application system design based on these processors. The contents contain the architecture and memory interfacing, interfacing I/O devices, instruction sets, addressing modes, assembly language programming, interrupts, timing diagram, microprocessor application, for microprocessors, microcontrollers, and general-purpose processors. Prerequisites: COMP 2400.

COMP 3710 Relational Databases (3). This course presents the principles of relational databases and relational database management systems. Topics include definitions of database systems, relations and their operations, design of and implementation of a relational database, creating queries and the SQL (structured Query Language). Prerequisite: COMP 2240.

COMP 3800 Mathematics for Data Science (3). This course introduces fundamentals of different mathematical theories and models required for understanding Data Science related algorithms and applications. The course includes selected topics from statistics, hypothesis tests, probability distributions, Bayes' theorem, linear algebra, matrix decomposition, graphs and trees. The course will briefly relate mathematical theories and models to Data Science applications to provide necessary foundation and preparation for higher level courses on Data Science and Machine Learning. Pre-requisites: MATH 2050 or MATH 3100 or STAT 3110 or MATH 3610 or MATH 2010.

COMP 3900 Numerical Analysis (3). This course is for programming some scientific problems including solutions of non-linear equation and simultaneous linear equations, matrix related computations, numerical differentiation and integration, interpolation and approximation. Prerequisites: MATH 3610 or equivalent.

COMP 4100 Operating Systems (3). This course presents both theory and practical lab exercises of operating systems. The course will start with a brief historical perspective of the evolution of operating systems over last five decades and then cove the major components of the most operating systems. Particular emphasis will be given to five core components of OS: process management, memory management, inter-process communication, file systems, and I/O manager. The lab exercises are based on Linux and Mac OS. Prerequisites: COMP 2400.

COMP 4200 Compiler Construction (3). This course is for teaching fundamentals of developing compilers for programming languages. Topics include: lexical analysis, parsing, semantic analysis and code generation. Prerequisites: COMP 3560.

COMP 4280 Web-based Application Development (3). This course is an introduction to current Web technologies. Contents include basic XHTML, CSSs, Client-Side programming, and advanced ASP.NET, Students are required to implement several Web-based projects. It also provides a practical training to senior undergraduate to enhance their programming skills and information processing skills. Prerequisite: COMP 2240.

COMP 4400 Artificial Intelligence (3). This course is a study to the design of computer systems that exhibit traits normally associated with intelligence in human behavior, such as the ability to understand natural language, to reason about the visual environment, and to solve complex problems. Topics includes knowledge representation formalisms and search techniques, natural language processing, logic and theorem proving, expert systems, planning, vision, machine learning, neural networks, and genetic algorithms. Prerequisite: COMP 3040.

COMP 4440 Mobile Robotics (3). This course provides students with hands-on experience in mobile robot design, implementation, and testing. It covers mobile robot topics such as robot hardware, robot sensing, actuation, embedded system programming, and algorithms for localization, path planning, and mapping. It briefly covers multi-robot systems. Students are expected to work in laboratory in teams to build and test increasingly complex LEGO-based mobile robots and compete in an end-of-semester robot contest. Prerequisite: COMP 2140 or equivalent.

COMP 4450 Computer Network Architecture (3). This course presents basic concepts of computer network architectures and devices. Topics include: Network layers and services types, circuit switching, bridges, routers, control signaling, traffic control, architectures of LANs, MANs, WANs, digital network and wireless and mobile networks. Prerequisite: COMP 3310.

COMP 4500 Senior Project I (2). An opportunity for students to integrate the theory, knowledge, design and analysis ability, and programming skills gained in previous computer science work into a team-based project carried out under the supervision of a member of the Computer Science faculty. Senior project I leads to the completion of the project in COMP-4510. Students are required to develop a written technical partial report as well as an oral status report. Prerequisite: Graduating Senior.

COMP 4510 Senior Project II (1). Continuation of senior project I leading to completion of the project. Students are required to develop a written technical report and have an oral defense of the project. Prerequisite: COMP 4500.

COMP 4550 Computer Network Protocols (3). This course presents concepts of computer network protocols. Topics include: Basic flow control, MAC, routing protocols, transport, contention, redundancy checks, encryption and decryption, Ethernet and Internet protocols, protocols of wireless and mobile networks. Prerequisites: COMP 4450

COMP 4600 Game Programming (3). This course introduces the basic concepts of computer gaming and problem-solving in the context of computer games. The students implement their game projects on various environments such as Windows PC and the state-of-the-art mobile devices. Prerequisite: COMP 2240.

COMP 4610 Object Oriented and Hybrid Database Systems (3). This course presents Object Oriented and hybrid database concepts. Topics include: definitions of objects and attributes, methods and messages, classes, object-oriented data models, architectural issues, the object-oriented database system manifesto, object-oriented database design, object-oriented database management systems, and object/relational database management systems. Prerequisite: COMP 3710.

COMP 4700 Algorithms (3). This course is to teach the principles of design, analysis, and implementation of algorithms. Topics include: algorithm complexity, mathematical tool for analyzing algorithm complexity, algorithm design techniques such as divide-and-conquer, dynamic programming, and heuristics, fundamental algorithms such as sorting, searching, and pattern matching, and ~~some~~ selected advanced data structures and algorithms. Prerequisites: COMP 3040 and COMP 3010.

COMP 4720 Cryptography and Computer Security (3). This course introduces modern cryptography and its applications in computer and network security. Topics includes mathematics in cryptography, attack and threaten models and security goals, traditional cryptography, modern cryptography, design of private and public key encryption schemes, digital signatures, authentication and key management, and selected applications. Prerequisite: COMP 3010 or equivalent.

COMP 4750 Computer Network Management (3). This course presents basic concepts of computer network management and tools. Topics include: Network interfacing, measuring failures and availability, reliability, security, maintenance, network statistics, reconfiguration and documentation. Prerequisites: COMP 3310.

COMP 4760 Distributed Algorithm Design (3). The course introduces the computing models and algorithms of distribution systems. The course also exposes students to an array of big data analysis theories, techniques and practices in different fields of study using distributed models. The topics include distributed computing models, massage-passing and shared memory systems, design and analysis of synchronous and asynchronous algorithms, fault tolerance, and data distribution, collection, processing and analysis in distributed systems. This is a project-based course that provides students with hands-on experience on distributed computing with different data types. Prerequisites: COMP 3040.

COMP 4770 Network Programming and Information Assurance (3). This course provides students fundamentals of network programming and network computing. The course reviews connection and connection-less network protocols, Winsock socket programming, network protocols, multi client-server system, peer-to-peer models, networked computer communication, coordination and information assurance through message passing and basics of cluster computing. Prerequisite: COMP 3310 or equivalent.

COMP 4780 Operating System Security (3). This course covers both the fundamentals and advanced topics in operating system (OS) security. Access control mechanisms, memory protections, and inter-process communications mechanisms will be studied. Students will learn the current state-of-the-art OS-level mechanisms and policies designed to help protect systems against sophisticated attacks.

COMP 4800 Computer Graphics (3). This course presents basics, including some mathematics required in developing graphics software. Topics include: Introduction, passive and interactive computer graphics, hardware, user languages and output devices, transformations, algorithms, object modeling, storage and manipulations and image processing. Prerequisite: COMP 2240.

COMP 4820 Introduction to Bioinformatics Computing (3). This course presents fundamental theory and practical skills for biological information processing. Topics include bioinformatics-oriented programming, data base, data structures, algorithms, visualization tools, hands-on training. Prerequisite: COMP 3112/3113 or BIOL 4112/4113.

COMP 4830 Introduction to Data Science (3). This course is an introduction to data science and the analysis of large data sets in order to draw insights and to extract information. The course covers using Python libraries for reading large data sets including Numpy and Pandas, reading input from standardized formats, calculating statistical measures from large data sets, linear regression, logistic regression, unsupervised learning including k-means clustering, and time series analysis with relational and non-relational databases. Prerequisites: COMP 3140.

COMP 4840 Machine Learning (3). This course provides an introduction to machine learning with the opportunity to develop and implement data-driven solutions and predictive models for different applications. Topics broadly include: (i) supervised learning, (ii) unsupervised learning, (iii) dimensionality reduction and feature selection techniques, and (iv) best practices and model evaluation methods in machine learning. The course will also draw examples from numerous case studies and applications. Prerequisites: COMP 3800 and COMP 4830.

COMP 4850 Data Visualization (3). This course is an introduction to data visualization and the graphical representation of data. The growing data deluge from multiple sources require skills in representing data, in order to extract meaning and actionable intelligence from these data sets. Students learn how to communicate the relationship between data through systematic mapping between graphical representations and the underlying data values. The class teaches how representations of data can give insight and make data analysis easier. Pre-requisite: COMP 4830.

COMP 4910 Special Topics (3). This course is for teaching important emerging computer science topics that are not covered in other CS courses. Prerequisites: junior or senior status and successful completion of at least 18 hours of CS courses.