Computing and Information Science

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Computing and Information Science is concerned with all aspects of computers and computation. The Computing and Information Science Department offers introductory and advanced courses using a Linux server, a Windows server, and networked personal computers. These courses cover computer science and information technology, common applications of computing, and the utilization of computers in society.

The Department offers a major in Computing and Information Science (CIS) with concentrations in Information Technology (IT), Computer Science (CS), Security (SEC), and Bioinformatics (BIN). The curriculum is based on the guidelines of several professional societies. Internships are strongly encouraged, and students have the opportunity to do "real world" projects in collaboration with various businesses.

A major in CIS is awarded a Bachelor of Science degree. The CIS major is designed to prepare the student for employment (as a software developer, programmer/analyst, IT professional, etc.) or to prepare the student for graduate school.

Computing and Information Science Learning Objectives:

• The most important goal is that the CIS graduate should demonstrate the ability to manage the complexity of a technical problem through the use of good problem solving and software engineering skills, as well as ethical and decision-making skills. This relates to severe Core Goals, especially forming habits of ordered inquiry, logical thinking and analysis. Also related are the Core Goals on communication skills, writing and mathematics. Finally, the Strategic Plan Goal on interdisciplinary teaching and learning is promoted due to the use by certain CS courses of aspects of the Interdisciplinary Writing Program.

• A secondary goal is that the the CIS graduate should be competent in at least three programming languages. This relates most directly to the Core Goals on logical thinking and mathematics.

• Another secondary goal is that the CIS graduate should have a broad knowledge of the field of computing.

The primary learning goals for the CIS major are as follows: By the end of the sophomore year, CIS majors typically have successfully completed coursework in computer architecture, are proficient in at least two programming languages, and are ready for internship positions. Internships done for credit are encouraged and the internships are reviewed each year for the quality of work provided and for the opportunity to acquire problem solving skills. By the end of the senior year, CIS majors have completed a broad range of CIS coursework, including database management, data structures, operating systems, programming languages, systems analysis and design or software engineering, and will have completed their senior capstone project. The capstone project demonstrates the students' ability to solve problems independently and to learn new technologies and skills on their own. Coursework in students' area of concentration, such as networking, security, web technologies, etc. round out the program.

A non-degree certificate program is offered. It is intended for people who wish to study computing, but not to the extent of a complete CIS major. It is especially helpful for someone who already has a degree in a different field.

The typical first course for a non-major interested in programming would be CS 110 (or CS 270 for a mathematics-oriented student with a calculus background), while a typical first course for a non-major interested in the use of computers would be CS 101 or CS 103.

Students interested in a career in webpage development may choose either the CS or IT concentration. Furthermore, they should choose CS 205 and CS 305 as two of their CIS electives and are strongly encouraged to also take the Communication department's webpage courses. Non-majors who would like a career in webpage development are urged to take the same webpage courses in the Communication department and at least CS 110, CS 205, and CS 305 in the CIS department.

Computer Science Concentration (CS)

Requirements for a Bachelor of Science Degree in Computing and Information Science
(See Core Curriculum requirements.)

A minor in another field is recommended. A statistics course is also recommended, especially for those considering graduate school. Logic is recommended as one of the courses chosen for the philosophy core requirement.

Major Requirements (49 credits):
The student must complete the requirements listed in the following three categories:

1) CIS Core Courses (33 credits):

CS 110	Computing and Information Science I	3
CS 111	Computing and Information Science II	3
CS 170	Discrete Structures I	3
CS 171	Discrete Structures II	3
CS 221	Data Structures	3
CS 230	Computer Architecture and Assembly Language	3
CS 310	Programming Languages	3
CS 330	Computer Architecture and Operating Systems	3
CS 350	Database Concepts and Information Structures	3
CS 355	Software Engineering	3
CS 357	Computing Science Project I	1
CS 358	Computing Science Project II (in a computer science area)	2

2) CIS Electives (12 credits):
Any CIS department courses numbered 200 or above may be included. One approved computer course from another department may be included, subject to the approval of the CIS department chairperson.

3) CIS Mathematics Requirement (4 credits):

MA 111, 112	Calculus I and II	4
or		
MA 109, 110	Calculus I and II	4

Either choice gives an 8-credit sequence, 4 credits of which can be used to fulfill the Core Curriculum mathematics requirement.

Electives (15 credits)

Information Technology Concentration (IT)

Requirements for a Bachelor of Science Degree in Computing and Information Science
(See Core Curriculum requirements.)

A minor in another field is recommended. A statistics course is also recommended, especially for those considering graduate school. Logic is recommended as one of the courses chosen for the philosophy core requirement.

Major Requirements (49 credits):
The student must complete the requirements listed in the following four categories:

1) CIS Core Courses (33 credits):

CS 110	Computing and Information Science I	3
CS 111	Computing and Information Science II	3
CS 170	Discrete Structures I	3
CS 221	Data Structures	3
CS 230	Computer Architecture and Assembly Language	3
CS 310	Programming Languages	3
CS 330	Computer Architecture and Operating Systems	3
CS 350	Database Concepts and Information Structures	3
CS 351	Information Systems Analysis and Design	3
CS 357	Computing Science Project I	1
CS 358	Computing Science Project II (in an information technology area)	2
CS 465	Information Systems Management	3

2) CIS Electives (12 credits):
Any CIS department courses numbered 200 or above may be included. One approved computer course from another department may be included, subject to the approval of the CIS department chairperson.

3) CIS Mathematics Requirement (4 credits):

MA 111, 112	Calculus I and II	4
or		
MA 109, 110	Calculus I and II	4

Either choice gives an 8-credit sequence, 4 credits of which can be used to fulfill the Core Curriculum mathematics requirement.

4) Required Social Science Courses (0 credits):
This concentration also requires 6 credits chosen from business and/or economics. These credits can be included under the Core Curriculum social science requirement.

Electives (15 credits)

Security Concentration (SEC)

Requirements for a Bachelor of Science Degree in Computing and Information Science
(See Core Curriculum requirements.)

A minor in another field is recommended. A statistics course is also recommended, especially for those considering graduate school. Logic is recommended as one of the courses chosen for the philosophy core requirement.

Major Requirements (49 credits):
The student must complete the requirements listed in the following three categories:

1) CIS Core Courses (33 credits):

CS 110	Computing and Information Science I	3
CS 111	Computing and Information Science II	3
CS 170	Discrete Structures I	3
CS 221	Data Structures	3
CS 310	Programming Languages	3
CS 321	Data Communications and Networking Security	3
CS 330	Computer Architecture and Operating Systems	3
CS 350	Database Concepts and Information Structures	3
CS 351	Information Systems Analysis and Design	3
or		
CS 355	Software Engineering	3
CS 357	Computing Science Project I	1
CS 358	Computing Science Project II (in a computer security area)	2
CS 465	Information Systems Management	3

2) CIS Electives (12 credits):

CS 225	Computer Security	3
CS 325	Advanced Topics in Security	3

Any CIS department courses numbered 200 or above may be included so as to give a total of 12 credits. One approved computer course from another department may be included, subject to the approval of the CIS department chairperson.

3) CIS Mathematics Requirement (4 credits):

MA 111, 112	Calculus I and II	4
or		
MA 109, 110	Calculus I and II	4

Either choice gives an eight-credit sequence, four (4) credits of which can be used to fulfill the Core Curriculum mathematics requirement.

Electives (15 credits)

Bioinformatics Concentration (BIN)

Requirements for a Bachelor of Science Degree in Computing and Information Science
(See Core Curriculum requirements.)

A minor in another field is recommended. BL 260 (Biostatistics) is recommended. Logic is recommended as one of the courses chosen for the philosophy Core requirement.

Major Requirements (49 credits):
The student must complete the requirements listed in the following four categories:

1) CIS Core Courses (33 credits):

CS 110	Computing and Information Science I	3
CS 111	Computing and Information Science II	3
CS 170	Discrete Structures I	3
CS 205	Web Site Design and Programming	3
or		
CS 305	Web Technologies	3
CS 221	Data Structures	3
CS 230	Computer Architecture and Assembly Language	3
CS 310	Programming Languages	3
CS 330	Computer Architecture and Operating Systems	3
CS 350	Database Concepts and Information Structures	3
CS 355	Software Engineering	3
BIN 358	Bioinformatics Project I	1
BIN 359	Bioinformatics Project II	2

2) CIS Electives (12 credits):

BIN 218	Bioinformatics, Genomics, and Proteomics	3
BIN 219	Biomedical Informatics	3

Any CIS department courses numbered 200 or above may be included so as to give a total of 12 credits.

3) CIS Mathematics Requirement (4 credits):

MA 111, 112	Calculus I and II	4

This is an 8-credit sequence, 4 credits of which can be used to fulfill the Core Curriculum mathematics requirement.

4) Required Natural Science Courses (0 credits):

BIN 110, 111	Genes, Cells, and Computers	0
A Tier 2 lecture and lab course from Biology		0

This concentration also requires the above eight (8) credits of lecture and lab courses from Bioinformatics and Biology. These credits can be used to fulfill the Core Curriculum natural science requirement and so add no additional credits here.

Electives (15 credits)

Typical First-Year Schedule:
(Actual schedules may vary based on students' needs, etc.)

	Fall	Spring
CS 110 Computing and Information Science I	3	
CS 111 Computing and Information Science II		3
Calculus I, II	4	4
EL 102 Language and Rhetoric	3	
TH 119 Exploring Religious Meaning		3
History	3	3
Social Science	3	3
Total	16	16

All students will take one course designated as a First-Year Seminar which will satisfy a Core Curriculum requirement.

Computing and Information Science Minor (18 credits):

CS 110	Computing and Information Science I	3
CS 111	Computing and Information Science II	3

Twelve additional credits in CIS courses, including at least three (3) credits at the 300 level or above. At most six (6) of these 12 credits may be at the 100 level. One approved computer course from another department may be included, subject to the approval of the CIS department chairperson.

The courses for the CIS minor can be chosen so as to specialize in one of the following areas: databases, web technologies, mathematics and computing, computer security, and computer languages. See the CIS faculty for assistance in planning the courses for the minor.

Certificate in Computing and Information Science (30 credits):

Fulfill the requirements for a CIS minor.		18
And complete the following courses:		
EL 102	Language and Rhetoric*	3
MA 104	Elementary Functions*	3
BA 100	Elementary Accounting I*	3
One other social science course		3

(*A higher level course may be substituted.)
Of the 30 credits required for the certificate, at least 15 must be taken at Saint Vincent College, including at least nine (9) credits in CIS courses at Saint Vincent.

Course Descriptions

CS 101 Survey of Computers and Computing
This course presents an overview of current concepts and terminology related to computers and information processing. It is designed for students who have had no previous college-level computing courses. It covers the use of graphical user interfaces, applications software, and telecommunications in a laboratory environment. Not open to CIS majors without departmental approval. Three credits.

CS 103 Animation, the Web, and Security: Three Views of Computing
This is an introductory, non-majors course. Students learn how to create animated objects and worlds using the popular Alice software. An animated ice skater in a virtual world will be used as a key example. Second, students learn different ways of creating web pages. This might lead into further webpage coursework. Finally, computer and Internet security issues are investigated. This includes problems such as identity theft, spyware, and phishing attacks, as well as how to defend against them. Not open to CIS majors without departmental approval. Three credits.

CS 104 Science of Computing (Tier 2)
This course establishes computing as a science and affirms the connection between computing and the sciences. Topics include the scientific method, methodologies used in computer science for evaluating hypotheses, as well as how computing is used as a tool in other fields of science. The course includes a lab component in which students will get hands-on experience investigating computer science problems. Programs will be set up for students to run so they can test different hypotheses. It will be possible to configure the programs with different parameters to see the impact of running over more data sets, running different algorithms, running in different environments, etc. The experiments involve generating and collecting data that can be analyzed to determine whether preliminary hypotheses are true or false. The data, analysis, and conclusions will be written up as lab reports. This is a Tier 2 science course open to students in any major. Any Tier 1 science course serves as the prerequisite. Offered spring semester. Four credits.

CS 110 Computing and Information Science I
An introduction to problem solving and computer programming using the C++ programming language. Topics include algorithms, program structure, input/output, modularity and parameters, control structures, data abstraction, arrays, text files, and structured techniques. Three credits.

CS 111 Computing and Information Science II
A study of advanced programming techniques and applications in C++ continuing from the point where CS 110 ended. Elementary data structures and associated algorithms are examined. Topics covered include arrays, strings, file processing, stacks, queues, linked lists, objects, and recursion. Prerequisite: CS 110. Offered spring semester. Three credits.

CS 170 Discrete Structures I
An introduction to the topics of discrete mathematics which are appropriate to computing. The major purpose is to help the student obtain some fluency in specific areas of mathematics and to encourage the use of the associated techniques within other computing courses. Topics to be covered include logic, sets, functions, simple proof techniques, algorithms, counting techniques, basics of graphs and trees, and simple finite state machines and grammars. Prerequisite: CS 110 or permission of instructor. Offered fall semester alternate years (Fall 2009). Three credits.

CS 171 Discrete Structures II
A continuation of CS 170 with an emphasis on the mathematical and theoretical foundations of computer science. Topics to be covered include proofs of correctness, recurrence relations and generating functions, algorithm analysis, computability theory (using Turing machines), complexity theory, and grammars. Prerequisite: CS 170. Offered spring semester alternate years (Spring 2010). Three credits.

CS 205 Web Site Design and Programming
Topics include basic aspects of good web design, introductions to software packages that facilitate webpage construction and introductions to scripting and programming languages that add functionality. This course is intended for both CIS majors and non-majors. Prerequisite: CS 110. Three credits.

CS 221 Data Structures
The study of data structures and associated algorithms is developed in an object-oriented fashion. This course attempts to show the value of object-oriented design. Various implementations of data structures and the efficiency of the associated algorithms are discussed. Topics to be covered include stacks, queues, keyed tables, recursion, linked lists, binary trees, B-trees and other types of trees, sorting, searching, hash functions, and external sorting. Prerequisite: CS 111. Offered spring semester. Three credits.

CS 225 Computer Security
This course examines both the theory and practice of computer and network security. Topics include cryptography, spyware, viruses, sniffers, rootkits, back doors, network attacks, Trojan horses, intrusion detection, and firewalls. Examples of attacks and how to protect against them will be drawn from both the Windows and Unix/Linux worlds. Hands-on exercises are included. Prerequisite or corequisite: CS 110. Three credits.

CS 230 Computer Architecture and Assembly Language
A study of the fundamentals of machine architecture and assembly language programming is conducted. This course emphasizes the relationships between computer organization (hardware) and programming components (software). Prerequisite: CS 111. Offered fall semester. Three credits.

CS 250 User Interface Design
Good decisions involving the design of a user interface can lead to programs that are easier for end users to execute. Code that is written by programmers who are sensitive to ergonomic issues will execute faster, have fewer errors, require less training time and ultimately give its end user a greater sense of satisfaction. This course will discuss the many issues involving such human-computer interaction. In addition, course participants will program interface applications using VB .NET. Prerequisite: CS 111. Three credits.

CS 251 Introductory Computer Graphics
Computer graphics is the art and science of communicating information using images that are generated and presented through computation. This requires the design and construction of models that represent information in ways that support the creation and viewing of images, the design of devices and techniques through which the person may interact with the model or the view, the creation of techniques for rendering the model, and the design of ways to preserve the images. In this course, both the mathematical foundations and practical implementation of these concepts will be explored with the help of a standard API. Prerequisites: CS 221 and either MA 110 or MA 112. Three credits.

CS 255 Introduction to Artificial Intelligence
This course will present overviews of the roots of artificial intelligence, predicate calculus, the importance of search and search techniques, knowledge representation and knowledge-based problem-solving, the complexity of natural language and machine learning. In addition to other assignments, students will be required to complete projects using PROLOG and LISP, which will be introduced during the course. Prerequisite: CS 111. Three credits.

CS 270 Introduction to Numerical Computation
An introduction to the algorithms of scientific computation and their application to problems in algebra and calculus. Topics covered include number representation, error analysis, programming techniques, function evaluation, solutions of nonlinear equations, solutions of linear systems, numerical integration, and solutions of differential equations. Prior programming experience is not required. Prerequisite: MA 109 or MA 111. Offered spring semester alternate years (Spring 2010). Three credits.

CS 305 Web Technologies
This course focuses on more complex web technologies than are covered in CS 205. The majority of the course involves building an ecommerce site and using webpages as front-ends to server-based databases. Prerequisite: CS 205 or permission of instructor. Three credits.

CS 310 Programming Languages
This course examines the features, implementation, and design of programming languages. Various high-level programming languages representing different programming paradigms will be covered. Java will be used as the primary example of an object-oriented programming language. Programming language translation and runtime features such as storage allocation will be among the topics that are considered. Prerequisite or corequisite: CS 221 or permission of instructor. Offered spring semester alternate years (Spring 2010). Three credits.

CS 321 Data Communications and Networking Security
This course covers the major areas of data communications and networking. It uses the ISO layered approach and focuses especially on the TCP/IP protocols and the Internet. LAN technologies and the configuration of routers and switches are also included. Prerequisite: CS 111. Three credits.

CS 325 Advanced Topics in Security
This course explores advanced topics in security, requiring a basic knowledge of security issues and a programming background. Prerequisites: CS 111 and CS 225. Three credits..

CS 330 Computer Architecture and Operating Systems
Computer architecture and operating systems are covered using the multilevel machine approach, with particular attention paid to the microprogramming level, the conventional machine level, and the operating system level. Linux and/or Windows server operating systems are used as case studies. Prerequisite: CS 111. Offered spring semester alternate years (Spring 2011). Three credits.

CS 350 Database Concepts and Information Structures
This is a first course in modeling complex organizations of data. It includes a review of logical file structures and access methods. Information structures and databases are studied, with detailed work using Access and SQL. Prerequisite: CS 111. Offered fall semester. Three credits.

CS 351 Information Systems Analysis and Design
An investigation of the discipline of systems analysis in relation to the information system life cycle. Structured and object-oriented techniques of analysis and design applicable to current system documentation and the development of general systems solutions are presented. Topics include process and data flows, I/O designs, and systems modeling. Problem solving and communication skills employed in the transition from analysis to design are stressed. Prerequisite: CS 111. Offered fall semester alternate years (Fall 2010). Three credits.

CS 355 Software Engineering
Since good programming involves the systematic mastery of complexity, one can consider programming to be an engineering discipline (if we use the term engineering in a wider sense than used when referring to traditional fields of engineering). This course will develop a methodology for program construction which will allow software of high quality to be constructed, where high quality software is defined as software which is reliable and reasonably easy to understand, modify, and maintain. Prerequisite: CS 111. Offered fall semester alternate years (Fall 2009). Three credits.

CS 357 Computing Science Project I
Using principles and techniques developed in CS 351 or CS 355, a capstone senior project is begun in this course. This includes items such as choosing a project, researching the requirements and technologies needed, and producing a requirements document. A team approach may be used at the discretion of the instructor. Some projects may be projects for real clients. Each project should be done in an area related to one's concentration. Prerequisite or corequisite: CS 351 or CS 355. Offered fall semester. One credit.

CS 358 Computing Science Project II
Using principles and techniques developed in CS 351 or CS 355, the capstone senior project begun in CS 357 is now implemented. A team approach to software development may be used at the discretion of the instructor. Some projects may be projects for real clients. Each project should be done in an area related to one's concentration. Prerequisite: CS 357. Offered spring semester. Two credits.

CS 450 Independent Study in Computing and Information Science
An independent study may be possible by arrangement with an individual faculty member. Course may be repeated with a different topic. Variable credit.

CS 465 Information Systems Management
This course provides an introduction to management information systems, e-commerce, planning, and decision support. It explains how information is used in organizations, the role of information technology professionals, and how information systems are used to an advantage in business settings. Social and ethical issues related to the design, implementation and use of information systems will be addressed. Basic information technology project management skills will be covered as well as the issues and challenges involved in managing an information services department. Offered fall semester alternate years (Fall 2009). Three credits.

CS 550 Cooperative Education—Computing and Information Science Internship
An internship involves practical work experience, typically with a local business. Course may be repeated. Variable credit. May be done for no credit.

Economics

Gary Quinlivan, Dean, McKenna School and Program Chairperson
Andrew R. Herr; Peter M. Hutchinson; Carla Zema

Adjunct Faculty: Matthew Lifson, Joseph Polka

Given a close collaboration with an excellent mathematics department at Saint Vincent College, the McKenna School's Economics Department is nationally ranked and is known for offering one of the best Ph.D. undergraduate preparations in the United States. The curriculum of the Economics Department is designed to provide a comprehensive education in both theoretical and applied economics. The economics program seeks to provide a strong academic foundation for understanding the complexities of economic activity and decision making within both the private and public sectors and for understanding the relationship between the economy and society as a whole. It seeks to enable students to apply rigorous analysis to economic issues and problems through the use of market-oriented theoretical models, quantitative techniques, and economic reasoning.

The study of economics, as part of the liberal arts and sciences approach to learning, helps students understand one of the most fundamental facets of human life in civil society—economic activity—and helps prepare them to effectively address the socioeconomic challenges and opportunities of contemporary public life. In addition to general economic theory and analysis, the special strengths of the Department include finance (public and international), international trade, game theory, econometrics, and experimental economics. In conjunction with the Center for Political and Economic Thought, the Department also seeks to provide exceptional educational experiences in the study of contemporary public policy and major issues in public life. Through these approaches and by working closely with its students, the goal of the Department's economics major is to help students achieve a strong academic background for successful graduate studies or professional employment. The Department of Economics awards both the Bachelor of Arts and Bachelor of Science degrees. The B.S. degree is designed for students intending to pursue graduate studies in economics, finance, or M.B.A programs with more demanding quantitative requirements. The B.A. is designed for students planning for immediate employment in business, government, or the nonprofit sector, as well as preparation for law school or other professional oriented graduate studies. For students interested in gaining a disciplined understanding of economics, courses in the department may be taken to satisfy the social science requirement of the College core.

The major's capstone requirement is a senior thesis that incorporates original research efforts. The thesis is written in conjunction with EC 480 and is taken during the senior or junior year.

Students are encouraged to join the staff of Center for Political and Economic Thought, which sponsors various lecture series, conferences, and publications; the Economics Club; and Mock Trial Team. The Economics Department is the Delta Sigma branch of Omicron Delta Epsilon, which is the national honor society for outstanding economics students.

Economics Learning Objectives:

- Provide a comprehensive education in both theoretical and applied economics;
- Provide a strong academic foundation for understanding the complexities of economic activity and decision making within both private and public sectors and for understanding the relationship between the economy and society as a whole;
- Enable students to apply rigorous analysis to economic issues and problems through the use of market-oriented theoretical models, quantitative techniques and economic reasoning.