Computer Science

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Description of the Major. Computers permeate every aspect of our society, and the science of computing is an exciting and rapidly changing field. Designed to give students the best preparation for careers in computer science, the program at Westmont equips students to learn core ideas and methods, develop communication skills, formulate and solve novel problems, and incorporate skills and knowledge into their vocations as followers of Christ. The major introduces students to computer science and develops the requisite technical skills for work in the field, further study, or research. By focusing on foundational concepts and ideas, students are prepared to grow and adapt as the field continues to change rapidly. Students who complete the major earn a B.A. or B.S. degree.

The Westmont program goes beyond the acquisition of technical skills by adding the perspective gained through group work, problem-solving, and critical thinking. The rationale for these emphases is simple: the modern computing environment involves professionals from many fields working together as a team to solve problems. Success in such an environment requires the ability to analyze problems from many sources and communicate clearly with people from other backgrounds.

Set in the context of a liberal arts college, the computer science program at Westmont offers broad opportunities for exposure to problems and ideas from other disciplines. In recognition of the increasingly interdisciplinary contexts faced by computer professionals, students may complete a B.S. in computer science with an emphasis in another discipline such as art, biology, psychology, business, or engineering.

The program offers students the opportunity to examine the ethical issues of modern computing from a Christian perspective. Our society needs the leadership and insight of individuals who are able to combine technical knowledge with ethical and moral principles.

Distinctive features. Students enjoy the benefits of working closely with faculty in a variety of settings. Students can gain deeper understanding and develop their ability to solve novel problems by participating in research with faculty, either during the summer or the academic year. Research also brings the opportunity for students to develop valuable communication skills by co-authoring papers with faculty and presenting their results at conferences.

The computer science program maintains a strong sense of community through weekly dinners shared between students and faculty, annual department retreats, and various events in faculty homes such as dinners, Bible studies, and movie nights.

Santa Barbara has earned the nickname "Silicon Beach" by being home to a number of high-tech companies, thus opening the way for student work and/or paid internships off-campus. Students can also engage in paid work for the department as teaching assistants or for the campus information technology department performing trouble-shooting and maintenance of campus networks and computers.

Career Choices. Opportunities for careers in computer science are both numerous and diverse, and a critical shortage of well-prepared professionals is predicted to exist for many years to come. Students who choose to further their studies in graduate school will be well prepared to do so. Students who wish to join the workforce immediately also have many opportunities. Computers have become ubiquitous and permeate every facet of our society. More and more careers are integrally related to computer science such as bioinformatics, cognitive science, digital media arts, neuroscience, artificial intelligence, computer graphics, management information systems, human-computer interaction, and intellectual property law. Essentially all fields and organizations welcome the talents of those properly trained in computer science. Computing on the mission field is also a growing area in which students will be able to make significant contributions.

Requirements for the Computer Science Major

Required Core: (32 units)

CS 10 Introduction to Computer Science I (4)

CS 15 Discrete Mathematics (4)

CS 30 Introduction to Computer Science II (4)

CS 50 Information and Computation: History and Ethics *or* PHI 104 Ethics *or* PHI 113 Contemporary Moral Problems (4)

CS 120 Data Structures/Algorithms (4)

CS 130 Software Development (4)

CS 192 Project (2)

CS 195 Senior Seminar (4)

CS 198 Research (2)

In addition to the core courses, students must complete one of the following four tracks, providing depth in computer science and optionally, an area of emphasis. The emphasis tracks allow a student to complete an interdisciplinary major combining computer science with another field of interest. Examples of additional fields of interest include business (management information systems), art (computer graphics), psychology and art (human-computer interaction) biology (bioinformatics), psychology (cognitive science or neuroscience), philosophy (artificial intelligence), art and communications (digital media arts), and engineering-physics (computer engineering). The emphasis tracks must be planned with the faculty advisor and also with a faculty member from the other discipline, to ensure that the resulting major is coherent. A student completing an emphasis track will be required to demonstrate the manner in which computer science and the emphasis field are integrated through a reflective essay written as part of the Senior Seminar.

B.A. in Computer Science General Track (44 units including core)

Additional CS courses numbered above CS 30 to bring the total to 44 units.

B.A. in Computer Science Emphasis Track (48 units including core)

Three courses from a second field, two of which must be upper-division courses

Additional CS courses numbered above CS 30 to bring the total to 48 units.

B.S. in Computer Science General Track (56 units including core)

Additional CS courses numbered above CS 30 to bring the total to 56 units.

B.S. in Computer Science Emphasis Track (56 units including core)

Three courses from a second field within the Natural and Behavioral Sciences Division, two of which must be upper-division courses

Additional CS courses numbered above CS 30 to bring the total to 56 units.

Requirements for a Computer Science Minor:

24 units

CS 5 Fundamentals of Computing (4)

CS 15 Discrete Mathematics

CS 10 Introduction to Computer Science I (4)

CS 30 Introduction to Computer Science II (4)

CS 130 Software Development (4)

CS 195 Senior Seminar (4)

Lower-Division Course Descriptions

CS 5 Fundamentals of Computing (4) No prior computer or programming experience required. Introduction to basic principles of computing, problem solving, algorithmic thinking, and abstraction. Overview of hardware and software. Applications including spreadsheets, databases, artificial intelligence, networks, and web development. Social and ethical issues including viruses, privacy, security, intellectual property, anti-trust, and the digital divide.

CS 10 Introduction to Computer Science I (4) No prior computer or programming experience required. Basics of programming including language features, disciplined programming style, and documentation. Problem solving, algorithm design, and the software development process.

CS 15 Discrete Mathematics (4) (Same as MA 15) Prerequisite: Admissions Math Requirement. The study of ideas of discrete mathematics including sets, permutations, relations, graphs, trees, and finite-state machines. Using these concepts, students will learn mathematical skills such as: methods of proof; problem solving via advanced counting techniques; problem solving through the creation of algorithms.

CS 30 Introduction to Computer Science II (4) Prerequisite: CS 10. Introduction to object-oriented programming. Abstract data types including lists, stacks, queues, and trees. Sorting and searching algorithms. Big-O notation. Software testing and program verification.

CS 45 Computer Organization and Architecture (4) Prerequisite: CS 10. Introduction to the hardware-software interface. Digital logic, data representation, computer arithmetic, software vs. hardware tradeoffs, instruction set architecture, addressing techniques, cache, virtual memory, and pipelining.

CS 50 Information and Computation: History and Ethics (4) Social and ethical impacts of information, computation, and computing machinery from ancient Babylon to the present. Develop an historical perspective on information and computation. Comprehensive coverage of ethical theories and how they apply to technology – particularly information technologies – and how they can inform policy decisions. Significant attention to philosophical concepts of property rights, how they apply to information, and how they have been applied through history. Consideration of interactions and tensions between privacy and information infrastructure.

Upper-Division Course Descriptions

CS 105 Programming Languages (4) Prerequisite: CS 30. Language processors; data; binding time; operations; sequence control; referencing environments; scope of a variable; storage management; operating environment, syntax; translation.

CS 116 Artificial Intelligence (4) Prerequisite: CS 30. Computational and philosophical principles of intelligence; methods for knowledge representation; automated reasoning, and learning.

CS 120 Data Structures and Algorithms (4) Prerequisite: CS 30. Advanced data structures including balanced trees, heaps, graphs and hash tables. Analysis of algorithms.

CS 125 Database Design (4) Prerequisite: CS 30. Database system architecture; relational and object-oriented databases, the Structure Query Language (SQL), normal forms and database design; query processing and optimization; handling transactions, concurrency control, crash recovery; data warehousing and data mining.

CS 130 Software Development (4) Prerequisite: CS 30. Software life-cycle. Fundamental concepts of software design. Supporting modern language features. Verification and validation techniques. The course is organized around a major group software project.

CS 135 Formal Languages and Automata (4) Prerequisite: CS 30. Regular languages; finite automata. Context-free languages; pushdown automata; Turing machines, halting problem. Computability.

CS 140 Networks (4) Prerequisite: CS 45 or consent of instructor. Network technologies including packet switching, framing, local and wide area technologies, network addressing, repeaters, bridges, hubs, switches, topologies, next-hop forwarding, shortest path computation, delay and throughput, and protocol layers. Internetworking including IP, TCP, UDP, datagrams,

routers, and protocol ports. Network applications including client-server paradigm and domain name system. Web technologies and protocols including HTTP, CGI, and Java.

CS 145 Operating Systems (4) Prerequisite: CS 45. Sequential processes; concurrent processes; scheduling algorithms; segmentation; paging; virtual systems; store management; networking; parallel processing; security.

CS 150 Topics in Computer Science (4) Prerequisite: CS 30 or consent of instructor. Special courses offered on selected advanced topics in computer science. Content as announced. May be repeated for credit in a different topic.

CS 190 Practicum (1-4) Prerequisite: CS 30. Field experience arranged in conjunction with the department and supervised by a professional computer scientist. Up to four units of practicum may be counted toward the major. (By arrangement.)

CS 190SS/CS191SS Service Learning Internship (0-1) Service experience in a local school providing tutoring or after-school enrichment programs relevant to computer science. (By arrangement.)

CS 192 Project (1-4) Prerequisite: CS 130. Participation in a multi-person computer science project. (By arrangement.)

CS 195 Senior Seminar (4) Prerequisite: CS 130 and senior standing as a computer science major or minor. In this capstone class, students reflect on computer science as a discipline, the connections with other disciplines, the impacts of technology upon society, and ethical considerations introduced by computers. In the process of completing a major project, students consider marketing, design, implementation, testing, and maintenance. In this class, seniors complete and present their online portfolio. As the culmination of their program, students explore the transition to graduate school or the commercial sector.

CS 198 Research (1-4) Prerequisite: CS 30. Work with faculty on original research. (By arrangement.)