

munication and culture, especially communication-related vocations. It concentrates on the relationships between the Christian faith and professional communication and focuses on the ways in which communication-related professions define professional activity and on the responsibilities that Christians have to work in and through professions. It also examines a Christian view of success, the importance of understanding

one's gifts, finding and using mentors, committing to a location, mastering persuasive, honest interviewing and resume-writing, networking with reciprocity, overcoming Christian tribalism in a world economy, and being patiently flexible in the face of economic and cultural changes. Prerequisites: Biblical Foundations I or Theological Foundations I, Developing a Christian Mind, and Philosophical Foundations.

## Computer Science

*Professors J. Adams, E. Fife, D. Laverell, †H. Plantinga, K. Vander Linden (chair)  
Assistant Professors P. Bailey, J. Frens, J. Nyhoff  
Adjuncts R. Pruijm, †M. Stob*

The department offers a variety of major concentrations for students who wish to pursue a computing-related career. These include the Bachelor of Computer Science degree for students who wish to focus primarily on computer science, the Bachelor of Arts and Bachelor of Science in Computer Science for students who wish to combine a study of computer science with another discipline, the Bachelor of Arts in Digital Communication for students who wish to combine a study of computing applications with communications, and the Bachelor of Arts in Information Systems for students who wish to combine a study of computing applications with business and management. The Bachelor of Computer Science degree is accredited by the Computing Accreditation Commission of ABET. The department also offers minors in computer science, computer science for students in the secondary education program, and information systems. More information about the departmental programs is available at the departmental website ([cs.calvin.edu](http://cs.calvin.edu)).

### BACHELOR OF COMPUTER SCIENCE (B.C.S.)

Computer Science 108  
Computer Science 112  
Computer Science 212  
Computer Science 214  
Computer Science 232  
Computer Science 262  
Computer Science 384  
Computer Science 394 or 396 and 398  
Four Computer Science, Engineering or Information Systems electives. These electives must be chosen from Computer Science 312, 320, 332, 342, 344, 352, 372, 374, 382, 386; Information Systems 333, 337, 341, 371; Engineering 304, 325; or an approved interim. At most one elective can be taken from IS 333, 337, and 341.

### Cognates

CAS 101  
Engineering 220  
Mathematics 156 and 256  
Mathematics 161 and 162  
Mathematics 243  
Three college laboratory science electives, including two (but no more than two) courses from one department. These electives may be chosen from: Astronomy 211 or 212 (but not both); Biology 141, 242, 243; Chemistry 103, 104; Physics 133, 134, 235.

### BACHELOR OF ARTS IN COMPUTER SCIENCE (B.A.)

Computer Science 108  
Computer Science 112

Computer Science 212  
 Computer Science 214  
 Computer Science 232  
 Computer Science 262  
 Computer Science 384  
 Computer Science 394 or 396 and 398  
 Three Computer Science, Engineering or Information Systems electives. These electives must be chosen from Computer Science 312, 320, 332, 342, 344, 352, 372, 374, 382, 386; Information Systems 333, 337, 341, 371; Engineering 304, 325; or an approved interim. At most one elective can be taken from IS 333, 337, and 341.

**Cognates**

Engineering 220  
 Mathematics 156 and 256  
 Mathematics 161 (or Mathematics 132 with permission of the advisor)  
 Mathematics 143 or 243

A minimum grade of C (2.0) in 212, 214, 232 or 262 is required for admission to these concentrations.

Students completing at least 58 hours of mathematics or science may elect to receive the BS degree in Computer Science rather than the BA degree.

**COMPUTER SCIENCE MINOR**

Computer Science 108  
 Computer Science 112  
 Computer Science 212  
 Computer Science 214  
 Computer Science 232  
 Computer Science 384  
 One 200 or 300-level Computer Science course (of at least 3 credit hours), or a 300 level Information Systems course or Engineering 304 or 325.

**MINOR IN COMPUTER SCIENCE FOR STUDENTS IN THE SECONDARY EDUCATION PROGRAM.**

Information Systems 151  
 Information Systems 153  
 Information Systems 171  
 Information Systems 141  
 Information Systems 221  
 Information Systems 271  
 Computer Science 108  
 Computer Science 112

Computer Science 212  
 Education W10

Prior to the secondary education teaching internship, students must have the approval of the department. Criteria for approval are found in the *Teacher Education Program Guidebook*, available in the Education Department.

**BACHELOR OF ARTS IN DIGITAL COMMUNICATION (group major)**

Information Systems 151  
 Information Systems 153  
 Information Systems 171  
 Information Systems 141  
 Information Systems 221  
 Information Systems 271  
 Information Systems 337  
 Information Systems 341  
 Information Systems 333  
 Computer Science 108  
 Computer Science 262  
 Computer Science 384  
 CAS 140  
 CAS 230  
 CAS 238  
 CAS 305  
 CAS 330  
 CAS 352  
 One course from CAS 141 or 143  
 One course from CAS 248, 249 or 250

**Cognates**

Mathematics 132 and 143

**BACHELOR OF ARTS IN INFORMATION SYSTEMS**

Information Systems 141  
 Information Systems 171  
 Information Systems 271  
 Information Systems 333  
 Information Systems 337  
 Information Systems 341  
 Information Systems 371  
 Computer Science 108  
 Computer Science 262  
 Computer Science 384  
 Business 160  
 Business 203  
 One course from Business 315, 363, Economics 325 or 326  
 One course from Business 351, 360, 365 or 380

One course from Business 359 or Computer Science 394  
Economics 221

**Cognates**

Mathematics 143 and 201

**INFORMATION SYSTEMS MINOR**

Information Systems 141  
Information Systems 171  
Information Systems 271  
Computer Science 108  
Computer Science 384  
Information Systems 341  
Business 160  
Business 203

**PHYSICS/COMPUTER SCIENCE GROUP MAJOR**

Physics 133  
Physics 134  
Physics 235  
Physics 381  
Computer Science 108  
Computer Science 112  
Computer Science 214  
One from Computer Science 212, Engineering 220, or an upper division computer-science elective  
Physics or Computer Science electives (to provide a minimum of 24 semester hours in either physics or computer science)

**Cognates**

Mathematics 161  
Mathematics 162  
Mathematics 231 or 256  
Mathematics 261 or 232

**HONORS**

Students wishing to graduate with honors in computer science can do so by completing the departmental honors program. In addition to the requirements of the college honors program, the Computer Science departmental honors program requires further coursework and a senior honors project. Details are available from the department website. This program requires careful planning to complete, and students should normally apply for admission to the departmental honors program in their sophomore year.

**COURSES**

**Computer Science**

104 **Applied C ++ (2)**. F An introduction to problem solving and program design for engineers using the language C++. Coverage includes I/O, types and expressions, libraries, functions and parameter passing, control structures, files, array processing and the use of predefined classes (including templates). Prerequisite Mathematics 132 or 161, which may be taken concurrently.

108 **Introduction to Computing (4)**. F and S. An introduction to computing as a problem-solving discipline. A primary emphasis is on programming as a methodology for problem solving, including: the precise specification of a problem, the design of its solution, the encoding of that solution, and the testing, debugging and maintenance of programs. A secondary emphasis is the discussion of topics from the breadth of computing including historical, theoretical, ethical and biblical perspectives on computing as a discipline. Laboratory. Prerequisite: Some prior programming experience recommended.

112 **Introduction to Data Structures (4)**. F and S. A continuation of 108, using C++ classes to introduce and implement the elementary data structures including lists, stacks, queues and trees. Advanced programming techniques such as indirection, inheritance and templates are introduced; along with an emphasis on algorithm analysis, efficiency and good programming style. Laboratory. Prerequisite: 108, 104, or permission of the instructor.

212 **Data Structures and Algorithms (3)**. F A systematic study of algorithms and their application to data structures, including arrays, lists, trees, heaps, hash tables and graphs. Algorithms and data structures are analyzed in their use of both time and space, and the choice of data structure in problem solving is studied. Theoretical issues, such as optimality, best and worst-case performance and limitations of algorithms are studied, as well as implementation issues. Prerequisite: 112 and Mathematics 156. (Mathematics 156 may be taken concurrently).

**214 Programming Language Concepts**

(3). S. Design principles and implementation issues of contemporary programming languages. Topics covered include programming paradigms, the syntax and semantics of programming language constructs, translation of high level languages to machine language, and formal languages. Several different languages will be introduced and examines to illustrate these topics. Laboratory. Prerequisite: 112.

**216 Programming Challenges** (1). F A hands-on laboratory forum to use the data structures and mathematics of other courses on a variety of problems, ranging in difficulty. The course consists of working on a variety of problems and examining techniques used in their solution. Students may take this course multiple times; the course does not count towards the major. Grading is pass/fail. Prerequisite: 212 and Mathematics 156, which may be taken concurrently.

**232 Operating Systems and Networking**

(3). S. An introduction to the major concepts modern operating systems must address. Topics include operating system structure, processes and threads, inter-process communication and synchronization, scheduling, main and secondary memory management, file systems, networking, client-server systems, distributed systems. Prerequisite: 112 and Engineering 220.

**262 Software Engineering** (3). F A survey of software engineering principles including software project management, system and requirements analysis, the design and implementation of software, design patterns, software quality assurance and testing, software maintenance and the use of CASE tools. Prerequisite: 108 and at least junior standing.

**312 Logic, Computability and Complexity**

(4). \* F, alternate years. Topics from the theory of computation including finite state concepts, formal languages and grammars, computability, computational complexity. (Cross-listed as Mathematics 312). Prerequisite: Mathematics 256. Not offered 2005-2006.

**320 Advanced Computer Architecture**

(3), \* S, alternate years. Principles of computer design, instruction set design prin-

ciples, instruction-level parallelism, cache principles, and multiprocessor systems. Prerequisite: Engineering 220.

**332 Advanced Computer Networks** (3). \*

F, alternate years. This course introduces the student to the field of computer networking. Students will develop an understanding of the general principles of computer communication as they are worked out in an appropriate protocol suite. Specific attention will be paid to principles of architecture, layering, multiplexing, addressing and address mapping, routing and naming. Problems considered include the writing of network software, the physical construction of networks, the Internet and its future development, and network security. Prerequisite: 232. Not offered 2005-2006.

**342 Database Management Systems** (3). \*

S, alternate years. An introduction to the structures necessary to implement a database management system. Topics include data models (including hierarchical, network and relational data models), normal forms for data relations, data description languages, query facilities. An introduction to existing database management systems is given. Laboratory. Prerequisite: 262.

**344 Artificial Intelligence** (3). \* I, alternate years.

An introduction to artificial intelligence. Topics include problem solving, knowledge representation, planning, machine learning, natural language processing and robotics. Students will be introduced to programming techniques from AI such as heuristic search, expert systems and neural networks, as well as to AI's philosophical, psychological and religious context. Prerequisite: 214 (or 112 and permission of the instructor). Not offered 2005-2006.

**352 Computer Graphics** (3). \* S, alternate years.

An introduction to interactive 2D and 3D computer graphics techniques such as transformations, lighting, shading and hidden surface removal; photorealistic rendering including ray tracing and image processing. Programming projects with graphics libraries such as Qt and OpenGL. Prerequisite: 212 and Mathematics 255 or 256. Not offered 2005-2006.

**372 Numerical Analysis** (4). \* F, alternate years.

Analysis of errors in numerical

methods, real roots of equations, approximations using polynomials, numerical integration, applications to differential equations, Lagrange and spline interpolation, least squares approximations, orthogonal polynomials and applications. (Also listed as Mathematics 335). Prerequisites: 104 or 108 and Mathematics 256 or 232. Not offered 2005-2006.

**374 High Performance Computing (3).** \*F, alternate years. A study of architectures, algorithms and programming techniques that help minimize the execution times of computer programs that solve particular problems. Topics include high performance computer architectures, parallel programming techniques for distributed and shared-memory multiprocessors, code optimization and hands-on experience using the Calvin College supercomputer. Laboratory. Prerequisite: 212 and Engineering 220 or permission of instructor.

**382 Special Topics in Computer Science: Compiler Design (4).** F, alternate years. An introduction to the basic constructs of modern programming languages and to the techniques for implementing these in the machine language of a typical computer. Topics include grammatical structure, syntax, semantics, storage allocation, error detection, and object code generation. Prerequisite: Computer Science 214. Not offered 2005-2006.

**384 Perspectives on Computing (3).** S. This course addresses social, ethical, legal and professional issues that arise in computer science from a Reformed, Christian perspective. Social issues concerning the computerization of society include privacy, security, the digital divide and changes in the way we receive information the way we relate with others. Ethical discussion starts with a survey of ethical theories and covers professional, ethical and legal issues in areas including intellectual property, privacy, liability and professional codes of conduct. In addition, some foundational issues are covered, including materialist vs. Christian view of what it means to be a person. Prerequisite: last year of a computing-related program. Meets the Integrative Studies requirement.

**386 Computer Security (4).** S, alternate years. An introduction to the principles of computing security. Topics include encryption, protocols, security models, trusted systems, program security, network security, legal and ethical issues. Laboratory. Prerequisite: Junior standing and at least one of 232, 332, or Information Systems 333. Not offered 2005-2006.

**390 Independent Study F, I, S.**

**394 Senior Internship in Computing (3).** F and S. Interns will work 10-20 hours per week in a local business or non-profit organization under the supervision of a computing professional. The internship experience will give students the opportunity to apply skills and concepts acquired in the classroom to a real-world setting and to participate in the design and/or implementation of a significant computing application. The intern will be expected to maintain a reflective journal and complete a summary paper. Prerequisite: 262 and senior standing.

**396 Senior Project in Computing (2).** F. This is the first course of a two-semester sequence, in which the student will complete a department-approved computing project. This capstone experience will give students the opportunity to apply concepts and techniques learned in the classroom by developing a significant computing application. The first semester will typically focus on any necessary library research, design and prototyping; implementation and wiring should normally be done in the second semester. The student will submit regular progress reports to a supervising faculty member and submit a preliminary report on the project's status for evaluation by a departmental committee. Prerequisite: 262 and senior standing.

**398 Senior Project in Computing II (2).** S. A continuation of 396. The student will submit regular progress reports to a supervising faculty member and submit a final report for evaluation by a departmental committee. Prerequisite: 396.

### Information Systems

**141 Computing with Databases (1)** S. An introduction to information processing with databases. This course introduces

table structure, keys, queries, reports and the relational database model. Prerequisite: Interdisciplinary 110.

**151 Computing Presentation (1).** F and S. An introduction to the use of presentation software and desktop publishing software. Students will use current software packages to create presentation materials and newsletters and brochures of publication quality. In addition to the mechanics of using the packages, layout and composition issues will be addressed. Prerequisite: Interdisciplinary 110.

**153 Computing with the Internet (1).** F and S. An introduction to the Internet- its origins, current nature and prospects for the future; a study of resources and tools for using, managing and creating materials for the Internet and the World Wide Web. Topics include information search and retrieval, communication, hypermedia, scripting and cultural and ethical issues. Prerequisite: Interdisciplinary 110.

**171 Computing with Spreadsheets (1).** F and S. An introduction to numerical computation using spreadsheets, including basic operations, graphs and charts, decision making, data management and macros. Prerequisite: Interdisciplinary 110.

**221 Personal Computer Administration (1).** S. An introduction to the concepts and practice of configuring and administering a personal computer system. Topics include: initial configuration, system administration, hardware expansion and networking. Students will learn to set up and maintain a computer system for a home or office. Prerequisite: Interdisciplinary 110.

**271 Introduction to Information Systems (4).** F This course introduces the field of Information Systems, with particular emphasis on the fundamentals of managing data resources with desktop databases and spreadsheets, and programming with a visual development environment. The technologies used in the course include Microsoft Access, Excel, Visual Basic.Net and Vi-

sual Studio. Laboratory. Prerequisite: IS 141 and IS 171 or permission of the instructor.

**333 Network Administration (3).** S. This course prepares students to set up and administer TCP/IP, Linux, and/or Microsoft networks. Topics include network protocols such as TCP/IP; networking hardware including wiring, interface, hubs, switches and routers; proxies; security and firewalls; social, legal and ethical issues. Prerequisite: 271 or Computer Science 108.

**337 Introduction to Website Administration (3).** F This course prepares the student to administer a site on the World Wide Web. Topics include platform options; server installation and configuration; creating forms in HTML; an introduction to Perl and Common Gateway Interface (CGI) scripting; legal and ethical issues. Prerequisite: Computer Science 108, or permission of the instructor.

**341 Database Administration (3).** F, alternate years. This course prepares students to set up and administer database servers and clients on a network. Topics include an introduction to database design; SQL programming; principles for interfacing with a database server using ODBC and Visual Basic; issues in data management, integrity and security; legal and ethical issues. Prerequisite: 141, 271 or permission of the instructor.

**371 Information Systems Leadership (3).** S, alternate years. This course explores the role of the Chief Information Officer and the key Christian leadership issues within a technical environment. It emphasizes aligning IT to provide optimal value to organizational missions. It explores the economic considerations of IT management, including project budgeting, outsourcing analysis, financial rations applied to technical investments and establishing service level agreements. The course will address these issues in the context of a significant, full-class project. Prerequisite: CS 262 or permission of the instructor. Not offered 2005-2006.