

## COMPUTER SCIENCE

### THE FACULTY

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### THE MAJORS

Computer science is the discipline that studies the concepts and techniques used in designing and developing software systems. Students will explore the conceptual underpinnings of computer science, including its fundamental algorithms and programming languages. Advanced topics are offered in areas such as mobile development and software engineering techniques. Students may also concentrate on the burgeoning field of Data Science in their study of computer science.

The Computer Science program offers both Bachelor of Arts and Bachelor of Science degrees. The Bachelor of Arts degree is suited for students seeking to blend computer science study with courses in other fields, such as in the humanities and the social sciences, leading to careers involving interdisciplinary applications. The Bachelor of Science degree offers students robust exposure to the core areas of computer science and provides the requisite background for graduate study or careers involving software development. Opting for the concentration in Data Science allows students to take advantage of current trends of increasing employment in Big Data and Data Analytics.

Both degrees start with the same set of foundation courses allowing students to decide on their exact program once they obtain a basic understanding of the discipline. We strongly recommend students begin either major with CS 110, Introduction to Programming, as early as possible, ideally, during the first year. Both degrees allow a student to choose the concentration in Data Science.

Capstone requirements are the same for both the Bachelor of Arts and the Bachelor of Science degrees and are found under the Bachelor of Science program description. Honors is currently only available for the Bachelor of Science. Students declaring a computer science major are required to have a 2.0 cumulative GPA in the introductory computer science and calculus sequences: CS 110, CS 111, MATH 121 (or MATH 119), and MATH 122 (for the BS degree). CS110 and CS111 must be taken for a numerical grade.

Learning outcomes for these programs can be found at: [www.redlands.edu/ba-csci/learning-outcomes/](http://www.redlands.edu/ba-csci/learning-outcomes/).

### BACHELOR OF ARTS IN COMPUTER SCIENCE

This program provides students with a basic understanding of the fundamentals of computer science and allows them to choose elective subjects to study at the advanced level. Students are encouraged to meet with computer science faculty early in their program in order to choose courses that will best prepare them for their future goals.

## REQUIREMENTS

COMPUTER SCIENCE FOUNDATION: 4 courses/16 credits

- CS 110 Introduction to Programming (4)
- CS 111 Data, File Structures, and OOP (4)
- CS 222 Web Application Development (4)
- CS 240 Theory of Algorithms (4) or CS 223 Game Programming and AI (4)

COMPUTER SCIENCE ELECTIVES: Choose 2 courses/8 credits

- CS 301 Business Analysis and Excel (4)
- CS 323 Mobile Programming (4)
- CS 330 Database Management (4)
- CS 340 Programming Languages (4)
- CS 341 Software Engineering (4)

RELATED FIELD REQUIREMENTS: 2 courses/8 credits

- MATH 111 Elementary Statistics with Applications (4)
- MATH 121 Calculus I (4) or MATH 119 Integrated Calculus II (4)

COMPUTER SCIENCE CAPSTONE: 4 credits

- CS 450 Computer Science Senior Project (4)

## BACHELOR OF SCIENCE IN COMPUTER SCIENCE

This program prepares students for professional careers in the areas of software design and applied computer science and gives them the necessary theoretical background for graduate study in the field. The required courses give students a firm foundation in the basic areas of computer science and related areas of mathematics/physics; a choice of electives allow them to tailor their program to their specific interests.

## REQUIREMENTS

COMPUTER SCIENCE FOUNDATION: 6 courses/24 credits

- CS 110 Introduction to Programming (4)
- CS 111 Data, File Structures, and OOP (4)
- CS 222 Web Application Development (4)
- CS 240 Theory of Algorithms (4)
- CS 301 Business Analysis and Excel (4) or CS 211 Introduction to Data Science (4)
- CS 341 Software Engineering (4)

COMPUTER SCIENCE CAPSTONE: 4 credits

- CS 450 Computer Science Senior Project (4)

COMPUTER SCIENCE ELECTIVES: Choose 3 courses/12 credits

- CS 223 Game Programming and AI (4)
- CS 323 Mobile Programming (4)
- CS 330 Database Management (4)
- CS 340 Programming Languages (4)

RELATED REQUIREMENTS: Choose 5 courses/20 credits

- MATH 111 Elementary Statistics With Applications (4) or MATH 311 Probability (4) or MATH 312 Mathematical Statistics (4)
- MATH 201 Discrete Mathematical Structures (4) or MATH 205 Mathematical Cryptology (3)
- MATH 231 Introduction to Mathematical Modeling (4)
- MATH 235 Differential Equations (4)
- MATH 331 Numerical Analysis (4)
- PHYS 231 General Physics I (4)
- PHYS 232 General Physics II (4)
- PHYS 310 Electronics Applications (4)

#### DATA SCIENCE CONCENTRATION

Data Science integrates skills from probability, statistics, and computer science. Data Scientists pursue the development of mathematical models and analysis to extract knowledge and insights for vast and complicated data sets. As a field, Data Science has emerged as a crucial discipline with innumerable opportunities in industry, government, and science.

Students earning the Bachelor of Arts or Bachelor of Science degree in computer science have an opportunity to concentrate on Data Science by emphasizing the theory and applications of the three core pillars of data science: coding, mathematics, and statistics. The data science concentration lends itself to the blending of multiple fields and facilitates connections with other departments on campus. Students are encouraged to take courses from different departments and choose the appropriate classes in consultation with an advisor.

The concentration consists of a minimum of four courses from the following list. Students may substitute courses as approved by an advisor. Crucial to the concentration is CS 211, Introduction to Data Science, as it gives students a good introduction to the work of a Data Scientist.

- CS 240 Theory of Algorithms (4)
- CS 211 Introduction to Data Science (4)
- CS 301 Business Analysis and Excel (4)
- CS 330 Database (4)

#### COMPUTER SCIENCE MINOR

The Computer Science Minor is designed to provide basic expertise in computer science. The requirements focus on a basic foundation and allow students who are specializing in another discipline to benefit from knowing more about computing.

REQUIREMENTS: 6 courses/ 24 credits

- CS 110 Introduction to Programming (4)
- CS 111 Data, File Structures, and OOP (4)
- 12 additional credits from Computer Science (CS) offerings
- MATH 111 Elementary Statistics With Applications (4)

## ADVANCED PLACEMENT IN COMPUTER SCIENCE

Students who receive a score of four or five on the exam will receive 4 credits and credit for CS 110.

## DEPARTMENTAL HONORS

A departmental honors program is available for exceptionally able and motivated students pursuing a Bachelor of Science degree. Admission to the program may come by departmental invitation or, should students initiate their own applications, by an affirmative vote of the computer science faculty. Students must work with a faculty advisor during their junior year to develop a detailed proposal, and then complete an individual honors project during their senior year.

## COURSE DESCRIPTIONS (CS)

### 101 Introduction to Computers (PC).

Fall (4), Spring (4).

Designed to make students computer literate. Introduction to computers and the Internet and how they work. Introduction to the Windows operating system, word processing, spreadsheets, graphics programs, databases, programming, email, searching, social-media sites and ethical issues in computer use.

### 103 Introduction to Multimedia.

Fall (4), Spring (4).

Introduction to interactive multimedia design and elements of interface design. Development of skills in creating interactive projects using animation, graphics, sound, virtual reality, and basic object-oriented programming (OOP) to facilitate navigation.

Offered as needed.

Numeric grade only.

### 110 Introduction to Programming.

Fall (4), Spring (4).

Introduction to problem-solving methods and algorithm development through the use of computer programming in the C++/Java language. Emphasis on data and algorithm representation. Topics include declarations, arrays, strings, structs, unions, expressions, statements, functions, and input/output processing.

Numeric grade only.

Corequisite: MATH 121 Calculus I (or MATH 118 and MATH 119).

### 111 Data, File Structures, and OOP.

Spring (4).

Advanced topics concerning Object-Oriented concepts, data structures, and algorithm representation using Java. Topics include stacks, recursion, linked lists, trees, sorting, and hashing.

Prerequisite: CS 110 and either MATH 121 (or higher) or a corequisite of MATH 119.

Co-requisite MATH 121.

### 208 Java Programming.

Fall (4), Spring (4).

Exploration of the Java language for students familiar with object-oriented programming. Topics include multimedia programming, threads, exception handling, and network communications.

Prerequisite: CS 111.

Offered as needed.

### 211 Introduction to Data Sciences.

Spring (4).

Techniques for data wrangling/munging (acquisition, cleaning, transformation), visualization (using the grammar of graphics), and modeling that are foundational to data science. Topics to include efficient management of large and sparse datasets, uni/multivariate graphical and numerical descriptive statistics, code efficacy (memory and speed), study reproducibility, and data ethics.

Prerequisite: CS 110.

Recommended MATH 111 or equivalent.

Offered as needed.

Numeric grade only.

### 221 Exploring Visual Basic.

Fall (4), Spring (4).

Basic principles of problem solving and algorithm development are studied. Various statements of the programming language Visual Basic will be presented and used in this context. A fairly rapid pace of coverage will occur in this course, as this is not the first course in programming; complex and demanding assignments will form part of the coursework.

Prerequisite: CS 111.

Offered as needed.

### 222 Web Application Development.

Fall (4).

The study of web technologies and emerging web standards, protocols, markup and web development languages. This course focuses on designing and developing both client-side and server-side Web-based applications. Students are exposed to service-side development including database access for data driven applications and asynchronous communication between client and server.

Prerequisite: CS 111 and one of MATH 119, MATH 121, MATH 122, or MATH 221.

Offered every year.

### 223 Game Programming and Artificial Intelligence.

Spring (4).

Examines AI approaches that can be applied to digital games. Students learn AI programming techniques and how they strongly interface with game design. Topics covered are rational behavior, knowledge representations, kinetic movement, collisions, finite state machines, path finding, and decision-making.

Prerequisite: CS 111 and one of MATH 119, MATH 121, MATH 122, or MATH 221.

Offered alternate years.

Numeric grade only.

### 230 Operating Systems.

Fall (4), Spring (4).

Introduction to principles of operating systems. Topics include processes (sequential and concurrent), tasks, task management, processor scheduling, memory management, file handling, device management, command languages, interrupts, I/O, and security.

Prerequisite: CS 111.

### 240 Theory of Algorithms with Python.

Fall (4).

Notions of complexity analysis, along with the mathematical underpinnings of efficient algorithm design will be studied. Techniques will incorporate divide-and-conquer and searches and sorts. Additional topics will include graph theory and simulations.

Prerequisites: CS 111 and one of MATH 119, MATH 121, MATH 122, or MATH 221.

### 260, 360, 460 Topics in Computer Science.

Spring (4).

Features a topic of current interest in computer science not otherwise offered in the curriculum.

Prerequisite: by permission. May be repeated for degree credit for a maximum of 8 credits, given a different topic.

Offered as needed.

### 301 Business Analysis with Excel.

Fall (4), Spring (4).

Data analysis and decision making is an integral part of any successful business and the study of large data sets with the help of Microsoft Excel is the main focus of this course. The processes that enable data consolidation to make meaningful business decisions will be studied in depth.

Prerequisite: ACCT 220 or CS 110.

### 303 Introduction to Machine Learning.

Spring (4).

Machine learning is the practice of programming computers to learn and improve through experience. This course provides an introduction to the mathematical underpinnings, algorithms, and practices that enable a computer to learn. Topics include supervised learning, unsupervised learning, and evaluation methodology. Students are required to program in Python. Programming Intensive.

Prerequisite: A grade of 1.7 or higher in MATH 241 and CS 111, or a grade of 1.7 or higher in MATH 122 and CS 240, or by permission. Some experience in Python programming is strongly recommended.

Numeric grade only.

### 323 Mobile Programming.

Spring (4).

Introduction to the development of mobile device applications with an emphasis on programming for the latest Android platform. Topics will include the implementation of multi-touch gestures, sensor and camera events, threads and background tasks, and working with location services. Current development issues are also examined.

Prerequisite: One of CS 222, CS 223, or CS 240.

Offered in alternate years.

### 330 Database Management.

Spring (4).

Introduction to principles of database design and management for information systems. Discussion of file design leads to study of logical and physical database concepts relating to three models of database organization: hierarchical, network, and relational. Includes issues relating to query processing, integrity and security of data, and distributed database systems.

Prerequisite: CS 111.

Offered as needed.

### 331 Artificial Intelligence.

Spring (4).

Introduction to artificial intelligence designed to introduce the basic ideas about search and control strategies, heuristics, problem solving, constraint exploitation, and logic. Rule-based systems and expert systems techniques and the process of generating intelligent behavior for computers using these information processing strategies are also discussed.

Prerequisite: CS 111.

Offered as needed.

### 340 Programming Languages.

Spring (4).

Introduction to programming language concepts and representatives of several different programming language techniques. Topics include data, operations, sequence control, data control, storage management, operating environment, syntax, and comparison of various programming paradigms.

Prerequisite: CS 111.

### 341 Software Engineering.

Fall (4).

Introduction to the new and maturing field of software engineering. Topics include the management of expectations, computer technologies, people and their skills, time, cost, and other resources needed to create, test, and maintain a software product that meets the needs of computer users.

Prerequisite: One of CS 222, CS 223, or CS 240.

### 450 Computer Science Capstone Project.

Spring (4).

This course provides the opportunity for a senior in Computer Science to design, develop, and implement a reasonably-sized software project as a capstone experience. This implementation work integrates the knowledge acquired from earlier computer science courses and the principles of project management and delivery.

Prerequisite: Senior standing.