COMPUTER SCIENCE
Natural and Applied Sciences Division

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Computer Science A.S. Degree

The Computer Science program is intended to meet the needs of students majoring in computer science, and students from other science disciplines where computer programming is required. These disciplines include computer engineering, networking and system administration, business, bioinformatics, information systems management, economics, business and information systems, engineering, and engineering technology. The Computer Science program offers one degree programs, four certificates of achievement, and two skills certificates. The A.S. Degree program transfers to four-year colleges and universi-ties. Note: UC will accept a total of 6 courses from Computer Science. One of the following courses is recommended for all potential com-puter science/computer engineering majors early in their academic career to help deter- mine their interest in pursuing the major: CS 1 or CS 11 (C++), CS 12GP, or CS 12J (Java).

Learning Outcomes:

1. Demonstrate software development skills necessary to succeed in programming intensive majors at 4-year colleges. (Critical Thinking, Professional Development)

2. Demonstrate professional conduct by meeting strict project deadlines, participating in self-managed teams, and adopting classroom behavioral norms. (Communication, Professional Development)

3. Demonstrate the capacity to use computer software to communicate and interact with computer hardware. (Critical Thinking, Communication, Professional Development)

4. Demonstrate information literacy individually, and as a team member (proper citations, documentation, ethical practices). (Critical Thinking, Communication, Professional Development, Global Awareness)

Model Program for Computer Science

These Associate Degrees require 60 units appropriate to your educational goal, to include general education and at least 30 units in a major. Courses should be selected to meet the lower-division major preparation requirements at your intended transfer university – these specific requirements can be found at www. assist. org for 4-year public institutions in California. Please see a counselor for advisement to ensure you are taking the best possible courses given your goal. This degree may be completed as a transferable Associate in Science degree with the addition of university admission requirements and increased general education requirements.

The department presents the following suggested Model Programs for this major. The courses listed below may or may not be appropriate depending on your specific goal. Please see a counselor for advisement for transfer to any 4-year institution.

General Education   **21 Units**
Computer Science Majors
Core courses for all transfer students (39 Units)   **Units**

CS 19	C++ Programming	4
or		
CS 20J	Java Programming	4
CS 21	Introduction to Data Structures and Algorithms	4
CS 23	*Discrete Mathematics	4
or		
MATH 23	*Discrete Mathematics	4
MATH 5A	Analytic Geometry and Calculus I	5
MATH 5B	Analytic Geometry and Calculus II	5

The following core courses are required for transfer for most computer science majors and transfer universities.

CS 24	**Elementary Computer Organization	4
MATH 5C	Analytic Geometry and Calculus III	5
MATH 6	Introduction to Linear Algebra	3
MATH 7	Introduction to Differential Equations	3
CHEM 1A	General Chemistry I	5
CHEM 1B	General Chemistry II	5
or		
PHYS 4A	Physics for Scientists and Engineers I	5
PHYS 4B	**Physics for Scientists and Engineers II	5
PHYS 4C	*Physics for Scientists and Engineers III	5
or		
BIO 9A	Molecular, Cellular, and Animal Biology	5
and		
BIO 9B	Ecology, Evolution, and Plant Biology	5

Computer Engineering Majors

CS 19	C++ Programming	4
or		
CS 20J	Java Programming	4
MATH 5A	Analytic Geometry and Calculus I	5
MATH 5B	Analytic Geometry and Calculus II	5
MATH 5C	Analytic Geometry and Calculus III	5
MATH 6	Introduction to Linear Algebra	3
MATH 7	Introduction to Differential Equations	3
CHEM 1A	General Chemistry I	5
PHYS 4A	Physics for Scientists and Engineers I	5
and		
PHYS 4B	**Physics for Scientists and Engineers II	5

The following core courses are required for transfer for most computer engineering majors and transfer universities:

CS 21	*Introduction to Data Structures and Algorithms	4
CS 23	*Discrete Mathematics	4
or		
MATH 23	*Discrete Mathematics	4
CS 24	**Elementary Computer Organization	4
PHYS 4C	*Physics for Scientists and Engineers III	5
or		
CHEM 1B	General Chemistry II	5
or		
BIO 9A	Molecular, Cellular, and Animal Biology	5
and		
BIO 9B	Ecology, Evolution, and Plant Biology	5

Total Units   **60**
 *spring only; **fall only

C++ Programming Certificate of Achievement

The C++ Programming Certificate of Achievement is intended to meet the needs of students pursuing academic and occupational disciplines where knowledge of the C++ programming language is required. These disciplines include, but are not limited to, computer science, computer engineering, digital media, computer networking, computer system administration, and engineering.

MATH 152 (Intermediate Algebra) is required for the beginning programming course (CS 11), and either completion of MATH 4 (Precalculus Algebra and Trigonometry) or the completion of the MATH 2/MATH 3 series (two-semester version of MATH 4) is required for the intermediate C++ programming course (CS 19).

Upon completion of the C++ Programming Certificate of Achieve-ment a student will have satisfied the ollowing objectives:

- Design and implement C++ programs to solve problems of simple and moderate complexity using procedural and object-oriented methods.

- Correctly and effectively use the following C++ language elements: Classes and objects, structured data types such as arrays and file , operator overloading, inheritance, and polymorphism.

- Design and implement basic dynamic data structures including a Linked List.

- Write code that is well documented and exhibits clarity of expression through effective use of mnemonic identifier , indentation and comments.

- Apply the following software development principles and techniques: step-wise refineme t, top-down and bottom-up design, incremental development, testing and debugging, information hiding, and data encapsulation.

- Develop C++ code in a command-line Unix environment using standard Unix tools, gcc compiler, emacs text editor, and gdb debugger.

- Design and implement C++ language programs to implement mathematical concepts such as statistical array value analysis, sets, trigonometric functions, simple geometry, and complex numbers.

For the occupational student the body of work completed for this certificate represents the intermediate programming preparation nec-essary for an entry level programmers working in a technical support capacity.

For the transfer student, completion of this certificate represents the first year courses within a four-year computer science program at most CSU and UC campuses.

Learning Outcomes:

1. Demonstrate software development skills implemented in the C++ programming language. (Critical Thinking, Professional Development)

2. Demonstrate information literacy individually, and as a team member (proper citations, documentation, ethical practices). (Critical Thinking, Communication, Professional Development, Global Awareness)

3. Demonstrate professional conduct by meeting strict project deadlines, participating in self-managed teams, and adopting classroom behavioral norms. (Communication, Professional Development)

Required Courses

CS 1	Introduction to Computers and Computer Technology	3
and		
CS 1L	Technology Tools	2
CS 11	Introduction to Programming Concepts and Methodology, C++	4
or		
CIS 32	Introduction to Internet Programming	4
CS 19	C++ Programming	4
MATH 4	Precalculus Algebra and Trigonometry	5
or		
MATH 2	Precalculus Algebra	4
and		
MATH 3	Precalculus Trigonometry	3
COMM 2	Group Discussion	3
or		
COMM 10	Communication Process	3
ENGL 1A/1AH/1AMC/1AMCH		3
Total Units		**24 – 26**

Java Programming Certificate of Achievement

The Java Programming Certificate of Achievement is intended to meet the needs of students pursuing academic and occupational disciplines where knowledge of the java programming language is required. These disciplines include, but are not limited to, computer science, computer engineering, digital media, computer networking, bioinformatics, and engineering.

Learning Outcomes:

1. Demonstrate software development skills implemented in the Java programming language. (Critical Thinking, Professional Development)

2. Demonstrate information literacy individually, and as a team member (proper citations, documentation, ethical practices). (Critical Thinking, Communication, Professional Development, Global Awareness)

3. Demonstrate professional conduct by meeting strict project deadlines, participating in self-managed teams, and adopting classroom behavioral norms. (Communication, Professional Development)

Required Courses

CS 1	Introduction to Computers and Computer Technology	3
and		
CS 1L	Technology Tools	2
CS 12GP	Introduction to Programming Using Games and Simulations	4
or		
CS 12J	Introduction to Programming Concepts and Methodology, Java	4
CS 20J	Java Programming	4
MATH 4	Precalculus Algebra and Trigonometry	5
or		
MATH 2	Precalculus Algebra	4
and		
MATH 3	Precalculus Trigonometry	3
COMM 2	Group Discussion	3

or		
COMM 10	Communication Process	3
ENGL 1A/1AH/1AMC/1AMCH		3
Total Units		**24 – 26**

Programming Certificate of Achievement

The Programming Certificate of Achievement is intended to meet the needs of students pursuing academic and occupational disciplines where knowledge of the C++ or Java programming language and knowledge of computer algorithms is required. These disciplines in-clude, but are not limited to, computer science, computer engineering, computer networking, computer system administration, bioinformat-ics, and engineering.

Learning Outcome:

1. Demonstrate software development skills implemented in the C++ or Java programming language. (Critical Thinking, Professional Development)

Required Courses

CS 19	C++ Programming	4
or		
CS 20J	Java Programming	4
CS 21	*Introduction to Data Structures and Algorithms	4
CS 23	*Discrete Mathematics	4
or		
MATH 23	*Discrete Mathematics	4
CS 24	**Elementary Computer Organization	4
Take 2 of the following CIS courses:		**Units**
CIS 31	Perl Programming in a UNIX Environment	4
CIS 32	Introduction to Internet Programming	4
CIS 34	Mobile Platforms-iPhone and Android	4
CIS 98	UNIX/Linux Shell Programming	4
and		
MATH 5A	Analytic Geometry and Calculus I	5
COMM 2	Group Discussion	3
or		
COMM 10	Communication Process	3
ENGL 1A/1AH/1AMC/1AMCH		3
Total Units		**35**

*spring only; **fall only

Web Programming Fundamentals Certificate of Achievement

The Web Programming Certificate of Achievement is intended to meet the needs of students pursuing academic and occupational disciplines where web programming is required. These disciplines in-clude, but are not limited to, computer science, computer engineering, digital media, business communications and marketing, economics, and engineering.

Learning Outcome:

1. Demonstrate software development skills implementing the following programming and Internet scripting language: Java, Perl, JavaScript, and PHP. (Critical Thinking, Professional Development)

Required Courses

CS 12GP	Introduction to Programming Using Games and Simulations	4
or		
CS 12J	Introduction to Programming Concepts and Methodology, Java	4
or		
CS 20J	Java Programming	4
CIS 31	Perl Programming in a UNIX Environment	4
CIS 32	Introduction to Internet Programming	4
CIS 33	Introduction to Programming Database-Driven Websites with PHP	4
MATH 154	Elementary Algebra	5
or		
MATH 152	Intermediate Algebra	5
or		
MATH 4	Precalculus Algebra and Trigonometry	5
or		
MATH 2	Precalculus Algebra	4
and		
MATH 3	Precalculus Trigonometry	3
COMM 2	Group Discussion	3
or		
COMM 10	Communication Process	3
ENGL 1A/1AH/1AMC/1AMCH		3

Total Units **27 - 29**

Game Programming Skills Certificate

Prepares the student to program at an intermediate level with an emphasis on video game programming techniques.

Learning Outcomes:

1. Demonstrate software game development skills implemented in the Java programming language. (Critical Thinking, Professional Development)

2. Demonstrate information literacy individually, and as a team member (proper citations, documentation, ethical practices). (Critical Thinking, Communication, Professional Development, Global Awareness)

3. Demonstrate professional conduct by meeting strict project deadlines, participating in self-managed teams, and adopting classroom behavioral norms. (Communication, Professional Development)

Required Courses

CS 11	Introduction to Programming Concepts and Methodology, C++	4
or		
CS 12J	Introduction to Programming Concepts and Methodology, Java	4
CS 12GP	Introduction to Programming Using Games and Simulations	4
CS 20J	Java Programming	4

Total Units **12**

Mobile Applications Skills Certificate

Program Description:

Prepares the student to program at an intermediate level with an emphasis on developing iOS and Android mobile applications and games.

Learning Outcomes:

1. Demonstrate Android application development skills using Java. (Communication, Critical Thinking, Global Awareness, Personal Responsibility and Professional Development)

2. Demonstrate iOS application development skills using Swift. (Communication, Critical Thinking, Global Awareness, Personal Responsibility and Professional Development)

3. Demonstrate Android and iOS game development skills. (Communication, Critical Thinking, Global Awareness, Personal Responsibility and Professional Development)

Required Courses

CS 12GP	Introduction to Programming Using Games and Simulations	4
or		
CS 12J	Introduction to Programming Concepts and Methodology, Java	4
or		
CS 19	C++ Programming	4
CS 20J	Java Programming	4
CIS 34	Mobile Platforms-iPhone and Android	4
CIS 35	Mobile Game Development	4

Total Units **16**

Web Programming Fundamentals Skills Certificate

Prepares the student to create interactive and dynamic web pages using client-side and server-side programming languages.

Learning Outcomes:

1. Demonstrate information literacy individually, and as a team member (proper citations, documentation, ethical practices). (Critical Thinking, Communication, Professional Development, Global Awareness)

2. Demonstrate professional conduct by meeting strict project deadlines, participating in self-managed teams, and adopting classroom behavioral norms. (Communication, Professional Development)

Required Courses

CS 12J	Introduction to Programming Concepts and Methodology, Java	4
or		
CS 20J	Java Programming	4
CIS 32	Introduction to Internet Programming	4
CIS 33	Introduction to Programming Database-Driven Websites with PHP	4
CIS 34	Mobile Platforms-iPhone and Android	4

Total Units **16**

Computer Science Courses

CS 1   Introduction to Computers and Computer Technology
3 units; 3 hours Lecture, 1 hour Laboratory
Eligibility for MATH 154.
Repeatability: May be taken a total of 1 time.
Surveys the fields of study within computer science and computer technology with a focus on computer literacy in the 21st century. Includes: hardware, software, development systems, the Internet, and networks, including PC and Macintosh. Students interested in a hands-on lab course to coincide with this class may enroll in CS 1L. May be offered in a Distance-Learning Format.
Transfer Credit: Transfers to CSU; UC.

CS 1L   Technology Tools
2 units; 2 hours Lecture, 1 hour Laboratory
Recommended Preparation: CS 1 (may be taken concurrently); Eligibility for MATH 154.
Repeatability: May be taken a total of 1 time.
Covers the fundamentals of college-level information literacy, computational logic, and computer proficien y. Topics include the online research process, essential skills in using computer operating systems, word processing, spreadsheets, e-mail, image manipulation, and presentation software at a college level. May be offered in a Distance-Learning Format.
Transfer Credit: Transfers to CSU; UC.

CS 11   Introduction to Programming Concepts and Methodology, C++
4 units; 3 hours Lecture, 4 hours Laboratory
Prerequisite: MATH 152.
Recommended Preparation: CS 1.
Repeatability: May be taken a total of 1 time.
Presents an introduction to computer programming using the C++ programming language beginning with basic principles and progressing to object-oriented programs. Includes: algorithms, data types, declarations, expressions, selection, repetition, functions, recursion, libraries, arrays, classes, objects, files and streams. Prepares students for CS 19 or CS 20J. May be offered in a Distance-Learning Format.
Transfer Credit: Transfers to CSU; UC. C-ID: COMP 112

CS 11M   Introduction to C/C++ Programming Using Microcontrollers
4 units; 3 hours Lecture, 4 hours Laboratory
Prerequisite: MATH 4 or MATH 2 and MATH 3.
Recommended Preparation: CS 1.
Repeatability: May be taken a total of 1 time.
Presents an introduction to computer programming concepts and methodologies in C/C++ using microcontrollers to program computer circuits and hardware. Covers a microcontroller such as the Arduino, Beaglebone, and Raspberry Pi single-board computers and circuits like LED displays and servo motors. Teaches algorithms, data types, declarations, expressions, selection, repetition, methods, recursion, libraries, arrays, classes, objects, hardware interfaces, and files and streams. May be offered in a Distance-Learning Format.
Transfer Credit: Transfers to CSU; UC. C-ID: CS 11M + CS 19 = C-ID ENGR 120

CS 12GP   Introduction to Programming Using Games and Simulations
4 units; 3 hours Lecture, 4 hours Laboratory
Prerequisite: MATH 154.
Repeatability: May be taken a total of 1 time.
Presents an introduction to computer programming concepts and methodologies by developing games and simulations in the Java programming language. Topics include: algorithms, data types, declarations, expressions, selection, repetition, methods, recursion, libraries, arrays, classes, objects, 2D graphics, animation, sound, files and streams. Prepares students for CS 19 or CS 20J. May be offered in a Distance-Learning Format.
Transfer Credit: Transfers to CSU; UC.

CS 12J   Introduction to Programming Concepts and Methodology, Java
4 units; 4 hours Lecture, 1 hour Laboratory
Prerequisite: MATH 152.
Recommended Preparation: CS 1.
Repeatability: May be taken a total of 1 time.
Presents an introduction to computer programming using the Java programming language beginning with basic principles and progressing to object-oriented programs and visual programming. Includes: algorithms, data types, declarations, expressions, selection, repetition, methods, recursion, libraries, arrays, classes, objects, components, events, files and streams. May be offered in a Distance-Learning Format.
Transfer Credit: Transfers to CSU; UC. C-ID: COMP 112

CS 19   C++ Programming

4 units; 3 hours Lecture, 4 hours Laboratory
Prerequisite: MATH 4 or MATH 2 and MATH 3.
Recommended Preparation: CS 11 or CS 11M or CS 12J or equivalent skills; Previous programming experience strongly recommended.
Repeatability: May be taken a total of 1 time.
Presents programming, documentation, and software design methodologies using C++. Assumes that students have been introduced to classes and objects, control structures, repetition, functions, and logical operators. Includes a brief review of functions, arrays, pointers and strings. New topics include classes, operator overloading, and inheritance. Prepares students for CS 21 and CS 23. May be offered in a Distance-Learning Format.
Transfer Credit: Transfers to CSU; UC. C-ID: CS 19 + CS 20J = C-ID COMP 122; CS 11M + CS 19 = C-ID ENGR 120

CS 20J   Java Programming

4 units; 3 hours Lecture, 4 hours Laboratory
Prerequisite: MATH 4 or MATH 2 and MATH 3.
Recommended Preparation: CS 11 or CS 11M or CS 12J or CS 12GP or equivalent skills.
Repeatability: May be taken a total of 1 time.
Presents programming, documentation, and software-design methodologies using Java. Includes a brief review of control structures, methods and arrays as students rapidly progress to object-oriented programs of moderate complexity. Advanced topics include: inheritance, polymorphism, exceptions, graphics, graphical-user interfaces, file , streams, threads, and dynamic data structures. Prepares students for CS 21 and CS 24. May be offered in a Distance-Learning Format.
Transfer Credit: Transfers to CSU; UC. C-ID: CS 19 + CS 20J = C-ID COMP 122.

CS 21   Introduction to Data Structures and Algorithms

4 units; 3 hours Lecture, 4 hours Laboratory
Prerequisite: CS 19 or CS 20J or equivalent skills and MATH 5A.
Repeatability: May be taken a total of 1 time.
Provides an introduction to data structures, algorithms, and software engineering techniques using the C++ or Java language. Presents the development of large programs including definition, implementation, analysis, use and reuse of abstract data types and associated algorithms. Reviews and elaborates arrays, lists, queues, stacks, sets, trees, priority queues, heaps, tables, hashing, balanced trees, graphs, recursion, searching and sorting. Offered spring only. May be offered in a Distance-Learning Format.
Transfer Credit: Transfers to CSU; UC. C-ID: COMP 132

CS 23   Discrete Mathematics

4 units; 3 hours Lecture, 3 hours Laboratory
Prerequisite: CS 11 or CS 11M or CS 12GP or CS 12J or equivalent skills; MATH 5A or equivalent skills.
Recommended Preparation: CS 19 or CS 20J or equivalent skills.
Repeatability: May be taken a total of 1 time.
Presents discrete mathematical systems including methods of proof that shape the foundations of computer science. Includes propositional logic, set and number theory, Boolean Algebra, deductive and inductive proof, functions and relations, combinatorics, discrete probability, graph theory and network models, and efficie y of algorithms. Math majors should enroll in MATH 23 (identical to CS 23). May be offered in a Distance-Learning Format.
Transfer Credit: Transfers to CSU; UC. C-ID: COMP 152

CS 24   Elementary Computer Organization

4 units; 3 hours Lecture, 4 hours Laboratory
Prerequisite: CS 19 or CS 20J and MATH 5A.
Repeatability: May be taken a total of 1 time.
Introduces organization of computer systems, machine level programming, and systems software. Includes processor organization, introduction to operating systems and assembly language programming on microprocessors. Offered fall only. May be offered in a Distance-Learning Format.
Transfer Credit: Transfers to CSU; UC. C-ID: COMP 142