UNDERGRADUATE HANDBOOK

A GUIDE FOR COMPUTER SCIENCE UNDERGRADUATES AT UC DAVIS

UC DAVIS
COMPUTER SCIENCE

CONTENTS

Welcome to Computer Science at UC Davis 2

The Computer Science Undergraduate Majors 2

University and College Requirements 4

Academic Advising Expectations 5

CS Major Sample Schedule 6

CS Major Requirements 7

CSE Major Sample Schedule 10

CSE Major Requirements 11

CS / CSE Major Tracks 13

Computer Science Minor 14

Computational Biology Minor 15

PLACEMENT EXAM 16

ECS 192 AND 199 COURSES 16

ECS 189 Courses 16

Enrollment Restrictions and Drop deadlines 16

Advising 17

Graduate Study 19

Computer Science Courses 20

WELCOME TO COMPUTER SCIENCE AT UC DAVIS

Computer Science is one of the most dynamic and exciting disciplines you can study at UC Davis. Forming much of the foundation of the information revolution, computing has transformed our society in fundamental ways.

While we all know that technological change is everywhere, many people are less aware that the science of computing is also evolving rapidly. Changes are happening at the core of the field, where multicore architectures are changing the way that basic programs must be written, moving the discipline from sequential to parallel methods. Changes in information networks impact everything in our daily lives.

Computer Science is impacting applications in a number of diverse fields, including engineering, the physical sciences, the biological sciences, medicine, and the social sciences.

Computer Science is one of the most employable degrees, and the opportunities opening up in a wide range of industries make this a particularly great time to be a computer scientist. At UC Davis, we strive to train our students in the fundamentals of the computer science field, with additional options to study the multidisciplinary application development that makes this field so broad.

We welcome you to the study of Computer Science at UC Davis.

The Department of Computer Science administers two undergraduate curricula: Computer Science and Engineering (CSE), in the College of Engineering, and Computer Science (CS), in the College of Letters and Science.

TWO DIFFERENT COMPUTER SCIENCE MAJORS

The Department of Computer Science is unique on the Davis campus as it manages two majors in two different colleges. The differences in the two majors largely depend on the College requirements that supplement the basic computer science material. Students from both majors take similar core computer science courses and attend the same classes. The courses offered by the Computer Science Department are completely available to students in either program.

The two Computer Science majors are designed to prepare students for careers involving the design of computer systems and their application to science, industry, and management. Students taking these majors receive solid grounding in fundamentals of programming languages, operating systems, and the formal mathematical tools required to use computers in addressing a number of application areas.

UNIVERSITY AND COLLEGE REQUIREMENTS

UNIVERSITY REQUIREMENTS

All undergraduate students, including those in CS and CSE, must fulfill requirements set out by the University in order to graduate. These requirements are listed in the **UC Davis General Catalog**.

GENERAL EDUCATION REQUIREMENT

All undergraduate students must satisfy the General Education (GE) requirements in addition to University requirements.

Refer to the **General Education webpage** for further information on General Education requirements.

COLLEGE REQUIREMENTS

Each College on campus additionally requires its own students to fulfill certain requirements, which are listed in the College's webpages.

CS students must satisfy the requirements of the College of Letters and Science (L&S), which are available online on the **L&S website**.

CSE students must satisfy the requirements of the College of Engineering (CoE), which are available in the General Catalog online on the **CoE website**.

PASSED / NOT PASSED (P/NP) GRADING

In particular, each College sets its own restrictions on the use of Passed / Not Passed (P/NP) grading. The CS department does not have an additional P/NP policy.

The Academic Senate limits the total number of courses graded P, including units earned in courses graded "P/NP only," to one third of the units completed on the UC Davis campus. This limitation applies to all UC Davis undergraduates.

P/NP GRADING FOR CS MAJORS

Excluding courses that are graded on a Passed / Not Passed (P/NP) basis only, the number of units graded P that may be accepted towards a degree in the College of Letters and Science is limited to not more than one fourth of the units completed in residence on the UC Davis campus.

P/NP GRADING FOR CSE MAJORS

Students enrolled in any undergraduate major in the College of Engineering may not take Passed/Not Passed grading for any coursework offered by the College of Engineering nor for satisfaction of course requirements towards their degree with the exception: GE courses or unrestricted electives taken outside the College of Engineering, up to 16 units, may be taken for P/NP grading. Courses offered only on a P/NP basis (e.g., Engineering 199's), are acceptable for specific program requirements.

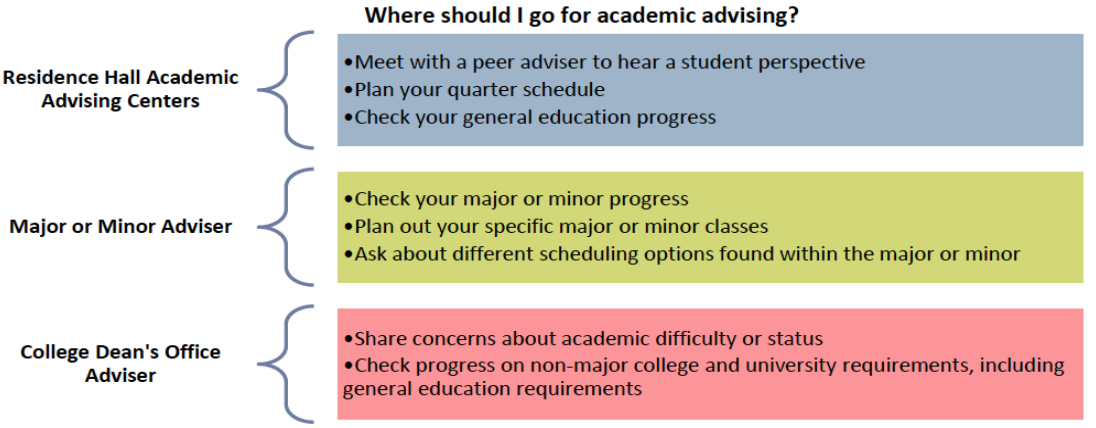
Additional information regarding P/NP grading can be found online on the Office of the **University Registrar's (OUR) website**.

ACADEMIC ADVISING EXPECTATIONS

ACADEMIC ADVISING

Academic advisors throughout campus can help you with your schedule and academic plan. You should plan to see more than one advisor throughout your time at UC Davis to make sure all your questions are answered.

Each of the advising resources are happy to help you, but in general, the best reasons to visit are listed below:



STUDENT ADVISING EXPECTATIONS

Attend annual advising appointment as required and have 3-quarter plan prepared in advance.

Come prepared to each appointment with questions or material for discussion. Ask questions if you do not understand an issue or have a specific concern. Clarify goals and provide accurate information.

Be willing to openly and honestly discuss factors that influence your academic experience including failures and successes.

Be open to feedback and alternative solutions. Follow through on suggested actions or referrals.

Read and respond regularly to your email and my.ucdavis.edu message system

Become knowledgeable about UC Davis and College of Engineering or College of Letters and Science programs, policies, and procedures

Be prepared to make and accept responsibility for academic decisions and performance

WHAT YOU CAN EXPECT FROM YOUR ADVISOR

Listen carefully to questions and concerns.

Explain curriculum, graduation requirements, UC Davis and College of Engineering/ Letters and Science policies and procedures.

Encourage, guide, and support development of realistic goals and educational plans.

Provide information and strategies for using university resources and services.

Monitor and document academic progress.

Be accessible during office hours, by telephone, or email/messaging system for advising.

Maintain confidentiality pursuant to FERPA.

CS MAJOR SAMPLE SCHEDULE

This is one sample of many variations of schedules. Depending on what classes you have taken, your schedule will vary. Course offerings will vary from year to year. Always verify that a course is being offered the quarter you wish to take it.

Elec. is short for Elective, and Req. is short for Requirement.

	FALL	WINTER	SPRING
FRESHMAN	MAT 21A	MAT 21B	MAT 21C
	ECS 36A*†	ECS 36B	ECS 50
	English Req. or GE	Science Req.	ECS 20
			Science Req.
FRESHMAN (ALTERNATE)	MAT 21A	MAT 21B	MAT 21C
	ECS 32A*	ECS 36A	ECS 36B
	English Req.or GE	ECS 20	Science Req.
SOPHOMORE	MAT 22A	STA Req.	ECS 122A
	ECS 36C / 50 (Alternate)	ECS 154A	ECS Elec.
	Science Req. or GE	Science Req. or GE	GE
JUNIOR	ECS 120/122B	ECS 150.	ECS 140A
	ECS Elec.	ECS Elec.	ECS Elec.
	GE	GE	UWP Req.
SENIOR	ECS Elec.	ECS Elec.	ECS Elec.
	Upper Division Units	Upper Division Units	GE
	GE	GE	

* Register for ECS 32A (Introduction to Programming) if you do not have prior experience with basic programming concepts, such as variables, loops, and conditional statements. After ECS 32A, take ECS 36A, and then follow the rest of the sequence.

† Registration for ECS 36A requires a passsing grade on the CS Placement Exam. Otherwise, students must register for ECS 32A prior to taking ECS 36A. Students will only receive 2 units for ECS 36A after completion of ECS 32A.

Note: this schedule does not inlcude all University and College of Letters and Science requirements. See the UC Davis General Catalog for the full list of requirements.

CS MAJOR REQUIREMENTS

PREPARATORY SUBJECT MATTER		☑
ECS 20	(4)	
ECS 32A or 36A**	(4)	☐
ECS 32B or 36B**	(4)	☐
ECS 34 or 36C**	(4)	☐
ECS 50	(4)	☐
MAT 21A	(4)	☐
MAT 21B	(4)	☐
MAT 21C	(4)	☐
MAT 22A or or MAT 27A or MAT 67	(3 – 4)	☐
COM 1, 2, 3, or 4 or ENL 3 or NAS 5 or UWP 1	(4)	☐
UWP 101, 102, or 104 or Upper Division Composition Exam	(0 – 4)	☐
Choose any three courses from the following:		☑
BIS 2A	(5)	☐
BIS 2B	(5)	☐
BIS 2C	(5)	☐
CHE 2A or 4A	(5)	☐
CHE 2B or 4B	(5)	☐
CHE 2C or 4C	(5)	☐
PHY 9A	(5)	☐
PHY 9B	(5)	☐
PHY 9C	(5)	☐
Total Preparatory Units		**54 – 59**

COMPUTER SCIENCE CORE		☑
ECS 132* or MAT 135A* or STA 131A*	(4)	☐
ECS 120* or ECS 122B*	(4)	☐
ECS 122A	(4)	☐
ECS 140A	(4)	☐
ECS 150	(4)	☐
ECS 154A	(4)	☐
Total CS Core Units		**24**

**** Completion of a core requirement will not satisfy an elective requirement simultaneously.***

***** Must complete one full series 1) ECS 36A, 36B, 36C or 2) ECS 32A, 32B, 32C, 34***

COMPUTER SCIENCE ELECTIVES		☑
A minimum of 7 courses, including at least 1 MAT or STA course from:		
ECS 120*	(4)	
ECS 122B*	(4)	☐
ECS 124	(4)	☐
ECS 127	(4)	☐
ECS 129	(4)	☐
ECS 130	(4)	☐
ECS 132*	(4)	☐
ECS 140B	(4)	☐
ECS 142	(4)	☐
ECS 145	(4)	☐
ECS 152A	(4)	☐
ECS 152B	(4)	
ECS 152C	(4)	☐
ECS 153	(4)	☐
ECS 154B	(4)	☐
ECS 158	(4)	☐
ECS 160	(4)	☐
ECS 161	(4)	☐
ECS 162	(4)	☐
ECS 163	(4)	☐
ECS 165A	(4)	☐
ECS 165B	(4)	☐
ECS 170	(4)	☐
ECS 171	(4)	☐
ECS 172	(4)	☐
ECS 173	(4)	☐
ECS 174	(4)	☐
ECS 175	(4)	☐
ECS 177	(4)	☐
ECS 178	(4)	☐
ECS 188	(4)	☐
ECS 189 (Topics vary, can take multiple)	(4)	☐
ECS 192 or ECS 199 (1 course)	(3-5)	
ECS 193A&B	(6)	☐
EEC 100	(6)	☐
EEC 171	(4)	☐
EEC 172	(4)	☐
EEC 180	(5)	☐
ECN 122	(4)	☐
LIN 127	(4)	☐
LIN 177	(4)	☐
PSC 120	(4)	☐
STA 131A*	(4)	☐
STA 131B	(4)	☐
STA 141B	(4)	☐
STA 141C	(4)	☐
Any upper division math course numbered between 100 – 189, with the exception of MAT 111*	(3 – 4)	☐
Total CS Elective Units		**26 – 33**
Total Units for Major		**104 – 116**

**** Completion of a core requirement will not satisfy an elective requirement simultaneously.***

HONORS

CS students with outstanding academic records may qualify for graduation with honors, high honors, or highest honors. To be awarded honors, a student must satisfy the minimum GPA requirements as described on the **L&S website**.

To be awarded high or highest honors, a student, in addition to meeting the general GPA requirements, must also complete an honors project as follows:

- The student must enroll in ECS 199 for two consecutive quarters with the same faculty member, for a minimum of 6 units of credit.
- The student must write an honors thesis on the work carried out.

To be eligible for an honors project, the student must have completed 135 units with a minimum GPA of 3.5 in courses taken towards satisfaction of the major requirements.

It is also the responsibility of the student to document completion of the honors project. This can be done by completing the Honors Program Petition available from the undergraduate advisor, obtaining the required signatures, and returning the petition to the undergraduate advisor.

CHANGE OF MAJOR TO CS

Students that are considering switching to Computer Science in the College of Letters and Science must have completed the following courses with a C- or better:

- MAT 21A and B
- ECS 20
- One of the following options: A) ECS 36A, and ECS 36B B) ECS 34

You must also have a 3.0 UC GPA. Additionally, University requirements state that all students considering switching their major must have completed at least one quarter at UC Davis, as well as be in good academic standing.

CHANGE OF MAJOR TO CSE

Students that are considering switching to Computer Science and Engineering in the College of Engineering must have completed MAT 21ABC, PHY 9A, and CHE 2A, all with a C- or better. You must also have a 3.0 UC GPA.

Additionally, University requirements state that all students considering switching their major must have completed at least one quarter at UC Davis, as well as be in good academic standing.

COE has additional GPA and course requriements for changing majors. Additional information can be found online on the **CoE website**.

CSE MAJOR SAMPLE SCHEDULE

This is one sample of many variations of schedules. Depending on what classes you have taken, your schedule will vary. Course offerings will vary from year to year. Always verify that a course is being offered the quarter you wish to take it.

Elec. is short for Elective, and Req. is short for Requirement.

	FALL	WINTER	SPRING
FRESHMAN	MAT 21A	MAT 21B	MAT 21C
	ECS 36A*†	ECS 36B	ECS 20
	English Req. or GE	CHE 2A**	ECS 50
			PHY 9A
FRESHMAN (ALTERNATE)	MAT 21A	MAT 21B	MAT 21C
	ECS 32A*	ECS 36A	ECS 36B
	English Req. or GE	ECS 20	PHY 9A
			GE
SOPHOMORE	MAT 21D	MAT 22A	MAT 22B
	ECS 36C / 50 (Alternate)	ECS 154A	ECS 154B
	PHY 9B	PHY 9C	PHY 9D
	GE	GE	ENG 17
JUNIOR	ECS 132	ECS 140A	ECS 152A
	ECS 150	ECS Elective	ECS 160
	EEC 100	GE	UWP 101
			GE
SENIOR	ECS 122A	EEC 172	ECS 188
	ECS Elec.	ECS 193A	ECS 193B
	CMN 1	ECS Elec.	ECS Elec.
	GE	GE	

* Register for ECS 32A (Introduction to Programming) if you do not have prior experience with basic programming concepts, such as variables, loops, and conditional statements. After ECS 32A, take ECS 36A.

† Registration for ECS 36A requires a passsing grade on the CS Placement Exam. Otherwise, students must register for ECS 32A prior to taking ECS 36A. Students will only receive 2 units for ECS 36A after completion of ECS 32A.

** CHE 2A can be taken during summer school, either at UC Davis or a community college.

Note: this schedule does not inlcude all University and College of Engineering requirements. See the UC Davis General Catalog for the full list of requirements.

CSE MAJOR REQUIREMENTS

LOWER DIVISION PROGRAM		☑
ECS 20	(4)	☐
ECS 32A or 36A**	(4)	☐
ECS 32B or 36B**	(4)	☐
ECS 34 or 36C**	(4)	☐
ECS 50	(4)	☐
MAT 21A	(4)	☐
MAT 21B	(4)	☐
MAT 21C	(4)	☐
MAT 21D	(4)	☐
MAT 22A or MAT 67	(3 – 4)	☐
MAT 22B or 27B	(3)	
CHE 2A	(5)	☐
PHY 9A	(5)	☐
PHY 9B	(5)	☐
PHY 9C	(5)	☐
PHY 9D	(4)	☐
ENG 17	(4)	☐
COM 1, 2, 3, or 4 or ENL 3 or NAS 5 or UWP 1	(4)	☐
CMN 1	(4)	☐
Total Prepatory Units		**78 – 79**

UPPER DIVISION PROGRAM		☑
UWP 101 or Upper Division Composition Exam	(0 – 4)	
ECS 120* or ECS 122A*	(4)	☐
ECS 132	(4)	☐
ECS 140A	(4)	☐
ECS 150	(4)	☐
ECS 152A	(4)	☐
ECS 154A	(4)	☐
ECS 154B	(4)	☐
ECS 160	(4)	☐
ECS 188	(4)	☐
ECS 193A&B	(6)	☐
EEC 100	(5)	☐
EEC 172	(4)	☐
Total CSE Core Units		**51 – 55**

**** Completion of a core requirement will not satisfy an elective requirement simultaneously.***

*****Must complete one full series: 1) ECS 36A, 36B, 36C or 2) ECS 32A, 32B, 32C, 34***

UPPER DIVISION ELECTIVES		☑
A minimum of 4 courses and 15 units from:		
ECS 120*	(4)	
ECS 122A*	(4)	☐
ECS 122B	(4)	☐
ECS 124	(4)	☐
ECS 127	(4)	☐
ECS 129	(4)	☐
ECS 130	(4)	☐
ECS 140B	(4)	☐
ECS 142	(4)	☐
ECS 145	(4)	☐
ECS 152B	(4)	
ECS 152C	(4)	☐
ECS 153	(4)	☐
ECS 158	(4)	☐
ECS 161	(4)	☐
ECS 162	(4)	☐
ECS 163	(4)	☐
ECS 165A	(4)	☐
ECS 165B	(4)	☐
ECS 170	(4)	☐
ECS 171	(4)	☐
ECS 172	(4)	
ECS 173	(4)	☐
ECS 174	(4)	☐
ECS 175	(4)	☐
ECS 177	(4)	☐
ECS 178	(4)	☐
ECS 189 (Topics vary, can be taken multiple times)	(4)	☐
EEC 192 or ECS 199 (1 course)	(3-5)	☐
EEC 171	(4)	
EEC 180	(5)	☐
**ECN 122	(4)	☐
**LIN 127	(4)	☐
**LIN 177	(4)	☐
**PSC 120	(4)	☐
**MAT 135A	(4)	☐
**MAT 135B	(4)	☐
**STA 131A	(4)	☐
**STA 131B	(4)	☐
Total CSE Elective Units		**15 – 19**
Total Units for Major		**144 – 153**

* Completion of both ECS 120 and ECS 122A will satisfy the core requirement and a computer science elective.

**Restricted Elective Course, limit of one course may be used to satisfy degree requirements.

CS / CSE MAJOR TRACKS

Some students may wish to specialize in a particular area of computer science. Listed below are suggestions on how to use your elective courses in support of informal tracks in certain areas. Note again that these are informal tracks, only suggestions.

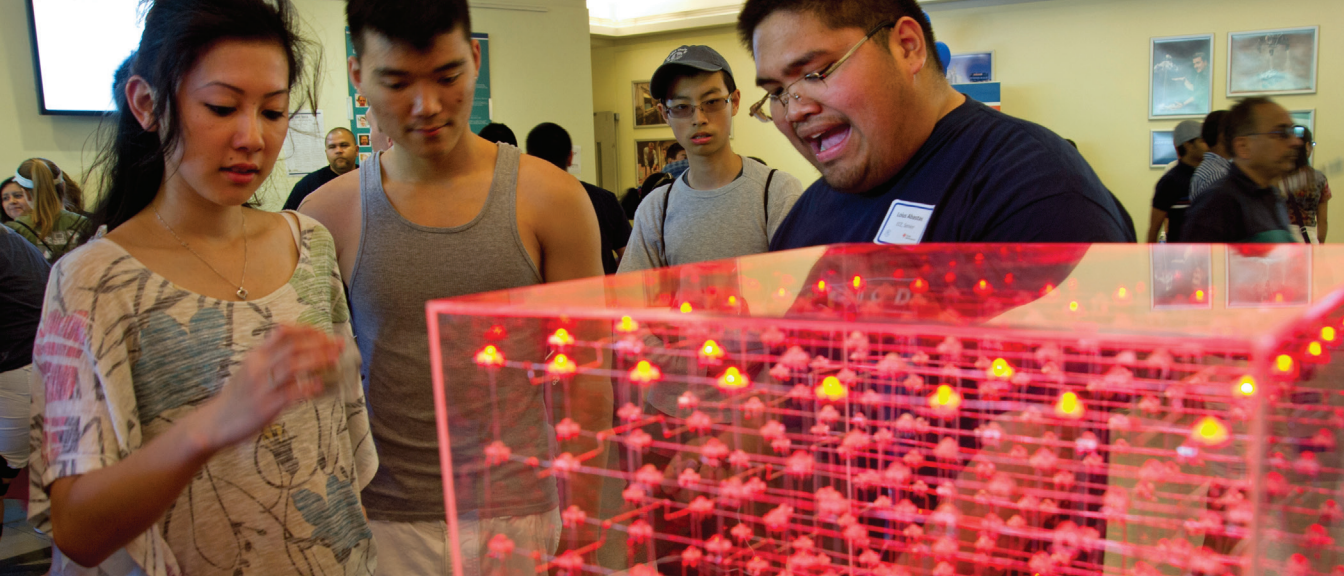
Databases and Data Management	
Core Courses:	
	ECS 165A
	ECS 165B
Supporting Courses:	
	ECS 145
	ECS 152A (required for CSE)
	ECS 152B
	ECS 153
	ECS 163
	MAT 135AB
	MAT 168

Graphics and Visualization	
Core Courses:	
	ECS 162
	ECS 163
	ECS 174
	ECS 175
	ECS 177
	ECS 178
Supporting Courses:	
	MAT 167

Networking	
Core Courses:	
	ECS 152A (required for CSE)
	ECS 152B
	ECS 152C
Supporting Courses:	
	ECS 153
	ECS 165A
	ECS 165B
	MAT 135A

Security and Cryptography	
Core Courses:	
	ECS 153
	ECS 188 (required for CSE)
Supporting Courses:	
	ECS 120
	ECS 122A
	ECS 127
	ECS 152A (required for CSE)
	ECS 152B
	ECS 160 (required for CSE)
	ECS 163
	MAT 108
	MAT 115AB
	MAT 135A
	MAT 145
	MAT 146
	MAT 148
	MAT 150ABC

Systems and Software Engineering	
Core Courses:	
	ECS 140B
	ECS 142
	ECS 145
	ECS 158
	ECS 160 (required for CSE)
	ECS 161
	ECS 163



COMPUTER SCIENCE MINOR

The minor in Computer Science is intended for students who wish to complement their major area of study with a background in computer science. Students must take a total of 20 units of upper-division electives. A minimum GPA of 2.0 is required for coursework in the minor. At most one course may be counted toward both the student's major and minor.

Students should also note that certain upper-division electives have prerequisites. For example, many courses will require ECS 36C (previously known as ECS 60) or ECS 32B. ECS 36C has a prerequisite chain of ECS 36A, 36B, and 20. ECS 32B has a prerequisite of ECS 32A. ECS 20 and 50 are not required but are recommended to allow more upper division course options.

COMPUTER SCIENCE MINOR		UNITS
	Five Upper Division ECS Electives	
	3 must be upper division ECS courses	12
	Any 2 other upper division courses accepted toward the CS Major	8
Total Units for Minor		20

COMPUTATIONAL BIOLOGY MINOR

The minor in Computational Biology will provide to students with engineering, physical or biological majors the foundations necessary to build efficient computational models and algorithms, use state-of-the-art techniques for scientific analysis and create scalable infrastructure environments for biological and biotechnological applications.

Students must take a total of 20 upper-division units, with two required courses and 12 units of upper-division electives. A minimum GPA of 2.0 is required for coursework in the minor. At most one course may be counted toward both the student's major and minor. Students should also note that most of the courses listed below have lower division prerequisites. In particular, the required course ECS 122A has a prerequisite chain of ECS 20, 36A, 36B, and 36C or ECS 20, 32A, and 32B.

*

COMPUTATIONAL BIOLOGY MINOR*		
ECS 122A	Algorithm Design and Analysis	4
ECS 124*	Theory and Practice of Bioinformatics	4
Biology Elective Choose one of the following courses:		
MCB 121	Molecular Biology of Eukaryotic Cells	4
MCB 124	Macromolecular Structure and Function	4
MCB 182	Principles of Genomics	4
EVE 100	Introduction to Evolution	4
EVE 101	Introduction to Ecology	4
EVE 102	Population and Quantitative Genetics	4
EVE 103	Phylogeny and Macroevolution	4
EVE 131	Human Genetic Variation and Evolution	4
BIS 101	Genes and Gene Expression	4
BIS 104	Regulation of Cell Function	4
BIS 122	Population Biology and Ecology	4
Computational Biology and Bioinformatics Elective Choose one of the following courses:		
ECS 129	Computational Structural Biology	4
BIS 132	Introduction to Dynamic Models in Biology	4
BIM 117	Analysis of Molecular and Cellular Networks	4
BIT 150	Applied Bioinformatics	4

Computational or Statistics Elective Choose one of the following courses:		
ECS 130	Scientific Computation	4
ECS 132	Probability and Statistical Modeling	4
ECS 140A	Programming Languages	4
ECS 145	Scripting Languages	4
ECS 158	Programming on Parallel Architectures	4
ECS 160	Software Engineering	4
ECS 165A	Database Systems	4
ECS 170	Artificial Intelligence	4
ECS 171	Machine Learning	4
ECS 177	Scientific Visualization	4
EVE 175	Computational Genetics	4
STA 130A	Brief Mathematical Statistics	4
STA 141A	Fundamentals of Statistical Data Science	4
STA 141B	Data & Web Technologies for Data Analysis	4
STA 141C	Big Data & High Performance Statistical Computing	4
BIT 150	Applied Bioinformatics	4
BIS 132	Introduction to Dynamic Models in Biology	4

*For Computational Biology minor, some course substitutions are available from prior petitons.

PLACEMENT EXAM

Enrollment in ECS 36A requires a passing score on the Computer Science Placement Exam or a grade of C- or better in ECS 32A or ECS 10. Students who enroll in ECS 36A after completing ECS 32A or ECS 10 will only receive 2 units in ECS 36A. Students enrolled in ECS 36A without meeting the requirements above will be dropped from the course.

The placement exam will only be open once a year during the summer and can only be taken once per year. Students that do not take the placement exam or do not receive a passing score will need to take ECS 32A or wait until the exam reopens before enrolling in ECS 36A. More information about the placement exam can be found online on the **CS Frequently Asked Question webpage** under "Placement Exam".

ECS 192 AND 199 COURSES

ECS 192 and 199 allow students to receive unit credit for an internship or research in computer science. One ECS 192 or 199 course may be counted towards a computer science elective for CS majors, CSE majors, and CS minors.

In order to receive credit for an internship or research, the Request to Take an ECS 92, 99, 192, or 199 form must be completed and turned in by the tenth day of instruction of the quarter that the internship or research will take place. For Summer Session this must be submitted by the 5th day of instruction of the session. Instructions on how to apply for ECS 92, 192, and 199, can be found online on the **CS Frequently Asked Questions webpage** under "ECS 192 and 199"

POLICY AND PROCEDURE FOR ELECTIVE CREDIT

To ensure that an ECS 192 or 199 course will be allowed to be used to satisfy a computer science elective requirement, CS Faculty will review the 192 / 199 proposal and the final documentation, and recommend approval or denial. Faculty will not approve previously completed 192 / 199 courses.

If the proposal or final report is not approved, the course will not satisfy a computer science elective requirement. Proposals not approved for elective credit may be used towards the 180 units needed for the degree.

An approved ECS 192 or 199 that is between 3 and 5 units will satisfy one course and one computer science elective. Students must complete 84 units prior to applying to take ECS 192 or ECS 199.

ECS 189 COURSES

ECS 189 courses are variable unit special topic courses. These courses may be repeated for credit multiple times when the topic differs. They may be used for elective credit if taken for 4 units. The units for special topic courses can be changed in Schedule Builder. The number of units each offering of ECS 189 is worth can be found on the course flyer. Taking an ECS 189 course for more units than advertised is a student conduct violation. Students that take the course for more units may face disciplinary action.

ENROLLMENT RESTRICTIONS AND DROP DEADLINES

All ECS undergraduate courses are Pass 1 restricted to select majors. Exact enrollment restriction information can be found in the the general catalog, Schedule Builder, and the CS Website. Exceptions to this restriction will not be made. Students in majors not listed in the restriction will need to wait until Pass 2 to enroll.

All ECS undergraduate courses have a 10-day drop deadline. Students that wish to drop an ECS course after the deadline will need to seek permission from their College Dean's Office.

ADVISING

The department major advisors act as a general information resource for students. They assist with academic advising issues such as: degree and major requirements, program planning, policies and procedures, graduation certifications, expanded course descriptions, community college articulations, and declaring or changing majors into CS or CSE.

The department additionally has peer advisors that also act as an information resource for students. Peer advisors can assist with academic advising issues such as degree and major requirements, and scheduling. They can additionally give a student's perspective upon topics such as classes and campus resources.

In addition, the department appoints several faculty to serve as faculty advisors each year. The faculty advisors assist with such matters as defining academic and career goals, approval for course equivalency and course substitution, and other related matters.

Students may seek advice from any of the major advisors, peer advisors, or faculty advisors. Please refer to the Advising Hours and Locations page, available at https://cs.ucdavis.edu/undergraduate/current-majors/advising/, to view advising hours and locations.

ADVISING HOLDS

In order to assist students to complete their program in a timely manner, and to ensure that students are prepared for courses, advising holds will be placed on students' records.

It is strongly recommended that you not wait until the deadline, but instead have the hold lifted prior to finals of the given quarter of your hold.

To increase your chances of enrolling in the ECS courses of your choice, it is very important that holds be lifted in time for Pass 1 registration, since enrollment restriction in ECS courses are lifted during Pass 2.

It is important to read your hold to see when it becomes active. An active hold will prevent you from registering and rolling into courses from the waitlists.

PROCEDURE FOR LIFTING AN ADVISING HOLD

Before seeing a department Staff Advisor or College Dean's Office Advisor to have your hold lifted, do the following:

1. Develop a quarterly academic plan, either with the Three Quarter Plan worksheet on OASIS, at students.ucdavis.edu, or the Academic Planning Worksheet on the department website. Refer to the CS planned courses on the department website to develop the plan. Always confirm that you meet the necessary prerequisites before enrolling in a class.
2. With your paperwork, meet with the appropriate advisor as explained in your hold notice. Appointments can be made at appointments.ucdavis.edu. Your hold will then be released.

DEPARTMENT WEBSITE

The department's website, www.cs.ucdavis.edu, contains information found in this handbook, expanded course descriptions, course schedules, class offerings, and links to other campus resources.

UNIX

It is crucial that transfer students be proficient with UNIX concepts and tools. This includes, but is not limited to: UNIX directory and file structures, and UNIX process control. For the most part, students will not receive formal instruction on these topics, but instead, must learn on their own.

There are two UNIX tutorial sites written by instructors in the department. One of these websites is provided by Sean Davis, and can be found online at csiflabs.cs.ucdavis.edu/~ssdavis/30/UnixWorkshop.pdf.

The other is provided by Professor Norm Matloff at heather.cs.ucdavis.edu/~matloff/unix.html.

Please also see Professor Norm Matloff's Guide to Installing and Using Linux, available at heather.cs.ucdavis.edu/~matloff/Linux/LinuxInstall.pdf.

DAVIS COMPUTER SCIENCE CLUB (DCSC)

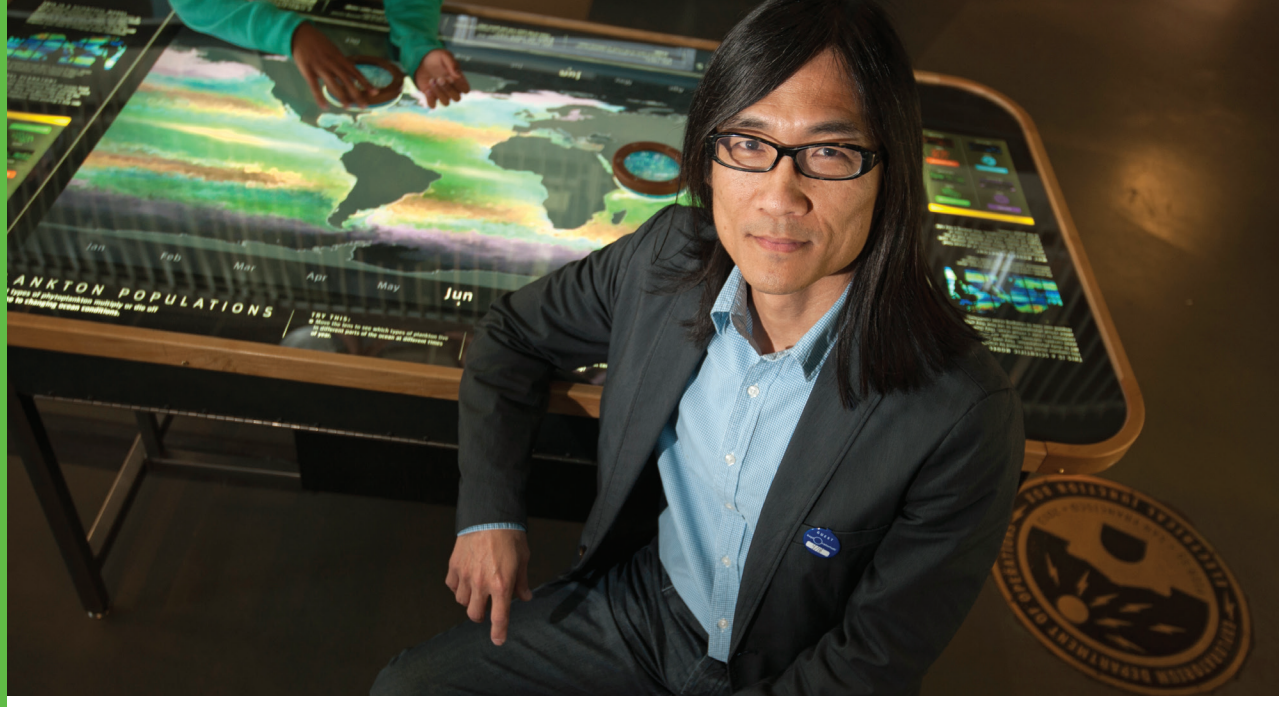
The Davis Computer Science Club (DCSC) connects UC Davis students interested in the field of computer science. For more information, see their website.

CAMPUS RESOURCES AND TOOLS

Registrar's Registration Calendar
registrar.ucdavis.edu/calendar/registration
Use the Registrar's Registration Calendar to see important dates in the quarter, such as when your pass times are available and deadlines for adding and dropping a course.

Schedule Builder
my.ucdavis.edu
Use Schedule Builder to look up courses, create multiple schedules, and register and change courses.

Online Advising Student Information System (OASIS) students.ucdavis.edu.
Use OASIS to access tools and information related to academic advising and your academic record, including your student information, forms and petitions, and a What-if GPA calculator.



GRADUATE STUDY

A major in Computer Science or Computer Science and Engineering provides the solid background needed for graduate study. Many of our recent graduates have been accepted to prestigious graduate programs, including UC Davis, which offers an integrated Bachelor's / Master's program.

For admission to graduate school, applicants are required to take the Graduate Record Examination (GRE), obtain three letters of recommendation, and complete application forms. Many schools require that all application materials for students applying for fellowships or assistantships be submitted by mid-December or early January. Consequently, the student should begin the application process early in the fall.

Students interested in attending graduate school should consult a faculty advisor regarding information on course selection and graduate programs.

INTEGRATED BACHELOR'S / MASTER'S PLAN

The Integrated Bachelor's Master's (BS/MS) program encourages undergraduates to consider graduate study, make course choices, and pursue undergraduate research opportunities that prepare them to complete a Master's degree in an accelerated time frame. Students must apply in Fall of their Junior year to be considered for the program.

Full details on the program may be found at www.cs.ucdavis.edu/graduate/integrated/.

COMPUTER SCIENCE COURSES

LOWER DIVISION COURSES

#	Course Title	Units
32A	Introduction to Programming Prerequisite: None. Introduction to programming and problem solving in Python. Aimed primarily at non-major students. No credit to students who completed previous ECS 010, ECS 030 or higher.	4
32B	Introduction to Data Structures Prerequisite: ECS 10 C- or better, or ECS 30 C- or better, or ECS 32A C- or better, or ECS 36A C- or better Design and analysis of data structures using Python; trees, heaps, searching, sorting, and graphs. No credit to students who completed previous ECS 36C or ECS 60 or higher..	4
34	Software Development in UNIX and C/C++ Prerequisite: ECS 32B C- or better, or Consent of Instructor. UNIX Operating system tools and programming environment. Methods for debugging and verification. Principles of C and object-oriented programming in C++. Extensive programming. Only three units of credit for students who have previously taken ECS 36B.	5
12	Introduction to Media Computation Prerequisite: None. Key computational ideas necessary to understand and produce digital media. Aimed primarily at non-computer science students, the course introduces the fundamentals of programming while also describing how media are represented and transmitted in digital form. Two units of credit for students who have taken course 10 or course 30 or Engineering 6.	4
15	Introduction to Computers Prerequisite: None. Computer uses in modern society. Emphasis on uses in non-scientific disciplines. Includes word processing, spreadsheets, web-page creation, elementary programming, basic computer organization, the Internet, the uses of computers and their influence on society. Course not intended for CS or CSE majors. Not open for credit to students who have completed course 30. Only two units of credit allowed to students who have completed Plant Science 21.	4

20	Discrete Mathematics for Computer Science Prerequisite: Grade of C- or better in Mathematics 16A, 17A or 21A. Discrete mathematics of particular utility to computer science. Proofs by induction. Propositional and first-order logic. Sets, functions, and relations. Big-O and related notations. Recursion and solutions of recurrence relations. Combinatorics. Probability on finite probability spaces. Graph theory.	4
36A	Programming and Problem Solving Prerequisite: Prior experience with basic programming concepts (variables, loops, conditional statements) required; must satisfy computer science placement exam, or C- or better in ECS 32A or ECS 10. Computers and computer programming for students with some prior experience, algorithm design, and debugging. Good programming style. Use of basic UNIX tools. Two units of credit for students who have completed ECS 32A. No credit for students who have completed ECS 32B or previous course ECS 30.	4
36B	Software Development and Object-Oriented Programming in C++ Prerequisite: Course 30 C- or better, or ECS 36A C- or better. Object-oriented programming in C++. Basic data structures and their use. Writing good programs of increased complexity and efficiency. Methods for debugging and verification. Not open for credit to students who have taken ECS 034, previous course ECS 040 or ECS 060.	4
36C	Data Structures, Algorithms, and Programming Prerequisite: (ECS 040 C- or better or ECS 036B C- or better); ECS 020 C- or better. Design and analysis of data structures for a variety of applications; trees, heaps, searching, sorting, hashing, and graphs. Extensive programming. Not open for credit to students who have taken ECS 032B or previous ECS 060.	4
50	Computer Organization and Machine-Dependent Programming Prerequisite: ECS 040 C- or better, or ECS 034 C- or better, or ECS 036B C- or better. Comparative study of different hardware architectures via programming in the assembly languages of various machines. Role of system software in producing an abstract machine. Introduction to I/O devices and programming. Only one unit of credit allowed for students who have taken Electrical and Computer Engineering 70.	4

89A-L	Special Topics in Computer Science Prerequisite: Consent of instructor. Special topics in (A) Computer Science Theory; (B) Architecture; (C) Programming Languages and Compilers; (D) Operating Systems; (E) Software Engineering; (F) Databases; (G) Artificial Intelligence; (H) Computer Graphics; (I) Networks; (J) Computer-Aided Design; (K) Scientific Computing; (L) Computer Science. May be repeated for credit when the topic is different.	1 – 5
92	Internship in Computer Science Prerequisite: Lower division standing; project approval prior to period of internship. Supervised work experience in computer science. Pass/No Pass grading only. May be repeated for credit.	1 – 5
98	Directed Group Study Prerequisite: Lower division standing; project approval prior to period of internship. Pass/No Pass grading only.	1 – 5
99	Special Study for Lower Division Students Prerequisite: Consent of instructor. Pass/No Pass grading only.	1 – 5

UPPER DIVISION COURSES

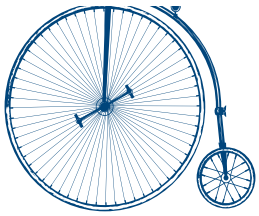
#	Course Title	Units
113	Computer Security for Non-Majors Prerequisite: ECS 010 or ECS 030 or ECS 032A or ECS 036A. Principles, mechanisms, implementation, and sound practices of computer security and data protection. Cryptography. Authentication and access control. Internet security. Malicious software. Common vulnerabilities. Practical security in everyday life. Course not intended for CS or CSE majors. Not open for credit to students who have completed course 153 or 155.	4
120	Theory of Computation Prerequisite: (ECS 020 or MAT 108); (ECS 32B or ECS 36C Recommended). Fundamental ideas in the theory of computation, including formal languages, computability and complexity. Reducibility among computational problems.	4
122A	Algorithm Design and Analysis Prerequisite: ECS 020; (ECS 060 or ECS 032B or ECS 036C). Complexity of algorithms, bounds on complexity, algorithms for searching, sorting, pattern matching, graph manipulation, combinatorial problems, randomized algorithms, introduction to NP-complete problems.	4
122B	Algorithm Design and Analysis Prerequisite: ECS 122A; (ECS 060 or ECS 034 or ECS 036C). Theory and practice of hard problems and problems with complex algorithmic solutions. NP-completeness, approximation algorithms, randomized algorithms, dynamic programming, and branch and bound. Students do theoretical analysis, implementation and practical evaluations. Examples from parallel, string, graph, and geometric algorithms.	4

124	Theory and Practice of Bioinformatics Prerequisite: (ECS 010 or ECS 032A or ECS 030 or ECS 036A or ENG 006); (STA 012 or STA 013 or STA 013Y or STA 032 or STA 100 or STA 131A or MAT 135A or BIM 105); (BIS 002A or MCB 010). Fundamental biological, mathematical and algorithmic models underlying bioinformatics and systems biology; sequence analysis, database search, genome annotation, clustering and classification, functional gene networks, regulatory network inference, phylogenetic trees; applications of common bioinformatics tools in molecular biology and genetics.	4
127	Cryptography Prerequisite: (ECS 020 or MAT 108); (ECS 010 or ECS 032A or ECS 030 or ECS 036A). Introduction to the theory and practice of cryptographic techniques used in computer security. Encryption (secret-key and public-key), message authentication, digital signatures, entity authentication, key distribution, and other cryptographic protocols. The social context of cryptography.	4
129	Computational Structural Bioinformatics Prerequisite: (BIS 002A or MCB 010); (ECS 010 or ECS 032A or ECS 036A or ENG 006). Fundamental biological, chemical and algorithmic models underlying computational structural biology; protein structure and nucleic acids structure; comparison of protein structures; protein structure prediction; molecular simulations; databases and on line services in computational structural biology.	4
130	Scientific Computation Prerequisite: (ECS 030 or ENG 006); (ECS 032A or ECS 036A); (MAT 022A or MAT 067). Matrix-vector approach using MATLAB for floating-point arithmetic, error analysis, data interpolation, least squares data fitting, quadrature, zeros, optimization and matrix eigenvalues and singular values. Parallel computing for matrix operations and essential matrix factorizations.	4
132	Probability and Statistical Modeling for Computer Science Prerequisite: (ECS 040 or ECS 034 or ECS 036B); ECS 050; MAT 021C; (MAT 022A or MAT 067). Univariate and multivariate distributions. Markov models. Sampling, estimation and model building. Regression analysis. Applications to data mining, networks, disk systems, security, software engineering and bioinformatics.	4
140A	Programming Languages Prerequisite: ECS 050; (ECS 060 or ECS 032B or ECS 036C); ECS 150. Syntactic definition of programming languages. Introduction to programming language features including variables, data types, data abstraction, object-orientedness, scoping, parameter disciplines, exception handling. Non-imperative programming languages. Comparative study of high-level programming languages.	4
140B	Programming Languages Prerequisite: 140A. Continuation of programming language principles. Further study of programming language paradigms such as functional and logic; additional programming language paradigms such as concurrent (parallel); key implementation issues for those paradigms; and programming language semantics.	4
142	Compilers Prerequisite: ECS 20, ECS 50, ECS 140A, and ECS 120 recommended. Principles and techniques of lexical analysis, parsing, semantic analysis, and code generation. Implementation of compilers.	4
145	Scripting Languages and Their Applications Prerequisite: ECS 034 or ECS 036C; or Consent of Instructor. Goals and philosophy of scripting languages, with Python and R as prime examples. Applications include networking, data analysis and display, and graphical user interfaces (GUIs).	4
150	Operating Systems and System Programming Prerequisite: (ECS 034 or ECS 036C); (ECS 154A or EEC 170). Basic concepts of operating systems and system programming. Processes and interprocess communication / synchronization; virtual memory, program loading and linking; file and I/O subsystems; utility programs.	4

152A	Computer Networks Prerequisite: (ECS 060 or ECS 032B or ECS 036C); (ECS 132 or EEC 161 or MAT 135A or STA 131A or STA 120 or STA 032). Overview of computer networks, TCP/IP protocol suite, computer-networking applications and protocols, transport-layer protocols, network architectures, Internet Protocol, routing, link-layer protocols, local area and wireless networks, medium access control, physical aspects of data transmission, and network-performance analysis. Cross listed as EEC 173A. Only 2 units of credit for students who have taken course 157.	4
152B	Computer Networks Prerequisite: ECS 150; (ECS 152A or EEC 173A). TCP/IP protocol suite, computer networking applications, client-server and peer-to-peer architectures, application-layer protocols, transport-layer protocols, transport-layer interfaces, sockets, network programming, remote procedure calls, and network management.	4
152C	Advanced Topics in Computer Networks Prerequisite: Course 152A or EEC 173A. Advanced topics in computer networks, wireless networks, multimedia networking, traffic analysis and modeling, network design and management, network simulation and performance analysis, and design projects in communication networks. Same course as EEC 173B.	4
153	Computer Security Prerequisite: ECS 150; (ECS 152A or EEC 173A). Principles, mechanisms, and implementation of computer security and data protection. Policy, encryption and authentication, access control, and integrity models and mechanisms; network security; secure systems; programming and vulnerabilities analysis. Study of an existing operating system. Not open for credit to students who have completed ECS 155.	4
154A	Computer Architecture Prerequisite: Course 50 or EEC 70. Introduction to digital design. Interrupts and interconnection hardware. Caching and memory hierarchy design. Hardware support for operating systems software (virtual memory). Only one unit of credit allowed for students who have taken EEC 170.	4
154B	Computer Architecture Prerequisite: Course 154A or both EEC170 and EEC 180A. Overview of Uniprocessor CPUs. Hardwired and microprogrammed CPU design. Pipelining. Memory Hierarchy design. Multiprocessors and Parallelism.	4
158	Programming on Parallel Architectures Prerequisite: ECS 150 and ECS 154B recommended. Techniques for software development using the shared-memory and message-passing paradigms on parallel architectures and networks of workstations. Locks, barriers, and other techniques for synchronization. Performance issues, such as memory contention and network latency and bandwidth. Introduction to parallel algorithms.	4
160	Software Engineering Prerequisite: ECS 140A; extensive programming experience recommended. Requirements, specification, design, implementation, testing, and verification of large software systems. Study and use of software engineering methodologies. Team programming.	4
161	Modern Programming Tools Prerequisite: (ECS 040 or ECS 032B or ECS 036B). Concepts and practice of collaborative software development using modern software tools	4

162	Web Programming Prerequisite: ECS 030 or ECS 034 or ECS 036B; or equivalent programming experience in C and the Unix environment. Technical aspects of building websites, including both server-side and client-side software development	4
163	Information Interfaces Prerequisite: ECS 060 or ECS 032B or ECS 036C. Art and science of information visualization and interfaces for information systems. Design principles of human-computer interaction. Visual display and navigation of nonspatial and higher dimensional data. Implementations, performance issues, tradeoffs, and evaluation of interactive information systems.	4
165A	Database Systems Prerequisite: ECS 060 or ECS 032B or ECS 036C. Database modeling and design (E/R model, relational model), relational algebra, query languages (SQL), file and index structures, query processing, transaction management.	4
165B	Database Systems Prerequisite: ECS 165A; (ECS 060 or ECS 034 or ECS 036C). Data modeling (object-relational, graph-based, spatiotemporal models). Querying semistructured data (XML). Database theory (normalization, integration, provenance). Database programming (stored procedures, embedded SQL, web programming). Advanced topics (data warehousing, parallel data processing).	4
170	Artificial Intelligence Prerequisite: ECS 060 or ECS 032B or ECS 036C. Design and implementation of intelligent computer systems. Intelligent search, adversarial search in games, reasoning with graphical models, reinforcement learning and connectionist machines.	4
171	Machine Learning Prerequisite: (ECS 060 or ECS 032B or ECS 036C); (Probability equivalent to STA 032 or STA 131A or ECS 132); (Linear algebra equivalent or MAT 22A). Introduction to machine learning. Supervised and unsupervised learning, including classification, dimensionality reduction, regression and clustering using modern machine learning methods. Applications of machine learning to other fields.	4
173	Image Processing and Analysis Prerequisite: (MAT 067 C- or better or MAT 022A C- or better); (ECS 060 or ECS 032B or ECS 036C). Techniques for automated extraction of high-level information from images generated by cameras, three-dimensional surface sensors, and medical devices. Typical applications include detection of objects in various types of images and describing populations of biological specimens as they appear in medical imagery.	4
174	Computer Vision Prerequisite: (ECS 060 or ECS 032B or ECS 036C); (STA 032 or STA 131A or MAT 135A or EEC 161 or ECS 132 recommended); (MAT 022A or MAT 067). Computer vision is the study of enabling machines to “see” the visual world (e.g., understand images and videos). Explores several fundamental topics in the area, including feature detection, grouping and segmentation, and recognition	4
175	Computer Graphics Prerequisite: (ECS 060 or ECS 034 or ECS 036C); (MAT 022A or MAT 067). Principles of computer graphics, with a focus on interactive systems. Current graphics hardware, elementary operations in two-and three-dimensional space, geometric transformations, camera models and interaction, graphics system design, standard graphics APIs, individual projects.	4
177	Scientific Visualization Prerequisite: Course 175. Computer graphics techniques for generating images of various types of measured or computer-simulated data. Typical applications for these graphics techniques include study of air flows around car bodies, medical data, and molecular structures.	4

178	Geometric Modeling Prerequisite: Course 175. Mathematical and interactive graphics techniques for defining and manipulating geometrical shapes, with applications in geometric modeling environments, e.g., computer animation systems, computer-aided design systems (car, aircraft and ship design), or creation of continuous geometry and functions from points.	4
188	Ethics in an Age of Technology Prerequisite: Upper division standing. Foundations of ethics. Views of technology. Technology and human values. Costs and benefits of technology. The character of technological change. The social context of work in computer science and engineering.	4
189A-L	Special Topics in Computer Science Prerequisite: Consent of instructor. Special topics in (A) Computer Science Theory; (B) Architecture; (C) Programming Languages and Compilers; (D) Operating Systems; (E) Software Engineering; (F) Databases; (G) Artificial Intelligence; (H) Computer Graphics; (I) Networks; (J) Computer-Aided Design; (K) Scientific Computing; (L) Computer Science. May be repeated for credit when the topic is different.	1 – 5
190C	Research Group Conferences in Computer Science Prerequisite: Consent of Instructor. Upper division standing in Computer Science or Computer Science and Engineering. Research group conferences. Pass/No Pass grading only. May be repeated for credit.	1
190X	Senior Seminar Prerequisite: Senior standing. Examination of a special topic in a small group setting.	2
192	Internship in Computer Science Prerequisite: Mandatory Completion of a minimum of 84 units prior to enrollment; project approval prior to period of internship. Supervised work experience in computer science.	1 – 5
193A	Senior Design Project Prerequisite: Senior standing in Computer Science or Computer Science and Engineering, or consent of instructor. Course 160 (may be concurrent) recommended. Team design project involving analysis, design, implementation and evaluation of a large-scale problem involving computer and computational systems. The project is supervised by a faculty member. Students must take course 193A and 193B to receive credit. Deferred grading.	3
193B	Senior Design Project Prerequisite: Senior standing in Computer Science and ECS 193A in the previous quarter. Team design project involving analysis, design, implementation and evaluation of a large-scale problem involving computer and computational systems. The project is supervised by a faculty member. Students must take course 193A and 193B to receive credit. Deferred grading.	3



197T	Tutoring in Computer Science Prerequisite: Upper-division standing; consent of instructor. Tutoring in computer science courses, especially introductory courses. Pass/No Pass grading only.	1 – 3
198	Directed Group Study Prerequisite: Lower division standing; project approval prior to period of internship. Pass/No Pass grading only.	1 – 5
199	Special Study for Advanced Undergraduates Pass/No Pass grading only.	1 – 5

UC DAVIS
COMPUTER SCIENCE