

# Computer Science, Ph.D.

Computer Science encompasses both theoretical and practical aspects of design, analysis, and implementation of computer systems, as well as applications of computing to numerous other fields. Core research areas include: (1) artificial intelligence and machine learning, (2) bioinformatics, (3) computer architecture, (4) embedded systems, (5) graphics and computer vision, (6) database systems and information management, (7) multimedia and gaming, (8) networks and distributed systems, (9) programming languages and compilers, (10) security, privacy, and cryptography, (11) design and analysis of algorithms, and (12) scientific computing.

The Ph.D. degree in Computer Science (CS) is a broad and flexible program, offering students opportunities for in-depth graduate study and cutting-edge research, covering a broad range of topics in Computer Science.

## Required Courses

Each student must complete at least 47 units of course work with an average GPA of at least 3.5 for Ph.D. students. In addition, students must receive at least a B in each course counted toward filling these requirements. The set of core and elective courses chosen by a student must be approved by the student's research advisor before advancement to candidacy. Faculty associated with each research area will provide suggested curricula for that area to guide students in their selection of courses. These curricula will also help Ph.D. students to prepare for their candidacy examination (see below) which must be taken in a specific research area.

Students must complete three quarters of COMPSCI 200S, four core courses, and seven elective courses. The course requirements are as follows:

Students must select four areas from the list of seven areas given below. From each area, they must select at least one of the courses listed for that area.

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| <b>Data Structures and Algorithms</b>  |  |
| COMPSCI 260                            | Fundamentals of the Design and Analysis of Algorithms  |
| COMPSCI 261                            | Data Structures  |
| COMPSCI 263                            | Analysis of Algorithms                                 |
| <b>Architecture/Embedded Systems</b>   |  |
| COMPSCI 250A                           | Computer Systems Architecture                          |
| COMPSCI 244                            | Introduction to Embedded and Ubiquitous Systems        |
| <b>System Software</b>                 |  |
| COMPSCI 205                            | Computer and Systems Security                          |
| COMPSCI 241                            | Advanced Compiler Construction                         |
| COMPSCI 230                            | Distributed Computer Systems                           |
| <b>Artificial Intelligence</b>         |  |
| COMPSCI 271                            | Introduction to Artificial Intelligence                |
| COMPSCI 273A                           | Machine Learning                                       |
| <b>Networks/Multimedia</b>             |  |
| COMPSCI 232                            | Computer and Communication Networks                    |
| COMPSCI 203                            | Network and Distributed Systems Security               |
| <b>Database Systems</b>                |  |
| COMPSCI 222                            | Principles of Data Management                          |
| COMPSCI 223                            | Transaction Processing and Distributed Data Management |
| <b>Scientific and Visual Computing</b> |  |
| COMPSCI 206                            | Principles of Scientific Computing                     |
| COMPSCI 211A                           | Visual Computing                                       |

Seven elective courses selected from any ICS graduate program, except COMPSCI 290, COMPSCI 296, COMPSCI 298, and COMPSCI 299, any course with a suffix of "S", "W", or "P" (e.g., 209S), and any non-COMPSCI course with a prefix "29" (e.g., 295).

## Notes/Restrictions:

- At most, two COMPSCI 295 courses are allowed.
- At most, two upper-division undergraduate courses are allowed, from the list below:

|             |                          |
|-------------|--------------------------|
| COMPSCI 111 | Digital Image Processing |
| COMPSCI 112 | Computer Graphics        |

|              |   |
|--------------|---|
| COMPSCI 122A | Introduction to Data Management                 |
| COMPSCI 132  | Computer Networks                               |
| COMPSCI 142A | Compilers and Interpreters                      |
| COMPSCI 143A | Principles of Operating Systems                 |
| COMPSCI 152  | Computer Systems Architecture                   |
| COMPSCI 161  | Design and Analysis of Algorithms               |
| COMPSCI 171  | Introduction to Artificial Intelligence         |
| COMPSCI 177  | Applications of Probability in Computer Science |
| COMPSCI 178  | Machine Learning and Data-Mining                |
| I&C SCI 161  | Game Engine Lab                                 |
| I&C SCI 162  | Modeling and World Building                     |
| I&C SCI 163  | Mobile and Ubiquitous Games                     |
| I&C SCI 166  | Game Design                                     |

- At most, two courses from combined 1 and 2 above are allowed.
- At most, two courses are allowed from non-ICS UCI graduate programs, with written consent of the advisor.
- Any course that was used toward an undergraduate degree cannot be used toward graduate requirements.

Ph.D. students are required to serve as teaching assistants for at least two quarters.

### Prior to Advancement to Candidacy

Prior to advancement to candidacy a student must complete all required coursework and pass all comprehensive examinations/thesis; affiliate with an advisor by the end of the sixth quarter in the program; complete a research project with an advisor to demonstrate research aptitude.

### Advancement to Candidacy Examination

The objective of the candidacy examination is to demonstrate in-depth knowledge of an area of computer science and readiness to carry out independent research at the doctoral level in that area. All requirements for candidacy including the candidacy examination must be completed by the end of the third year (or, for students entering the program with an M.S. in Computer Science, by the end of the second year). If the student does not pass on the first trial, the student will be allowed until the end of the first quarter of the fourth year to advance to candidacy. Consult the ICS Graduate Office for policies regarding committee membership. The format is an oral examination during which the student is tested on knowledge relevant to the chosen area of specialization. Each area is defined by a set of topics and reading list, which are maintained by the Computer Science Department office. New areas or changes to existing areas must be approved by a majority vote of the CS faculty in accordance with the Department's bylaws. The current areas include the following: Algorithms and Data Structures; Computer Architecture and Embedded Systems; Database Systems and Multimedia; Computer Networks; Distributed Systems; Artificial Intelligence and Machine Learning; Informatics in Biology and Medicine; Computer Graphics and Visual Computing; Cryptography and Computer Security; Computational Neuroscience; Scientific Computing; Systems Software.

The examination is graded pass or fail. In order to pass, the Candidacy Committee must unanimously approve the final outcome. In the case of a fail, the examination may be retaken once. Students who fail on the second try will be recommended for disqualification from the doctoral program.

The advancement exam must be passed at least three quarters prior to the doctoral dissertation and final exam.

### Doctoral Dissertation Topic Defense

The student must produce a substantial written document representing the dissertation plan. This must include the proposed dissertation abstract, a dissertation outline, and a detailed plan for completing the work. A dissertation defense committee is formed in accordance with UCI Senate regulations. The dissertation committee must unanimously approve the student's proposal. At the discretion of the student's advisor, the student may be required to give an oral presentation of the proposed plan to the committee. This must be completed by the end of the fourth year. It is expected that this will be done at least a year prior to the final examination and before most of the dissertation research and writing are undertaken. The idea is for students to demonstrate that they have a clear plan for carrying out the research for their dissertation. It also gives the student an understanding of what will be expected for final approval of the dissertation.

### Doctoral Dissertation and Final Examination

Ph.D. students are required to complete a Ph.D. dissertation in accordance with Academic Senate regulations. In addition, they must pass an oral dissertation defense which consists of a public seminar presenting results followed by a private examination by the doctoral committee and other interested members of the Computer Science Department faculty.

Students entering the Ph.D. program with an M.S. in Computer Science must advance to candidacy within two years. All others must advance within three years. The normative time for completion of the Ph.D. is six years, and the maximum time permitted is seven years.