Proposal for a

Bachelor of Science Degree in

Computer Game Science

Submitted by

Department of Computer Science
and
Department of Informatics
Donald Bren School of Information and Computer Sciences
University of California, Irvine

I. Introduction

1. Name of major and degree title

Bachelor of Science in Computer Game Science

2. School/Department/Program which will administer the major

The Department of Computer Science and the Department of Informatics in the Donald Bren School of Information and Computer Sciences

3. Faculty vote

The faculty concerned are the members of the Department of Computer Science and the Department of Informatics.

Department of Computer Science

Number eligible to vote	: 46
Number who recommend approval	:
Number who recommend against approval	:
Number who abstain	:

Department of Informatics

Number eligible to vote	:
Number who recommend approval	:
Number who recommend against approval	:
Number who abstain	:

Comments included in response to the ballot were:

4. Is the major included in the most recent five-year plan?

No.

5. Briefly describe:

(a) The historical development of the field, the discipline as offered at other UC campuses, and development of the discipline at UCI. Is the major addressed in the Campus Academic Plan?

The study of computer games is an emerging field that is driven by advancing computer hardware and software technology, the widespread popularity of video games as an entertainment medium, and by the interest of artists, social activists, economists, educators, scientists and many others to use game technologies for communication, visualization, computation and learning. Computer games can be studied from many different perspectives. Faculty in the Bren School primarily focus on games as digital learning systems, computational media - visualization and experiential tools, and complex distributed software systems.

The proposed major in Computer Game Science (CGS) is designed to attract and educate students who desire a solid foundation in computer science in the context of game design, development and production. Several hallmarks of computer games and virtual worlds which will be incorporated into the new proposed courses and organization (required and electives) of the major include an emphasis on hardware design and software engineering (ICS 51, 52, 62, 160, 161), distributed and networked systems (ICS 167), graphics and 3D modeling (ICS 162), interactivity and human-centered design (ICS 60, 63), mobility and ubiquity (ICS 163). The program is interdisciplinary with several lab and project courses (ICS 161, 168, 169A/B) aimed at teaching the students various aspects of game design, development and production, both as a stand alone single user application and as a large online multi system that requires a team effort. The goal is to provide a view of computer game systems as a communication, teaching, and entertainment media; and an interest in computer game technology as part of our culture that can be a force for education, social change, and activism.

Many faculty at UC Irvine are actively engaged in research in computer games and virtual worlds. The Bren School's Center for Games & Virtual Worlds has thirty two affiliated faculty, eighteen from the Bren School and fourteen from other schools across the campus. The Bren School and the School of the Arts have offered since 2006, a Concentration in Game Culture and Technology, which will continue if the CGS major is established. The new major has no overlap with the concentration. However, non major students can take courses in the CGS major if all the prerequisites are met.

A similar major, named Computer Science: Computer Game Design, has been offered at UC Santa Cruz by the Jack Baskin School of Engineering since Fall, 2007. The University of Southern California has also recently established programs leading to a B.S. in Computer Science (Games) and to a B.A. in Interactive Media, as well as related graduate level programs. Other technical colleges like the Laguna College for Art and Design, the Art Institute of Orange County, and DeVry Technical Institute, offer three or four year programs of study in game design, game art, or game development, but do not offer such programs within a Computer Science department. Consequently, these more vocational type programs are not treated as four year degree programs, and most of their coursework would not transfer, nor be considered as comparable to coursework offered by a major university. Currently, only a handful of research-oriented universities (UCSC, USC, Carnegie Mellon University, Georgia Tech, Worcester Polytechnic, NYU) have game oriented undergraduate majors. Of those, only UCSC and USC are offered in the Computer Science departments. The growing trend in the industry is to hire graduates that not only understand the concepts of game technology and design but also have a strong background in math, hardware and software engineering and distributed systems. The CGS degree program draws on the strengths of both the Computer Science and Informatics departments, With this degree, UC Irvine has the opportunity to be a leader in the rapidly growing area of games.

(b) Why is it important to begin the major now?

- The proposed B.S. in Computer Game Science builds upon the establishment

of the Bren School Center for Computer Games and Virtual Worlds, established in Summer 2009.

- Enrollment in traditional computer science degrees is on a downward trend nationwide, and has been particularly sharp at UC Irvine. This trend raises the need for rethinking degree programs in order to attract more students to increase the overall enrollment levels in the school of ICS.
- Orange County is a world wide center of computer game development. Dozens of video game companies are located in Irvine and nearby cities, including Blizzard (now a branch of Activision Blizzard), one of the three largest software (not just game) companies in the world. Several of these companies have been started by UC Irvine alumni.

(c) Ways in which the program will meet the needs of society

We know of more than 35 computer game companies located in Orange County, and another 75 located in the Los Angeles and San Diego corridor. California is the world center for the computer game industry, with six of the ten largest game companies, and Southern California is the regional base for most of this industry with four of these companies. This is one reason all the other leading game companies in the world, especially those based in South Korea, have setup offices in Orange County. So our proposed program is located within one of the world's leading industrial centers for computer games.

(d) Is this considered a standard major at other major research universities?

No, Computer Game Science is not a standard major at most other major research universities in the United States. This is not surprising; UCI is in the unique position of being one of the first universities in the country that has a critical mass of faculty in the area of Computer Game Science.

Many universities offer Game Studies programs which are not based on computer science and programming. Most of these have a strong Art and Design focus and are taught out of schools or departments other than Computer Science.

6. Address the following educational aspects of the major:

(a) Educational goals and objectives of the major, that is, what graduating seniors are expected to know or be able to do at the end of their course of study, and how this will be assessed

The main objective is to create a degree program in Computer Game Science that will:

- provide students with a solid foundation in computer science and mathematics;
- teach students how to design, implement, and critique computer games;
- provide students with extensive experience developing a wide range of computer game systems - ranging from entertainment to learning and

visualization;

The student learning outcomes for the Computer Game Science program are as follows:

- to be able to create interactive and human-centered computer game designs;
- to be able to employ an interdisciplinary approach to computer game design and development, an approach that draws on expertise in a number of areas such as modeling and design, graphics, software engineering, hardware architectures, AI, algorithms, distributed systems, human interfaces, and aesthetics;
- to be able to discuss, in writing, computer game systems as communication, teaching, and entertainment media; and
- to be able to describe computer game technology as part of our societal culture that can be a force for education, social change, and activism.

These outcomes will be addressed throughout the program's core curriculum, as evidence by the table below that shows the connection between the student learning outcomes and core courses:

Core Course	Outcome 1 (Create interactive and human-centered computer game designs)	Outcome 2 (Employ an interdisciplinary approach to computer game design and development)	Outcome 3 (Discuss computer systems as communication, teaching, and entertainment media)	Outcome 4 (Describe computer technology as part of our societal culture)
Computer Games and Society			x	x
Game Systems and Design		x	x	
Game Technologies and Interactive Media	x	x	x	
Game Engines & Hardware		x		
Game Engine Lab	x			
Modeling & World Building	x	x		x
Multiplayer Game Systems			x	x
Multiplayer Game Project	x	x		
Mobile & Ubiquitous Games		x	x	

Capstone Game Project A	x	x	x	x
Capstone Game Project B	x	x	x	x

This major includes a two-quarter senior capstone course that integrates the students' coursework and gives them an opportunity to apply it by working on a team and designing and building a significantly sized computer game.

(b) How the proposed structure of the curriculum leads to the achievement of the stated learning goals and objectives. This may take the form of a curriculum matrix that aligns courses with learning outcomes; a description of a capstone course; a discussion of prerequisite courses and progression in the major; an explanation of how introductory courses provide a foundation needed for success in the upper division courses; or an explanation of how and where in the curriculum students will develop both breadth and depth in the discipline.

The lower-division CGS curriculum is a superset of the lower division courses in the Information and Computer Science major. At the lower division level, CGS students take six courses (32 units) of introductory computer science, programming, computer organization, and software engineering, as well as six courses (24 units) in mathematics and statistics and one course in Physics (4 units). To initiate their study of computer games, CGS majors take three lower division courses, ICS 60, ICS 61 and ICS 62 (12 units) that cover the societal impacts of games, the design and history of video games, and the technological underpinnings of computer games. In order to appreciate computer games as media and to understand the relationship of games to film and new media, CGS majors take the Film and Media Studies three quarter introductory sequence, Flm&Mda 85A-B-C (12 units).

The lower division CGS curriculum is substantial and prepares students to think about computer games in a sophisticated, critical, and capable way. Students will acquire a firm quantitative grounding in computation, mathematics, physics, and statistics, and will be familiar with the cultural and historical context of computer games.

The foundation of the upper-division CGS program is the new course ICS 160, Game Engines and Hardware, which is followed by the new ICS 161, Game Engine Lab. In ICS 160, students are introduced to two technological underpinnings of modern computer games: specialized video hardware, and game engine software that encapsulates a vast amount of functionality (including communicating with the video hardware and the drivers for that hardware). In ICS 161 students apply what they learned in ICS 160 as they implement a computer game that is based on a game engine and which takes advantage of advanced hardware capabilities. After completing ICS 160 and ICS 161, CGS students will have both the theoretical and the practical knowledge required to study computer games in a sophisticated and mature way.

Other new upper-division courses in the CGS major also contribute essential learning to the students. In ICS 162, Modeling and World Building, students become familiar with the concepts of 3D content creation and the software which is used to design and animate

the characters, objects, structures, and landscapes which appear in many computer games. In ICS 163, Mobile and Ubiquitous Computing, students look beyond desktop and console based games to the rapidly approaching world where games and other forms of interactive media are widely present. The two courses ICS 167 and ICS 168 focus on multiplayer, networked, and persistent game worlds, an area of vast economic and intellectual interest.

An important component of the Computer Game Science major is the flexible set of upper-division electives. These electives are organized into tracks, and are listed in the following paragraph (track names are underlined). The goals of the elective structure are to give students a choice of where to specialize within the many technical areas that contribute to computer game development, to encourage students to take a variety of courses from several areas, and to leverage the many excellent courses currently offered by the Department of Computer Science and the Department of Informatics. The CGS major requires a student to take seven elective courses. To ensure a deep understanding of two sub-fields, a student's electives must include three courses in one ICS track and two courses in a second ICS track. The other two elective courses can be selected from the ICS tracks or from the large set of courses in Management, Mathematics, Cognitive Science, and Film and Media Studies as listed below.

ICS tracks

Algorithms: CS 161 (Design and Analysis of Algorithms); one of CS 162 (Formal Languages and Automata), CS 163 (Graph Algorithms), CS 164 (Principles of Computational Geometry); CS 165 (Project in Algorithms and Data Structures).
Artificial Intelligence: CS 171 (Introduction to Artificial Intelligence); one of ICS 174 (Bioinformatics), CS 177 (Applications of Probability in Computer Science), CS 178 (Machine Learning), CS 179 (Algorithms for Probabilistic and Deterministic Graphical Models); CS 175 (Project in Artificial Intelligence).
Computational Biology: CS 183 (Introduction to Computational Biology; CS 184A (Representations and Algorithms for Molecular Biology), CS 184B (Probabilistic Modeling of Biological Data), CS 184C (Computational Systems Biology).
Computer Graphics and Vision: CS 112 (Computer Graphics); one of CS 111 (Digital Image Processing), CS 116 (Computational Photography and Vision); one of CS 114 (Projects in Advanced 3D Computer Graphics), CS 117 (Project in Computer Vision).
Computer Networks: CS 132 (Computer Networks); two of CS 131 (Distributed Computing, CS 133 (Advanced Computer Networks), CS 134 (Computer and Network Security).
Databases: CS 122A (Introduction to Data Management); one of CS 121/Inf 141 (Information Retrieval), CS 125 (Next Generation Search Systems); CS 122B (Project in Database Management).
Hardware: CS 151 (Digital Logic Design), one of CS 145A (Embedded Computer Systems), CS 152 (Computer Systems Architecture), CS 153 (Logic Design Laboratory); CS 154 (Computer Design Laboratory).
Human Computer Interaction: Inf 131 (Human Computer Interaction); Inf 133 (User Interaction Software); one of Inf 132 (Project in Human-Computer Interaction and User Interfaces), Inf 134 (Project in User Interaction Software).

Operating Systems: CS 143A (Principles of Operating Systems); one of CS 144 (High-Performance Computers and Program Optimization), CS 146 (Programming in Multitasking Operating Systems); CS 143B (Project in Operating System Organization).
Programming Languages and Compilers: Inf 101/CS 141 (Concepts in Programming Languages I); CS 142A (Compilers and Interpreters); one of Inf 102 (Concepts of Programming Languages II), CS 142B (Language Processor Construction).
Project Management: Inf 111 (Software Tools and Methods); Inf 161 (Social Analysis of Computerization); one of Inf 151 (Project Management), Inf 162 (Organizational Information Systems).
Simulation and Optimization: CS 169 (Introduction to Optimization); CS 168 (Network Optimization); CS 115 (Computer Simulation).
Social Impacts of Computing: Inf 161 (Social Analysis of Computerization); Inf 162 (Organizational Information Systems); Inf 163 (Project in the Social and Organizational Impacts of Computing).
Software Design: Inf 121 (Software Design I), Inf 122 (Software Design II), Inf 123 (Software Architectures, Distributed Systems, and Interoperability).
Software Engineering: Inf 111 (Software Tools and Methods); Inf 113 (Requirements Analysis and Engineering); Inf 115 (Software Testing, Analysis, and Quality Assurance).

Non-ICS tracks
Business Management: Mgmt 101 (Management Science), Mgmt 102 (Managing Organizational Behavior), Mgmt 105 (Introduction to Marketing), Mgmt 107 (Introduction to Management Information Systems), Mgmt 109 (Introduction to Managerial Finance), Mgmt 121 (Global Collaboration), Mgmt 153 (Integrated Marketing Communication), Mgmt 154 (International Marketing).
Cognitive Science: Psych 130A (Perception and Sensory Processes), Psych 131A (Vision), Psych 131B (Hearing), Psych 135M (The Mind/Body Problem), Psych 135 A-B-C (Memory and Decision Making Research), Psych 140C (Cognitive Science).
Mathematics: Math 112A-B-C (Introduction to Partial Differential Equations and Applications), Math 115 (Mathematical Modeling), Math 121A-B (Linear Algebra).
Film and Media Studies: Flm&Mda 113 (Narrative/Image), Flm&Mda 143 (Critical Theory of Television), Flm&Mda 185 (Television and New Media).

The culmination of the upper-division program is a two-quarter project sequence in the senior year. The capstone project courses will be the primary source of assessment evidence. In this course sequence, the students (seniors) will be required to work in teams and design and develop a fully operational game using all the knowledge and skills they acquired throughout the program. The assessment of these capstone projects will take place at the end of the spring quarter. A variation of the following scoring rubric will be used to assess the student projects:

Criteria	Below Expectations	Meet Expectations	Exceeds Expectations
A fully operational interactive and human-centered computer game on par with other student-developed games at the Annual Game Developers Conference.			
The computer game employs an interdisciplinary approach to design and development, drawing on a number of disciplinary areas.			
The project's final report discusses their computer game system as communication, teaching, and entertainment media.			
Students formed into a functioning team, in which each individual team member demonstrated their strengths and expertise developed throughout the program.			

(c) Distinctive features of the major which differentiate it from similar majors offered at UCI and at other major research universities

At UC Irvine, Computer Game Science is most similar to Information and Computer Science; two students in the two majors could easily take twenty-one of the same courses for their respective majors. What most distinguishes the CGS major from other computer science based majors (such as, at UCI, Computer Science, Information and Computer Science, Informatics, and Computer Science and Engineering) is the twelve new courses

that are part of this proposal and that all CGS majors will take. In these courses the students will learn fundamentals and principles about software, hardware, programming languages, teamwork, and the relationship between technology and society. They will also use computer games as a lens to focus what they have learned in other courses. For instance, a student interested in Artificial Intelligence might make that one of his or her tracks in the electives portion of the major. Then in courses such as ICS 163 Mobile and Ubiquitous Computing, ICS 168 Multiplayer Game Project, and especially ICS 169A-B Capstone Game Project the student will have the opportunity to design and implement a novel and extensive in-game AI that is a major part of a game, applying knowledge that was acquired during the track's electives. Even if this student does not pursue a career or graduate studies related to Artificial Intelligence, the experience of taking knowledge from lecture courses and using it in a project that is personally important and very visible to others could well be transformative.

7. Elements and timetable for developing and sustaining the major (e.g., faculty hiring, departmentalization, curricular development, space, library, student support services, etc)

We expect to roll out the major over the four years following its approval and first appearance in the catalog, such that, by the end of year 4, all courses including the Capstone Game Project will have been taught at least once and a regular teaching schedule will have been established. The school has allocated a large space on the ground floor of Bren Hall for the Computer Game and Interactive Media Lab. This space will be used to teach the different project and lab courses taught in the major.

Over time, we do expect a strong influx of students, given the current and projected growth in the field of Computer Games and Interactive Media. Should this level be achieved and sustained, we expect to broaden the program with future specializations and new classes, which may lead to our requesting funds for additional faculty positions at that time. For example, one anticipated growth path, reserved for the future, would involve transforming the introductory programming course sequence ICS 21, 22, 23 into a version specialized to Computer Game Science which would have the similar educational content but use game, virtual world, and simulation examples and homework assignments and introduce C++ programming, therefore eliminating the need for the separate C++ programming course (ICS 65) required now for the major. We also envision developing three tracks in the degree program that will address different interests that students may have in computer games. A Games Studies track would focus more on societal issues surrounding games and interactive media, Game Core Technologies would focus more on the hardware underlying computer games, and Game Design would incorporate a stronger Arts component.

Since the degree program is being established within the School of Information and Computer Sciences, we expect that students will exploit existing resources within the School for student services, guidance, exercises, laboratories, and so on.

8. What is the relationship of the proposed major to existing programs on campus? What effect will the proposed major have on other undergraduate and graduate programs at UCI?

The proposed major is complementary to existing programs on campus, such as computer science, informatics, film and media studies, and studio art. We expect that the proposed degree program will not significantly affect enrollment in other ICS degree programs or programs in other schools.

As the proposed Computer Game Science degree program involves required courses from Film and Media Studies, Mathematics, and Physics, the School of Humanities and the School of Physical Sciences may experience an increase in enrollment for the classes related to the new major. The CGS major also includes elective courses in Mathematics, Management, Cognitive Science, and Film and Media Studies.

Otherwise, we expect minimal impact on other degree programs.

II. Projected Demand

1. Projected student demand for the major (include estimated number of majors each year for the first five years)

Projected student demand is high. Surveys conducted by the Bren School Student Affairs Office show that for many high school students, video games is what draws them to study computers. A recent visit to a neighborhood high school mentoring program showed that out of the 21 juniors interested in joining a Computer Science program, 9 wanted to specialize in video/computer games. In 2006-07, 2007-08, and 2008-09 the Division of Undergraduate Education offered a very popular three quarter sequence titled Computer Games as Art, Culture, and Technology. Within the Bren School, the upper division elective Computer Game Development has been offered once or twice a year since 1999, with annual enrollments of 40-50 students. The School of the Arts offers several courses that pertain to computer games and these classes are well populated.

Student interest in studying computer games is driven both by their enjoyment of the games themselves, and by the expanding career opportunities for people who have both a solid technical foundation and exposure to game specific concepts. PricewaterhouseCoopers predicts that the video game market will expand to $46 billion world wide in 2010.[1] As noted above, many game, entertainment, and media companies are in Southern California.

Recently introduced game-oriented majors at UC Santa Cruz and the University of Southern California have been quite successful in attracting new students to their campuses. The following table shows the number of freshmen selecting the traditional Computer Science and the new game focused majors at UCSC and USC, plus combined UCI Bren School majors for comparison.[2] Blanks indicate data is not available.

University and Major	2003	2004	2005	2006	2007	2008	2009
UCSC Computer Science	33	19	22	22	25	24	
UCSC Computer Game Design					55	70	
USC Computer Science				36	24		
USC Computer Science (Games)					24		
UCI All Bren School majors except Business Information Management	277	197	153	184	155	137	91

[1] "PricewaterhouseCoopers Says Entertainment and Media Industry in Solid Growth Phase" at http://www.pwc.com/tr/en/press-releases/entertainment-media-growth.jhtml.

[2] UC Santa Cruz information from "New Fall Freshmen by Proposed Major (historical, MC)" at http://planning.ucsc.edu/irps/majors.asp. Univ. of Southern California data from Zyda, M., Lacour, V., and Swain, C., Operating a computer science game degree program. In *Proceedings of the 3rd International Conference on Game Development in Computer Science Education* (Miami, Florida, February 27 - March 03, 2008). GDCSE '08. ACM, New York. DOI= http://doi.acm.org/10.1145/1463673.1463688. UC Irvine data from "Total enrollment by major and student level" reports at http://www.oir.uci.edu/ .

The evidence from USCS and USC indicates that offering a game-oriented major significantly increases overall computer science enrollment. At USC it is possible that the Games major partially "cannibalized" the traditional Computer Science major, but at UCSC the Game Design major seems to have attracted students who otherwise would not have enrolled at that university. The number of incoming freshmen selecting the game-oriented major ranges from two thirds the previous year's computer science count at USC, to almost three times the previous year's computer science count at UCSC. Selecting an intermediate ratio of slightly greater than 1.0, and considering the larger size of UCI, the following table illustrates conservative estimates of student enrollment for the Computer Game Science major at UCI:

Year	**New Freshman**	**New Transfer Students**	**Students in major**	**Graduates**
1	100	0	100	0
2	100	0	200	0
3	100	50	350	0
4	100	50	500	150
5	100	50	500	150

2. The projected number of degrees to be awarded each year for the first five years

Courses in the major will be gradually introduced starting with the first year courses, with the goal of having all courses taught at least once by the end of the fourth year. We therefore expect the projected number of degrees awarded to be as follows:

Year	Number of Degrees Awarded
1	0
2	0
3	0
4	100[3]
5	150

3. Please describe student input, if any, to the development of this major

No formal or systematic approach was used to consult with undergraduates about the proposal. However, many students, including those in the active Video Game Development Club, have informally heard about the new major and have expressed tremendous enthusiasm for it.

[3] This is based on the assumption that transfer students will take 2.5 – 3yrs to complete the major due to the number of game oriented courses taught in the first two years of the program.

III. Student/Faculty Opportunities

1. Opportunities for graduates (e.g., graduate school, careers)

As the computer game industry has a large presence in California in general, and mostly in Southern California, game companies are often pre-disposed to hire people near at hand, rather than paying high fees in order to relocate professionals from other parts of the country. However, we believe that future employment opportunities will arise in firms, government agencies, science labs, and educational institutions as computer game and virtual world technologies are recognized to represent a major new source of technology-driven innovation, much like the Internet and World Wide Web have already been. UCI may be unique compared to alternative programs in that we already have research relationships in place with a number of organizations in these different sectors, and these relationships are giving rise to both research and educational projects that welcome student participation. This participation in turn gives rise to internships and potential follow-up placements. Thus, we believe UCI is well positioned both geographically and strategically to help enable and facilitate initial career opportunities for its participating students.

2. Relationship of the program to research and/or professional interests of the faculty

The Computer Game Science program is well aligned with the research and professional interests of the faculty in the Department of Computer Science and the Department of Informatics. Below, we alphabetically list the entire faculty in the Department of Computer Science and the Department of Informatics, with the respective areas of research interest.

The diverse research interests of the faculty cover the constituent areas of Computer Games: computer architectures, distributed systems, networked systems, embedded systems, software engineering, programming languages, algorithms, multimedia, human computer interfaces, long distance collaborations, graphics, mobile and ubiquitous computing, and will be taught as part of the proposed degree program.

Department of Computer Science

- James Arvo
  Research Area: Computer Graphics / Visualization / Digital Arts
- Pierre Baldi
  Research Area: Artificial Intelligence: Automated Reasoning / Machine Learning / Data Mining / Large-Scale Data Analysis: Information Access & Management / Databases / Information Infrastructure / Bio-Medical Informatics / Computational Biology
- Lichun Bao
  Research Area: Networked & Distributed Systems

- Lubomir Bic
  Research Area: Networked & Distributed Systems
- Elaheh (Eli) Bozorgzadeh
  Research Area: Computer System Design / Embedded Computer Systems
- Michael J Carey
  Research Area: Large-Scale Data Analysis: Information Access & Management / Databases / Information Infrastructure / Internet Technologies / Applications
- Rina Dechter
  Research Area: Artificial Intelligence: Automated Reasoning / Machine Learning / Data Mining
- Michael Dillencourt
  Research Area: Theory: Analysis of Algorithms and Data Structures
- Nikil Dutt
  Research Area: Computer System Design / Embedded Computer Systems / Systems Software: Operating Systems / Compilers / Programming Languages / Ubiquitous Computing
- Magda El Zarki
  Research Area: Networked & Distributed Systems / Internet Technologies / Applications / Multimedia / Wireless Networks / Sensor Networks
- David Eppstein
  Research Area: Theory: Analysis of Algorithms and Data Structures / Computer Graphics / Visualization / Digital Arts
- Charless Fowlkes
  Research Area: Artificial Intelligence: Automated Reasoning / Machine Learning / Data Mining / Bio-Medical Informatics / Computational Biology
- Michael Franz
  Research Area: Internet Technologies / Applications
  Systems Software: Operating Systems / Compilers / Programming Languages / Security & Cryptography
- Tony Givargis
  Research Area: Embedded Computer Systems
- Michael T. Goodrich
  Research Area: Security & Cryptography / Theory: Analysis of Algorithms and Data Structures / Computer Graphics / Visualization / Digital Arts
- Ian G. Harris
  Research Area: Embedded Computer Systems
- Wayne Hayes
  Research Area: Large-Scale Data Analysis: Information Access & Management / Databases / Information Infrastructure / Bio-Medical Informatics / Computational Biology / Theory: Analysis of Algorithms and Data Structures

- Daniel S. Hirschberg
  Research Area: Theory: Analysis of Algorithms and Data Structures
- Alexander Ihler
  Research Area: Artificial Intelligence: Automated Reasoning / Machine Learning / Data Mining
- Sandra Irani
  Research Area: Theory: Analysis of Algorithms and Data Structures
- Ramesh Jain
  Research Area: Artificial Intelligence: Automated Reasoning / Machine Learning / Data Mining / Large-Scale Data Analysis: Information Access & Management / Databases / Information Infrastructure / Computer Graphics / Visualization / Digital Arts
- Stanislaw Jarecki
  Research Area: Security & Cryptography
- Scott Jordan
  Research Area: Networked & Distributed Systems / Internet Technologies / Applications
- Dennis Kibler
  Research Area: Artificial Intelligence: Automated Reasoning / Machine Learning / Data Mining / Bio-Medical Informatics / Computational Biology
- Richard Lathrop
  Research Area: Artificial Intelligence: Automated Reasoning / Machine Learning / Data Mining / Bio-Medical Informatics / Computational Biology
- Chen Li
  Research Area: Large-Scale Data Analysis: Information Access & Management / Databases / Information Infrastructure / Internet Technology / Urban Crisis Response
- George S. Lueker
  Research Area: Theory: Analysis of Algorithms and Data Structures
- Aditi Majumder
  Research Area: Computer Graphics / Visualization / Digital Arts
- Gopi Meenakshisundaram
  Research Area: Computer Graphics / Visualization / Digital Arts
- Sharad Mehrotra
  Research Area: Large-Scale Data Analysis: Information Access & Management, Databases / Information Infrastructure / Networked & Distributed Systems / Internet Technologies / Urban Crisis Response
- Eric Mjolsness
  Research Area: Artificial Intelligence: Automated Reasoning / Machine Learning / Data Mining / Bio-Medical Informatics / Computational Biology

- David Newman
  Research Area: Artificial Intelligence: Automated Reasoning / Machine Learning / Data Mining / Large-Scale Data Analysis: Information Access & Management / Databases / Information Infrastructure
- Alexandru Nicolau
  Research Area: Computer System Design
  Embedded Computer Systems
  Systems Software: Operating Systems / Compilers / Programming Languages
  Ubiquitous Computing
- Natasa Przulj
  Research Area: Bio-Medical Informatics / Computational Biology
  Theory: Analysis of Algorithms and Data Structures
- Deva Ramanan
  Research Area: Artificial Intelligence: Automated Reasoning / Machine Learning / Data Mining / Large-Scale Data Analysis: Information Access & Management / Databases / Information Infrastructure / Computer Graphics / Visualization / Digital Arts
- Amelia C. Regan
  Research Area: Large-Scale Data Analysis: Information Access & Management / Databases / Information Infrastructure / Theory: Analysis of Algorithms and Data Structures / Statistics
- Isaac D. Scherson
  Research Area: Computer System Design / Embedded Computer Systems / Networked & Distributed Systems
- Padhraic Smyth
  Research Area: Artificial Intelligence: Automated Reasoning / Machine Learning / Data Mining /Large-Scale Data Analysis: Information Access & Management / Databases / Information Infrastructure / Internet Technologies / Applications / Statistics
- Tatsuya Suda
  Research Area: Networked & Distributed Systems
- Shannon Tauro
  Research Area: Embedded Computer Systems
- Gene Ho Tsudik
  Research Area: Internet / Technology
- Alexander Veidenbaum
  Research Area: Computer System Design / Embedded Computer Systems
  Systems Software: Operating Systems / Compilers / Programming Languages
- Nalini Venkatasubramanian
  Research Area: Networked & Distributed Systems / Internet Technologies / /

Applications / Ubiquitous Computing
Urban Crisis Response

- Max Welling
  Research Area: Artificial Intelligence: Automated Reasoning / Machine Learning / Data Mining / Large-Scale Data Analysis: Information Access & Management / Databases / Information Infrastructure / Statistics
- Xiaohui Xie
  Research Area: Artificial Intelligence: Automated Reasoning / Machine Learning / Data Mining / Bio-Medical Informatics / Computational Biology

Department of Informatics

- Yunan Chen
  Research Area: Interactive & Collaborative Technology: Human-Computer Interaction / Computer Supported Cooperative Work / Bio-Medical Informatics / Computational Biology
- Paul Dourish
  Research Area: Interactive & Collaborative Technology: Human-Computer Interaction / Computer Supported Cooperative Work / Security & Cryptography / Computer Graphics / Visualization / Digital Arts / Ubiquitous Computing
- Dan Frost
  Research Area: Computer Graphics / Computer Games, Computer Games for Education
- Gillian R. Hayes
  Research Area: Interactive & Collaborative Technology: Human-Computer Interaction / Computer Supported Cooperative Work / Educational Technology / Ubiquitous Computing
- James A. Jones
  Research Area: Software Engineering
- Alfred Kobsa
  Research Area: Interactive & Collaborative Technology: Human-Computer Interaction / Computer Supported Cooperative Work / Security & Cryptography / Educational Technology / Ubiquitous Computing
- Cristina V. Lopes
  Research Area: Systems Software: Operating Systems / Compilers / Programming Languages / Ubiquitous Computing / Environmental Informatics
- Gloria Mark
  Research Area**:** Interactive & Collaborative Technology: Human-Computer Interaction / Computer Supported Cooperative Work
- Melissa Mazmanian
  Research Area: Internet Technology / Interactive & Collaborative Technology: Human-Computer Interaction / Computer Supported Cooperative Work

- Bonnie Nardi
  Research Area: Interactive & Collaborative Technology: Human-Computer Interaction / Computer Supported Cooperative Work / Educational Technology
- Judy Olson
  Research Area: Interactive & Collaborative Technology: Human-Computer Interaction / Computer Supported Cooperative Work
- Gary Olson
  Research Area: Interactive & Collaborative Technology: Human-Computer Interaction / Computer Supported Cooperative Work
- Don Patterson
  Research Area: Artificial Intelligence: Automated Reasoning / Machine Learning / Data Mining / Interactive & Collaborative Technology: Human-Computer Interaction / Computer Supported Cooperative Work / Ubiquitous Computing
- David Redmiles
  Research Area: Software Engineering / Interactive & Collaborative Technology: Human-Computer Interaction / Computer Supported Cooperative Work / Security & Cryptography / Ubiquitous Computing
- Debra J. Richardson
  Research Area: Software Engineering
- Susan Sim
  Research Area: Software Engineering / Environmental Informatics
- Richard Taylor
  Research Area: Internet Technology / Software Engineering
- Bill Tomlinson
  Research Area**:** Educational Technology / Computer Graphics / Visualization / Digital Arts / Environmental Informatics
- Andre van der Hoek
  Research Area: Software Engineering / Educational Technology

IV. Program and Courses

1. Curriculum

(a) List all required and elective courses (course number and title), including all university level prerequisite and corequisite courses

In the PREREQUISITES column of the following table, courses in **bold face** are required in the CGS major; courses in *italics* are electives in the CGS major.

Computer Game Science Prerequisite Chart

COURSE NUMBER	COURSE NAME	Required	Elective	PREREQUISITES
CS 111	Digital Image Processing		x	**ICS 23**/CSE 23, **ICS6D/ Math 6D,** and **Math 6G** or 3A.
CS 112	Computer Graphics		x	**ICS 22**/CSE 22 or ICS H22.
CS 114	Projects in Advance 3D Computer Graphics		x	***CS 112*** or equivalent, recommended *CS 161/*CSE 161, *CS 164*, *CS 165.*
CS 115	Computer Simulation		x	**ICS 6B/Math 6B, Math 6G, Math 67/Stats 67, ICS 51 and ICS 52**, all with grades of C or better, upper-division standing.
CS 121	Information Retrieval		x	**ICS 23**/CSE 23/ ICS H23 or Info. 43; **Stats 7/Math 7** or **Stats 67/Math 67.**
CS 122A	Introduction to Data Management		x	Either **ICS 52** or Inf 43 with a grade of C or better (for ICS or Informatics majors; either **ICS 23**/ICS H23 or EECS 114 with a grade of C or better (for Computer Engineering majors).
CS 122B	Project in Database Management		x	*CS 122A*/EECS 116
CS 125	Next Generation Search Systems		x	**ICS 21**/CSE 21 or Info. 41 or consent of instructor, upper-division standing.

COURSE NUMBER	COURSE NAME	Required	Elective	PREREQUISITES
CS 131	Distributed Computing		x	CS141/CSE141/*Inf. 101*. Recommended: *CS 132*
CS 132	Computer Networks		x	**ICS 23**/CSE 23 or ICS H 23, **ICS 51** or CSE 132/EECS 112; **ICS 6D/ Math 6D; ICS 6B/ Math 6B; Math 6G** or 3A.
CS 133	Advanced Computer Networks		x	*CS 132* or equivalent, or consent of instructor.
CS 134	Computer and Network Security		x	**ICS 6D/Math 6D**; **ICS 22/** CSE 22 or Info 42; and one from *CS 122A/*EECS 116, *CS132*, or *CS 143A*/CSE 104.
CS 142A	Compilers and Interpreters		x	*CS 141/Inf 101*
CS 142B	Language Processor Construction		x	*CS 142A.*
CS 143B	Project in Operating System Organization		x	*CS 143A*/CSE 104
CS 144	High-Performance Computers and Program Optimization		x	**ICS 51** with a grade of C or better. Recommended: CS 142A.
CS 145A	Embedded Computing System		x	**ICS 23/CSE 23, ICS 51,** or CSE 31 and CSE 132.
CS 146	Programming in Multitasking Operating Systems		x	**ICS23**/CSE 23 and **ICS 51** with a grade of C or better.
CS 151	Digital Logic Design		x	**ICS 23**/CSE 23 and **ICS 51, ICS 6D/Math 6D/ Math 6B.**
CS 152	Computer System Architecture		x	*CS 151***.**
CS 153	Logic Design Laboratory		x	*CS 151*
CS 154	Computer Design Laboratory		x	*CS 151*
CS 161	Design and Analysis of Algorithms		x	**ICS 23**/CSE 23 and **ICS 51** or CSE 31/EECS 31, **ICS 6D/ Math 6D**; **ICS 6D/Math 6D; ICS 6B/ Math 6B**; **Math 6G** or Math 3A; **Math 2B.** Same as CSE 161.
CS 163	Graph Algorithms		x	*CS 161*/CSE 161.
CS 164	Principles of Computational		x	*CS161*/CSE 161 or

COURSE NUMBER	COURSE NAME	Required	Elective	PREREQUISITES
	Geometry			equivalent.
CS 165	Project in Algorithms and Data Structures		x	*CS 161*/CSE 161**.**
CS 168	Network Optimization		x	Upper-division standing or consent of instructor.
CS 169	Introduction to Optimization		x	Math 2D, Math 3A or **6G, Math 67/Stats 67**.
CS 171	Introduction to Artificial Intelligence		x	**ICS 23; Math 2A-B** and **Stats 67/Math 67.**
CS 174	Bioinformatics		x	**ICS 21/CSE 21, ICS 22/ CSE 22,** and **ICS 23/CSE 23;** *CS 171***.**
CS 175	Project in Artificial Intelligence		x	*CS 171*
CS 177	Applications of Probability in Computer Science		x	**Math 2A-B** and **Stats 67/Math 67; ICS 6D/Math 6D, ICS 6B/Math 6B,**and either **Math 6G** or 3A.
CS 178	Machine Learning and Data Mining		x	**ICS 6D/ Math 6D, ICS 6B/Math 6B, Math 6G** or 3A**, Math 2A-B** and **Stats 67/ Math 67.**
CS 179	Algorithms for Probabilistic and Deterministic Graphical Models		x	**ICS 23/**CSE 23; **Math 2A-B** and **Statistics 67/Mathematics 67**
CS 183	Introduction to Computational Biology		x	**Math 2D or** 2J or 7 or Stats 8.
CS 184A	Representations and Algorithms for Molecular Biology		x	Biological Science M123 or *CS 183***.**
CS 184B	Probabilistic Modeling of Biological Data		x	*CS 184A***.** Concurrent with CS 284B.
CS 184C	Computational Systems Biology		x	*CS 184B.* Concurrent with CS 284B.
F&MS 85A	Visual Media and Contemporary Culture	x		(none)
F&MS 85B	History of Broadcasting	x		**F&MS 85A** or consent of instructor.
F&MS 85C	New Technologies	x		**F&MS 85A** and **F&MS 85B** or consent of instructor.
F&MS 113	Narrative/Image		x	**F&MS 85A** or consent of instructor.
F&MS 143	Critical Theory of Television		X	**F&MS 85A-B** or consent of instructor

COURSE NUMBER	COURSE NAME	Required	Elective	PREREQUISITES
F&MS 185	Television and New Media		x	**F&MS 85A-B-C** or consent of instructor.
ICS 21	Introduction Computer Science I	x		(none)
ICS 22	Introduction Computer Science II	x		**ICS 21** or ICS H 21
ICS 23	Introduction Computer Science III	x		**ICS 22** or ICS H 22 or CSE 22 or Inf. 42 or EECS 40.
ICS 51	Introductory Computer Organization	x		**ICS 21** or ICS H 21 or CSE 21 and **Math 6B** or **ICS 6B.**
ICS 52	Introduction to Software Engineering	x		**ICS 23**, or ICS H23 or CSE 23
ICS 60	Computer Games and Society	x		(none)
ICS 61	Game Systems and Design	x		(none)
ICS 62	Game Technologies and Interactive Media	x		**ICS 21** with a grade of C or better, or Inf 41 with a grade of C or better.
ICS 65	Advanced Programming with C++	x		**ICS 23** or one year of Java programming
ICS 160	Game Engines & Hardware	x		**ICS 51** with a grade of C or better.
ICS 161	Game Engine Lab	x		**ICS 160**
ICS 162	Modeling and World Building	x		**ICS 160**
ICS 163	Mobile and Ubiquitous Games	x		**ICS 160**
ICS 167	Multiplayer Game Systems	x		**ICS 160**
ICS 168	Multiplayer Game Project	x		**ICS 167; ICS 52** with a grade of C or better.
ICS 169A	Capstone Game Project	x		**ICS 168**
ICS 169B	Capstone Game Project	x		**ICS 169A**
Inf. 101/CS 141	Concepts of Programming Languages I		x	Inf 43 with a grade of C or better; or **ICS 23** with a grade of C or better and either **ICS 51** or CSE31/EECS31 with a grade of C or better.
Inf. 102	Concepts of Programming Languages II		x	*Inf 101* with a grade of C or better
Inf. 113	Requirements Analysis and Engineering		x	Inf. 43 or **ICS 52** with a grade of C or better. Recommended: Philosophy 29.
Inf. 115	Software Testing, Analysis, and		x	**ICS 6B/Math 6B** with a

COURSE NUMBER	COURSE NAME	Required	Elective	PREREQUISITES
	Quality Assurance			grade of C or better, and either Inf. 43 or **ICS 52** with a grade of C or better. Recommended: Philosophy 29.
Inf. 121	Software Design I		x	*Inf 102* with a grade of C or better
Inf. 122	Software Design II		x	*Inf 121*
Inf. 123	Architectures, Distributed Systems, and Interoperability		x	*Inf 122* or the following: **ICS 51** with a grade of C or better; *Inf 101* and *Inf 111*; **Math 2A-B** and **Statistics 67**.
Inf. 133	User Interaction Software		x	**ICS 23** or Inf 45
Inf. 134	Project in User Interaction Software		x	*Inf 131* and *Inf 133*
Math 2A	Calculus	x		Math 1B or Placement test or AP Calculus AB (min score 3) and No AP Calculus AB score of 4 or greater and No AP Calculus BC score of 3 or greater.
Math 2B	Calculus	x		**Math 2A** or AP Calculus AB (Min score 4 or AP Calculus BC (min score 3 and No AP Calculus BC score of 4 or greater.
Math 6B/ICS 6B	Boolean Algebra and Logic	x		High school math through trigonometry.
Math 6D/ICS 6D	Discrete Mathematics for Computer Science	x		High school math through trigonometry.
Math 6G	Linear Algebra	x		High school math through trigonometry.
Math 67/ Stats 67	Probability and Stats for Comp Sci.	x		**Math 2B** and **Math 6D/ICS 6D**
Math 112A	Introduction to Partial Differential Equations and Applications		x	Math 2D, Math 3D
Math 112B	Introduction to Partial Differential Equations and Applications		x	Math 2E, *Math 112A*
Math 112C	Introduction to Partial Differential Equations and Applications		x	(none listed)
Math 115	Mathematical Modeling		x	Corequisite or

COURSE NUMBER	COURSE NAME	Required	Elective	PREREQUISITES
				prerequisite: *Math112A* or Eng. MAE140. Prerequisites: **Math** 2D; 3A or **6G**; 3D.
Math 121A	Linear Algebra		x	Math 3A or **Math 6G**
Math 121A	Linear Algebra		x	(none listed)
Mgmt 101	Managing Organization Behavior		x	Management 7
Mgmt 102	Managing Organizational Behavior		x	Management 5 is recommended.
Mgmt 105	Introduction to Marketing		x	(none)
Mgmt 107	Introduction to Management Information System		x	(none)
Mgmt 109	Introduction to Managerial Finance		x	**Math 2B** and Management 30A.
Mgmt 121	Global Collaboration		x	*Management 102*
Mgmt 153	Integrated Marketing Communication		x	*Management 101*
Mgmt 154	International Marketing		x	*Management 105*
Physics 3A	Basic Physics	x		**Math 2A**
Psych 130A	Perception and Sensory Processes		x	Psychology 7A or 9A, or Psychology and Social Behavior 9 or 11A, or equivalent, or consent of instructor.
Psych 131A	Vision		x	(none)
Psych 131B	Hearing		x	Psych. 9A, B, or Psychology and Social Behavior 11A, B; upper-division standing or consent of instructor.
Psych 135A, B, C	Memory and Decision Making Research (2-2-2)		x	(none)
Psych 135M	The Mind/Body Problem		x	(none)
Psych 140C	Cognitive science		x	Psychology 7A or 9A, 9B or Psychology and Social Behavior 9 or 11A, 11B or equivalent.

(b) Include Course Action Forms (CAFs) for all new or revised courses

The CAFs of the following new courses are attached:

ICS 60 Computer Games and Society ICS 61 Game Systems and Design

ICS 62 Game Technologies and Interactive Media
ICS 65 Advanced Programming with C++
ICS 160 Game Engines & Hardware
ICS 161 Game Engine Lab
ICS 162 Modeling and World Building
ICS 163 Mobile and Ubiquitous Games
ICS 167 Multiplayer Game Systems
ICS 168 Multiplayer Game Project
ICS 169A-B Capstone Game Project

(c) Special requirements, if any (e.g., research projects, examinations, field studies)

The new capstone course sequence ICS 169A-B is a two-quarter senior project in which students will form teams to design and implement a complete computer game. Teams may work with art students from nearby art colleges, such as students majoring in Game Art at the Laguna College of Art and Design in Laguna Beach. Computer Game Science students must take the entire sequence during the same academic year, and the final grade for the entire sequence will be assigned after completion of the last part of the sequence (ICS 169B). This will be achieved through the use of IP grades in CS 169A.

(d) Will specializations, concentrations, or emphases be offered? If so, list specific titles and requirements

The BS in Computer Game Science will not initially have specializations, concentrations, or emphases.

(e) Provide a sample four-year program for completion of the degree

The table below provides a sample program. The program requires a total of 144 units (84 lower-division and 60 upper-division).Note that the ICS 21/22 sequence can be replaced with the Inf 41/42 (Informatics Core 1/2) sequence.

Fall		Winter		Spring			Credit Units
ICS 21	6	ICS 22	6	ICS 23	4	FRESH	48
ICS 60 Computer Games and Society	4	ICS 61 Game Systems and Design	4	ICS 62 Game Technologies and Interactive Media	4		
Math 2A	4	Math 2B	4				
		WR 39B	4	ICS 6B	4		
				WR 39C	4		
	14		18		16		
Fall		**Winter**		**Spring**			
ICS 51	6	ICS 65 C++	4	ICS 52	6	SOPHO	52
ICS 6D	4	ICS 160 Game	4	ICS 161 Game Engine			
Physics 3A	4	Engines & Hardware		Lab	4		
Flm & Mda 85A	4	Flm & Mda 85B	4	Flm & Mda 85C	4		
		Math 6G	4	Stats/Math 67	4		
	18		16		18		
Fall		**Winter**		**Spring**			
ICS 162 Modeling and World Building	4	ICS 167 Multi Player Game Systems	4	ICS 168 Multi Player Game Project	4	JUNIOR	44
CGS Elective	4	CGS Elective	4	CGS Elective	4		
CGS Elective	4	UD Writing	4	CGS Elective	4		
GE III/VIII	4			GE III	4		
	16		12		16		
Fall		**Winter**		**Spring**			
ICS 163 Mobile and Ubiquitous Games	4	ICS 169A Capstone	4	ICS 169B Capstone	4	SENIOR	37
CGS Elective	4	Game Project		Game Project			
GE III/VII	4	CGS Elective	4	Elective	4		
Summer Internship	0	Elective	4	Language (VI)	5		
	12		12		13		

2. Academic preparation for the major

(a) What is the recommended preparation for success at the freshman level?

Students should have completed a traditional college-preparatory high school curriculum including four years of high school mathematics through at least the pre-calculus level. Students should have strong reading, writing, and math skills including critical, logical thinking. Coursework in computer science or computer programming is not expected of incoming students. Grades of B or better are recommended in mathematics, science, and writing courses.

(b) What is the recommended preparation for junior standing?

The recommended preparation for junior standing is completion of two years of study at a community college with a UC curriculum track or at a traditional four-year institution, with a course of study equivalent, as far as possible, to the lower-division requirements of the Computer Game Science degree program.

Grades of B or better are recommended in mathematics, science, writing, and computer science courses. Completion of IGETC is optional.

(c) Please list prerequisites for admission of new students at the freshman and transfer levels

High School Students:

Completion of four years of mathematics through at least the pre-calculus level. Students should have strong reading, writing, and math skills including critical, logical thinking. Coursework in computer science or computer programming is not expected of incoming students.

Transfer Students:

Students wishing to transfer into the Computer Game Science program should prepare themselves as they would for transfer into other ICS programs (i.e., according to ICS's detailed guidelines that describe the equivalency of college preparation courses with ICS courses) and then use the change-of-major equivalencies from ICS courses to Computer Game Science courses to determine the set of courses for which they will be exempted.

Applicants who satisfactorily complete course requirements will be given preference for admission. Applicants must satisfy at least the following requirements:

1. Completion of one year of discrete mathematics or one year of calculus, preferably both. A semester of pre-calculus and a semester of calculus are not sufficient to satisfy this requirement.
2. Completion of one year of UC-transferable computer science courses, including at least one course involving the concepts of object-oriented programming (e.g., in Java or C++) or functional programming (e.g., in Scheme). Additional courses beyond the two courses required for admission are strongly recommended, particularly courses that focus on topics such as data structures, algorithms, software design, software engineering, human-computer interaction, and programming language concepts, if such courses are available. It is strongly recommended that transfer students enter

UCI with knowledge of Java and/or C++ since they are used in many of the required courses.

3. Completion of one course of introductory physics covering at least the concepts of units, vectors, motion, force, energy, momentum, rotation, gravity is recommended.

Additional courses beyond those required for admission must be taken to fulfill the lower-division degree requirement.

Change of Major Students:

The following requirements will hold, which are very similar to the requirements for other Bren School majors:

- Cumulative UC GPA must be 2.0 or higher.
- 2.0 or higher average GPA in ICS 21 and ICS 22 or Informatics 41 and 42, and one of the following: Math 2A, Math 2B, ICS 6B/Math 6B, or ICS 6D/Math 6D.
- Students with more than 60 units will be reviewed on a case-by-case basis and may not be admitted to the major.
- Students will not be able to complete the degree in Computer Game Science prior to Spring, 2014.

3. Include a list of present and proposed courses including potential instructors. What impact will this have on existing course loads?

Below, we list the set of courses to be taught by the faculty of the School of Information and Computer Sciences as part of the proposed degree in Computer Game Science, along with faculty members who are qualified to teach each course. In most cases, several other faculty members are qualified to teach the course as well.

- *ICS 60 (Computer Games and Society)* – Paul Dourish, Dan Frost, Bonnie Nardi
- *ICS 61 (Game Systems and Design)* – Dan Frost, Walt Scacchi, Bill Tomlinson
- *ICS 62 (Game Technologies and Interactive Media)* – Cristina V. Lopes, Walt Scacchi, Bill Tomlinson
- *ICS 65 (C++ Programming)* – Norm Jacobson
- *ICS 160 Game Engine Hardware* – Ian Harris, Gopi Meenakshisundaram
- *ICS 161 Game Engine Lab* – Dan Frost, Gopi Meenakshisundaram, Bill Tomlinson
- *ICS 162 Modeling and World Building* – Walt Scacchi, Dan Frost, Eric Mjolsness, Max Welling
- *ICS 163 Mobile and Ubiquitous Games* – Paul Dourish, Don Patterson, Bill Tomlinson

- *ICS 167 Multi Player Game Systems* – Cristina V. Lopes, Magda El Zarki
- *ICS 168 Multi Player Game Project* – Cristina V. Lopes, Magda El Zarki
- *ICS 169 A-B Capstone Game Project* – Dan Frost, Walt Scacchi, Cristina V. Lopes, Ian Harris, Gopi Meenakshisundaram, Magda El Zarki

Note that the courses ICS 21, 22, 23, 6B, 6D, 51, and 52 are already regularly taught in ICS more than once each year by faculty from the departments of Computer Science and Informatics in the School of Information and Computer Sciences as part of the ICS lower-division core. The Stats 67 course is regularly taught by faculty from the Department of Statistics. All listed courses from Film and Media Studies, Physics, Cognitive Science, and Management are taught regularly by their respective departments.

4. What impact will the proposed major have on other undergraduate and graduate programs at UCI?

(a) If the major includes courses and faculty participation from related fields or other departments, letters of agreement from the department chair(s) (or equivalent) must be included

Attached are letters of agreement from the Department of Management in the Merage School of Business, the Departments of Mathematics, and Physics, in the School of Physical Sciences, the Department of Cognitive Science in the School of Social Sciences, the Department of Film and Media Studies in the School of Humanities, and the Departments of Computer Science, Statistics and Informatics in the School of Information and Computer Sciences. These are all departments with courses included in the core requirements of the Computer Game Science degree program.

(b) Include comment letters from all department chairs from areas related to the proposed major

Attached are letters of support from the Chairs of the Departments of Informatics and Computer Science in the School of Information and Computer Sciences.

5. Proposed catalog copy including description of major, the educational goals and objectives of the major, and all requirements

To go in the **UNDERGRADUATE PROGRAM** *section:*

B.S. in Computer Game Science. The Computer Game Science (CGS) major combines a solid foundation in computer science with a focus on designing, building, and understanding computer games and other forms of interactive media. The fundamentals of information and computer science, along with coursework in mathematics, statistics, physics, and film and media studies, provide students with the concepts and tools to study a wide scope of computer game technologies. The major emphasizes design, collaboration, and the understanding of computer games and related technologies and media in a social and cultural context. See page XXX.

Major and Minor Restrictions

Add "Computer Game Science (CGS)" to this existing paragraph:
The major or minor in Information and Computer Science (ICS) cannot be combined with the majors in Computer Game Science (CGS), Computer Science (CS), Computer Science and Engineering (CSE), or Informatics.

Add this paragraph:
The Computer Game Science major may not be combined with the Concentration in Game Culture and Technology.

Add "Computer Game Science" to this existing paragraph:
Students who have completed both Informatics 41 and 42 with grades of C or better and who wish to change majors to Computer Game Science or Computer Science or Information and Computer Science may use Informatics 41 and 42 in satisfaction of the requirement of ICS 21 and 22, and similarly with Informatics 43 and ICS 52.

Undergraduate Major in Computer Game Science (CGS)

The Computer Game Science major gives students a strong foundation in introductory information and computer science, an extensive education in technologies and design practices associated with computer games, and an opportunity to specialize in two areas of particular interest to the student. Students who complete the major will be able to create interactive and human-centered game designs, implement games using skills in modeling, graphics, software engineering, hardware architectures, human interfaces, and aesthetics, and evaluate games and game technology for their use in education, art, and social change.

ADMISSIONS

Freshman Applicants: See pages xx-yy.

Transfer Applicants:

Junior-level applicants who satisfactorily complete course requirements will be given preference for admission. Applicants must satisfy the following requirements:

1. Completion of one year of college level mathematics (calculus or discrete math)
2. Completion of one year of transferable computer science courses*; at least one of these should involve concepts such as those found in Java, Scheme, C++, or other object-oriented or high-level programming language.

*NOTE: Additional computer science courses beyond the two required are strongly recommended, particularly those that align with the major(s) of interest. Java is used extensively in the curriculum; therefore, transfer students should plan to learn it by studying on their own or by completing a Java-related programming course prior to their

first quarter at UCI.

Additional courses beyond those required for admission must be taken to fulfill the lower-division degree requirements, as many are prerequisites for upper-division courses. For some transfer students, this may mean that it will take longer than two years to complete their degree.

REQUIREMENTS FOR THE BACHELOR'S DEGREE IN COMPUTER GAME SCIENCE

University Requirements: See pages XX-YY.

Major Requirements

Lower division:

A. ICS 21, ICS 22, ICS 23, ICS 51, ICS 52, ICS 65.

B. Mathematics 2A, Mathematics 2B, Mathematics 6G, ICS/Mathematics 6B, ICS/Mathematics 6D, Statistics/Mathematics 67.

C. ICS 60, ICS 61, ICS 62.

D. Physics 3A.

E. Film and Media Studies 85A-B-C.

Upper division:

A. *Computer Game Science Core requirements:* ICS 160, ICS 161, ICS 162, ICS 163, ICS 167, ICS 168, ICS 169A-B.

B. Seven elective courses: three courses from one Bren ICS track, two courses from a second Bren ICS track, plus two courses from any Bren ICS or non Bren ICS track listed below.

Bren ICS Tracks:

Algorithms: CS 161; CS 165; one of CS 162, CS 163, CS 164.
Artificial Intelligence: CS 171; CS 175; one of CS 174, CS 177, CS 178, CS 179.
Computational Biology: CS 183; CS 184A; CS 184B; CS184C.
Computer Graphics and Vision: CS 112; one of CS 111, CS 116; one of CS 114, CS 117.
Computer Networks: CS 132; two of CS 131, CS 133, CS 134.
Databases: CS 122A; CS 122B; one of CS 121/Informatics 141, CS 125.
Hardware: CS 151; CS 154; one of CS 145A, CS 152, CS 153.
Human Computer Interaction: Inf 131; Inf 133; one of Inf 132, Inf 134.
Operating Systems: CS 143A; CS 143B; one of CS 144, CS 146.
Programming Languages and Compilers: Inf 101/CS 141; CS 142A; one of Inf 102, CS 142B.
Project Management: Inf 111; Inf 161; one of Inf 151, Inf 162.
Simulation and Optimization: CS 169; CS 168; CS 115.
Social Impacts of Computing: Inf 161; Inf 162; Inf 163.
Software Design: Inf 121; Inf 122; Inf 123.

Software Engineering: Inf 111; Inf 113; Inf 115.

non-Bren ICS Tracks (*Some of these courses have prerequisites that are not part of the CGS major.)*

Business Management: Mgmt 101, Mgmt 102, Mgmt 105, Mgmt 107, Mgmt 109, Mgmt 121, Mgmt 153, Mgmt 154.
Cognitive Science: Psych 130A, Psych 131A, Psych 131B, Psych 135M, Psych 135 A/B/C, Psych 140C.
Mathematics: Math 112A-B-C, Math 115, Math 121A-B.
Film and Media Studies: Flm&Mda 113, Flm&Mda 143, Flm&Mda 185.

With the approval of the ICS Associate Dean for Student Affairs, a student may design a new track, or an Independent Study, Honors Research, or Special Topics course may be substituted for a course in a track. CGS elective courses may not be counted as part of the Management Minor or the Biomedical Computing Minor.

Sample Program of Study – Computer Game Science		
FALL	**WINTER**	**SPRING**
Freshman		
ICS 21	ICS 22	ICS 23
Math 2A	Math 2B	ICS 6B/Math 6B
ICS 60	ICS 61	ICS 62
	Gen. Ed. (I)	Gen. Ed. (I)
Sophomore		
ICS 51	ICS 65	ICS 52
ICS 6D	ICS 160	ICS 161
Physics 3A	Math 6G	Stats/Math 67
Flm&Mda 85A	Flm&Mda 85B	Flm&Mda 85C
Junior		
ICS 162	ICS 167	ICS 168
CGS Elective	CGS Elective	CGS Elective
CGS Elective		CGS Elective
Gen. Ed. (III/VIII)	UD Writing	Gen. Ed. (III)
Senior		
ICS 163	ICS 169A	ICS 169B

CGS Elective	CGS Elective	Elective
Gen. Ed. (III/VII)	Elective	Gen. Ed. (VI)

Career Paths. A wide variety of careers and graduate programs are open to Computer Game Science graduates. The video game industry is comparable in size to the film and music industries, and job growth projections are strong for people with strong technical backgrounds. Many other fields, including mobile software development, interactive entertainment, and training and education software have demand for similar skill sets and knowledge. CGS graduates are well-trained in computer science, and can thus pursue graduate programs or any career in that involves designing, implementing, evaluating, or interacting with computer-based systems.

V. Academic Staff

1. Attach the endorsement of the complete proposal by the Faculty Executive Committee, or equivalent, of the school with the official vote attached

To be completed.

2. List

(a) List of faculty members in your department expected to teach majors' courses on a regular basis, including faculty ranks and areas of specialization

- Computer Science
  - Elaheh (Eli) Bozorgzadeh - Computer System Design, Embedded Computer Systems
  - Magda El Zarki – Networked and Distributed Systems, Multimedia, Wireless and Mobile Networks, Sensor Networks
  - Ian Harris – Embedded Computer Systems
  - Gopi Meenakshisundaram – Computer Graphics, Visualization, Digital Arts
  - Shannon Tauro – Embedded Computer Systems
- Informatics
  - Paul Dourish - Interactive & Collaborative Technology: Human-Computer Interaction, Computer Supported Cooperative Work, Security & Cryptography, Computer Graphics, Visualization, Digital Arts, Ubiquitous Computing
  - Dan Frost – Computer Graphics, Computer Games
  - Cristina V. Lopes – Systems Software: Operating Systems, Compilers, Programming Languages, Ubiquitous Computing, Environmental Informatics
  - Bonnie Nardi - Interactive & Collaborative Technology: Human-Computer Interaction, Computer Supported Cooperative Work, Educational Technology
  - Don Patterson – Artificial Intelligence: Automated Reasoning, Machine Learning, Data Mining, Interactive & Collaborative Technology: Human-Computer Interaction, Computer Supported Cooperative Work, Ubiquitous Computing
  - Walt Scacchi – Computer Games and Virtual Environments
  - Alex Thornton – Software Engineering
  - Bill Tomlinson – Educational Technology, Computer Graphics, Visualization / Digital Arts Environmental Informatics

(b) Submit proposed course teaching assignments for at least one year in advance

Academic Year 2010/2011

ICS 60 – Dan Frost

ICS 61 – Dan Frost
ICS 62 – Cristina V. Lopes

Academic Year 2011/2012

ICS 60 – Dan Frost
ICS 61 – Dan Frost
ICS 62 – Cristina V. Lopes
ICS 65 – Alex Thornton
ICS 160 – Ian Harris
ICS 161 – Gopi Meenakshisundaram

VI. Resource Requirements

Explain the intended method of funding this major for the first five years.

Given the current budget crisis, our design goal was to have minimal new resource consumption. We largely achieved this goal by reducing the frequency of some existing course offerings so that the faculty can teach the new courses introduced by this major. Courses that were offered twice a year will be offered only once and some courses with low enrollments will be offered every other year.

1. Faculty FTE, including proposals for release time, if relevant.

We do not expect to need any special campus resources for supporting the faculty in course development or degree creation. We expect to roll out the major over the next four years, such that, by the end of year 4, all courses will have been taught at least once and a regular teaching schedule will have been established. The School of Information and Computer Sciences employs several highly-qualified lecturers who traditionally teach some of its courses, and we expect a proportionate share of those lecturers' time (i.e., time shared with the other degree programs in the School of Information and Computer Sciences).

The senior capstone project course will require the assignment of (an) existing FTE(s) as required by the project nature of the course. The faculty members involved in setting it up should be given teaching release time for its development.

Over time, we do expect a strong influx of students, given the current and projected growth in the field of Computer Games. Should this level be achieved and sustained, we expect to broaden the program with specializations and new classes, which may lead to our requesting funds for additional faculty positions in the future.

2. Teaching assistantships required.

We believe we will be able to draw upon existing resources within the School of Information and Computer Sciences to address teaching assistant needs within the first two years.

3. New library acquisitions.

No new library acquisitions are necessary for this major.

4. Instructional equipment, including computer and laboratory.

Since the degree program is being established within the School of Information and Computer Sciences, we expect that students will be able to exploit existing resources within the School for student services, guidance, exercises, laboratories, and so on.

5. Staff: staff shared with other programs; staff exclusive to administration of this major.

At this time, no staff will be allocated exclusively to the program. Staff in the Student Affairs Office of the School of Information and Computer Sciences will be shared with the other degree programs housed by the School.

6. Describe the resources or infrastructure available for academic advising of new majors.

Academic advising will be performed through the usual channels associated with the School of Information and Computer Sciences, namely its Student Affairs Office. The Department of Computer Science, however, will assist in developing a comprehensive online guide to the degree program, its objectives, and its requirements.

7. Space and other capital facilities.

Existing space and capital facilities in the School of Information and Computer Sciences will suffice for the introduction of the program. Should the program grow to or above its anticipated size, we expect to need larger laboratories for some of the activities associated with the program. We believe the existing Donald Bren Hall building and the associated expansion of the School of Information and Computer Sciences will help in addressing these needs.

8. Other operating costs.

No other operating costs are expected at this time.

REQUEST FOR COURSE ACTION

Department: I&C Sci
Course #: 60
Course Title: Computer Games and Society
Units: 4

Abbr Titl: CMP GAMES & SOCIETY

Catalogue Description:

The study and critical analysis of computer games as art objects, cultural artifacts, gateways to virtual worlds, educational aids, and tools for persuasion and social change. Emphasis on understanding games in their historical and cultural context

Corequisite: None.

Prerequisite: None.

Restriction: None.

Cross-Listed with: None

Overlaps with: University Studies 12ABC.

Hours per Week: Lecture, 3. Discussion, 1.

Grading Option: Letter grade with P/NP option.

Repeatability: May be taken once only for credit.

Fulfills General Education Category: III Social and Behavioral Sciences

Required for the Computer Game Science major.

Instructors/Titles:

Paul Dourish, Professor
Daniel Frost, Lecturer
Bonnie Nardi, Professor
Bill Tomlinson, Associate Professor

Justification for Action:
ICS 60 will be required of all Computer Game Science majors, and will also be open to students from other majors. Students will learn to see games as more than a form of entertainment as they are introduced to the study of computer games from a variety of perspectives. A key idea in the course is how the interactive and computational nature of computers enables computer games to be a new kind of media for communication, persuasion, and education. Much of the content and design of this course is based on University Studies 12ABC, Computer Games as Art, Culture, and Technology, which was developed by Daniel Frost and Bill Tomlinson from the Bren School, as well as Peter Krapp from Humanities.

ICS 60 is appropriate for General Education Category III because the course emphasizes understanding computer games as social, historical, economic, and cultural phenomena. Incoming students will probably think of video games solely as a form of entertainment. By the end of the course they will know how games can be used for persuasion and social change, for education and training in schools, companies, and the military, and as components of art practices. Students will be able to critically evaluate games in the social and historical context, and taking into consideration ethical, cultural, and legal concerns.

Weekly topic outline:

1. Historical overview of computer games.
2. How to "read" a computer game with a detailed analysis; principles of game studies and McLuhan's writings on "hot" and "cool" media and "electronic interdependence.
3. Playing "with" games – mods, machinima, , interactive art.
4. Computer games as a social medium for communication and creation of social networks.
5. Serious and persuasive games for social change.
6. Serious and persuasive games for education.
7. Game technology and art practice; the aesthetics of play.
8. Social, anthropological, and economic perspectives on massively multiplayer online role playing games.
9. Ethical and legal issues in game design.
10. Review and recap.

Grading:

Short paper – game critique	20%
Serious game design project	20%
Several homework assignments	10%
Midterm exam	20%
Final exam	30%

Textbook:

A collection of readings put together by the instructor.

REQUEST FOR COURSE ACTION

Department: I&C Sci
Course #: 61
Course Title: Game Systems and Design
Units: 4

Abbr Titl: GAME SYS & DESIGN

Catalogue Description:

Principles and usage of game design elements. Introduction to technologies that support modern computer games. Students design, implement, and critique several small games.

Corequisite: None.

Prerequisite: None.

Restriction: None.

Cross-Listed with: None

Overlaps with: None.

Hours per Week: Lecture, 3. Lab, 1.

Grading Option: Letter grade with P/NP option.

Repeatability: May be taken once only for credit.

Fulfills General Education Category: II Science and Technology

Required for the Computer Game Science major.

Instructors/Titles:
Daniel Frost, Lecturer
Walt Scacchi, Senior Scientist
Bill Tomlinson, Associate Professor

Justification for Action:
ICS 61 will be required of all Computer Game Science majors, and will also be open to students from other majors. Students gain an introductory, hands-on exposure to designing and implementing several small computer games. Students will program in an environment such as Scratch, Alice, or GameMaker. Much of the content and design of this course is based on University Studies 12ABC, Computer Games as Art, Culture, and Technology.

This course is appropriate for General Education Category II because it teaches students many fundamental principles and skills from computer science. Students in ICS 61 will learn about software engineering principles and the software development lifecycle. After two lectures on artificial intelligence they will design and implement an autonomous character for a game. Every game project will involve 2D graphics, and students will learn in this context about bits and bytes, representing data such as pixels and colors, file organization for graphics, and data compression. Other computer science topics that the course will cover at an introductory level include computer networks, 3D computer graphics, and digital audio.

Weekly topic outline:

1. History of computers and computer games. How computer games are conceived, designed, implemented, marketed, updated, and modified by players. What is a game and what is not a game?
2. Fundamentals of the software process: the Proposal – Specification – Design – Implementation – Testing – Deployment lifecycle. Introduction to the course's programming environment.
3. Principles of animated character design; sprites; cartoon physics.
4. Theory and principles of game design. Archetypal stories, interactivity, simulation, metaphor, rules.
5. Artificial Intelligence in games; is AI judged by how it appears or how it is implemented?
6. Computer networks and multiplayer games. Internet technology.
7. Music in games. Principles of digital audio.
8. Human-computer interfaces and interaction; usability testing.
9. Fundamental ideas of 2D and 3D computer graphics; basics of 3D modeling.
10. Review, student demos of game projects.

Grading:

Three game projects (20% each)	60%
Attendance and participation	10%
Midterm exam	10%
Final exam	20%

Textbook:

Possibly, The Art of Game Design: A Book of Lenses, by Jesse Schell. Morgan Kaufman, 2008.

REQUEST FOR COURSE ACTION

Department: I&C Sci
Course #: 62
Course Title: Game Technologies and Interactive Media
Units: 4

Abbr Titl: GAME TECH INT MEDIA

Catalogue Description:

Technologies for interactive media and game design. Web-based software systems, virtual world platforms and game engines. Emphasis on conceptual and architectural aspects of these technologies.

Corequisite: None.

Prerequisite: ICS 21 with a grade of C or better; or Inf 41 with a grade of C or better.

Restriction: None.

Cross-Listed with: None

Overlaps with: None.

Hours per Week: Lecture, 3. Discussion, 1.

Grading Option: Letter grade with P/NP option.

Repeatability: May be taken once only for credit.

Required for the Computer Game Science major.

Instructors/Titles:
Crista Lopes, Associate Professor
Walt Scacchi, Senior Scientist
Bill Tomlinson, Associate Professor

Justification for Action:
ICS 62 will be required of all Computer Game Science majors, and will also be open to students from other majors. Students will be introduced to a large variety of technologies, with emphasis on the technical aspects of game and interactive media systems. By being exposed to several different platforms and technologies that are used to create games—some of which were not created with games in mind—students will learn common principles and key ideas that underlie both computer games and a wide variety of interactive media, computer modeling software, and virtual worlds. An important role of this course, along with ICS 61, for CGS majors, is to introduce them to the spectrum of specialization areas (such as networking, databases, graphics, and human computer interaction) that are marshaled to make computer games and many other types of systems. This exposure will help students select upper division elective courses, as well as prepare them for more in-depth treatment of related topics in later CGS core courses.

Weekly topic outline:

1. Web architecture, protocols, servers, clients, and media types
2. Principles of dynamic Web pages – JavaScript and Ajax
3. Web APIs and Mashups – principles of interoperability
4. Animations and computer graphics.
5. Game Engines – History and uses – the Unreal engine
6. Game Engines – APIs and development issues – the Unity engine
7. Key concepts in Massive Multi-user Online systems – databases and interaction design.
8. Virtual World Platforms – Second Life – designing for the network and distributing computation between client and server
9. Virtual World Platforms – OpenSim – open source software as a software development paradigm
10. Review and recap.

Grading:

Projects	50%
Quizzes	20%
Final exam	30%

Textbook:

A class package will be put together by the instructors.

REQUEST FOR COURSE ACTION

Department: I&C Sci
Course #: 65
Course Title: Advanced Programming with C++
Units: 4

Abbr Titl: C++ PROGRAMMING

Catalogue Description:

An introduction to the C++ language for experienced Java programmers. Emphasis on object oriented design and using standard libraries.

Corequisite: None.

Prerequisite: ICS 23 or one year of Java programming.

Restriction: None.

Cross-Listed with: None

Overlaps with: None.

Hours per Week: Lecture, 3. Discussion, 1.

Grading Option: Letter grade with P/NP option.

Repeatability: May be taken once only for credit.

Required for the Computer Game Science major.

Instructors/Titles:
Norm Jacobson, Senior Lecturer

Justification for Action:
ICS 65 will be required of students in the Computer Game Science major, and will be of interest to students in other Bren School majors who want to learn the widely used computer programming language C++. This course is based on ICS 80, which has been successfully taught for several years.

Weekly topic outline:

1. Design goals for C++; differences from Java; compilation and linking.
2. The C++ memory model; pointers and references;
3. Classes, access control, constructors and destructors, object lifetimes.
4. Overloading operators; designing good classes.
5. Namespaces; the Standard C++ library; templates.
6. Inheritance; virtual functions and polymorphism; casting.
7. Interacting with library APIs; C++ and C.
8. Windows-specific issues: DLLs, the Windows API.
9. Unix variant-specific issues.
10. Review and recap.

Grading:

Four programming assignments (20% each)	80%
Final exam	20%

Textbook:

Absolute C++, 3rd edition, by Walter Savitch, Addison-Wesley.

REQUEST FOR COURSE ACTION

Department: I&C Sci
Course #: 160
Course Title: Game Engines and Hardware
Units: 4

Abbr Titl: GAME ENG & HARDWARE

Catalogue Description:

Principles of computer architecture emphasizing hardware used with a general purpose processor to support high performance computer games and graphics engines. Design of game engines and abstraction layers for this hardware.

Corequisite: None.

Prerequisite: ICS 51.

Restriction: None.

Cross-Listed with: None

Overlaps with: None.

Hours per Week: Lecture, 3. Discussion, 1.

Grading Option: Letter grade with P/NP option.

Repeatability: May be taken once only for credit.

Required for the Computer Game Science major.

Instructors/Titles:

Ian G. Harris, Associate Professor
Gopi Meenakshisundaram, Associate Professor
Alex Nicolau, Professor
Alex Veidenbaum, Professor

Justification:
ICS 160 is required of all students in the Computer Game Science major. The course covers two areas of computer science which are central to computer games, large scale simulations, virtual worlds, and other applications. The first area is the principles and design of high performance hardware, with a focus on parallelism in multi-core processors and graphics processing units (GPUs). Advances in this area have enabled exciting progress in computer graphics, algorithms, and the way software is written. The second area is the development of abstraction layers, code libraries, and APIs (Application Programmer Interfaces) which make the power of high performance hardware accessible to application developers. In the field of computer games these libraries are called "game engines." Abstraction is the life blood of computer science, and students in this course will learn how principles of modularity, separation of concerns, and reusability are expressed in widely used libraries and game engines.

Weekly Topic Outline*:*

1. Design and core concepts underlying Hardware/Game Engine/Scripting Language Interfaces, Instruction Sets
2. Key ideas and trade-offs in game engine performance
3. Datapath and control in multi-core processors
4. Game console vs. PC architectures
5. Principles of game engine design for achieving platform independence
6. Game specific input and output devices
7. Overview of GPUs: architecture, features, programming model
8. GPU Programming: rendering pipeline, programmable shaders
9. Game Engines: Unreal and Unity game engines; rendering animation, audio, physics
10. OpenGL and DirectX APIs for high performance 3D graphics and media

Grading:

Several homework assignments	50%
Midterm exam	20%
Final exam	30%

Textbook:

D. A. Patterson and J. L. Hennessey, Computer Organization and Design The Hardware/Software Interface Third Edition, Morgan Kaufmann Publishers, 2005. The textbook will be augmented with several articles on recent hardware development, and with reference materials for the game engines.

REQUEST FOR COURSE ACTION

Department: I&C Sci
Course #: 161
Course Title: Game Engine Lab
Units: 4

Abbr Titl: GAME ENGINE LAB

Catalogue Description:

The use of an industry standard game engine in the design and implementation of a new computer game. Principles of game engine design. Students work on a team to design, implement, and evaluate a new computer game based on an engine.

Corequisite: None.

Prerequisite: ICS 160.

Restriction: None.

Cross-Listed with: None

Overlaps with: None.

Hours per Week: Lecture, 3. Discussion, 1.

Grading Option: Letter grade with P/NP option.

Repeatability: May be taken once only for credit.

Required for the Computer Game Science major.

Instructors/Titles:

Daniel Frost, Lecturer
Ian G. Harris, Associate Professor
Gopi Meenakshisundaram, Associate Professor

Justification for Action:
ICS 161 will be required of Computer Game Science majors. Building on knowledge gained in ICS 160 about input devices, video cards, and other hardware, students will use a game engine as the basis for a new computer game. Throughout the quarter, students will study the game engine source code critically, to see how its authors balanced run-time efficiency, ease of use, platform independence, and functionality. Being able to make such trade-offs with good judgment based on principles and experience is a key objective for students in the course. Students will work in small teams, and will therefore also learn team building, scheduling, cooperative implementation, and version control skills which will be essential for much larger projects they will tackle in later courses in the CGS major.

Weekly topic outline:

1. Fundamentals of the Game Engine API; sample code.
2. Working on a team; version control software.
3. Writing a new game engine: principles of modularity and platform independence.
4. Advanced game engine techniques and visual effects.
5. Student game design presentations.
6. Modeling, rigging, skinning, and animation.
7. Terrain and level editing
8. Writing your own game engine: principles of using accelerated hardware transparently and efficiently
9. Design and use of scripting languages
10. Student project presentations.

Grading:

Participation and several short exercises	10%
Team design document	40%
Game Project	50%

Textbook:

No textbook will be assigned. Books, web sites, and manuals about the game engine will be listed by the instructor.

REQUEST FOR COURSE ACTION

Department: I&C Sci
Course #: 162
Course Title: Modeling and World Building
Units: 4

Abbr Titl: MOD & WORLD BLDG

Catalogue Description:

Use of 3D modeling software and related tools to design and create animated, textured models and expansive virtual worlds incorporating objects, scenes, and venues for activity within game worlds and online environments.

Corequisite: None.

Prerequisite: ICS 160.

Restriction: None.

Cross-Listed with: None

Overlaps with: None.

Hours per Week: Lecture, 3. Discussion, 1.

Grading Option: Letter grade with P/NP option.

Repeatability: May be taken once only for credit.

Required for the Computer Game Science major.

Instructors/Titles:

Walt Scacchi, Adjunct Professor
Daniel Frost, Lecturer
Eric Mjolsness, Professor
Max Welling, Professor

Justification for Action:
ICS 162 is a required course for Computer Game Science majors. Students in this program are generally not artists or game designers, but they will interact closely with artists and designers who use 3D content creation software to produce the visual components of games and virtual worlds. This course gives CGS majors an exposure to a variety of 3D modeling software and associated add-ons, and a deeper understanding of their constraints and capabilities. In the course students learn the principles behind and experience designing a virtual world that embodies or enables some kind of storytelling, enterprise process simulation, simulation of complex physical objects, or game-based training simulator.

Weekly topic outline:

1. Principles of 3D modeling and virtual world development.
2. Creating complex objects: modeling, surfacing and texturing, rigging, and animation.
3. Converting, importing, and using 3D models in a program or game engine.
4. High and low resolutions; making every polygon count
5. Mathematics, engineering, and art in transformation stacks
6. Designing terrain, landscapes, and extensive environments
7. Algorithms for procedural texturing and lighting
8. Virtual humans, creatures and avatar development, and interaction
9. Incorporating embeddable media into a virtual world
10. Student project presentations

Grading:

Five small modeling projects, 10% each	50%
Large project	30%
Take-home final exam	20%

Textbook:
Several articles and reference materials selected by the instructor, based on the specific software used during the quarter. Assigned background reading might include:

- Bartle's *Designing Virtual Worlds* (http://www.amazon.com/Designing-Virtual-Worlds-Richard-Bartle/dp/0131018167),
- Meigs, *Ultimate Game Design: Building Game Worlds* (http://www.amazon.com/Ultimate-Game-Design-Building-Worlds/dp/0072228997/ref=sr_1_1?ie=UTF8&s=books&qid=1258769170&sr=1-1),
- *Level Design for Games*, (http://www.amazon.com/Level-Design-Games-Compelling-Experiences/dp/0321375971/ref=pd_sim_b_4

REQUEST FOR COURSE ACTION

Department: I&C Sci
Course #: 163
Course Title: Mobile and Ubiquitous Games
Units: 4

Abbr Titl: MOBILE & UBI GAMES

Catalogue Description:

Design and technology of mobile games, including mixed reality gaming, urban games and locative media. Case studies of significant systems. Uses and limitations of location-based technologies. Infrastructures and their relationships to gameplay and design.

Corequisite: None.

Prerequisite: ICS 160.

Restriction: None.

Cross-Listed with: None

Overlaps with: None.

Hours per Week: Lecture, 3. Discussion, 1.

Grading Option: Letter grade with P/NP option.

Repeatability: May be taken once only for credit.

Required for the Computer Game Science major.

Instructors/Titles:

Paul Dourish, Professor
Don Patterson, Assistant Professor
Bill Tomlinson, Associate Professor

Justification for Action:
This new course provides critical content for the Computer Game Science major. Mobile and handheld platforms are significant platforms for gaming experiences, offering both design opportunities and technological constraints that have a significant impact on game design. This course covers these from both a technical perspective and through a critical review of significant cases and exemplars. The course emphasizes non-entertainment uses of the concepts and technologies for scientific, business, educational, and productivity purposes.

Weekly topic outline:

1. Typology of mobile and ubiquitous games. Challenges and opportunities. Case study 1 (Can You See Me Now).
2. Locative media. Location-based technologies – GPS, GSM triangulation, fingerprinting. Cartographic and other representations.
3. Infrastructures and seamfulness. Case study 2 (Treasure).
4. Mixed reality gaming. Boundaries and transitions.
5. Urban gaming. Theory and practice of urban game design. Case study 3 (Fiasco). Case study 4 (Big Urban Game).
6. Urban gaming (continued).
7. Platforms. Sensor-driven interaction. Interaction styles and tangible media.
8. Ambiguity, audience, and narratology in daily experience. Gaming and everyday life. Case study 5 (Hitchers).
9. Spaces of encounter and playable spaces. Narrating everyday space. Case study 6 (Finding Yoshi).
10. Review and recap.

Grading:

Mobile game design project	30%
Several homework assignments	20%
Midterm exam	20%
Final exam	30%

Textbook:

No current text covers this material. A reader will be provided, incorporating both research papers and excerpts from other texts (e.g. “Expressive Processing,” “Critical Play”.)

REQUEST FOR COURSE ACTION

Department: I&C Sci
Course #: 167
Course Title: Multiplayer Game Systems
Units: 4

Abbr Titl: MULTIPLAYER SYSTEMS

Catalogue Description:

Foundations and technologies that enable multiuser, networked, and persistent virtual environments. Emphasis on database design and management, network protocols, and concurrency control to accommodate large numbers of simultaneous users.

Corequisite: None.

Prerequisite: ICS 160.

Restriction: None.

Cross-Listed with: None

Overlaps with: None.

Hours per Week: Lecture, 3. Discussion, 1.

Grading Option: Letter grade with P/NP option.

Repeatability: May be taken once only for credit.

Required for the Computer Game Science major.

Instructors/Titles:
Crista Lopes, Associate Professor
Magda El Zarki, Professor

Justification for Action:
ICS 167 focuses on multiplayer, networked, and persistent game worlds, an area of vast economic and intellectual interest. Similar technology is used for modeling and visualizing scientific and social systems, and for social networking Web sites. Students learn technology and implement a small project, which will prepare them for ICS 168.

Weekly topic outline:

1. Architectures for Massive Multi-user online systems
2. Databases – designs, structures, and redundancy
3. Databases – privacy and security
4. External representations of data
5. Network protocols -- UDP
6. Network protocols -- TCP
7. Network protocols -- HTTP
8. Threads and concurrency control
9. Threads and concurrency control
10. Review and recap.

Grading:

Homework Assignments and Project	25%
Midterm exam	25%
Final exam	50%

Textbook:

A course package will be provided by the instructor.

REQUEST FOR COURSE ACTION

Department: I&C Sci
Course #: 168
Course Title: Multiplayer Game Project
Units: 4

Abbr Titl: MULTIPLAYER PROJECT

Catalogue Description:

Designing and implementing a multiuser, networked, and persistent virtual environment or game. Emphasis on cultural aspects, community building, user interface issues and design, security, privacy, and economics.

Corequisite: None.

Prerequisite: ICS 52 with a grade of C or better; ICS 167.

Restriction: None.

Cross-Listed with: None

Overlaps with: None.

Hours per Week: Lecture, 3. Discussion, 1.

Grading Option: Letter grade with P/NP option.

Repeatability: May be taken once only for credit.

Required for the Computer Game Science major.

Instructors/Titles:

Crista Lopes, Associate Professor
Magda El Zarki, Professor
Bonnie Nardi, Professor

Justification for Action:
In ICS 168 students will apply their knowledge of multiplayer game systems from ICS 167 as they work on a team to build a game, virtual world, or educational environment. The term project in this course plays an important role in the educational development of the CGS major. Principles and mathematical models from ICS 167 and other courses will be reinforced by hands-on use. The lectures will put the technical training in a larger context. Perhaps most importantly, students will have a one-quarter team- and project-oriented experience from which they will learn lessons that can be applied in the senior year two-quarter capstone course.

Weekly topic outline:

1. Multiplayer virtual worlds: history, culture, and economics
2. Technology platforms
3. Team presentations of designs and technology trade-offs
4. Privacy, security, and enforcing the rules against griefers and hackers
5. User interface principles and options
6. Building communities and social networks
7. Business models for online communities and networked games
8. No lectures – meetings with individual teams
9. No lectures – meetings with individual teams
10. Team project presentations

Grading:

Participation	10%
Project design	20%
Term project implementation	70%

Textbook:

A course package will be provided by the instructor.

REQUEST FOR COURSE ACTION

Department: I&C Sci
Course #: 169A
Course Title: Capstone Game Project
Units: 4

Abbr Titl: CAPSTONE GAME

Catalogue Description:

Students work in teams to design and implement a new computer game or virtual world. Emphasis on sound, art, and level design, building a community, cut scenes, production values, full utilization of hardware and software platform, and current industry trends.

Corequisite: None.

Prerequisite: ICS 167, ICS 168.

Restriction: None.

Cross-Listed with: None

Overlaps with: None.

Hours per Week: Lecture, 3. Discussion, 1.

Grading Option: In Progress.

Repeatability: May be taken once only for credit.

Required for the Computer Game Science major.

Instructors/Titles:

Magda El Zarki, Professor
Daniel Frost, Lecturer
Ian Harris, Associate Professor
Christina V. Lopes, Associate Professor
Gopi Meenakshisundaram, Associate Professor
Walt Scacchi, Adjunct Professor

Justification for Action:
ICS 169A-B are the capstone of the Computer Game Science major. In this two quarter sequence, students work in a team of five to ten students to design and build a polished and substantially sized computer game. Students will be encouraged to create a game with an educational or persuasive mission. Some games/virtual worlds/educational environments/simulations may have a specific customer, possible a professor or research group.

Weekly topic outline:

1. Overview of two-quarter sequence; customer presentations; team formation.
2. Level design.
3. Production values and final testing.
4. Trends in the game industry and discussion of options and trade-offs
5. Team design presentations.
6. Team design presentations.
7. Marketing.
8. Designing and using non-interactive cut-scenes.
9. Recent developments in hardware for games.
10. Student progress reports and planning for next quarter.

Grading:

Grade will be IP. Instructor will write an evaluation for each team and student.

Textbook:

No book will be assigned. The instructor will point students and teams to texts, articles, and web sites of interest based on the specific projects.

REQUEST FOR COURSE ACTION

Department: I&C Sci
Course #: 169B
Course Title: Capstone Game Project
Units: 4

Abbr Titl: CAPSTONE GAME

Catalogue Description:

Students work in teams to design and implement a new computer game or virtual world. Emphasis on sound, art, and level design, building a community, cut scenes, production values, full utilization of hardware and software platform, and current industry trends.

Corequisite: None.

Prerequisite: ICS 167, ICS 168.

Restriction: None.

Cross-Listed with: None

Overlaps with: None.

Hours per Week: Lecture, 3. Discussion, 1.

Grading Option: Letter grade with P/NP option.

Repeatability: May be taken once only for credit.

Required for the Computer Game Science major.

Instructors/Titles:

Magda El Zarki, Professor
Daniel Frost, Lecturer
Ian Harris, Associate Professor
Christina V. Lopes, Associate Professor
Gopi Meenakshisundaram, Associate Professor
Walt Scacchi, Adjunct Professor

Justification for Action:
ICS 169A-B are the capstone of the Computer Game Science major. In this two quarter sequence, students work in a team of five to ten students to design and build a polished and substantially sized computer game. Students will be encouraged to create a game with an educational or persuasive mission. Some games/virtual worlds/educational environments/simulations may have a specific customer, possible a professor or research group. In the second 169B quarter students will be well underway on their projects, and many lecture periods will be devoted to meetings between the instructor and each team.

Weekly topic outline:

1. Art and sound design.
2. Meetings with teams.
3. Web sites, wikis, and other ways to support games and users
4. Meetings with teams.
5. Employment trends in the video game and interactive entertainment industries
6. Meetings with teams
7. Tuning and refining games
8. Meetings with teams
9. Team project presentations.
10. Team project presentations.

Grading:

Grade will be based on the two-quarter team project. In most cases, a student's grade will be the team grades, but the instructor can increase or decrease a student's grade as warranted.

Textbook:

No book will be assigned. The instructor will point students and teams to texts, articles, and web sites of interest based on the specific projects.