USC Viterbi
School of Engineering

# CSCI-599 Game Development

**Units: 4**
**Term—Day—Time: Fall & Spring, Wednesdays 7pm to 10pm, Lab Wednesdays 6pm to 7pm**

**Location:** EGG-108

**Instructor: Khaled Abdel Rahman, Everett Daniel Arey**
**Office:** EGG-209
**Office Hours:** 5pm Wednesdays

**Contact Info:** khaledar@google.com

**Teaching Assistant:**
**Office:** EGG-205
**Office Hours:**
**Contact Info:**

**IT Help:** GamePipe Laboratory Manager
**Hours of Service:**
**Contact Info:**

## Introduction:

**The course will focus on Game Design and Production and will be a project-based class, taking you through all the steps needed to build a high quality game prototype. We'll be covering various topics such as developing game worlds, statistical modeling, mobile and location-based games such as Pokémon Go, and various game production techniques throughout the entire process. The course should act as a great set up for the year long Advanced Game Projects class.**

## Course Description

This is an advanced course covering topics in game development. Computer science students will learn state-of-the-art skills for developing sophisticated games. The student will understand how development is a combination of design and engineering, and how these aspects interrelate from both the developer and player perspectives. The student will additionally learn advanced game development topics such as the following 3D game development, game worlds, advanced multiplayer options, game AI: agent and multi-agent, integrating narratives and puzzles into games, augmented reality and statistical modeling for games. Students will prototype an advanced game on paper and in software as well as critique and analyze classmates' games via formal playtests. At the end of the course each student will have an advanced game prototype that demonstrates mastery of the topics taught in the course.

## Learning Objectives

Upon successful completion of this course, each student is expected to be able to:

1. Demonstrate mastery of class material via prototyping, in-class exercises, playtesting, and quizzes.
2. Deliver game prototype that compels users and complies with a range of constraints. Prototype using non-digital materials as well as Unity 3D. (There is no emphasis on production values in this course.)
3. Conduct playtest sessions that elicit formal feedback from playtesters that can be used to improve the quality of the play experience (no emphasis on production values).
4. Iterate on prototype to improve player experience as measured by playtester feedback and instructor judgment with proficiency
5. Present interactive game concepts with clarity

## Prerequisite(s): none

## Required Readings and Supplementary Materials

Textbook Title: The Art of Game Design: A Book of Lenses
ISBN-13: 978-0123694966
Publisher: CRC Press; 1 edition (August 4, 2008)

Textbook Title: Unity 5.x Game Development by Example Beginner's Guide
ISBN-13: 978-1849695268
Publisher: Packt Publishing (2015)

Supplies: Students will be provided with software tools and non-digital materials by the instructor. For the paper prototyping assignments students should expect to purchase some basic art supplies - such as dice, tokens, scissors, glue, colored pencils, etc.

## Grading Breakdown

Students will be evaluated as follows:

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| Quizzes (3) | 20% |
| In-Class Design Exercises | 10% |
| Playtests | 10% |
| Final Project Proposal | 5% |
| Final Project Design Document | 20% |
| Final Project Presentation | 35% |
| **Total** | **100%** |

## Course Schedule: A Weekly Breakdown

| Date | Topic |
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| Week 1 | Lecture: Overview and Introduction<br>Our opening session will provide an overview of the course, the grading criteria, and other administrative details. After that, we'll discuss the partially overlapping aspects of game development for the purposes of this course: design and engineering. We will lay out course mechanics: lectures, quizzes, reading, in-class exercises, playtesting/critiquing*, and final project. We will briefly discuss the topics that will be presented in the course.<br><br>Reading: Schell, Chapters 1 – 2, Unity 3D, Chapter 1. Note: Reading assignments are due the week they appear in the syllabus. Students are encouraged to read ahead in both books as well as the syllabus topics in order to generate the documents that will guide their projects, exercises, and presentations.<br><br>In-Class Exercise: Learning Unity 3D<br>Assignment: Basic game development tutorial<br>Presentation: Play game resulting from tutorial |
| Week 2 | Lecture: 3-Dimensional Game Development I<br>An in depth introduction to, and analysis of, the elements that make up a 3D game, and how the development process is different from making a 2D game, particularly when prototyping.<br><br>Reading: Schell, Chapters 3 – 4, Unity 3D, Chapter 2<br><br>In-Class Exercise: 3D Paper Prototypes<br>Assignment: Non-computerized 3D development tutorial<br>Presentation: Play game resulting from tutorial |
| Week 3 | Lecture: 3-Dimensional Game Development II<br>The engineering view of 3D game development, in a nutshell. 3D environments and graphic models, 3D motion and animations, particle and light systems, 3D scripting and math.<br><br>Reading: Schell, Chapters 5 – 6, Unity3D, Chapter 3<br><br>In-Class Exercise: 3D Software Prototypes<br>Assignment: 3D development tutorial<br>Presentation: Play game resulting from tutorial<br><br>Final Project Proposal due at end of class |
| Week 4 | Lecture: Developing Game Worlds I<br>Game worlds are designed to maximize the player's experience in an immersive game environment. Both static and dynamic aspects of the world need varying levels of detail, especially as regards the player characters.<br><br>Reading: Schell, Chapters 7 – 8, Unity 3D, Chapter 4<br><br>In-Class Exercise: Game World Design<br>Assignment: Design (not code) a 3D map of a game world, a global state machine, and a schedule of events and their consequences.<br>Presentation: Visualize the world state before, during, and after each event.<br><br>Note: From this week forward, students are encouraged to use the exercises to support the development of their final projects, and to work ahead on the in-depth assignments before the in-class exercise. The end of |

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| | each exercise period will be devoted to presentation and critique (and sometimes playtesting). |
| Week 5 | Lecture: Developing Game Worlds II<br>The engineering view of how to develop game worlds in Unity 3D. Use the game base created earlier in the term. Learn to develop the game world as an object /environment but also as an agent acting upon itself and its inhabitants.<br><br>Reading: Schell, Chapters 9 – 10, Unity 3D, Chapter 5<br><br>Quiz #1, Covering Weeks 1 – 5 Lectures and Reading<br><br>In-Class Exercise: Game World Encoding<br>Assignment: Implement game world based on previous week's design.<br>Presentation and Playtest: Visualize the world state before, during, and after each event.<br><br>Final Project Design Document due at end of class |
| Week 6 | Lecture: Advanced Multiplayer Options I<br>Developing a multiplayer game requires a lot of attention to game balance and fairness, as well as the social aspects of the game. There are many universal ways that a game developer can provide an engaging experience to multiple gamers and gamer types, regardless of game genre or platform.<br><br>Reading: Schell, Chapters 11 – 12, Unity 3D, Chapter 6<br><br>In-Class Exercise: Advanced Multiplayer Game Design<br>Assignment: Draft a multiplayer specification for final project.<br>Presentation: Explain the specification in detail. |
| Week 7 | Lecture 7: Advanced Multiplayer Options II<br>The engineering view of implementing multiplayer options. There are several concerns at this level that do not appear in the designer's view. How many players will need to be supported at a time? Central server, shards, peer-to-peer, peer as server, etc.? Local multiplayer, remote, and/or in between? Real-time/synchronous or not? What level of lag is tolerated?<br><br>Reading: Schell, Chapters 13 – 14, Unity 3D, Chapter 7<br><br>In-Class Exercise: Advanced Multiplayer Encoding<br>Assignment: Implement multiplayer option based on previous week's spec.<br>Presentation and Playtest: Demonstrate the multiplayer operations. |
| Week 8 | Lecture 8: Game AI: Agent and Multiagent I<br>Game AI is an important feature for single-player and multiplayer games alike. There are many definitions and uses for Game AI, and specific elements are usually picked based on the needs of the game.<br><br>Reading: Schell, Chapters 15 – 16, Unity 3D, Chapter 8<br><br>In-Class Exercise: Game AI Research<br>Assignment: Choose and specify aspects of Game AI for final project.<br>Presentation: Show detailed operation of Game AI with respect to agents, the game world, and the players. |
| Week 9 | Lecture 9: Game AI: Agent and Multiagent II<br>Engineering game AI is often easy at first, e.g., insert a simple agent state machine into a game behind the scenes, but can be difficult to optimize or even to make work according to the game's design spec. The more |

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| | complicated the AI agent(s) or environment, the more things that can go wrong. We will look at some of the cutting edge AI tools and approaches available to game developers.<br><br>Reading: Schell, Chapters 17 – 18, Unity 3D, Chapter 9<br><br>In-Class Exercise: Game AI Implementation<br>Assignment: Implement AI based on previous week's spec.<br>Presentation and Playtest: Demonstrate detailed operation of Game AI with respect to agents, the game world, and the players. |
| Week 10 | Lecture 10: Integrating Narratives and Puzzles into Games I<br>This class will examine means and mechanisms of puzzles and interactive narrative. Games, and particularly 3D game worlds, hold many options for narrative and puzzle integration. Narrative can guide development of dialogue, character storylines, available player actions, scripted/themed events, and audiovisuals in order to make a game more thematically interesting and engaging, and can even inform gameplay or puzzle mechanics. The relation between puzzles and games will be explored, as well as the similarities and differences between mechanic-based and narrative-based puzzles.<br><br>Reading: Schell, Chapters 19 – 20, Unity 3D, Chapter 10<br><br>Quiz #2, Covering Weeks 6 – 10 Lectures and Reading<br><br>In-Class Exercise: Puzzle Mechanics and Interactive Storylines<br>Assignment: Develop an engaging and thematic integration of puzzles and/or interactive narrative for a 3D game.<br>Presentation: Explain the narrative and/or puzzle structure. |
| Week 11 | Lecture 11: Integrating Narratives and Puzzles into Games II<br>Engineering of interactive narrative can go beyond the simple matter of writing canned dialogue trees and descriptions. Narrative can be seen as part of the UX of game information, where that information can appear as needed by theme, plot elements, characters, or gameplay. How to shape that information in the context of a 3D game world and its inhabitants is one goal of this class. The other is organic puzzle implementation, where the puzzle mechanics and other game elements match by their context of theme, plot elements, characters, and gameplay. The creation and effective use of a puzzle level editor, autosolver, and hint system will also be taught.<br><br>Reading: Schell, Chapters 21 – 22, Unity 3D, Chapter 11<br><br>In-Class Exercise: Implementing Puzzle Mechanics and Interactive Storylines<br>Assignment: Develop an engaging and thematic integration of puzzles and/or interactive narrative for a 3D game.<br>Presentation and Playtest: Guide players through the narrative and/or puzzles. |
| Week 12 | Lecture 12: Augmented Reality I<br>The extra dimensions of immersion in a game that can be gained with virtual and augmented reality can alter scope and gameplay, as well as change the atmosphere and other aesthetics. Several aspects of augmented reality in particular have huge untapped potential for new environments, characters, storylines, and game mechanics.<br><br>Reading: Schell, Chapters 23 – 24, Unity 3D, Chapter 12<br><br>In-Class Exercise: Designing AR<br>Assignment: Develop an engaging game scenario involving the visual overlap of the real world and game |

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| | world.<br>Presentation: Explain the concept and scenario. |
| Week 13 | Lecture 13: Augmented Reality II<br>Engineering perspective of Augmented Reality development. Challenges include localization vs. geomobile accuracy, image recognition speed and accuracy, and VR agents interacting with real people and navigating real-world spaces.<br><br>Reading: Schell, Chapters 25 – 26, Unity 3D, Chapter 13<br><br>In-Class Exercise: Implementing AR<br>Assignment: Using the augmented reality development kit supplied in Unity 3D, implement your concept and scenario from the previous week.<br>Presentation and Playtest: Demonstrate how the game works in the real world. |
| Week 14 | Lecture 14: Statistical Modeling For Games I<br>Statistics inform gameplay on many levels. One of the most important is game balance. The results of Excel (or other spreadsheet) prototyping tests can be used to quantitatively fine-tune agent behavior as well as environment and gameplay parameters.<br><br>Reading: Schell, Chapters 27 – 28, Unity 3D, Chapter 14<br><br>In-Class Exercise: Spreadsheet Prototyping<br>Assignment: Develop a spreadsheet to test game sensitivity to different parameters.<br>Presentation: Show the relationships between game parameters and gameplay results over multiple test runs. |
| Week 15 | Lecture 15: Statistical Modeling For Games II<br>Statistics can come out of a game as well as go into it. Analysis of gameplay data gathered over many test runs of a game can indicate player engagement and frustration, as well as specific points in the game that are imbalanced: too easy or difficult, overconstrained or underconstrained, etc.<br><br>Reading: Schell, Chapters 29 – 33<br><br>Quiz #3, Covering Weeks 11 – 15 Lectures and Reading<br><br>In-Class Exercise: Statistics and Gameplay<br>Assignment: Develop a data logging system that can enable analysis of gameplay and player state.<br>Presentation and Playtest: Visually show the results of the data analysis, partially fueled by playtest telemetry data and other feedback. |
| Finals Period | Presentation of Final Projects<br>Final write-up and brief demo for instructors and entire class. |

*Playtest/Critique Requirements:

Participating in in-class play tests is a requirement of the class. During each play test session, the class will break up into groups. In each group, each developer must quickly and clearly explain their game system to the play testers and lead them through a 20-minute play session. After the group has played the game, the developer must lead a critique of their own game, eliciting as much feedback as possible from their play testers. At the end of the session, the developer must submit a critique document from the comments of the play testers. Both of these documents will be evaluated as part of the assignment grade.

## Statement on Academic Conduct and Support Systems

### Academic Conduct

Plagiarism – presenting someone else's ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in *SCampus* in Section 11, *Behavior Violating University Standards* https://scampus.usc.edu/1100-behavior-violating-university-standards-and-appropriate-sanctions. Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, http://policy.usc.edu/scientific-misconduct.

Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the *Office of Equity and Diversity* http://equity.usc.edu or to the *Department of Public Safety* http://adminopsnet.usc.edu/department/department-public-safety. This is important for the safety of the whole USC community. Another member of the university community – such as a friend, classmate, advisor, or faculty member – can help initiate the report, or can initiate the report on behalf of another person. *The Center for Women and Men* http://www.usc.edu/student-affairs/cwm/ provides 24/7 confidential support, and the sexual assault resource center webpage http://sarc.usc.edu describes reporting options and other resources.

### Support Systems

A number of USC's schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more. Students whose primary language is not English should check with the *American Language Institute* http://dornsife.usc.edu/ali, which sponsors courses and workshops specifically for international graduate students. *The Office of Disability Services and Programs* http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html provides certification for students with disabilities and helps arrange the relevant accommodations. If an officially declared emergency makes travel to campus infeasible, *USC Emergency Information* *http://emergency.usc.edu* will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.