USC Viterbi
School of Engineering

ITP 485 Programming Game Engines

Units: 4
Spring 2019—MW—10:00 – 11:50am:

Location: KAP 107

Instructor: Matt Whiting
Office: OHE 530 E
Office Hours:
MW 9-10 KAP 107 (just come to class early)
TTh 9-10 OHE 540
TW 12-1 OHE 530E
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Course Description

This course provides students with an in-depth exploration of 3D game engine architecture.

Students will learn state-of-the-art software architecture principles in the context of game engine design, investigate subsystems typically found in a real game engine, survey engine architectures from actual shipped games, and explore how the differences between game genres can affect engine design.

Students will participate in individual hands-on lab exercises to reinforce these concepts.

Learning Objectives

Engine subsystems including rendering, audio, collision, physics, and game world models. Large-scale C++ software architecture in a games context. Tools pipelines for modern games.

Prerequisite(s): ITP-380
Co-Requisite(s):
Concurrent Enrollment:
Recommended Preparation:

Course Notes

Throughout the semester, students will work by themselves to build features in a simplified game engine. These assignments must be completed *individually*.

Each assignment builds upon the previous one, and late assignments cannot be accepted.

From time to time during the semester, we'll have in-class assignments. Each in-class assignment is to be completed individually during the time allotted during that class period and is "open-book". Any and all reference material is allowed, but collaboration is not. This is a chance to practice finding and using reference material.

There are two exams which are comprehensive of all topics covered. The exams are "closed-book".

Technological Proficiency and Hardware/Software Required

The course is taught exclusively in C++ using Windows DirectX 11 and Visual Studio.

Due to the nature of programming with the DirectX API, students should have access to a machine with Windows. If you are on a Mac, you can download Windows from USC Viterbi Dreamspark, and install it on your Mac via Bootcamp. Because we are using DirectX 11, Parallels or VMWare fusion do not work. You have to boot via bootcamp.

Students will have access to usable machines in the classroom, and acceptable laptops can be checked out from either the CS or ITP departments.

Required Readings and Supplementary Materials

Required:
Game Engine Architecture, Third Edition. Jason Gregory. ISBN-13: 978-1138035454.
Optional:

Real-Time Collision Detection. Christer Ericson. ISBN-13: 978-1-55860-732-3.
Effective C++ (3rd Edition). Scott Meyers. ISBN-13: 978-0321334879.

Description and Assessment of Assignments

There are 11 lab assignments. These are programs to be written individually. Some in-class time will be devoted to labs, but it is expected that students will spend about 8 hours per week working on these outside of class.

Each lab assignment will be given one of 4 grades:

- (Z)ero 0%
- (R)evision Needed 60%
- (M)eets expectations 80%
- (E)xemplary 100%

Labs will be graded by the TAs. First, they will check that the lab functions correctly. Labs that are not turned in on time or do not function will be given a grade of Z. Labs that partially function will be given a grade of R. If your lab functions reasonably well, the TAs will perform a "code review" where they inspect your source code for efficiency an readability. Based on this review, they may assign a grade or R, M, or E. In the case of an R or an M, the grader will provide specific notes for revisions to be made for a regrade.

You will have up to 2 weeks past the original due date to submit revisions for a regrade, and the final revision will be the grade awarded.

Late labs can be submitted up to the 2 week deadline for regrade, but will incur a 20% late submission penalty.

In addition, there are 10 "In-Class" assignments intended to be performed during the class session, although these may become take-home assignments if we don't have time during class.

There are also 5 "At-Home" assignments in the form of blackboard quizzes.

Grading Breakdown

Assignment	% of Grade
"In-Class" Assignments	10
Lab Assignments	30
Midterm	30
Final Exam	30
TOTAL	100

Grading Scale (Example)

Course final grades will be determined using the following scale

A	93-100
A-	90-92
B+	87-89
B	83-86
B-	80-82
C+	77-79
C	73-76
C-	70-72
D+	67-69
D	63-66
D-	60-62
F	59 and below

Half percentage points will be rounded up to the next whole percentage. So for instance, 89.5% is an A-, but 89.4% is a B+.

Assignment Submission Policy

Each student will make a git repo on https://www.bitbucket.org, and that repo must be shared (for viewing) with the instructor and the TAs. Lab assignments are to be pushed into that git repo.

In-class assignments and exams are generally conducted on paper and will be turned in at the end of the course period.

Grading Timeline

All assignments are expected to be graded within 1 week of the due-date.

Additional Policies

There is generally no curving. Students will receive the grade they earn.

Some assignments and exams will get a “do-over” as a take-home assignment. When offered, “do-over” assignments are weighted equally with the original assignment.

Extra credit is generally not offered.

Make-up policy for exams: To make up for a missed exam, the student must provide a satisfactory reason (as determined by the instructor) along with proper documentation. Make-up exams are only allowed under extraordinary and emergency circumstances.

Late Lab Assignments: There will be a 20% reduction for any lab assignments that did not get turned in on time, and no labs will be accepted for regrade more than 2 weeks past the original due date.

Course Schedule: A Weekly Breakdown

	Topics/Daily Activities	Readings and Homework	Deliverable/ Due Dates
Class 1 8/26	**Introduction**	§5.1 – §5.5 02_MathReview.pdf	**In-Class 01 (git repo)**
Class 2 8/28	**Math Review** **Begin Lab 01 SIMD**	§4.10 03_SIMD.pdf Blackboard "SIMD Tutorial";	**In-Class 02 a/b** **At-Home 02 Due @ 10am**
No Class 9/2	**Labor Day**		
Class 3 9/4	**SIMD** **Continue Lab 01**	§6.2	**In-Class 03** **At-Home 03 Due @ 10am**
Class 4 9/9	**Custom Memory Allocators**	05_Graphics1.pdf	**In-Class 04**
Class 5 9/11	**Rendering 1** **Begin Lab 02 Triangle**	§11.1.0 – §11.1.2.4 06_C++.pdf	**Lab 01 Due @ 10am**
Class 6 9/16	**The C++ Compiler** **Continue Lab 02**	§2.2 07_Graphics2.pdf	**In-Class 06 a/b**
Class 7 9/18	**Rendering 2** **Begin Lab 03**	§10.1.4	**Lab 02 Due @ 10am** **At-Home 07 Due @ 10am**
Class 8 9/23	**Cache**	§3.5.4 09_Graphics3.pdf	**In-Class 08**
Class 9 9/25	**Rendering 3** **Begin Lab 04**	§11.1.2.5 – §11.1.3 10_GameObjects.pdf	**Lab 03 Due @ 10am** **At-Home 09 Due @ 10am**
Class 10 9/30	**Game Object Models** **Continue Lab 04**	§16.1 – §16.4	
Class 11 10/2	**Serialization** **Begin Lab 05**	§7.2	**Lab 04 Due @ 10am**
Class 12 10/7	**Guest Lecture** **Jason Gregory**		
Class 13 10/9	**Profiling** **Lab 06**	§2.3, §10.8 **Begin Lab 06 Profiling**	**Lab 05 Due @ 10am**
Class 14 10/14	**Hardware & 3D Math**	§3.3	**In-Class 14**
Class 15 10/16	**Midterm Review**		
Class 16 10/21	**Midterm Exam**	17_Animation1.pdf	
Class 17 10/23	**Animation 1** **Begin Lab 07**	§12.1 – §12.3 18_Animation2.pdf	**Lab 06 Due @ 10am**
Class 18 10/28	**Animation 2** **Continue Lab 07**	§12.4 – §12.6	**At-Home 18 Due @ 10am**
Class 19 10/30	**Multithreading** **Lab08**	§4.5-§4.9; §16.6-§16.7 **Begin Lab 08 Job Manager**	**In-Class 19 a/b** **Lab 07 Due @ 10am**
Class 20 11/4	**Multiplayer**		
Class 21 11/6	**Collision Detection** **Lab 09**	§13.3; §13.5 **Begin Lab 09 Collisions**	**Lab 08 Due @ 10am**

Class 22 11/11	**GJK** **Lab 09**		**In-Class 22**
Class 23 11/13	**Normal Maps** **Lab 10**	§11.3 **Begin Lab 10 Normal Map**	**Lab 09 Due @ 10am**
Class 24 11/18	**Post Effects**	§11.2.7; §11.3	**In-Class 24**
Class 25 11/20	**Content Pipelines** **Lab 11**	**Begin Lab 11 Bloom**	**Lab 10 Due @ 10am**
Class 26 11/25	**Scripting & Audio** **Continue Lab 11**	§16.8-§16.9; §14.1-§14.4	
No Class **11/27**	**Thanksgiving Recess**		
Class 27 12/2	**TBD**		**Lab 11 Due @ 10am**
Class 28 12/4	**Final Review**		
FINAL **12/16**	**Final Exam**	**Monday Dec 16 8am**	Date: For the date and time of the final for this class, consult the USC *Schedule of Classes* at www.usc.edu/soc.

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 Part B, Section 11, "Behavior Violating University Standards" https://policy.usc.edu/scampus-part-b/. 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.

Support Systems:
Student Counseling Services (SCS) - (213) 740-7711 – 24/7 on call
Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention. https://engemannshc.usc.edu/counseling/

National Suicide Prevention Lifeline - 1-800-273-8255
Provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week. http://www.suicidepreventionlifeline.org

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-4900 - 24/7 on call
Free and confidential therapy services, workshops, and training for situations related to gender-based harm. https://engemannshc.usc.edu/rsvp/

Sexual Assault Resource Center
For more information about how to get help or help a survivor, rights, reporting options, and additional resources, visit the website: http://sarc.usc.edu/

Office of Equity and Diversity (OED)/Title IX Compliance – (213) 740-5086
Works with faculty, staff, visitors, applicants, and students around issues of protected class. https://equity.usc.edu/

Bias Assessment Response and Support
Incidents of bias, hate crimes and microaggressions need to be reported allowing for appropriate investigation and response. https://studentaffairs.usc.edu/bias-assessment-response-support/

The Office of Disability Services and Programs
Provides certification for students with disabilities and helps arrange relevant accommodations. http://dsp.usc.edu

Student Support and Advocacy – (213) 821-4710
Assists students and families in resolving complex issues adversely affecting their success as a student EX: personal, financial, and academic. https://studentaffairs.usc.edu/ssa/

Diversity at USC
Information on events, programs and training, the Diversity Task Force (including representatives for each school), chronology, participation, and various resources for students. https://diversity.usc.edu/

USC Emergency Information
Provides safety and other updates, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible, http://emergency.usc.edu

USC Department of Public Safety – 213-740-4321 (UPC) and 323-442-1000 (HSC) for 24-hour emergency assistance or to report a crime.
Provides overall safety to USC community. http://dps.usc.edu