USC Viterbi
School of Engineering

ITP 485 Programming Game Engines

Units: 4
Fall 2018—TTh—10:00 – 11:50am:

Location: OHE 540

Instructor: Matt Whiting
Office: OHE 530 E
Office Hours:
Mon 10-11:30am
Wed 10-11:30am, 2-3:00 pm
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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, Second Edition. Jason Gregory. ISBN-13: 978-1466560017.
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 is expected to compile and run without error. If the program does not compile, 10 points will automatically be deducted from the lab score. (If the failure to compile is the result of a failure to push files to the repo, the deduction will be reduced to 5 points, but the student will be required to demonstrate that the work was done on time.)

Each lab is expected to compile without warnings. If there are any warnings, 2 points will automatically be deducted from the lab score. If there are multiple warnings, 1 additional point will be deducted for each additional warning after the first.

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: In general, each lab builds upon the previous one. Therefore, we cannot accept late lab assignments.

Course Schedule: A Weekly Breakdown

	Topics/Daily Activities	Readings and Homework	Deliverable/ Due Dates
Class 1 8/21	**Introduction**		**In-Class 01 (git repo)**
Class 2 8/23	**Math Review**	§4.1 – §4.4	**In-Class 02 a/b**
Class 3 8/28	**SIMD** **Lab 01**	§4.7 Blackboard "SIMD Tutorial"; **Begin Lab 01 SIMD**	**In-Class 03**
Class 4 8/30	**Custom Memory Allocators**	§5.2; §3.3	**In-Class 04**
Class 5 9/4	**Rendering 1** **Lab 02**	§10.1.0 – §10.1.2.4 **Begin Lab 02 Triangle**	**Lab 01 Due 9/11 @ 10am**
Class 6 9/6	**The C++ Compiler**		**In-Class 06 a/b**
Class 7 9/11	**Rendering 2** **Lab 03**	§10.1.4 **Begin Lab 03 Cube**	**Lab 02 Due 9/18 @ 10am**
Class 8 9/13	**Caching**	§10.1.2.5 – §10.1.3	**In-Class 08**
Class 9 9/18	**Rendering 3** **Lab 04**	**Begin Lab 04 Lighting**	**Lab 03 Due 9/25 @ 10am**
Class 10 9/20	**Game Object Models** **Lab 04**	§15.1 – §15.4	
Class 11 9/25	**Serialization** **Lab 05**	**Begin Lab 05 Model**	**Lab 04 Due 10/2 @ 10am**
Class 12 9/27	**Profiling** **Lab 06**	§3.4, §2.3, §9.8 **Begin Lab 06 Profiling**	**Lab 05 Due 10/9 @ 10am** **In-Class 12**
Class 13 10/2	**Midterm Review**		
Class 14 10/4	**Midterm Exam**		
Class 15 10/9	**Animation 1** **Lab 07**	§11.1 – §11.10 **Begin Lab 07 Animation**	**Lab 06 Due 10/16 @ 10am**
Class 16 10/11	**Animation 2** **Lab 07**		
Class 17 10/16	**Multithreading**	§7.6; §15.6; **Begin Lab 08 Job Manager**	**Lab 07 Due 10/25 @ 10am** **In-Class 17 a/b**
Class 18 10/18	**Scripting**	§15.8	
Class 19 10/23	**Hardware & 3D Math** **Lab 08**	§4.1 – §4.6; §4.8	
Class 20 10/25	**Collision Detection** **Lab 09**	§12.3; §12.5 **Begin Lab 09 Collisions**	**Lab 08 Due 11/1 @ 10am**
Class 21 10/30	**GJK** **Lab 09**		
Class 22 11/1	**Normal Maps** **Lab 10**	§10.3 **Begin Lab 10 Normal Map**	**Lab 09 Due 11/13 @ 10am**
Class 23 11/6	**Audio**	§7.7	

Class 24 11/8	**Post Effects**	§14.4	
Class 25 11/13	**Content Pipelines** **Lab 11**	**Begin Lab 11 Bloom**	**In-Class 23** **Lab 10 Due 11/20 @ 10am**
Class 26 11/15	**Multiplayer**		**In-Class 26**
Class 27 11/20	**Audio**		**Lab 11 Due 11/29 @ 10am**
11/22	**No Class**	**Thanksgiving Holiday**	
11/27	**TBD**		
Class 28 11/29	**Final Review**		
FINAL 12/11	**Final Exam**	**December 11 @ 8-10 am**	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