Sp18 - COMPUTER GRAPHICS: HONORS (51710)

Jump to Today

Computer Graphics: Honors/Graduate

CS 378H/384G (51710/51730)

Essential Information

Location:
Time:
Piazza:

Instructor:
Contact:
Office Hours:

GDC 5.302
3:30 — 5:00 TTh
Click Here (http://piazza.com/utexas/spring2018/cs378h384g/home)

Etienne Vouga
evouga@cs.utexas.edu
5:00 — 6:00 M & W
GDC 5.508

Teaching Assistant:
Contact:
Office Hours:

Xinya Zhang
xinyazhang@utexas.edu
5-6pm TTh, GDC basement.

The Force Awakens © The Walt Disney Company

Course Summary: This is an accelerated introductory course on the major topics in the areas of image synthesis, interactive techniques, geometric modeling, and computer-based animation. The material covered includes

- OpenGL and shader programming;
- principles of operation of raster graphics systems;
- sampling and antialiasing;
- homogeneous coordinate transformation techniques;
- parallel and central projection and perspective transformations;
- hidden surface removal;
- light and reflectance models for local and global illumination;
- shading techniques;
- ray tracing;
- basic object modeling techniques;
- visual perception and basic color theory;
- parameterization and texturing;
- basic animation.

Upon course completion, you should have mastered both the mathematical principles of these techniques and their implementation. Implementation of these techniques will be demonstrated through a series of programming assignments in C++, in many cases using OpenGL. Your mastery of the mathematical fundamentals will be exercised through the programming assignments and the in-class midterm.

Prerequisites: (The following courses with a grade of at least C-: [CS429 || CS310 || CS429H || CS310H] && [M340L || SDS329C] **)** || **(**permission of instructor**)**.

Required Textbooks: None, but see below.

Optional Textbooks:

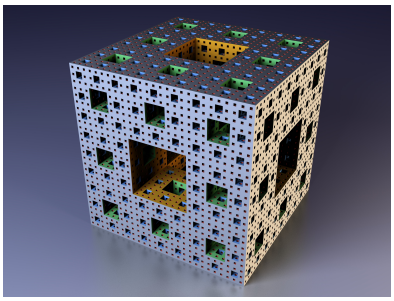
- *Interactive Computer Graphics: A Top-Down Approach with WebGL (7th Edition)*. Edward Angel and Dave Shreiner. ISBN 978-0133574845.
- *Mathematics for 3D Game Programming and Computer Graphics, Third Edition*. Eric Lengyel. ISBN 978-1435458864.
- *OpenGL Programming Guide: The Official Guide to Learning OpenGL, Version 4.3 (8th Edition)*. Dave Shreiner, Graham Sellers, John Kessenich, and Bill Licea-Kane. ISBN 978-0321773036.

The OpenGL Programming Guide (the "Red Book") is optional, but highly recommended, as it is the go-to reference for OpenGL and shader programming. While all of the material in the book needed for this course can also be found in online references, **OpenGL has many, mutually-incompatible versions** and reference guides for version 4.3 specifically can be hard to find.

Assignments and Grading: The course includes five programming projects; the final grade for the course

will be computed based on performance on these projects, an in-class midterm, and one written assignment. There will be no final exam. Your final grade will include pluses and minuses. The five projects and final grade breakdowns are:

- **Linear Algebra Worksheet (5%):** This short written assignment will refresh your knowledge of linear algebra, and serves as a self-assessment of your preparation to tackle the course material.
- **Ray Tracer (15%):** The classic Computer Graphics project. You will implement ray tracing "by hand," and accelerate it using a hierarchical spatial data structure. This project is the only one that will *not* use OpenGL.
- **Menger Sponge (15%):** In this project, you will write a program to generate the Menger Sponge, a typical example of a fractal. In addition, you will implement camera controls that allow the user to pan, rotate, and zoom around 3D space.



- **In-class Midterm (15%)**
- **Virtual Mannequin (15%)**: In this project, you will build a rigged model of a mannequin, allowing you to animate the mannequin by manipulating its bones. You will implement a simple scene editor that allows the user to place keyframes encoding an animation of the mannequin. You will also compute a parameterization of the mannequin geometry, and use it to texture map and shade the mannequin.
- **Minecraft (15%)**: You will implement a procedurally-generated 3D world similar to that found in the popular game Minecraft, putting to work advanced shading techniques such a procedurally-generated textures, ambient occlusion, bump mapping, and water effects.
- **Final Project (20%):** For the final project, you have free reign to show off the skills you have learned in the course: you might implement one of the topics discussed in lectures that's not covered by the projects above, or substantially expand one of your existing applications, or research and implement an algorithm not covered in class at all.

Please see the schedule below for the due dates of the assignments and the date of the midterm.

Due Dates, Lateness, and Late Days: Each programming assignment is due by 3:29 PM (**before class**) on the dates listed in the schedule below. Each project specification will include details for how to submit that project. For every day that a milestone is turned in late, rounded up to the nearest day, one letter grade (10%) will be deducted from the total milestone grade.

We all know that sometimes unforeseen events disrupt the best-laid plans: an assignment turns out to take a lot more time than you expected, you have to spend a lot of time studying for an exam in a different course, you need to travel to an interview, etc. Some leniency has therefore been built into the above policy: each student begins the semester with **three late days**. The first three times a letter grade would be deducted per the above policy, that student loses a late day instead. Please plan ahead: other than the three late days, ***no exceptions*** will be made to the lateness policy, except in the case of documented medical emergency or as mandated by university policy. *Plan ahead!*

Examples: An assignment is due on Friday, and Alice turns in the assignment at 3:31 PM; Bob turns it in at 9:00 PM; and Charles at 4:00 PM on Saturday. Alice and Bob will both be charged a late day, or if they have no late days remaining, will lose 10% of the project grade. Charles will lose two late days, or one late day

and 10%, or 20%, depending on how many late days he has remaining.

The instructor/TA will keep track of your late days remaining, and will allocate them to your late assignments in the way most beneficial to you (i.e. to the most highly-weighted assignments first) at the end of the semester. Until the end of the semester, your Canvas grades will reflect the worst-case scenario where no late days are used on any assignments.

It is courteous, but not required, to inform the instructor and TA if you intend to turn in a project late using late days.

Warning: the projects in this class are complex and difficult, and will require multiple days worth of programming effort even for the brightest students. Exercise good time management and **plan ahead!!**

Formal Collaboration: You are allowed (but not required) to work on each assignment in self-selected (and self-managed) teams of two. If you work in a team, you must submit, with each assignment, an *individual* collaboration report stating, from your perspective, how much and which parts of the project each student contributed to. Discrepancies will be investigated by the instructor, and credit for the project will be distributed in proportion to each student's contribution.

Informal Collaboration and Academic Honesty: You are allowed, and encouraged, to discuss the projects with your classmates, to work together on understanding the theory and math involved in the projects, to help each other debug, etc. You may also use Internet resources like Stackoverflow to get help on the math and theory, or to ask generic questions about C++ or OpenGL. That said, ***the code submitted by each team must be their own***, except for a) "starter code" provided by the instructor, and b) external libraries explicitly approved by the instructor.

If in doubt, please contact the instructor. Violations of this policy will be reported to Student Judicial Services.

CS Lab Account: You must obtain an account for the CS department computer lab. Visit this website to request an account: **https://apps.cs.utexas.edu/udb/newaccount/** **(https://apps.cs.utexas.edu/udb/newaccount/)** . (If you had an account the previous semester it should renew automatically.) Accounts take at least a day to become active, so please request your account as soon as possible so that it is available in time for the first assignment. Please obtain an account even if you intend to complete the assignments on your personal computer: all grading will be done on the CS lab machines and it is ***your responsibility to ensure your code runs on these machines***.

Piazza: The best way to get in touch with the instructor and TA outside of office hours is via the Piazza page linked at the top of the syllabus. Important announcements and clarifications about the assignments will also be posted to Piazza, so please create an account and check in regularly.

Students with Disabilities: The University of Texas at Austin provides upon request appropriate academic adjustments for qualified students with disabilities. For more information, contact the Office of the Dean of Students at 471-6259.

Some Final Advice: Writing working graphics code is very rewarding, but also challenging and at times frustrating. To get the most out of this course,

- **Start Early:** Yes, every professor in every computer science class has told you the same thing. Graphics

code can be particularly tricky to debug, since it's not always immediately obvious whether or not code is correct, or whether a bug is due to wrong code or wrong math. By starting early, you have plenty of time to fix things if they go wrong.

- **Get Help:** Double-check your math formulas with your classmates; take advantage of the opportunity to work in teams; come to office hours for help deriving formulas, finding bugs, or even just to check whether you're on the right track.

Schedule: A tentative schedule of lecture topics is listed below.

Course Summary:

Date	Details	
Tue Jan 16, 2018	Introduction; History of Computer Graphics (https://utexas.instructure.com/calendar?event_id=1266004&include_contexts=course_1214517)	3:30pm to 5pm
Thu Jan 18, 2018	Review: Linear and Vector Algebra (https://utexas.instructure.com/calendar?event_id=1266005&include_contexts=course_1214517)	3:30pm to 5pm
Tue Jan 23, 2018	Basic Ray Tracing (https://utexas.instructure.com/calendar?event_id=1266006&include_contexts=course_1214517)	3:30pm to 5pm
Thu Jan 25, 2018	Linear Algebra Worksheet (https://utexas.instructure.com/courses/1214517/assignments/4243422)	due by 3:29pm
	Lighting and Shading (https://utexas.instructure.com/calendar?event_id=1266008&include_contexts=course_1214517)	3:30pm to 5pm
Tue Jan 30, 2018	Barycentric Coordinates; Parameterizations (https://utexas.instructure.com/calendar?event_id=1266009&include_contexts=course_1214517)	3:30pm to 5pm
Thu Feb 1, 2018	Texturing (https://utexas.instructure.com/calendar?event_id=1266010&include_contexts=course_1214517)	3:30pm to 5pm
Tue Feb 6, 2018	Ray Tracer Milestone I (50 pts in grand total) (https://utexas.instructure.com/courses/1214517/assignments/4243427)	due by 3:29pm
	Spatial Data Structures (https://utexas.instructure.com/calendar?event_id=1266011&include_contexts=course_1214517)	3:30pm to 5pm
Thu Feb 8, 2018	Linear and Affine Transformations; Coordinate Systems (https://utexas.instructure.com/calendar?event_id=1266012&include_contexts=course_1214517)	3:30pm to 5pm

Date	Details	
Tue Feb 13, 2018	The Graphics Pipeline (https://utexas.instructure.com/calendar?event_id=1266013&include_contexts=course_1214517)	3:30pm to 5pm
Thu Feb 15, 2018	Ray Tracer Milestone II (https://utexas.instructure.com/courses/1214517/assignments/4243425)	due by 3:29pm
	Global Illumination: Path Tracing and Radiosity (https://utexas.instructure.com/calendar?event_id=1266014&include_contexts=course_1214517)	3:30pm to 5pm
Tue Feb 20, 2018	Projective Geometry (https://utexas.instructure.com/calendar?event_id=1266015&include_contexts=course_1214517)	3:30pm to 5pm
Thu Feb 22, 2018	Menger Sponge Milestone I (https://utexas.instructure.com/courses/1214517/assignments/4243428)	due by 3:29pm
	Rotations and Projections (https://utexas.instructure.com/calendar?event_id=1266016&include_contexts=course_1214517)	3:30pm to 5pm
Tue Feb 27, 2018	Color and Perception (https://utexas.instructure.com/calendar?event_id=1266017&include_contexts=course_1214517)	3:30pm to 5pm
Thu Mar 1, 2018	Menger Sponge Milestone II (https://utexas.instructure.com/courses/1214517/assignments/4243434)	due by 3:29pm
	TBD (Slack Day) (https://utexas.instructure.com/calendar?event_id=1266018&include_contexts=course_1214517)	3:30pm to 5pm
Tue Mar 6, 2018	Midterm (https://utexas.instructure.com/courses/1214517/assignments/4243444)	due by 3:29pm
	In-class Midterm (no lecture) (https://utexas.instructure.com/calendar?event_id=1266021&include_contexts=course_1214517)	3:30pm to 5pm
Thu Mar 8, 2018	Midterm Post-mortem (https://utexas.instructure.com/calendar?event_id=1266022&include_contexts=course_1214517)	3:30pm to 5pm
Tue Mar 13, 2018	No Class (Spring Break) (https://utexas.instructure.com/calendar?event_id=1266019&include_contexts=course_1214517)	12am
Thu Mar 15, 2018	No Class (Spring Break) (https://utexas.instructure.com/calendar?event_id=1266020&include_contexts=course_1214517)	12am
Tue Mar 20, 2018	Animation (https://utexas.instructure.com/calendar?event_id=1266023&include_contexts=course_1214517)	3:30pm to 5pm
Thu Mar 22, 2018	Rigging and Skinning (https://utexas.instructure.com	3:30pm to 5pm

Date	Details	
	/calendar?event_id=1266024&include_contexts=course_1214517)	
Tue Mar 27, 2018	Virtual Mannequin Milestone I (https://utexas.instructure.com/courses/1214517/assignments/4243429)	due by 3:29pm
	Curves and Splines (https://utexas.instructure.com/calendar?event_id=1266026&include_contexts=course_1214517)	3:30pm to 5pm
Thu Mar 29, 2018	Advanced Shading I: Normal and Bump Mapping; Mipmapping (https://utexas.instructure.com/calendar?event_id=1266027&include_contexts=course_1214517)	3:30pm to 5pm
Tue Apr 3, 2018	Advanced Shading II: Shadows; Ambient Occlusion (https://utexas.instructure.com/calendar?event_id=1266028&include_contexts=course_1214517)	3:30pm to 5pm
Thu Apr 5, 2018	Virtual Mannequin Milestone II (https://utexas.instructure.com/courses/1214517/assignments/4243431)	due by 3:29pm
	Advanced Shading III: Procedural Textures and Noise (https://utexas.instructure.com/calendar?event_id=1266030&include_contexts=course_1214517)	3:30pm to 5pm
Tue Apr 10, 2018	Geometry Data Structures and CSG (https://utexas.instructure.com/calendar?event_id=1266031&include_contexts=course_1214517)	3:30pm to 5pm
Thu Apr 12, 2018	Minecraft Milestone I (https://utexas.instructure.com/courses/1214517/assignments/4243436)	due by 3:29pm
	Minecraft Milestone II (https://utexas.instructure.com/courses/1214517/assignments/4243438)	due by 3:29pm
	GPU Architecture and GPGPU (https://utexas.instructure.com/calendar?event_id=1266032&include_contexts=course_1214517)	3:30pm to 5pm
Tue Apr 17, 2018	Advanced Topics: Geometry Processing (https://utexas.instructure.com/calendar?event_id=1266033&include_contexts=course_1214517)	3:30pm to 5pm
Thu Apr 19, 2018	Advanced Topics: Physical Simulation (https://utexas.instructure.com/calendar?event_id=1266034&include_contexts=course_1214517)	3:30pm to 5pm
Tue Apr 24, 2018	Advanced Topics: Collision Handling (https://utexas.instructure.com/calendar?event_id=1266035&include_contexts=course_1214517)	3:30pm to 5pm

Date	Details	
Thu Apr 26, 2018	Advanced Topics: 3D Capture and Reconstruction (https://utexas.instructure.com/calendar?event_id=1266036&include_contexts=course_1214517)	3:30pm to 5pm
Tue May 1, 2018	Advanced Topics: 3D Printing (https://utexas.instructure.com/calendar?event_id=1266037&include_contexts=course_1214517)	3:30pm to 5pm
Thu May 3, 2018	TBD (Slack Day) (https://utexas.instructure.com/calendar?event_id=1266038&include_contexts=course_1214517)	3:30pm to 5pm
Fri May 4, 2018	Final Project (https://utexas.instructure.com/courses/1214517/assignments/4243440)	due by 11:59pm
	Letter (https://utexas.instructure.com/courses/1214517/assignments/4372518)	
	Score (https://utexas.instructure.com/courses/1214517/assignments/4372513)	