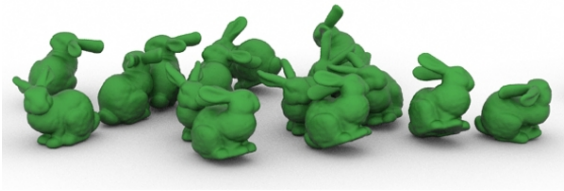
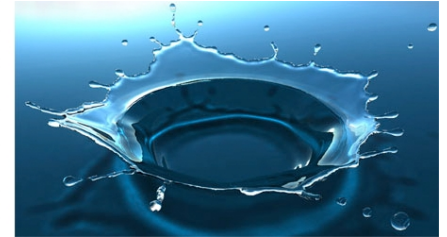


CSCI 420 Computer Graphics, Spring 2021



Source: USC, Cornell, Georgia Tech



**Lecture: Monday and Wednesday,
10:00-11:50, online on Zoom**

Instructor:
[Jernej Barbic](#),
jnb@usc.edu
Office:
online
(Zoom)
Office
hours:
Monday
5:00 - 6:00

TA: Bohan Wang,
bohanwan@usc.edu
Producers: Jingtao
Huang
(jingtah@usc.edu),
TBA
TA Office hours:
Tuesday 6pm-7pm,
and Friday 4pm-5pm
(online on Zoom)

Introduction and Purpose

This course is an introduction to three-dimensional computer graphics. Students will learn both the theory of 3D computer graphics, and how to program it efficiently using **OpenGL**. The course primarily teaches the "modern" **shader-based OpenGL (core profile)**, but also introduces the "classic" fixed-function OpenGL (compatibility profile). Topics include 2D and 3D transformations, Bézier and B-Spline curves for geometric modeling, interactive 3D graphics programming, computer animation and kinematics, and computer graphics rendering including ray tracing, shading and lighting. There will be an emphasis on the mathematical and geometric aspects of computer graphics. This course is regularly offered every semester (the instructor may vary from offering to offering, as may the content somewhat).

[Schedule](#) | [Prerequisites](#) | [Textbooks](#) | [Assignments](#) | [Grading](#) | [Resources and Supplementary Reading](#) | [Academic Integrity](#)

Date	Topic	Reading (Angel)	Reference	Assignments
Mon Jan 18 2021	No class (Martin Luther King Day)			
Wed Jan 20	What is Computer Graphics	Ch 1	PDF PDF-6X-BW	
Mon Jan 25	Introduction to OpenGL	Ch 2	PDF PDF-6X-BW	
Wed Jan 27	Graphics Pipeline	Ch 2	PDF PDF-6X-BW	
Mon Feb 1	Color and Hidden Surface Removal	Ch 2	PDF PDF-6X-BW	
Wed Feb 3	Transformations	Ch 3	PDF PDF-6X-BW	

Mon Feb 8	Viewing and Projection	Ch 4	PDF PDF-6X-BW Assign1-Tips	
Wed Feb 10	Shaders	Ch 1, 2, App A	PDF PDF-6X-BW	Assignment 1 out
Mon Feb 15	No class (President's Day)			
Wed Feb 17	Shaders (continuation)			
Mon Feb 22	Hierarchical Modeling	Ch 8	PDF PDF-6X-BW	
Wed Feb 24	Polygonal Meshes, Curves and Surfaces	Ch 10	PDF PDF-6X-BW	
Mon Mar 1	Splines	Ch 10	PDF PDF-6X-BW	
Wed Mar 3	Lighting and Shading	Ch 5	PDF PDF-6X-BW	Assignment 1 due
Mon Mar 8	Catch-up day			Assignment 2 out
Wed Mar 10	Texture Mapping	Ch 7	PDF PDF-6X-BW Assign2-Tips	
Fri Mar 12	Wellness day			
Mon Mar 15	Review for midterm			Assignment 2 milestone due
Wed Mar 17	Midterm exam (in-class, on Zoom)			
Fri Mar 19	Extra reading: Rasterization	Ch 6	PDF PDF-6X-BW	
Mon Mar 22	Ray Tracing	Ch 11	PDF PDF-6X-BW	
Tue Mar 23	Wellness day			
Wed Mar 24	Catch-up day			
Mon Mar 29	Ray Tracing: Geometric Queries	Ch 11	PDF PDF-6X-BW Assign3-Tips	
Wed Mar 31	Spatial Data Structures	Ch 8	PDF PDF-6X-BW	Assignment 2 due Assignment 3 out

Mon Apr 5	Global Illumination	Ch 11	PDF PDF-6X-BW	
Wed Apr 7	Wellness day			
Mon Apr 12	Keyframe Animation	Ch 9	PDF PDF-6X-BW	
Wed Apr 14	Guest lecture: TBA			
Fri Apr 16	Extra reading: Physically Based Simulation	Ch 9	PDF PDF-6X-BW	
Mon Apr 19	Image Processing	Ch 6, 7	PDF PDF-6X-BW	
Wed Apr 21	Non-Photorealistic Rendering		PDF PDF-6X-BW	Assignment 3 due
Thu Apr 22	Wellness day			
Mon Apr 26	Virtual Reality		PDF PDF-6X-BW	
Wed Apr 28	Visualization	Ch 11	PDF PDF-6X-BW	
Mon May 10	Final exam	8a.m.-10a.m., online		

Prerequisites

- Junior, senior, MS or PhD student, or explicit permission of instructor
- CSCI 104 (Data Structures and Object-Oriented Design)
- MATH 225 (Linear Algebra and Differential Equations)
- Familiarity with calculus and linear algebra
- C/C++ programming skills

Textbooks (both strongly recommended)

- Edward Angel: **Interactive Computer Graphics: A Top-Down Approach Using OpenGL, Sixth edition**, Publisher: Addison Wesley, ISBN: 9780321535863
- Dave Shreiner: **OpenGL Programming Guide: The Official Guide to Learning OpenGL, Version 4.3**, Eighth edition, Publisher: Addison-Wesley Professional, ISBN: 9780321773036

Assignments

There will be three programming homework assignments, teaching students OpenGL and how to program 3D

computer graphics. Please see the schedule for links to assignments and due dates. All assignments must be done **individually**.

Grading

- Assignments: 17% each (51% total)
- Mid-term exam: 19%
- Final exam: 30%

All assignments must be completed to pass the course. Students must take the mid-term and final exams to pass the course. The assignments will have a small amount of extra credit.

Late policy: Programming assignments should be turned in by midnight on the day they are due. A total of **three late days** may be taken during the semester on programming assignments. For example, you can use one late day on the second assignment, and two on the third assignment. All days are counted, including any weekends and holidays, as follows:

Less than 24 hours late = 1 late day, 24-48 hours late = 2 late days, 48-72 hours late = 3 late days, and so on. The flexibility provided by the late days is intended to get you through the time where all your classes just happen to have assignments due on the same day. Beyond the three late days, there will be a penalty of 10% of the value of the assignment / day. Exceptions will be granted only under most dire circumstances and must be discussed with and approved by the instructor at least one week in advance. Assignment and exam grading may be discussed within three weeks of them being returned to the students.

Forum

There is a forum on Piazza where students can ask questions.

Resources and Supplementary Readings

- www.opengl.org, the OpenGL home page
- [OpenGL SDK documentation](http://www.opengl.org) on www.opengl.org
- [Real-Time Rendering Resources](#)

Computer Graphics References

- **OpenGL Shading Language**
Randi J. Rost.
3rd edition, Addison-Wesley Professional, 2009.
ISBN 9780321637635
- **Real-Time Rendering.**
Tomas Akenine-Möller and Eric Haines.

2nd edition, AK Peters, 2002.

ISBN 1-56881-182-9.

- **Computer Graphics: Principles and Practice.**
James D. Foley, Andries van Dam, Steven K. Feiner, and John F. Hughes.
2nd edition in C, Addison-Wesley, 1996.
ISBN 0201848406.
- **Fundamentals of Computer Graphics.**
Peter Shirley, Steve Marschner.
3rd edition, A K Peters, 2009.
ISBN 1568814690.
- **An Introduction to Ray Tracing.**
Andrew S. Glassner, editor, Academic Press, 1989.
ISBN 0-12-286160-4.
- **Advanced Animation and Rendering Techniques, Theory and Practice.**
Alan Watt and Mark Watt, ACM Press and Addison-Wesley, 1992.
ISBN 0-201-54412-1.

Prerequisite-related Resources

- **(Math for graphics) Appendices B and C of the course textbook (Angel)**
- **(Math for graphics) Chapter 2, "Miscellaneous Math" of Shirley and Marschner, Fundamentals of Computer Graphics**
- **Introduction to Linear Algebra.**
Gilbert Strang.
Wellesley-Cambridge Press, 1998.
ISBN 0-9614088-5-5.
- **Calculus: Early Transcendentals.**
James Stewart.
Fourth edition, Brooks/Cole Publishing Company, 1999.
ISBN 0-534-36298-2.
- **[Khan Academy, free math instructional videos](#)**
- **The C Programming Language.**
Brian W. Kernighan and Dennis M. Ritchie.
Second edition, Prentice Hall, 1988.
ISBN 0-13-110362-8 (paperback).

Academic integrity

All students are expected to maintain the utmost level of academic integrity. Do not copy any parts of any of the assignments from anyone. Do not look at other students' code, papers, assignments or exams. The university policies on academic conduct will be applied rigorously, and the USC Office of Student Judicial Affairs and Community Standards will be notified.

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://capsnet.usc.edu/department/department-public-safety/online-forms/contact-us>. This is important for the safety 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 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.

Statement for Students with Disabilities

Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me (or to TA) as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m.–5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776.

Credits

I wish to thank Prof. Frank Pfenning and Prof. Jessica Hodgins from Carnegie Mellon University for generously providing materials from their computer graphics courses at CMU. This course has also been influenced by computer graphics courses at Cornell, MIT and UC Berkeley.