

CS6533/CS4533 Interactive Computer Graphics

Spring 2023

Lectures: Mondays 2pm–4:30pm
Classroom: 2 MTC Room 909
Course Web sites: <https://cse.engineering.nyu.edu/cs653/>
& NYU LMS (Brightspace)

Instructor: Professor Yi-Jen Chiang
Office: 370 Jay Street, 1103 (11F)
Office Hours: Mondays 4:50pm–5:50pm (via Zoom meetings)
Phone & Email: (646) 997-3395; chiang@nyu.edu

TA: Yuchen Liu. Email: yl5680@nyu.edu. Office Hours (via Zoom meetings): Fridays 3pm–5pm.

Description: This course introduces the fundamentals of Computer Graphics with hands-on graphics programming experiences. Topics include: graphics software and hardware, 2D line-segment scan conversion, 3D transformations, viewing and projection, programmable shaders, polygon scan-conversion, hidden-surface removal, illumination and shading, compositing, texture mapping, effects of shadow, decal, lattice, fog, firework, etc, ray tracing and radiosity, and so on.

Graphics programming projects will be assigned using the academics and industry graphics standard *OpenGL*, compiled with the Microsoft Visual C++ under Windows, or on Mac OS or Linux. The first homework is a warm-up exercise to get started with *OpenGL* programming, and the remaining three homeworks put pieces together to form one course project, which is an animation system with various graphics effects. You will work on the programming homeworks on your own (laptop) computer (it needs to have a programmable GPU to support shader-based OpenGL (OpenGL 3.1 and above), which is usually the case).

Course Objectives:

- Hands-on programming skills for 3D computer graphics using shader-based OpenGL.
- Ability to understand and derive advanced transformations such as sphere rolling and shadow projection.
- Understanding shading and illumination.
- Understanding texture mapping and related techniques.
- Understanding techniques for producing effects of decal, lattice, fog, firework, etc.
- Ability to understand and program shaders on programmable GPU.

Prerequisites: You need to have knowledge of Data Structures and Algorithms, and be comfortable with C/C++ programming.

Required Textbook: S. Gortler, *Foundations of 3D Computer Graphics*, The MIT Press, 2012.

Optional Recommended Textbook: E. Angel and D. Shreiner, *Interactive Computer Graphics: A Top-Down Approach with Shader-Based OpenGL*, 6th Edition, Pearson, 2011.

Recommended Reference: J. Kessenich, G. Sellers, and D. Shreiner, *OpenGL Programming Guide: The Official Guide to Learning OpenGL, Version 4.5 with SPIR-V*, 9th Edition, Addison-Wesley, 2016.

Grading Distribution: Midterm Exam: 25%, Final Exam: 25%, 4 Programming Assignments (last three put pieces together to form one course project): 50%. (The total score of the 4 Assignments is 600 points; the sum of the 4 Assignment scores will be **divided by 5** and then multiplied by 50% for the overall score). The full score of the overall score typically **exceeds 100 points**, and the **final grades** are based on the **distribution of the overall scores** of the class.

Midterm and Final Exams: in-class, closed-book, with limited notes.

General Instructions for Programming Assignments: Submit your write-up, your source code (with full comments and documentation), and include brief instructions on how to compile and run your programs. Submit everything to NYU LMS (Brightspace) of this course (if your write-up is hand-written, scan it into a PDF file to submit).

Note: You may discuss the programming assignments with other students currently taking the course, but **each write-up and program must be done individually and independently**, and you should show that you **personally understand everything that you submit**.

Sharing code, e.g., copying from others or Internet, allowing others to copy your code, making your code publicly accessible on the web (such as on Github), is Cheating. (See also **Policy on Academic Dishonesty** below.)

Policy for Late Assignment Submissions: There will be 10% off for each week passed from the deadline, i.e., the actual score is 90% of the raw score if you miss the deadline but are less than one week late, 80% of the raw score if your time of delay is more than one week but less than two weeks, and so on. (But no assignments will be accepted after the deadline of HW4.)

Policy on Academic Dishonesty:

First time: 0 point for the whole homework/exam; second time: F for the course. All instances will be reported to the department and to the Dean of Student Affairs.

NYU School of Engineering Policy on Academic Dishonesty

See Student Code of Conduct:

<https://engineering.nyu.edu/sites/default/files/2018-06/code-conduct2-2-16.pdf>

Instruction Mode:

The instruction mode of this course is **in-person**. All lectures will be given by the professor in-person in the classroom. **In general, the lectures will not be video-recorded.** Other course materials, such as this syllabus, lecture notes, handouts, sample programs, homework assignments, will be posted online at the course web sites. The office hours of the professor and of the TA will be conducted via Zoom meetings.

You are expected to attend the classes in person. But please **stay at home if you do not feel well**. If you cannot attend a class, you should **send an email to the professor and the TA before the absence, with a short explanation of the reason for the absence**. (However, we do **not** ask

for proof of illness or a doctor's note.)

If you have to miss the classes for a longer period of time or to miss an exam, you should contact Ms. Deanna Rayment (deanna.rayment@nyu.edu) at the Office of Student Affairs, to apply for accommodations. See **NYU School of Engineering Policies and Procedures on Excused Absences** below.

Tentative Schedule (subject to change):

- 1 1/23 Motivations, Overview, Graphics Software and Hardware [Lecture Notes]
- 2 1/30 2D Line-Segment Scan Conversion; OpenGL Standard [Lecture Notes, Ch 1]
Assgn 1 given
- 3 2/6 3D Transformations [Ch 2, 3, 4, Appendix B]
- 4 2/13 3D Transformations [Ch 2, 3, 4, Appendix B];
Viewing & Projection [Ch 5, Lecture Notes]
- 5 2/20 No Class (Presidents' Day)
- 6 2/27 Viewing & Projection [Ch 5, 10, 11, 12.1, Lecture Notes];
Programmable Shaders & Shader-Based OpenGL [Lecture Notes, Ch 1, 6, Appendix A]
Assgn 1 due; Assgn 2 given
- 7 3/6 Programmable Shaders & Shader-Based OpenGL [Lecture Notes, Ch 1, 6, Appendix A];
[Additional Reading: Appendix B, Ch 12, 13]
Polygon Scan-Conversion [Lecture Notes, Sec 12.4]
- 8 3/13 No Class (Spring Break)
- 9 3/20 **Midterm Exam**
- 10 3/27 Hidden Surface Removal [Lecture Notes, Ch 11]; BSP Trees [Lecture Notes]
Assgn 2 due; Assgn 3 given
- 11 4/3 Illumination and Shading [Lecture Notes, Ch 14]
- 12 4/10 Illumination and Shading [Lecture Notes, Ch 14]
- 13 4/17 Illumination and Shading [Lecture Notes, Ch 14]; Compositing [Lecture Notes]
- 14 4/24 Compositing [Lecture Notes]; Textures [Lecture Notes, Ch 15]
Assgn 3 due; Assgn 4 given
- 15 5/1 Textures [Lecture Notes, Ch 15]
- 14 5/8 Textures [Lecture Notes, Ch 15]; Ray Tracing and Radiosity [Lecture Notes, Ch 20]
- 16 5/15 **Final Exam**
Assgn 4 due (Wed. 5/17 at 11:55pm)

Note: If you have two exams at the same time, **report the conflict to your professors as soon as possible. Do not make any travel plans until the exam schedule is finalized.**

Also, please pay attention to notable dates such as Add/Drop, Withdrawal, etc. For confirmation of dates or further information, please contact Susana M. Garcia-Henriquez (sgarcia@nyu.edu).

NYU School of Engineering Policies and Procedures on Excused Absences

Complete policy is found here:

<https://engineering.nyu.edu/campus-and-community/student-life/office-student-affairs/policies>
with associated form:

<https://docs.google.com/forms/d/e/1FAIpQLSeKZ5o47mYztrgtCOlBoDyesKepBBjhSJ3veiqpPc1ae6USBg/viewform>

Deanna Rayment (deanna.rayment@nyu.edu) is the *Assistant Director of Student Advocacy & Compliance* and handles excused absences. She can assist you should it become necessary.

The Moses Center Statement for Student Accessibility

If you are student with a disability who is requesting accommodations, please contact New York University's Moses Center for Student Accessibility (CSA) at 212-998-4981 (or 646-997-3451 for Satellite Office at Tandon School of Engineering) or mosescsa@nyu.edu. You must be registered with CSA to receive accommodations. Information about the Moses Center can be found at <https://www.nyu.edu/students/communities-and-groups/student-accessibility.html>.

The Moses Center is located at 726 Broadway on the 2nd and 3rd floors, New York, NY (Main Office), and 2 MetroTech Center, 962, Brooklyn (Satellite Office at Tandon School of Engineering).

Please do this at the start of the semester.