Syllabus
CMSC 381: Intro to graphics programming

Spring 2017

Time:	MWF 2:00
Room:	Ruffner 352
Website:	`http://cs.longwood.edu/courses/cmsc381/`

This course is designed to introduce students to computer graphics programming techniques. It will combine the use of a high level programming language with a publicly available graphics application programming interface. Other topics will include the mathematics to manipulate geometric objects.

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Office hours:	Mondays 1–2pm; Wednesdays 4–5:30pm; Thursdays 11–12:30pm

Overview

Computers have been creating graphics since at least the 1960s, but in the last few decades an exponential increase in computing power has meant that computer graphics are now capable of incredibly high-definition photorealistic graphical output at high speeds—which in turn means that we all now see computer-generated images and video on a daily basis. Games, movies, print media, and most professional websites are all but guaranteed to make use of some sort of generated graphics.

In this course, we'll write programs to create graphics and better understand some of the math and theory that makes them work.

Objectives

At the end of this course, the successful student will be able to:

1. build and display polygon-based 3D models using WebGL,

2. describe and perform the standard affine transformations of scaling, rotation, and translation on sets of coordinates,
3. diagram and describe a variety of projection transformations representing different camera models,
4. integrate a lighting model into a graphical display using a standard shading algorithm, and
5. implement a dynamic graphical application that actively responds to user input.

Textbook and resources

The textbook is Edward Angel and Dave Shreiner, *Interactive computer graphics: a top-down approach with WebGL*, 7e. (ISBN 978-0-13-357484-5.) The author has provided slides and screencast lectures from an online version of his own course, which will be linked from the course website and which you are encouraged to use to help you understand the material. The website will also link to various other important resources (e.g. the WebGL API).

All our implementations will be done on the departmental Linux systems. If you do not have an active account on those systems, contact me ASAP to get that set up.

Content

Grading scale

I tend to grade hard on individual assignments, but compensate for this in the final grades. The grading scale will be approximately as follows:

A−	[85, 90)	A	[90, 100)	[1]	
B−	[70, 75)	B	[75, 80)	B+	[80, 85)
C−	[55, 60)	C	[60, 65)	C+	[65, 70)
D−	[40, 45)	D	[45, 50)	D+	[50, 55)

While there will be no "curve" in the statistical sense, I may slightly adjust the scale at the end of the term if it turns out some of the assignments were too difficult.

[1] Alas, no A+, unfortunately.

Graded assignments

I figure that I have about 8–10 hours of your time every week, including class time as well as reading assignments and projects. If you find you're spending more time than this, please do come discuss it with me, and we'll see what we can work out. The work you do for this course will be evaluated as follows:

Preparation and homework. For most days, there will be reading and/or something to watch or listen to in order to prepare for class; I expect that you will have done so. For many days, there will be practice work (written or programming) assigned at the end of the previous class; and on those days I'll expect that you've done that practice work to the best of your ability and that you're prepared to talk about it. I might check either one with a (open-notes) quiz, or in the case of homework, I may just check that you've done it. 20%

Active participation. My plan is to spend a large part of our in-class time, possibly the majority, in active practice work. That will only work if everyone stays reasonably focussed and on-task. If you focus and stay on task (and are present), you'll get these points. 5%

Projects and exams. Some portions of this course will be best assessed with programming work, while others are best assessed with exams of various kinds. For grade calculation purposes, they will be grouped together. 75%

- Unit 1: getting started: programming project **due 13 Feb**
- Unit 2: vectors and matrices: sit-down exam **on 24 Feb**
- Unit 3: cameras: take-home exam **due 27 Mar**
- Unit 4: light and shading: programming project **due 24 Apr**
- Unit 5: other topics: exam format TBA **due/on 8 May**

These assessments will each be worth 15%, and collectively make up 75% of the grade.

Calendar (tentative)

Wk	M	W	F
	January		
1		**18** — Introductions Policies	**20** Ch. 1 / L1_5 Img construction graphics pipeline
2	**23** — Javascript basics	**25** * L1_3 Intro to WebGL	**27** §§2.1–2.4,2.8–2.8.1 / L2_3,2_4 Sierpinski
		February	
3	**30** §§2.5–2.7,2.8.2–2.10 / L3_1,3_2 Shaders	**1** §3.1 / L4_2 Animation	**3** §§3.6–3.8 / L4_3,4_4 Event models Interaction **Project out**
4	**6** §4.1 / L4_6 Intro to linear algebra Vectors	**8** — Dot products	**10** — Cross products Lines, planes
5	**13** §§4.2–4.3 / L5_1 Matrices Matrix multiplication **Project due**	**15** §4.3.4–4.3.6 / L5_2 Homogeneous coordinates	**17** §§4.4, 4.5, 4.8 Matrices in WebGL Translation, rotation, scaling
6	**20** §§4.9–4.11 / L5_3,5_4 Affine transformations	**22** §§4.6,4.12 / L5_5 More examples in WebGL	**24** ** — **Exam**
		March	
7	**27** — Exam debrief Cameras and projections	**1** §§5.1–5.3 / L6_3,6_4 Types of projections	**3** — Manual projection work Viewing APIs

* **25 January**: Deadline to add/drop classes (5pm)

** **24 February**: Deadline to elect pass/fail option (5pm)

Wk	M	W	F
	March		
		Spring break	
8	**13** *	**15**	**17**
	§5.4 / L7_1	§§5.5–5.7 / L7_2	—
	Parallel projections	Perspective projections	Perspective cont'd
9	**20**	**22**	**24**
	§5.8	—	—
	Hidden surfaces	Analysis of projection matrices	Practice with projection types
			Exam out
10	**27**	**29**	**31**
	—	§§6.2–6.3 / L7_5	§§6.3–6.4 / L8_1
	Intro to light	Light sources	Phong lighting model
	Optical illusions	Phong lighting model	
	Exam due		
	April		
11	**3**	**5**	**7**
	§§6.7–6.8 / L8_2	§6.6	§6.5 / L8_3
	Lighting/shading in WebGL	Recursive subdivision of spheres	Polygon shading Gouraud and Phong models (theory)
12	**10**	**12**	**14**
	L8_4	—	—
	Gouraud and Phong models (practice) Specular reflection	Implementing diffuse and specular shading	Continued or TBA **Project out**
13	**17**	**19**	**21**
	—	—	—
	Survey of advanced graphics topics	Continued or TBA	Continued or TBA
14	**24**	[Showcase day **no class**]	**28**
	—		—
	Raytracing or TBA **Project due**		Raytracing or TBA
	May		
15	**1**		
	—		
	Raytracing or TBA		

Exam: Mon 8th, 3–5:30pm

* **13 March**: Deadline to withdraw from a class (5pm)

Policies

Support

Don't hesitate to talk to me if you're having trouble with any part of the class. I can help—it's my job! I'm in my office a lot (not just during posted office hours). Feel free to come in and ask questions (or just to talk). If you can't catch me in my office, email is probably your best bet.

Honor code policy

Above all, I ask and expect that you will conduct yourself with honesty and integrity—and not to ignore the other ten points of the Honor Code, either. Take pride in what you are capable of, and have the humility to give credit where it is due.

The two main forms of academic dishonesty are "cheating" and "plagiarism". "Cheating" is getting help from someplace you shouldn't, and "plagiarism" is presenting someone else's idea as if it's your own. If you ever find yourself inclined towards either of these, know that there are always other, better options. Persevere! See my website[2] for some discussion and examples of how to steer clear of these problems, and feel free to come talk to me if you need help finding some of those other options (even if it's for another course).

Cheating or plagiarism (on any assignment) will normally receive a *minimum* penalty of a lowered *course* grade, ranging up to an F in the course. Cases will also be turned in to the Honor Board. But: I believe in your potential, and I hope that you will, or will grow to, observe this policy not simply to evade punishment but positively as a matter of character.

Accommodations

If you have any special need that I can accommodate, I'm happy to do so; come speak to me early in the term so we can set things up. If you have a documented disability, you should also contact Longwood's Office of Disability Resources (Graham Hall, x2391) to discuss some of the support the college can offer you. All such conversations are confidential.

[2] `http://cs.longwood.edu/~dblaheta/collab.html`

Attendance and late policy

Attendance is required, and assignments must be turned in on time. That said, if you have a good reason to miss class or hand something in late, I tend to be fairly liberal with extensions if you ask in advance. (Good reasons do include assignments due for other classes.) (And medical and family emergencies are exempted from the "in advance" part, of course. But contact me ASAP.)

Frequent absence will result in a lowered participation grade; habitual absence may in extreme cases result in a failing grade for the class. *Unexcused* late assignments will normally be given a zero.

Inclement weather policy

I don't plan to cancel class for weather unless the entire college shuts down. If you are commuting or are otherwise significantly affected by a weather event, use your own best judgement; and if you do miss class for this reason, contact me as soon as possible to make up missed work.

Early bird policy

Nobody's perfect, and on occasion an assignment gets written a little unclearly (or, once in a while, with an actual error in it). If you catch one and bring it to my attention early, so that I can issue a clarification or correction to the rest of the class, there'll be some extra credit in it for you.