University of Massachusetts Boston

CS460

Syllabus for CS460 Computer Graphics

Web-based 3D Visualizations

After completion of this course, you will be able to develop rich and interactive web-based 3D visualizations for computers, smartphones, and tablets! By using WebGL, you will learn to create immersive and high-quality graphics including 3D geometric transformations, camera transformations, the image-rendering process, as well as materials and texture mapping. This course also includes advanced topics such as color representations, light simulation, dealing with geometries, and creating animations. And since everything runs in the browser, you can show your work to your friends with a link to a website—how cool is that!

We will learn and use:

- JavaScript (including some HTML and CSS)
- XTK (`https://goXTK.com`)
- Three.js (`https://threejs.org`) and other WebGL frameworks of your choice
- GLSL and ”vanilla” WebGL
- glTF (`https://www.khronos.org/gltf/`)
- Github / git (for version control and assignment submission)
- Overleaf / LaTeX (for reports)

FCK COVID! This is an in-person course. To stay safe, we need to follow the university policies of wearing masks and social distancing.

Teaching Staff

Instructor: Daniel Haehn
Teaching Assistant: TBA
Contact: `staff@cs460.org`

Lectures

Mondays, Wednesdays, Fridays
10:00-10:50am
University Hall Y04-4170

Office Hours

Mondays, Wednesdays, Fridays
11:00am-12:00pm and by request
McCormack M-3-0201-02, please use `https://calendly.com/haehn/` to reserve a slot.

Blackboard Access

Please use Blackboard to access lecture videos, slides, assignments, and all other materials.
Login at `https://umb.umassonline.net/`.

Questions and Concerns

Please direct questions and concerns of any kind (now and during the semester) to the teaching staff in person or at `staff@cs460.org`.

Course Structure

41 Lectures
10 Assignments (30% of final grade, plus 10% bonus)
13 Quizzes (20% of final grade, take-home through blackboard)
Final Project (40% of final grade)
Participation (in-class, in-office, and as part of blackboard discussions, 10% of final grade)
No exams

We will have **multiple guest lectures** from experienced graphics researchers.

Final Grade

The weighted scores from above will result in a final grade as follows:

$\geq$ 90 = A	69-66 = C
89-86 = A-	65-62 = C-
85-82 = B+	61-58 = D+
81-78 = B	57-54 = D
77-74 = B-	53-50 = D-
73-70 = C+	below 50 = F

The ”STRAIGHT A”-Shortcut

There are **two special ways to get a straight A** in this course: **(1)** if we can submit your final project to the International ACM Conference on 3D Web Technology (`https://www.web3d.org/conferences`), or **(2)** if your final project significantly contributes to an existing open source library and gets merged back into the parent code repository (new features, or important bugfixes).

Interactive Lectures (Bring your Laptop!)

Lectures will include interactive components. Please bring your laptop. If you do not have a laptop, please contact the teaching staff at `staff@cs460.org`.

Assignments

Weekly assignments include research questions and coding challenges. All assignments require a written report in LaTeX. You will use a standard git workflow to submit your work. Instructions and templates are available in the Blackboard system. **Assignments are due Mondays at 11:59pm. No late submissions.**

Quizzes

Quizzes include multiple-choice and free-text questions. They are take-home quizzes and available in the Blackboard system. **Quizzes are due Fridays at 11:59pm. No late submissions.**

Final Project

The final project is the capstone of this course and counts as 40% of your final grade. This is your chance to apply your newly learned skills. You can fully enjoy the freedom and come up with your project idea or you can ask the teaching staff for suggestions. Project teams are encouraged but working alone is also fine. In lecture 37, all students will present their final project plans as part of the fast forward event. The following week, all students will present progress towards their final delivery. **And finally, all projects, including reports are due on 12/20/2021. No late submissions.**

Participation

Class attendance and participation, as well as posts in the Blackboard discussion forum count towards your grade. Please skip at most 4 classes and contribute at least once to every official discussion topic, if you want a 100% participation score.

Collaboration Policy

You are allowed and encouraged to collaborate with anybody. However, please make sure to give proper credit. For instance, if your friend helps you with an assignment or you copied code from another source, you must acknowledge their name in your code and the assignment report.

Open Source License

The course material is publicly available under the MIT license (`https://opensource.org/licenses/MIT`). This includes assignment code. You are free to adopt a different license for your assignment solutions.

Readings

There are no required readings for this course. However, the material is based on the following three books:

- Foundations of 3D Computer Graphics by S. Gortler
- WebGL Programming Guide: Interactive 3D Graphics Programming with WebGL by K. Matsuda and R. Lea
- Secrets of the JavaScript Ninja by J. Resig and B. Bibeault

Limited copies of all books are available through the teaching staff. While the books are great, **you do not need to purchase them**—the most up-to-date information is available online.

Disability Accomodations

If you have a disability and feel you will need accommodation to complete course requirements, please contact the Ross Center for Disability Services at 617.287.7430.

Other Policies

We follow the Academic Policies of the Office of the Registrar.
See `https://www.umb.edu/registrar/academic_policies` or contact `staff@cs460.org` for questions.

Timeline

Date			Lecture	Due at 11:59pm
09/06/2021	M		No class	
09/08/2021	W	01	Introduction	
09/10/2021	F	02	Web Developer Tools	Quiz 1
09/13/2021	M	03	JavaScript	Assignment 1 (Intro)
09/15/2021	W	04	XTK Intro	
09/17/2021	F	05	Scene and Camera	Quiz 2
09/20/2021	M	06	Three.js Intro	Assignment 2 (XTK Cube)
09/22/2021	W	07	The Rendering Pipeline	
09/24/2021	F	08	Shaders	Quiz 3
09/27/2021	M	09	WebGL I	
09/29/2021	W	10	WebGL II	Assignment 3 (Three.js Cube)
10/01/2021	F	11	WebGL III	Quiz 4
10/04/2021	M	12	Transformations	
10/06/2021	W	13	Transformations II	Assignment 4 (WebGL)
10/08/2021	F	14	The Scene Graph	Quiz 5
10/11/2021	M		No class (Indigenous Peoples' Day)	
10/13/2021	W	15	Quaternions	
10/15/2021	F	16	The Arcball	Quiz 6
10/18/2021	M	17	3D Picking	Assignment 5 (Transformations)
10/20/2021	W	18	Colors	
10/22/2021	F	19	Recap I	Quiz 7
10/25/2021	M	20	Animations	Assignment 6 (Robot)
10/27/2021	W	21	Animations II	
10/29/2021	F	22	Guest Lecture by Allyssa A Lewis (My Animation Life)	Quiz 8
11/01/2021	M	23	Textures	Assignment 7 (Animated Robot)
11/03/2021	W	24	Guest Lecture by Funda Durupinar (UMass Boston)	
11/05/2021	F	25	Geometry I	Quiz 9
11/08/2021	M	26	Geometry II	Assignment 8 (Robot Crowd)
11/10/2021	W		No class (Veterans Day)	
11/12/2021	F	27	Materials	Quiz 10
11/15/2021	M	28	Lighting	
11/17/2021	W	29	AR/VR and Graphics Research, Jasmine Roberts (Google)	
11/19/2021	F	30	Volume Rendering	Quiz 11
11/22/2021	M	31	glTF I	Assignment 9 (Geometry, Materials, Lighting)
11/24/2021	W	32	Recap II	
11/26/2021	F		No class (Thanksgiving Recess)	
11/29/2021	M	33	Guest Lecture by Dan Ginsburg (Upsample Software)	
12/01/2021	W	34	Field Trip / Outside Lecture	
12/03/2021	F	35	Skybox	Quiz 12
12/06/2021	M	36	Guest Lecture by Ismail Salhi and Johanna Hartzheim (Qleek)	Assignment 10 (glTF)
12/08/2021	W	37	Final Project Fast Forward	
12/10/2021	F	38	Final Recap	Quiz 13
12/13/2021	M		Final Project Presentations 10:00-12:00p	
12/15/2021	W		No class / Office hours only	
12/17/2021	F		No class / Office hours only	
12/20/2021	M		No class / Office hours only	Final Project