

Computer Graphics Fundamentals

CS F484 | CS F684 | CSCE A381 | Syllabus

Description

Learn the fundamentals of computer graphics including vector and matrix mathematics, 2D and 3D primitives, rendering algorithms, and application design.

Important Information

Course Name	CS F484 F684/CSCE A381 Computer Graphics Fundamentals
CRN	74165, 74169, 77484
Credits	3+0
Course Type	Web
Instructor	Dr. Jonathan Metzgar
Virtual Office	https://alaska.zoom.us/my/drmetzgar
Virtual Office Hours	MW 1:00pm - 2:00pm, or by appointment
Phone	(907) 474-6104
Email	jbmetzgar@alaska.edu
Discord	#csf484f684-f01
Prerequisites	CS F202, MATH F253X
Location	Online course with video lectures https://alaska.zoom.us/my/drmetzgar
Time	3:30pm- 5:00pm MW
Final	Take-home exam
Office Hours	By appointment only via Zoom or Phone

Teaching Mode

You will learn the material in this course from viewing video lectures, attending Zoom sessions, completing homework assignments, and collaborating in a group project. The lecture videos and quizzes should be watched prior to joining the Zoom session to get the most learning experience. The Zoom session consists of special topics and group discussions. The homeworks range from short speeches, white papers, and more. Each homework will have a video that explains what it is about.

Group Project

Part of this course is about writing computer graphics applications in a group setting. Your team (of three people) will design an interactive game or demoscene animation combining graphics, audio, and a human user interface, which needs to be a small scope, approximately 40 hours of software development time. It needs to be a modern graphics application that a non-technical person can use. The main restriction is that it should be capable of running on a Windows 10 or macOS device with an Intel graphics card using either Vulkan, DirectX 12, or Metal. At your option, you may also use ShaderToy or Unity as long as it will run in a Web Browser.

Research Project

The research project is a personal project that has a midterm presentation, midterm paper, and final paper associated with it. The paper must use either the LaTeX article, acmart, or IEEEtran format. The midterm paper will be about 3 pages in length and survey the existing state of the art of a problem in the computer graphics field using at least five journal or conference citations. The final paper will be 5 pages in length and detail your experiments, results, and analysis. Graduate students need to add 33% more pages in additional length and citations. It is also expected that graduate students produce novel work--something that has never been tried, compared, or implemented before.

Course Materials

- (Required) Ray Tracing in One Weekend by Peter Shirley (<https://github.com/RayTracing/raytracing.github.io>)
- (Optional) Real-Time Rendering Fourth Edition by Tomas Akenine-Möller, et al. (ISBN: 9781138627000)
- Other reading assignments as determined by the instructor

Student Learning Outcomes

- Understand and apply linear algebra principles to perform vector and matrix calculations
- Understand and apply the computer graphics pipeline
- Understand the rendering equation and the rules for physically based reflection
- Understand the representation of geometric surfaces and curves
- Understand and apply directed acyclic graphs and scene graphs
- Understand and apply quaternion algebra

Course Calendar

Note: This list is tentative and subject to change at any time. TBA means “To Be Announced.”

Week	Content	Assignments Due	Week Start
01	Introduction, LaTeX, and Research	W01 Quiz + LaTeX Paper	Aug 24, 2020
02	Vector and Matrix Algebra	W02 Quiz + TBA	Aug 31, 2020
03	The Computer Graphics Pipeline	W03 Quiz + TBA	Sep 7, 2020
04	User Interfaces and Human Computer Interaction	W04 Quiz + 3 min Research Video	Sep 14, 2020
05	Geometric Representations on the Computer	W05 Quiz + TBA	Sep 21, 2020
06	The Rendering Equation	W06 Quiz + TBA	Sep 28, 2020
07	Sampling Pixels	W07 Quiz + Midterm Paper	Oct 5, 2020
08	Computer Game Design	Exam 1	Oct 12, 2020
09	Curves and Surfaces	W09 Quiz + Group Demoscene	Oct 19, 2020
10	Quaternions and Animation	W10 Quiz + TBA	Oct 26, 2020
11	Ray Tracing Spheres	W11 Quiz + TBA	Nov 2, 2020
12	Signed Distance Functions	W12 Quiz + TBA	Nov 8, 2020
13	Real-Time Ray Tracing	W13 Quiz + TBA	Nov 15, 2020
14	Exam	W14 Quiz + TBA	Nov 22, 2020
15	Presentations	6 min Research presentation	Nov 30, 2020

16	Finals	Exam 2	Dec 7, 2020
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Course Policies

Grading

Your final grade is determined by percentage of correctly done homework. Correctly done means you scored a 70% or better on the assigned homework. All assignments will have the grading criteria specified in their instructions. The grade for all assignments are distributed according to the grading distribution listed below. The final percentage (rounded to the nearest integer) is then mapped to your letter grade.

Example: 100 = A+, 89 = B+, 75 = C, 60 = D-

Use the grading page on Black Board to track your progress. The lowest two grades.

Grading Schema

A+	97-100	A	93-96	A-	90-92
B+	87-89	B	83-86	B-	80-82
C+	77-79	C	73-76	C-	70-72
D+	67-69	D	63-66	D-	60-62
F	0-59				

Grading Distribution

Item	Amount	Primary Assessment
Lectures	30%	Weekly Quizzes
Research Project	25%	LaTeX paper and video presentation
Game / Demoscene Project	15%	Group project with video presentation
Exam 1	10%	Blackboard Test
Exam 2	10%	Blackboard Test

Discord Participation	10%	#ScreenshotSaturday and #LessonsLearned
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Contacting the Instructor

I believe communication is our most valuable tool to encourage learning in this class. So I encourage you to use the Discord channel to ask general questions about class content and assignments because other students will likely have similar questions and we want to promote communication between our fellow students. However, if you have a question that is of a personal nature, then please use email. I generally do not have notifications of direct messages on Discord and I seldom check them.

University and Department Policies

- UAF academic policies <http://www.uaf.edu/catalog/current/academics>
- CS Department policies <http://www.cs.uaf.edu/departmental-policies>
- UAF embraces and grows a culture of respect, diversity, inclusion, and caring. Students at this university are protected against sexual harassment and discrimination (Title IX). Faculty members are designated as responsible employees which means they are required to report sexual misconduct. Graduate teaching assistants do not share the same reporting obligations. For more information on your rights as a student and the resources available to you to resolve problems, please go to the following site: <https://catalog.uaf.edu/academics-regulations/students-rights-responsibilities/>.
- Students should keep up-to-date on the university's policies, practices, and mandates related to COVID-19 by regularly checking this website: <https://sites.google.com/alaska.edu/coronavirus/uaf/uaf-students?authuser=0> Further, students are expected to adhere to the university's policies, practices, and mandates and are subject to disciplinary actions if they do not comply.