جامعة الملك عبدالله
للعلوم والتقنية
King Abdullah University of
Science and Technology

Course Syllabus: Computer Graphics - CS 248

Division	Computer, Electrical and Mathematical Sciences & Engineering
Course Number	CS 248
Course Title	Computer Graphics
Academic Semester	Fall
Academic Year	2021
Semester Start Date	08/30/2020
Semester End Date	12/15/2020
Class Schedule (Days & Time)	03:00 PM - 04:30 PM | Mon Thu

Instructor(s)				
Name	**Email**	**Phone**	**Office Location**	**Office Hours**
Ivan Viola	IVAN.VIOLA@KAUST.EDU.SA	+966128080617	2115, 1, Al-Khawarizmi (bldg. 1)	Please make an appointment via email.

Teaching Assistant(s)	
Name	**Email**
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Course Information	
Comprehensive Course Description	The Computer Graphics course teaches the fundamentals of computer graphics based on the book "Fundamentals of Computer Graphics, 4th Edition by Steve Marschner and Peter Shirley". The course first reviews the basic mathematical background necessary for computer graphics. Then fundamental computer graphics methods are being presented, such as the graphics pipeline, ray tracing, surface shading, and texturing. After the basal computer graphics

	knowledge, fundamental theoretical background from signal processing and sampling are explained, necessary for comprehension of further more advanced computer graphics topics. Advanced topics will include: computer animation, global illumination, light, color, introduction to visual perception and tone mapping, as well as global illumination, hardware-accelerated rasterization graphics, computer graphics in games and visualization. This fundamental knowledge will be taught in a form of pre-recorded online lectures. These lectures will be coupled with Q&A sessions where students can ask questions regarding the content that are sent by students to the instructor in advance. On such session, we will also solve some geometric problems relevant for computer graphics. The subject comprehension will be tested by a written exam at the end of the semester. The exam will constitute 30% of the final grade. The other 70% will come from the practical implementation of programming assignments, described below. These assignments will be reviewed with the instructor in an interview to verify the genuinity of the programmed code. Afterward, students will show their implementation and results in a form of a 15 minute presentation to the other participants of the course in a dedicated online session.
Course Description from Program Guide	Prerequisites: solid programming skills and linear algebra. The course first reviews the basic mathematical background necessary for computer graphics. Then fundamental computer graphics methods are being presented, such as the graphics pipeline, ray tracing, surface shading, and texturing. After the basic computer graphics knowledge fundamental theoretical background from signal processing and sampling are explained necessary for comprehension of further more advanced computer graphics topics. Advanced topics will include: computer animation, global illumination, light, color, introduction to visual perception and tone mapping, as well as global illumination, hardware-accellerated rasterization graphics, computer graphics in games and visualization.
Goals and Objectives	There are three main learning objectives: learning the fundamentals of computer graphics; learning to program computer graphics algorithms; learning the mathematics behind computer graphics;
Required Knowledge	Linear algebra and calculus; programming; writing medium sized programs in C++ (500 - 2000 lines of code);
Reference Texts	Fundamentals of Computer Graphics, 4th Edition, Peter Shirley, Steve Marschner, A K Peters/CRC Press, 2015
Method of evaluation	**70.00**% - Homework /Assignments **30.00**% - Final exam
Nature of the assignments	There will be four assignments. 1. Implementation of a software ray caster: The task is to implement a software raycaster that casts the rays from the viewpoint through a viewing

	plane's pixel centers into the scene. The scene consists of few analytically defined solid primitives such as spheres, cylinders, boxes, etc. The light and camera position are fixed and so are the scene elements. For illumination model the Phong illumination model should be used. (17.5%) 2. Implementation of interactive viewing parameters, lights, and scene elements: Built on the top of the previous assignment, make the every setting adjustable through parameter settings. All the scene elements should be possible to change position and orientation and scale, if applicable. The camera should implement the arcball metaphor around the scene center, with additional zoom in and out functionality. The light position and scene elements position and orientation should be adjustable directly in the 3D scene through picking. (17.5%) 3. Software based rasterization: Implement a CPU-based rasterizer, where the vertices are drawn clipped onto the display, edges are drawn with a line-rasterization algorithm and the faces are drawn with a rasterization algorithm with interpolated normals, shaded with the Phong shading illumination model. (17.5%) 4. Advanced version of ray-tracing with importance sampling, advanced material properties, secondary rays, animated objects, area lights, bounding volume hierarchies. (17.5%)

Note

The instructor reserves the right to make changes to this syllabus as necessary.