COM 391, Computer Graphics

American University of Central Asia
Software Engineering Department

1 Course Information

Course Code
COM 391

Course ID
4954

Prerequisite
COM-119, Object-oriented Programming

Credits
6

Professors, TAs, Time, Place
Lecture (Dmitrii Toksaitov): Monday 10:50–12:05, Online
Practice (Dmitrii Toksaitov): Wednesday 10:50–12:05, Online
Practice (Dmitrii Toksaitov): Wednesday 12:45–14:00, Online

Course Repository
`https://github.com/auca/com.391`

Class Discussions
`https://piazza.com/auca.kg/spring2021/com391`

2 Contact Information

Instructor
Toksaitov Dmitrii Alexandrovich
toksaitov_d@auca.kg

Office
AUCA, room 315

Office Hours
By appointment throughout the work week remotely through Zoom

3 Course Overview

The course teaches students fundamentals of computer graphics through a process of developing a 3-D engine in a series of laboratory tasks throughout the course. Students will study on how to work with graphics accelerators with the help of the OpenGL ES API to deliver rich 3-D computer-generated images, animations, or interactive applications.

As a result, students should be able to research and analyze the functioning of a complex real-time computational system, improve their skills using programming languages for software design and development in accord to the goals of the AUCA Software Engineering Department and the 510300 IT competency standard (including competency elements OK 1–7, 1–7, 1–15).

4 Topics Covered

- Week 1–2: Introduction, Brief History, Dev. Environment, First Program (6 hours)
- Week 3–4: Vectors, Matrices, Scene Graph, Camera (6 hours)
- Week 5–6: Geometry, Buffer Objects, GPU Pipeline (6 hours)
- Week 7–8: Materials, Shading, GLSL (6 hours)
- Week 9: Lambert, Phong, Blinn-Phong Shading (3 hours)
- Week 10–11: Texturing and Mapping (6 hours)
- Week 12: Procedural Geometry (3 hours)
- Week 13–14: Particle Systems, Rendering Optimizations (6 hours)
- Week 15–16: Real-time Graphics in Games, Building a Game with your Engine (6 hours)

5 Assignments and Exams

5.1 GitHub Checkpoints

Students will have to maintain a personal (!) private GitHub repository with all their works shared with their instructor. Students have to periodically commit and push a specific number of lab solutions (or project parts) as told by the instructor. The instructor will periodically check the work and give points for the accomplished work.

5.2 Labs, Course Project

Students will have around eight laboratory tasks and have to finish one course project developing a clone of a popular computer game. Students will have to defend their work to the instructor during midterm, final, and project defence examination sessions.

6 Course Materials, Recordings and Screencasts

Students will find all the course materials on GitHub. We hope that by working with GitHub, students will become familiar with the Git version control system and the popular (among developers) GitHub service. Though version control is not the focus of the course, some course tasks may have to be submitted through it on the GitHub Classroom service.

Every class is screencasted online and recorded to YouTube for students' convenience. An ability to watch a class remotely at any time MUST NOT be a reason not to attend the online Zoom session. Active class participation is necessary to succeed in this course.

7 Software

Students are recommended to install the following software on their machines.

- Git: `https://git-scm.com`
- Python 3: `https://www.python.org`
- CMake: `https://cmake.org`

On macOS install Xcode `https://developer.apple.com/xcode`. On Windows install Visual Studio 2019 Community `https://visualstudio.microsoft.com/vs` or any other edition if you can acquire it legally.

You can use any other IDEs (like CLion) or code editors (like VS Code, Vim, Emacs) that you like. Please note that we can only provide support for Visual Studio 2019 on Windows and Xcode on macOS.

You can also work on Linux, but you have to figure out the driver/tools/editor-installation process on your own.

8 Hardware

We did our best to select a graphics API that will most likely work on your machine, whether it is a top of the line expensive personal computer or a low-powered notebook. Nevertheless, every year we have students with computers where GPUs are too old, or the drivers are too buggy and don't run our code. Unfortunately, you will have to put some effort into getting an environment that will work in that case. We will not give you extensions or preferential treatment if your machine can't handle

our code. Your first option is to try a different native or virtualized environment (e.g., GNU/Linux) on your computer. Some open-source drivers are known to work better on old devices than those one provided by the manufacturer. You can also contact the IT department of AUCA to offer you a computer where you can run the programs. Note that they have a limited amount of machines. Your last bet is probably getting a different machine on your own.

9 Reading

1. 3D Math Primer for Graphics and Game Development, Second Edition by Fletcher Done and Ian Parberry (ISBN: 978-1-4398-6981-9)

9.1 Supplemental Reading

1. Mathematics for 3D Game Programming and Computer Graphics, Third Edition by by Eric Lengyel (ISBN: 978-1435458864)
2. Game Engine Architecture, Second Edition by Jason Gregory (ISBN: 978-1568814131)
3. Game Programming Patterns by Robert Nystrom (ISBN: 978-0990582908)

10 Grading

10.1 GitHub Checkpoints

Your instructor will announce a periodic review of your work. You will be awarded up to the following number of points for such checks.

- Labs (10%)
- Project (10%)

10.2 Exam Interviews and Participation

- Class participation (through Piazza) (5%)
- Practice Midterm (35%)
- Practice Final (40%)

11 Scale

– 92%–100%: A
– 85%–91%: A-

- 80%–84%: B+
- 75%–79%: B
- 70%–74%: B-
- 65%–69%: C+
- 60%–64%: C
- 55%–59%: C-
- 50%–54%: D+
- 45%–49%: D
- 40%–44%: D-
- Less than 40%: F

12 Rules

Students are required to follow the rules of conduct of the Software Engineering Department and the American University of Central Asia.

12.1 Participation

Active work during the class may be awarded with up to 5 extra points at the instructor's discretion.

Poor student performance during a class can lead to up to 5 points being deducted from the final grade.

Instructors may conduct pop-checks during classes at random without prior notice. Students MUST be ready for every class in order not to lose points.

12.2 Questions

We believe that a question from one student is most likely a question that other students are also interested in. That is why we encourage students to use Piazza to ask questions in public that other students can see and answer and NOT ask them through E-mail. Make your threads private if it is a private matter. We will not be answering any email messages this semester to consolidate all the course correspondence in one place.

12.3 Late Policy

Late submissions and late examination defence are not allowed. Exceptions may be made at a discretion of the professor only in force-majeure circumstances. If you got ill, got severe personal issues, got problems with your computer or the Internet, you MUST notify me at least 24 hours in advance. Otherwise, we will not give you an extension. We will consider that you were procrastinating until the very last day. We will also not be giving more than one extension throughout the course.

Forty-eight hours before the deadline for any work on the course, instructors will go into a silent mode. No questions will be answered about the work that has to be submitted, no requests to have office hours will be considered. Usually, it will be Saturday and Sunday (that are not working days for us anyway). At any other work time before the deadline, we will try our best to answer your questions and help you through Zoom.

12.4 Exam Ceremonies

Students MUST follow exam ceremonies. It means they MUST prepare task list forms with all points appropriately calculated. They MUST submit them correctly. They must bring task list forms to the exam. Failure to do so will result in lost points. Throughout your career, you will have to work with various supporting documents (contracts, timesheets, etc.). It is a good idea to start learning to work with such documents accurately early. We will remove points for not following these rules or even refuse to accept your exam defense. We will give zero for not following the strict exam timing rules.

12.5 Incomplete

As with late exams, the grade *I* may be awarded only in exceptional circumstances. The student must start a discussion on getting the grade I with the instructors in advance and not during the last week before the final exams.

12.6 Academic Honesty

Plagiarism can be defined as "an act or an example of copying or stealing someone else's words or ideas and appropriating them as one's own". The concept of plagiarism applies to all tasks and their components, including program code, abstracts, reports, graphs, statistical tables, etc.

In addition to being unethical, this indicates that the student has not studied the given material. Tasks written from somewhere for 5% or less will be assessed accordingly or will receive a 0 at the discretion of the teacher. If plagiarism is more than 5%, the case will be transferred to the AUCA Disciplinary Committee.

On this course team work is NOT encouraged. The same blocks of code or similar structural pieces in separate submissions will be considered as academic dishonesty and all parties will get zero for the task.

The following are examples of some common acts of plagiarism:

1. Representing the work of others as their own
2. Using other people's ideas or phrases without specifying the author
3. Copying code snippets, sentences, phrases, paragraphs or ideas from other people's works,published or unpublished, without referring to the author
4. Replacing selected words from a passage and using them as your own

5. Copying from any type of multimedia (graphics, audio, video, Internet streams), computer programs, graphs or diagrams from other people's works without representation of authorship

6. Buying work from a website or from another source and presenting it as your own work

Students are not recommended to memorize before exams, as this is a difficult and inefficient way to learn; and since practice exams consist of open questions designed to test a student's analytical skills, memorization invariably leads to the fact that the answers are inappropriate and of poor quality.