COM 410, Computer Architecture

American University of Central Asia
Software Engineering Department

1   Course Information

Course Codes
COM-410

Course IDs
3268

Prerequisite for
COM-117-119, Programming II. Object-oriented Programming
and
COM-310-311.1, Circuit Engineering
COM-223.1, Algorithms and Data Structures

Credits
6

Professors, TAs, Time, Place
Lecture (Dmitrii Toksaitov): Tuesday 10:50–12:05, Online
Lab (Dmitrii Toksaitov): Tuesday 12:45–14:00, Online
Lab (Dmitrii Toksaitov): Tuesday 14:10–15:25, Online

Course Repository
`https://github.com/auca/com.410`

Class Discussions
`https://piazza.com/auca.kg/spring2021/com410/home`

2   Contact Information

Professors
Dmitrii Toksaitov
toksaitov_d@auca.kg

Office
AUCA, room 315

Office Hours
By appointment throughout the work week remotely through Zoom

3   Course Overview

The course introduces students to the topic of computer architecture and organization. Students will focus on studying the structure and design of modern central processing units. Students will learn the basics of the x86-64 and aarch64 instruction sets, the assembly languages for the platforms, and the representation of high-level language structures in the low-level languages.

At the end of the course student should be able to research, analyze, design, develop, and maintain software in low-level programming languages in accord to the goals of the AUCA Software Engineering Department and the 510300 IT competency standard (OK 17, 17, 115).

4   Topics Covered

- Week 1–2: The modern computer architectures and organization

- Week 3–5: The x86-64 and ARM64 assembly languages

- Week 6–9: Representation of high-level language structures in low-level assembly languages

- Week 10–13: Acceleration with SIMD instructions

- Week 14: System emulation

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, Projects

Students will have a number of laboratory tasks and have to finish one course project. Students will have to defend their work to the instructor during midterm, final examination sessions.

6   Course Project

Throughout the course, students will have to work on one significant project. The work will require to accelerate an image processing application by optimizing the hot path of a C program in x86-64 and ARM64 assembly.

7 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.

8 Software

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

- Git: `https://git-scm.com`

The compilers, assemblers and debuggers will be available on the remote course server.

9 Reading

- Computer Architecture: A Quantitative Approach, 5th Edition by David Patterson and John L. Hennessy (ISBN: 978-0123838728)

- Assembly Language for x86 Processors, 7th Edition by Kip R. Irvine (ISBN: 978-0133769401)

- ARM 64-Bit Assembly Language by Larry D. Pyeatt and William Ughetta (ISBN: 978-0128192214)

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%)

10.3 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

11 Rules

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

11.1 Participation

Active work during the class may be awarded with up to 5 extra points at the instructors 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.

11.2 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.

Do not post the full source code for any task on this course on Piazza. You will get zero for that work for any public post. Do not ask generic questions about your code that you do not know why your code does not work. Please spend some time thinking about it, debugging it.

11.3 Late Policy

Late submissions and late exams are not allowed. Exceptions may be made at the 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.

11.4 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.

11.5 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.

11.6 Academic Honesty

Plagiarism can be defined as an act or an example of copying or stealing someone elses words or ideas and appropriating them as ones 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 10% or less will be assessed

accordingly or will receive a 0 at the discretion of the teacher. If plagiarism is more than 10%, the case will be transferred to the AUCA Disciplinary Committee.

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 students analytical skills, memorization invariably leads to the fact that the answers are inappropriate and of poor quality.

On this course teamwork 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