COM-392, System Programming

American University of Central Asia
Software Engineering Department

1   Course Information

Course Codes
COM-392

Course IDs
4953

Prerequisite
COM-341, Operating systems
or
COM-410, Computer Architecture

Credits
6

Professors, TAs, Time, Place
Lecture (Dmitrii Toksaitov): Tuesday 12:45–14:00, Room 410
Lab (Dmitrii Toksaitov): Thursday 12:45–14:00, Lab 432
Lab (Dmitrii Toksaitov): Thursday 14:10–15:25, Lab 432

Course Repository
`https://github.com/auca/com.392`

2   Contact Information

Professors
Dmitrii Toksaitov
toksaitov_d@auca.kg

TAs
TBD

Office
AUCA, room 315

Office Hours
By appointment throughout the work week (write to your professor or TA to
make an appointment)

3 Course Overview

The course introduces students to the topic of programming multi-core multi-processor systems with data-parallel facilities of various hardware on a single machine or in a distributed system connected to a high-performance network. The students will learn the most popular shared-memory parallel programming API such as Pthreads and CUDA, and a distributed memory programming API such as MPICH. Students will get a chance to work on two projects accelerating image processing tasks and astronomy simulations. Results of the projects will be tested together with students on high-performance parallel machines in the cloud.

At the end of the course student should be able to research, analyze, design, develop, and maintain functioning parallel software systems in accord to the goals of the AUCA Software Engineering Department and the 510300 IT competency standard (OK 1–7, IK 1–7, PK 1–15).

4 Topics Covered

- Flynn's Taxonomy, Amdahl's Law

- CPU Caches and Locality

- CPU Pipelines and Branch Prediction

- Data-parallelism with SIMD Instructions

- Hardware Multithreading

- Synchronization

- Shared and Distributed Memory Systems

- General-purpose computing on graphics processing units

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 project solutions as told by the instructor. The instructor and TAs will regularly check the work and give points for the accomplished work.

6 Reading

An Introduction to Parallel Programming by Peter Pacheco (ISBN: 978-0123742605)

6.1 Supplemental Reading

1. Parallel Programming, 2nd Edition by Thomas Rauber and Gudula Rünger (ISBN: 978-3642048173)

2. Computer Architecture: A Quantitative Approach, 6th Edition by David Patterson and John L. Hennessy (AUCA Library Call Number: QA76.9.A73 P377 2019, ISBN: 978-0128119051)

7 Grading

7.1 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.

- Projects (35%)

- Bonus Project (5%)

7.2 Exams

- Midterm Exam (30%)

- Final Exam (35%)

7.3 Totals

- 100% is formed from the GitHub submissions (35%) and the two exams (65%).

7.4 Scale

- [92%–100]%: A
- [85%–92)%: A-
- [80%–85)%: B+
- [75%–80)%: B
- [70%–75)%: B-
- [65%–70)%: C+
- [60%–65)%: C
- [55%–60)%: C-
- [50%–55)%: D+
- [45%–50)%: D
- [40%–45)%: D-
- Less than 40%: F

Please, note that requests to award a better grade if the number of points is close to such a grade will be ignored. For example, 91.99 is A-, NOT A. Likewise, requests to get extra assignments to increase the number of points will also be overlooked entirely.

8 Rules

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

8.1 Participation

Active work during the class may be awarded with extra points at the instructor's discretion. Poor student performance during a class can lead to 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. Students absent without a good reason from such classes with graded work will also lose points unless it is force-majeure circumstances. TAs and instructors must be notified in advance about why a student is absent not to lose points.

8.2 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 the Canvas online discussion board to ask questions in public that other students can see and answer. We discourage students from asking questions through E-mail. If it is a private matter, write direct messages to TAs or your instructor there on Canvas too. We will not be answering most E-mail messages this semester (unless it is a severe emergency) to consolidate all the course correspondence in one place on our LMS (Learning Management System).

Do not post the complete source code for any task on the Canvas discussion board. You will get zero for that work for any such public post. Do not ask generic questions about your code to know why it does not work. Please spend some time thinking about your code, debugging it.

8.3 Late Policy

Late submissions and late exams are not allowed. Exceptions may be made at the professor's discretion 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 emergency extension throughout the course.

Six 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 (which are not working days for us anyway). However, at any other work time before the deadline, we will try our best to answer your questions and help you through Zoom or in our office.

8.4 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.

8.5 Incomplete Grade

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.

8.6 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, comments, documentation, abstracts, reports, graphs, statistical tables, etc.

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

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.

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

Students are not recommended to memorize lab and project code before exams, as this is a difficult and inefficient way to learn; and since practice exams may 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.