CIS*2030: Structure and Application of Microcomputers
Fall 2021, (3,3) [0.5] Credit

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Course Web Page: Available through CourseLink: https://courselink.uoguelph.ca

General Description

This course introduces the topic of *Computer Architecture*. Computer architecture refers to those attributes of a computer system that are visible to a programmer, or put another way, those attributes that have a direct impact on the logical execution of a program. As a result of this course, students will gain insight into the operation of the major components of a computer system, assembly-language programming, and computer interfacing. The Motorola 68000 has been selected as the example architecture to study, due to the simplicity and clarity of its architecture, and the availability of a simulation tool that supports many facets of the 68000 architecture, including its data types, memory organization, registers, instruction set, address modes, processor states, exceptions and exception processing facility, memory-mapped I/O, and assembler language.

Course Outline

Each bullet corresponds to *roughly* 1-3 weeks of the semester.

- Binary encoding and data representation: number systems, binary arithmetic, complement arithmetic, ranges, arithmetic overflow, other code systems, and fixed-point and floating-point representations (bonus material)
- Basic computer components, importance of Instruction-Set Architecture (ISA) role of memory versus registers, and simplified instruction cycle
- An assembler language view of the Motorola 68000's ISA
- Hardware support for high-level language (i.e., C): data types, data structures, loops, conditional statements, hardware stack, functions, parameter passing, return values, stack frames, local variables, recursion and re-entrant code
- Hardware support for Operating Systems: privileged states; exception processing
- Interaction among components: device operation, device control, bus signals, input/output protocols: polling, interrupts, direct-memory access
- Memory Hierarchy and Caching

Textbook

- MacKenzie S., (1995). *The 68000 Microprocessor*, Prentice-Hall. (Required)
- Lab Exercises are provided online
- Additional readings (PDFs) are provided online

Lectures

To provide students with maximum flexibility throughout the semester, lecture materials are pre-recorded and available on CourseLink. Online discussions with the instructor will be held MWF 8:30am to 9:20am and 10:30am to 11:20am for sections 01XX and 02XX, respectively. These synchronous meetings are *optional*. Should you choose to attend, the Monday time-slots will be used to review assignment/practice problems solutions from the previous week. Wednesday and Friday time slots will be used for any student questions (i.e., office hours). Zoom links for these meetings are available in the CourseLink calendar.

Recording Lectures and Labs in an Online World

Presentations which are made in relation to course work, including lectures, *cannot* be recorded, downloaded or copied without the permission of the presenter, whether the instructor, a classmate or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

Course Evaluation

Your final grade will be determined as follows:

Weight	Description	Notes
12%	3 Homework Assignments Uniform weighting	See schedule at the end of this document for due dates.
4%	Bonus Assignment Optional	Must be submitted no later than 11:59pm, December 3, 2021.
48%	8 Lab Exercises Uniform weighting Face-to-Face	See schedule at the end of this document for due dates. Labs are due at the end of your scheduled 3-hour lab section. However, labs can be handed in up to 24 hours after end of the lab without penalty.
15%	Term Test Face-to-Face	Monday, November 1, 2021; in class during regularly scheduled class time; duration 50 minutes May bring required textbook to term test.
25%	Final Exam Face-to-Face	Tuesday, December 14, 2021; 11:30am to 01:30pm; Place: TBD May bring required textbook to exam.
Total Grade = 12% (Assignment) + 48% (Labs) + 15% (Term Test) + 25% (Final Exam)		

You must achieve a passing grade on the combined term test and final exam (i.e., 20 out of 40). Failure to satisfy the previous case will result in the following calculation for your final grade: Final Grade = MIN(45, Total Grade). Otherwise, Final Grade = Total Grade + Bonus

Labs

In accordance with the university's desire for face-to-face student learning, labs will be held face-to-face. Students can only attend their own scheduled lab section, not other lab sections. Therefore,

please do not ask the teaching assistants to allow you to move between lab sections – even temporarily.

Prior to attending your scheduled lab section, you should have completed most of the lab exercise on your own. Any outstanding questions can then be targeted to the lab instructor for clarification. You are expected to submit your completed lab electronically at the end of the scheduled lab, so it is your responsibility to come prepared. Labs can, however, be handed in up to 24-hours after the end of your lab without penalty.

Lab exercises will be completed using Easy68K – a Windows based 68000 assembler and simulator. This software is accessible through the School of Computer Science Windows' servers. Please visit the School's wiki (wiki.socs.uoguelph.ca) if you require technical instructions on how to connect to the server. Should you ever run into technical difficulties accessing the SoCS' server, etc., please contact help@socs.uoguelph.ca. Make sure to identify yourself, and to clearly explain the problem that you are having. Neither the instructor nor the TAs have access to the school's servers. Therefore, all technical problems must be directed to the school's IT personnel.

Learning Outcomes

Successfully completing the assignment and laboratory excercises in this course will contribute to the following learning outcomes:

1. Explain the digital representation of numeric and non-numeric data.
2. Identify the main abstractions that exist between programs and the actual hardware they run on, explain why these abstractions exist, and describe how they build upon each other.
3. Create assembly-language programs to implement some of the main abstractions and evaluate your program through testing and debugging.
4. Implement interfaces with external devices using common input-output strategies.
5. Describe the memory hierarchy and list tradeoffs

Teaching Assistants

Contact information and advising times for each Teaching Assistant are posted on CourseLink. Discussions with your particular TA will take place over Zoom. (See CourseLink calendar for your TA's zoom links.) All requests for re-grades must be made by email to your TA within one week of the grade being posted on CourseLink. It is your responsibility to be vigilant and check your grades regularly.

Electronic Mail

As per university regulations, all students are required to check their mail.uoguelph.ca e-mail account regularly: e-mail is the official route of communication between the University and its students.

Considerations and Constraints for Online Course Elements and Learning

- Do not redistribute recorded interactive discussions that involve your instructor, teaching assistant or classmates. This includes advising times, lab times, and question and answer sessions with the instructor.

- Online activities such as advising times, question and answer sessions, and interactive lectures may be recorded by the instructor or TAs and posted to Courselink. By taking this course you are agreeing that your participation in these activities can be used in this manner. If you do not wish to have your image or voice recorded as part of these activities then either do not take this course or do not ask verbal questions during these activities.

- A reliable internet connection that is sufficient for online learning is necessary for this course. If you do not have a sufficiently fast and reliable internet connection, you may not be able to view lectures or other course material. It may also not be possible to attend labs or online advising with teaching assistants or the instructor.

- This course is offered in the Eastern Standard Time (EST) zone. While taking this course you will be required to attend online activities such as advising times or labs between 8:30am and 9:50pm EST.

- Keep copies of assignments which you have submitted. You may be asked to resubmit assignments at a later time.

- Do not upload any course material (Intellectual Property) to other sites on the internet, including Chegg and CourseHero, or share course material in any other way. To do so will be treated as a violation.

- Restrictions may be put in place that cause the instructor to determine that the some parts of the marking scheme cannot be completed as currently described. Any such change would affect all students in the class and not individual students. If this occurs, the percentage of the grade-weight that is affected will be communicated to the class, along with an appropriate strategy for dealing with the situation. These changes may also necessitate a revision of the format of course offering, changes in classroom protocols, and academic schedules. Any such changes will be announced via CourseLink and/or class email.

A Word of Caution

Needless to say, plagiarism in any form must be dealt with severely. *There is no group work in this course. Therefore, when answering questions do it yourself. Be original.* All submitted items will be checked for plagiarism, as well as for uploads to websites, like Chegg, in search of answers. All cases of academic misconduct are handled by the Dean, in conjunction with the Department Chair. Successive infractions of misconduct affirmed by this process could have consequences as serious as expulsion from the University. *(It is your responsibility to acquaint yourself with the definitions and ramifications of academic misconduct as described in the university's undergraduate Calendar.)* The risks are sufficiently great that they are not worth taking. If you are having trouble,

please see the teaching assistant or the instructor for help. Moreover, if you are not sure whether a potential action is appropriate, check either with the instructor or Dr. Greg Klotz – the undergraduate faculty advisor for the School of Computer Science.

Semester Schedule

There are several important dates this semester:

- Friday, September 10, 2021 class commences.
- Monday, October 11, 2021 no classes are scheduled due to Thanksgiving holiday 😊
- Tuesday, October 12, 2021 no classes are scheduled due to Fall study break 😊
- Thursday, December 2, 2021 classes rescheduled from October 12.
- Friday, December 3, 2021 classes rescheduled from October 11.

Over the course of the semester, there are 3 assignments and 8 labs. Table 1 and Table 2 below show the due date and the topic of each assignment and lab, respectively.

Table 1: Assignment Schedule.

Week	Due	Assignment Topic
1	September 18, 2021	Binary Representations
2	September 25, 2021	Computer Architecture
3	December 3, 2021	Caching

Table 2: Lab Schedule.

Week	Due	Lab Topic
1	-	-
2	-	-
3	End of lab*	Introduction to Easy68K
4	End of lab*	Data Types and Arithmetic Operations
5	-	-
6	End of lab*	Assembler Directives and Address Modes
7	End of lab*	Program Control Flow
8	End of lab*	Runtime Stacks and Functions
9	End of lab*	Stack Frames and Recursion
10	End of lab*	Operating Modes and Exceptions
11	End of lab*	Memory-Mapped I/O
12	-	-

* Lab may be handed in at most 24-hours after the end of the scheduled lab