CIS*2030: Structure and Application of Microcomputers
Computer Science, Fall 2022

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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, exemptions and exception processing facility, memory-mapped I/O, and assembler language.

Course Topics

Weeks specified are estimates:

- Weeks 1 – 2: Binary encoding and data representation: number systems, binary arithmetic, complement arithmetic, ranges, arithmetic overflow, other code systems, and fixed-point and floating-point representations
- Week 3: Basic computer components, importance of Instruction-Set Architecture (ISA) role of memory versus registers, and simplified instruction cycle
- Week 4: An assembler language view of the Motorola 68000's ISA
- Week 5: Address Modes
- Weeks 6 – 9: 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
- Week 10: Hardware support for Operating Systems: privileged states; exception processing
- Weeks 11 – 12: Interaction among components: device operation, device control, bus signals, input/output protocols: polling, interrupts, direct-memory access
- Week 13: Memory Hierarchy and Caching (if time permits)

Textbook

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

Lectures

There will be synchronous (live) lectures held three times per week: MWF 11:30 am to 12:20 pm. A Zoom link for the lectures is posted in the course calendar on Courselink. These lectures will be recorded and shared to CourseLink. Discussion with the instructor and Q and A will be held during these lectures as well. **Any lecture materials are restricted to the course, and cannot be downloaded or shared in anyway. All access and use is restricted to CourseLink.**

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. 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
20%	11 Homework Assignments	Assignments will be due on Friday 11:59 pm and the topics will coincide with the lecture material from that week. **Assignments more than 2 days late (i.e. Sunday 11:59 pm) will receive a zero grade.**
30%	8 Laboratory Assignments	Each lab will have a digital handout that you must work through during your lab time. TAs will be there to guide and assist you. Your work will be marked during the lab time once you are finished. **You must attend the lab and do your work there in order to receive a grade.**
20%	Midterm	**Date:** Friday Oct 28. Time and location TBD. Weight of a missed midterm will be transferred to the final exam.
30%	Final Exam	**Date:** December 10, 11:30 am to 1:30 pm, Room: TBD
Total Grade = 20% (Homework) + 30% (Labs) + 20% (Midterm) + 30% (Final Exam)		

You must achieve a passing grade on the examination portion of the course (i.e., at least 25 out of 50 for Midterm and Final combined) and a passing grade (i.e., at least 15 out of 30) on the labs. Failure to satisfy either of the previous cases results in the following calculation for your final grade: Final Grade = MIN(45, Total Grade).

Labs

Labs will be conducted in room THRN 3401. You must attend your section and your section only. Do not ask to switch sections as each section is already at full capacity. You must attend the labs in person to receive a grade.

In each lab you will receive a digital handout of the lab work. You will complete this handout during the lab time. TAs will be there to guide and assist you. You are required to work independently, aside from any assistance of the TAs. Once you have completed the lab work a TA will mark your work and record your mark for you.

Everyone must leave their lab sections on time so that TAs can get to their next scheduled activity and so that the next lab section can begin on time. This means that everyone must get marked before the lab is over.

Labs will be performed using a simulator (EASy68K) rather than a physical board. Please bring your textbooks with you to the lab as they are very helpful, if not essential. More information on labs will be given in the lab handouts. Lab 1 is an introduction and will help everyone figure out how the labs will operate.

Learning Outcomes

Successfully completing the homework and laboratory assignments 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 the Teaching Assistants (TA) is posted on CourseLink. All requests for re-grades must be made by email to the TA who marked your assignment/lab 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 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 8:20pm 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.

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 Greg Klotz – the undergraduate faculty advisor for the School of Computer Science.

Semester Schedule

There are several important dates this semester:

- Friday, September 9, 2022: First day of class for this course.
- Monday, October 10, 2022: No classes are scheduled due to Thanksgiving holiday
- Tuesday, October 11, 2022: No classes are scheduled due to Fall study break
- Monday, October 17 to Friday, October 21, 2022: No live/synchronous lectures and no instructor office hours. Lectures will be pre-recorded.
- Friday, October 28: Midterm
- Friday, December 2, 2022: Last day of class.
- Saturday, December 10, 2022: Final Exam

Over the course of the semester, there are 11 assignments and 8 labs. The table below shows the *estimated week*[1] in which each lab and assignment will be performed and due. Assignments coincide with the topics covered in lectures that week.

Table 1: Labs and Assignments

Monday's Date	Week Number	Lab	Assignment
05-Sep	1	-	-
12-Sep	2	-	A1: Binary Representation
19-Sep	3	Lab 1: Intro to EASy68K	A2: Computer Architecture
26-Sep	4	Lab 2: Data Types and Operations	A3: Assembler
03-Oct	5	Lab 3: Assembler Directives and Address Modes	A4: Addressing modes
10-Oct	6	-	A5: Control Flow
17-Oct	7	Lab 4: Program Control Flow	A6: Logical and Shift Operations
24-Oct	8	No Lab: Midterm this week	A7: Runtime Stacks
31-Oct	9	Lab 5: Subroutines - Stacks and Functions	A8: Subroutines and Stack Frames
07-Nov	10	Lab 6: Stack Frames and Recursion	A9: Operating Modes and Exceptions
14-Nov	11	Lab 7: Operating Modes and Exceptions	A10: Interfacing and Timing
21-Nov	12	Lab 8: Memory-Mapped Input-Output	A11: Input/Output
28-Nov	13	-	-

[1] Lab and assignment timing may change. Do not use this table to determine if you have or do not have a lab that week. The most up to date information on Labs and Assignments will be posted on courselink as well as mentioned in class.