# CIS*2030: Structure and Application of Microcomputers
# School of Comptuer Science, Fall 2023

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## General Description

This course is intended to provide an introduction to the topic of *Computer Architecture*. Computer architecture refers to those attributes of a 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, exception-processing facility, memory-mapped I/O, and assembler language.

## Course Outline

Each bullet corresponds to *roughly* 1-2 weeks of the semester.

- Binary encoding and data representation: number systems, binary arithmetic, complement arithmetic, ranges, arithmetic overflow, and other code systems
- Basic hardware components, overall architecture and data flow of a typical computer, Instruction-Set Architecture for M68000
- An assembler language view of the M68000
- Hardware support for high-level language (C) concepts: 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
- Fixed- and Floating-Point represenations

## Textbook

- MacKenzie S., (1995). *The 68000 Microprocessor*, Prentice-Hall. (Required)
- 68KMB Lab Exercises (Paper copies provided to you in the lab.)

## Requirements

Students are required to:

- **Attend face-to-face lectures.** There are *two* lecture sections each with three *three* lectures per week: MWF 11:30am to 12:20pm and MWF 2:30pm to 3:20pm. Both lecture sections are held in ALEX 100. Due to limited seating capacity, students are required to attend the lecture session assigned to them by the registrar. Lectures will not be recorded. It is against course policy to make electronic recordings or copies of any class materials and to share these in anyway including online.

- **Attend face-to-face labs.** These are held during the hours allocated by the registrar. (See Webadvisor for your particular lab section.) You must attend your scheduled lab section, and you cannot attend another lab section for any reason. Beginning with the first, introductory lab session, paper copies of the next week's lab exercises will be distributed at the start of each current lab session. You are expected to attend and work through the lab exercises in the lab under the guidance and evaluation of a lab instructor. All marking will be performed in real time by the lab instructor (in an incremental fashion) during the 3-hour lab session. No marking will take place outside of the regularly scheduled lab times; labs cannot be completed or submitted online.

## Course Evaluation

Your final grade will be determined as follows:

| Weight | Description | Notes |
|---|---|---|
| 12% | 8 Lab Quizzes | Quizzes will be held during the first 15 minutes of each lab session. It is your responsibility to be on time, as quizzes cannot be written at any other time. |
| 28% | 9 Lab Sessions, 8 Marked Exercises | Further details will be provided during the first introductory lab. No marks are assigned to the first introductory lab. See the table at the end of this document for dates. |
| 20% | In-Class Test | November 3, 2023. During regularly scheduled class hours. |
| 40% | Final Exam | December 13, 2023 @ 2:30pm |
| Total Grade = 12% (Lab Quizzes) + 28% (Labs) + 20% (In-Class Test) + 40% (Final Exam) | | |

You must achieve a passing grade (i.e., at least 30 out of 60) on the In-Class Test + Final Exam portions of the course to earn a passing grade. Failure to satisfy this requirement will result in the following calculation for your final grade: Final Grade = MIN(45, Total Grade).

## Contact

1. Lead teaching assistant, Charlotte Barnes (cis2030@uoguelph.ca), for questions regarding the course material, including lectures, labs, quizzes, and reading assignments.
2. Your particular lab instructors for questions regarding your grades. Contact information for each lab instructor is provided on the course website.
3. The instructor (ggrewal@uogueph.ca) for all other issues, including course delivery, personal issues, administrative issues.

## Discussion Forum

Active participation and engagement in the course's discussion forum (in CourseLink) is encouraged. The lead teaching assistant, Charlotte Barnes, will be actively monitoring the forum to provide assistance, clarify concepts, and facilitate meaningful discussions. When posting questions related to course content, or any other queries, please direct your questions to the teaching assistant by providing an informative, precise subject line. By clearly stating the issue, it will be easier for the lead teaching assistant to identify your questions and respond promptly. Our lead teaching assistant is committed to fostering a supportive online community, so feel free to ask questions, share insights, and engage in *constructive* conversations with your fellow learners.

## Office Hours

In addition to the discussion forum, the lead teaching assistant will also hold regular online office hours where you can join live Q&A sessions, seek further clarification, and receive real-time assistance. Office hours will be held using Zoom. Office hours will commence September 15, 2023. See the calendar in CourseLink for more details.

## Regrade Requests

If you feel you deserved a better grade on a quiz or on the midterm exam, you may submit a regrade request. The request must be e-mailed to your lab instructor within *five calendar days* of the grade being posted on CourseLink. You are therefore encouraged to make sure your work has been correctly graded and your grade correctly recorded. The request must be submitted with a clear and sound explanation of why you feel the original grade was unfair. Note that a regrade request may result in your entire work being regraded, and the revised grade may be higher or lower than the original grade.

## Electronic Devices

Turn off and store away all electronic devices (e.g., laptops, tablets, calculators, mobile phones, cameras, video recorders, audio recorders) before you walk into the classroom. The only excep-

tions are devices used with a stylus for note-taking. Note-taking must then be the only use of the device. Photos, videos and audio recordings are not permitted during lectures and labs.

## A Word of Caution

You are expected to work on each problem on your own and present your own solution. The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community – faculty, staff, and students – to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages miscon- duct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection. Please note: whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work be- fore submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor. Please review the Academic Misconduct Policy detailed in the Undergraduate Calendar: https://calendar.uoguelph.ca/undergraduate-calendar/undergraduate-degree-regulations-procedures/academic-misconduct/

## Drop Date

The last day to drop CIS*2030 is Dec 1, 2023. The regulations and procedures for dropping courses are available here: https://calendar.uoguelph.ca/undergraduate-calendar/undergradu- ate-degree-regulations-procedures/dropping-courses/

## Learning Outcomes

Successfully completing the lectures, labs, reading assignments, an assessments 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 used in computers 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 trade-offs.

## Lab/Quiz Schedule for Fall 2023

| Start of Week | Lab Topic | Quiz |
|---|---|---|
| September 10 | No labs scheduled | |
| September 17 | Lab 0: Introductory lab | Quiz 1 |
| September 24 | Lab 1: Introduction to Easy68K | Quiz 2 |
| October 01 | Lab 2: Datatypes and Arithmetic | Quiz 3 |
| October 08 | No lab scheduled due to Monday/Tuesday Holiday | |
| October 15 | Lab 3: Assembler Directives and Address Modes | Quiz 4 |
| October 22 | Lab 4: Program Control | Quiz 5 |
| October 29 | Lab 5: Runtime Stack | Quiz 6 |
| November 05 | Lab 6: Stack Frames and Recursion | Quiz 7 |
| November 12 | Lab 7: Operating Modes and Exceptions | Quiz 8 |
| November 19 | Lab 8: Memory-Mapped I/O, Polling and Interrupts | |
| November 26 | No labs scheduled | |