ENGG*4540 Advanced Computer Architecture - DRAFT

Winter 2018
Section(s): C01

School of Engineering
Credit Weight: 0.50
Version 1.00 - January 10, 2018

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1 Course Details

1.1 Calendar Description

This course covers topics such as: basics of pipeline structure, advanced pipelining and instruction level parallelism, multiprocessor and thread-level parallelism, memory-hierarchy design (main memory, virtual memory, caches), storage systems, interconnection networks, multiprocessor architectures (centralized and distributed). Advanced topics related to new emerging computer architectures will also be presented. The emphasis in each topic is on fundamental limitations and the trade-offs involved in designing computer systems, including memory and processing bandwidth, network bandwidth and latency, synchronization, and storage system bandwidth and latency.

Pre-Requisite(s): ENGG*3380

1.2 Course Description

The aim of this course is to familiarize students with the basic principles of computer architecture and design, with an emphasis on cost-performance-energy trade-offs, good engineering design, and a focus on quantitative analysis of real systems.

1.3 Timetable

Lectures

Tuesday 11:30 am – 12:50 pm MCKN 316
Thursday 11:30 pm – 12:50 pm MCKN 316

Lab sessions

Friday 2:30 pm – 4:20 pm RICH 1532

1.4 Final Exam

Thursday April 19, 2018, 7:00 pm - 9:00 pm. Room TBA.

Exam time and location is subject to change. Please see WebAdvisor for the latest information.

2 Instructional Support

2.1 Instructor(s)

Rafik Guindi Ph.D.
Email: rguindi@uoguelph.ca

2.2 Teaching Assistant(s)

Teaching Assistant: Brendan Duke
Email: bduke@uoguelph.ca

3 Learning Resources

3.1 Required Resource(s)

Course Website (Website)
Course material, news, announcements, and grades will be regularly posted to the ENGG*4540 CourseLink. You are responsible for checking the site regularly.

Computer Architecture: A Quantitative Approach (Textbook)
John L. Hennessy and David A. Patterson, 5th Edition, Morgan Kaufmann

3.2 Recommended Resource(s)

Any good reference on VHDL (Other)

3.3 Additional Resource(s)

Additional Resources (Other)
Lecture Information: All lecture notes are posted on the ENGG*45400 CourseLink system

Lab Information: The Lab Manual will be posted on the ENGG*4540 CourseLink system

4 Learning Outcomes

4.1 Course Learning Outcomes

By the end of this course, you should be able to:

1. Identify the tasks involved in computer architecture design, with trends in technology, usage, and cost
2. Measure and report performance of computer architectures
3. Classify instruction set architectures, and comprehend the instruction formats and semantics
4. Identify and analyze basic pipeline operations, data and control pipeline hazards, and

instruction- level parallelism

5. Communicate effectively about advanced computer architectures and memory-hierarchy design, including cache design issues and performance evaluation

4.2 Engineers Canada - Graduate Attributes

Successfully completing this course will contribute to the following:

#	Outcome Set Name	Course Learning Outcome
1	Knowledge base	1, 2
1.1	Recall, describe and apply fundamental mathematical principles and concepts	1, 2
1.2	Recall, describe and apply fundamental concepts and principles in natural sciences	1, 2
1.3	Comprehend and apply fundamental engineering concepts	1, 2
1.4	Comprehend and apply program-specific engineering concepts	1, 2
2	Problem analysis	1, 2, 3
2.1	Formulate a problem statement in engineering and nonengineering terminology	1, 2, 3
2.2	Construct a conceptual framework	1, 2, 3
2.3	Identify, organize and justify appropriate information	1, 2, 3
2.4	Execute an engineering solution	1, 2, 3
2.5	Critique and appraise results	1, 2, 3
3	Investigation	4, 5
3.1	Propose and test working hypotheses	4, 5
3.2	Design and apply an investigation plan	4, 5
3.3	Analyze and interpret experimental data	4, 5
3.4	Assess validity of conclusions within limitations of data and methodologies	4, 5
4	Design	1, 2, 4, 5
4.1	Describe the design process	1, 2, 4, 5
4.2	Construct design-specific problem statements	1, 2, 4, 5
4.3	Create engineering design solutions	1, 2, 4, 5
4.4	Develop engineering design solutions	1, 2, 4, 5
4.5	Assess engineering design solutions	1, 2, 4, 5

#	Outcome Set Name	Course Learning Outcome
4.6	Implement engineering design solutions	1, 2, 4, 5
5	Use of engineering tools	1, 2, 5
5.1	Select appropriate engineering tools from various alternatives	1, 2, 5
5.2	Apply selected engineering tools	1, 2, 5
5.3	Recognize limitations of selected engineering tools	1, 2, 5
6	Individual and team work	5
6.1	Act as an individual team member to promote team success	5
6.2	Demonstrate leadership through team building, providing feedback and positive attitude	5
7	Communication skills	1, 2, 5
7.1	Develop and deliver clear, key concepts using methods appropriate for the intended audience	1, 2, 5
7.2	Critically evaluate received information	1, 2, 5
7.3	Demonstrate active listening and follow instructions	1, 2, 5

5 Teaching and Learning Activities

5.1 Lecture

Topic(s): Introduction
Reference(s): Chapter 1

Topic(s): Instruction Set Architecture
Reference(s): Appendix A

Topic(s): Pipelining Basics (Review)
Reference(s): Appendix C

Topic(s): Memory Hierarchy (Review)
Reference(s): Appendx B

Topic(s): Advanced Caches
Reference(s): Chapter 2

Topic(s): Superscalar
Reference(s): Chapter 3

Topic(s): Out Of Order (OOO) Execution
Reference(s): Chapter 3

Topic(s): Very Large Instruction Word (VLIW)
Reference(s): Chapter 3

Topic(s): Multithreading

Reference(s): Chapter 3

Topic(s): Vector Processors
Reference(s): Chapter 4

Topic(s): Warehouse-Scale Computers
Reference(s): Chapter 6

Topic(s): Extra Topics

5.2 Lab

Topic(s): Intro to Lab Equipment and Safety Training

Topic(s): Lab 1

Topic(s): Lab 2

Topic(s): Lab 3

Topic(s): Lab 4

Topic(s): Extra

5.3 Other Important Dates

Tuesday January 9, 2018: First class
Monday February 19 – Friday February 23, 2018: Winter Break
Friday March 9, 2018: 40th class day – Last day to drop the course
Thursday April 5, 2018: Last class

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6 Assessments

6.1 Marking Schemes & Distributions

Name	Scheme A (%)
Assignments	15.00
Labs	25.00
Presentation	5.00
Midterm	20.00
Final Exam	35.00
Total	100.00

6.2 Assessment Details

Assignments (15.00%)
5 take home problem sets

Labs (20.00%)
4 labs

Group Presentation (5.00%)

1 topic per group

Midterm (20.00%)
Date: Thursday, March 1st 2018, 11:30 am to 12:50 pm.In class.

Final Exam (35.00%)
Date: Thursday, April 19th 2018, 7:00 pm to 9:00 pm.Room TBD.

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7 Course Statements

7.1 Course Grading Policies

Missed Assessments: If you are unable to meet an in-course requirement due to medical, psychological, or compassionate reasons, please email the course instructor. See the undergraduate calendar for information on regulations and procedures for Academic Consideration:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml

Accommodation of Religious Obligations: If you are unable to meet an in-course requirement due to religious obligations, please email the course instructor at the start of the semester to make alternate arrangements. See the undergraduate calendar for information on regulations and procedures for Academic Accommodation of Religious Obligations:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-accomrelig.shtml

Missed Quiz or Midterm Exam: There will be no makeup quizzes or midterm exam under normal circumstances. Please check the above paragraphs on Missed Assessments and Accommodation of Religious Obligations if you believe that they apply to your situation.

Lab Work: You must attend and complete all laboratories. If you miss a lab with grounds for granting academic consideration or religious accommodation, arrangements must be made with the instructor to complete a makeup lab upon presentation of a written request and suitable documentation.

Late Lab Reports: Late submissions of lab reports will not be accepted.

7.2 Relationships with other Courses & Labs

ENGG*3380: Internal bus structure, registers, control sequence design, microprogramming and memory organization.

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8 School of Engineering Statements

8.1 Instructor's Role and Responsibility to Students

The instructor’s role is to develop and deliver course material in ways that facilitate learning for a variety of students. Selected lecture notes will be made available to students on Courselink but these are not intended to be stand-alone course notes. Some written lecture notes will be presented only in class. During lectures, the instructor will expand and explain the content of notes and provide example problems that supplement posted notes. Scheduled classes will be the principal venue to provide information and feedback for tests and labs.

8.2 Students' Learning Responsibilities

Students are expected to take advantage of the learning opportunities provided during lectures and lab sessions. Students, especially those having difficulty with the course content, should also make use of other resources recommended by the instructor. Students who do (or may) fall behind due to illness, work, or extra-curricular activities are advised to keep the instructor informed. This will allow the instructor to recommend extra resources in a timely manner and/or provide consideration if appropriate.

8.3 Lab Safety

Safety is critically important to the School and is the responsibility of all members of the School: faculty, staff and students. As a student in a lab course you are responsible for taking all reasonable safety precautions and following the lab safety rules specific to the lab you are working in. In addition, you are responsible for reporting all safety issues to the laboratory supervisor, GTA or faculty responsible.

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9 University Statements

9.1 Email Communication

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

9.2 When You Cannot Meet a Course Requirement

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. The regulations and procedures for Academic Consideration are detailed in the Undergraduate Calendar.

9.3 Drop Date

Courses that are one semester long must be dropped by the end of the fortieth class day; two-semester courses must be dropped by the last day of the add period in the second semester. The regulations and procedures for Dropping Courses are available in the Undergraduate Calendar.

9.4 Copies of Out-of-class Assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

9.5 Accessibility

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required, however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.

Use of the SAS Exam Centre requires students to book their exams at least 7 days in advance, and not later than the 40th Class Day.

More information: www.uoguelph.ca/sas

9.6 Academic Misconduct

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 misconduct. 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 before 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.

The Academic Misconduct Policy is detailed in the Undergraduate Calendar.

9.7 Recording of Materials

Presentations which are made in relation to course work—including lectures—cannot be recorded 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.

9.8 Resources

The Academic Calendars are the source of information about the University of Guelph's procedures, policies and regulations which apply to undergraduate, graduate and diploma programs.

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