

Course Outline (W2025)

COE818: Advanced Computer Architecture

Instructor(s)	Dr. Nagi Mekhiel [Coordinator] Office: ENG446 Phone: (416) 979-5000 x 557251 Email: nmekhiel@torontomu.ca Office Hours: Wed 11AM-12PM
Calendar Description	The main topics include: instruction set architecture for advanced processor, advanced pipelining, including branch predication, instruction level parallelism. It also covers advanced architecture including superscalar VLIW, speculative, vector processors, multithreading and multi-processors. It discusses the performance limitations and scalability issues and introduces real-world examples including MMX technology, and Pentium architectures. The laboratory work includes performance evaluation of advanced architectures.
Prerequisites	COE 758
Antirequisites	None
Corerequisites	None
Compulsory Text(s):	<ol style="list-style-type: none"> 1. David Patterson and John Hennessy "Computer Architecture A Quantitative Approach" 2006, Morgan Kaufmann Publishers, San Francisco, California ISBN0080475027, 9780080475028 2. Laboratory Manual: Available through D2L and http://www.ee.ryerson.ca/~courses/ele818
Reference Text(s):	
Learning Objectives (Indicators)	<p>At the end of this course, the successful student will be able to:</p> <ol style="list-style-type: none"> 1. Uses numerical and analytical models to predict, control, and design component, system. (1b) 2. Identifies potential hazards and checks for alternative solutions. (2a) 3. Compares model predictions with real-world data Proposes model improvements (2b) 4. Appraises the validity/reliability of data relative to the degrees of error and limitations of theory and measurement (3a) 5. Anticipates the needs of the project, customizes design processes, analyzes progress, and revises plans as necessary. Uses strategic planning in more complex design problems/systems. (4a) 6. Uses strategic planning in more complex design problems/systems. (4c) 7. Generates solutions for more complex design engineering problems/systems. (4b) 8. Designs and develops simple tools (software, hardware) to perform given tasks as required by the project. (5a) <p>NOTE: Numbers in parentheses refer to the graduate attributes required by the Canadian Engineering Accreditation Board (CEAB).</p>

Course Organization	3.0 hours of lecture per week for 13 weeks 1.0 hours of lab per week for 12 weeks 0.0 hours of tutorial per week for 12 weeks												
Teaching Assistants	TBA												
Course Evaluation	<table border="1"> <thead> <tr> <th colspan="2">Theory</th> </tr> </thead> <tbody> <tr> <td>Midterm Exam</td> <td>25 %</td> </tr> <tr> <td>Final EXam</td> <td>50 %</td> </tr> <tr> <th colspan="2">Laboratory</th> </tr> <tr> <td>Lab Reports</td> <td>25 %</td> </tr> <tr> <td>TOTAL:</td> <td>100 %</td> </tr> </tbody> </table> <p>Note: In order for a student to pass a course, a minimum overall course mark of 50% must be obtained. In addition, for courses that have both "Theory and Laboratory" components, the student must pass the Laboratory and Theory portions separately by achieving a minimum of 50% in the combined Laboratory components and 50% in the combined Theory components. Please refer to the "Course Evaluation" section above for details on the Theory and Laboratory components (if applicable).</p>	Theory		Midterm Exam	25 %	Final EXam	50 %	Laboratory		Lab Reports	25 %	TOTAL:	100 %
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TOTAL:	100 %												
Examinations	Midterm exam in Week 7 or 8, for two hours, closed book (covers Weeks 1-6). Final exam, during the exam period, 2 and half hours, closed-book (covers Weeks 1-13).												
Other Evaluation Information	None												
Teaching Methods	lecture time Wednesday from 12 to 3 VIC205												
Other Information	None												

Course Content

Week	Hours	Chapters / Section	Topic, description
1	3		Instruction Set Principles - Review and Introduction - Instruction Set Architectures - Memory Addressing (Chapter 2 Section 2.1-2.4)

2	3		<p>Instruction Set Principles</p> <ul style="list-style-type: none"> - Operations Introduction to - Operands - Encoding Instruction Set - Role of Compilers <p>(Chapter 2 Section 2.5-2.12)</p>
3	3		<p>Pipelining Basic and Intermediate Concepts</p> <ul style="list-style-type: none"> - Basic Pipeline for MIPS <p>(Appendix A Section A.1)</p>
4	3		<p>Pipelining:</p> <ul style="list-style-type: none"> - Pipeline Hazards - Data Hazards <p>(Appendix A Section A.2-A.3)</p>
5	3		<p>Pipelining:</p> <ul style="list-style-type: none"> - Control Hazards - Multicycle operations - Dealing with Exceptions - MIPS Pipeline <p>(Appendix A Section A.4-A.6)</p>
6	3		<p>Instruction Level Parallelism:</p> <ul style="list-style-type: none"> - Concept - Dynamic Scheduling <p>(Chapter 3 Section 3.1-3.2)</p>
7	3		Examples and Review Midterm
8	3		<p>Instruction Level Parallelism:</p> <ul style="list-style-type: none"> - Dynamic Scheduling and hazards - Superscalar <p>(Chapter 3 Sections 3.3-3.6)</p>
9	3		<p>Instruction Level Parallelism:</p> <ul style="list-style-type: none"> - VLIW - Branch Prediction <p>(Chapter 4 Sections 4.1-4.3)</p>

10	3		Vector Processors and GPU: - Concept and Architecture - Performance (Appendix G Sections G.1-G.2)
11	3		Multiprocessors: - Introduction - Shared Memory Architecture (Chapter 6 Sections 6.1-6.3)
12	3		Multiprocessors: - Coherency and Synchronization (Chapter 6 Sections 6.4-6.7)
13	3		Multithreading (Chapter 6 Section 6.9) Review

Laboratory(L)/Tutorials(T)/Activity(A) Schedule

Week	L/T/A	Description
2-3	TBA	Using SIMPLESCALAR Simulator
4-7	TBA	Evaluating Performance of Computer System
8-12	TBA	Using GPU

University Policies & Important Information

Students are reminded that they are required to adhere to all relevant university policies found in their online course shell in D2L and/or on [the Senate website](#)

Refer to the [Departmental FAQ page](#) for further information on common questions.

Important Resources Available at Toronto Metropolitan University

- [The Library](#) provides research [workshops](#) and individual assistance. If the University is open, there is a Research Help desk on the second floor of the library, or students can use the [Library's virtual research help service](#) to speak with a librarian.
- [Student Life and Learning Support](#) offers group-based and individual help with writing, math, study skills, and transition support, as well as [resources and checklists to support students as online learners](#).
- You can submit an [Academic Consideration Request](#) when an extenuating circumstance has occurred that has significantly impacted your ability to fulfill an academic requirement. You may always visit the [Senate website](#) and select the blue radio button on the top right hand side entitled: **Academic Consideration Request (ACR)** to submit this request.

For Extenuating Circumstances, Policy 167: Academic Consideration allows for a once per semester ACR request without supporting documentation if the absence is less than 3 days in duration and is not for a final exam/final assessment. Absences more than 3 days in duration and those that involve a final exam/final assessment, require documentation. Students must notify their instructor once a request for academic consideration is submitted. See Senate [Policy 167: Academic Consideration](#).

- If taking a remote course, familiarize yourself with the tools you will need to use for remote learning. The [Remote Learning Guide](#) for students includes guides to completing quizzes or exams in D2L Brightspace, with or without [Respondus LockDown Browser and Monitor, using D2L Brightspace](#), joining online meetings or lectures, and collaborating with the Google Suite.
- Information on Copyright for [Faculty](#) and [students](#).

Accessibility

- Similar to an [accessibility statement](#), use this section to describe your commitment to making this course accessible to students with disabilities. Improving the accessibility of your course helps minimize the need for accommodation.
- Outline any technologies used in this course and any known accessibility features or barriers (if applicable).
- Describe how a student should contact you if they discover an accessibility barrier with any course materials or technologies.

Academic Accommodation Support

Academic Accommodation Support (AAS) is the university's disability services office. AAS works directly with incoming and returning students looking for help with their academic accommodations. AAS works with any student who requires academic accommodation regardless of program or course load.

- Learn more about [Academic Accommodation Support](#).
- Learn [how to register with AAS](#).

Academic Accommodations (for students with disabilities) and Academic Consideration (for students faced with extenuating circumstances that can include short-term health issues) are governed by two different university policies. Learn more about [Academic Accommodations versus Academic Consideration and how to access each](#).

Wellbeing Support

At Toronto Metropolitan University, we recognize that things can come up throughout the term that may interfere with a student's ability to succeed in their coursework. These circumstances are outside of one's control and can have a serious impact on physical and mental well-being. Seeking help can be a challenge, especially in those times of crisis.

If you are experiencing a mental health crisis, please call 911 and go to the nearest hospital emergency room. You can also access these outside resources at anytime:

- **Distress Line:** 24/7 line for if you are in crisis, feeling suicidal or in need of emotional support (phone: 416-408-4357)
- **Good2Talk:** 24/7-hour line for postsecondary students (phone: 1-866-925-5454)
- **Keep.meSAFE:** 24/7 access to confidential support through counsellors via [My SSP app](#) or 1-844-451-9700

If non-crisis support is needed, you can access these campus resources:

- **Centre for Student Development and Counselling:** 416-979-5195 or email csdc@torontomu.ca

- **Consent Comes First - Office of Sexual Violence Support and Education:** 416-919-5000 ext 3596 or email osvse@torontomu.ca
- **Medical Centre:** call (416) 979-5070 to book an appointment

We encourage all Toronto Metropolitan University community members to access available resources to ensure support is reachable. You can find more resources available through the [Toronto Metropolitan University Mental Health and Wellbeing](#) website.