Faculty of Engineering, Architecture and Science

Department of Electrical and Computer Engineering

Course Outline

COE818: Advanced Computer Architecture

Prerequisite

COE 758

Reference

Text


Laboratory Manual: Available through the course web page: http://www.ee.ryerson.ca/~courses/ele818

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.

Learning Objectives

At the end of this course, the successful student will be able to:

1-Integrates mathematics with natural and applied sciences to develop numerical and analytical models for processes and systems. Uses numerical and analytical models to predict, control, and design component, system. Compares model predictions with real-world data. Proposes model improvements. Appraises the validity/reliability of data relative to the degrees of error and limitations of theory and measurement. Creates simulated data for pre analysis.

Students are given a project to evaluate performance of new MIPS based architectures using modeling and compare it with real computer.

2-Generates solutions for more complex design engineering problems/systems. Evaluates results using several skills and tools to determine the one that best explains ‘reality’. Identifies potential hazards and checks for alternative solutions. Students must understand advanced pipelining including hazards and trade-offs in design.

3-Anticipates the needs of the project, customizes design processes, analyzes progress, and revises plans as necessary. Appraises the validity/reliability of data relative to the degrees of error and limitations of theory and measurement.

Students are expected to understand microarchitecture of real processors and analyze the design features used and define limitations.

4-Uses strategic planning in more complex design problems/systems.
Students expected to understand complex system of multiprocessor architecture and cache coherency.

5-Generates solutions for more complex design engineering problems/systems. Designs and develops simple tools (software, hardware) to perform given tasks as required by the project.

Students expected to understand Multithreading and synchronization for multiprocessors and discuss their limitations and encouraged to come up with their own solutions. Students expected to write synchronization code for multiprocessors.

Course Organization
3 hours of lecture per week for 13 weeks, in 1 section
1 hour of lab/tutorial per week for 12 weeks

Course Evaluation
Midterm exam 25%
Lab reports 25%
Final exam 50%
Total 100%

Examinations
Midterm exam in Week 7, two hours, multiple-choice, closed book (covers Weeks 1-6). Final exam, during exam period, two and half hours, closed book (covers Weeks 1-13).

Course Content

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| 2     | 2.1-2.4  | 3     | Instruction Set Principles  
- Review and Introduction  
- Instruction Set Architectures  
- Memory Addressing |
| 2     | 2.5-2.12 | 3     | Instruction Set Principles  
- Operations Introduction to  
- Operands  
- Encoding Instruction Set  
- Role of Compilers |
| Appendix A | A.1     | 3     | Pipelining; Basic and Intermediate Concepts  
- Basic Pipeline for MIPS |
| Appendix A | A.2-A.3 | 3     | Pipelining:  
- Pipeline Hazards  
- Data Hazards |
| Appendix A | A.4-A.6 | 3     | Pipelining:  
- Control Hazards  
- Multicycle operations  
- Dealing with Exceptions  
- MIPS Pipeline |
| 3     | 3.1-3.2  | 3     | Instruction Level Parallelism:  
- Concept  
- Dynamic Scheduling |
| Review and Midterm |            | 3     | Examples and Review Midterm |
Laboratory/Tutorials

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<tr>
<td>2,3</td>
<td>Introduction to WINMIPS Simulator</td>
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<td>4,5,6</td>
<td>Evaluating MIPS Performance</td>
<td>ENG412</td>
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<tr>
<td>7,8,9</td>
<td>Studying pipeline Hazards</td>
<td>ENG412</td>
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<tr>
<td>10,11,12</td>
<td>Performance of MIPS with pipelining</td>
<td>ENG412</td>
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Important Notes

1. All of the required course-specific written reports will be assessed not only on their technical/academic merit, but also on the communication skills exhibited through these reports.

2. Should a student miss a mid-term test or equivalent (e.g. studio or presentation), with appropriate documentation, a make-up will be scheduled as soon as possible in the same semester. Make-ups should cover the same material as the original assessment but need not be of an identical format. Only if it is not possible to schedule such a make-up may the weight of the missed work be placed on the final exam, or another single assessment. This may not cause that exam or assessment to be worth more than 70% of the student’s final grade. If a student misses a scheduled make-up test or exam, the grade may be distributed over other course assessments even if that makes the grade on the final exam worth more than 70% of the final grade in the course.

3. Students who miss a final exam for a verifiable reason and who cannot be given a make-up exam prior to the submission of final course grades, must be given a grade of INC (as outlined in the Grading Promotion and Academic Standing Policy) and a make-up exam (normally within 2 weeks of the beginning of the next semester) that carries the same weight and measures the same knowledge, must be scheduled.

4. Medical or Compassionate documents for the missing of an exam must be submitted within 3 working days of the exam. Students are responsible for notifying the instructor that they will be missing an exam as soon as possible.

5. Requests for accommodation of specific religious or spiritual observance must be presented to the instructor no later than two weeks prior to the conflict in question (in the case of final examinations within two weeks of the release of the examination schedule). In extenuating circumstances this deadline may be extended. If the dates are not known well in advance because they are linked to other conditions, requests should be submitted as soon as possible in advance of the required observance. Given that timely requests will prevent
difficulties with arranging constructive accommodations, students are strongly encouraged to notify the instructor of an observance accommodation issue within the first two weeks of classes.

6. The results of the first test of mid-term test will be returned to students before the deadline to drop an undergraduate course in good Academic Standing.

8. Students are required to adhere to all relevant University policies including the Student Code of Academic Conduct (www.ryerson.ca/senate/policies/pol60.pdf) and Non-Academic Conduct (www.ryerson.ca/senate/policies/pol61.pdf).

9. Students are required to obtain and maintain a Ryerson Matrix e-mail account for timely communications between the instructor and the students.

10. Any changes in the course outline, test dates, marking or evaluation will be discussed in class prior to being implemented.

Approved by _______________________________                Date ________________________________

Associate Chair, Program Director
or Department Chair