EECS 598: Integrating Emerging Technologies with Computer Architecture

Winter 2016

Course Info

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Tue. &amp; Thur. 12:10 - 1:30 PM in 1008 FXB</th>
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</thead>
<tbody>
<tr>
<td>Web Page</td>
<td><a href="http://www.eecs.umich.edu/~rdreslin/eecs598/">http://www.eecs.umich.edu/~rdreslin/eecs598/</a> (TBD)</td>
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<tr>
<td>Instructor</td>
<td>Ronald Dreslinski</td>
</tr>
<tr>
<td>Email</td>
<td>rdreslin /at/ umich.edu</td>
</tr>
<tr>
<td>Office</td>
<td>2637 BBB</td>
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<tr>
<td>Office Hours</td>
<td>Tuesdays 1:30 - 2:30 PM</td>
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<tr>
<td></td>
<td>Thursdays 1:30 - 2:30 PM</td>
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Description

The intersection of computer architecture and devices is becoming an important research area, particularly as Moore’s law may be nearing its end. In this course material will focus on giving students detailed background into the device characteristics of emerging technologies and then explore how they may be integrated into computer architecture to tackle difficult future problems. Of particular focus will be new non-volatile memory devices, circuit approaches to solving “Dark Silicon”, on- and off-chip interconnects, and 2.5D & 3D chip integration. In addition, the course will help to explain how experiments are organized to model and/or build systems using emerging technologies. Strategies for early design exploration and proper methodologies for evaluations will also be discussed.

What knowledge does this course assume?

This special topics class assumes that you are familiar with the following material:

- Basic digital logic design (EECS 270 or equivalent)
- Basic machine organization (EECS 370 or equivalent)
- Memory system design and out-of-order execution (EECS 470 or equivalent)

Readings

All reading material and lecture slides will be available on the course home page.
**Grading**

A tentative breakdown of grade is given below.

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Midterm</td>
<td>30%</td>
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<tr>
<td>Paper Presentation</td>
<td>10%</td>
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<tr>
<td>Paper Written Reports</td>
<td>20%</td>
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<tr>
<td>Group Project</td>
<td>30%</td>
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<tr>
<td>Participation</td>
<td>10%</td>
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**Class Structure**

The class will be organized in two halves. In the first half of the course material will be presented in traditional lecture style covering the topics listed in the tentative schedule. At the conclusion of the first half of material a midterm exam will be given to cover the lecture material. There will be a set of papers posted to correlate with the lecture material. The second half of the course will be presentations by students on published papers. The instructor will provide a list of papers the students can choose to present on, or they can propose interesting papers of their choosing with approval from the instructor.

**Paper Presentations**

Each student will be expected to present one paper during the course of the semester. The student will prepare original slides (not using one’s prepared by the papers authors) to present the material to the class in a 25-minute presentation.

**Paper Written Reports**

Each student will be responsible for writing a 2,000 word summary and critique of the paper they choose to present. In addition, students will be asked to provide shorter 600 word critiques for one paper presented each week by other students in the class.

**Group Project**

Student groups of 1-3 students will be asked to perform a preliminary project and derive a research approach. The workload for the project will remain light. The expectation is that students will do a rough-order-of-magnitude analysis to make an early decision on the feasibility of a research direction. The students will provide a final report detailing their assessment of the idea. In addition, each group will present the project and outcome to the class.

**Participation**

The success of the second half of the class relies on class discussion and participation around each of the presented papers. It is expected that the students will actively engage in dialog and questions with the other students around the presentations.
Lecture Schedule (Tentative)

1/7 – Intro
1/12 – Experimental Methodologies and Figures of Merit
1/14 – Intro on Emerging Non-Volatile Memory (NVM) Technologies
1/19 – Into to DRAM and Embedded-DRAM Technologies
1/21 – Integrating NVM/DRAM into Architectures
1/26 – The Four Horsemen of Dark Silicon
1/28 – Guest Lecture (TBD)
2/2 – No Lecture (ISSCC)
2/4 – Near-Threshold Computing
2/9 – 2.5D and 3D Integration
2/11 – 2.5D and 3D Integration cont.
2/16 – Interconnect Technologies (On-chip)
2/18 – Interconnect Technologies (Off-chip)
2/23 – Midterm Review / Project Descriptions / Paper Descriptions
2/25 – Midterm Exam
3/1 – No Lecture (Spring Break)
3/3 – No Lecture (Spring Break)
3/8 – Student Paper Presentations
3/10 – Student Paper Presentations
3/15 – No Lecture (HPCA) (Project Descriptions Due)
3/17 – Student Paper Presentations
3/22 – Student Paper Presentations
3/24 – Student Paper Presentations
3/29 – Student Paper Presentations
3/31 – Student Paper Presentations
4/5 – Student Paper Presentations
4/7 – Student Paper Presentations
4/12 – Group Project Presentations (Project Writeups Due)
4/14 – Group Project Presentations