TOPICS IN COMPUTING WITH EMERGING TECHNOLOGIES

FALL 2020
PROF. IRIS BAHAR
SEPTEMBER 9, 2020
LECTURE 1: COURSE INTRODUCTION

INSTRUCTORS

- Iris Bahar
  - Prof. of Engineering, Prof. of CS
  - Office: CIT449
  - Research interests: energy-efficient computing, computer architecture, robotics, emerging computing technologies
  - Teaching interests: digital design, robotics, emerging technologies, VLSI, low power computing, design

A LITTLE BIT ABOUT ME

- B.S., M.S. in Computer Engineering from the University of Illinois, Urbana
- Needed to find out what a computer engineer really did...
  - Went off to work in microprocessor design industry after graduation

- Ph.D., in Computer Engineering from the University of Colorado, Boulder
- Strong group in electronic design automation
- Dissertation: automatic logic synthesis for low power design
SCOPE OF MY RESEARCH

- My research interests:
  - Energy-efficient and reliable computing from the system level to the device level.
  - Examples:
    - Energy-efficient data management across multiple computers
    - Enabling low-power and reliable computing in error-prone computing conditions
    - Efficient techniques for online error detection
    - Approximate computing (at the architecture and circuit level)
    - Accelerating image processing algorithms using specialized hardware
    - Efficient use of Machine Learning and computing in robotics

ABOUT THIS COURSE

- This course will consider how emerging device technologies will affect our past assumptions about computing from both a hardware and software perspective.
- Class will include a mix of lectures and discussion on assigned reading of recent publications. Students will be responsible for leading and participating in these discussions.
- A final project of your choosing will allow you to delve deeper into a topic discussed in class

COURSE FORMAT

- This course is officially being offered in a hybrid format
- TBD: Percentage in-person vs. remote
- This semester will be one big experiment, so we all need to be flexible...
- Class time will be primarily discussion based, so it is important that you participate during class (in person or zooming)
- Lecture will be synchronous only
- In addition, supplementary online discussion will be required via canvas (in teams or individually).
CLASS MEETING TIMES

- Lectures M, W 3:00-4:20pm, (zoom or McMillan 117)
- Office hours:
  - Mondays 4:30-5:30pm, ERC lobby (or zoom)
  - Tuesdays 10-11am, CIT449 (zoom)
  - by appointment

MEETING TIME LOGISTICS

- I know some of you taking this course remotely
- I know some of you will be zooming in across many time zones
- I know that 3am is not a convenient time for some of you have class
- Depending on who is registered for the course and where you are physically located this semester, I will explore alternate meeting times
- Remember: this course is set up for synchronous lectures since class participation is essential.

COURSE REQUIREMENTS

- Zoom.
  - It is preferable that you have your video on during class to encourage better engagement, so if you have the internet bandwidth, please use video during class time.
- VPN
  - You may need to access papers directly from publication sites, which may require to be on the Brown VPN.
  - download F5 Desktop client from software.brown.edu

DIVERSITY AND INCLUSION

- It is my intent that students from all diverse backgrounds be well-served by this course.
- The diversity the students bring to this class is a resource, strength, and benefit.
- I aim to present materials and create an environment that is inclusive and respectful of diversity
- Likewise, I expect all students in class to be respectful of diversity and do their part in creating an inclusive environment.
- Your suggestions are encouraged and appreciated.
**COURSE ASSIGNMENTS**

- **Discussion**: Most classes will consist of discussion of 1-2 papers on a particular emerging technology topic.
  - All students expected to read papers before class and come prepared to discuss them.
  - Student teams meet to review paper before class and must post comments to online discussion board (via Canvas)
  - Summarize key aspects, raise questions, discuss open issues, ideas for future work.
  - 1-2 designated discussion leaders assigned for each class. Start by reviewing comments. Discussion leaders generally get to select the reading for that class.
  - It is expected that **ALL** students be involved in active discussion of the papers.

- **Homework**: Expect 1-2 homeworks (not a major component of this course)
  - Use of open source tools to evaluate some emerging technology.

- **Final Project**: Last 6 weeks of course. Investigate some aspect of emerging technologies or non-conventional computing. Group projects (typically groups of two) are possible.

**MORE ABOUT PAPER DISCUSSION**

- **Online discussion**: Managed through the Canvas discussion board
  - Paper evaluations will be done in teams of 2 people.
  - Everyone on the team is responsible for making sure he/she understands the essence of the work.
  - What are the most innovative components and weaknesses?
  - Do you have follow-up ideas to develop into extended research projects?
  - What are some relevant related works?
  - Team members are responsible for setting up their own zoom/hangout sessions to have these discussions.

- **Etiquette**: Posts should be substantive, professional in content, and discussion provoking. No inflammatory statements (but disagreeing with another student, or the instructor is perfectly fine).

- **Class discussion**:
  - Online discussion posts will be our starting point for class discussion.
  - 1-2 students from class will be designated as scribes during class time discussion.
  - Scribe notes will be compiled in a shared google document.

**GRADING**

- Following is a tentative breakdown for the course grading:
  - **Discussion Leader Presentations**: 20%
  - **Online Discussion Participation**: 25%
  - **Class Participation**: 10%
  - **Final Project**: 35%
  - **Homework**: 10%

**DISCUSSION #0: INTRODUCTION**

1. Log on to Canvas and select this course: CSCI2952J
   - Go to Modules → Course Orientation and read through the course Welcome & Overview
   - Set up your Profile and Notification preferences, then click Next at the bottom of the screen to view Assignment #0

2. **Self introduction**: share with the class something about yourself
   - Where is your hometown? What year are you in your studies?
   - What research topics are you working on?
   - Why are you interested in taking this course?
   - What are your hobbies?
   - Add a fun photo or video clip

3. Click **Reply** to post your response to the questions posed above.

4. After a few of your peers have posted their introductions, click **Reply** and respond to 2-3 posts.

5. Please complete by Sept. 18 (the sooner the better)
WEEK #1 ASSIGNMENTS

Under Modules → Week #1 you will find links to today’s assignments:

1. Complete Discussion #0 introducing yourself
   - Find under the orientation module
2. Submit a list of topics about which you are most interested in learning.
3. Read the following 2 papers:
   - Computing’s Energy Problem (and what we can do about it)
   - The era of hyper-scaling in electronics
4. Complete the online discussion for the papers

SUBMIT TOPICS OF INTEREST

- Find under Modules → Week #1
- Click on list of topics
- Also find under Assignments → Assignment #1
- Think of topics you are most interested in learning about this semester. They may or may not relate to your own research.
- Submit as a text entry with a list of 2-4 topics you would like to cover this semester.
- This will help me plan paper topics for the semester and pair up people with mutual interests.
- Due by Sept 16

OVERVIEW OF EMERGING TECHNOLOGIES

Read and comment on 2 survey papers on emerging technologies
- Find under Modules → Week #1
  - Read the following 2 papers:
    - Computing’s Energy Problem (and what we can do about it)
    - The era of hyper-scaling in electronics
  - Click on online discussion
- For the first reading assignment, please complete evaluation alone. Post 1-2 comments that related to the following (or something similar that sparks your interest):
  - What big new idea did you learn?
  - How does this relate to your own research interests?
  - What topics were you most familiar with?
- Post your comments by the end of Monday, Sept. 14.

COMING UP FOR WEEK #2

- Many emerging technologies focus on replacements for silicon-based memory design
- Before we jump into research papers, I will spend a week reviewing computing memory hierarchy design
- Recommended textbook:
  - Hennessy, Patterson, Computer Organization and Design: The Hardware/Software Interface, Morgan Kaufmann
COMING UP FOR WEEK #3

- We will start our paper discussion during the 3rd week of class:
  - Emerging NVM: A Survey on Architectural Integration and Research Challenges
  - Memory that never forgets: emerging nonvolatile memory and the implication for architecture design
- I will post papers for week #3 some time next week
  - I will assign teams for reviewing the papers
  - Expect different team assignments weekly
- I will also assign discussion leaders for the week
  - If you want to volunteer, let me know
  - We will rotate discussion leaders throughout the semester. Expect to lead 2-3 times
- Starting the 5th or 6th week of class, students will be able to choose papers to review

QUESTIONS?

- Send me email if you have questions
- I will stay on zoom for my office hours today