CSCI2952J/ENGN2952J – Topics in Computing with Emerging Technologies
Semester I, AY 2020-21
M, W 3:00pm-4:20pm

CLASS TIMES: MW 3:00 – 4:20 p.m.  TBD

INSTRUCTOR: R. Iris Bahar 863-1430
CIT 449 Iris_Bahar@brown.edu
Office Hours: Mon. 4:30 – 5:30 pm, ERC lobby
Tuesday, 10 – 11am, CIT 449
or by appointment

COURSE DESCRIPTION: Over the past few decades, computer system performance was driven by improvements in silicon fabrication technology. However, a number of promising candidates for new basic technologies have emerged recently, including single-molecule organic switches and non-volatile memory structures. This course will consider how these new basic devices 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 course project will also be required. Prerequisites: some knowledge of computer architecture is helpful, but not required.

COURSE MATERIAL: Required: Reading material will be made available from the website throughout the semester

LECTURES: The first couple of weeks of the course will be devoted to providing the class with an overview of issues in current device technology and their implications for computing and memory design. We will also touch on various emerging technology that have shown to be promising alternatives to the standard. Students can expect a homework assignment that explores some of these technologies (old and new) following these lectures.

DISCUSSION: After the overview, most classes will consist of a discussion of one or two papers on a particular topic in emerging computing/memory technologies or alternative approaches to computing. All students are expected to read the papers and come prepared to discuss them in class. There will be one discussion leader assigned for each class. The discussion leader is responsible for keeping the discussion going and/or preparing a formal presentation of the material. In addition, all students are expected to contribute to online discussion (via Canvas) before and after class to summarize key aspects of the papers, raise questions on proposed approaches, and discuss open issues, and ideas for future work, etc. It is expected that ALL students be involved in active discussion of the papers and a significant portion of their grade will be allocated to assessment in their participation in the online discussion.

TOPICS: The exact topics to be covered will depend on students’ interests. However, some topics I would like to cover include the following:
1. CMOS technology (combinational and sequential logic circuits, noise margins, power dissipation, performance, scaling challenges)
2. Volatile vs. non-volatile memory
3. Molecular technologies for computing and memory storage
4. Processing-in-memory (PIM) and Near-data-processing (NDP)
5. Neuromorphic computing
6. Implications for the “memory wall” with emerging technologies
7. Retaining security with emerging technologies
**HOMEWORK:** While homeworks are not intended to be a major component of this course, they are intended to give students some appreciation of current design approaches and the tools available for creating these designs in either traditional CMOS or other non-silicon technology.

**Final Project:** The project will involve investigating some aspect of emerging technologies or non-conventional computing. Typically, a project will investigate one of the areas discussed during class; however, students are free to propose any appropriate research topic. Group projects (typically groups of two) are encouraged.

**COURSE 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%

**Work Expectation:** There are three hours per week of class for 14 weeks (42 hours). I expect active participation during class. There are weekly readings for class. Expect about 2 hours of preparation for each of the papers with an average of 2 papers assigned per class (so 14x4=56 hours). Participation in online discussion is expected to consume another 2 hours per week (28 hours) and preparation for the in-class presentation another 8 hours. The homework assignments will require around 10 hours of effort. The final project will be spread out over 4 weeks and will require about 10 hours/week (40 hours total). The total is 42+56+28+8+10+40 = 184 hours.

**Accommodations:** Any student with a documented disability or other challenges brought about by the COVID-10 pandemic is welcome to contact me as early in the semester as possible so that we may arrange reasonable accommodations. As part of this process, please be in touch with Student and Employee Accessibility Services by calling 401-863-9588 or online at http://brown.edu/Student_Services/Office_of_Student_Life/seas/index.html

**Diversity & Inclusion:** It is our intent that students from all diverse backgrounds and perspectives be well-served by this course, that students' learning needs be addressed both in and out of class, and that the diversity that the students bring to this class be viewed as a resource, strength and benefit. It is our intent to present materials and activities that are respectful of diversity: gender identity, sexuality, disability, age, socioeconomic status, ethnicity, race, nationality, religion, and culture. Your suggestions are encouraged and appreciated. Please let me know ways to improve the effectiveness of the course for you personally, or for other students or student groups. Likewise, I expect all students in class to be respectful of diversity and do their part in creating an inclusive environment for all in the classroom and online. Again, I would appreciate any suggestions for improving the learning environment regarding student-student, student-TA, or student-professor interaction.