EE 8950: PHYSICS OF COMPUTATION [SPRING 2014]

1 COURSE OVERVIEW

COORDINATES: M/W 16:00-17:15
AmundH 156
https://ay13.moodle.umn.edu/course/view.php?id=12535

INSTRUCTOR:

Ulya Karpuzcu
Office: 4-155 KHKH
Phone: (612) 626 72 03
E-mail: ukarpuzc @ umn
Office Hours: F 15:00-16:00

SYNOPSIS: Inspired by Richard Feynman's lectures in computation, Physics of Computation will explore how physical principles/limits have been shaping paradigms of computing. A key goal of this course is to understand how (and to what extent) a paradigm shift in computing can help with emerging energy problems.

Topics include but are not limited to: Physical limits of computing, coding and information theoretical foundations, computing with beyond-CMOS devices, reversible computing, quantum computing, stochastic computing. For each computing paradigm, (i) how information is represented, processed, stored, and communicated; (ii) to what extent shortcomings can be addressed; (iii) how the application domain looks like will be covered.

PREREQUISITES: Although some knowledge in computer architecture can be beneficial, basics will be covered in class.

REFERENCE MATERIAL: "Feynman Lectures on Computation", R. P. Feynman, Westview, June 2000 represents the main textbook. We will also cover classic and recent research papers on the subject matter.

GRADING:		
	Project	40%
	Paper review	25%
	Perspective papers	35%

PROJECT: The most significant component of EE8950. We expect a small-scale research project. The scope should be computing paradigm - technology interaction. We encourage novelty, but students can also try to re-generate the results of an already published research paper. We will post a pool of ideas on the course website. Project teams of up to 2 students are allowed. The final date represents the due to date for the project:

PAPER REVIEWS: Students are expected to write an up-to-two page review on the assigned papers. Throughout the semester, approximately 10-12 reviews will be assigned. An assignment may cover multiple papers, and some may seek answers to explicit questions.

PERSPECTIVE PAPERS: Students are expected to write an up-to-six page (double column) perspective paper on assigned subjects. Open-ended, thought-provoking research questions constitute the scope. Throughout the semester, approximately 4-5 papers will be assigned. These assignments may demand extended literature search on the subject matter.

MECHANICS:

- Academic dishonesty: Independent of the scope any conduct leads to F as the immediate final grade.
- If the students fail to submit **all** of the assignment papers, their project will not be graded.
- Any non-submitted or non-graded item will be processed with a grade of 0.

2 (TENTATIVE) SYLLABUS

Week	Mon	Wed	Note
1	No class	Technology Scaling Artifacts	
2	Introduction to Computers	Computer Organization	
3	Theory of Computation	Theory of Computation	Perspective Paper I out
4	Coding & Information Theory	Coding & Information Theory	
5	Reversible Computing	Reversible Computing	Project proposal due
6	Quantum Mechanical Computers	Quantum Mechanical Computers	Perspective Paper I due Perspective Paper II out
7	Quantum Mechanical Computers	Quantum Mechanical Computers	
8	Physical Aspects of Computation: CMOS	Physical Aspects of Computation:CMOS	
9	Spring Break	Spring Break	Perspective Paper II due Perspective Paper III out
10	Physical Aspects of Computation: Beyond CMOS	Physical Aspects of Computation: Beyond CMOS	
11	Emerging (Non-volatile) Memory Technologies	Emerging (Non-volatile) Memory Technologies	
12	Emerging (Non-volatile) Memory Technologies	Emerging (Non-volatile) Memory Technologies	Perspective Paper III due Perspective Paper IV out Project status report due
13	Soft Computing	Soft Computing	
14	Stochastic Computing	Stochastic Computing	
15	Stochastic Computing	Stochastic Computing	Perspective Paper IV due Perspective Paper V out*
16	Brain-inspired Computing	Brain-inspired Computing	

* due Wed, May 14, along with the final project report