

EE 5940: PHYSICS OF COMPUTATION [SPRING 2015]

1 COURSE OVERVIEW

M/W 16:00-17:15

COORDINATES: KHKH 3-111

<https://ay14.moodle.umn.edu/course/view.php?id=11797>

INSTRUCTOR:

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Office Hours: Tue 12:00-13:00

SYNOPSIS: Inspired by Richard Feynmans 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, we will cover (i) how information is represented, processed, stored, and communicated; (ii) to what extent shortcomings can be addressed; (iii) how the application domain looks like.

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.

	Project	30%
GRADING:	Quiz ×2	30%
	Assignment ×5	40%

PROJECT: 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. **Project due date: Friday, May 08.**

ASSIGNMENTS: There will be 5 assignments. Assignments may include thought-provoking open-ended challenge questions, paper summaries/reviews, or very basic scripting/programming.

QUIZZES: Each quiz may be designated as an open book/notes/... take-home to be submitted 24 hours after the release of questions (the following exam dates are to be interpreted as release dates in this case).

Quiz 1: Wed, March 11, 16:00-18:00

Quiz 2: Thu, May 14, 16:00-18:00

MECHANICS:

- Regarding academic integrity and scholastic dishonesty, according to the Office for Student Conduct and Academic Integrity (OSCAI), "Academic integrity is essential to a positive teaching and learning environment. All students enrolled in University courses are expected to complete coursework responsibilities with fairness and honesty. Failure to do so by seeking unfair advantage over others or misrepresenting someone elses work as your own, can result in disciplinary action. The University Student Conduct Code defines scholastic dishonesty as follows: Scholastic Dishonesty: submission of false records of academic achievement; cheating on assignments or examinations; plagiarizing; altering, forging, or misusing a University academic record; taking, acquiring, or using test materials without faculty permission; acting alone or in

cooperation with another to falsify records or to obtain dishonestly grades, honors, awards, or professional endorsement.” applies. **Independent of the scope (be it a homework assignment, exam, ...), any conduct leads to F as the immediate final grade.**

- The students are expected to attend all class meetings. Office hours are not designated to serve as make-up lectures.
- **All assignments are due at the beginning of class, on the designated due date. Late assignments will receive a reduction of 20% for each day they are late, except for documented illnesses and family emergencies.**
- Any question or concern about grading must be communicated to the instructor within one week after the return of the exam or assignment concerned.
- You can work in groups to discuss assignments, as long as the submission reflects your own work.
- UNITE students should submit all assignments according to the UNITE procedures.
- **To obtain a passing grade, *all* assignments should be turned in, *all* quizzes should be taken, and the project should be submitted.**
- Any non-submitted or non-graded item will be processed with a grade of 0.
- Regarding incomplete grades, according to University Senate policy, “The I grade shall be assigned at the discretion of the instructor when, due to extraordinary circumstances, the student was prevented from completing the work of the course on time. The assignment of an I requires a written agreement between the instructor and student specifying the time and manner in which the student will complete the course requirements. In no event may any such written agreement allow a period of longer than one year to complete the course requirements.” applies. An “I” will only be assigned if less than 15% of the course remains to be completed. In such a case, the “extraordinary circumstances” must be properly documented.
- Any student with disabilities to affect their ability to participate fully in class or to meet all course requirements is encouraged to notify the instructor so that appropriate accommodations can be timely arranged.

2 (TENTATIVE) SYLLABUS

Week	Mon	Wed	Note
1	No class	Introduction	
2	Technology Scaling Artifacts	Basic Computer Architecture	Assignment I out
3	Theory of Computation	Theory of Computation	Assignment I due Assignment II out
4	Coding & Information Theory	Coding & Information Theory	Assignment II due
5	Coding & Information Theory	Coding & Information Theory	Project Proposal due
6	Coding & Information Theory	Reversible Computing	Assignment III out
7	Reversible Computing	Reversible Computing	Assignment III due
8	Reversible Computing	Reversible Computing	Quiz I out
9	Spring Break	Spring Break	
10	Reversible Computing	Quantum Computing	Project status report due
11	Quantum Computing	Quantum Computing	Assignment IV out
12	Quantum Computing	Quantum Computing	Assignment IV due
13	Physical Aspects of Computation: CMOS	Physical Aspects of Computation: Beyond CMOS	Assignment V out
14	Physical Aspects of Computation: Beyond CMOS	Physical Aspects of Computation: Beyond CMOS	Assignment V due
15	Emerging (Non-volatile) Memory Technologies	Emerging (Non-volatile) Memory Technologies	
16	Emerging (Non-volatile) Memory Technologies	Emerging (Non-volatile) Memory Technologies	Project (final) report due

Note: Quiz II will be out on May 14.