COSC-566, Non-Standard Computing, Spring, 2009
Computer Science Department
Georgetown University

SYLLABUS

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DESCRIPTION:

This seminar course will study the concepts of information and computation from a broader perspective than that based on typical modern computing machinery. As a group, we will present a series of articles and discuss their implications. The topic order will be approximately the following: the coming end of Moore's Law ("Moore's Law" is the empirical observation that the number of transistors per chip area has roughly doubled every 18 months, which translates to similar rate of increase in processor performance), physical systems and information, the thermodynamics of computation, computational complexity and parallel execution, cellular automata, DNA computing, optical computing, and quantum computing. Alternate or additional topics as interest and time permit.

The instructor and students will each present one or more topical papers chosen from the reading list. The number of presentations each student will make depends on the number of students in the class and available time. Presentations and discussions will be during class meeting times. A semester project or paper on a topic approved by the instructor is required. A project might be focused on simulating a non-standard computing system, for instance. A paper might explore ideas suggested by our reading or be a review of existing literature on a particular topic, for example.

Prerequisites: There are no official prerequisites, and the course is open to undergraduates. However, familiarity with the Turing model of computation and standard computer architecture is assumed.

TOPICS:

1. Moore's Law, Physical Limits of Silicon Computing
2. Physical Information Processing, Philosophy of Information
3. Statistical Mechanics, Information and Entropy
4. Reversible Computing, Cellular Automata
5. Complexity, Chaos, Analog Computing, Diffusion, Emergence, and P=NP
6. Quantum Computing and Information Theory
7. DNA Computing
8. Optical Computing
9. Genetic Algorithms, Evolutionary Methods, Complex Systems
10. Simulation, Models, Experimental Methods

READINGS:

A reading list and copies of articles will be made available over the course of the semester on the course's Blackboard web site. As this course is new, we will be developing the reading list as we go and as student interests directs. If you care to start early, see "Computing is a Natural Science" by Peter Denning (http://cs.gmu.edu/cne/pjd/PUBS/CACMcols/cacmJul07.pdf). Reference materials and other resources will be available on the course's Blackboard web site.

ACADEMIC INTEGRITY:

In assigning grades, one of my jobs as instructor is to ascertain your growth in understanding the intellectual content of the course during our studies together. Course assignments and projects are intended to facilitate that growth. However, at times, one's thinking can get lead astray by side-issues that may seriously hamper your efforts to understand. It is very important that you do not dwell fruitlessly on some point that has you stuck. You should seek help as soon as practical, and your classmates can be an efficient resource. For that reason, I encourage you to freely exchange information, and this Academic Integrity Policy is designed to allow for, and encourage that kind of cooperation. The default policy for the Computer Science Department is amended as follows. You are free to discuss problems and solutions of any assignment or project with your classmates or others. You need not cite these conversations nor indicate which parts of your submitted material was garnered from such conversations. You are free to collect information from any source, electronic or otherwise, and you need not indicate the original source nor that the material did not originate with you. In addition, in this context, I consider it a fault to withhold useful information from others; although, this policy makes no stricture against it. The ability to work cooperatively together is a learned skill that will be important later in life.

GRADING:

My grading system does not evaluate your progress based on material of unknown origin. Homework is graded, but used solely to provide feedback, not in determining grades (However, see class participation below.) I do use your submitted material as a guide in developing examinations, and will ask that all your work be returned to me temporarily; so, keep ALL your work together as a portfolio. If you feel you are not being evaluated thoroughly enough, it is incumbent on you to bring this to my attention while there is still time to address your concerns before grades are submitted. You are welcome to discuss these issues with me at any time.

Grades will be based on the quality of discussion participation (30%), the quality of presentation preparation and understanding (30%), and the quality of the semester project or paper (40%). Evaluation of papers and project materials will be done by oral inquiry of the student's grasp of the submitted material and its import with respect to the course content.