Overview of CS 499: Fall 2009
Understanding Computing in an Interdisciplinary Context

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Course Schedule: TTh 12:30-1:50
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Office Hours: TTh 2:00-3:00 (tentative)

The overall goal for this course is for students to gain a better understanding of the structure, scope and future of the discipline of computing in the broader context of the physical, life and social sciences/engineering. Computing is much more than just hardware, software and theory. It is one of the four great science and engineering domains, up alongside the physical, social and life domains. It is at the heart of *understanding* and *shaping* not just computing itself, but also ourselves and the world in which we live.

In this class we will focus on computing in the large, disregarding the traditional distinctions between science and engineering, hardware and software, research and applications, and within-discipline versus multidisciplinary work. We will investigate an organizing framework for this broad landscape based on the relationships between computing and the four great domains, yielding what can be termed unary, binary and n-ary computing (as a function of how many domains are involved). We will also dig further into two specific kinds of inter-domain relationships – *implementation* and *interaction* – to generate a much finer grained structuring of the field. The result is a map of binary computing that is capable of organizing many of computing's existing topics, as well as the more general *Metascience Expression (ME) language* that is capable of characterizing arbitrary points and regions within the domain of computing.

This map and language will structure a systematic exploration of many of the multidisciplinary directions at the forefront, or in the future of computing, including: new substrates for computing based on quantum, biological, optical, chemical and other novel technologies; computational implementation of (real and/or virtual) worlds, bodies, minds, societies and computing systems (covering such areas as computational science, intelligent agents and virtual humans, virtual environments and games, biomimetics and digital physics); sensing and manipulation of the physical world, minds, bodies, societies and computing (covering such areas as smart robots, immersion, sensor networks, ubiquitous computing, cognitive and neural prostheses, autonomic computing, and social networks); cyberinfrastructure and informatics for science/engineering, bio/chemical/medical, emergency response, etc.; and layered architectures for complex systems combining humans, computers and the world.

This course will focus on the reading and understanding necessary to grasp the rather wide range of concepts to be covered and how they relate to each other and to computing as a whole. The core of the reading will be the instructor's book in progress, tentatively entitled *Computing Compass: Exploring Computing in a Multidisciplinary Context*, but it will also be supplemented by additional readings. Class sessions will be composed of a mixture of lectures, student presentations, and discussions. Students will be expected to have read the assigned readings prior to each class session in order to be active contributors to the discussions.

Planned topics on a weekly basis:

1. Introduction and Computing Landscape
2. Computing Map and Language
3. Physical Implementation of Computing
4. Biological Implementation of Computing
5. Computer Implementation/Simulation of the Physical World
6. Computer Implementation/Simulation of the Biological World
7. Computer Implementation/Simulation of the Social World
8. Midterm
9. Interaction with the Physical World
10. Interaction with the Biological World
11. Interaction with the Social World
12. Complex Amalgamations of Computing with Itself
13. Complex Amalgamations of Computing with the Physical, Biological and Social Worlds
14. Informatics and Cyberinfrastructure
15. Ethics and Review

Grading Policy:

Grades will be based on: in-class participation (10%), one in-class presentation (20%), a midterm (20%), a 5-10 page term paper (20%), and a final (30%). The midterm and final will be open book and notes, but must – along with the term paper – reflect just the work of the individual student, with no outside help (except for questions asked of the instructor). The term paper will be on an interdisciplinary topic of the student's choice that is relevant to the overall topic of this course, subject to the approval of the instructor.