Computational Systems Biology:

Special edition with a focus on Development

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What is systems biology? Why do biologists need it? How can computer scientists and mathematical modelers make a difference in biology?

In biology we see a rich variety of molecular and cellular mechanisms, all coordinated somehow to produce functioning organisms that live, reproduce, and evolve. How are molecular mechanisms coordinated to create cellular functions? Hypotheses that bridge the gap from mechanism to function have become much more elaborate as we analyse novel forms of experimental data and learn more about the complexity of cells and organisms. This is why there is a huge unmet need for computing and modeling: to understand the consequences of biological hypothesis, and to significantly improve them in concert with experiment. Computational systems biology is a "hypothesis amplifier" and it is essential to future understanding of cells, development, disease, biotechnology, and many industries of the future.

In this course we will learn how to create biological models, mathematical models, algorithms, and software that represent the regulatory networks and other mechanisms by which cells control their own processes and their interactions with the environment, including other cells. Software includes cutting-edge projects in biological network specification, simulation, pathway databases, and assimilation of real data including imagery. Models cover processes involving transcriptional regulation, signal transduction, metabolism, cell cycle, morphogenesis, development, and evolution. Open problems in multiscale modeling will be discussed. There will be team or individual final projects (your choice). Graduate students from all relevant disciplines are invited to register.

For Spring 2006, there will be a special emphasis on developmental modeling, an exciting topic that is often postponed to the point of omission in systems biology.

For some major research projects in computational systems biology that have been benefited from previous 277C class project work, see:
http://www.igb.uci.edu/servers/sb.html → Sigmoid, → Cellerator, → Computable Plant.