SYDE 750 Topic 37 / ECE 750 Topic 33 **Artificial Life: Biology and Computation**
(Spring 2019)

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Text: Readings (articles, journal papers, book chapters) to be made available to students, assigned weekly. These should be read before the next class meeting. No required textbook.
Home Page: SYDE topic 37/ ECE 750 topic 33 on Learn
Class Times: [redacted]

Course Grading:

- 20% Problem Worksheets. Frequent weekly worksheets will check and develop student understanding of concepts covered in-class.
- 20% Class participation, including note-taking for the class on a rota system.
- 60% Individual Project: Students propose an individual project to carry out, and critically evaluate, using artificial life techniques in a particular application area. An 8-page IEEE-style formatted report to which all code and additional appendices must be added. All projects must be demoed to the instructors. The report has to demonstrate background review, software/system development, experimental results and analysis, and critical evaluation. The report will serve as the main basis of assessment. There is no final exam.

Artificial Life is study of the simulation and synthesis of living or life-like systems. This course treats the basic principles of biology and computation in nature that underpin the organization of living systems in life as we know it, as it might exist elsewhere in the universe, and in digital or artificial media. We explore the mechanisms within living individuals that grow and change in a complex environment. This provides a variety of methods for understanding, modeling, and designing complex adaptive systems, whether naturally occurring or engineered, in simulation, in physical systems, with a view to applications in artificial life as the foundation for artificial intelligence.

Course Outline:

1. Origins of Artificial Life, Cybernetics and AI: Simulation & Synthesis of Living and Life-like Systems, Properties of Life.
2. Biological Background for Engineers – Evolution of Life on Earth, Molecular Genetics, Genetic Code (and its digital aspects), Protein Biosynthesis, & Darwinian Evolution, Digital Organisms.
3. Cellular Automata, Synchronous/Asynchronous Automata Networks, Genetic Regulatory Networks
4. Swarm Intelligence & Stigmergy
5. Self-Reproducing Systems
6. Evolutionary Systems, Sex, and Nature-Inspired Optimization
7. Models of Growth and Morphogenesis
8. Ethical issues for Artificial Life
9. Topics chosen from: theory and applications of Differentiated Multicellularity as computational paradigm; Evolution of Individuality; Major Transitions, Evo-Devo; Evolution of Evolvability; Complexity and Interaction Machines.

Students should be able to program well in at least one high-level computer language. They are expected to attend all lectures, take detailed notes and participate in class discussions.
It is expected that students understand the university position on copying (in terms of assignments) and plagiarism (in terms of the project). All work / figures which are not your own must be explicitly identified.