

SYDE 750 Topic 38 / ECE 750 Topic 34
(Winter 2020)

Artificial Life: Embodied Intelligence

Prof. Kerstin Dautenhahn x31455 kerstin.dautenhahn@uwaterloo.ca

Prof. Chrystopher L. Nehaniv x40168 chrystopher.nehaniv@uwaterloo.ca

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/ECE 750 topic 38/34 on Learn

Class Times:

Location:

Course Grading:

- 40% Problem Worksheets, Note-taking and participation. Frequent worksheets will check and develop student understanding of concepts covered in-class.
- 60% Individual term project: Students propose an individual project to carry out, and critically evaluate an individual project 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.

This course in Artificial Life addresses the foundational role of *embodiment* and *interaction* in living and life-like systems as a paradigmatic approach for Embodied Intelligence in living organisms, complex adaptive systems, agents and interactive social robots. This is fundamental for understanding and modeling social and physically grounded intelligent behavior of living systems, and for the synthesis of embodied intelligence in artificial interactive systems and AI robotics.

Course Outline:

1. Logic of Life vs. Embodied Artificial Life; Braitenberg Vehicles; Role of the Observer; Emergence; Self-Organization; Self-* Properties (autopoiesis, self-maintenance, etc.)
2. Embodied agents, classification, issues of autonomy and design, degrees of embodiment
3. Enactive, Connectionist, and Cognitivist concepts and paradigms
4. Life-like believable robots and agents, varieties of social intelligence
5. Subsumption and other behavior-based robot architectures; behavior selection and modulation techniques, potential fields, behaviour-orientation.
6. Cognitive and developmental approaches to AI robotics; social learning and imitation.
7. Human-Robot Interaction (HRI), and applications
8. Definitions of different types of agents
9. Ethics of artificial life agents
10. Post-Reactive Natural and Artificial Intelligence & Robotics:
Topics chosen from perception-action loop, Shannon information and empowerment; the temporal horizon: reactive / affective / learning / deliberative / post-reactive agents and robots; autobiographic agents, sensor evolution; interaction games; experience histories; and narrative intelligence.

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.

ECE M.Eng. students wishing to enrol should have taken ECE 650 or have equivalent computer software background.