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DISTINGUISHED LECTURE SERIES

Semester 2

2011/12

Artificial Life as an approach to Artificial Intelligence

by

Prof Larry Yaeger

Monday 12 March 2012

UCH (Upper College Hall), St Salvator's quad
http://www.st-andrews.ac.uk/visiting/Virtualtours/Chapels/StSalvators/Quadrangle/

Overview

Covered will be an introduction to Artificial Life, its underpinnings—including neuroscience, genetic algorithms, information theory, and animal cognition—and an incremental, evolutionary approach to Artificial Intelligence built upon these cornerstones.

Biography

Larry Yaeger is a scientist, programmer, and educator who has made innovative contributions in the fields of computational fluid dynamics, computer graphics, neural networks, handwriting recognition, and artificial life.

He produced the first 3D hypersonic computational flow field studies over the space shuttle and carried out many pioneering fluid dynamics studies, including the first ever whole-body computational solution for flow over a submarine (incorporating hull, lifting surface, and turbulent wake effects).

As Director of Software Development for groundbreaking computer special effects house, Digital Productions, Mr. Yaeger helped create the first feature film using photo-realistic computer graphics: *The Last Starfighter*, as well as a variety of Clio and NCGA award-winning television commercials. He was responsible for the creation of the planet Jupiter for the film *2010*, and the flying-owl opening title sequence for *Labyrinth*. His SIGGRAPH '86 paper on the simulation of Jupiter for *2010* is often cited as one of the first examples of work combining physical simulation with computer graphics imaging. He later co-authored possibly the first book+CD-ROM title, the multiple award-winning *Visualization of Natural Phenomena*.

As part of Alan Kay's Vivarium Program at Apple Computer, Mr. Yaeger designed and programmed a computer "voice" for Koko the gorilla, helped introduce Macintoshes into routine production on *Star Trek: The Next Generation*, and created one of the earliest and most sophisticated Artificial Life computational ecosystems, Polyworld, that evolves neural network topologies resulting from the mutation and recombination of genetic codes, via behavior-based, sexual reproduction of artificial organisms.

As part of Apple's Advanced Technology Group, Mr. Yaeger was Technical Lead in the development of a neural network-based handwriting recognition system that many have deemed the "first usable" such technology, and for which he holds multiple patents. It shipped as the "Print Recognizer" in second and subsequent generation Newton PDAs, and has been integrated as "Inkwell" into Mac OS X.

He currently teaches at Indiana University, Bloomington, and has extended his Artificial Life research into the evolution of neural complexity and the relationship between neural network structure and function.

Programme: Monday 12 March 2012

10.30-11.00	Coffee & Tea with Biscuits
LCH (Lower College Hall)	Break
11.00 – 12.00	Lecture 1: Some Really Big Questions
UCH (Upper College Hall)	**Abstract:** What is Life? What is Intelligence? What is Artificial Life and how can it help us develop a better understanding of biological life and intelligence? I will introduce the historical and modern field of Artificial Life and its many facets, present some of the field's seminal results using computer simulation, and discuss some of the underlying methods of evolutionary computation.
12.00 – 13.30	Lunch
LCH (Lower College Hall)	Break
13.30– 14.30	Lecture 2: A Spectrum of Life & Intelligence
UCH (Upper College Hall)	**Abstract:** We will look at examples of non-human intelligence, in support of a thesis that life and intelligence are best thought of as a near-continuum, and examine the suggestion that information theory and complexity may yield methods for quantifying these elusive phenomena. I will also introduce core ideas underpinning theories of a neural basis of behaviour and introduce my neuro-evolutionary simulator, Polyworld.
14.30– 15.00	Coffee & Tea with Biscuits
LCH (Lower College Hall)	Break
15.00– 16.00	Lecture 3: Evolution of Neural Complexity—Structure & Function
UCH (Upper College Hall)	**Abstract:** I will show results from a study of the evolution of neural complexity and discuss its relevance to questions posed by Gould, McShea, Dawkins, and others on the evolution of biological complexity. I will also combine information theoretic analysis of neural complexity with graph theoretic analysis of neural networks to illuminate the relationship between network structure and function. Results will suggest fairly tight bounds on the structures capable of supporting complex neural dynamics, and reveal a fortunate convergence between purely functional evolutionary pressures and expected physical evolutionary pressures (such as wiring length and brain volume) that together give rise to natural intelligence.