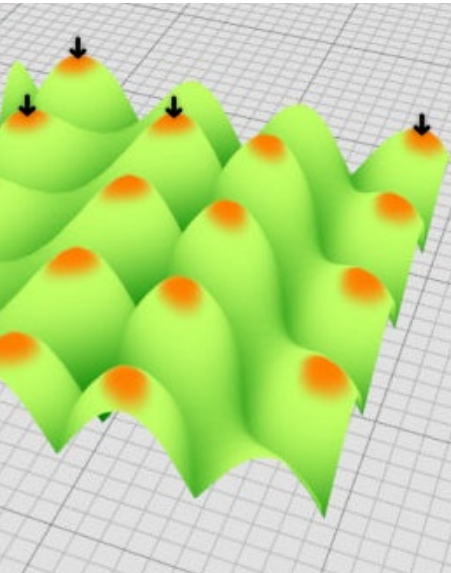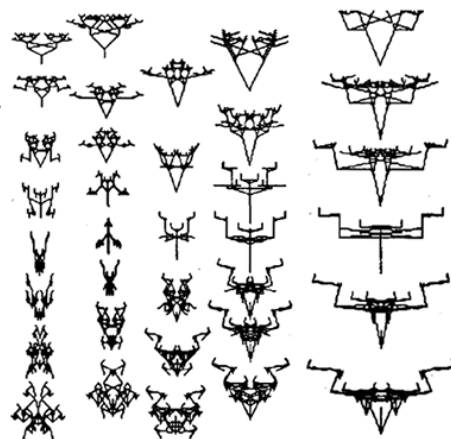# A4707
Evolutionary Design

This seminar presents evolutionary systems, alongside other computational design approaches, as pragmatic and open-ended tools for realizing architectural structures. Evolution provides a powerful framework for natural systems to bootstrap to increasingly more sophisticated outcomes. The seminar is an introduction to evolutionary design concepts such phenotypes, fitness and selection alongside their applications in the world of design. A combination of lectures, workshops and individual project support are goaled to incubate new design methodologies in which evolutionary mechanics are at work.

Seminar Approach

The seminar addresses evolutionary design at a conceptual level through readings and lectures on creative evolutionary systems. A core component of the seminar is a series of workshops exploring digital simulation tools. Simulation is approached as a primary vehicle to realize an active environment of forces and interactions largely ignored in traditional design software. In our workshops we will explore how simulation tools can not only assess shape, but also participate in its formation through iterative feedback. Each workshop will introduce key technical explanations of simulation algorithms along with the hands-on demonstrations to help students critically examine the limits of modern simulation tools and methods.

Fitness Landscape
from Galapagos Evolutionary Solver

Seminar Project

The seminar project is to illustrate and quantify a design methodology that integrates digital simulation and evolutionary mechanics. The research will culminate in a short but well-illustrated technical paper detailing the methodology, its application to prototypical design situations, and relevant results. Students are encouraged not only to craft and demonstate a design approach, but also to quantify its production and efficacy. Successful papers will be supported to submit to ACADIA or other similar architectural technology conference for publication. Students may work individually or in small groups.

Biomorphs, Artifically Evolved Networks
From "The Blind Watchmaker"

Seminar Software

The seminar will introduce a range of simulation tools to support the research

proposals, each of which will be the focus of a in-class workshop. As a class we will work primarily in Rhino Grasshopper, utilizing David Rutten's Galapagos evolutionary solver as well the Geco Ecotect Link plugin and Kangaroo Physics solver. Each software workshop will be complimented with a review of the underlying assumptions, abstractions and algorithms that allow each to evolve design candidates.

Seminar Readings*

An Evolutionary Architecture, Frazer John

Performative Architecture: Beyond Instrumentality, Kolarevic, Branko

Computer Aided Architectural Design, Mitchell, Bill

Origin of the Species, Charles Darwin

Endless Forms Most Beautiful, Sean Carroll

Creative Evolutionary Systems, Bentley

Karl Simms, Evolving Virtual Creatures

The Blind Watchmaker, Richard Dawkins

Genetic Algorithms, John Holland

Complex and Adaptive Dynamical Systems, Gros

Artificial Evolution, from Out of Control: The New Biology of Machines, Social Systems and the Economic World, Kelly, Kevin

Class Wiki (workshop materials, shared files)

* each student will be asked to specialize in one reading

Schedule

Class	Type	Topic
01	Introduction	Introduction, Design Through Simulation
02	Lecture	Evolutionary Mechanics
03	Workshop	Rhino Galapagos
03	Discussion	Evolution Reading Discussion
05	Meetings	Individual or Group Meetings
06	Workshop	Physics Based Simulation in Kangaroo
07	Workshop	Environment Simulation in Ecotect
08	Meetings	Individual or Group Meetings
09	Workshop	Finite Element Analysis
xx	No Class	Election Day
10	Lecture	Technical Paper Reading Discussion
11	Meetings	Individual or Group Meetings
12	Meetings	Individual or Group Meetings
13	Presentatons	Final Presentations
		Deadline for Technical Papers