



Genetic Algorithms

22c: 145, Chapter 4.3



What is Evolutionary Computation?

An abstraction from the theory of biological evolution that is used to create optimization procedures or methodologies, usually implemented on computers, that are used to solve problems.



The Argument

Evolution has optimized biological processes;

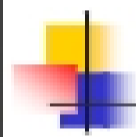
therefore

Adoption of the evolutionary paradigm to computation and other problems can help us find optimal solutions.



Evolutionary Computing

- Genetic Algorithms
 - invented by John Holland (University of Michigan) in the 1960's
- Evolution Strategies
 - invented by Ingo Rechenberg (Technical University Berlin) in the 1960's
- Started out as individual developments, but converged in the later years



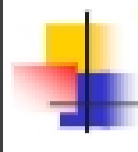
Natural Selection

- Limited number of resources
- Competition results in struggle for existence
- Success depends on fitness --
 - fitness of an individual: how well-adapted an individual is to their environment. This is determined by their genes (blueprints for their physical and other characteristics).
- Successful individuals are able to reproduce and pass on their genes



When changes occur ...

- Previously "fit" (well-adapted) individuals will no longer be best-suited for their environment
- Some members of the population will have genes that confer different characteristics than "the norm". Some of these characteristics can make them more "fit" in the changing environment.



Genetic Change in Individuals

- Mutation in genes
 - may be due to various sources (e.g. UV rays, chemicals, etc.)

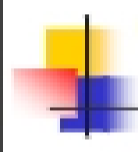
Start:

1001001001001001001

After Mutation:

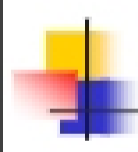
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Location of Mutation



Genetic Change in Individuals

- Recombination (Crossover)
 - occurs during reproduction -- sections of genetic material exchanged between two chromosomes



Recombination (Crossover)

Chromosome Crossing-over

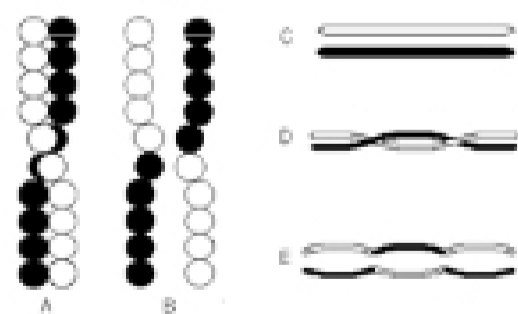


Image from <http://veg-www.mil.edu/2001/biol/mecross.html>
