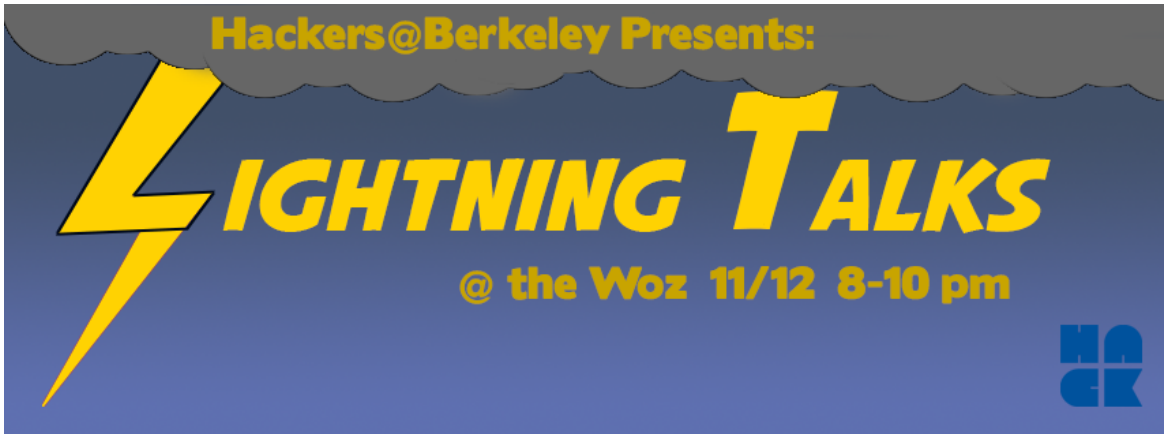


Algorithms Inspired by Nature

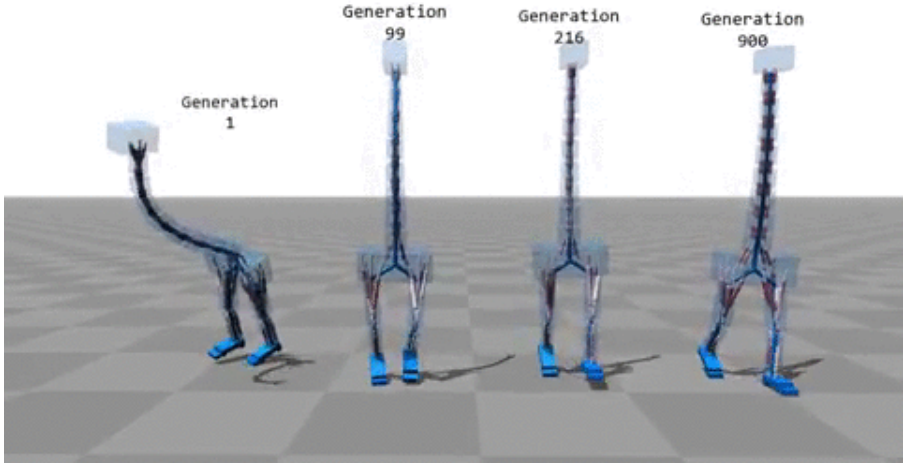
by Stephanie Djidjev

H@B: Lightning Talks

Evolution: Nature's Optimization

- Optimization
  - An act, process, or methodology of making something as fully perfect, functional, or effective as possible.
- Evolution
  - Life began 3.8 billion years ago
  - Nature weeds out weak species
  - Species slowly optimize their way of living

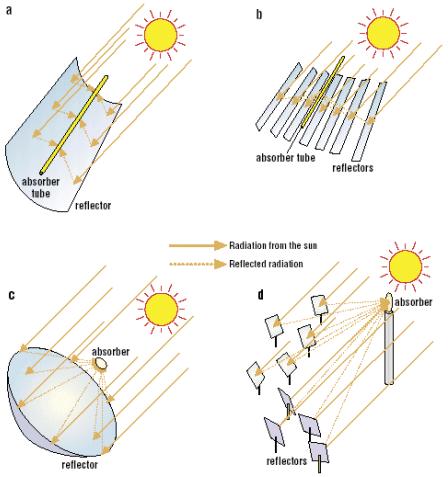
Genetic Algorithms



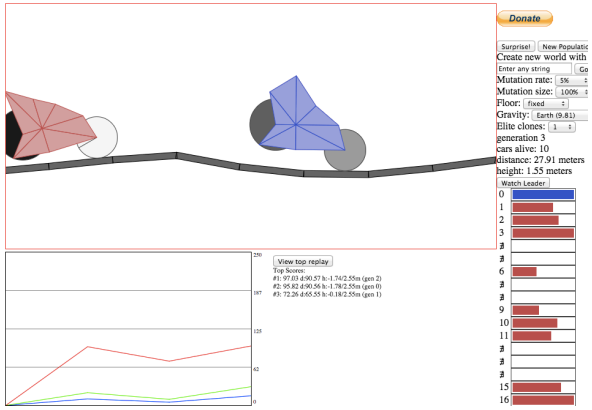
- Multiple parameters
  - Muscle size, frequency of flexing
- Fitness function
  - How far it goes
- Random parameters at first
- Pick the best solutions and make minor changes (mutations)

Genetic Algorithms

Spacecraft antenna found to have best radiation pattern



Mirrors designed to funnel sunlight to a solar collector



Best shape for a car
http://rednuht.org/genetic_cars_2/

Ant Colony Optimization

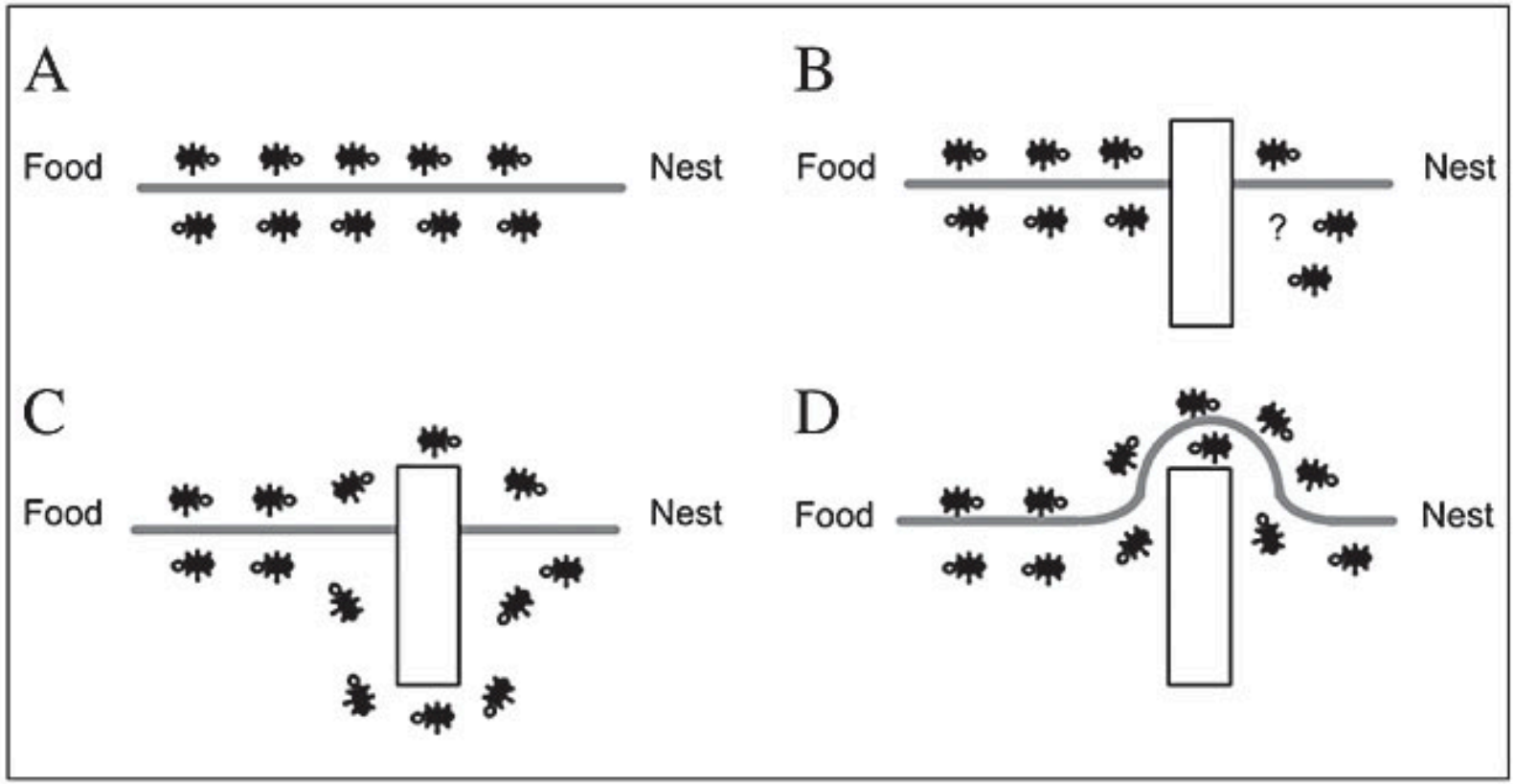
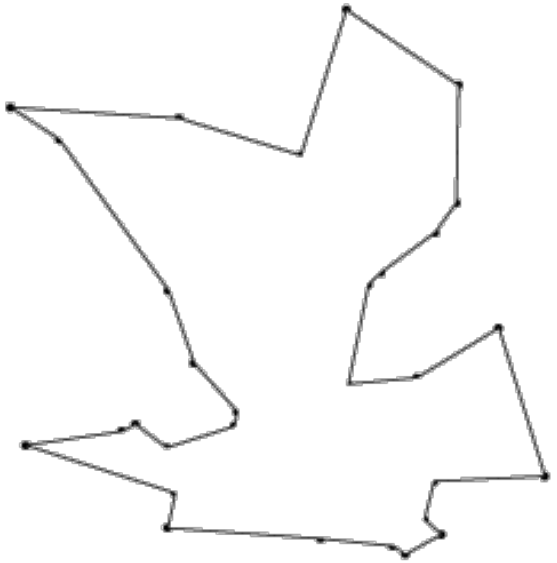


Figure 2. A. Ants in a pheromone trail between nest and food; **B.** an obstacle interrupts the trail; **C.** ants find two paths to go around the obstacle; **D.** a new pheromone trail is formed along the shorter path.

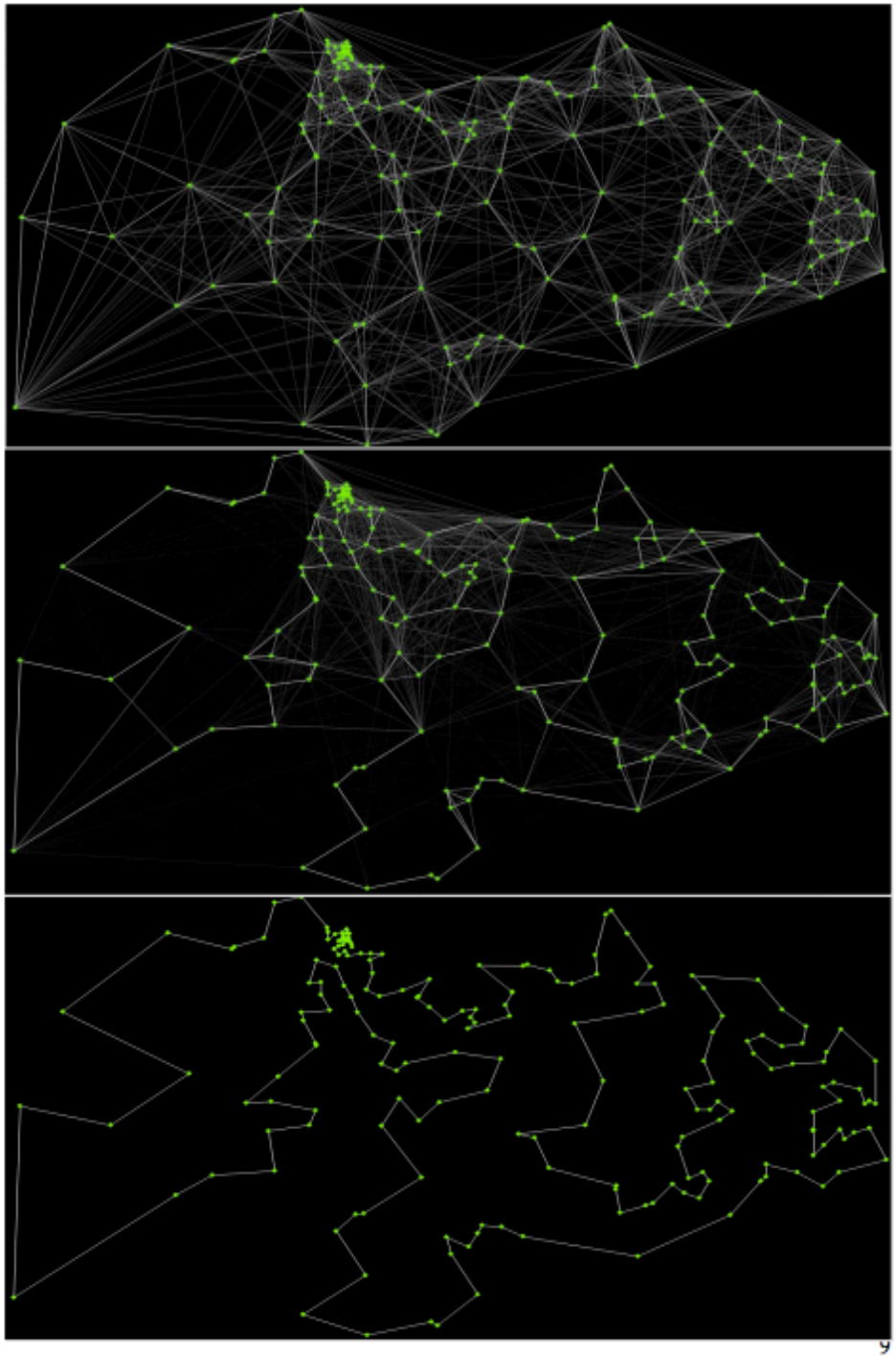
Ant Colony Optimization

- Can find good solutions to Travelling Salesman Problem
  - Find shortest path that visits every city exactly once



Ant Colony Optimization

- Ants lay down attractive pheromones
- Pheromones evaporate over time
- Shorter paths will have more pheromone
- Most travelled path likely the shortest one



Bees Algorithm

- Honey bees collect nectar from flower patches.
- Hive sends out scout to search for best patches
  - Communicates via ‘waggle dance’
    - Direction
    - Distance
    - Quality

Bees Algorithm

- Exploring a problem search space
- Send out bee scouts to randomly explore sites
- Scouts tell bees where the best sites are
- Bees continuously go to the best sites
- Scouts still randomly explore sites, just in case

Questions?