Evolutionary Computing

- Traditional Genetic Algorithm
- Interactive Selection
- Ecosystem Simulation

Brute Force Search

“to be or not to be that is the question”

```
likelihood of typing a “t” randomly:    1/27
likelihood of typing “to” randomly:     1/27 * 1/27

likelihood of typing entire phrase:     (1/27) ^ 39 or

1 in
66,555,937,033,867,822,607,895,549,241,096,482,953,017,615,834,735,226,163

A computer simulation with 1 million phrases per second would take:

~ 9,719,096,182,010,563,073,125,591,133,903,305,625,605,017 years.

Age of the universe: 13,750,000,000 years (estimated).
```

Darwinian Natural Selection

- ***Heredity***. There must be a process in place by which children receive the properties of their parents.

- ***Variation***. There must be a variety of traits present in the population or a means with which to introduce variation.

- ***Selection***. There must be a mechanism by which some members of a population have the opportunity to be parents and pass down their genetic information and some do not. This is typically referred to as “survival of the fittest.”

Genetic Algorithm

SETUP

Step 1: ***Initialize:*** Create a population of N elements, each with randomly generated DNA.

DRAW

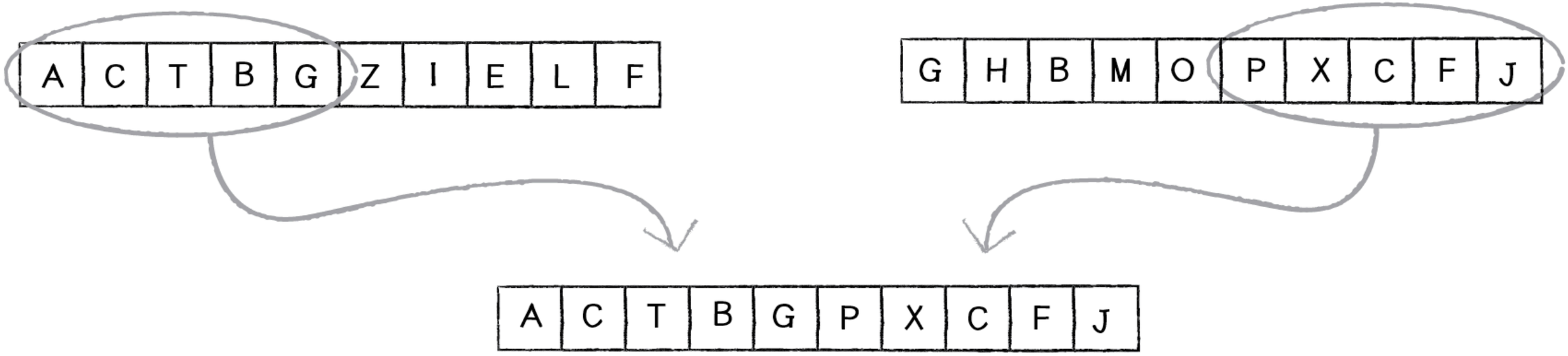
Step 2: ***Selection:*** Evaluate the fitness of each element of the population and build a mating pool.

Step 3: ***Reproduction:*** Repeat N times:

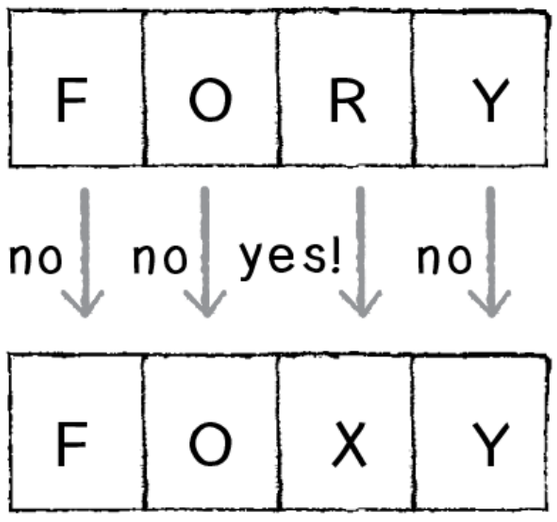
a. Pick two parents with probability according to relative fitness.
b. Crossover — create a “child” by combining the DNA of these two parents.
c. Mutation — mutate the child’s DNA based on a given probability.
d. Add the new child to a new population.

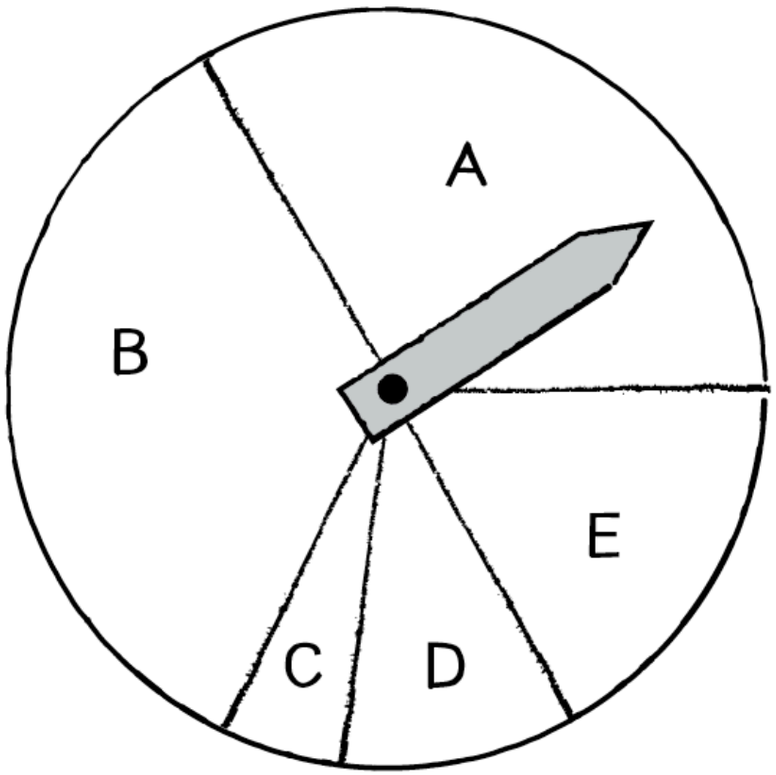
Step 4. Replace the old population with the new population and return to Step 2.

Crossover



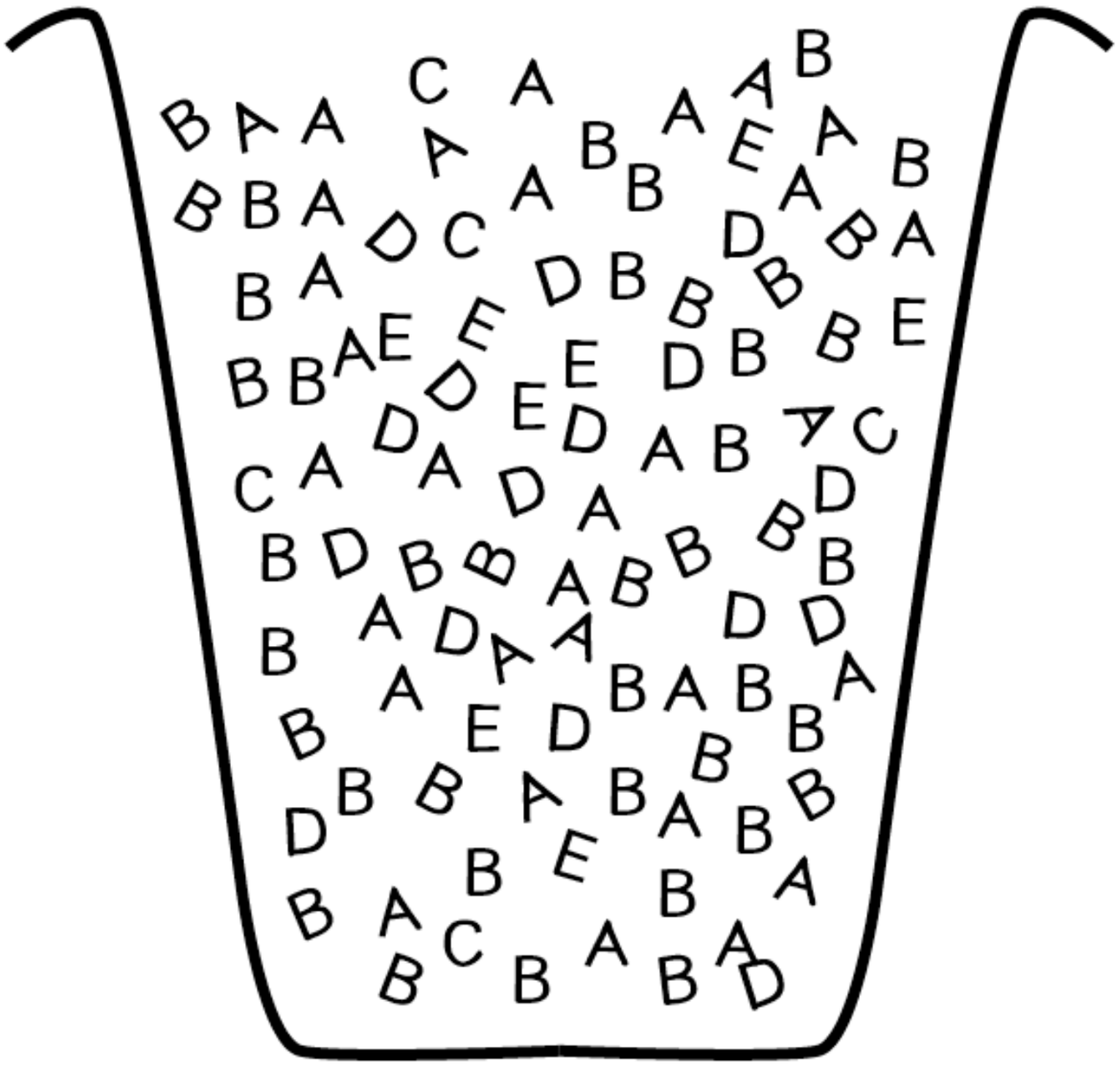
Mutation





Spin the wheel!

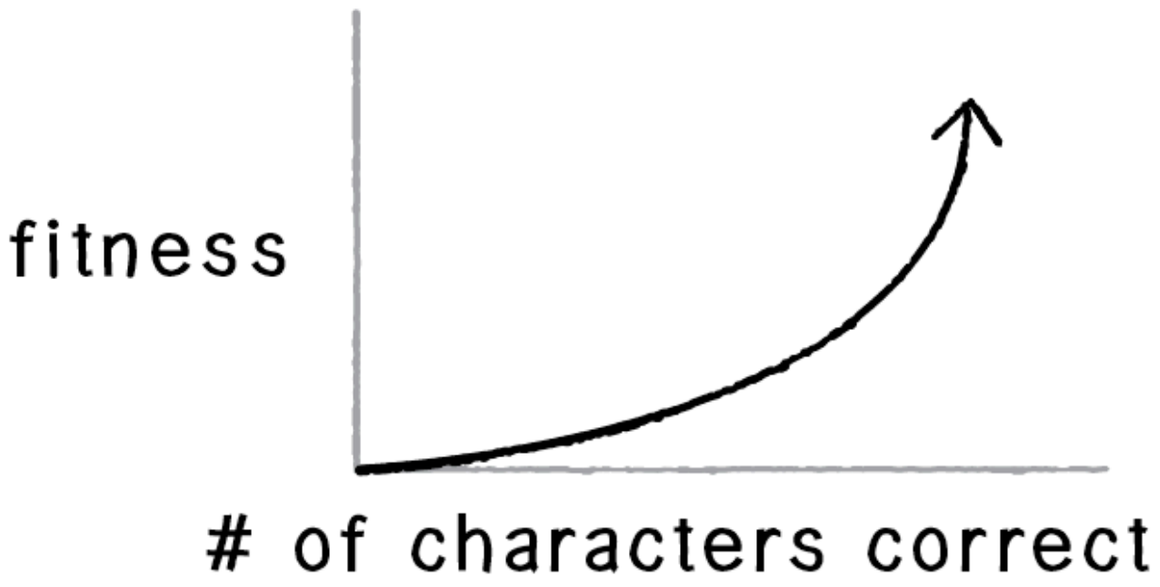
Parent	Probability
A	30%
B	40%
C	5%
D	10%
E	15%

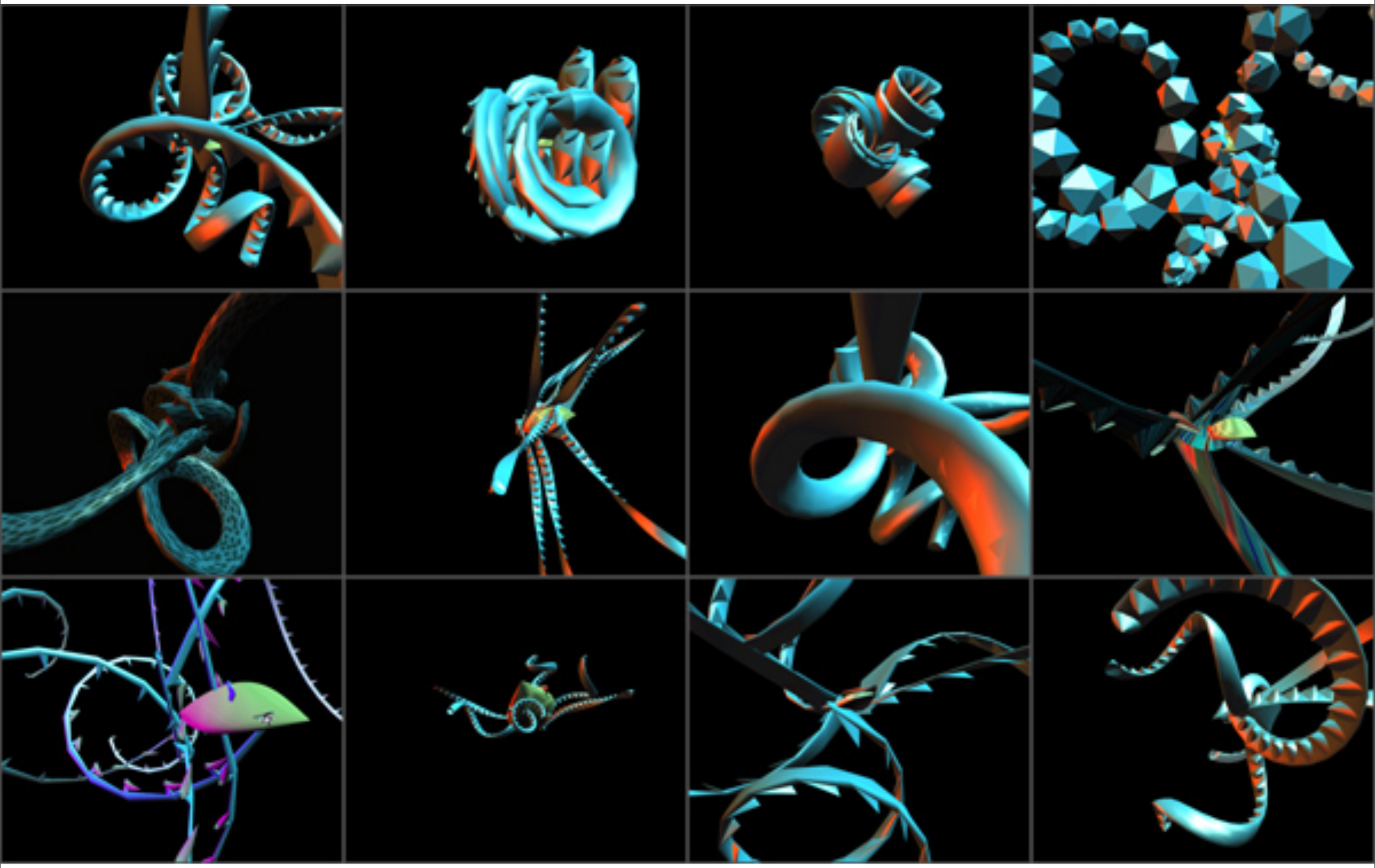


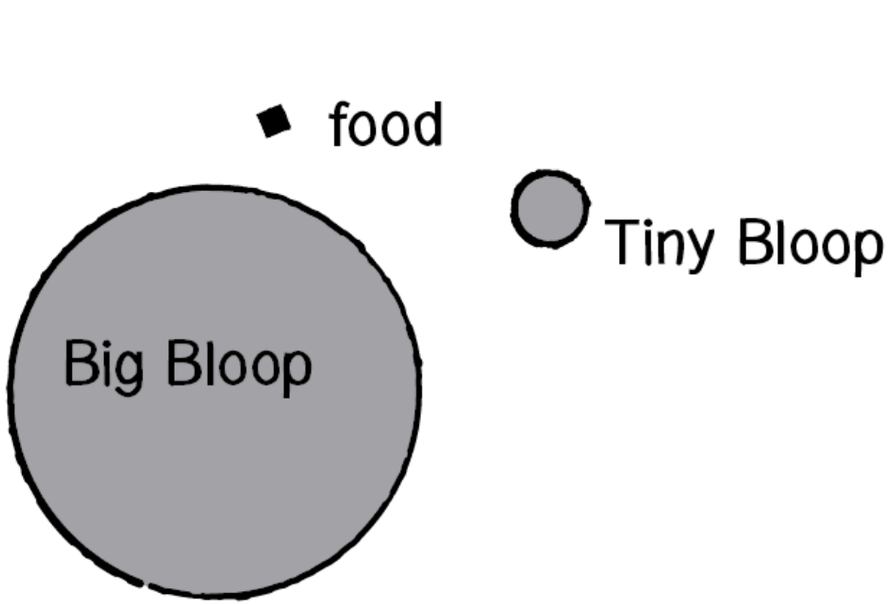
Customizing the GA

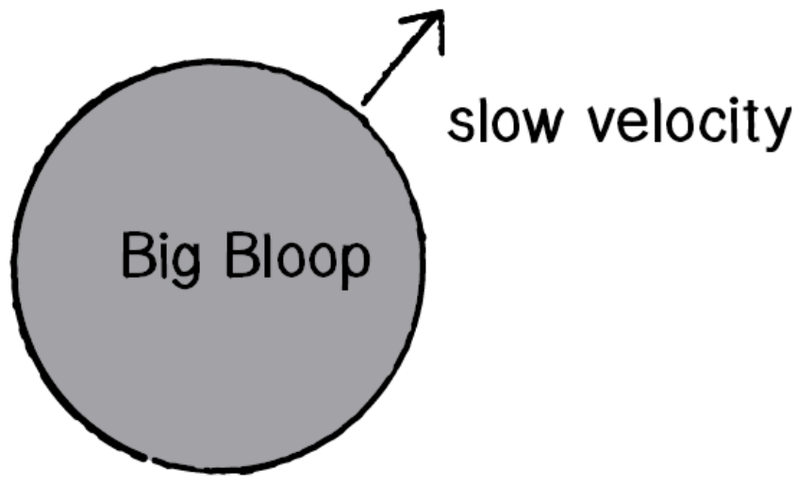
1) Parameters
    a) Population Size
    b) Mutation Rate
2) Genotype and Phenotype
3) Fitness Function

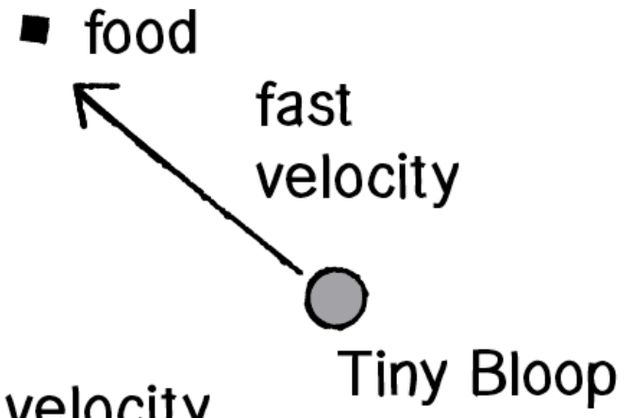

fitness
# of characters correct


fitness
# of characters correct




food
Tiny Bloop
Big Bloop


slow velocity
Big Bloop


food
fast
velocity
Tiny Bloop