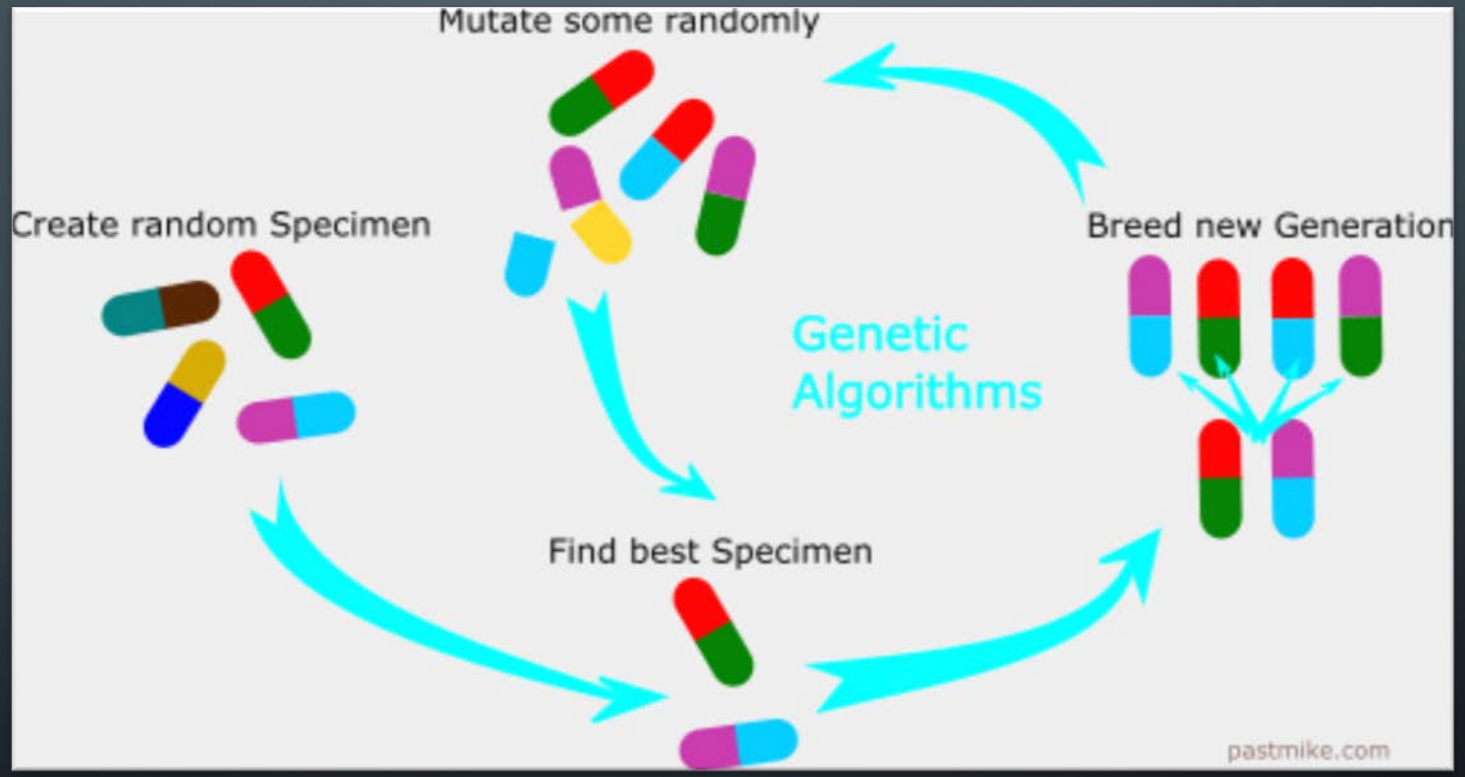
GENETIC ALGORITHM

MOHAMMAD GH

WHAT IS GENETIC ALGORITHM



MAIN IDEA

- Selection force
  - Resource
  - Keep population small
- Reproduction force
  - Makes new individuals

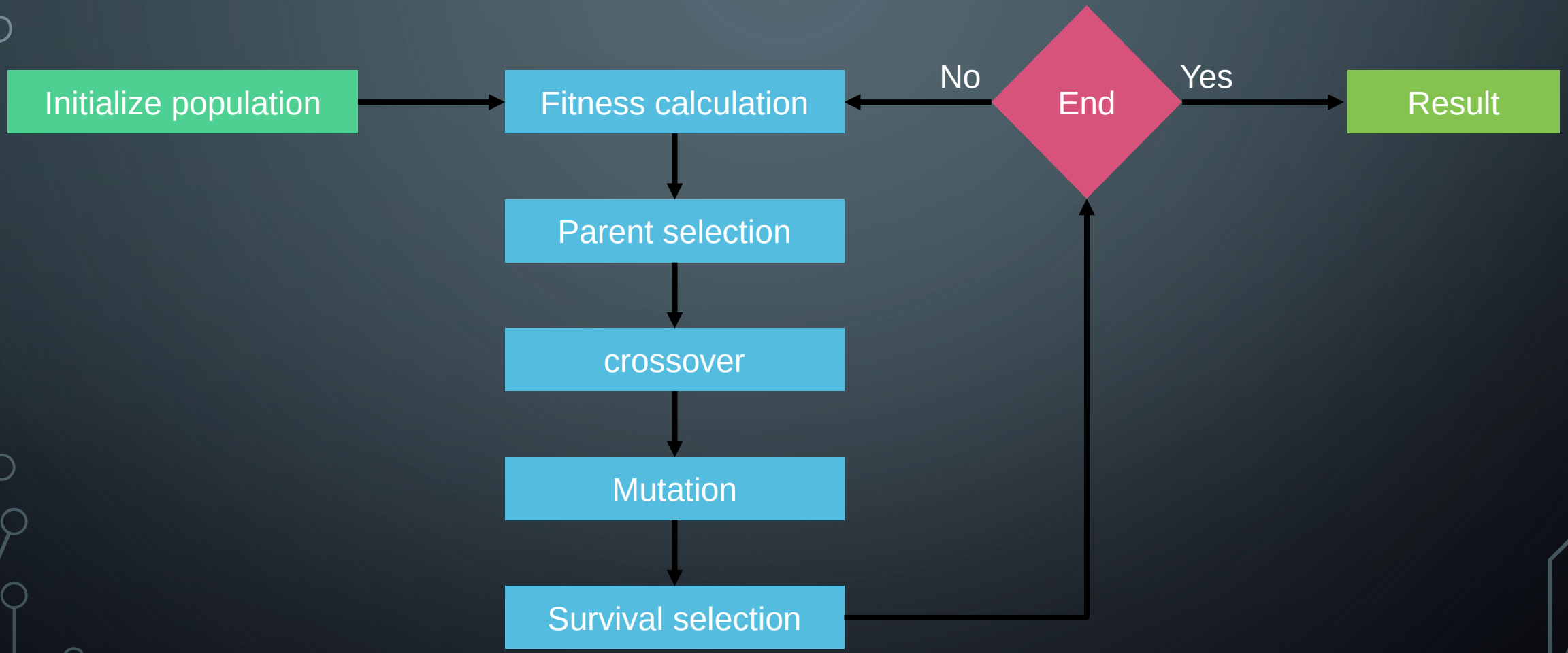
GENETIC ALGORITHM IN NATURE

- DNA
- Chromosome
- Natural selection
- Reproduction
- Evolution

GENETIC ALGORITHM IN MACHINE LEARNING

- We have a set of weights
  - Like DNA and chromosomes
- We want to minimize cost function
  - Fittest individual is the one with lowest cost

GENETIC ALGORITHM



EXAMPLE

- We want to find best weights for a neural network:
  - 10 input neurons – 20 hidden neurons – 3 output neurons
  - (10 + 1) * 20 + (20 + 1) * 3 weights = 283 weights
  - We have a chromosome with 283 real numbers
- Make 100 random NNs, each with 283 random weights
- Compute Cost
- Select parents
- …

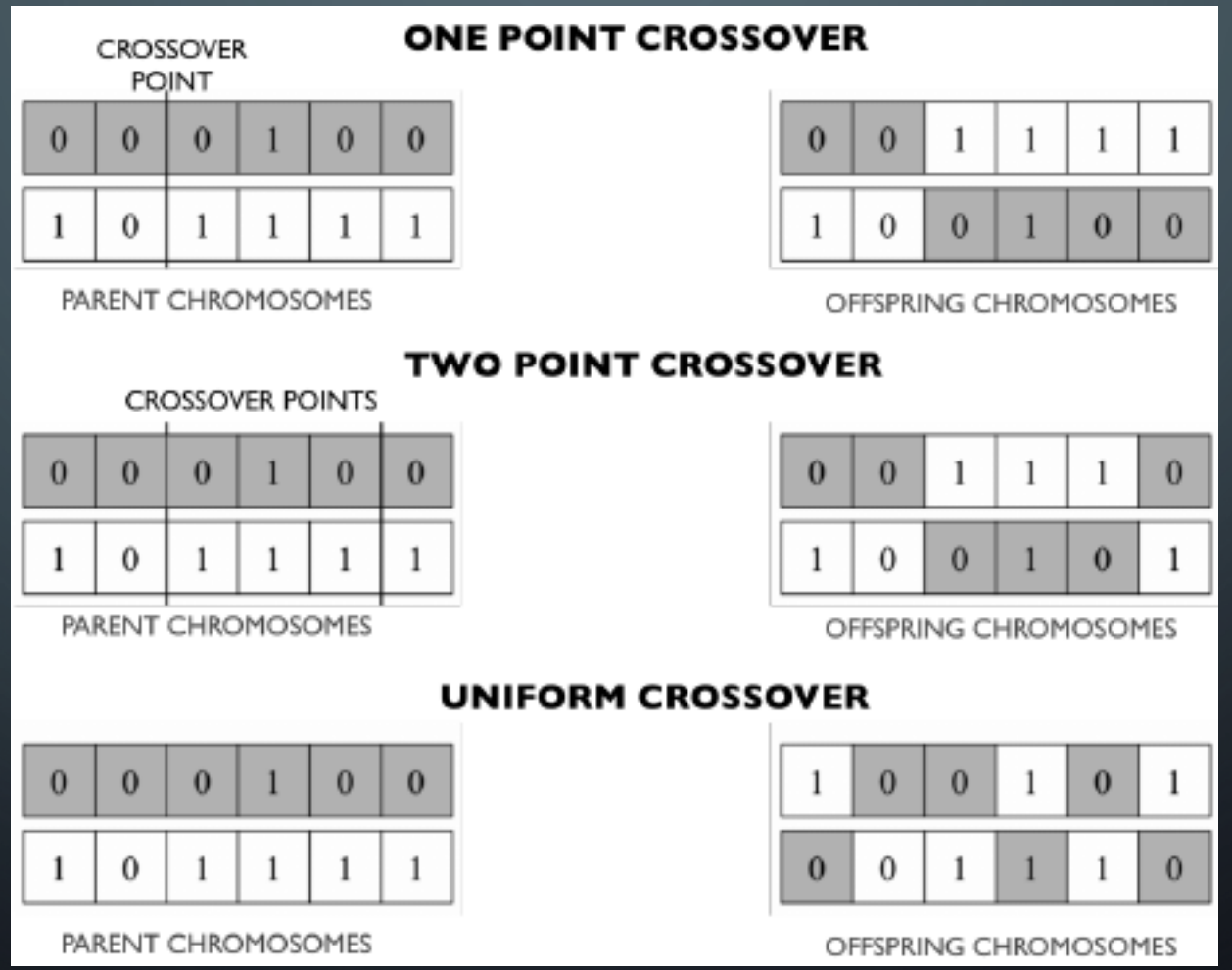
FITNESS

- Fitness is equal to cost function
- MSE
- Cross Entropy
- regularization
- ...

PARENT SELECTIN

- Uniform random
- Fitness proportional
  - $P(individual\ t\ be\ parent) = \frac{fitness_t}{\sum fitness_i}$

CROSSOVER


ONE POINT CROSSOVER
CROSSOVER POINT
0 0 0 1 0 0
1 0 1 1 1 1
PARENT CHROMOSOMES
0 0 1 1 1 1
1 0 0 1 0 0
OFFSPRING CHROMOSOMES
TWO POINT CROSSOVER
CROSSOVER POINTS
0 0 0 1 0 0
1 0 1 1 1 1
PARENT CHROMOSOMES
0 0 1 1 1 0
1 0 0 1 0 1
OFFSPRING CHROMOSOMES
UNIFORM CROSSOVER
0 0 0 1 0 0
1 0 1 1 1 1
PARENT CHROMOSOMES
1 0 0 1 0 1
0 0 1 1 1 0
OFFSPRING CHROMOSOMES

MUTATION

- We have a small mutation chance
- Just reset the weight to a new random number
- Or add a small random number to weight
- Guarantees finding the best solution

SURVIVAL SELECTION

- (μ + λ) Selection
  - Select from parents and offspring
- (μ, λ) Selection
  - Just select from offspring