# Biologically Inspired Artificial Intelligence Project

## Traveling Salesman with Genetic Algorithm

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# What is traveling salesman problem?

“Given a list of cities and the distances between each pair of cities, what is the shortest possible route that visits each city and returns to the origin city?“ ~ *wikipedia.org*

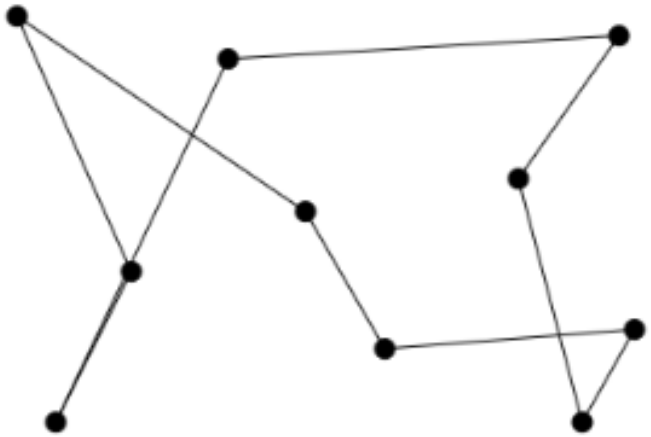
- Brute force solution is n! complex, which is not what we want.

- One of the fastest ways to get quite good solution is to use:

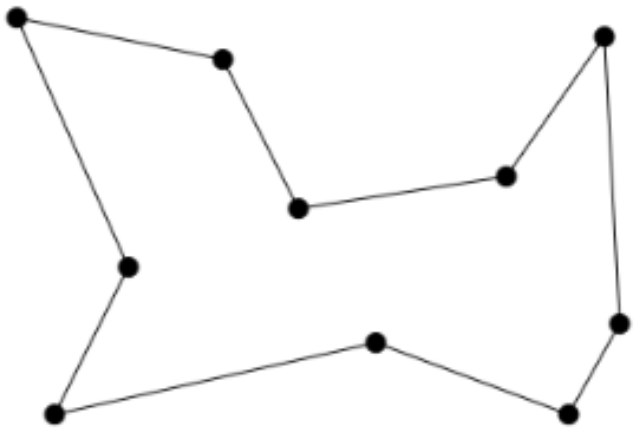
**Genetic Algorithm**

# Example

One of the possibilities:



Better solution:



# Darwinian Natural Selection

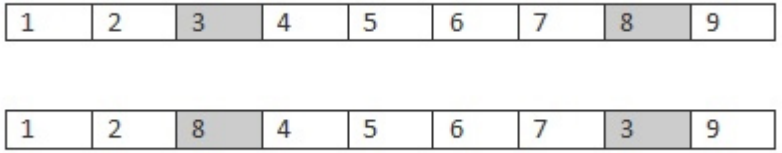
- **Heredity** – There must be a process in place by which children receive the properties of their parents.
- **Variation** – There must be a variety of traits present in the population or a means with which to introduce variation.
- **Selection** – there must be a mechanism by which some members of 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”.

# Heredity

- At first iteration algorithm is creating given amount of random children called population.
- Then in every following iteration the next population is created based on the previous one.
- Probability of inheriting parents' genes depends on "fitness" parameter which will be discussed later.

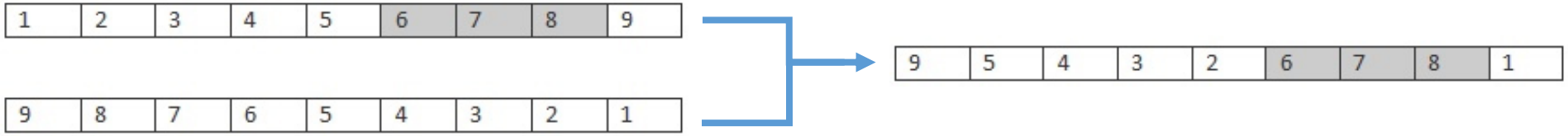
# Variation

- Algorithm implements two kinds of creating variation:
  - Mutation swaps two genes from a child with a given chance for example:




  - Ordered crossover algorithm uses two parents to create a child:

*(Slices part of one parent and fills with what's left from another one)*



# Selection

Algorithm is using fitness function that depends full distance between each points

$$fitness = \left(\frac{1}{distance}\right)^2$$

*Power of two is supposed to increase probability of picking children with better fitness exponentially*

At the end of calculating fitness of whole population, the values are normalized. The higher fitness, the higher chance of picking it for next population.

# Links

Github repository:

- https://github.com/paczulapiotr/BIAI_TravelingSalesman

Demo:

- https://salesman-biai.herokuapp.com