

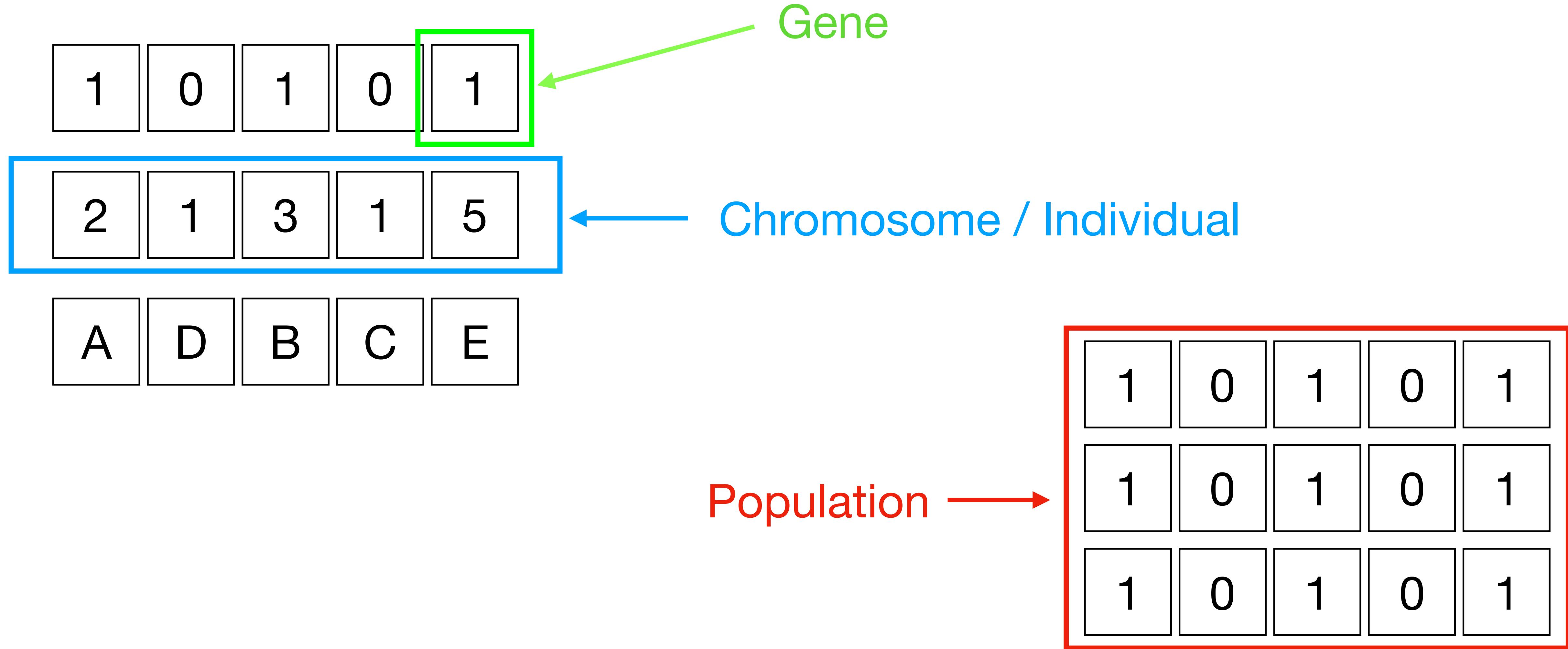
# Genetic Algorithm

From Zero to Hero  
(Tom Baranowicz)

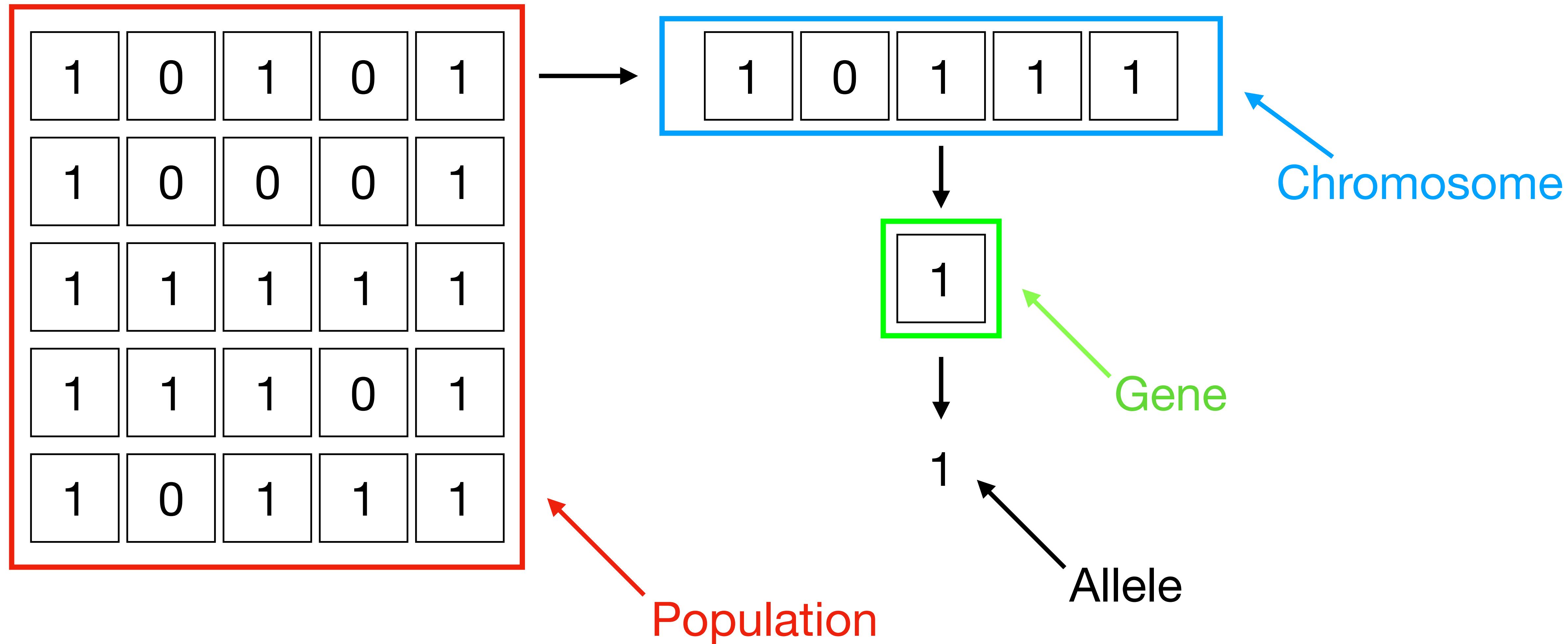
# What is Genetic Algorithm?

- search heuristic inspired by the process of natural selection
- solution for problem is described in a form of array of genes
- efficient tool to provide usable solution in a short time

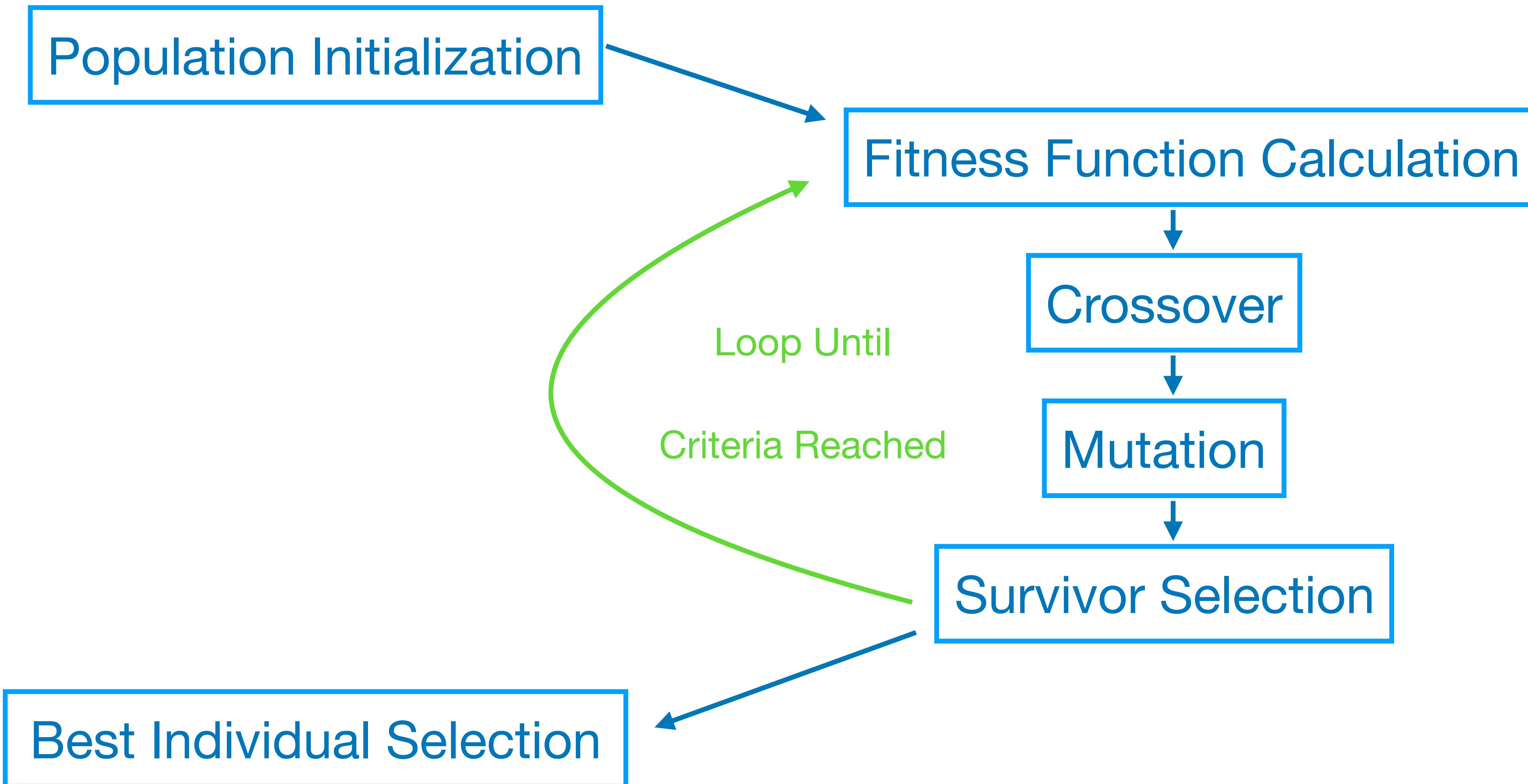
# Basic Terminology



# Basic Terminology



# Basic Algorithm



# Population

## Population Initialization:

- **Random Initialization** – Populate the initial population with completely random solutions.
- **Heuristic initialization** – Populate the initial population using a known heuristic for the problem.

# Fitness Function

- Enable to measure each individual and tells us how good the solution is for the problem we are solving

1	2	3	4	5
---	---	---	---	---

Item Index

1	1	1	1	0
---	---	---	---	---

Chromosome

1	2	4	1	12
---	---	---	---	----

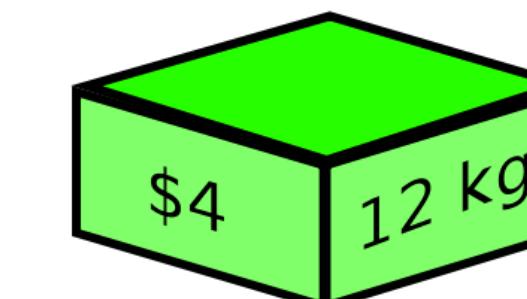
Item Weight

1	2	10	2	4
---	---	----	---	---

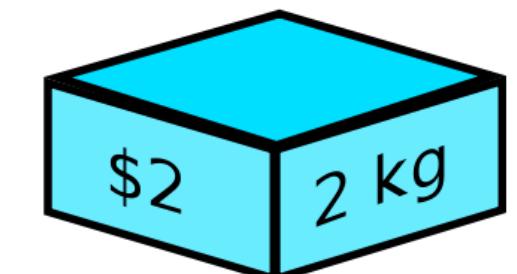
Item Value

Value = 15

Weight = 8

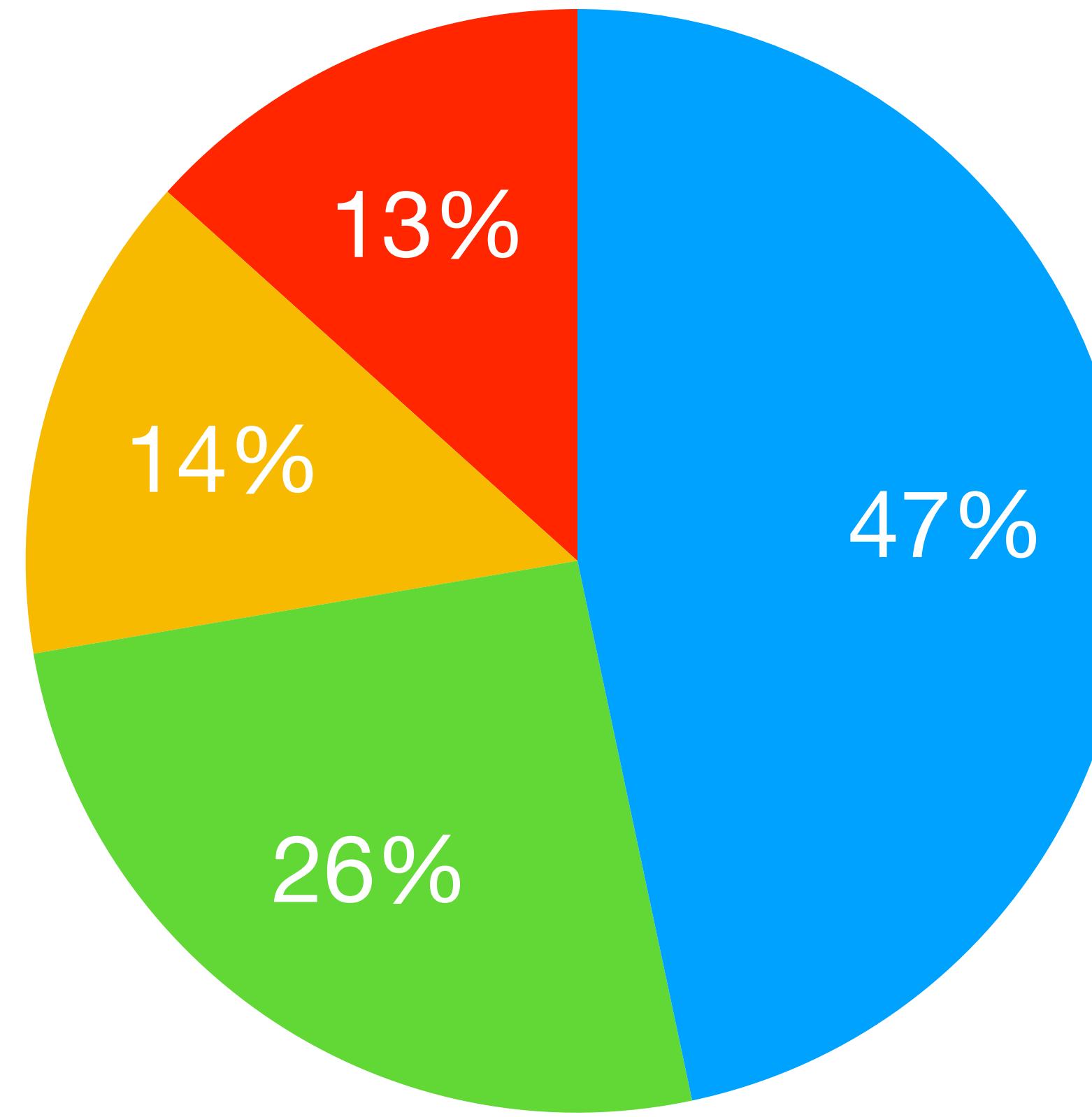


?

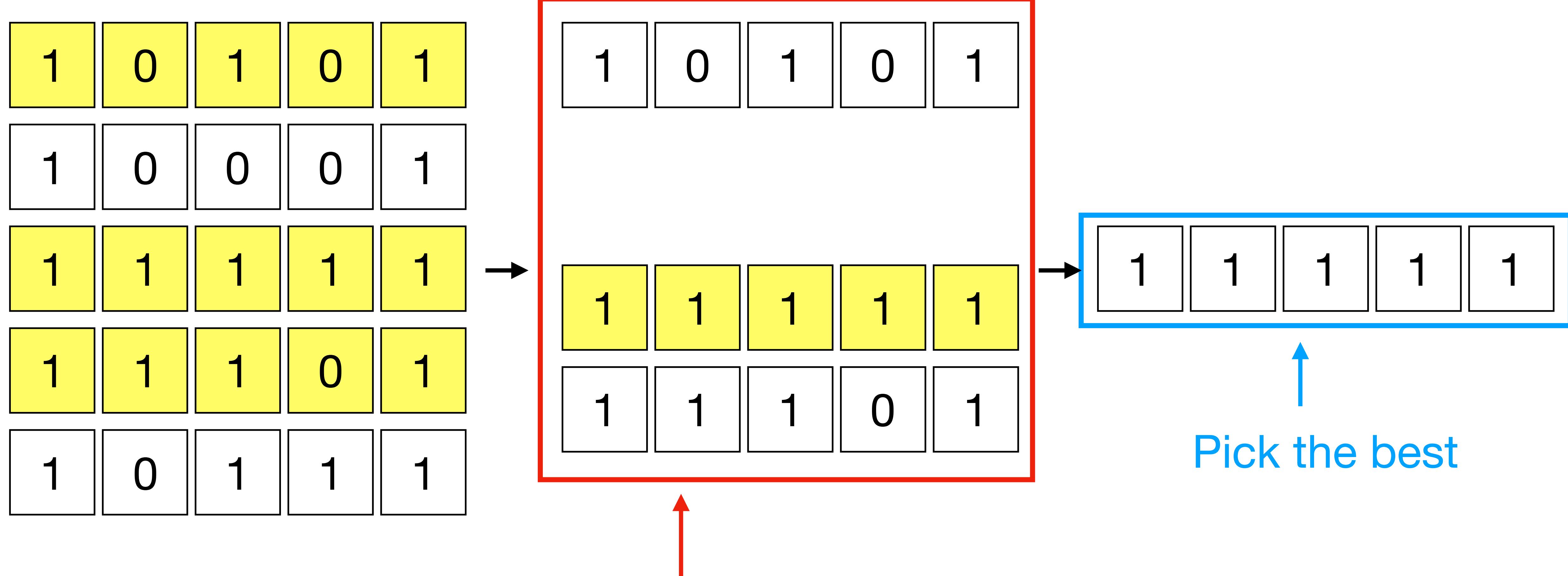


# Parent Selection - Roulette

- Chromosome 1 - 91
- Chromosome 2 - 50
- Chromosome 3 - 30
- Chromosome 4 - 26



# Parent Selection - Tournament

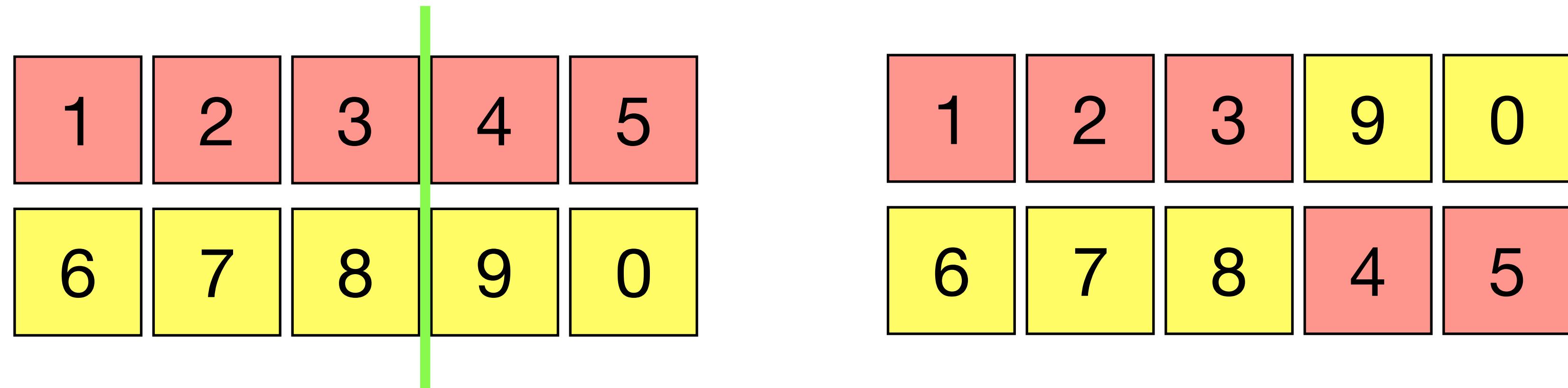


Select k random individuals

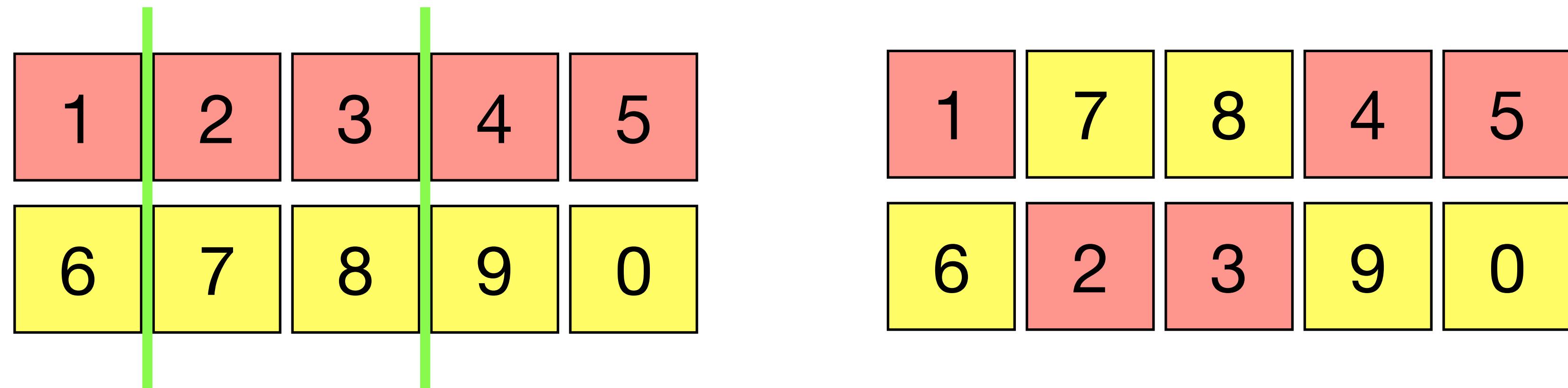
Pick the best

# Crossover

One Point  
Crossover

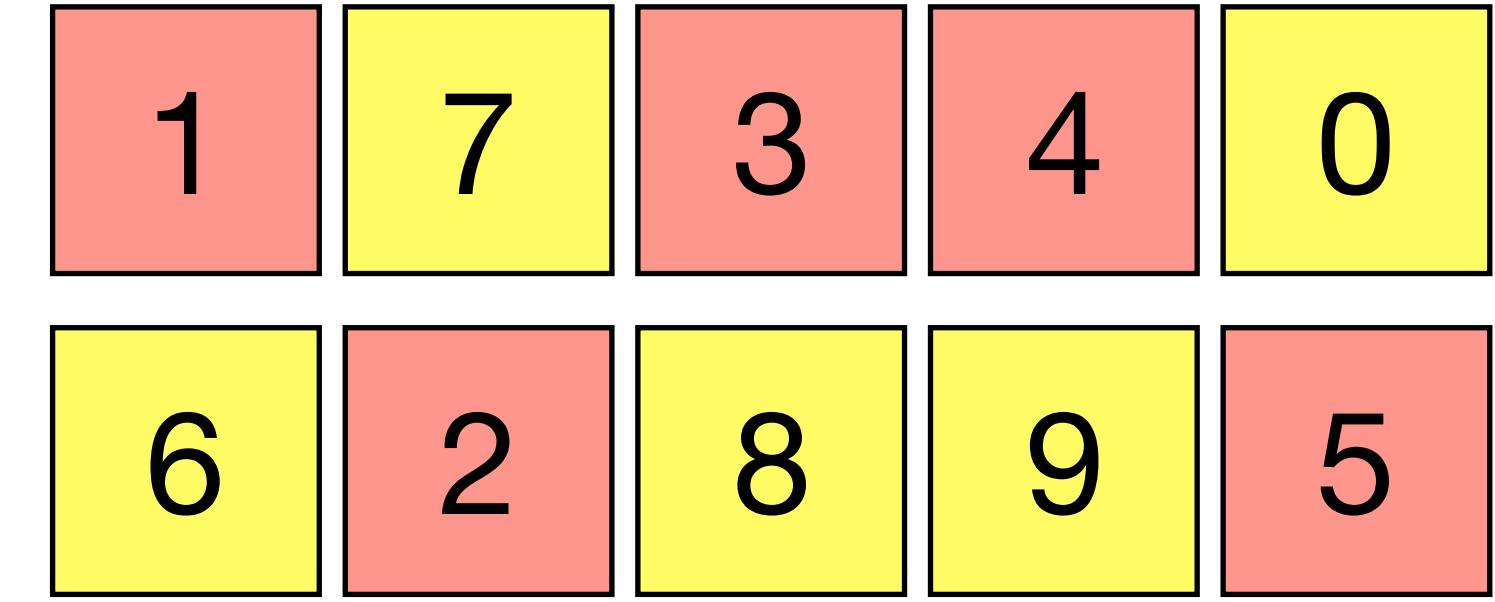
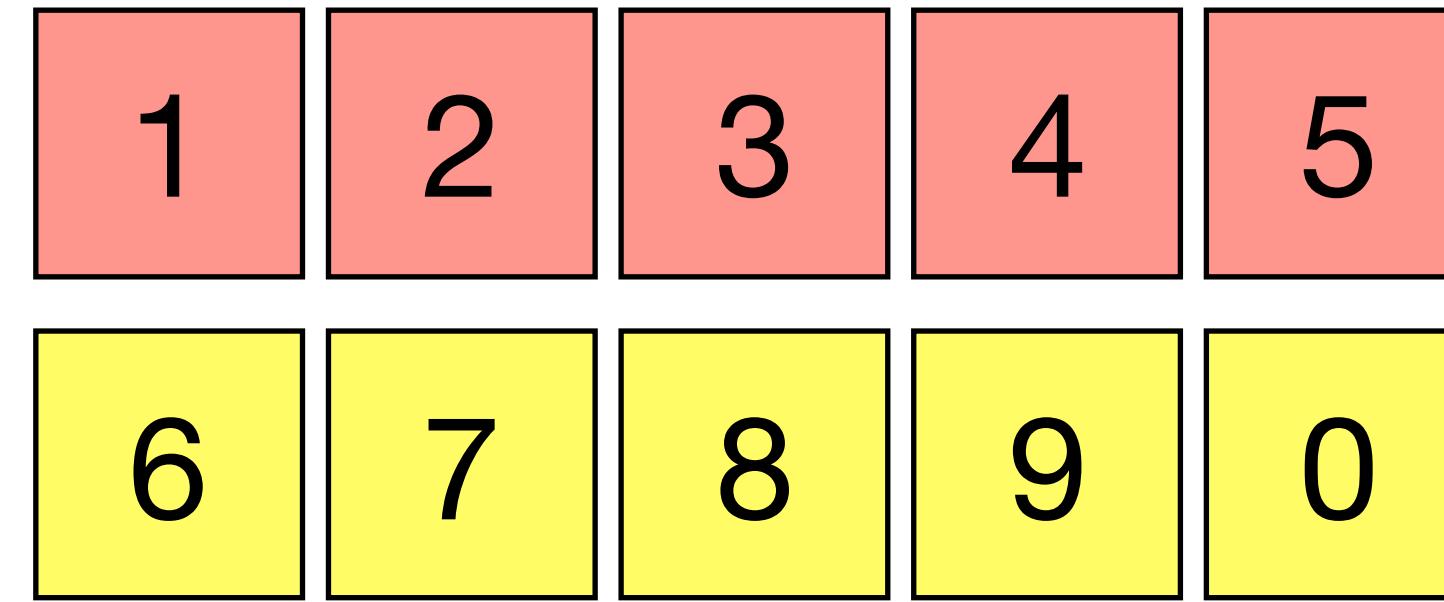


Multi Point  
Crossover



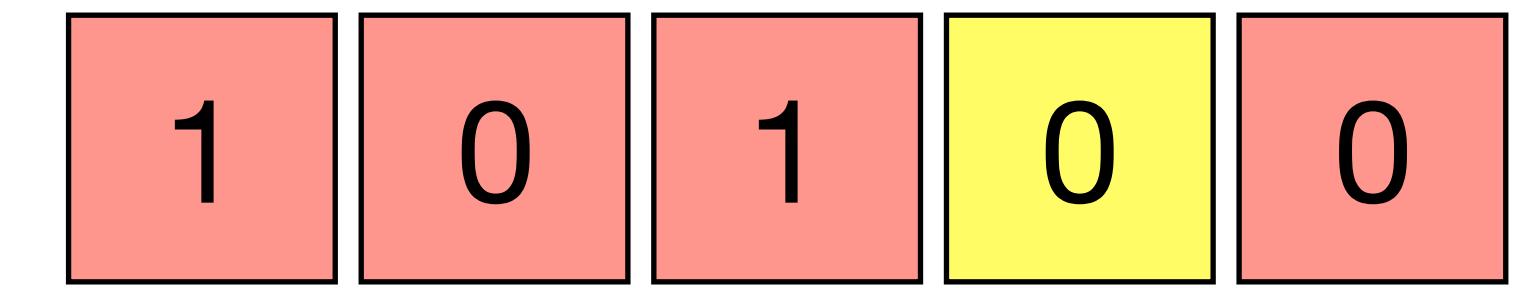
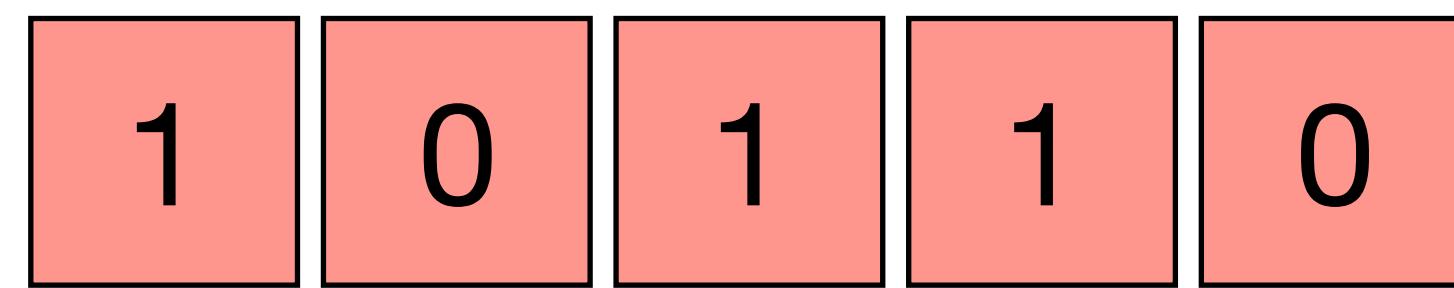
# Crossover

Uniform  
Crossover

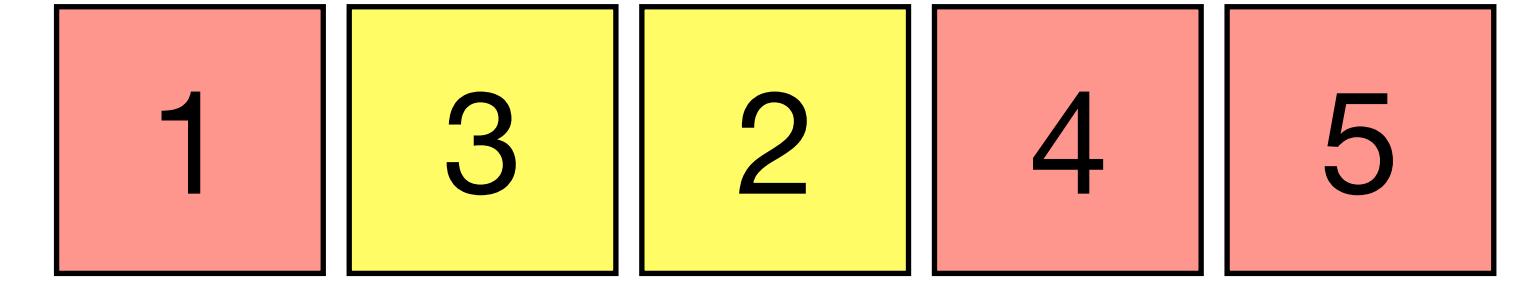
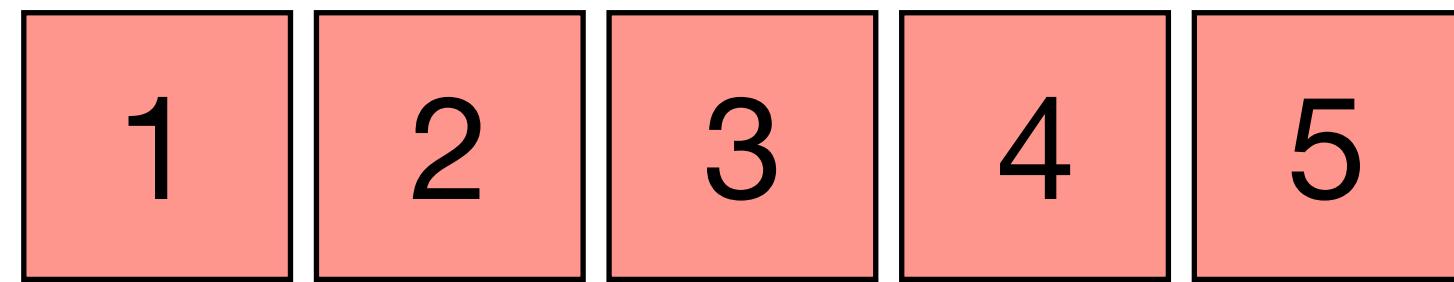


# Mutation

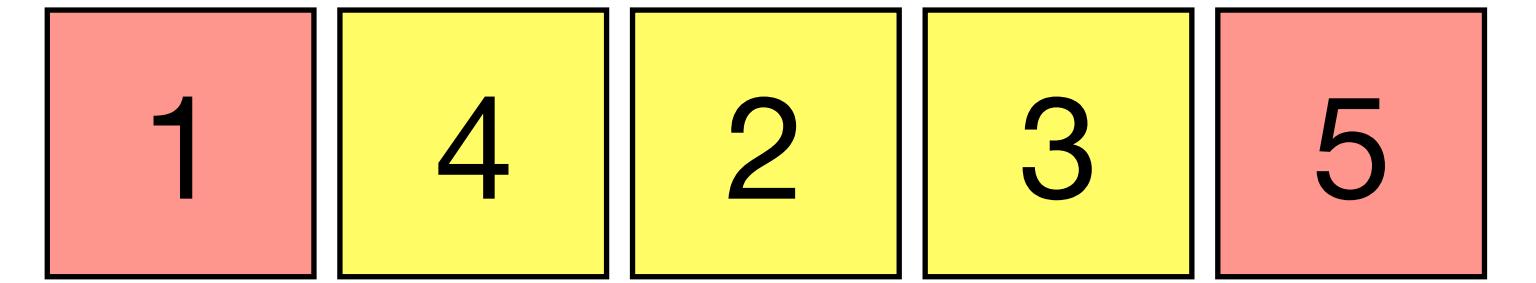
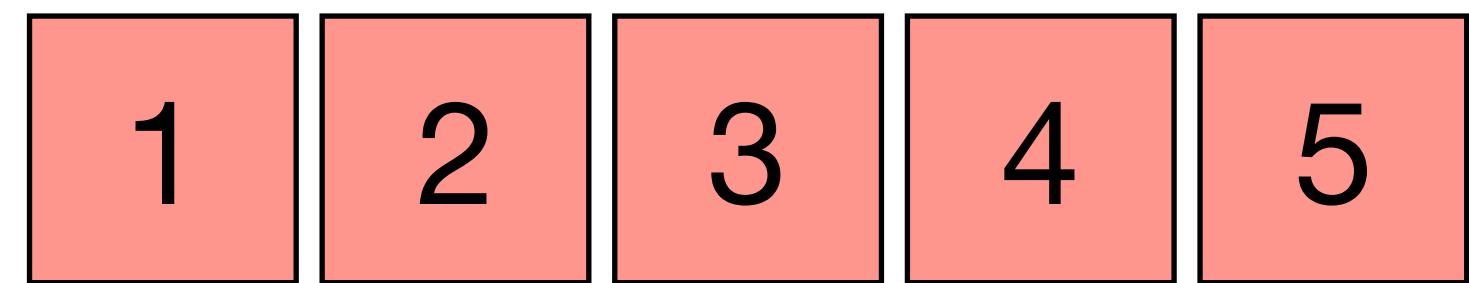
Random switch



Swap Mutation



Scramble Mutation



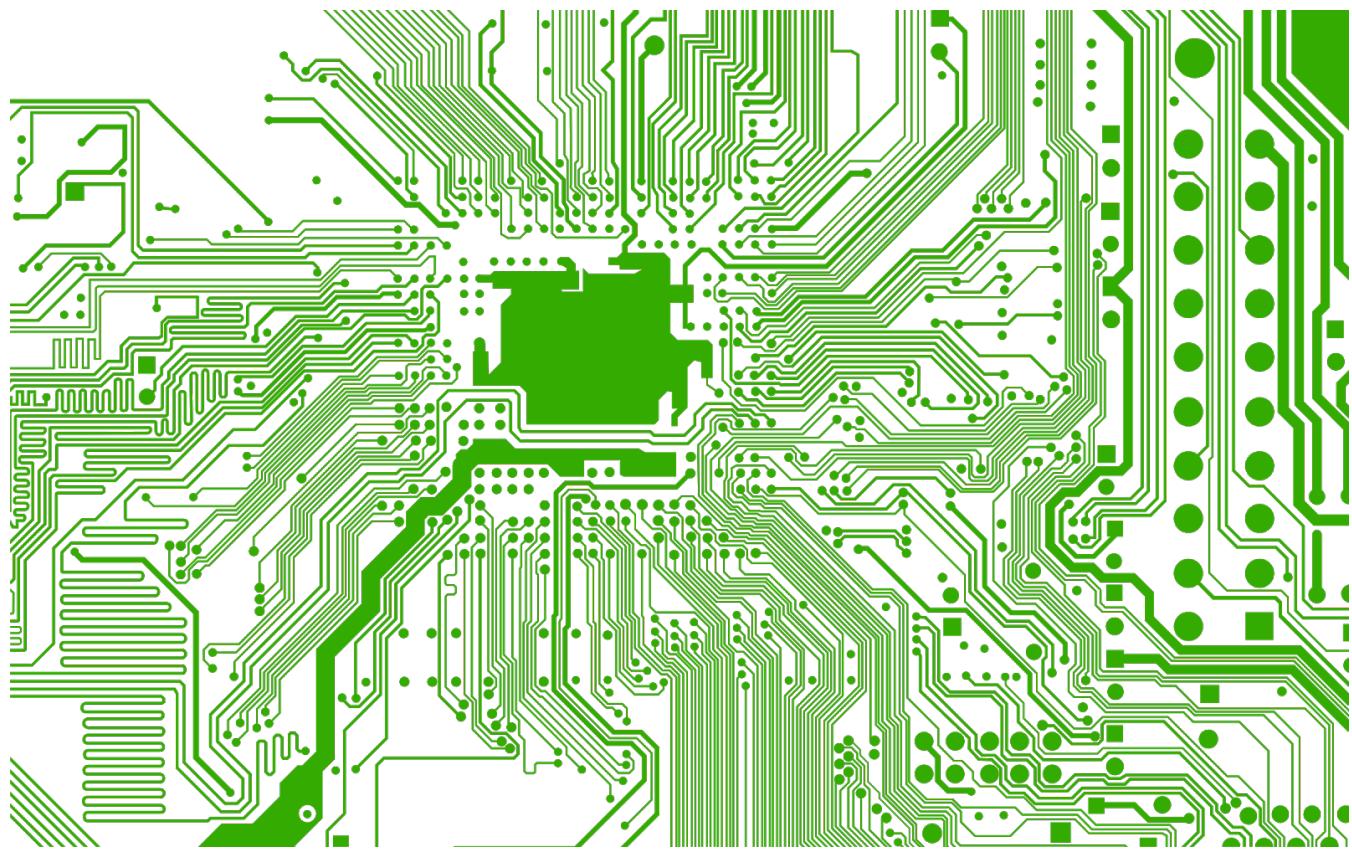
# Survivor Selection

- All chromosomes are replaced
- Age Based Selection
- Fitness Based Selection

# Termination Condition

- When there has been no improvement in the population for X iterations
- When we reach an absolute number of generations
- When fittest chromosome/individual is ‘good enough’

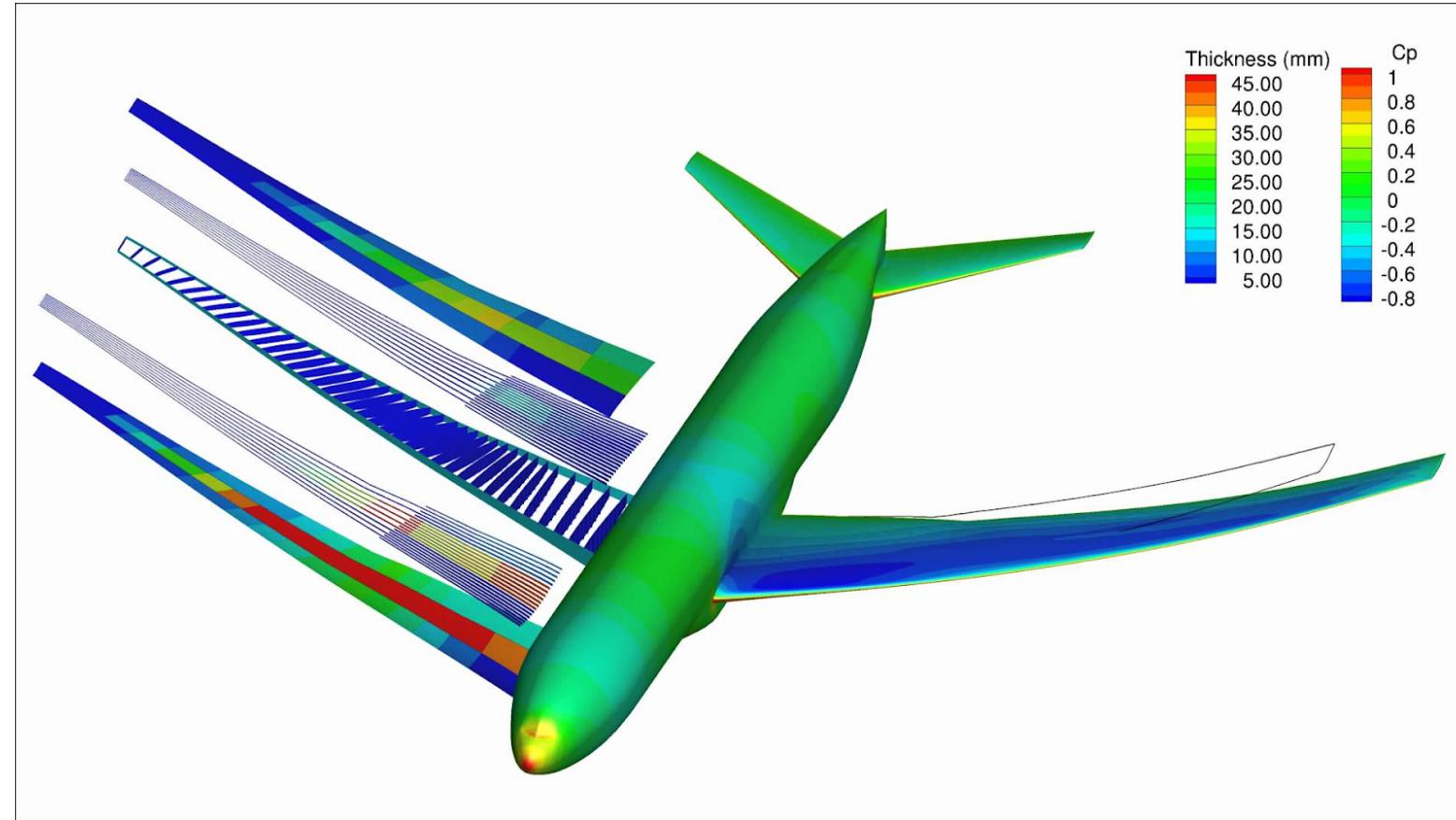
# Popular Applications



**Electronic circuit design**



**Container loading**



**Engineering design**

**Production Planning**

