TOPIC: Genetic Algorithm

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TECHNO MAIN SALTLAKE

CONTENT

INTRODUCTION

➜ Genetic Algorithms are a subset of artificial intelligence techniques.

➜ They draw inspiration from the process of natural selection to optimize and search for solutions.

➜ GAs are part of the broader evolutionary computation paradigm in AI.

➜ This paradigm simulates the process of evolution to solve complex problems.

WHAT IS OPTIMIZATION ?

➔ Optimization refers to the process of finding the best possible solution among a set of alternative.
➔ It involves either maximizing a desired outcome or minimizing an undesired outcomes.
➔ Optimization problems are defined by an objective function that quantifies the quality of a solution.

SET OF INPUTS

SET OF OUTPUTS

PROCESS

WHAT ARE GENETIC ALGORITHMS ?

➔ Genetic Algorithms are computational problem-solving techniques inspired by natural selection.

➔ GAs are a part of a much larger branch of computation known as Evolutionary Computation.
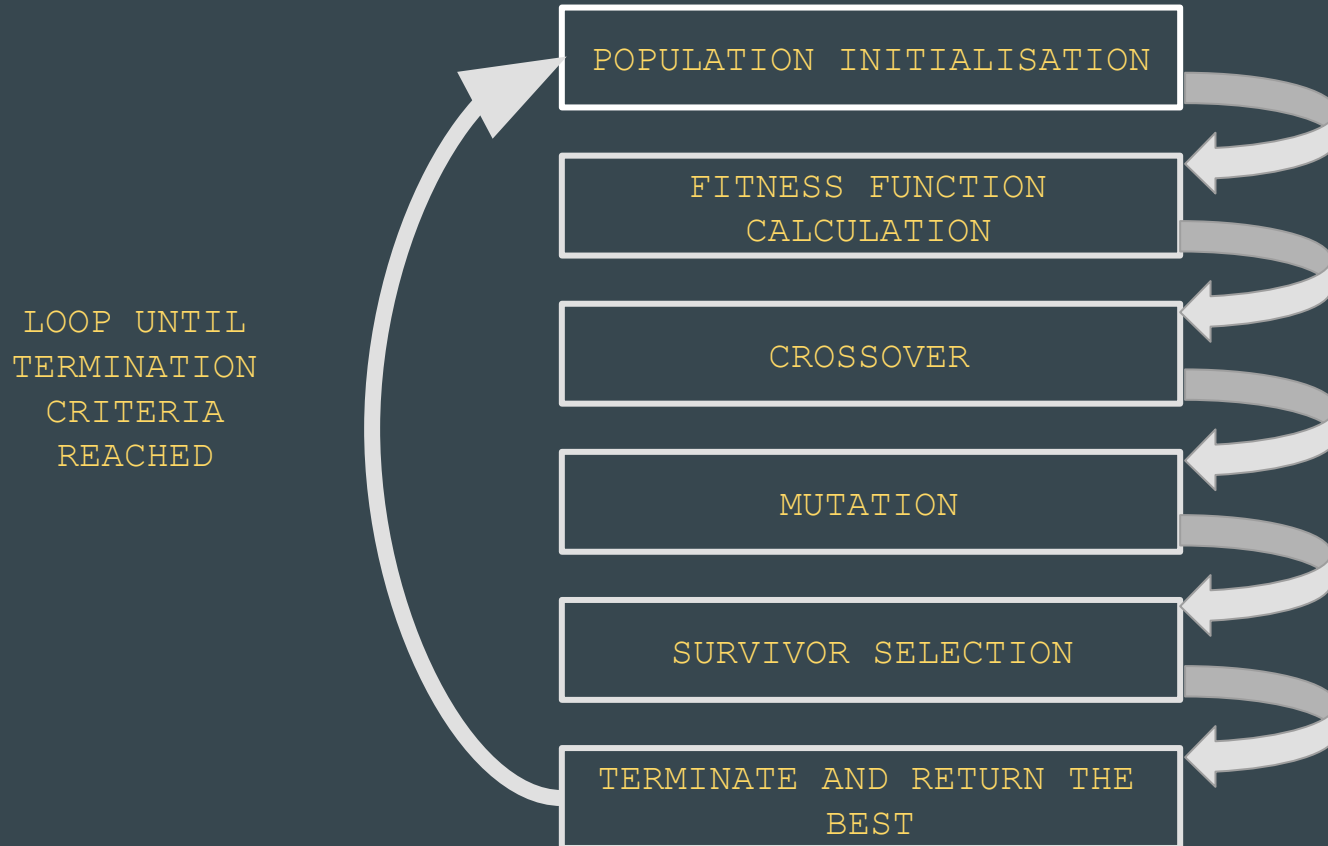
BASIC TERMINOLOGY

- ❏ *Population* : It is a subset of all the possible solutions to the given problem.
- ❏ *Chromosome* : It is a solution to one such problem.
- ❏ *Gene* : It is one element position of chromosome.
- ❏ *Allele* : It is the value that gene takes for one particular chromosome.
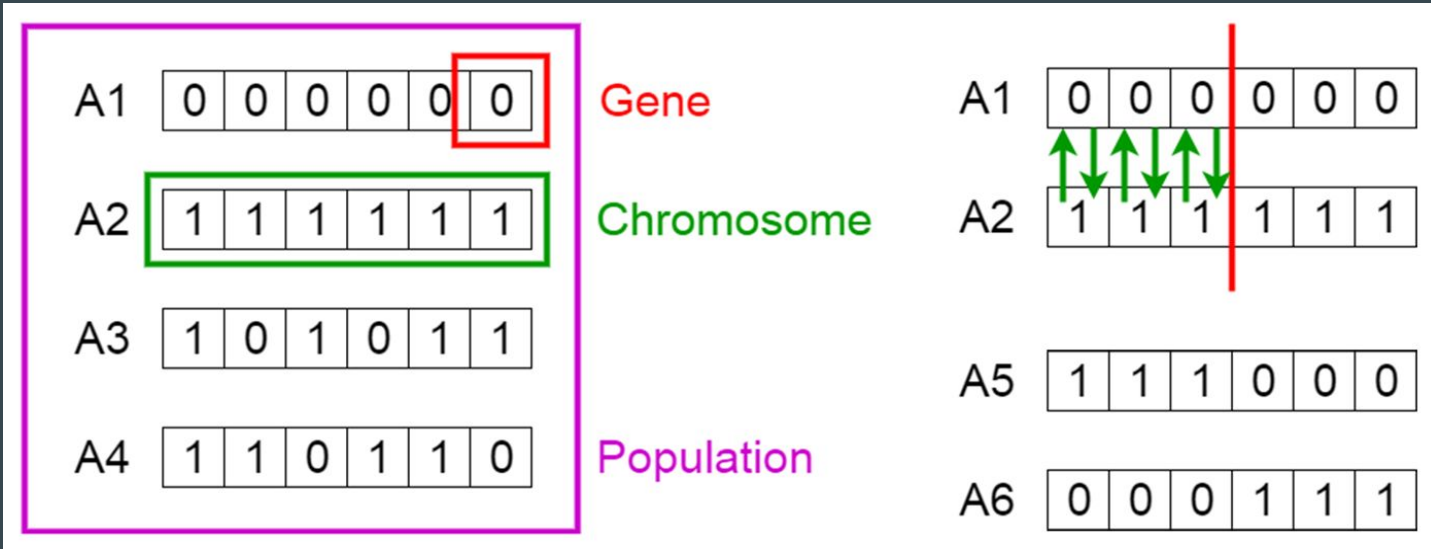
BASIC TERMINOLOGY (continued)

❏ *Genotype* : refers to the genetic representation of an individual's characteristics or traits in a genetic algorithm.
❏ *Phenotype* : observable or expressed traits of an individual, resulting from the interaction between its genotype and the environment, in a genetic algorithm.
❏ *Decoding and Encoding* : Decoding is the process of transforming solution from genotype to phenotype space and encoding is the process of transforming solution from phenotype to genotype space.
❏ *Fitness function* : Function which takes input and gives a suitable output.
❏ *Genetic operator* : These alter the genetic composition of the offspring. These include crossover, mutation, selection etc.

BASIC STRUCTURE OF GA

POPULATION INITIALISATION

FITNESS FUNCTION CALCULATION

CROSSOVER

MUTATION

SURVIVOR SELECTION

TERMINATE AND RETURN THE BEST

LOOP UNTIL TERMINATION CRITERIA REACHED

GENOTYPE REPRESENTATION

BINARY REPRESENTATION

0	0	1	0	1	1	1	0	0	1

REAL VALUED REPRESENTATION

0.5	0.2	0.6	0.8	0.7	0.4	0.3	0.2	0.1	0.9

INTEGER REPRESENTATION

1	2	3	4	3	2	4	1	2	1

PERMUTATION REPRESENTATION

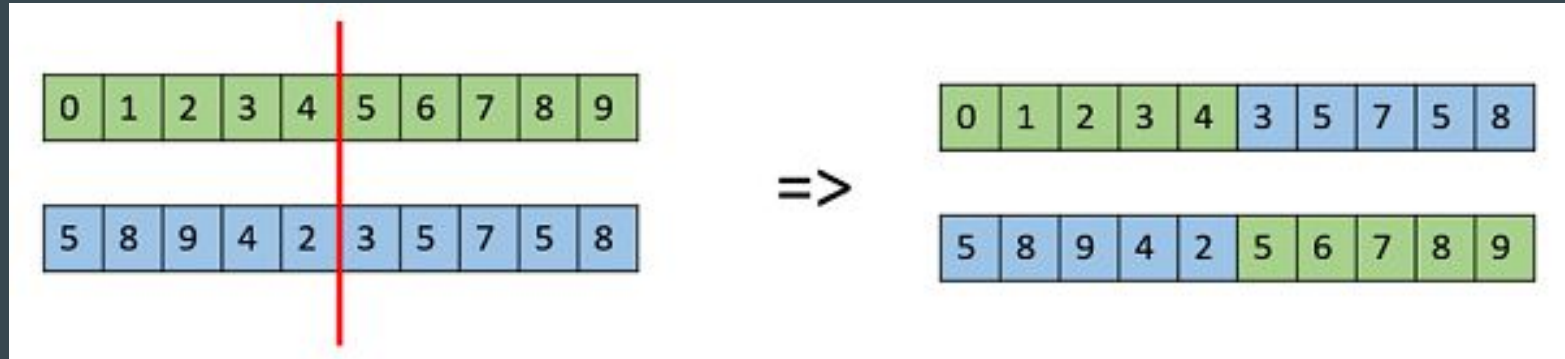| 1	5	9	8	7	4	2	3	6	0

GA-POPULATION

➔ Population is a subset of solutions in the current generation.
➔ Population Initialisation
  ◆ Random Initialisation
  ◆ Heuristic Initialisation
➔ Population Model
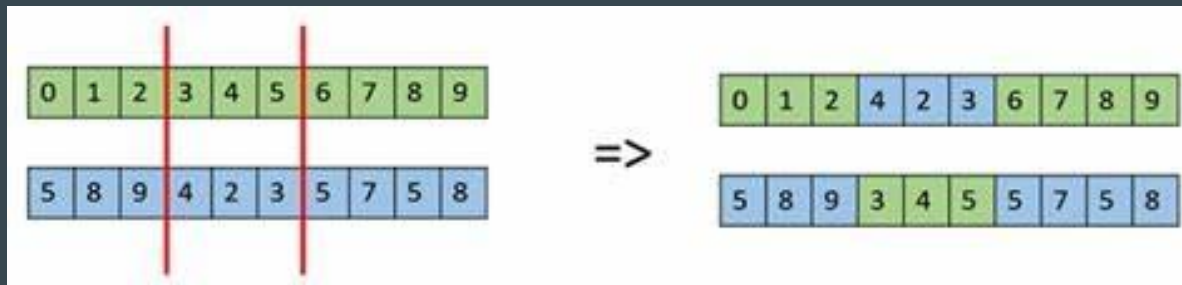 ◆ Steady State
  ◆ Generational

GA-CROSSOVER

One parent is selected and one or more offsprings are created using the genetic material of the parents
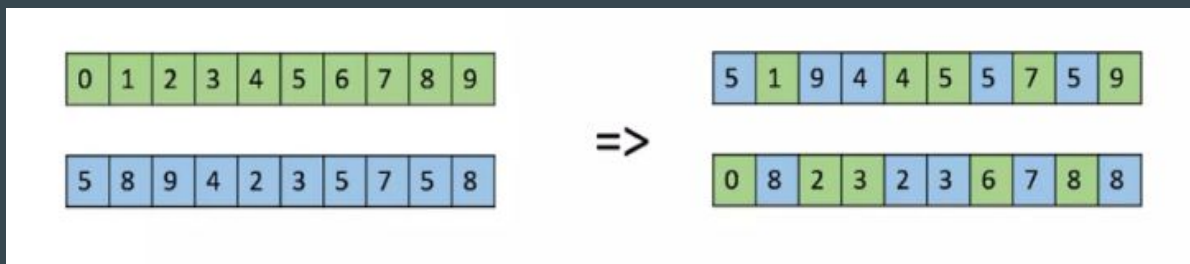
One Point Crossover

GA-CROSSOVER (continued)

Multipoint Crossing

Uniform Crossover

GA-MUTATION

Used to maintain and introduce diversity in the genetic population.

-Bit Flip Mutation

| 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 |

=>

| 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 |

-Random Resetting
-Swap Mutation

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 |

=>

| 1 | 6 | 3 | 4 | 5 | 2 | 7 | 8 | 9 | 0 |

GA-MUTATION (continued)

- Scramble Mutation

- Inversion Mutation

REFERENCES

- **Introduction to Genetic Algorithm (iitkgp.ac.in)**
- **cs.cmu.edu/~02317/slides/lec_8.pdf**
- **Genetic Algorithms-1.ppt (live.com)**

THANK YOU