

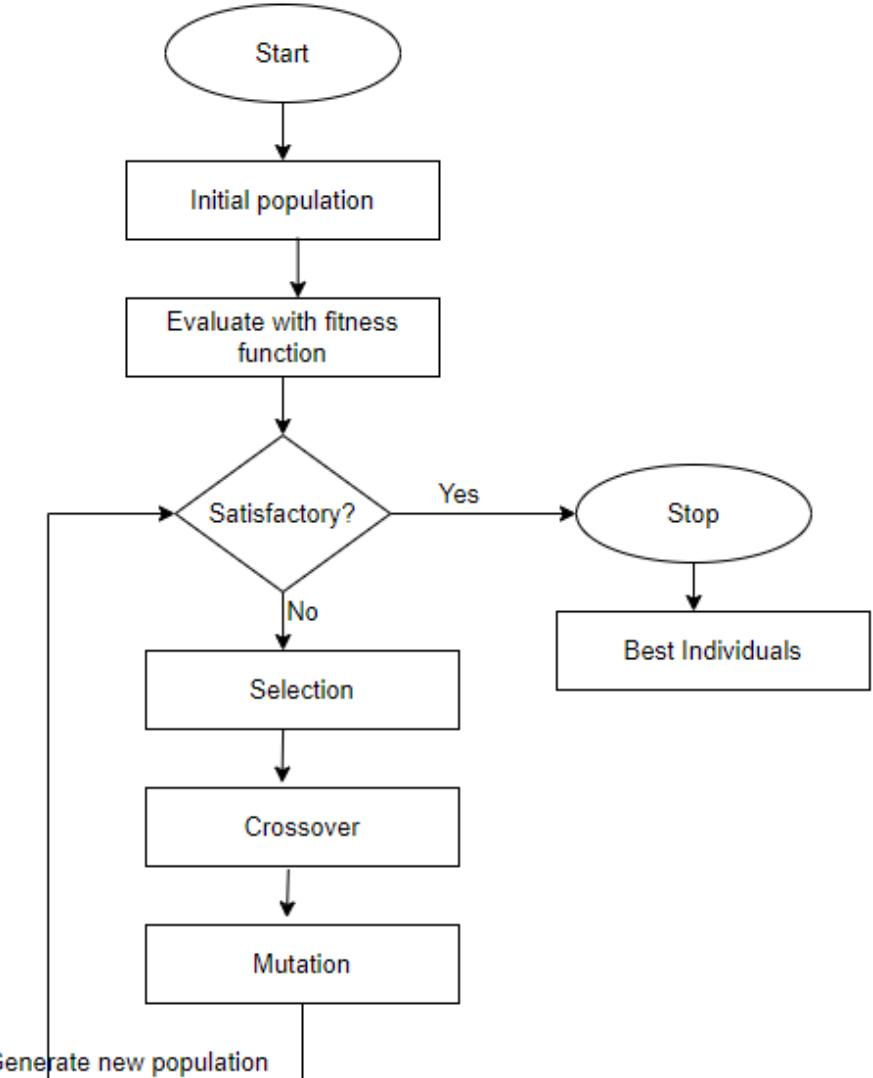
# Project 2

Implement a genetic algorithm to find the maximum value for the function:

$$f(x, y) = \sin(\sqrt{x^2 + y^2}) \cos(x + y) (x + y)$$

with boundaries:  $-5 \leq x, y \leq 5$

using a population of 16  
for 1024 generations.



## **Submission:**

Please use Jupyter Notebook for the implementation. Your submission should include code, output, and documentation. You can choose to develop library-based functions, and do the final runs/analysis in the Notebook (the path I would recommend as best practice), or write all code in the Notebook. Clearly document your representation of the individuals and how you implement the selection, crossover, and mutation processes using notebook text cells. All three processes must be stochastic in nature, and the initial population must be randomly generated.

## **Output:**

1. plot the fitness score of the best individual in every generation using a log scale for the horizontal axis;
2. plot the coordinates of those best individuals and connect them to show the path of movement;
3. run your genetic algorithm 100 times (without the plots) with a different random initial population each time, and print the number of times it finds the global maximum ( defined as  $> 6.3$  )

Discussion: analyze how effective or ineffective your genetic algorithm finds the global maximum. Explain why and discuss how you can improve your algorithm without increasing the population size. (Ref. Section 4.1.4)

Each student should complete the project individually. You can use utility packages, but you must implement the core algorithm.

## **Grading:**

- 70% for successful execution and correct output
- 10% for methodology documentation, code structure, and readability
- 20% for discussion on the effectiveness of your algorithm
- Extra credit: 10% if you animate your plot over the generations
- Extra credit: up to 20% if you implement the improvement ideas and demonstrate the improvements by measuring its performance over 100 iterations.