Project Proposal

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Project name: Smart Rockets [1]. 🚀
Mission: To implement Smart Rockets [1] using all different optimizing algorithms [3] and compare their results

Problems & Solution 📈

Problem: Autonomous rockets aim for reaching a target in a space filled with obstacles. The rockets can achieve this by finding a path from source to target, which can be achieved by finding and optimizing path function [2]. (This problem is also known as Smart Rockets [1] 🚀)

Solution: We will be using five different optimizing techniques [3] to find the solution for same problem in different scenarios, and find the behaviour of these optimizing techniques [3]. ☄️

Methodology & Project Scope 📜

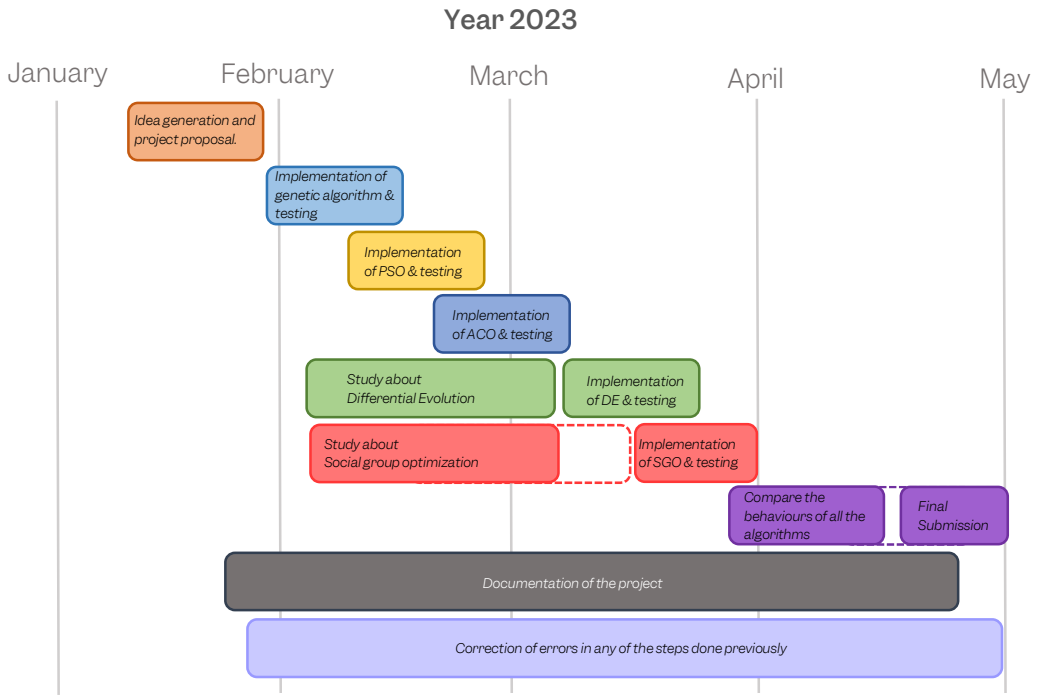
Methods: We are using the instantaneous motion[4] of the rocket as the criteria to be optimized. Optimizing techniques to be used are:

- Genetic Algorithm 💉: This algorithm encodes the instantaneous motion of the rocket and saves it into the DNA of the rockets and then uses it to optimize the path to the target using a fitness function.
- Particle Swarm Optimization 🟪: It uses a swarm (group) of randomly spread particles to find the closest points to the actual solutions. Each particle maintains a local and a global best, using which the swarm finds the best path.
- Ant Colony Optimization 🐜: Ants in real-life uses pheromones [5] to mark the path, they took to get to a particular place. This algorithm implements the same, and uses two pheromones to mark path for coming to the source and path coming from the target. The ants based on their state follow a particular pheromone.
- Differential Evolution 📈: The algorithm is similar to Genetic Algorithm, but it doesn't need encoding [6] of values to represent the problem's solution function. It can be done directly using mathematical tools.
- Social Group Optimization 👥: It works similar to PSO but is more detailed. As it uses the agents in the space for optimizing the strategy to reach the goal, by using the group's performance as a measure of success, and then using game theory[8] to find the equilibrium strategy.

Scope 🔭

Aim 🎯 : We will be visualizing the algorithms using Processing IDE[7]. The scope is to implement the simplest form of all mentioned optimizing methods, then compare them to each other. Each algorithm will be individually tested and gathered results, by taking multiple simulation data to average out any error from inconsistent CPU performance. The resolution of the search space/optimizing area will be reduced for faster and easy to understand results.

Timeline 🕛 : The complete project will take approximately three to four months. The complete plan is charted below.



According to our planning the project will be complete by May of 2023.

Goals, KPIs & Outcomes 🎯

Goal: To produce a worthy result by comparing the best performing algorithms under different circumstances. Then compare the results from each algorithm acting in different scenarios, produce a report using that and see if the algorithms can be improved or be combined to make a better performing algorithm. We have an intuition that Genetic Algorithm and Ant Colony Hybrid will result in a better optimizer.

KPIs:

- We should be able to produce reports for the performance of each algorithm after its completion.
- All tasks should be completed at least three days before deadline.
- All the reports cumulatively should be worthy of a research paper.
- A GitHub [9] repository will be used to track the progress and see the project after the project ends.

Outcomes:

- High-quality implementations of optimizing algorithms [3].
- Better understanding of the subject in question.
- One paper comparing the behaviour of optimizing algorithms and proving insight in how to improve or hybridize the algorithms for better performance.

Glossary 📑

[1]: Smart Rocket is a path finding problem that uses agents like virtual rockets that aim to reach a particular target.

[2]: This would optimize the path from the source to the target, i.e., it will reduce the travel time and also ideally smoothen the path.

[3]: Optimizing techniques are mentioned in the methodology section of the proposal.

[4]: The current next step it should take in the space.

[5]: Pheromone are natural secretion done by insects/animals to give others the idea of their presence or some other information important for the group.

[6]: Conversion of actual problem / values into some form of data that can be easily encoded into the problem-solving algorithms.

[7]: This is a Java based programming environment that provides tools for visualizing easily.

[8] It is a branch of mathematics that analyses and predicts trends in a number of different game scenarios with a varying number of players.

[9] Track the project on GitHub, here.