DATA STRUCTURES AND ALGORITHMS

PROJECT PROPOSAL

PROJECT TITLE: THE A* (A – START) ALGORITHM

GROUP MEMBERS:

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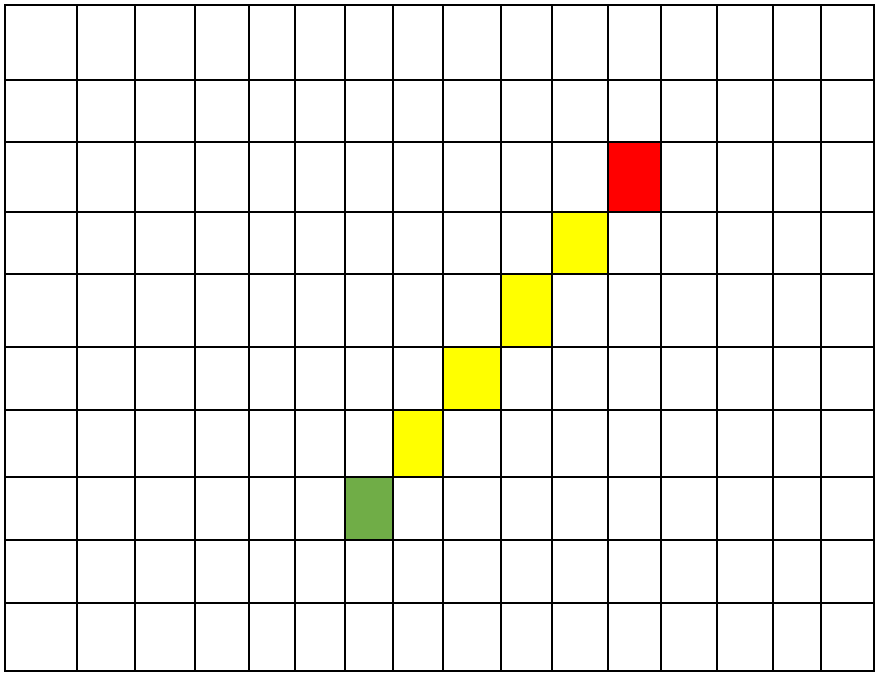
PROJECT DESCRIPTION:

The A* search algorithm is an Artificial Intelligence (AI) algorithm that is used for graph traversals and path finding. It is frequently used in computer science due to its completeness, optimality and accuracy. A* algorithm has a higher rate of precision because it utilizes heuristics to perform its search.

The A* algorithm is a pretty smart algorithm in determining the shortest path from the starting to the goal position. Consider the square grid below on which the starting point is marked from the green, and the goal is marked is red. What A* algorithm does is that it selects a node from the starting point with respect to $f(n)$, and the node with the lesser value is chosen. The path is shown from yellow. Similarly, from that node, it selects another node towards the goal position in the same manner, the node with the least value is chosen. What interesting here is the calculation of $f(n)$. It is calculated as follows:

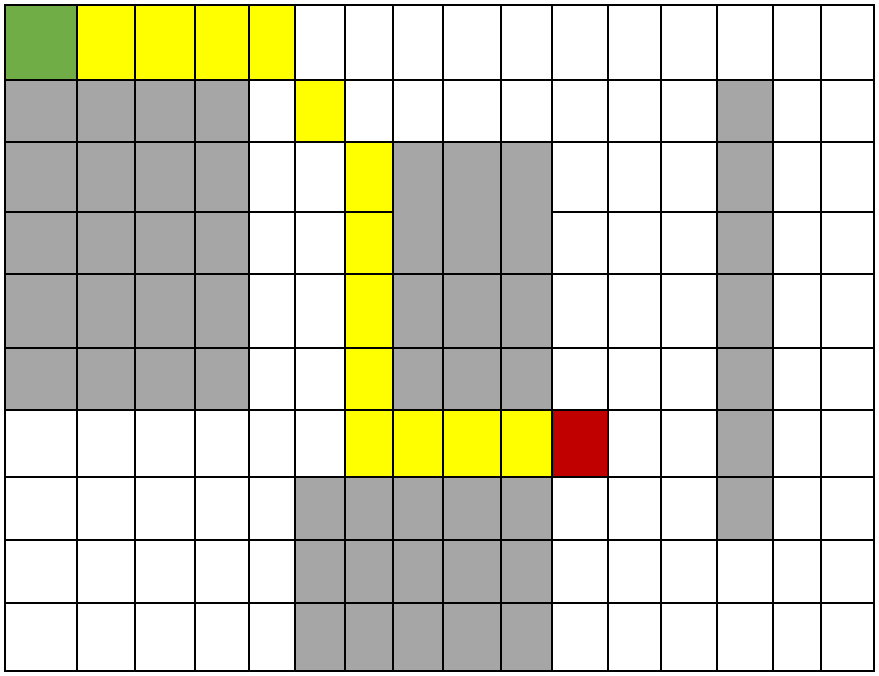
$$f(n) = g(n) + h(n)$$

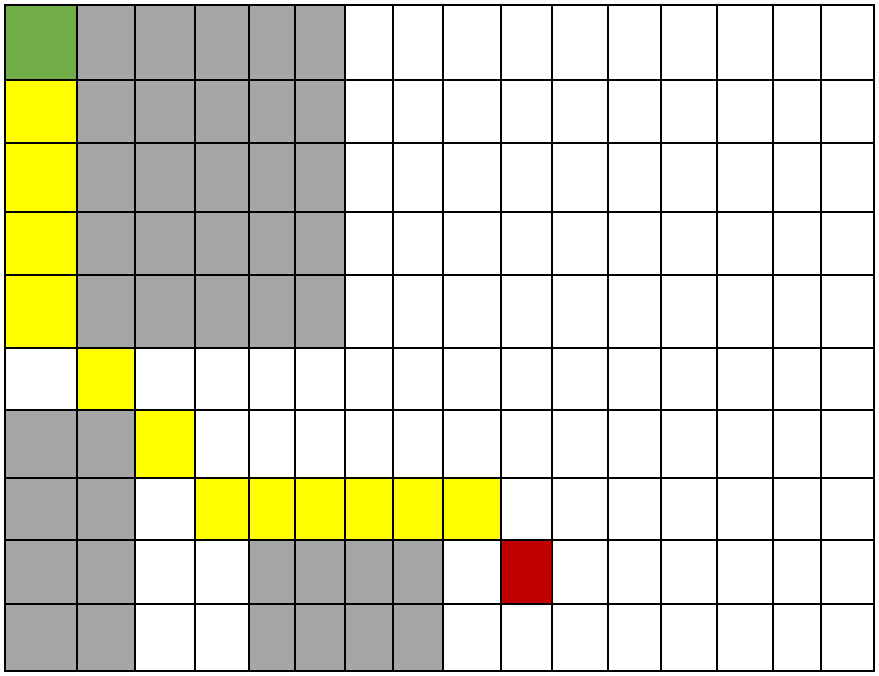
Where, $g(n)$ is the distance from the initial node to the other node, and $h(n)$ is the heuristic part, and it is the approximate distance from the next node to the goal node. It can be calculated through several methods, however, we will use Euclidean distance formula $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ to calculate $h(n)$.



PROJECT SCOPE:

A-star algorithm has vast applications, and is used in variety of fields and programs. From robotics, machine learning and AI based applications to games, maps and graphs, programmers highly rely upon A-star algorithm. Therefore, in our project too, we will be implementing A-star for **path-finding.** As it is stated above, A-star is widely used in Game Development, and in our project, we will be giving a grid of specific dimension along with some obstacles in it. We need to implement A-star to find the shortest and the smartest path from the starting point to the goal. Similar to what is implemented in games, if you want to go from one place to another or find a specific character in the game, you are directed towards it, and is given the path to the desired location by the game engine itself. On the backhand, it is actually A-star that is implemented in the game. Therefore, we will be solving this kind of a problem in our project. Following are a few examples to give the insights of our project.





Here, in this demonstration, yellow denotes the path, green starting point and red destination. We can see the how smartly the algorithm chooses the path to the goal, and cuts between the obstacles marked by the gray color. That is why it is said that this is the algorithm with “brains” in it.

PROJECT OUTCOME:

The one of the most prominent reasons why we chose this algorithm is that it is an Artificial Intelligence algorithm. It is commonly known as the algorithm with brains. Thus, it

would give some exposure of AI, and how it works since it is an emerging field, and most of us want to pursue this in future. Furthermore, we will be introduced to some new concepts of data structures and algorithms such as how to create nodes and the heuristics part in the algorithm. Therefore, we will have some background of AI algorithms and heuristic, and some handful knowledge of how to create classes and nodes.

Moreover, the other dominant outcome of this project is that we will be introduced to github. It is an online platform for developers where we can collaborate with our colleagues to write codes and other documentation, and it can be shared with others too easily. Therefore, it will be really beneficial for us in our corporate future as we will get acquainted with github now.

Other than that, we will learn how to work in a team more productively, and it will help us to hone our soft skills which are key aspects for becoming successful in today's world.

LIBRARIES/OTHER RESOURCES TO BE USED:

In this project, we may need to use the following resources:

- We will need to create new classes for nodes, for parent and children nodes.
- Best search or informed search algorithms.
- Dijkstra algorithm implementation.
- Lists, tuples and basic python data collections.
- We may need to use Priority Queue for the implementation of A* algorithm.