

Report Assignment 1.2
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1- Give the representation of a solution (answer) of the problem

- The Spain map consists of several cities that are connected to each other. Each city is represented in a node, and the distance from one city to another is represented in the weights of the edges. The objective is to determine the shortest distance between the start city and the goal city.
- $X = \{X_1, X_2, X_3, X_i, \dots, X_n\}$ where (n) is the number of cities, and (X_i) is a city

$$d = \sum_{X_i}^{X_j} K_j$$

- (d) denotes the distance
- (X_i) denotes the start city
- (X_j) denotes the goal city
- (K_j) denotes the distance from the current city to the next city
- (K_{nj}) denotes the distance of the path between previously visited city and the goal city and it is used in A* algorithm.

2- Give the equation of $f(n)$ used in Greedy Best-first Search (or Explain how to calculate $f(n)$).

- $f(n) = h(n)$
 - $f(n)$ is equal to the heuristic function $h(n)$.
 - $h(n)$ is a heuristic function that estimates the cost from city n to the goal city, which is the straight line distance.
 - Straight line distance = $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

3- Give the equation of $f(n)$ used in A^* (or Explain how to calculate $f(n)$).

- $f(n) = g(n) + h(n)$
 - $f(n)$ It represents the estimated total cost of the cheapest solution through city n .
 - $g(n)$ is the actual cost of the path from the start city to city n .
 - $h(n)$ is a heuristic function that estimates the cost from city n to the goal city, which is the straight line distance.
 - Straight line distance = $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

4- Explain both algorithms and the differences between them.

- A^* is an algorithm that uses a heuristic cost-to-goal estimate along with the actual cost-so-far from the start node to the current node. It calculates the $f(n) = g(n) + h(n)$ function for each node, where $g(n)$ is the cost-so-far to reach node n and $h(n)$ is the heuristic estimate of the remaining cost to reach the goal from node n . A^* explores nodes in order of increasing $f(n)$ using a priority queue, prioritizing nodes with the lowest cost.
- Greedy best first search, on the other hand, only considers the heuristic estimate of the remaining cost to the goal and disregards the actual cost-so-far. The algorithm uses a priority queue to explore nodes in order of increasing $h(n)$, always prioritizing the nodes that are closest to the goal.
- The main difference between A^* and GBF is that A^* takes both the actual cost-so-far and the heuristic estimate into account, while GBF only considers the heuristic estimate. As a result, A^* is generally considered to be more optimal than GBF, as it can avoid exploring paths that may seem promising based on the heuristic but actually turn out to be suboptimal.