CSCI-630 - Foundations of AI

WriteLAB 1 - Orienteering Write-up

1. Read the elevation file and stored elevations in a 2D array.

2. Read the terrain image using the Python Image Library, allowing us to access pixel values in a 2D array manner.

3. Modified the Vertex class to act as a pixel on the image, storing the terrain type (color value) and elevation together in one Vertex object.

4. Used to dictionaries to map pixel color value to terrain type, and terrain type to the speed.

5. Created a graph with the pixels as vertices of the graph. Then added edges from each pixel to 8 neighboring pixels, provided that the pixel and the neighbor(s) are not 'Out Of Bounds'.

6. Used the Heap data structure to simulate a priority queue while implementing the A-star algorithm

7. Cost function is the time it takes to travel from one pixel to another. The distance between two pixels is the 3D distance between them, taking into account the distance in x-axis, distance in y-axis and the difference in elevation. Also, the real-world pixel size is determined by that of the National Elevation Dataset, which in our case is one third of an arc-second, equivalent to 10.29 m in longitude (X) and 7.55 m in latitude (Y). These were taken into consideration during the calculation of distance. The speed depends upon the terrain type of the destination pixel (mapped in a dictionary).
   In short, **COST = 3D-DISTANCE / TERRAIN SPEED**

8. Heuristic value chosen is the cost between a pixel and the end-goal pixel while assuming that we have a direct path between them on the fastest terrain-type. Our fastest terrain is the 'footpath' with a speed of 9. Thus, the heuristic value is the 3D distance divided by this maximum possible speed of 9. It is admissible because the actual cost between the two pixels (on a slower or the same terrain) will always be either less than to or equal to this heuristic value (cost of an optimal path). There is no faster terrain than the one used for the heuristic value.
   In short, **HEURISTIC VALUE = 3D-DISTANCE / MAXIMUM TERRAIN SPEED**