

Prerequisite:  
Pillow is installed.

Run the program:

```
Lab1.py "testcases/normal/terrain.png" "testcases/normal/mpp.txt" "summer"  
"testcases/normal/brown.txt"
```

Lab1.py <image name> <elevation file> <season> <set of points>

Color Speed:

I have chosen the following speeds for each color

Open land	#F89412 (248,148,18)	9
Rough meadow	#FFC000 (255,192,0)	6
Easy movement forest	#FFFFFF (255,255,255)	3
Slow run forest	#02D03C (2,208,60)	4
Walk forest	#028828 (2,136,40)	2
Impassible vegetation	#054918 (5,73,24)	0.5
Lake/Swamp/Marsh	#0000FF (0,0,255)	0.1
Paved road	#473303 (71,51,3)	10
Footpath	#000000 (0,0,0)	8
Out of bounds	#CD0065 (205,0,101)	
Mud	(255,0,0)	1
Ice	(165, 242, 243)	6
Fall path	(255, 102, 204)	7

I have added the last three colors for mud, ice, and path next to the easy run forest.

Heuristic Function:

For the heuristic function, I have used the euclidean distance between the two points along with the height and dividing that distance by the best speed i.e. 10. This function does not overestimate since it considers there exists a straight line path from any point to the destination

having the best speed. So in best case the speed will be 10 and the time for the actual path will be equal to the heuristic distance. This is true for all other seasons as well since for each season we are decreasing speed and not increasing it.

#### A-star Algorithm:

For A-star algorithm, all eight neighboring points have been considered. I have used a priority queue(heap) to find the point with the lowest heuristic value and then that point is removed from the queue. The point is a class that contains the parent from which it was generated, hence when tracing the path we can look at the parent until the parent is None at which point it is the first point.

#### Winter:

First, the water pixels which are next to land are found, next BFS is applied to find the water pixels that are within seven pixels of the border pixels.

#### Spring:

First, the land pixels next to water are found. Then BFS is applied, but the entry in the queue also contains the height of the water. Hence if a pixel is at a height greater than 1 meter then that pixel is ignored and not colored.

#### Fall:

The pixels which are next to easy moving forests are found and are colored pink.

#### Path Coloring:

I have created a class node that contains the X, Y, Z coordinates the color and a node to the parent. The parent is the point that generated this point in the queue. So for drawing the path I go from the last point to the first point.