RBE 550: Motion Planning Programming Assignment 4

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RRT and RRT* Overview:

- Grow a tree rooted at the starting configuration
- Randomly sample from the search space
- For each sample, try to connect it to the nearest node of the tree
  Success – add a new node
  Fail – discard the sample

```
BUILD_RRT (q_init) {
  T.init(q_init);
  for k = 1 to K do
    q_rand = RANDOM_CONFIG();
    EXTEND(T, q_rand)
}
```

STEP_LENGTH: How far to sample
1. Sample just at end point
2. Sample all along
3. Small Step

Extend returns
1. Trapped, cant make it
2. Extended, steps toward node
3. Reached, connects to node

- Roadmap should capture the connectivity of the free space.

Methods:

check_collision:

Incrementations calculated in the X and Y directions, and these are added to the original points being checked -> The line segment between two the points are divided into mini segments based on precision decided and check if that position is an obstacle or not.

dis:

Calculates Euclidean distance.

get_new_point:

Based on goal_bias probability we either chose the next point as goal or not.

get_nearest_node:

Find the nearest node in self.vertices with respect to the new point

extend:

I have used the RRT Extend method for extension.

Find the new node to be added to the tree in the direction of node2 based on a distance comparison.

get_neighbors:

Get the neighbors that are within the neighbor distance from the node argument.

rewire:

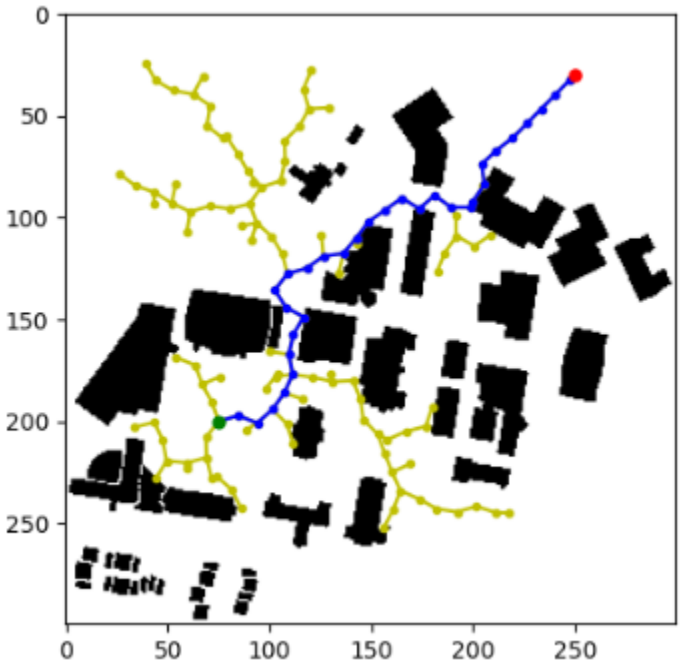
Rewire the new node and all its neighbors. Propagates the cost after rewiring.

RESULTS:

Number of points sampled is 1000 for both the algorithm.

RRT

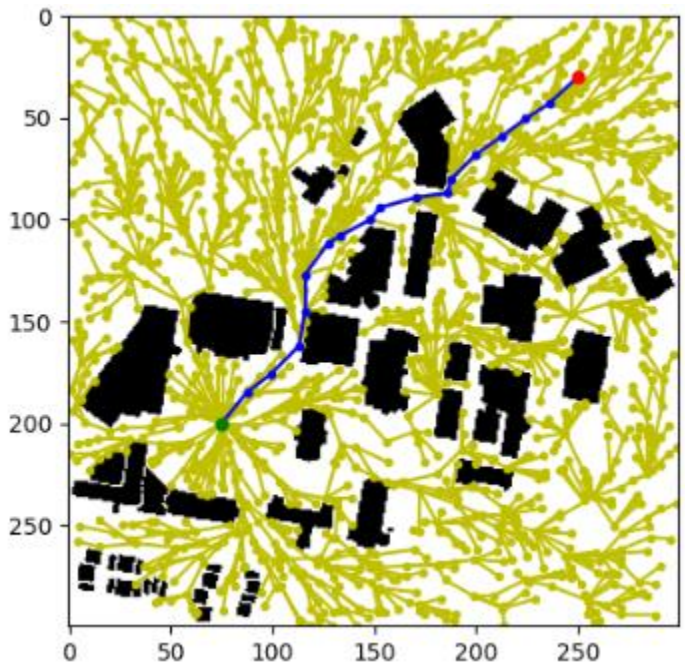
```
--------- RRT Algorithm ----------
C:\Users\anujp\Desktop\Academics\Se
  img = img.resize((new_x, new_y),
It took 127 nodes to find the curre
The path length is 306.43
--------------------------------
```



RRT*:

Number of neighbors is considered as 20.

```
 --------- RRT* Algorithm ----------
It took 1551 nodes to find the current path
The path length is 262.88
 -------------------------------
```



DISCUSSION:

Path length is lower for RRT* as compared to RRT.

The above results are obtained when the goal bias I set to 5%

Increasing the goal bias increased the number of nodes by around 50% for RRT and 10% for RRT*.

In the slides a question was posed; what happens when the goal bias is set to 100%?
No path was found for RRT and RRT*
This is logical as we are straying away from sampling any of the rest of the space and obstacles are bound to hinder finding a path to the goal when its considered as next point while building the tree.

RRT requires fewer nodes as compared to PRM, thus less computation.

References:

https://github.com/AtsushiSakai/PythonRobotics

https://theclassytim.medium.com/robotic-path-planning-rrt-and-rrt-212319121378

Class slides