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04/09/2023

RBE 550 – Motion Planning

# Advanced Algorithm Implementation

D* updates a path by updating the cost of moving between nodes. This is composed of two parts: 1) the priority queue, and 2) the list of *changed* nodes. The priority queue records the nodes to be expanded next, while the list of *changed* nodes records the nodes whose costs have changed since the last step. Each step, the lowest-cost node is selected, and the costs of the neighbors are updated if necessary (depending on RAISE or LOWER state based on the *k_min* value.

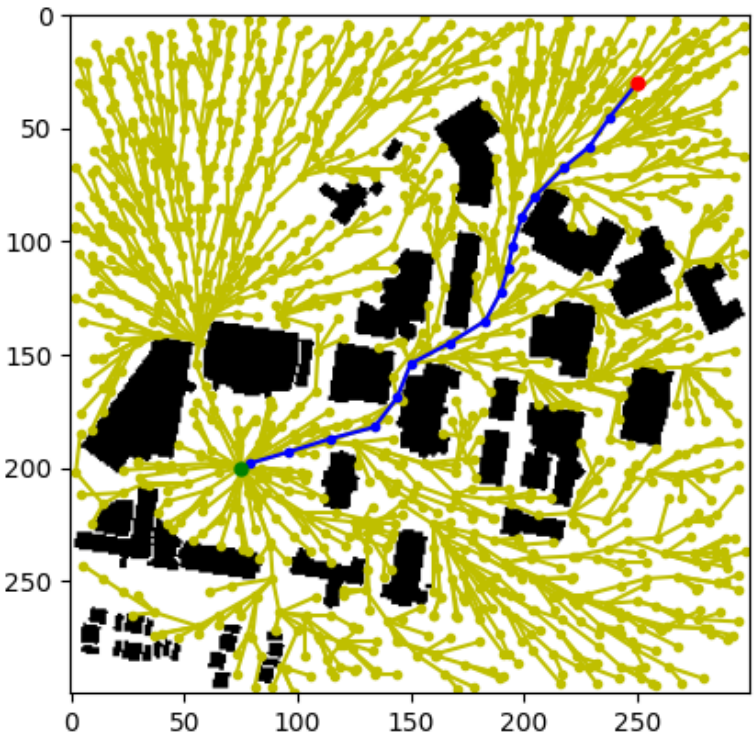
D* can replan faster than A* or Dijkstra's algorithm because only the local search space is updated when a change is noticed. On the other hand, the other two algorithms must perform a full graph search from start to goal every time a replan is required. D* does this by using the two parts described above.

The main difference between RRT* and informed-RRT* is the scope of the optimization once a feasible path has been found. Regular RRT* continues searching the entire space for more optimal solutions, adding nodes along the way. Informed-RRT*, however, only searches an ellipsoid area surrounding the start and goal nodes. This way, much fewer nodes can be explored and added, and the search criteria is minimized to the area that *actually* may contain a better solution.

As seen below, the results of RRT* vs informed-RRT* demonstrate the improvement of the latter algorithm over the former. The density of the points sampled inside the ellipsoid (which is continually updated as better solutions are found) is much higher than the density of points outside the ellipsoid. This results in two improvements: 1) fewer nodes explored, and 2) shorter path found.

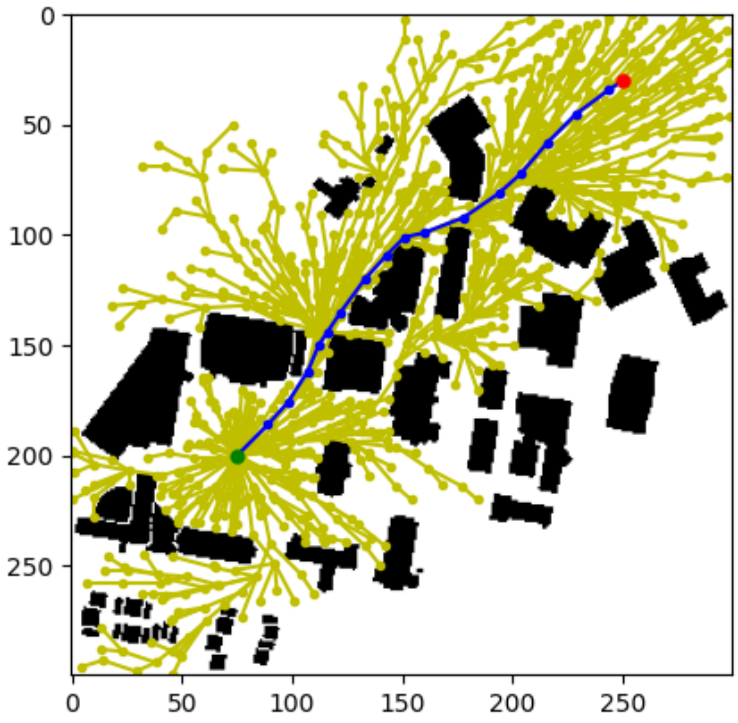
**RRT* vs Informed-RRT***

**RRT*:**



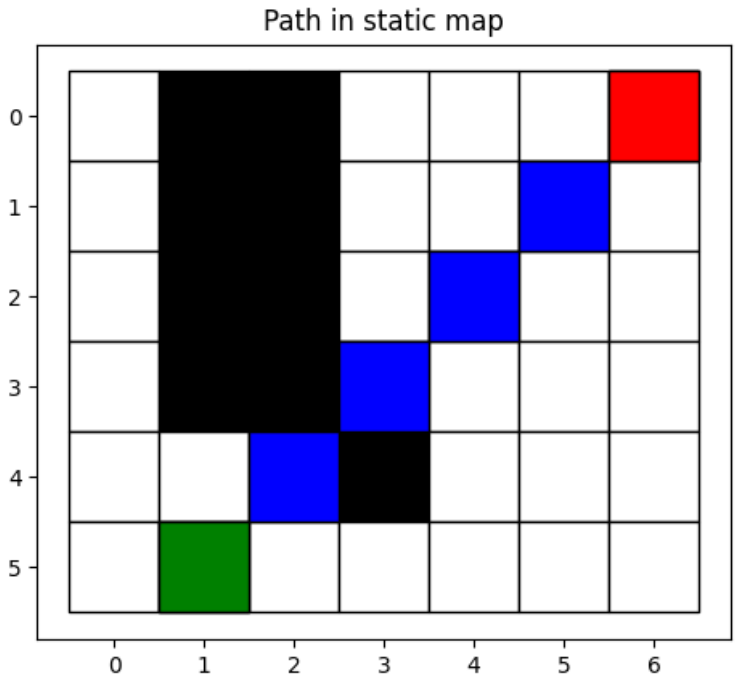

It took **1448 nodes** to find the current path, the path length is **259.86**

**Informed-RRT*:**

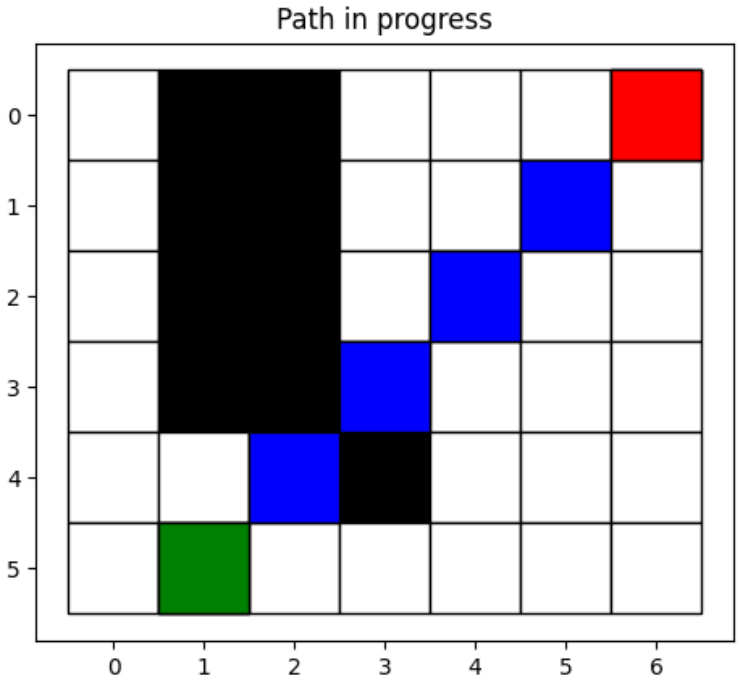


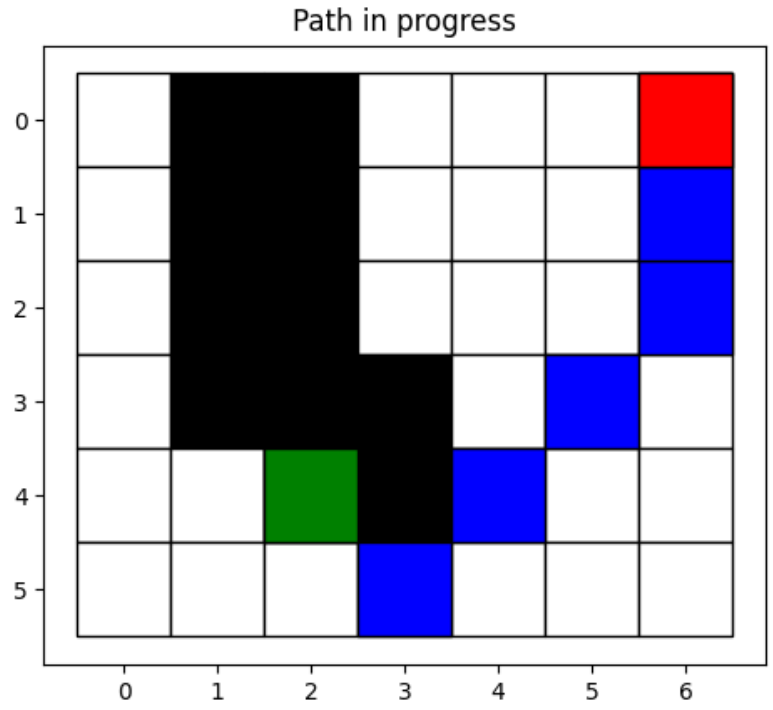

It took **1114 nodes** to find the current path, the path length is **249.74**

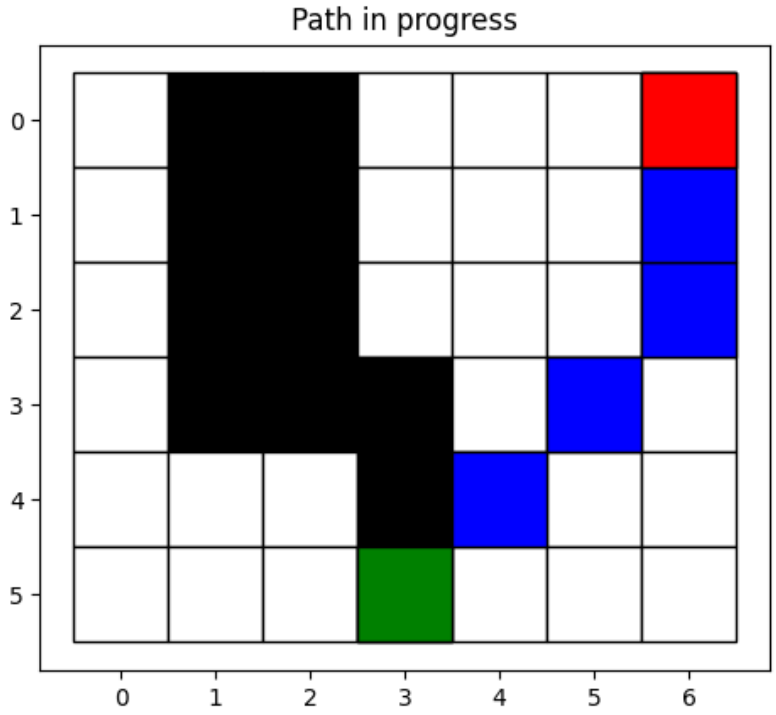
**D* Algorithm:**

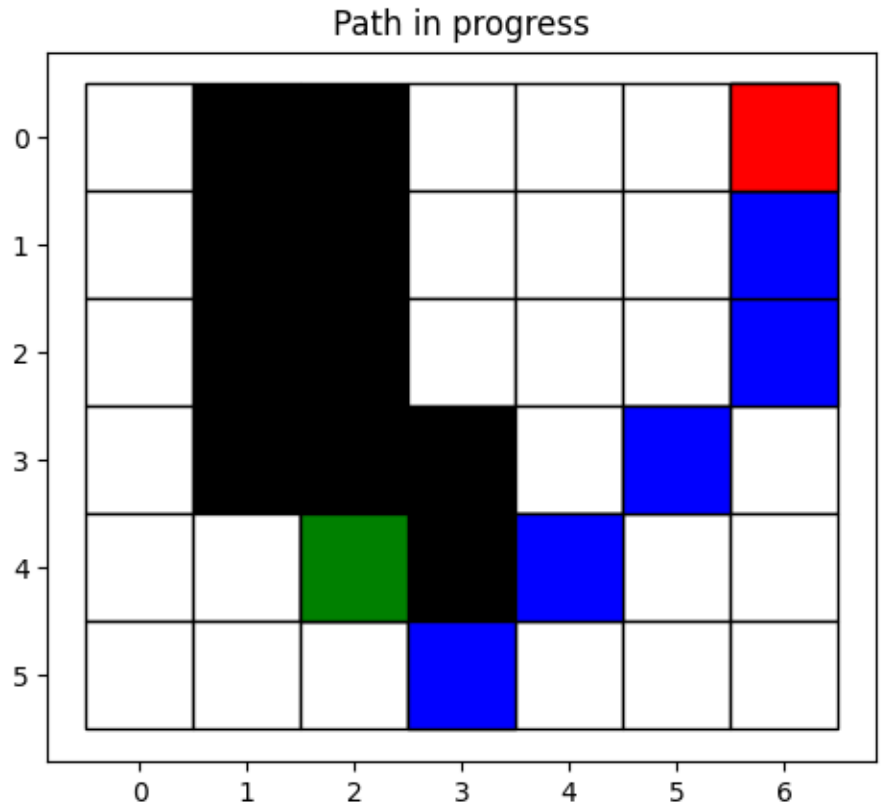



**Dynamic Map (only the replan steps):**




Path in progress
0
1
2
3
4
5
0
1
2
3
4
5
6


Path in progress
0
1
2
3
4
5
0
1
2
3
4
5
6


Path in progress
0
1
2
3
4
5
0
1
2
3
4
5
6