Homework # 3

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Question 1.

Run the Breadth-First search, Depth-First search and A-Star planner for the 2D configuration space. Run each planner 3 times, using resolutions of 0.05, 0.1 and 0.25. Report path length, plan time and number of nodes expanded for each planner and each resolution (9 runs total). Submit a video of one of the AStar runs. Include in your writeup a plot for the paths generated by each of the methods for resolution 0.1.

Breadth-First Search

Resolution	0.05	0.1	0.25
Path Length	5.53	5.46	5.64
Plan Time	24.65 secs	5.61 secs	0.89 secs
Nodes Expanded	21557	5355	931

Depth-First Search

Resolution	0.05	0.1	0.25
Path Length	191.93	101.86	36.65
Plan Time	21.88 secs	1.21 secs	0.19 secs
Nodes Expanded	16014	2147	326

A-Star Search

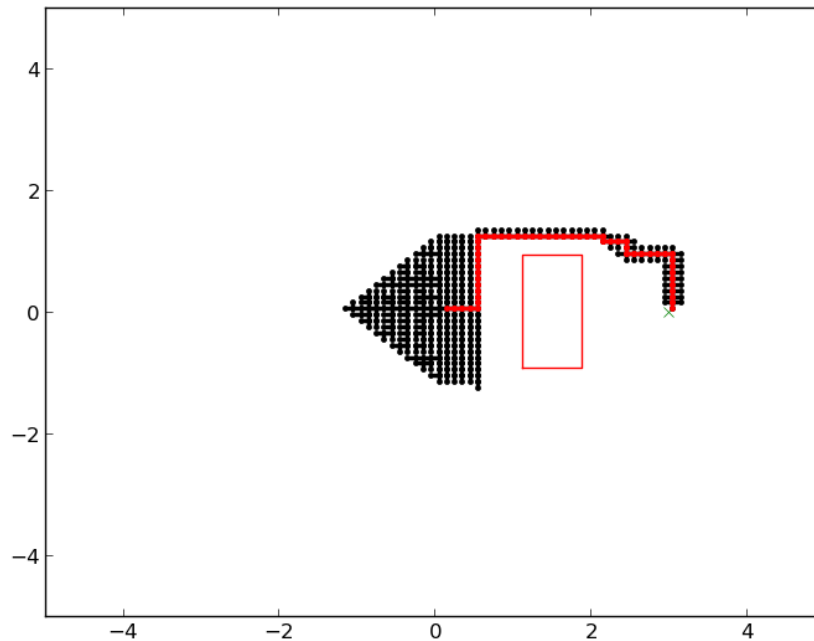| Resolution	0.05	0.1	0.25
Path Length	5.45	5.3	5.25
Plan Time	1.38 secs	0.41 secs	0.08 secs
Nodes Expanded	1067	296	52

Breadth-First Search
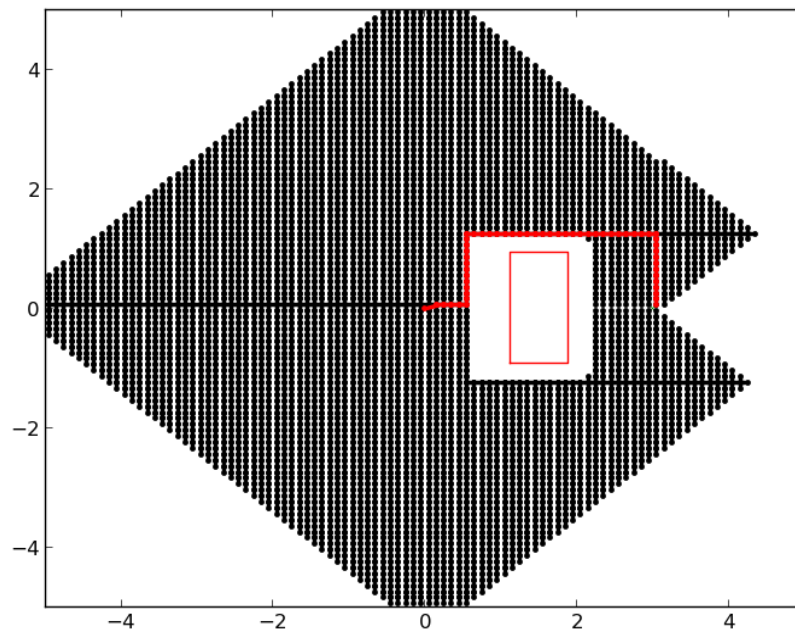
Depth-First Search
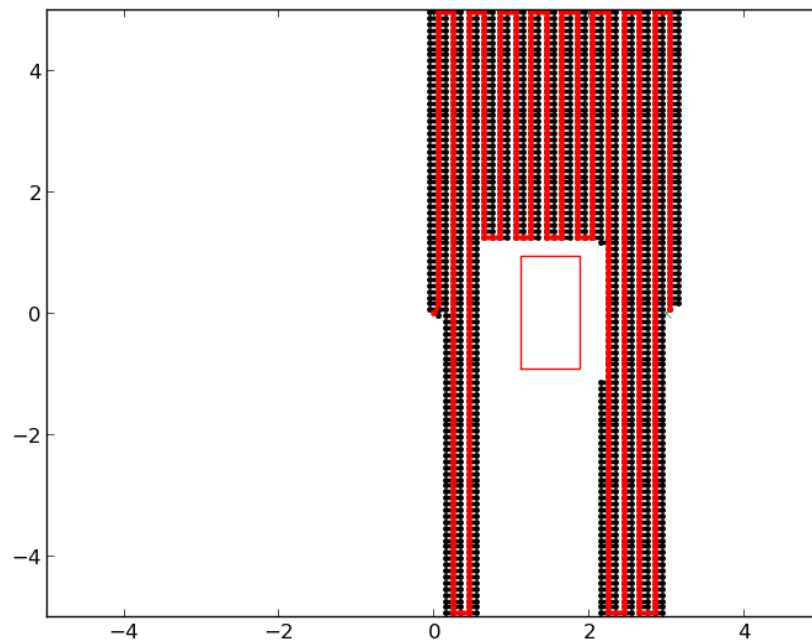
A-Star Search

Question 2.

Run the AStar planner for the WAM arm. Use a resolution of 0.1. Report path length, plan time and number of nodes expanded during the search in the tree. Submit a video of the run.

A-Star Search

Resolution	0.1
Path Length	2.5
Plan Time	323.44 secs
Nodes Expanded	12357

Question 3.

For the 2D space, run the RRT algorithm with path shortening you implemented during the last homework using the start and goal defined for the 2D space in this homework. Run the RRT planner several times. Compare the path length of the AStar generated

paths (for all three resolutions) to the paths generated by your RRT algorithm with path shortening. Do the same for the WAM arm. Comment on the strengths and weakness of using AStar versus RRT with path shortening.

Simple Environment

A-Star Search

Resolution	0.05	0.1	0.25
Path Length	5.45	5.3	5.25

Bidirectional RRT with path shortening

Test Number	1	2	3	4	5	avg
Path Length	5.17	4.86	9.88	6.80	6.05	6.55

Herb Environment

A-Star Search

Resolution	0.1
Path Length	3.0

Bidirectional RRT with path shortening

Test Number	1	2	3	4	5	avg
Path Length	21.96	24.27	11.59	20.60	11.67	18.02

Comment: (Astar v.s. RRT)

	Astar	RRT
Pros.	Can find the shortest path (with finer resolution)	Faster in general case (especially in high dimensional)
Cons.	Takes lots of time	Much longer plan path

Question 4.

Extra Credit: Implement the hRRT algorithm. To do this, implement the Plan method in HeuristicRRTPlanner.py. Copy over the relevant functions for HerbEnvironment and SimpleEnvironment from your previous homework. Use the same cost and heuristic that you implement for the AStar algorithm. Run the planner several times on both environments. Compare the plan times and path lengths to those obtained using the AStar algorithm.

Simple Environment

A-Star Search

Resolution	0.05	0.1	0.25
Path Length	5.5	5.4	5.5
Plan Time	0.3789 secs	0.1221 secs	0.0415 secs

Heuristic RRT with path shortening

Test Number	1	2	3	4	5	avg
Path Length	5.72	5.94	6.84	5.93	4.75	5.84
Plan Time	1.80	9.84	7.17	3.35	30.93	10.62

Herb Environment

A-Star Search

Resolution	0.1
Path Length	3.0
Plan Time	4.457 secs

Heuristic RRT with path shortening

Test #	1	2	3	4	5	avg
Path Length	X	X	X	X	X	X
Plan Time	92.51	46.42	88.58	31.78	106.38	73.13

X: fail to find the path in the number of 500 iterations