

## Results for Homework 2

	RRT	RRT-connect	RRT-star	PRM
Mean Planning time(s)	6.9	3.84	5.76	35
Mean number of samples	1062	1	153	10000
Mean plan length	7	4	6	7

### Summary:

Mean time (best to worst): RRT connect<RRT<RRT\*<PRM

Number of samples (best to worst): RRT\_connect<RRT\*<RRT<PRM

Plan Length(best to worst): RRT connect<(RRT and RRT\*)<=PRM

From above results,

- We can see that RRT connect is fastest which comes from the fact that we are doing bidirectional search and trying to move as much as possible (connect operation). According to data, the step size can be very large which reduces the path length as compared to RRT, RRT\*, PRM.
- RRT\* is slowest of all and the reason being the rewiring step that increases the computations. But, it results in a better path in terms of smoothing. The path length are similar to RRT.
- PRM highly depends on the connectivity of the graph. Here, radius of 1 has been used to create edges and same radius used to connect start and goal vertices to the graph
- RRT and RRT\* use the most samples to find a path due to their nature of sampling.
- PRM and RRT variants are highly dependent on the dimensions of the space, configuration space, and step size.

### Methodology:

- RRTs and variants use KD trees to calculate the nearest neighbor and thus the timings should not be compared with PRM. PRMs do trivial NN search by looking at all the configurations
- Random sampling in PRMs have also been biased to sample near the collision boundaries. This would have been much more helpful if we could put some constraint on the range of angles of each arm (all configurations with first angle>pi are waste-- which could have reduced the space a lot)

- Radius of PRM had to be kept a little higher than max step of RRT because 10000 samples were not able to generate a graph that connected Goal and start config very closely.
- The radius is same for nearest neighbors and for goal and start config to find the nearest node in the graph.
- RRT connect works really well as the connect method avoids taking extra samples if you could just connect it directly.