

## COMP550 Project3 Report

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1.

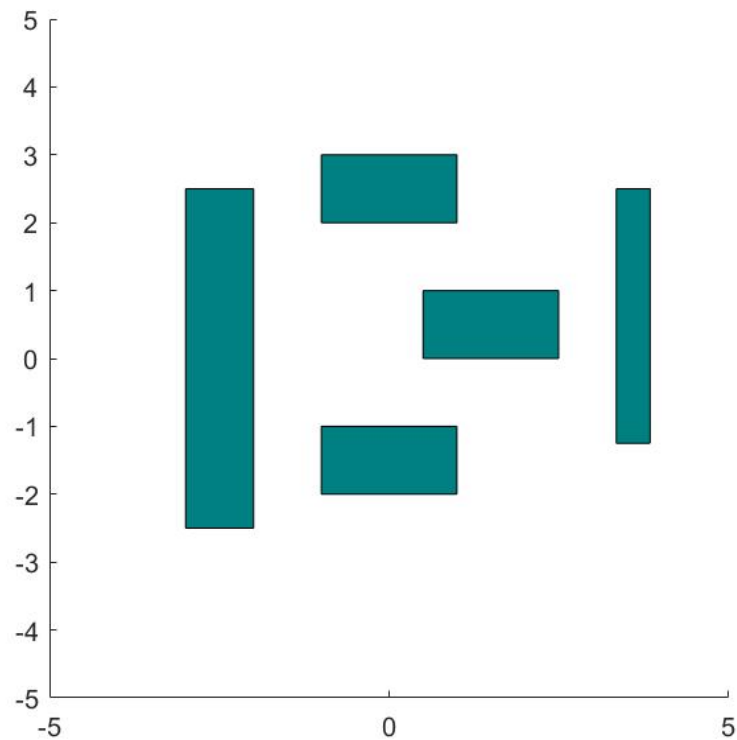
For this project, I implemented a basic planner RTP and compared its performance with some other more advanced planners. It is expected that RTP will behave worse than other planners.

2.

Two kinds of robots: one is point robot, its configuration space is  $\mathbb{R}^2$ , the other is square robot with side length of 0.3, its configuration space is SE2.

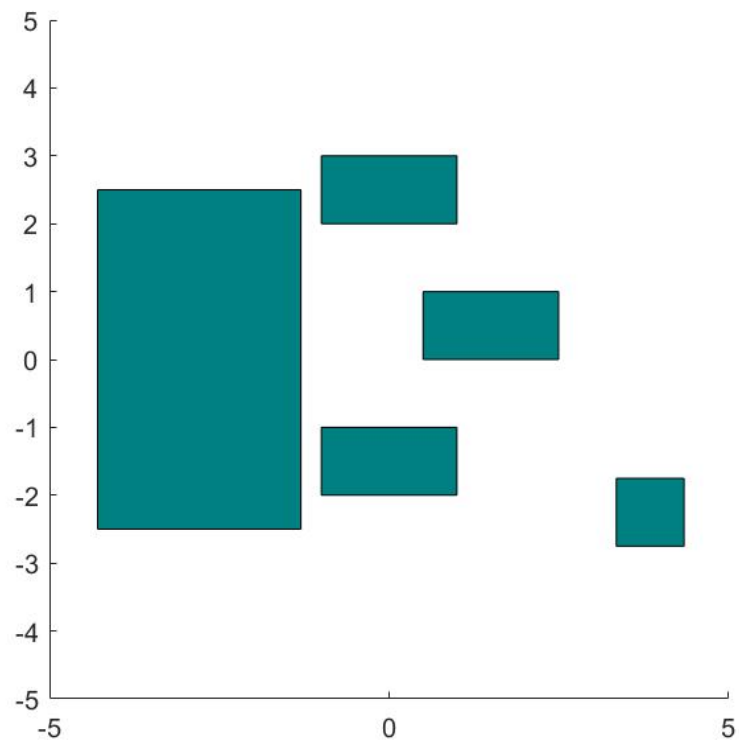
3.

environment 1:



lower bound is -5 and upper bound is 5

Environment 2:



lower bound is -5 and upper bound is 5

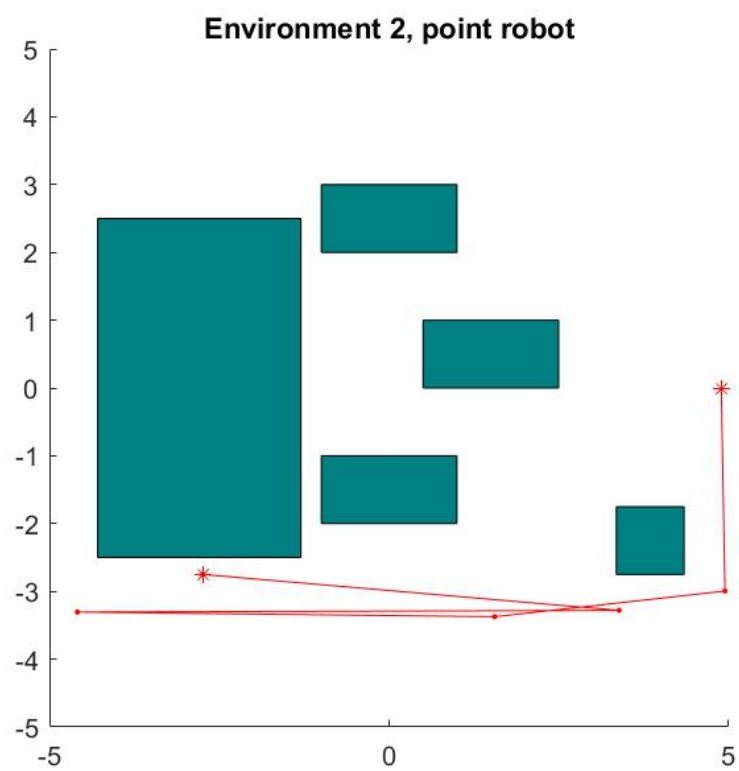
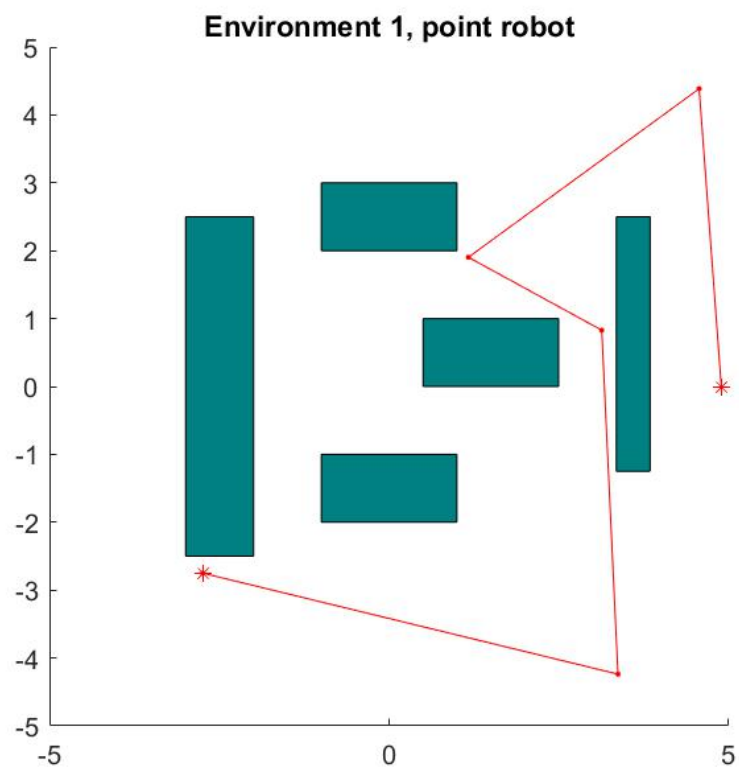
Point robot:

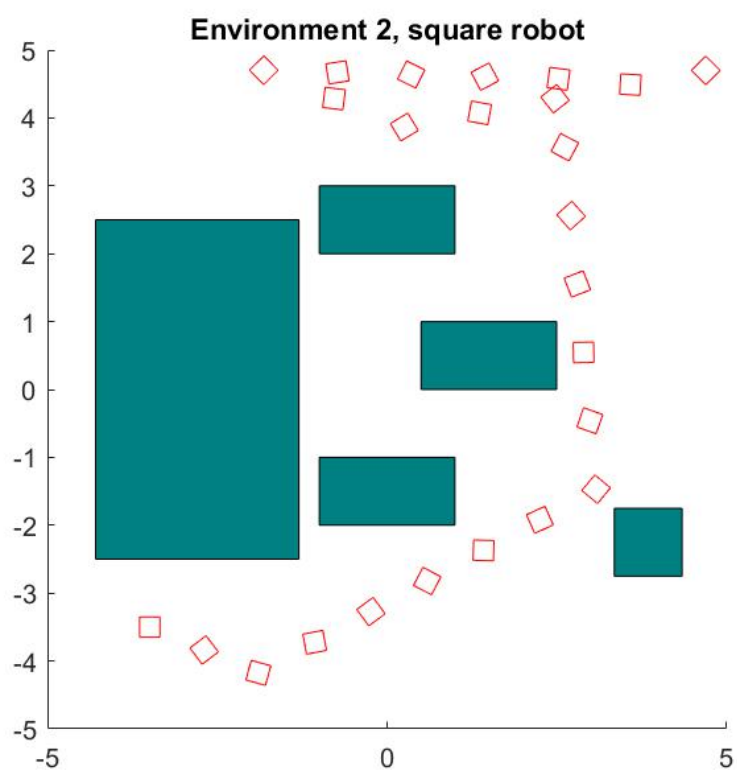
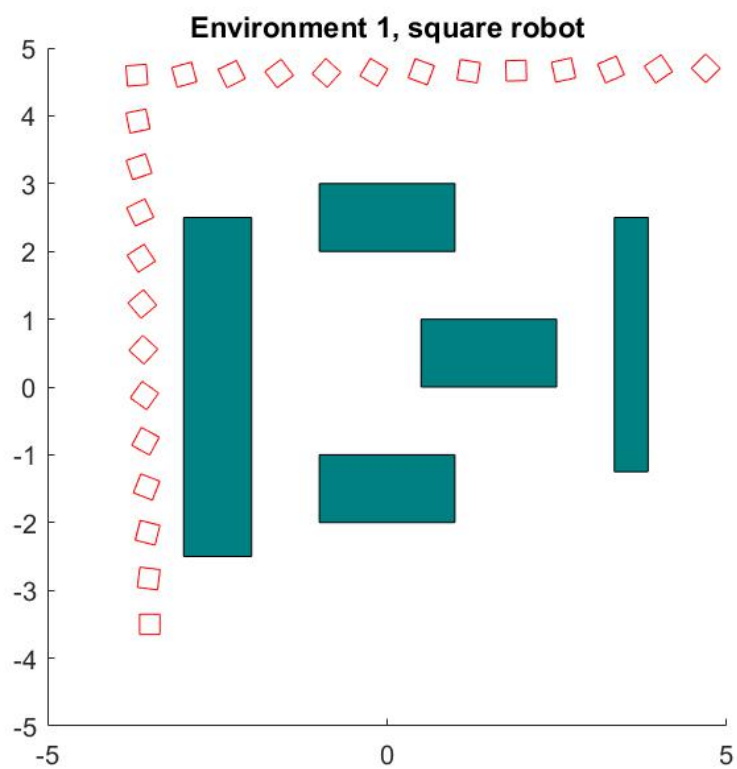
start state:  $(x, y) = (-2.75, -2.75)$ , goal state:  $(x, y) = (4.9, 0)$

Square robot:

State state:  $(x, y, \text{theta}) = (-3.5, -3.5, 0)$ , goal state:  $(x, y, \text{theta}) = (4.7, 4.7, \pi/4)$

4.





6.

For implementing RTP, I referred to the implementation of RRT in OMPL. I do not need the nearest neighbor data structure in RRT and I simply randomly expand the random tree.

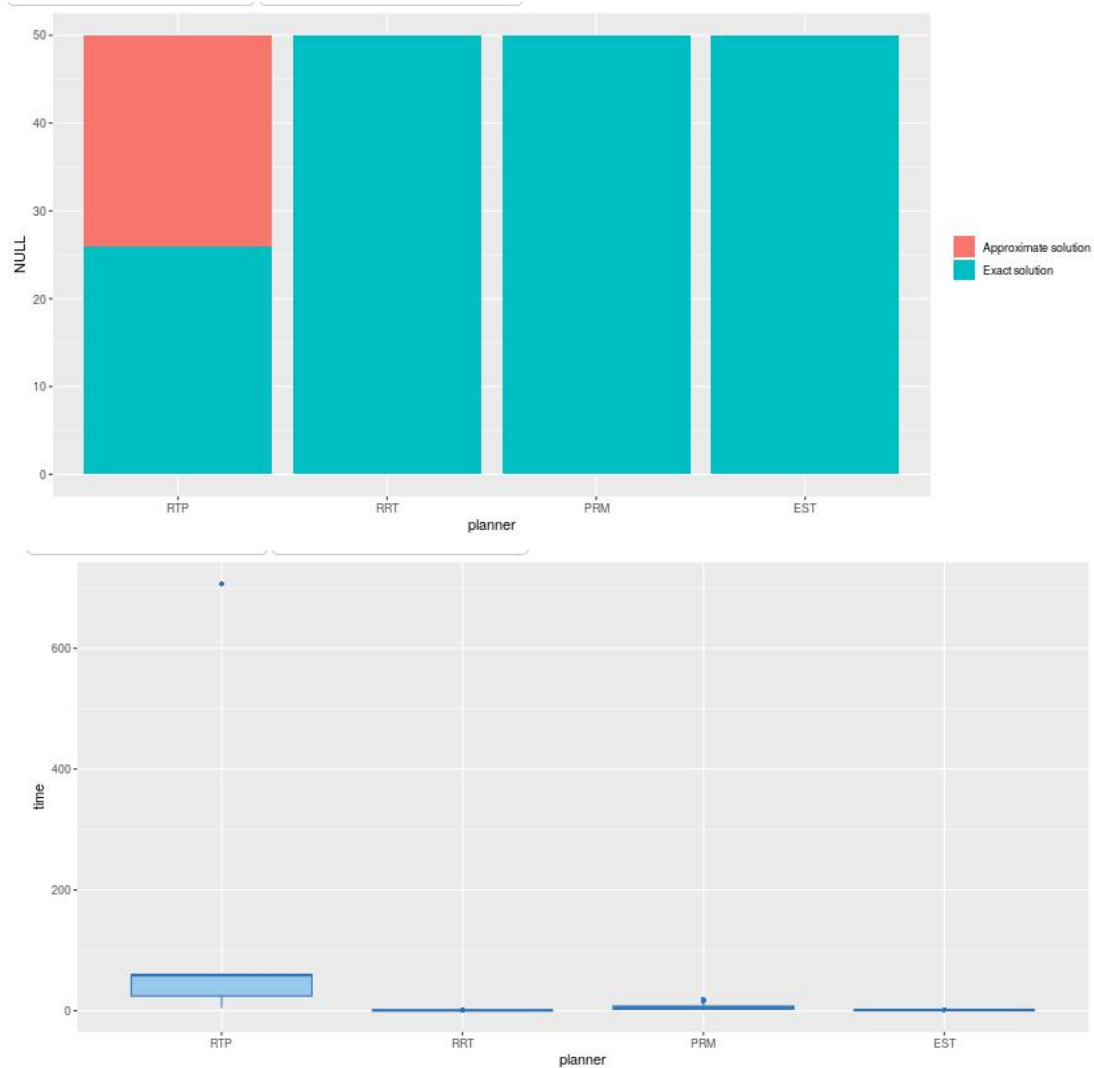
For testing RTP, I visualized the path of robots in the environment and check if the robot collided with obstacles or it moved out of boundary.

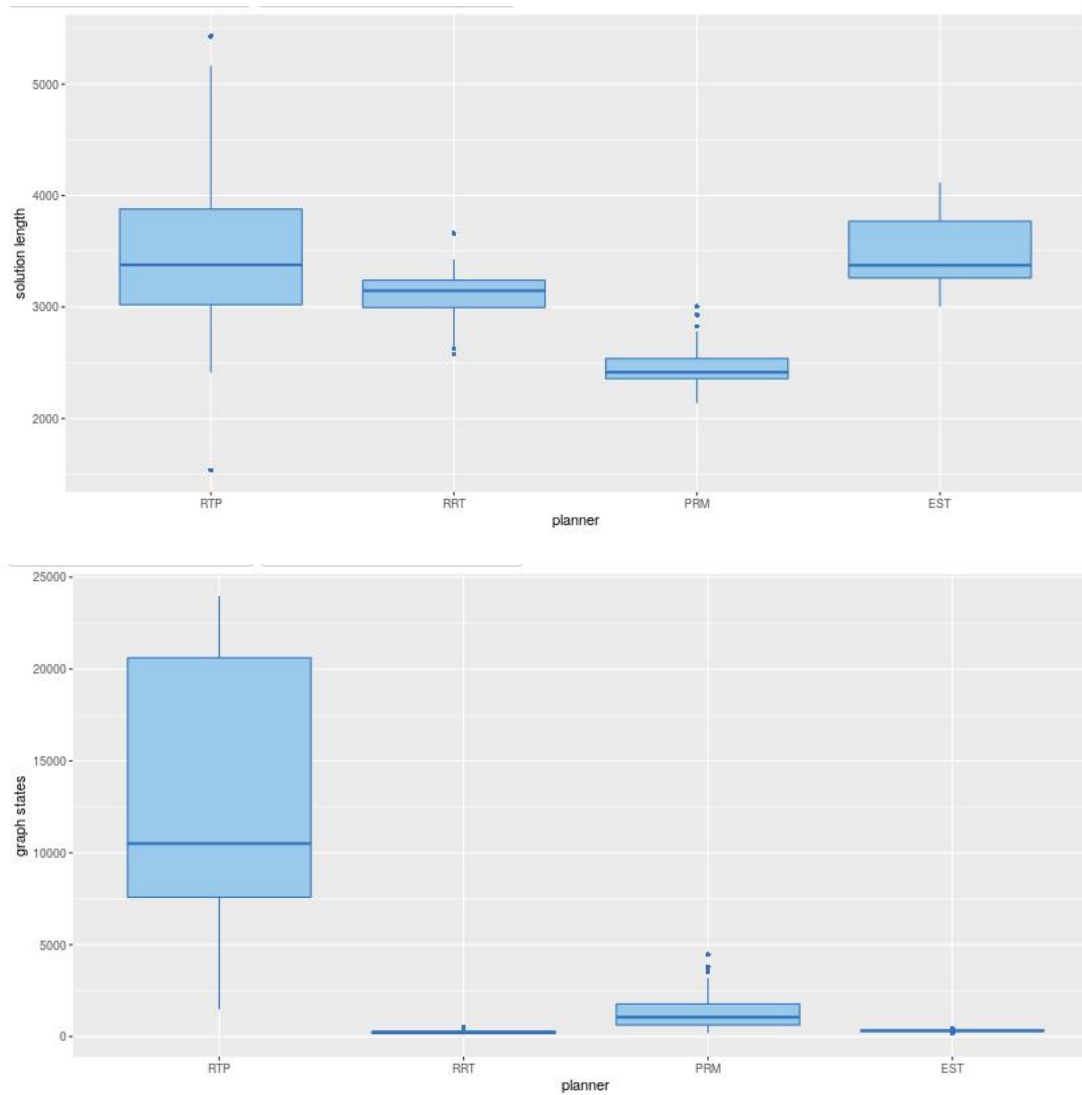
From the visualization outputs, obviously RTP is not performing well because the path is not the shortest path and it can deviate from the goal.

7.

Cubicles:

Time limit is 60s, the experiment is repeated 50 times for each planner

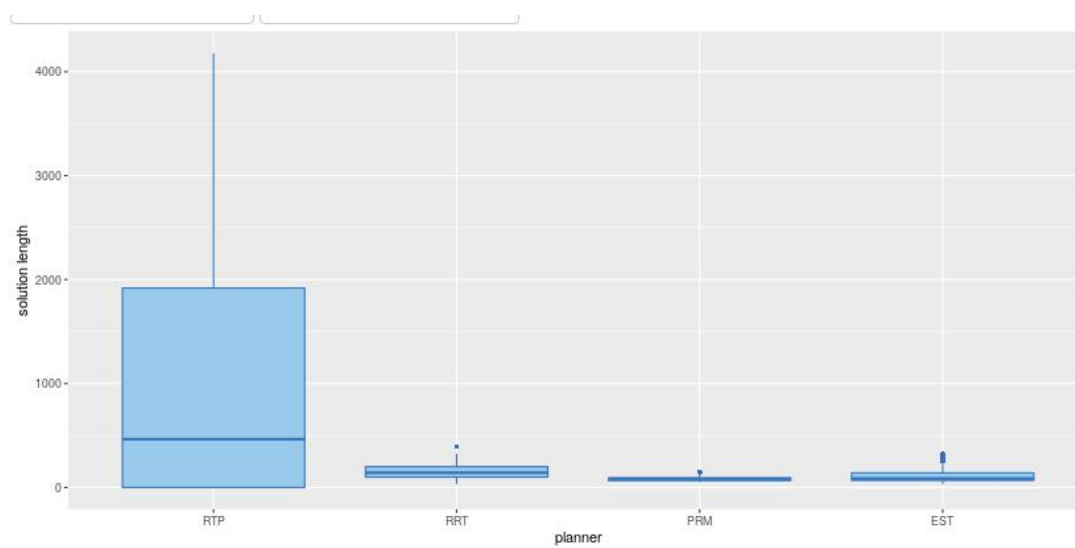
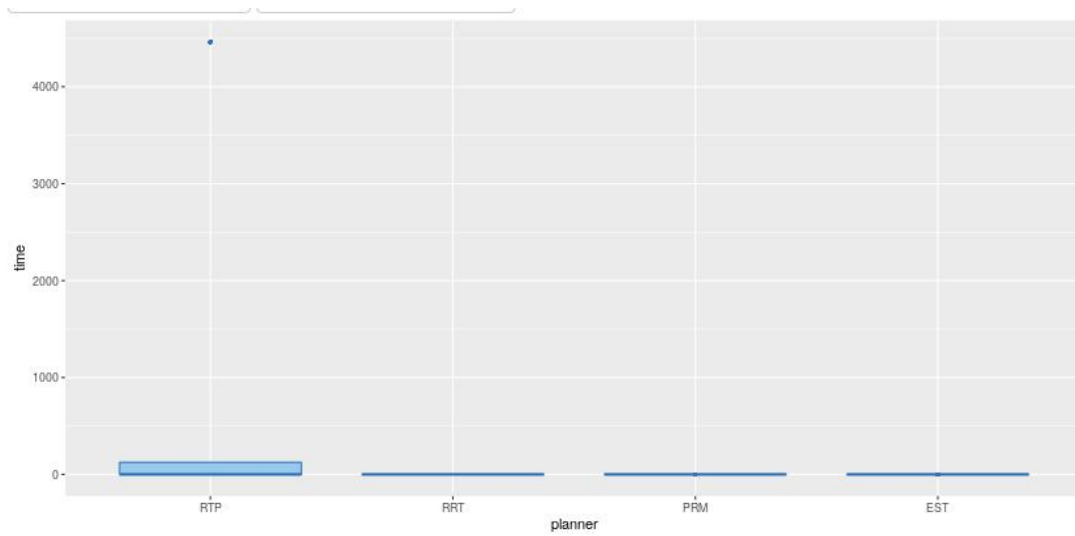
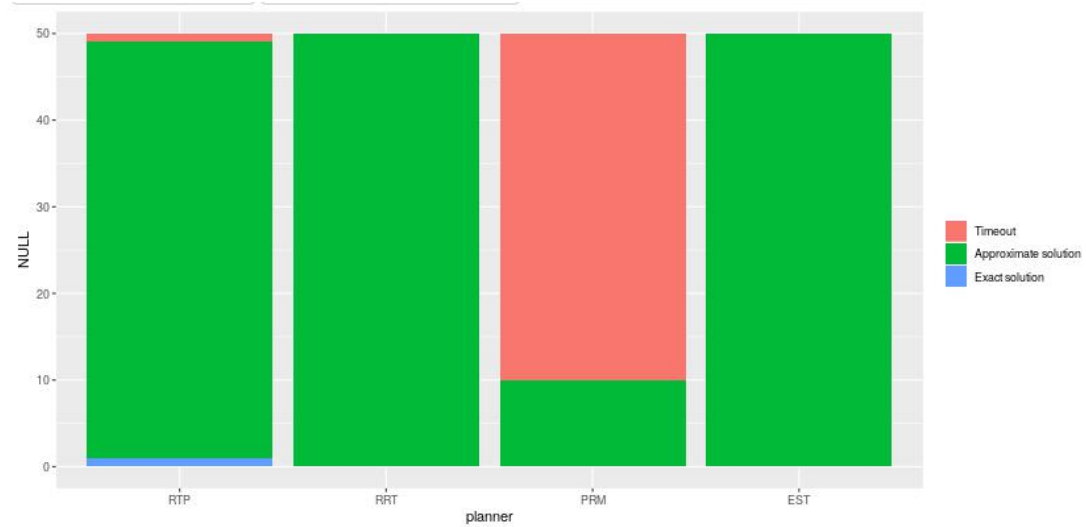


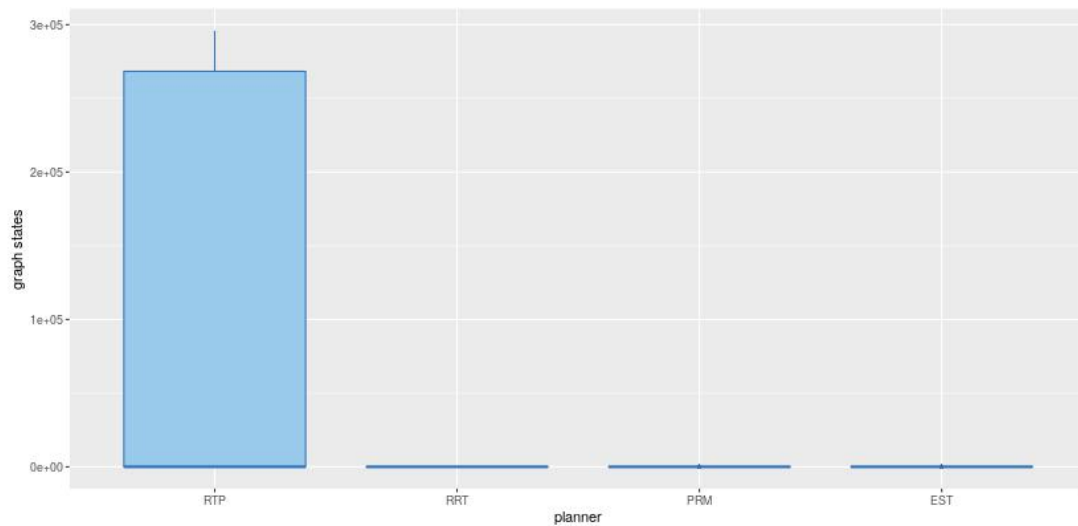


From this collection of statistic plots, we can see that 26 out 50 runs of RTP are exactly solved, the rest are approximate solutions. In terms of running time, most runs of RTP exhausted 60 seconds and only 25% can solve the problem in 20 seconds. In terms of solution length, the average length of RTP is around 3350, which is comparable to other planners, however, it has a much bigger deviation because the maximum solution length can exceed 5000. In terms of graph states produced by RTP, it is much bigger than other planners. The average number of states is over 10000 while the average of other planners are all below 2500.

Twistycool:

Time limit is 125s, the experiment is repeated 50 times for each planner





We can see that RTP can only get 1 exact solution for Twistycool problem and it even has 1 time-out record. In terms of running time, RTP can reach up to the time limit while RRT and EST take less time and are more stable. In terms of solution length, the average value for RTP is almost 500, which is higher than other planners, it also has a big deviation when the maximum solution length can exceed 4000. In terms of graph states, the maximum number of states of RTP is close to  $3e+05$ , which is much higher than other planners.

In conclusion, RTP is a pretty simple planner and performs worse than other planners.