Assignment 1 - Report

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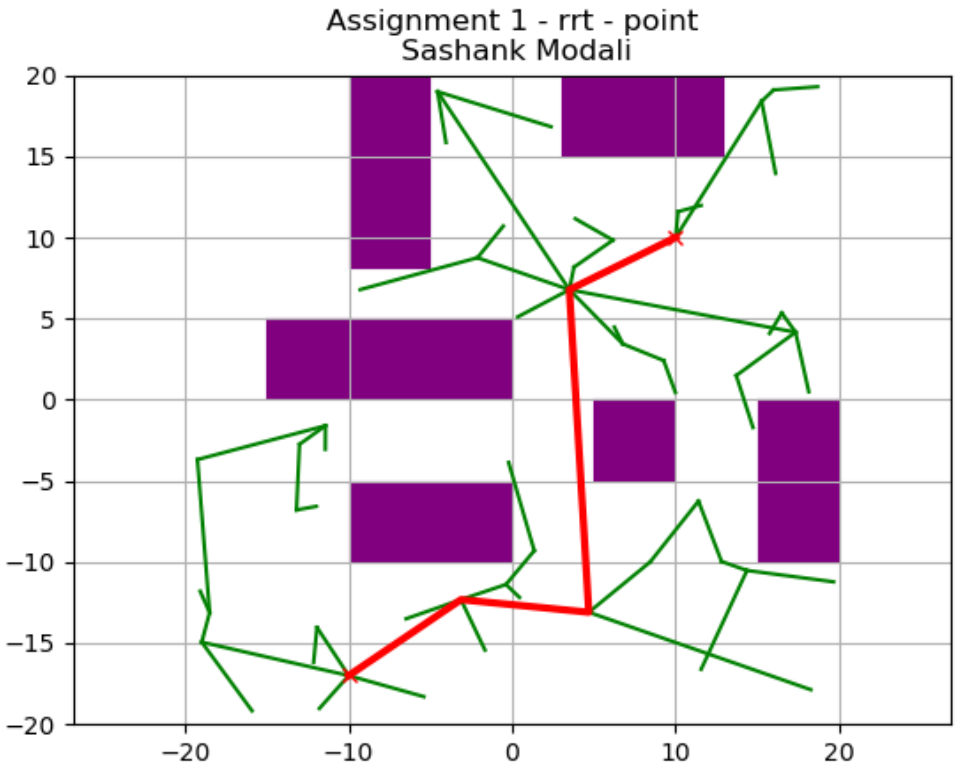
This report contains results obtained from assignment 1.

Question 1

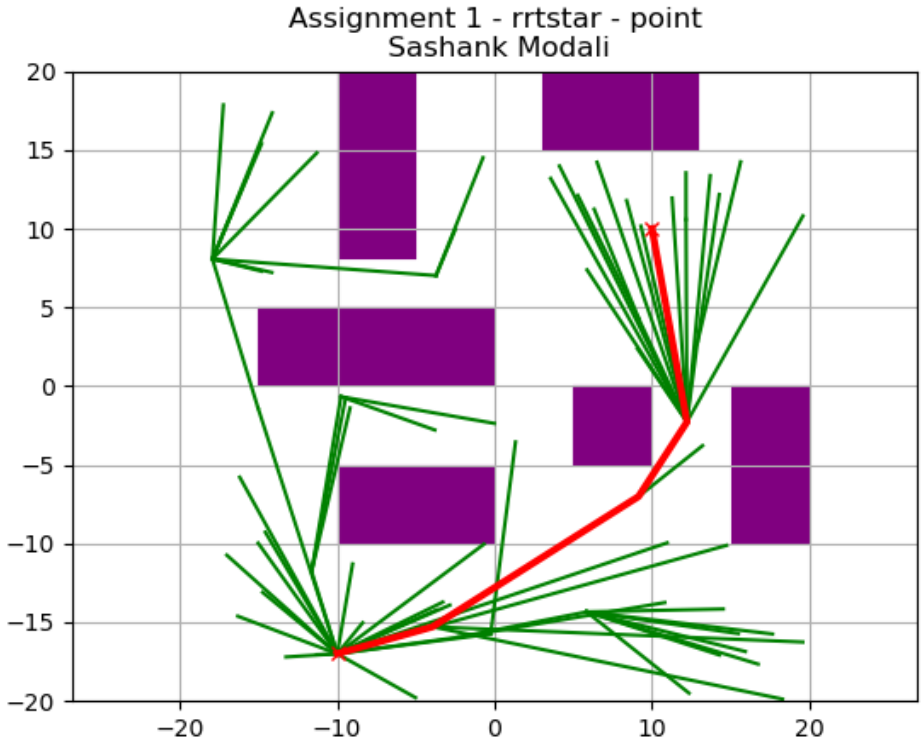
1) Results for 2d point mass are presented in this question.
    a) RRT - 2d point mass

        The image containing the tree and final path is presented below:



    b) RRT star - 2d point mass

        The image containing the tree and final path is presented below:



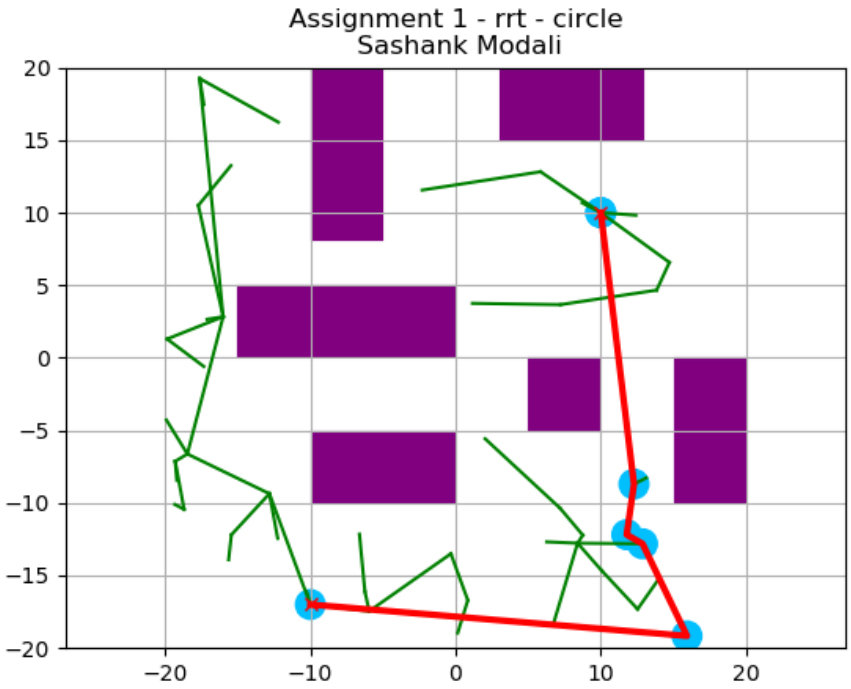
c) The table summarizing the above image (which is one sample of execution) for both RRT and RRT-star is presented below:

2D point-mass	RRT	RRT*
path cost	43.33986	35.60500
computation time	0.36 sec	19.78 sec

Here, it should be noted that these were obtained in headless mode.

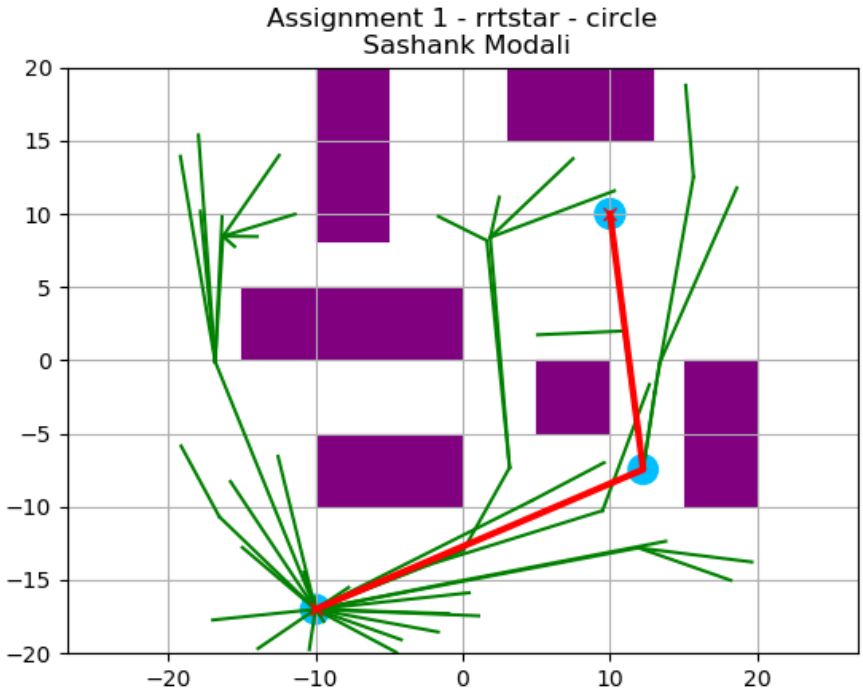
2) Results for Circular Rigid body are presented in this question.
   a) RRT - Circular Rigid body

The image containing the tree and final path is presented below:



b) RRT star - 2d point mass

The image containing the tree and final path is presented below:



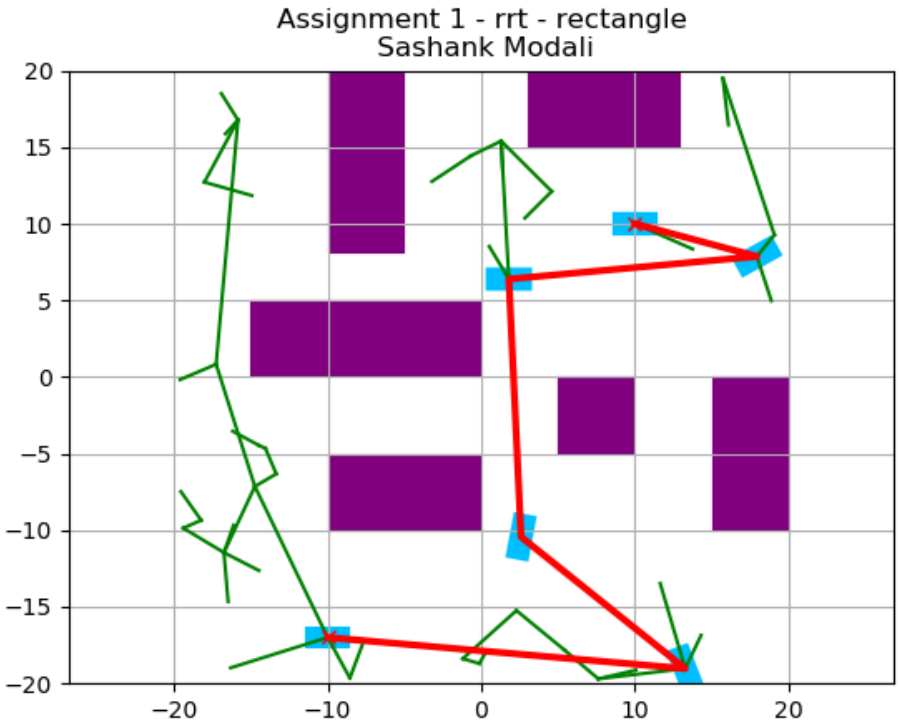
c) The table summarizing the above image (which is one sample of execution) for both RRT and RRT-star is presented below:

2D point-mass	RRT	RRT*
path cost	56.69354	41.80810
computation time	1.22 sec	19.00 sec

Here, it should be noted that these were obtained in headless mode.

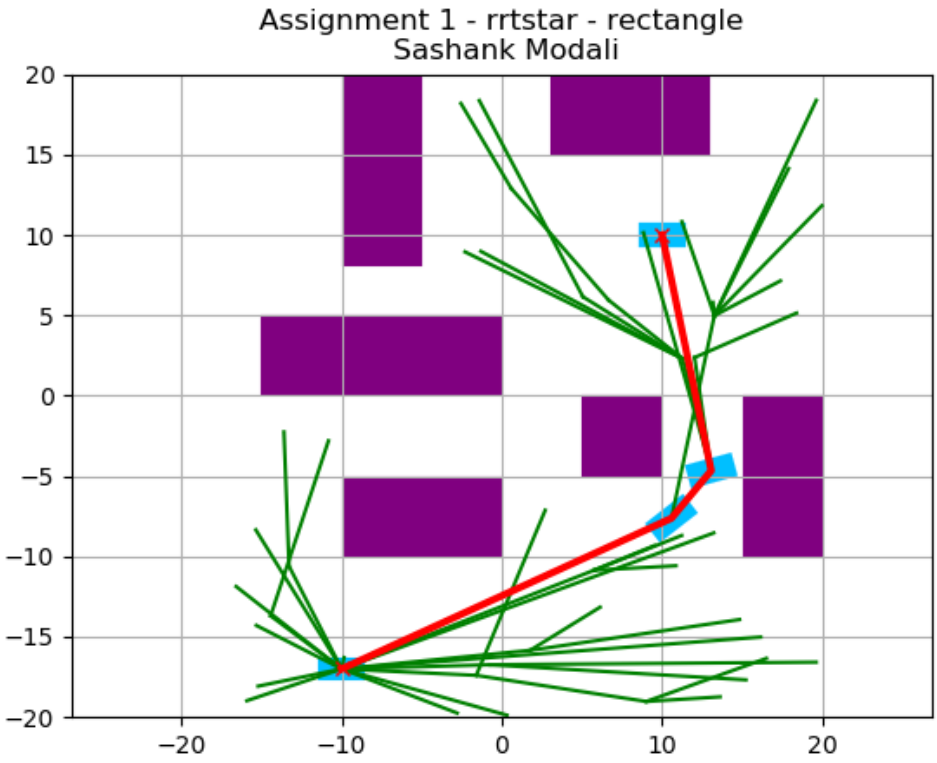
3) Results for Rectangular Rigid body are presented in this question.
   a) RRT - Rectangular Rigid body

The image containing the tree and final path is presented below:



   b) RRT star - 2d point mass

The image containing the tree and final path is presented below:



c) The table summarizing the above image (which is one sample of execution) for both RRT and RRT-star is presented below:

2D point-mass	RRT	RRT*
path cost	78.34727	41.46223
computation time	1.22 sec	21.54 sec

Here, it should be noted that these were obtained in headless mode.

4) Appendix - results :
For each of the above cases, 9 successful iterations were considered and the last iteration's results were presented above. The outputs obtained from +executing the code in each iteration have been presented below for the sake of completeness :

Results-RRT-point

--> Trial - 1 ----------
SUCCESS - found path of cost 65.99455 in 0.35sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (8.84, 9.72, '0.0°'), (17.43, 14.1, '0.0°'), (18.46, 18.52, '0.0°'), (12.02, -7.22, '0.0°'), (-10, -17, '0.0°')]

--> Trial - 2 ----------
SUCCESS - found path of cost 43.68318 in 0.26sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (4.49, 6.56, '0.0°'), (4.24, 3.76, '0.0°'), (5.73, -14.66, '0.0°'), (-10, -17, '0.0°')]

--> Trial - 3 ----------
SUCCESS - found path of cost 48.43590 in 0.30sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (14.71, 11.15, '0.0°'), (4.46, 9.29, '0.0°'), (3.78, 5.59, '0.0°'), (2.44, -8.9, '0.0°'), (-10, -17, '0.0°')]

--> Trial - 4 ----------
SUCCESS - found path of cost 53.06799 in 0.27sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (13.66, 14.12, '0.0°'), (9.11, -13.65, '0.0°'), (-10, -17, '0.0°')]

--> Trial - 5 ----------
SUCCESS - found path of cost 62.86707 in 0.22sec
Path found - [(10, 10, '0.0°'), (12.23, 13.15, '0.0°'), (14.04, 15.84, '0.0°'), (14.28, 17.54, '0.0°'), (16.96, 17.58, '0.0°'), (7.69, -14.63, '0.0°'), (-10, -17, '0.0°')]

--> Trial - 6 ----------
SUCCESS - found path of cost 48.18297 in 0.29sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (2.49, -2.35, '0.0°'), (-5.72, -0.7, '0.0°'), (-16.7, -5.75, '0.0°'), (-14.6, -11.31, '0.0°'), (-10, -17, '0.0°')]

--> Trial - 7 ----------
SUCCESS - found path of cost 67.44504 in 0.34sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (14.22, 11.81, '0.0°'), (13.89, -4.88, '0.0°'), (10.96, -10.55, '0.0°'), (8.27, -12.72, '0.0°'), (6.76, -16.84, '0.0°'), (2.55, -13.68, '0.0°'), (3.64, -7.51, '0.0°'), (5.64, -7.3, '0.0°'), (-10, -17, '0.0°')]

--> Trial - 8 ----------
SUCCESS - found path of cost 46.85501 in 0.38sec
Path found - [(10, 10, '0.0°'), (8.51, 5.38, '0.0°'), (10.16, 1.18, '0.0°'), (2.96, 3.88, '0.0°'), (3.29, -11.54, '0.0°'), (-10, -17, '0.0°')]

--> Trial - 9 ----------
SUCCESS - found path of cost 43.33986 in 0.36sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (3.5, 6.78, '0.0°'), (4.69, -13.1, '0.0°'), (-3.13, -12.32, '0.0°'), (-10, -17, '0.0°')]

Results-RRT-circle

--> Trial - 1 ----------
SUCCESS - found path of cost 48.04688 in 1.65sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (13.44, 6.15, '0.0°'), (12.49, -9.74, '0.0°'), (11.24, -13.17, '0.0°'), (-3.57, -19.9, '0.0°'), (-10, -17, '0.0°')]

--> Trial - 2 ----------
SUCCESS - found path of cost 49.94337 in 1.78sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (15.17, 8.71, '0.0°'), (11.75, -13.64, '0.0°'), (-10, -17, '0.0°')]

--> Trial - 3 ----------
SUCCESS - found path of cost 45.70789 in 1.55sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (4.9, 13.6, '0.0°'), (3.05, -11.71, '0.0°'), (-10, -17, '0.0°')]

--> Trial - 4 ----------
SUCCESS - found path of cost 61.35603 in 1.53sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (12.92, 8.61, '0.0°'), (11.44, -6.23, '0.0°'), (8.14, -10.89, '0.0°'), (17.53, -13.48, '0.0°'), (-10, -17, '0.0°')]

--> Trial - 5 ----------
SUCCESS - found path of cost 84.40434 in 1.62sec
Path found - [(10, 10, '0.0°'), (10.21, 11.46, '0.0°'), (3.23, 11.35, '0.0°'), (-1.2, 10.57, '0.0°'), (0.49, 6.04, '0.0°'), (-4.97, 6.94, '0.0°'), (-16.13, 6.62, '0.0°'), (-15.37, 17.31, '0.0°'), (-19.51, -9.4, '0.0°'), (-10, -17, '0.0°')]

--> Trial - 6 ----------
SUCCESS - found path of cost 56.17672 in 1.38sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (3.61, 10.14, '0.0°'), (3.6, 9.92, '0.0°'), (4.44, 4.02, '0.0°'), (1.37, -5.81, '0.0°'), (11.37, -9.47, '0.0°'), (-10, -17, '0.0°')]

--> Trial - 7 ----------
SUCCESS - found path of cost 44.50279 in 1.74sec
Path found - [(10, 10, '0.0°'), (10.92, 10.61, '0.0°'), (13.4, -5.88, '0.0°'), (3.68, -10.75, '0.0°'), (1.29, -13.52, '0.0°'), (-2.15, -16.06, '0.0°'), (-10, -17, '0.0°')]

--> Trial - 8 ----------
SUCCESS - found path of cost 42.58129 in 1.74sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (2.15, -0.23, '0.0°'), (5.04, -9.88, '0.0°'), (-6.03, -19.71, '0.0°'), (-10, -17, '0.0°')]

--> Trial - 9 ----------
SUCCESS - found path of cost 56.69354 in 1.22sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (12.28, -8.7, '0.0°'), (11.78, -12.19, '0.0°'), (12.87, -12.81, '0.0°'), (15.93, -19.17, '0.0°'), (-10, -17, '0.0°')]

Results-RRT-rectangle

--> Trial - 1 ----------
SUCCESS - found path of cost 55.06419 in 2.07sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (13.02, -5.33, '69.26°'), (12.09, -6.41, '10.89°'), (9.23, -9.12, '115.03°'), (12.62, -19.88, '44.4°'), (-10, -17, '0.0°')]

--> Trial - 2 ----------
SUCCESS - found path of cost 49.06863 in 1.70sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (8.47, 10.03, '252.21°'), (13.35, -5.26, '76.09°'), (7.18, -11.86, '283.04°'), (-6.26, -14.86, '95.28°'), (-7.84, -12.02, '188.73°'), (-10, -17, '0.0°')]

--> Trial - 3 ----------
SUCCESS - found path of cost 69.40498 in 2.29sec
Path found - [(10, 10, '0.0°'), (6.17, 8.51, '191.67°'), (13.35, -1.36, '247.33°'), (9.98, -10.17, '121.62°'), (7.98, -13.08, '324.0°'), (18.44, -18.19, '104.47°'), (-10, -17, '0.0°')]

--> Trial - 4 ----------
SUCCESS - found path of cost 47.50565 in 2.15sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (1.0, -2.01, '54.41°'), (5.18, -8.77, '191.35°'), (4.58, -14.2, '269.51°'), (4.44, -15.13, '124.76°'), (6.24, -15.23, '269.1°'), (-10, -17, '0.0°')]

--> Trial - 5 ----------
SUCCESS - found path of cost 52.13111 in 1.75sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (12.22, 4.3, '208.46°'), (12.72, -6.31, '214.2°'), (11.99, -7.02, '35.61°'), (6.51, -6.52, '8.45°'), (6.68, -9.38, '53.29°'), (7.8, -17.44, '312.21°'), (-7.93, -16.54, '74.16°'), (-10, -17, '0.0°')]

--> Trial - 6 ----------
SUCCESS - found path of cost 38.60149 in 2.29sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (1.34, -1.96, '326.71°'), (2.66, -9.4, '310.88°'), (1.33, -13.67, '301.49°'), (-10, -17, '0.0°')]

--> Trial - 7 ----------
SUCCESS - found path of cost 53.17941 in 1.40sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (15.59, 10.64, '344.41°'), (11.68, -5.84, '213.24°'), (7.21, -18.41, '110.75°'), (-10, -17, '0.0°')]

--> Trial - 8 ----------
SUCCESS - found path of cost 56.62966 in 1.05sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (16.36, 10.54, '279.92°'), (14.49, 14.81, '254.28°'), (11.45, -6.83, '105.14°'), (-10, -17, '0.0°')]

--> Trial - 9 ----------
SUCCESS - found path of cost 78.34727 in 1.22sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (17.94, 7.87, '29.08°'), (1.8, 6.39, '359.91°'), (2.59, -10.43, '79.42°'), (13.27, -19.03, '111.09°'), (-10, -17, '0.0°')]

Results-RRTstar-point

--> Trial - 1 ----------
SUCCESS - found path of cost 35.07718 in 14.24sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (5.66, 2.48, '0.0°'), (1.41, -9.57, '0.0°'), (-10, -17, '0.0°')]

--> Trial - 2 ----------
SUCCESS - found path of cost 37.44980 in 14.04sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (4.9, 7.93, '0.0°'), (4.54, -3.99, '0.0°'), (2.15, -7.7, '0.0°'), (-2.37, -13.08, '0.0°'), (-10, -17, '0.0°')]

--> Trial - 3 ----------
SUCCESS - found path of cost 38.99418 in 17.13sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (1.19, 4.72, '0.0°'), (2.39, -9.43, '0.0°'), (-10, -17, '0.0°')]

--> Trial - 4 ----------
SUCCESS - found path of cost 36.59491 in 19.13sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (4.51, 0.05, '0.0°'), (4.49, -3.45, '0.0°'), (-0.98, -14.56, '0.0°'), (-10, -17, '0.0°')]

--> Trial - 5 ----------
SUCCESS - found path of cost 38.31609 in 18.71sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (4.5, 2.32, '0.0°'), (-1.5, -1.59, '0.0°'), (-10.2, -4.45, '0.0°'), (-10, -17, '0.0°')]

--> Trial - 6 ----------
SUCCESS - found path of cost 36.41877 in 17.41sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (4.59, 5.56, '0.0°'), (1.63, -8.38, '0.0°'), (-1.37, -13.33, '0.0°'), (-10, -17, '0.0°')]

--> Trial - 7 ----------
SUCCESS - found path of cost 39.90434 in 18.80sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (12.22, -2.28, '0.0°'), (9.15, -7.01, '0.0°'), (-3.94, -15.29, '0.0°'), (-10, -17, '0.0°')]

--> Trial - 8 ----------
SUCCESS - found path of cost 35.59498 in 18.46sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (5.01, 0.57, '0.0°'), (-0.09, -12.53, '0.0°'), (-10, -17, '0.0°')]

--> Trial - 9 ----------
SUCCESS - found path of cost 35.60500 in 19.78sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (3.67, 0.34, '0.0°'), (2.61, -7.05, '0.0°'), (-3.62, -14.57, '0.0°'), (-10, -17, '0.0°')]

Results-RRTstar-circle

--> Trial - 1 ----------
SUCCESS - found path of cost 41.98798 in 42.64sec
Path found - [(10, 10, '0.0°'), (11.97, 7.74, '0.0°'), (13.28, -4.99, '0.0°'), (0.8, -11.21, '0.0°'), (-10, -17, '0.0°')]

--> Trial - 2 ----------
SUCCESS - found path of cost 38.02508 in 44.75sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (1.66, -0.8, '0.0°'), (3.24, -9.71, '0.0°'), (-4.29, -15.28, '0.0°'), (-10, -17, '0.0°')]

--> Trial - 3 ----------
SUCCESS - found path of cost 39.18735 in 51.33sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (5.66, 6.2, '0.0°'), (1.78, -5.33, '0.0°'), (4.07, -8.08, '0.0°'), (-1.46, -15.08, '0.0°'), (-10, -17, '0.0°')]

--> Trial - 4 ----------
SUCCESS - found path of cost 40.82203 in 52.93sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (12.81, 0.02, '0.0°'), (11.05, -6.78, '0.0°'), (-2.51, -13.94, '0.0°'), (-10, -17, '0.0°')]

--> Trial - 5 ----------
SUCCESS - found path of cost 41.29049 in 54.10sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (2.98, 7.18, '0.0°'), (1.56, -5.31, '0.0°'), (3.67, -11.28, '0.0°'), (-10, -17, '0.0°')]

--> Trial - 6 ----------
SUCCESS - found path of cost 41.01423 in 58.44sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (12.24, -6.09, '0.0°'), (-10, -17, '0.0°')]

--> Trial - 7 ----------
SUCCESS - found path of cost 42.20454 in 58.97sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (11.32, 2.72, '0.0°'), (11.88, -8.07, '0.0°'), (8.92, -7.82, '0.0°'), (-10, -17, '0.0°')]

--> Trial - 8 ----------
SUCCESS - found path of cost 37.58449 in 60.13sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (1.48, -2.71, '0.0°'), (2.81, -9.22, '0.0°'), (-0.32, -13.59, '0.0°'), (-10, -17, '0.0°')]

--> Trial - 9 ----------
SUCCESS - found path of cost 41.80810 in 19.00sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (12.25, -7.45, '0.0°'), (-10, -17, '0.0°')]

Results-RRTstar-rectangle

--> Trial - 1 ----------
SUCCESS - found path of cost 42.87163 in 46.44sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (13.1, -4.06, '124.71°'), (5.26, -14.44, '114.97°'), (-10, -17, '0.0°')]

--> Trial - 2 ----------
SUCCESS - found path of cost 38.25681 in 49.51sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (1.29, -2.24, '169.32°'), (2.43, -12.02, '298.39°'), (-10, -17, '0.0°')]

--> Trial - 3 ----------
SUCCESS - found path of cost 55.76093 in 52.02sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (16.75, 4.56, '206.7°'), (11.73, -0.92, '17.07°'), (14.46, -15.84, '273.72°'), (-10, -17, '0.0°')]

--> Trial - 4 ----------
SUCCESS - found path of cost 41.52605 in 51.37sec
Path found - [(10, 10, '0.0°'), (10.49, 9.78, '248.83°'), (13.15, -1.45, '328.18°'), (11.33, -7.1, '129.13°'), (-10, -17, '0.0°')]

--> Trial - 5 ----------
SUCCESS - found path of cost 48.45386 in 55.96sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (10.77, 12.63, '243.93°'), (13.63, 4.15, '266.48°'), (12.84, -7.99, '329.2°'), (7.2, -9.62, '239.82°'), (-10, -17, '0.0°')]

--> Trial - 6 ----------
SUCCESS - found path of cost 38.29512 in 55.13sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (1.6, -1.6, '63.05°'), (4.32, -7.77, '356.79°'), (-5.49, -15.45, '183.45°'), (-10, -17, '0.0°')]

--> Trial - 7 ----------
SUCCESS - found path of cost 38.62208 in 55.62sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (3.08, 2.52, '342.18°'), (3.3, -8.53, '48.77°'), (-3.45, -16.99, '129.18°'), (-10, -17, '0.0°')]

--> Trial - 8 ----------
SUCCESS - found path of cost 42.17058 in 61.09sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (13.35, -6.01, '284.01°'), (9.2, -7.77, '167.25°'), (-10, -17, '0.0°')]

--> Trial - 9 ----------
SUCCESS - found path of cost 41.46223 in 21.54sec
Path found - [(10, 10, '0.0°'), (10, 10, '0.0°'), (13.06, -4.66, '195.25°'), (10.58, -7.63, '37.9°'), (-10, -17, '0.0°')]
