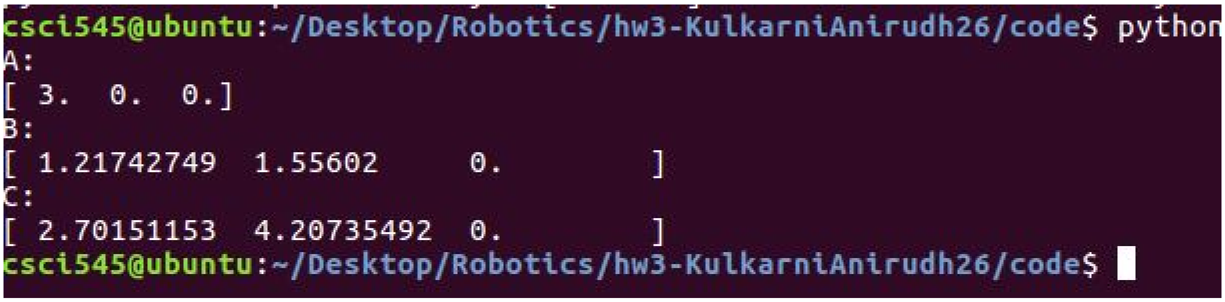
ROBOTICS HOMEWORK 3 REPORT

Q. 1



As we can observe from the screenshot above, the forward kinematics for

1. Q = [0,0,0], L = [1,1,1] : [3,0,0]
2. Q = [0.3,0.4,0.8] , L = [0.8,0.5,1.0]: [1.217,1.556,0]
3. Q= [1, 0, 0], L = [3, 1, 1]: [2.7015, 4.2073, 0]

Q. 2

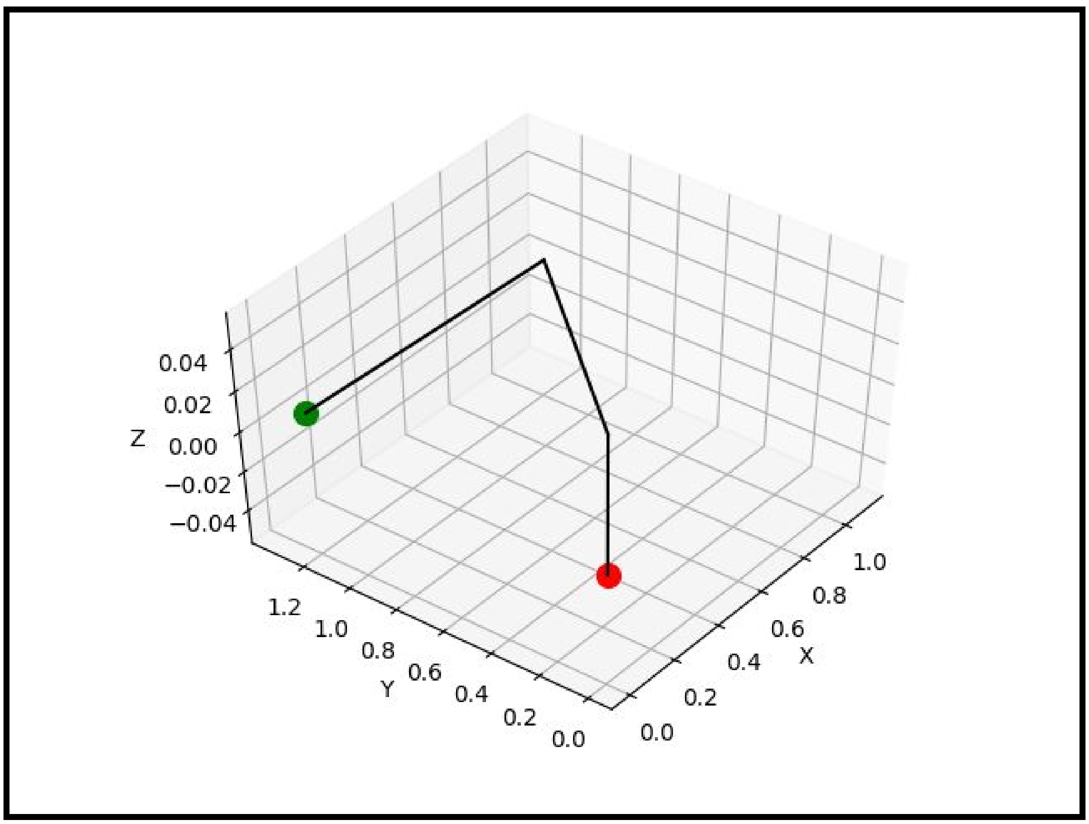


Figure 1

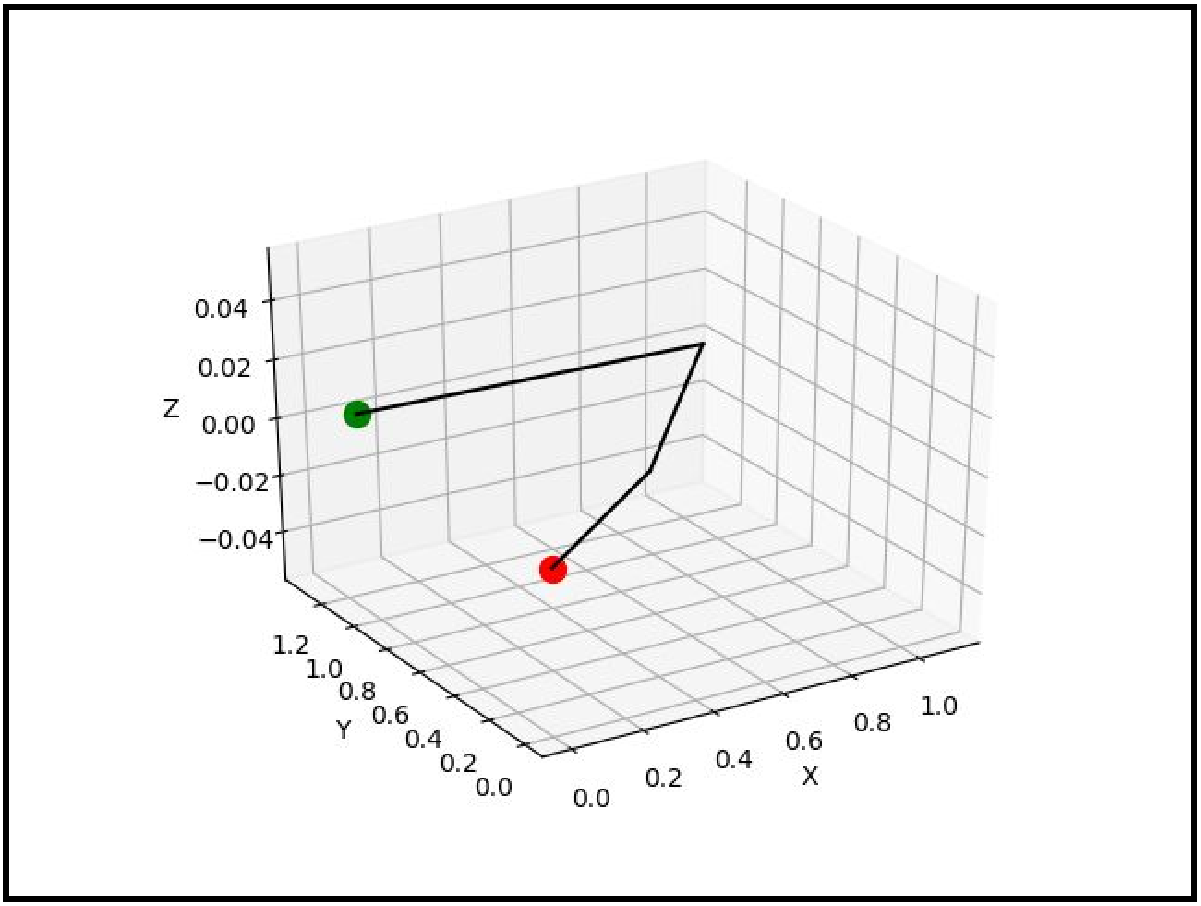


Figure 2

```
csci545@ubuntu: ~/Desktop/Robotics/hw3-KulkarniAnirudh26/code
csci545@ubuntu:~/Desktop/Robotics/hw3-KulkarniAnirudh26/code$ python ik-a.py
Initial SSE Objective: 1.86676139743
Final SSE Objective: 5.9739204714e-10
Solution
x1 = 0.743128294758
x2 = 0.204527996217
x3 = 2.14960306153
csci545@ubuntu:~/Desktop/Robotics/hw3-KulkarniAnirudh26/code$
```

Figure 1 and Figure 2 show two different views for the same robot, the base of the robot is at red circle, while its end-effector position is marked at green blob

Q. 4

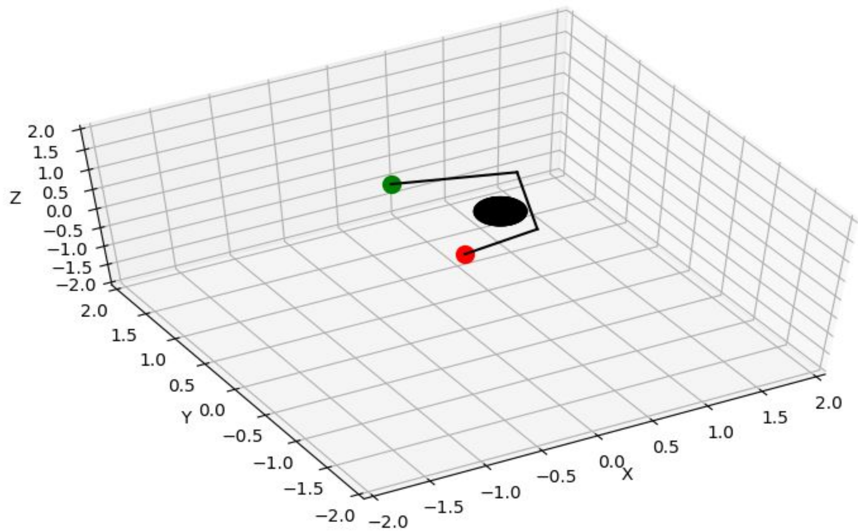


Figure 3

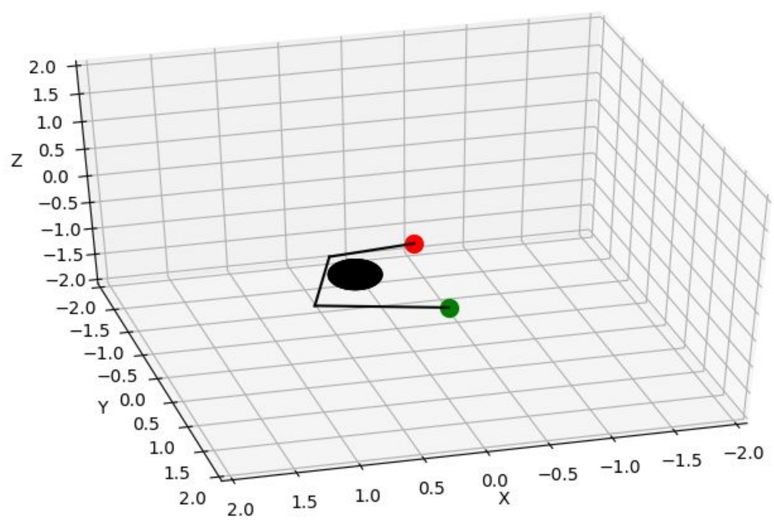


Figure 4

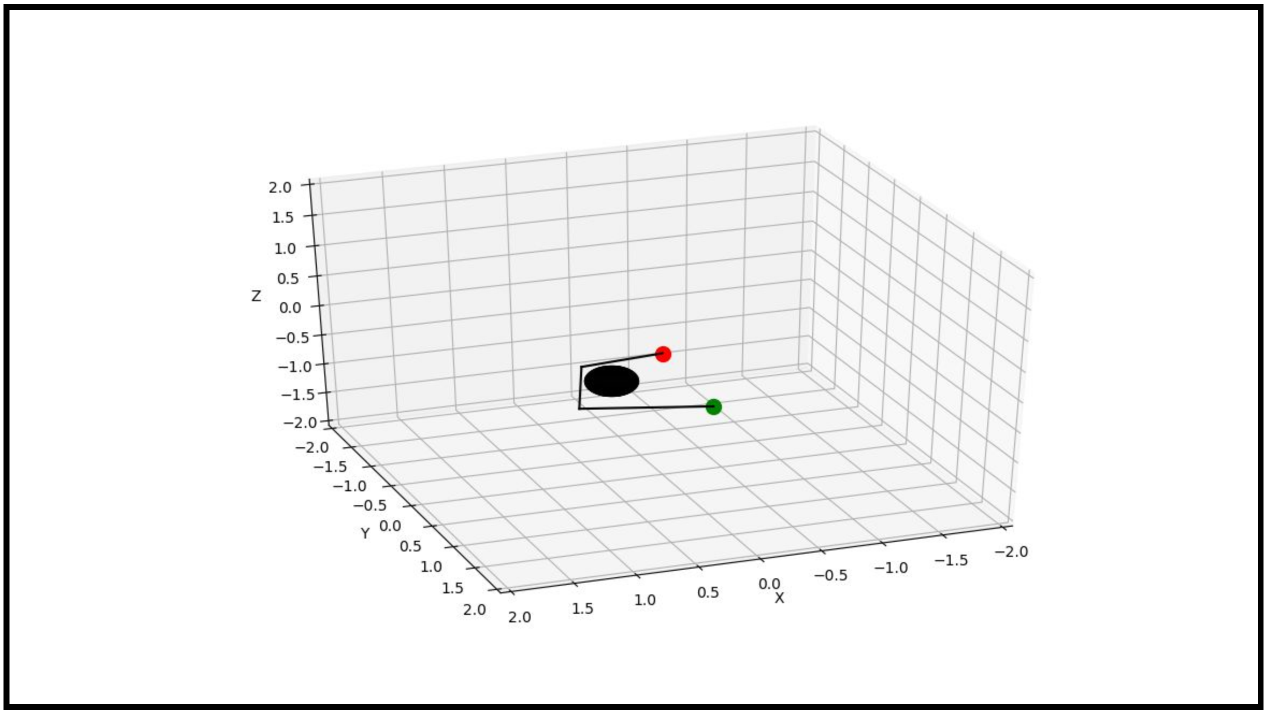


Figure 5

Figure 3, Figure 4, Figure 5 represent the links of the robot avoiding obstacles and placing the end-effector at the desired location.

Q.5
Changing radius

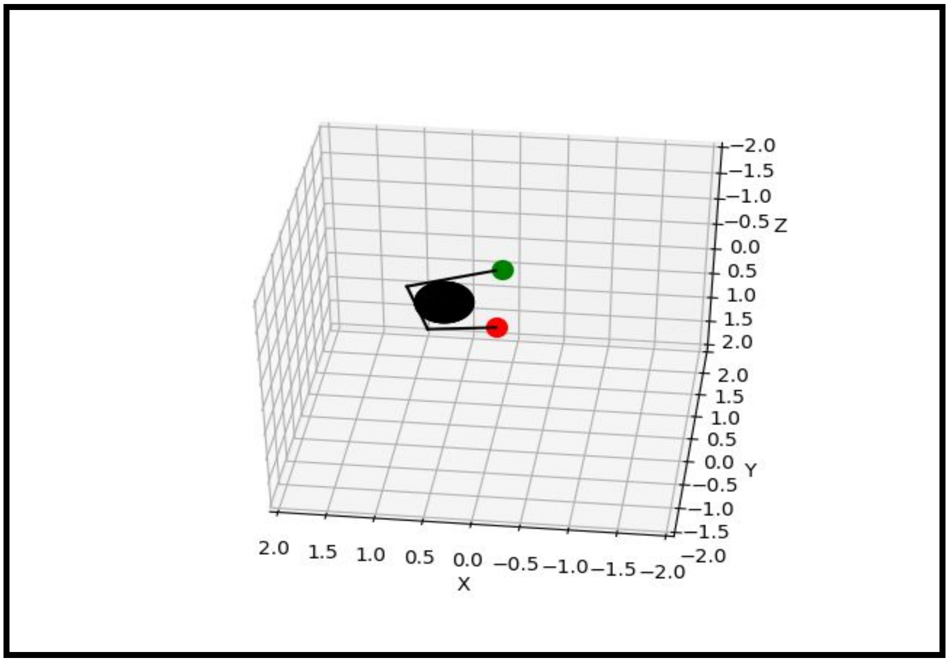


Figure 6 radius= 0.3

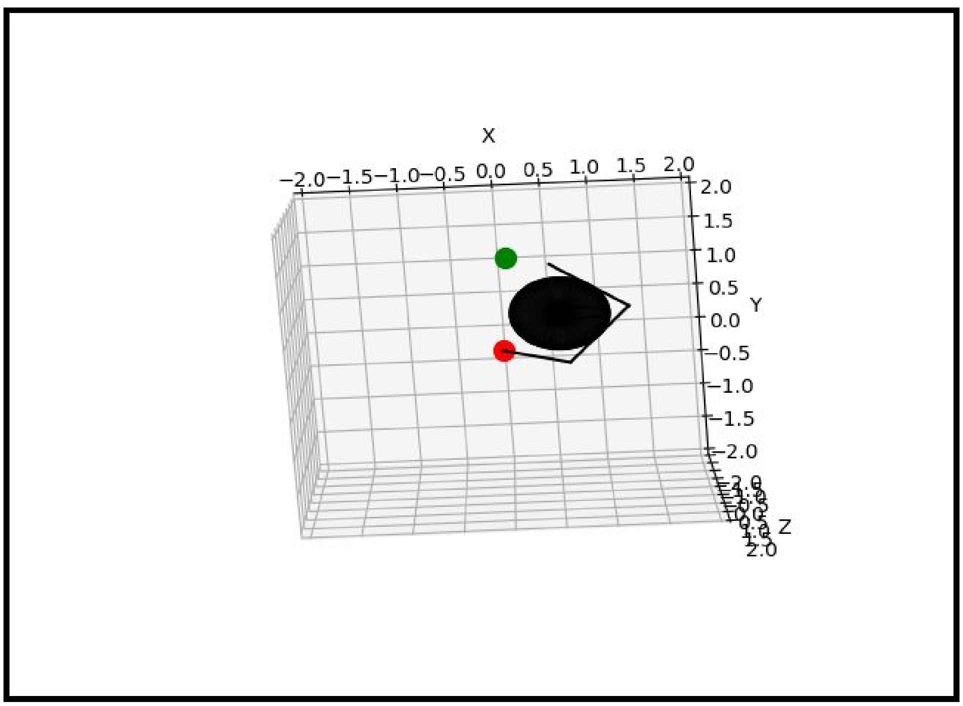


Figure 7 radius= 0.5

We can observe that as the radius of the sphere increases, it becomes difficult for the robot to find a combination of link angles (q), such that it reaches the end-effector position specified by the green blob, without intersecting with the sphere.

In Figure 6, the radius of the obstacle is 0.3. Although, the robot could find the link configurations that did not intersect with the obstacle, we can see that the last link of the robot is very close to the green blob but not exactly there.

In FIgure 7, the radius of the obstacle is 0.5. Here, we can observe that the robot links could not reach the specified destination, as it was trying to avoid the sphere (obstacle).

The final configuration of the robot links is obtained by minimizing the objective function (distance) along with the constraint of not intersecting with the obstacle. Increasing the radius of the sphere (obstacle) changes the constraint conditions and as a result the final configuration of the links

Changing starting position

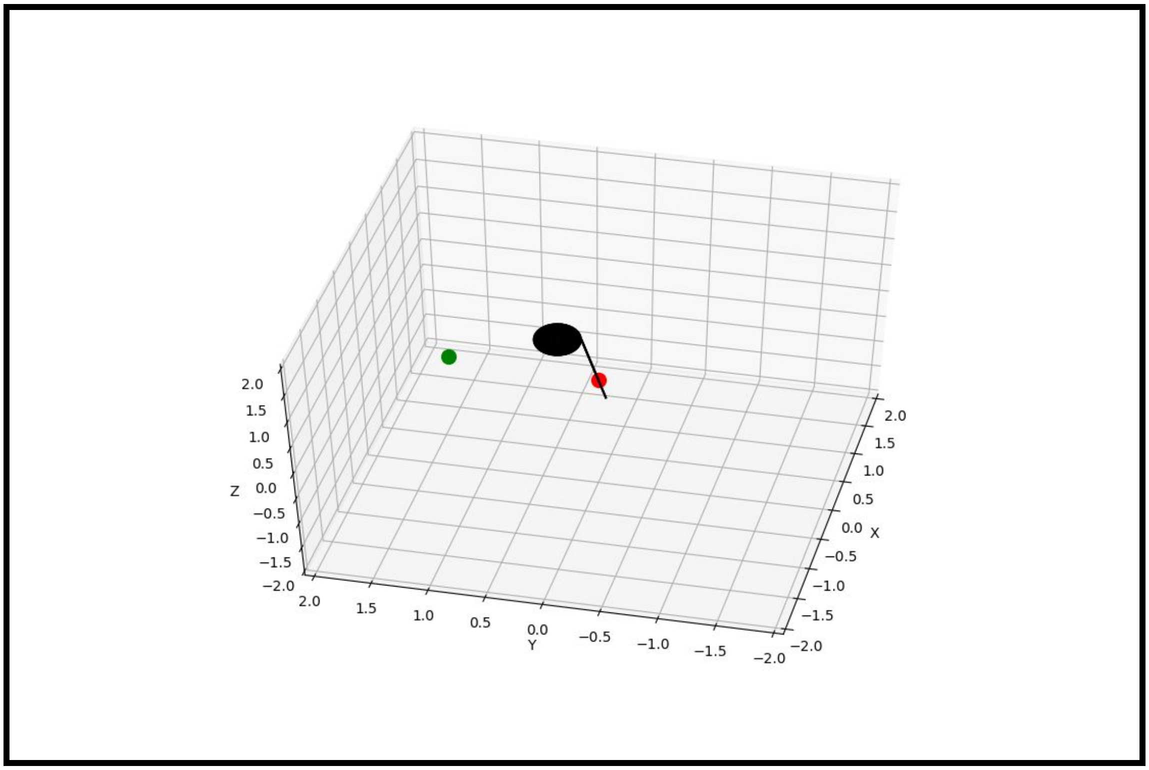


Figure 8 q0 = [0,0,2]

In Figure 8, the starting position of the robot links is given as [0,0,2]. Although it is very close to the original starting position, we see that the robot could not align its links to reach the end-effector.

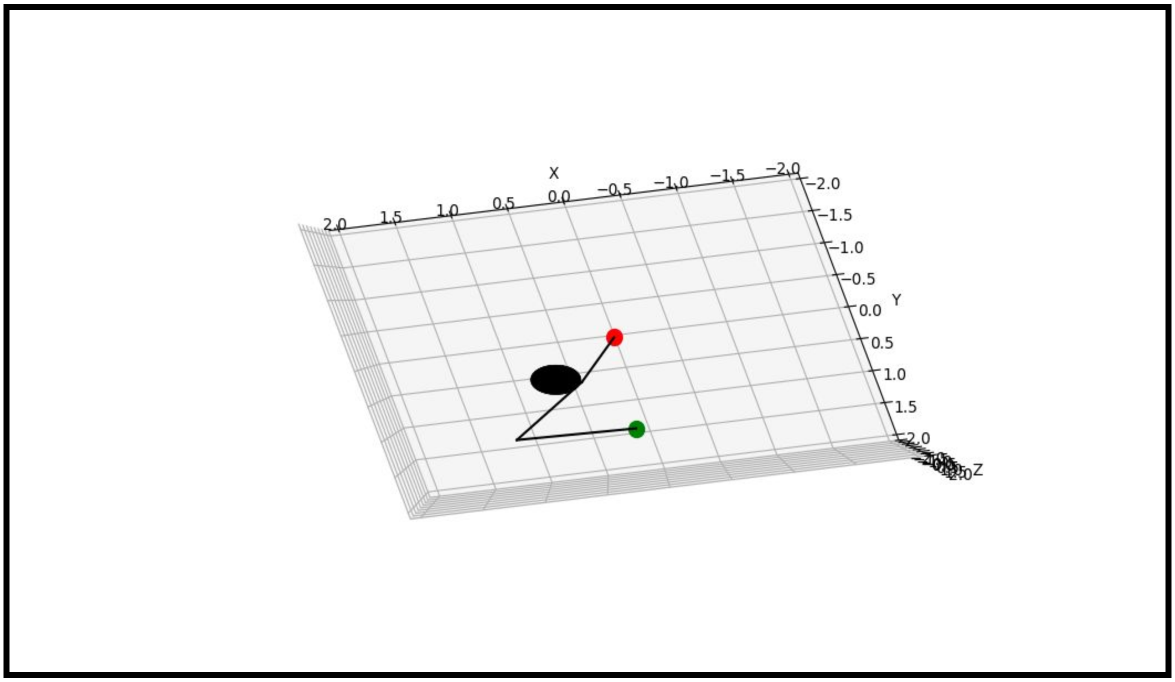


Figure 9 qo = [1,0,2]

In Figure 9, the robot's initial configuration is given as [1,0,2]. We can see that the robot was able to find a solution that could align the robot links to the desired location, in-spite of having a different initial configuration. However, it is going very close to the obstacle.

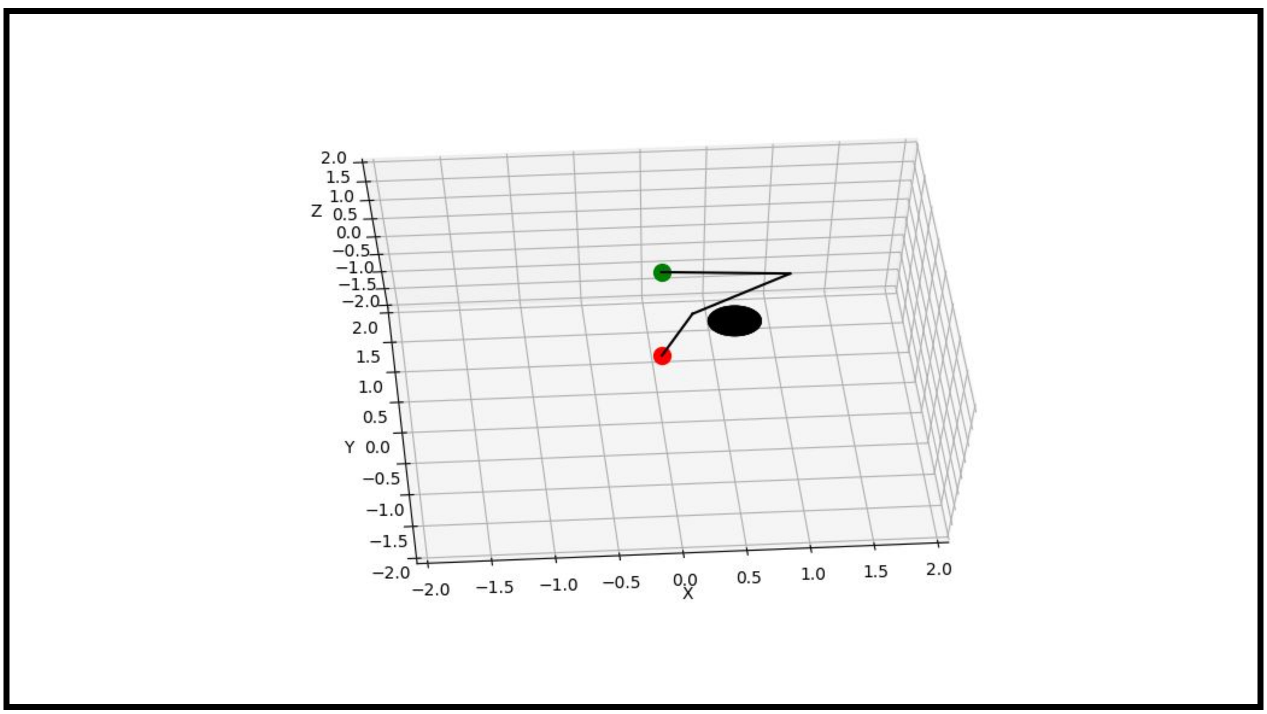


Figure 10 q0 = [1,1,2]

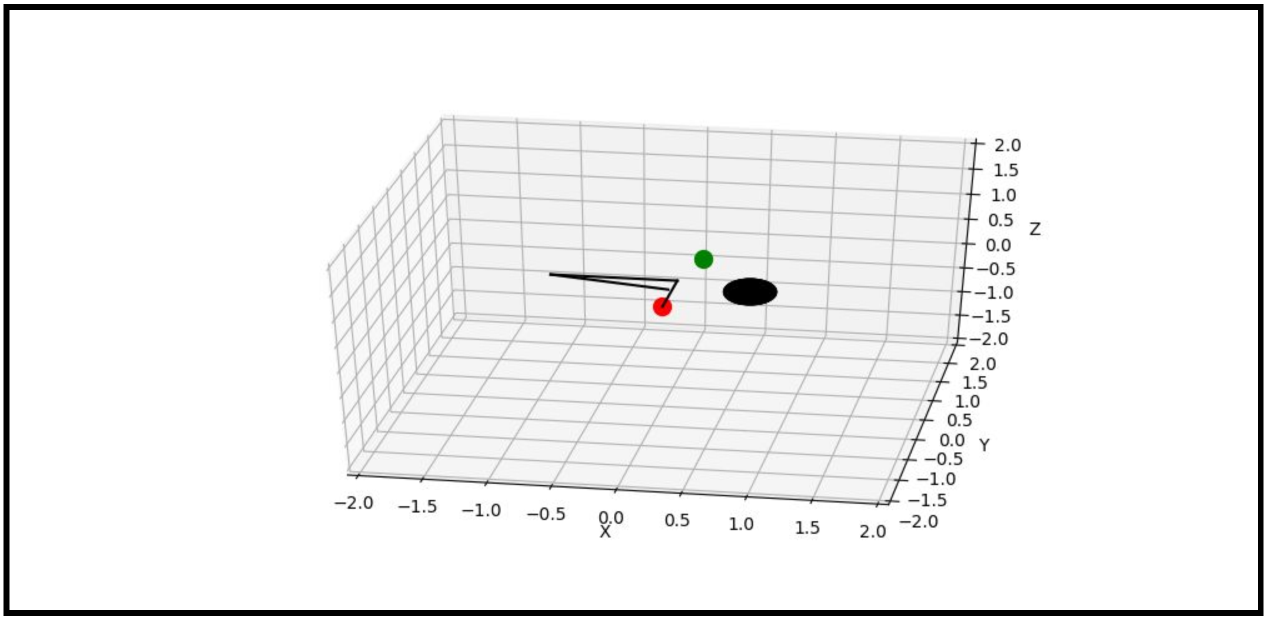


Figure 11 qo = [2,2,2]

In Figure 10, in-spite of a different initial configuration, the robot could find a way to align its links to reach the desired position and avoid obstacles as well.

In FIgure 11, the initial position was such that the arms could not be moved to reach the desired end-effector position.

Thus, in general
If the initial position is such that the arms/links of the robot cannot move themselves in-order to reach the destination, then we cannot find a solution. Thus, the starting position of the planar plays an important role