

**Q2.**

**Ans:** Following are the actions with defined preconditions and effects:

**a. Action 1: Move to Pantry from Kitchen:**

**i. Description:** This action enables the robot to transition from the kitchen to the pantry, allowing it to access or store items specifically located in the pantry.

**ii. Preconditions:**

1. The robot must be in the kitchen.
2. The robot must not already be in the pantry.

**iii. Effects:**

1. The robot's location is updated from the kitchen to the pantry.
2. The robot is no longer considered to be in the kitchen.

**iv. Code Snippet:**

```
#### Move to Pantry
Precond=np.zeros([nrObjects, nrPredicates])
# TODO: Robot in the kitchen and Robot not in the pantry
Precond[0][1] = 1
Precond[0][5] = -1

Effect=np.zeros([nrObjects, nrPredicates])
# TODO: Move robot from the kitchen to the pantry (remove from kitchen and add to
pantry)
Effect[0][1] = -2
Effect[0][5] = 2

ActionPre.append(Precond)
ActionEff.append(Effect)
ActionDesc.append("Move to Pantry from Kitchen")
```

**b. Move to Kitchen from Pantry**

**i. Description:** This action allows the robot to move from the pantry back to the kitchen. It is crucial for scenarios where the robot needs to bring items from the pantry into the kitchen.

**ii. Preconditions:**

1. The robot must be in the pantry.
2. The robot must not be in the kitchen.

**iii. Effects:**

1. The robot's location is changed from the pantry to the kitchen.
2. The robot is no longer in the pantry.

**iv. Code Snippet:**

```
#### Move from Pantry
Precond=np.zeros([nrObjects, nrPredicates])
# TODO: Robot not in the kitchen and Robot in the pantry
```

```
Precond[0][5] = 1
Precond[0][1] = -1
```

```
Effect=np.zeros([nrObjects, nrPredicates])
# TODO: Move robot from the pantry to the kitchen (remove from pantry and add to
kitchen)
Effect[0][5] = -2
Effect[0][1] = 2
```

```
ActionPre.append(Precond)
ActionEff.append(Effect)
ActionDesc.append("Move to Kitchen from Pantry")
```

**c. Action 3: Cut Fruit in Kitchen**

- i. Description:** This action represents the robot utilizing a knife to cut fruit in the kitchen, a that requires the robot, the fruit, and the knife to be co-located in the kitchen, and it changes the state of the fruit from uncut to cut.

**ii. Preconditions:**

1. The robot, the fruit, and the knife must all be in the kitchen.
2. The fruit must not have been cut already.

**iii. Effects:**

1. The state of the fruit is changed to indicate it has been cut, facilitating further processing or consumption.

**iv. Code Snippet:**

```
###Cut fruit in kitchen
for j in [1,2]:
    Precond=np.zeros([nrObjects, nrPredicates])
    # TODO: Robot in the kitchen, fruit in the kitchen, knife in the kitchen, fruit not
chopped
    Precond[0][1] = 1
    Precond[j][1] = 1
    Precond[4][1] = 1
    Precond[j][6] = -1

    Effect=np.zeros([nrObjects, nrPredicates])
    # TODO: Fruit is chopped
    Effect[j][6] = 2

    ActionPre.append(Precond)
    ActionEff.append(Effect)
    ActionDesc.append("Cut "+Objects[j]+" in the kitchen")
```

Q3.

Ans:

Algorithm	Number of vertices	Length of final plan
Dijkstra	5894	16
A*	2005	16

Plan for Dijkstra:

```
(base) gordian@shahram95:~/Desktop/16662_S24/16_662_HW3$ python SymDiscreteSearch.py
Path Found: True
States Explored: 5894
Plan Length: 16

Plan:
Move to InKitchen from InHallway
Move to Pantry from Kitchen
Pick up Lemon from InPantry
Move to Kitchen from Pantry
Move to InHallway from InKitchen
Move to InOffice from InHallway
Pick up Knife from InOffice
Move to InHallway from InOffice
Move to InGarden from InHallway
Pick up Strawberry from InGarden
Place Lemon at InGarden
Move to InHallway from InGarden
Move to InKitchen from InHallway
Place Strawberry at InKitchen
Place Knife at InKitchen
Cut Strawberry in the kitchen
```

Plan for A\*:

```
(base) gordian@shahram95:~/Desktop/16662_S24/16_662_HW3$ python SymDiscreteSearch.py
Path Found: True
States Explored: 2005
Plan Length: 16

Plan:
Move to InKitchen from InHallway
Move to Pantry from Kitchen
Pick up Lemon from InPantry
Move to Kitchen from Pantry
Move to InHallway from InKitchen
Move to InGarden from InHallway
Pick up Strawberry from InGarden
Place Lemon at InGarden
Move to InHallway from InGarden
Move to InOffice from InHallway
Pick up Knife from InOffice
Move to InHallway from InOffice
Move to InKitchen from InHallway
Place Strawberry at InKitchen
Place Knife at InKitchen
Cut Strawberry in the kitchen
```