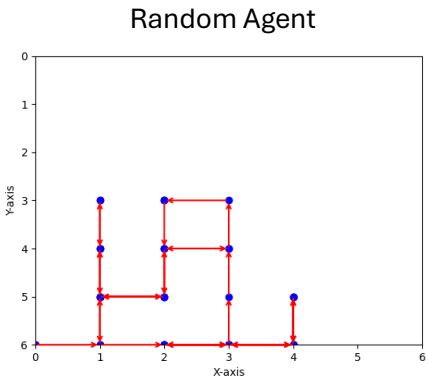
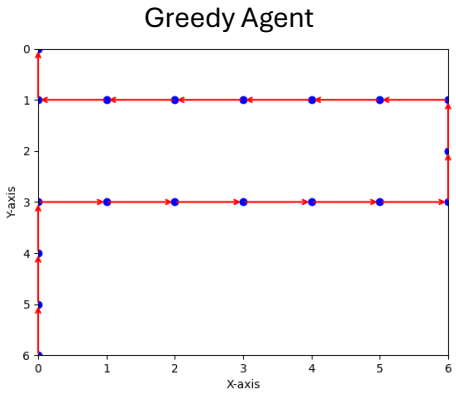
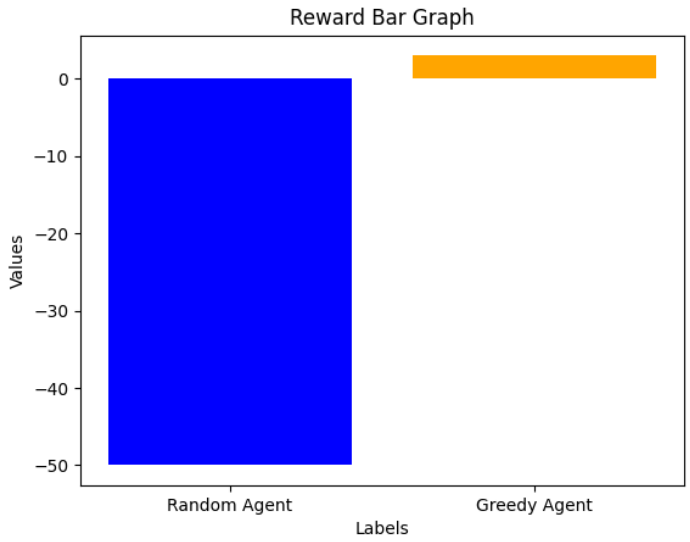
2180153 - Tumi
2332155 - Tao Yuan
2424161- Shakeel Malagas







Main.py

```
from World import World,movelist
from agent import RandomAgent, SmartAgent
from policyGrid import GRID
import matplotlib.pyplot as plt


def debugBoards(agent):
   path = agent.getPath()

   y,x = zip(*agent.getPath())
   plt.scatter(x,y,color='blue', marker='o')
   for i in range(len(x) - 1):
      plt.annotate(
         '',
         xy=(x[i+1], y[i+1]),
         xytext=(x[i], y[i]),
         arrowprops=dict(arrowstyle='->', color='red', lw=1.5)
      )
   plt.xlabel('X-axis')
   plt.ylabel('Y-axis')
   plt.xlim(0, 6)
   plt.ylim(0, 6)
   plt.gca().invert_yaxis()
   plt.show()

START = (6,0)
GOAL = (0,0)

obstacleList = [(2,0), (2,1), (2,2), (2,3), (2,4), (2,5)]
world = World((obstacleList), START, GOAL)
grid = GRID()
policy=grid.gridWorld

board = world.getBoard()
print(board)

def run():
   agent1 = RandomAgent(position=START)
   agent2 = SmartAgent(position=START)
   world = World((obstacleList), START, GOAL)
   # ================== AGENT 1 ====================
   print(f"AgentOne initial position: {agent1.position}")
   for _ in range(50):
      move1 = agent1.chooseMove(movelist)
      agent1.makeMove(move1, world)

   print(f"AgentOne final position: {agent1.position}")
   print(f"AgentOne world final position: {world.getPath()[-1]}")
```

```
    # ================== AGENT 2 ====================
    world = World((obstacleList), START, GOAL)
    print(f"Agent Two initial position: {agent2.position}")
    while agent2.currentReward!=20:
        move1 = agent2.chooseMove(movelist,policy)
        agent2.makeMove(move1, world)
    print(f"AgentTwo final position: {agent2.position}")
    return agent1,agent2

def many_runs(runs:int):
    sum1 = 0
    sum2 = 0
    for i in range(runs):
        agent1,agent2 = run()
        sum1 +=agent1.reward
        sum2 += agent2.reward
    return sum1/runs,sum2/runs


agent1,agent2 = run()

print(agent1.getPath())
print(agent1.reward)

print(agent2.getPath())
print(agent2.reward)

debugBoards(agent1)
debugBoards(agent2)

average1,average2 = many_runs(20)

numbers = [average1, average2]
labels = ['Random Agent', 'Greedy Agent']

# Plot
plt.bar(labels, numbers, color=['blue', 'orange'])
plt.xlabel('Labels')
plt.ylabel('Values')
plt.title('Reward Bar Graph')
plt.show()
```

agent.py

```
import random
import numpy as np
class Agent:
    def __init__(self, position=(0, 0)):
        self.position = position
        self.reward=0
        self.currentReward=0
```

```
        self.path=[position]

    def chooseMove(self,movelist):
        raise NotImplementedError("This method should be overridden by subclasses")

    def makeMove(self, move, world):
        self.position, move_reward  = world.takeAction(move)
        self.currentReward=move_reward
        self.reward+=move_reward
        self.path.append(tuple(self.position))

    def getPath(self):
        return self.path


class RandomAgent(Agent):
    def chooseMove(self,movelist):
        return random.choice(movelist)

class SmartAgent(Agent):
    def chooseMove(self, movelist, policy):
        scores = []
        for move in movelist:
            possible_move = self.position + np.array(move)
            if 0 <= possible_move[0] < policy.shape[0] and 0 <= possible_move[1] < policy.shape[1]:  #
Check boundaries
                scores.append((policy[tuple(possible_move)], move))
            else:
                scores.append((float('-inf'), move))  # Out of bounds moves get the lowest score

        max_score = max(scores, key=lambda x: x[0])
        best_moves = [move for score, move in scores if score == max_score[0]]

        return best_moves[0]
```

World.py

```
import numpy as np

#constants
UP = (-1,0)
DOWN = (1,0)
LEFT = (0,-1)
RIGHT = (0,1)
movelist=[UP,DOWN,LEFT,RIGHT]
class World:

    def setObstacles(self, obstacles):
        for obstacle in obstacles:
            self.grid[obstacle[0]][obstacle[1]] = 0
```

```
    def __init__(self, obstacles, start, goal): #obstacles is a list of tuple coordinates,  start and goal are tuple coordinates
        self.grid = np.zeros((7,7))
        self.grid = self.grid - 1

        self.AgentCoordinates = np.array(start)
        self.PathTravelled = [start]
        self.obstacleList = obstacles
        self.goal = goal

        #adding goal and obstacle to grid for visual
        self.grid[goal[0]][goal[1]] = 20

        self.setObstacles(obstacles)


    def takeAction(self, move):
        #move is integer, 1 2 3 4 (up down left right respectively)
        projectedCoordinates = self.AgentCoordinates + move

        if(projectedCoordinates[0] < 0 or projectedCoordinates[1] < 0 or projectedCoordinates[0] > 6 or projectedCoordinates[1] > 6): #out of bounds check
            self.PathTravelled.append(tuple(self.AgentCoordinates))
            return self.AgentCoordinates, -1

        #hitting obstacle check
        if any(np.array_equal(projectedCoordinates, obstacle) for obstacle in self.obstacleList):
            self.PathTravelled.append(tuple(self.AgentCoordinates))
            return self.AgentCoordinates, -1

        #goal check
        if np.array_equal(projectedCoordinates, self.goal):
            self.PathTravelled.append(tuple(projectedCoordinates))
            self.AgentCoordinates = projectedCoordinates
            return self.AgentCoordinates, 20

        #normal move
        self.PathTravelled.append(tuple(projectedCoordinates))
        self.AgentCoordinates = projectedCoordinates
        return self.AgentCoordinates, -1

    def getBoard(self):
        return self.grid

    def getPath(self):
        return self.PathTravelled




# example usage
```

```
# start = (6,0)
# goal = (0,0)
# obstacleList = [(2,0), (2,1), (2,2), (2,3), (2,4), (2,5)]
# world = World((obstacleList), start, goal)

# board = world.getBoard()
# print(board)

# position, reward = world.takeAction(UP)

# print(position, reward) #position is returned as np array, if you want coordinates then cast with tuple(position)

# path = world.getPath()
# print(path)
```

policyGrid.py

```
import numpy as np

# up down left right
class GRID:
   def __init__(self) -> None:
      self.gridWorld = np.array([[20,17,16,15,14,13,12],
                        [18,17,16,15,14,13,12],
                        [0 ,0 ,0 ,0 ,0 ,0 ,11],
                        [4 ,5 ,6 ,7 ,8 ,9,10],
                        [3 ,4 ,5 ,6 ,7 ,8,9],
                        [2 ,3 ,4 ,5 ,6 ,7,8],
                        [1 ,2 ,3 ,4 ,5 ,6,7]
                        ])
```