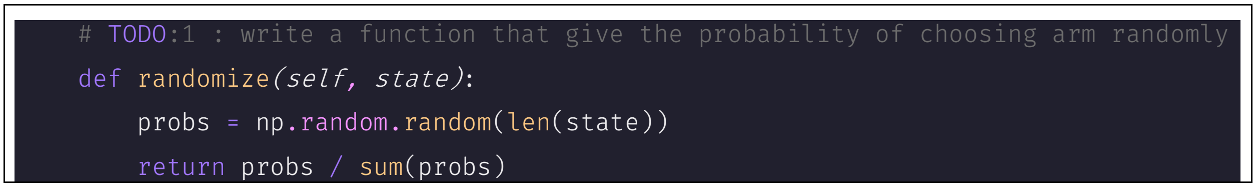
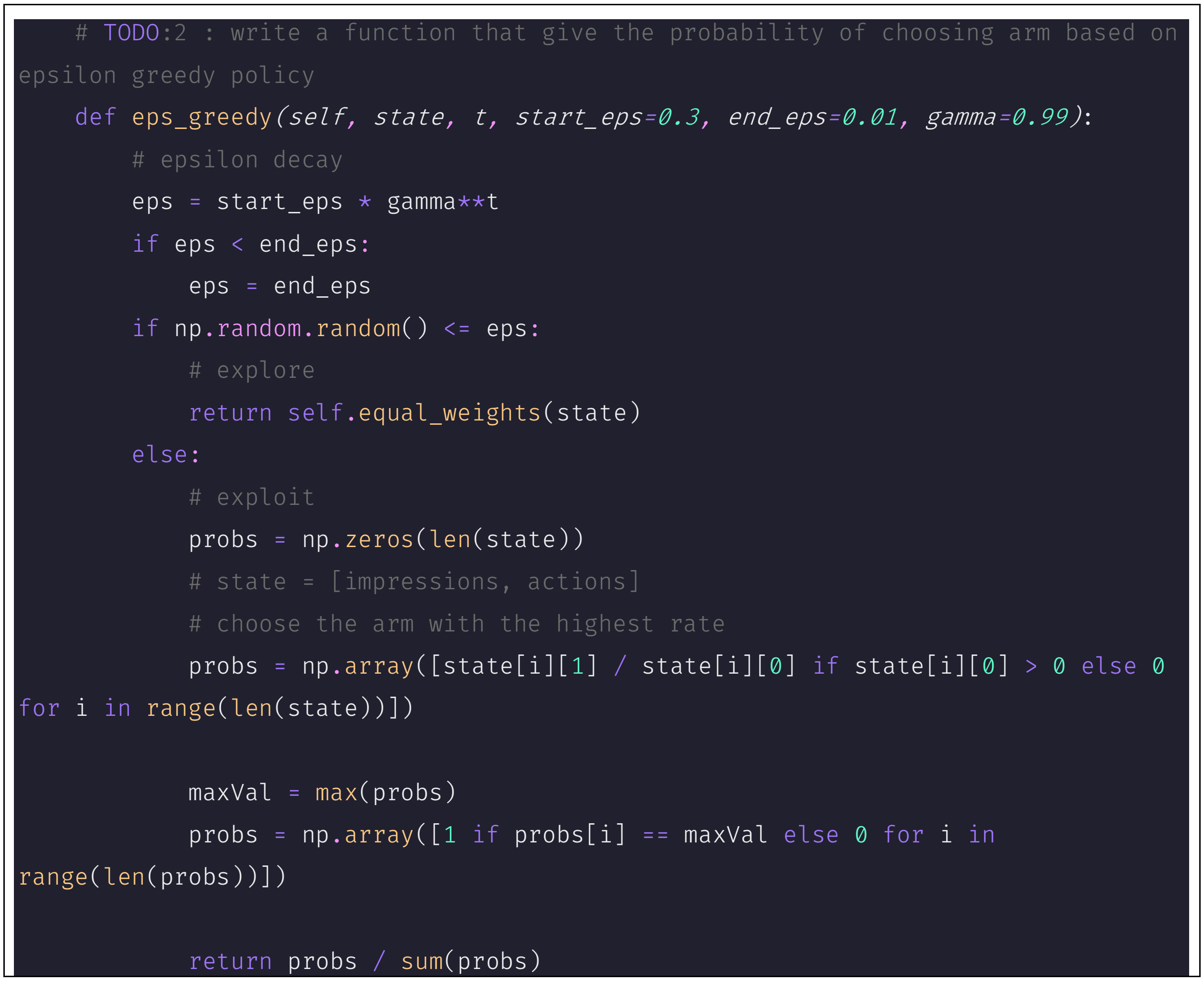
Multi Arm Bandit

TODO #1



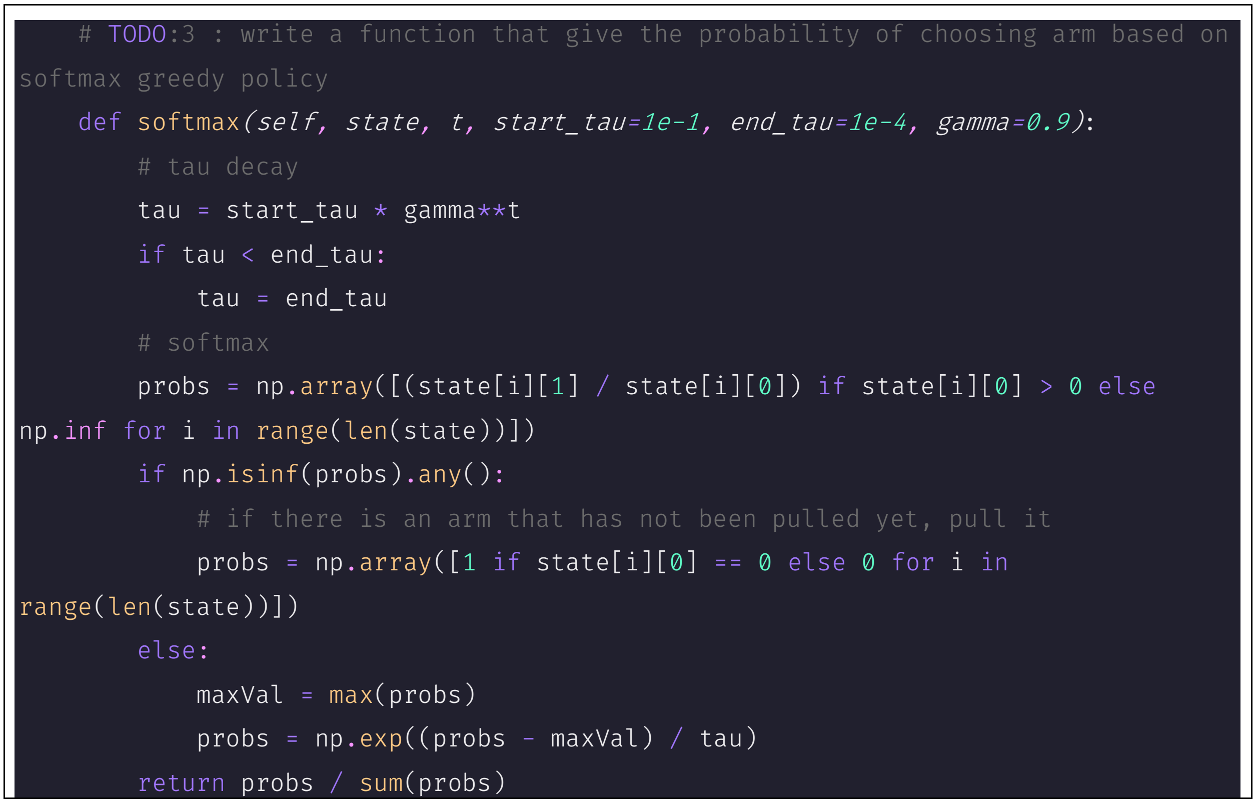
```python
    # TODO:1 : write a function that give the probability of choosing arm randomly
    def randomize(self, state):
        probs = np.random.random(len(state))
        return probs / sum(probs)
```

TODO #2



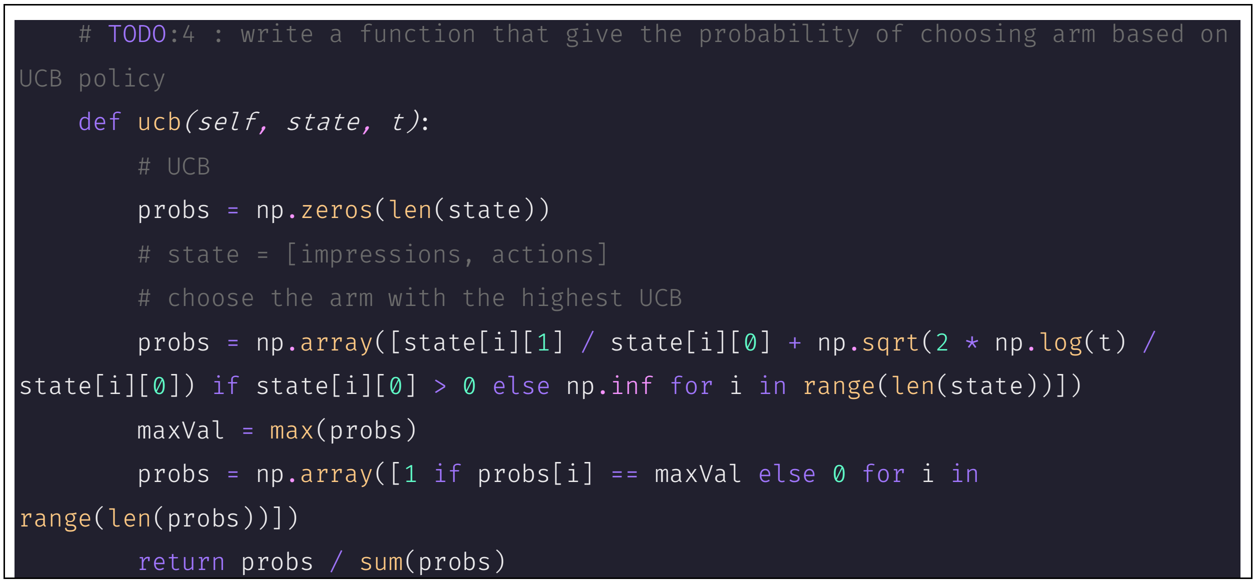
```python
    # TODO:2 : write a function that give the probability of choosing arm based on epsilon greedy policy
    def eps_greedy(self, state, t, start_eps=0.3, end_eps=0.01, gamma=0.99):
        # epsilon decay
        eps = start_eps * gamma**t
        if eps < end_eps:
            eps = end_eps
        if np.random.random() <= eps:
            # explore
            return self.equal_weights(state)
        else:
            # exploit
            probs = np.zeros(len(state))
            # state = [impressions, actions]
            # choose the arm with the highest rate
            probs = np.array([state[i][1] / state[i][0] if state[i][0] > 0 else 0 for i in range(len(state))])

            maxVal = max(probs)
            probs = np.array([1 if probs[i] == maxVal else 0 for i in range(len(probs))])

            return probs / sum(probs)
```

TODO #3



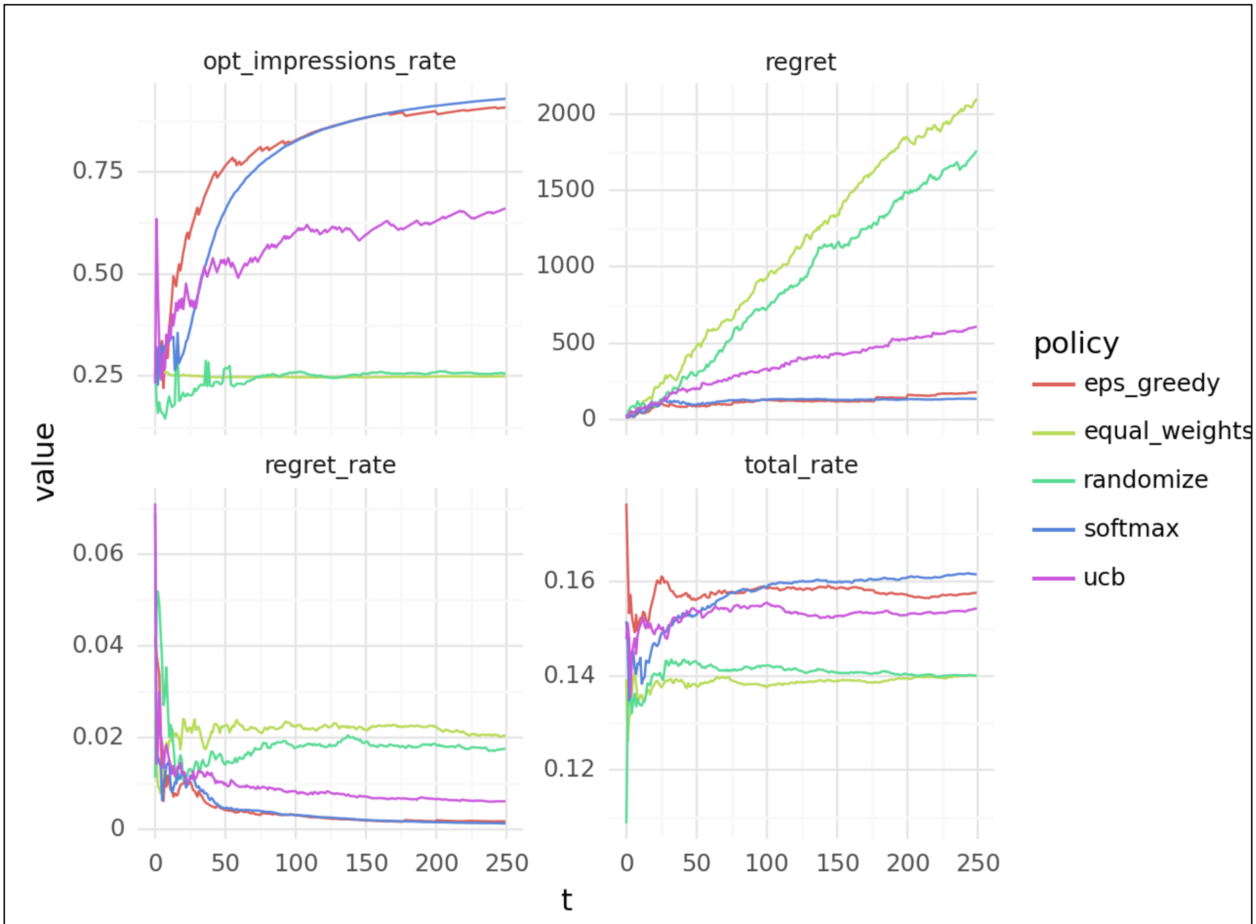
```
    # TODO:3 : write a function that give the probability of choosing arm based on softmax greedy policy
    def softmax(self, state, t, start_tau=1e-1, end_tau=1e-4, gamma=0.9):
        # tau decay
        tau = start_tau * gamma**t
        if tau < end_tau:
            tau = end_tau
        # softmax
        probs = np.array([(state[i][1] / state[i][0]) if state[i][0] > 0 else np.inf for i in range(len(state))])
        if np.isinf(probs).any():
            # if there is an arm that has not been pulled yet, pull it
            probs = np.array([1 if state[i][0] == 0 else 0 for i in range(len(state))])
        else:
            maxVal = max(probs)
            probs = np.exp((probs - maxVal) / tau)
        return probs / sum(probs)
```

TODO #4



```
    # TODO:4 : write a function that give the probability of choosing arm based on UCB policy
    def ucb(self, state, t):
        # UCB
        probs = np.zeros(len(state))
        # state = [impressions, actions]
        # choose the arm with the highest UCB
        probs = np.array([state[i][1] / state[i][0] + np.sqrt(2 * np.log(t) / state[i][0]) if state[i][0] > 0 else np.inf for i in range(len(state))])
        maxVal = max(probs)
        probs = np.array([1 if probs[i] == maxVal else 0 for i in range(len(probs))])
        return probs / sum(probs)
```

TODO #5



From the result, the best performance is SoftMax policy. (Highest Impressions rate and Lowest regret)