Assignment 1

In this assignment, we will delve into two fundamental concepts: Dynamic Programming (DP) and Monte Carlo methods. Both play pivotal roles in solving reinforcement learning problems, and we will implement and compare these techniques using the OpenAI Gym environment.

Task 1: Dynamic Programming

Background:

Dynamic Programming involves breaking down a complex problem into simpler subproblems and solving them recursively. In reinforcement learning, DP is commonly used for solving problems with optimal substructure and overlapping subproblems.

Instructions:

1. Choose a discrete environment from OpenAI Gym (Choose something other than FrozenLake).
2. Implement the policy evaluation, value iteration, and policy iteration using DP.
3. Analyze and discuss the convergence properties of DP in the chosen environment.
4. Experiment with different discount factors and observe their impact on the convergence.

Task 2: Monte Carlo Methods

Background:

Monte Carlo methods rely on random sampling to obtain numerical results. In the context of reinforcement learning, Monte Carlo methods estimate the value function by averaging over multiple episodes.

Instructions:

1. Select a different environment from OpenAI Gym (e.g., Blackjack).
2. Implement the Monte Carlo policy evaluation algorithm.
3. Compare the performance of Monte Carlo with Dynamic Programming in terms of convergence and computational efficiency.
4. Discuss the impact of exploration-exploitation strategies (e.g., epsilon-greedy) on Monte Carlo methods.

Task 3: Comparative Analysis

Instructions:

1. Compare and contrast the strengths and weaknesses of Dynamic Programming and Monte Carlo methods.
2. Discuss scenarios where one method might be more suitable than the other.
3. Evaluate the impact of problem characteristics (e.g., episodic vs. continuing tasks) on the performance of these methods.

Submission Guidelines:

1. Provide well-documented Python code for each task.
2. Include comments explaining the rationale behind your implementation choices.
3. Present visualizations (e.g., convergence plots, value function maps) to support your analysis.
4. Write a report discussing your findings, insights, and conclusions.