RL Assignment 1

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February 8, 2024

Part 1: Defining RL Environments

References:

[1] A1 Video Overview

[2] RL Env Creation and Random Agent

[3] RL Environment visualization

[4] Gymnasium documentation

1. Describe the deterministic and stochastic environments, which were defined (set of actions/states/rewards, main objective, etc).

- **Deterministic Environment:**
  - **Set of Actions:** The agent can take four actions - DOWN, UP, RIGHT, and LEFT.
  - **Set of States:** The environment is represented as a 3x4 grid, and the state is a flattened representation of the grid, indicating the current positions of the agent and the goal.
  - **Rewards:** The agent receives rewards based on the *rewards_map*, which contains rewards at specific grid locations. Additional rewards and penalties are specified at certain grid locations.
  - **Main Objective:** The goal is for the agent to reach the specified goal position within a maximum number of timesteps (10 in this case).
- **Stochastic Environment:**
  - **Extension of Deterministic Environment:** The stochastic environment is an extension of the deterministic environment with the addition of stochasticity.
  - **Stochasticity:** There is a probability ($p_{\text{stochastic}}$) that the agent's chosen action will be replaced by a random action. This introduces randomness into the environment, making it stochastic.

2. Provide visualizations of your environments.

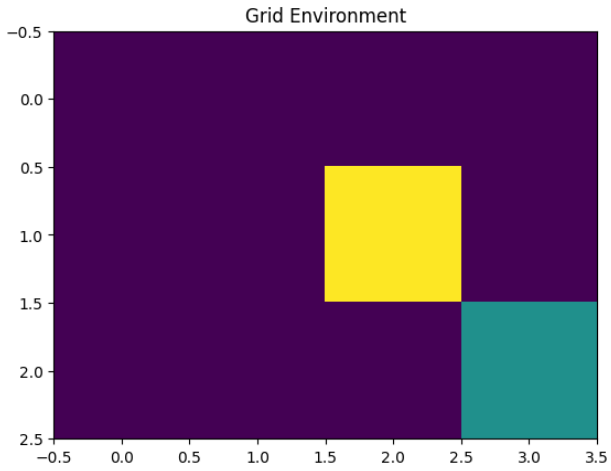

Figure 1: Deterministic Environment Visualization

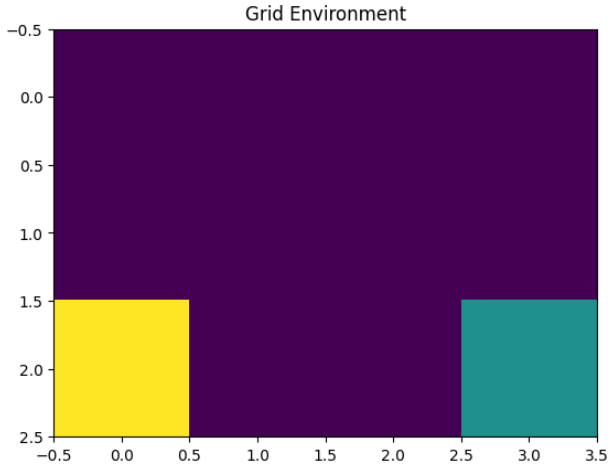

Figure 2: Stochastic Environment Visualization

3. How did you define the stochastic environment?

The stochastic environment is defined by creating a new class `StochasticGridEnv` that inherits from the `DeterministicGridEnv` class. The `step` method in the `StochasticGridEnv` class introduces stochasticity by randomly choosing to replace the agent's chosen action with a random action based on the probability *p_stochastic*.

4. What is the difference between the deterministic and stochastic environments?

In the deterministic environment, the agent's chosen action determines its next state completely. In the stochastic environment, there is a probability that the agent's chosen action will be replaced by a random action, introducing randomness into the agent's decision-making process.

5. Safety in AI: Write a brief review (∼5 sentences) explaining how you ensure the safety of your environments. E.g. how do you ensure that agent choose only actions that are allowed, that agent is navigating within defined state-space, etc.

The safety measures in the code include:

- The `step` method in both environments checks if the agent's position is within the permitted cells, ensuring the agent is navigating within the defined state-space.

- The agent's position is clipped to stay within the grid boundaries, providing a safe and predictable manner for the agent to learn.
- The code includes checks for termination (`terminated`) and truncation (`truncated`) conditions to ensure the safety of the agent and the environment.