

REINFORCEMENT LEARNING Exercise 5



1 Q-learning: Pen and Paper

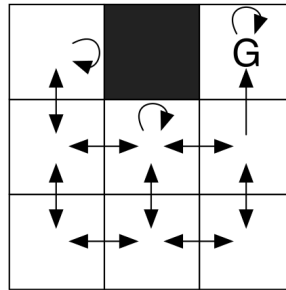


Figure 1: Grid MDP

Consider the deterministic MDP in Figure 1. There exists a terminal state G and a wall that cannot be entered. The agent remains in its current position if it chooses an action that moves it against the wall or off the grid. All transitions have a reward of -1 . We discount with 0.5 .

- How is the Q-learning update defined for a transition from state i to j , if j is a terminal state?
- We initialize all Q-values with 0 . The agent starts in the upper left corner. It then moves one cell down, then one cell to the right and tries unsuccessfully to move one cell upwards (i.e. remains in its current cell), then moves one cell to the right and finally moves upwards into the terminal state. Which values of the Q-function change during this episode if we apply Q-learning with a learning rate of 1.0 ? Calculate the updated Q-function after this first episode. Repeat the calculation for a second identical episode.
- Calculate the optimal Q-values $Q_*(s, a)$ for all state-action pairs.

2 Q-learning: Implementation

The tests for this task are based on the Cliff Walking example from the book¹. An implementation can be found in `cliff_walking.py`. Implement the Q-learning algorithm,

```
q_learning(env, num_episodes, discount_factor=1.0, alpha=0.5, epsilon=0.1),
in q_learning.py.
```

¹<http://incompleteideas.net/book/RLbook2018.pdf#page=154>

3 Experiences

Make a post in thread *Week 05: Temporal-Difference Learning* in the forum², where you provide a brief summary of your experience with this exercise and the corresponding lecture.

²https://ilias.uni-freiburg.de/goto.php?target=frm_1380029&client_id=unifreiburg