Machine Learning Summer School 2020 - Reinforcement Learning Workshop - Assignment 1

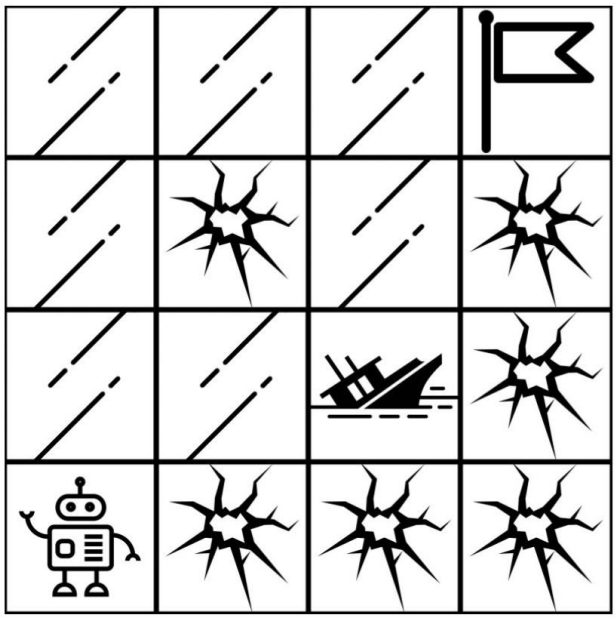
This document describes a simple (yet challenging) environment for which you will develop reinforcement learning agents. The first section presents the environment, the next one contains questions and suggestions about what to do next.

World Description

The ice world is a small, 4x4 icy grid. A robot is tasked to cross through the ice to reach the opposite side of the small world, while, if possible, collecting some treasure from a shipwreck embedded in the ice.

Unfortunately, the ice has been melting, is slippery, and is already cracked in several places. The robot must avoid falling through the cracks! Due to the slippery nature of the ice, the robot risks sliding on it at each step.

The world can be represented as follows:



The robot tries to take one step on the ice, one cell at a time, vertically or horizontally (not diagonally). At each time-step, the robot has a 5% chance of slipping on the ice, and go all the way to the side of the environment. For instance, if the robot tries to go up from any cell in the first column, it may slide across the environment and end up on the top-left cell (or in any crack it may encounter while sliding). The robot cannot move outside the environment, so trying to go up when in the first row has no effect.

Reaching the goal rewards the robot with 100 points. Passing on the shipwreck will allow the robot to collect some of the treasure inside: each time the robot passes there it will get an additional 20 points reward. If the robot falls through the cracks is destroyed (ending the episode), and so it's penalized with -10 points. Additionally it has been added that each ice step is penalized with -5 points in order to motivate the robot to finish the game as soon as possible.

More formally, the environment has a total of 16 states (one for each possible positions of the robot in the ice world). The robot has 4 actions available ('UP', 'RIGHT', 'DOWN' and 'LEFT'). Each action moves the robot in its direction with probability 0.95. When the robot tries to move outside of the grid, the action will have no effect with probability 1.

Slipping will happen with probability 0.05, and it results in the robot moving in the direction specified by the action up to either the grid border, or to the first crack (into it). (NB: it is possible for both slipping and not slipping as a result of an action to result in the same state, i.e., when the robot is one step away from the edge in the direction of movement, or when the agent is already at the edge and cannot move in that direction any further. Therefore, the transition function for states near the edge (for a given action/direction) looks different from states further away from the edge.)

Implementation of the environment described above are provided in Python. You can also re-implement the environment yourself in any language you want, but we strongly advise you to use our implementation.

Questions

The first question covers basic aspect of Reinforcement Learning, and should be implemented by you. The other questions are optional, as they illustrate challenges and ways to improve RL algorithms.

1. Implement Q-Learning core logic. Does Q-Learning lead to the optimal policy?
2. What is the result if EPISOLON == 0.0, or if EPISLON == 1.0 and why?
3. What does the result policy look like if “Goal” square returns 0 points reward?
4. What does the result policy look like if “crack” square returns 100 points?