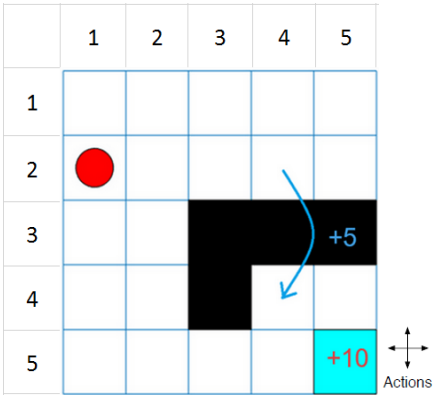
COM 762: Deep Learning and Its Application

Assignment 2
Submission date due: Friday 23rd August 2024 (Week 12)
Feedback date due: After 20 working days

This assignment carries 60% of the coursework marks of the module. The submitted file has to be named by the first half of your University email address and should be uploaded to the Assignment-1 folder in Blackboard by noon on the due date.

The objective of this assignment is to provide students with practical experience of developing a Q-learning agent for solving a grid world environment by a reinforcement learning and Python. The grid world environment is illustrated below:



which has the following configuration and rules:

1. the grid world is 5-by-5 and bounded by borders, with four possible actions (North = 1, South = 2, East = 3, West = 4).
2. the agent begins from cell [2,1] (second row, first column).
3. the agent receives a reward +10 if it reaches the terminal state at cell [5,5] (blue).
4. the environment contains a special jump from cell [2,4] to cell [4,4] with a reward of +5 (a special treatment may be necessary).
5. the agent is blocked by obstacles (black cells).
6. all other actions result in -1 reward.
7. the iteration function below will be used to calculate state values

$$V(S_t) \leftarrow V(S_t) + \alpha\Big[V(S_{t+1}) - V(S_t)\Big]$$

The specific tasks are below:

(a) detail the task and process of exploration and exploitation for solving gird world problem.

(b) describe the formulation of policy, environment, observation (state or grid cell or position) and action, etc. in the context of the grid world problem.
(c) create a value table (or Q-table) using the state and action specifications from the grid world environment, set the learning rate to be 1 and various values in between [0, 1] to run the code.
(d) create a Q-learning agent using this table representation and configure the epsilon-greedy exploration.
(e) train the agent with the following options:
    train for 100 episodes, where each episode should have the ability to control unlimited paths from starting position to terminal or jump-end position (for instance, stop training when the agent receives an average cumulative reward greater than 10 over 30 consecutive episodes.)
(f) Visualise the state values in each of the grid cells with the board layout

The submission package includes:

1. A report should be 5-7 pages in the IEEE format (maximum 3000 words), consisting of the description of tasks (a)-(f); and a screenshot for task (f). Note that the screenshot must be captured in the PyCharm environment,
2. The source code and the explanation of how to run the program.