CS 451 – Computational Intelligence
Spring' 2024
Assignment # 3 – Reinforcement Learning and Self Organizing Maps

Objective: *This assignment gives students a hands-on experience with Self-organising maps (SOM) and Reinforcement learning. The students will apply SOM for clustering and visualization of Covid19 data and will also implement a basic reinforcement learning agent for a grid world environment.*

Question 1- [30 points] Clustering COVID data using SOM

a) In this question, you will apply Self Organizing Maps (SOM) on the attached Covid19 dataset that gives country-wise data of COVID19 confirmed, recovered and expired cases by Jan 2021. SOM will cluster the data and each country will belong to a cluster.

b) For Visualization, you can map these three data fields (confirmed, recovered, and expired cases) to RGB values so that they appear on the grid in different colors and gradual convergence of SOM could be seen over iterations. Each color represents a cluster and its varying shades denotes nearby/similar clusters.

Figure 1- Convergence of SOM

You will use sum of squared distance between two input and weight vectors to find the best matching unit (BMU). Both radius and learning rate will decay over time using the exponential decay. Here are some starting parameters to begin with:

- Size of SOM grid: 10* 10
- Initial learning rate: 0.2
- Initial radius: half of the size of grid

c) You will further enhance your visualization by showing each country on the world map using the color of the respective cluster on the SOM grid. This will result in a visualization similar to the following:

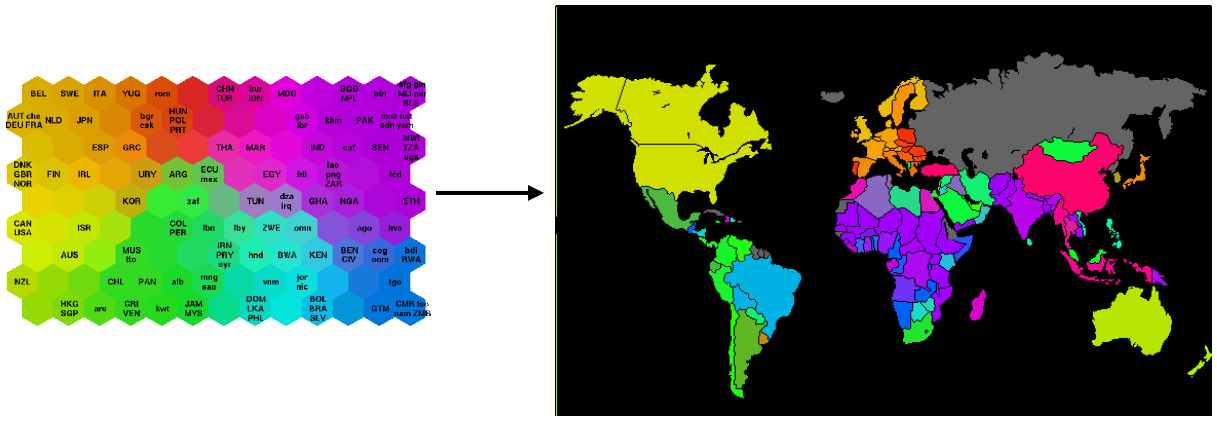

Figure 2- SOM clustering of world poverty data and its visualization on world map

(Note: The sample is taken from World Poverty Map showing clustering based on poverty related dataset.)

Grading:

The grading will be based on the following components:

Component	Weight
Overall process of SOM	35%
Decay of radius and learning rate	10%
Initialization and convergence	10%
Visualization in SOM grid	15%
Visualization on World Map	15%

Question 2 [20 points]- Learning to navigate in FrozenLake

You are building your RL based agent for the Frozen Lake environment. The environment is available in OpnAI gym and it involves going from Start(S) to Goal(G) without falling into any Holes(H) by walking over the Frozen(F) lake. Your agent is moving around (via Up, Down, Left, Right actions) to accumulate the reward that is received when a goal state is reached. The presence of holes in the grid restricts the movement of the agent. You have to determine a policy via value iteration to guide the agent while navigating in the grid.

A skeleton code is attached with the assignment that already creates FronzenLake environment in gym and makes the agent perform selected actions. You need to write your code to learn the policy for action selection. You will learn your policy and experiment with grids of different sizes and configurations. Three different grid configurations are given in the skeleton code. You have to test and make sure that your agent performs well in all cases.

*Figure 3- A 4*6 frozen lake grid*

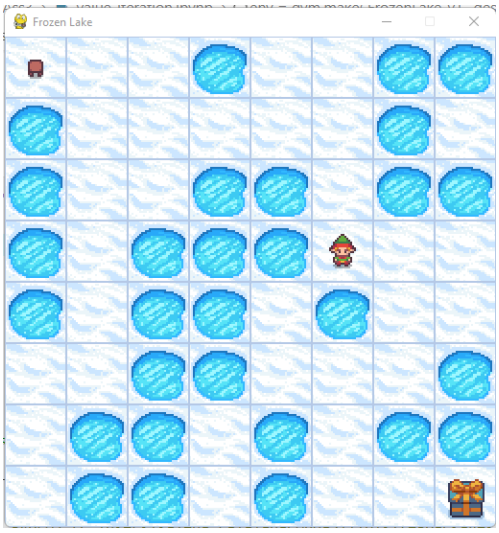

*Figure 4- A 8*8 frozen lake grid*

Grading:

The grading will be based on the following components:

Component	Weight
Overall process of value Iteration	35%
Value Update	10%
Stopping criteria	10%
Action selection from learned policy	15%
Execution of learned policy	20%
Working on different grids	10%

Submission: You will submit your properly commented code in the form of a separate python notebook for each question. No pdf report is required for this assignment.