**Report**

**Project 4: The Imitation Game**

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1. How should the state space (current information) and action space (action selected) be represented for the model? How does it capture the relevant information, in a relevant way, for your model space? One thing to consider here is local vs global information.

* The state space can be represented in two forms as follows:

Local information:

We capture the information of agent and its immediate neighbors and decide on which node to move next.

Advantage:

* The data for training of the Neural Network doesn’t need to have all the combinations of agent position, blocked and free nodes. This consecutively reduces massive dataset size to train the Neural Network.
* This 3 x 3 local grid can be utilized to facilitate the agent to traverse through a grid of any N x N matrix.

Disadvantage:

* The information is local and hence, this the agent can only decide its next action based on its neighbors regardless of target’s position.

In the example shown below (a sample representation),

![Shape, square

Description automatically generated]() Represents current position of Agent in the local grid

![Shape, square

Description automatically generated]() Represents visited cells

![Shape

Description automatically generated with medium confidence]() Represents blocked cells

Chart

Description automatically generated

At every iteration we check the grid window of 3 x 3 with agent in the center. However, if the agent is present in the edges of grid world, then the agent is also represented to be in the edge of the local 3 x 3 grid.

In this scenario at this iteration, the information that the agent has is as follows:

* The agent is at the last row (nth row)
* The agent has 5 neighbors, and it is in the bottom most row of the grid world.
* The neighbor above is visited and free
* The neighbor to the left is blocked.
* The Neural Network now ideally predicts to move right.

How does this impact the agent?

If at a particular situation network predicts and decides to move downwards to next cell and in the next iteration, if the network predicts to move upwards, the agent might have to move up and down in an infinite loop.

Also, since the agent doesn’t have any information on the location of target at any point in time, the actions taken might not be necessarily in the direction of the target.

* Global Information:

We capture the information of entire grid and decide how should the agent move towards target.

Advantages:

* The Neural Network precisely predicts the next action of the agent towards the target, for a solvable maze.

Disadvantages:

* For precise prediction, the neural network must be trained with all possible combinations of agent’s current position, agent’s observed grid world (blocked and free nodes) and the target.
* For higher dimensions of grid world, the neural network demands a huge dataset.
* A dataset for N x N grid could only be used to solve N dimension test grid unlike the local grid which can be used for grid of any dimension.

1. How are you defining your loss function when training your model?
2. In training, how many episodes on how many different grid worlds were necessary to get good performance of your model on the training data?
3. How did you avoid overfitting? Since you want the ML agent to mimic the original agent, should you avoid

overfitting?

1. How did you explore the architecture space, and test the di\_erent possibilities to \_nd the best architecture?
2. Do you think increasing the size or complexity of your model would o\_er any improvements? Why or why not?
3. Does good performance on test data correlate with good performance in practice? Simulate the performance of your ML agent on new gridworlds to evaluate this.
4. For your best model structure, for each architecture, plot a) performance on test data as a function of training rounds, and b) average performance in practice on new gridworlds. How do your ML agents stack up against the original agents? Do either ML agents over an advantage in terms of training time?