

CSE 4/546: Reinforcement Learning
Spring 2024

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Quiz 6

Due Date: March 4, 11:59pm

Description

There are two parts for this quiz. In the first part, we explore one of the main RL environments library - Gymnasium. Understand the environments and their respective characteristics, we explore Cartpole and any one of the other environments of your choice.

In Part 2, you will explore the basics of deep learning framework.

These tasks will help you to get started with Assignment 2. If you plan to use CCR GPU resources, we suggest to complete the tasks on CCR.

Task 1: Exploring Gymnasium [10 points]

STEPS:

1. Install Gymnasium library, and explore the available environments and main functions. [2 points]

You can refer to the documentation and learn about Gymnasium here [Gymnasium Documentation](#).

Read about the environment, functions used to interact with it, and the attributes that define it. Example of a few main functions:

[\[Environment functions and attributes\]](#)

- [step\(\)](#) - Updates an environment with actions returning the next agent observation, the reward for taking that actions, if the environment has terminated or truncated due to the latest action and information from the environment about the step, i.e., metrics, debug info.
- [reset\(\)](#) - Resets the environment to the initial state, required before the calling step. Returns the first agent observation for an episode and information, i.e., metrics, debug info.

- [render\(\)](#) - Renders the environments to help visualize what the agent sees, examples modes are “human”, “rgb_array”, “ansi” for text.
- [close\(\)](#) - Closes the environment, important when external software is used, i.e., pygame for rendering, databases

Observe the output returned by each function after every step.

2. Explore ‘CartPole-v1’ [4 points]

Gymnasium provides an environment [CartPole-v1](#), your task is to use this environment and perform the following:

1. Run the random agent for at least 1000 steps
2. Render the environment
3. Save the rewards and print the reward graph
4. Describe the environment. Provide the main details about the environment (e.g., possible actions/states, goal, rewards, etc.).

3. Explore any other environment [4 points]

You have to perform the same tasks as part 2 using any one of the environments other than CartPole. Select a simple one from the [Classic control](#), no need to go for the complex ones for this quiz.

1. Run the random agent for at least 1000 steps
2. Render the environment
3. Save the rewards and print the reward graph
4. Describe the environment. Provide the main details about the environment (e.g., possible actions/states, goal, rewards, etc.).

Notes:

- For the “Describe the environment” task (Steps 2.4 and 3.4), you can create a small report using pdf and write about both environments.
- The documentation has the snippet for running a random agent. You can use the same snippet, save the rewards obtained after every step and plot a graph.

[Snippet to run the random agent.](#)

- Complete this task within one Jupyter notebook by clearly defining the sections

Task 2: Exploring PyTorch [20 points]

1. PyTorch tutorial [5 points]

Complete an official tutorial [Deep Learning With Pytorch: A 60 Minute Blitz](#)

Complete all 5 parts:

- Tensors
- A Gentle Introduction to torch.autograd
- Neural Networks
- Training a Classifier

Use your own example values and hyperparameters, where applicable, while following the tutorial examples.

You can combine all the results into one Jupyter notebook file. Code with your values and clear section naming is sufficient.

There is no need to include theoretical materials.

2. Hyperparameters changing [4 points x 3 (different sets of parameters for NN)]

Based on the last part of the tutorial “Training a classifier”. Provide the results of the neural network setup using your own THREE different sets of parameters (consider changing the number of layers, number of nodes, activation function, optimizer, etc.).

Accuracy will not be considered as a priority for this task. The primary motivation is for you to explore how different NN setups influence the accuracy of the model.

Include the following information for each hyperparameter set:

- Number of layers
- Number of nodes per layer
- Activation function
- Optimizer
- Learning rate
- Accuracy on training set

- Accuracy on validation set

3. Optuna Tuning [3 points]

Using [Optuna](#) find the best hyperparameter values for the model you built. These values might result in higher accuracies.

Include the following information for your Optuna tuning results:

- Best hyperparameter values
- Accuracy on training set
- Accuracy on validation set

Submission

Due: March 4, Monday, 11:59pm

- Create two different Jupyter notebooks for Task 1 and Task 2 respectively.
- Submit the work as Jupyter Notebook with all the saved outputs, named as
YOUR_UBIT_quiz6_part1.ipynb
YOUR_UBIT_quiz6_part2.ipynb
(e.g. avereshc_quiz6_part1.ipynb & avereshc_quiz6_part2.ipynb)
- Report for Task 1, submit a pdf as YOUR_UBIT_quiz6_report.pdf (e.g. avereshc_quiz6_report.pdf).
- Submit files to UBlearns > Quiz 6.

Note on reusing your previous submission

If you have completed a similar task as part of your other CSE course, you can reuse your code. However, we would like to see you come up with a couple of changes in your submission, e.g. you can use different values, NN setup and various hyperparameters changes.

If you are using the logic/implementation from your previous assignment, make sure to add relevant references. E.g. "Part II is based on my (John Smith) Assignment 2 submission for CSE 574, Fall 2023."

FAQ

For part 1, how should the graph be?

Since the agent is running randomly, the rewards will be random. The graph should be rewards per timestep. i.e., it should represent 1000 rewards for 1000 timesteps respectively.

How should be the report format for Q6 Task 1?

Include the environment name, its description, and main details about the environment. (e.g. possible actions/states, goal, rewards, etc). That should be enough. Write the descriptions of both environments in the same report, no need to create two different reports.

For step 1 in task1, makes me confused on what exactly we need to code for this?

You can execute the different functions of the environment and see what they do.

Aside from putting in our own values wherever possible and the variations of hyper-parameters that we are supposed to implement in the NN, the base code for our convolutional neural network would be based on the code provided in the PyTorch tutorial, correct? I just wanted to confirm if this will flag any academic integrity violations.

Yes, you can use the tutorials as a base. The main motivation of this task is to let students review the basics of deep learning framework. You just have to use your own values (where applicable) and hyperparameters when following the tutorial.

Regarding Task 2.2 of the quiz, suppose I do below 3 things:

- 1. Used Adam instead of SGD in one 1 NN**
- 2. Added another hidden layer in 1 NN**
- 3. Used another activation function other than RELU in 1 NN**

These will be considered as separate sets, correct? Implementing these 3 neural nets would be enough for completion of part 2 (Task 1) of the quiz?

Yes, that would be sufficient. Try out other things as well and see how changing the hyperparameters affects performance. Try different optimizers, different numbers of neurons in each layer, train the network for a different number of epochs, and so on.

Can I tune hyperparameters other than the given ones? E.g. learning rate and no. of iterations.

You are encouraged to do this! It will help you get an understanding of how changing the hyperparameters affects the performance of the neural network.

How should I format my Q6 report for Task 2? Does "Hyperparameter-name, Values, Testing-results & Conclusion" suffice?

Quiz 6 Part 2 doesn't require a report, just the Jupyter notebook. In case you want to include a report the format you mentioned would suffice.

For Quiz 6 - Task 2, I have submitted four .ipynb files, one for the tutorial and other 3 for hyperparameter variations, zipped in one folder. Is that an okay format for submission?

That should be okay.

Quiz 6 Task 2 part 2. Can we just play around with the Training a neural network classifier module for part 2, change the parameters and showing o/p? Should that work?

Yes, just change the hyperparameters and note how they affect the performance.

I am confused about the expectation of Quiz 6 Task 2. Can you please clarify what is expected? On what example do I try out or change the hyperparameters and values?

Follow along with the tutorial and change the hyperparameters on every example. Just try more layers, neurons in each layer, different optimizers, batch size, and so on to get experienced with how changing these affect the overall performance.

Will the accuracy of the models affect our score (as long as it's greater than 10%)?

No, play around with the model parameters to see how those changes affect the performance.