1.1

steps	States (s)	Action (a)	Next State (s`)	Reward (R)	Total
1	0	2	2	0.0	0.0
2	2	3	3	3.0	3.0
3	3	2	2	0.0	3.0
4	2	3	4	3.0	6.0
5	3	2	2	0.0	6.0

Highest rewarding transition belongs to the step where from state 2 action 3 was taken and next state was reached. After starting from state 0, 1 step makes it to state

2. Then we can perform state 2 to state 3 transition twice while coming back 1 time and spending 4 steps of a single episode. Last transition is from state 3 to state 2 again because rest of the other options incur negative rewards.

1.3.b

I believe the optimal achievable reward was achieved. The scores of “DejaVu Sans” are included along side score.png

findfont: score(<Font 'DejaVu Sans' (DejaVuSans-Bold.ttf) normal normal 700 normal>) = 0.33499999999999996

:

:

:

findfont: Matching sans\-serif:style=normal:variant=normal:weight=normal:stretch=normal:size=10.0 to DejaVu Sans ('C:\\Users\\Nayeem\\anaconda3\\envs\\cs234-torch\\lib\\site-packages\\matplotlib\\mpl-data\\fonts\\ttf\\DejaVuSans.ttf') with score of 0.050000.

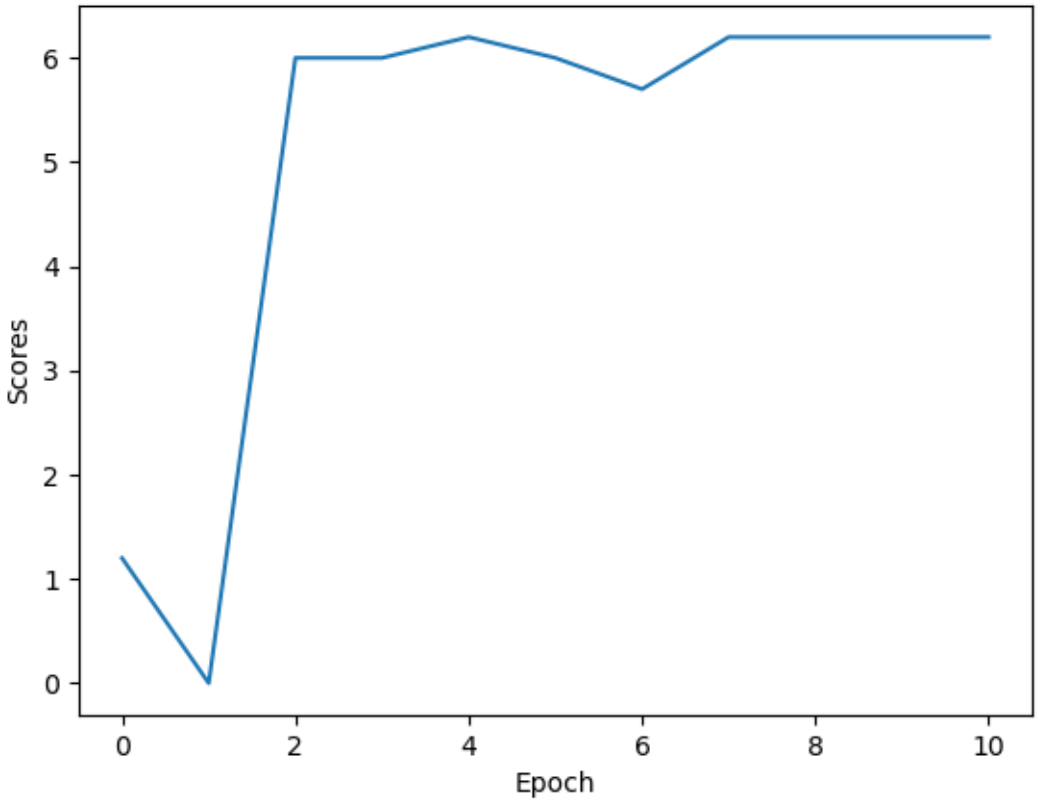


Fig1: the “scores.png” of q3_linear_torch.py

1.3.d.

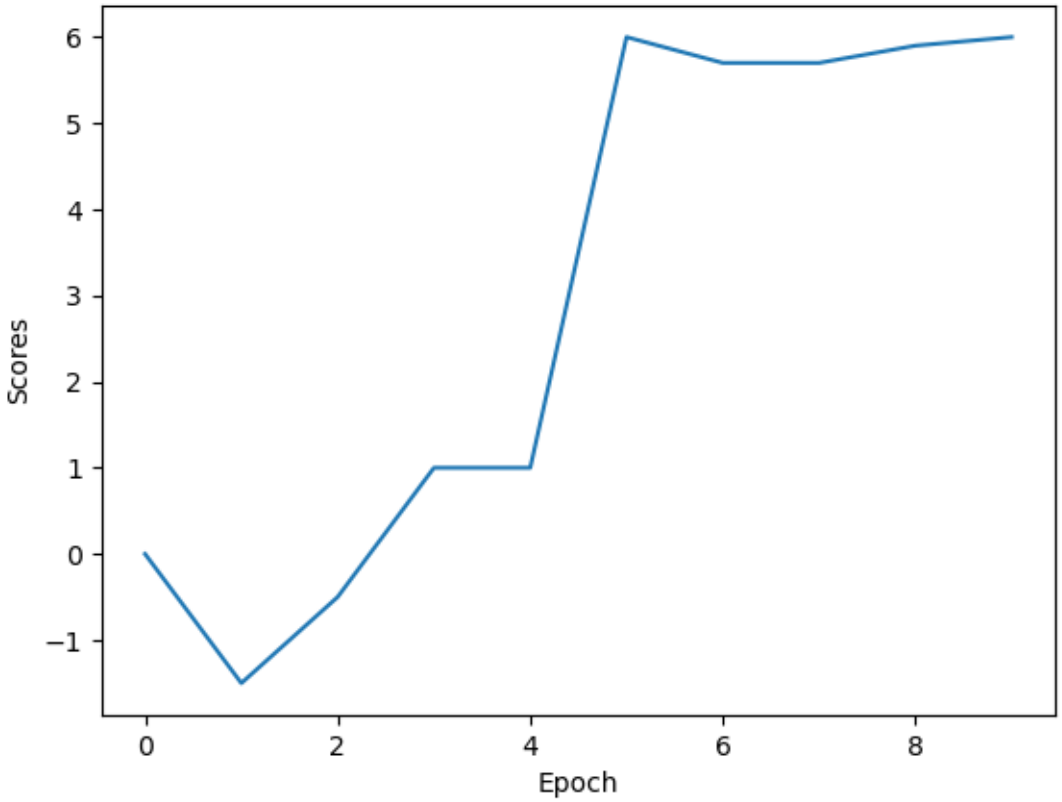


Fig2: the “scores.png” of q4_nature_torch.py

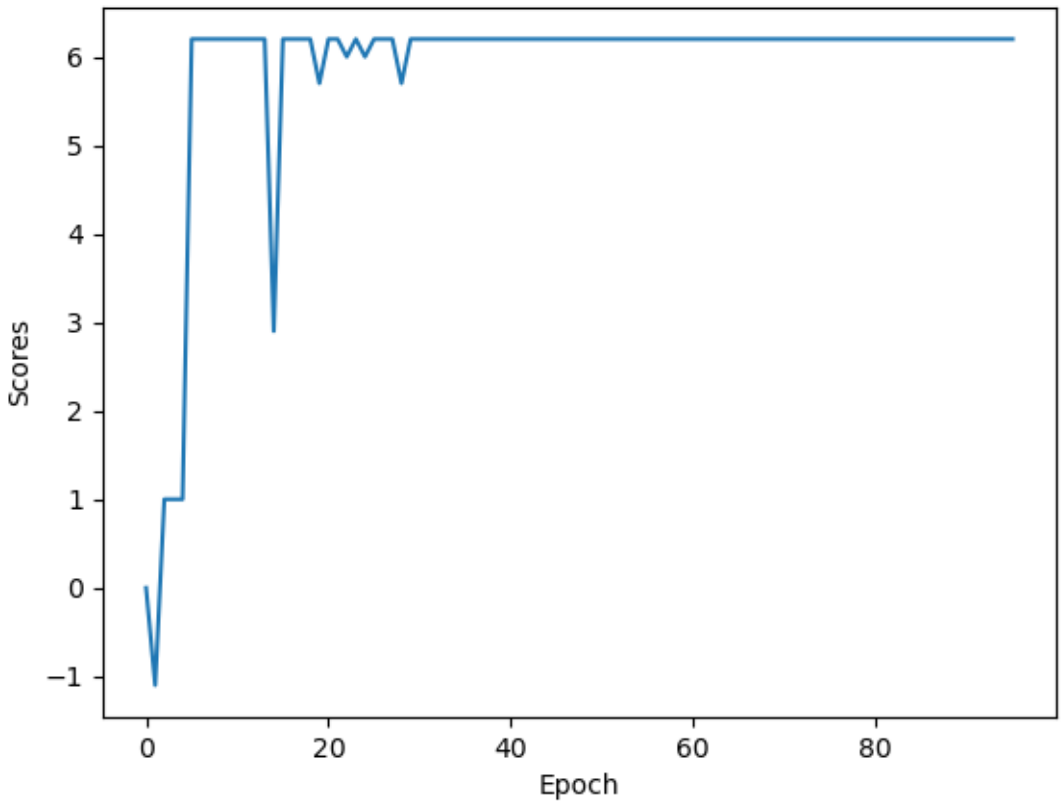


Fig3: the “scores.png” of q4_nature_torch.py after config of q4_nature.py was modified. I changed the nsteps_train from 1,000 to 10,000. Time took approximately 6x of (nsteps_train=1,000)’runtime. ~5/6 minutes.

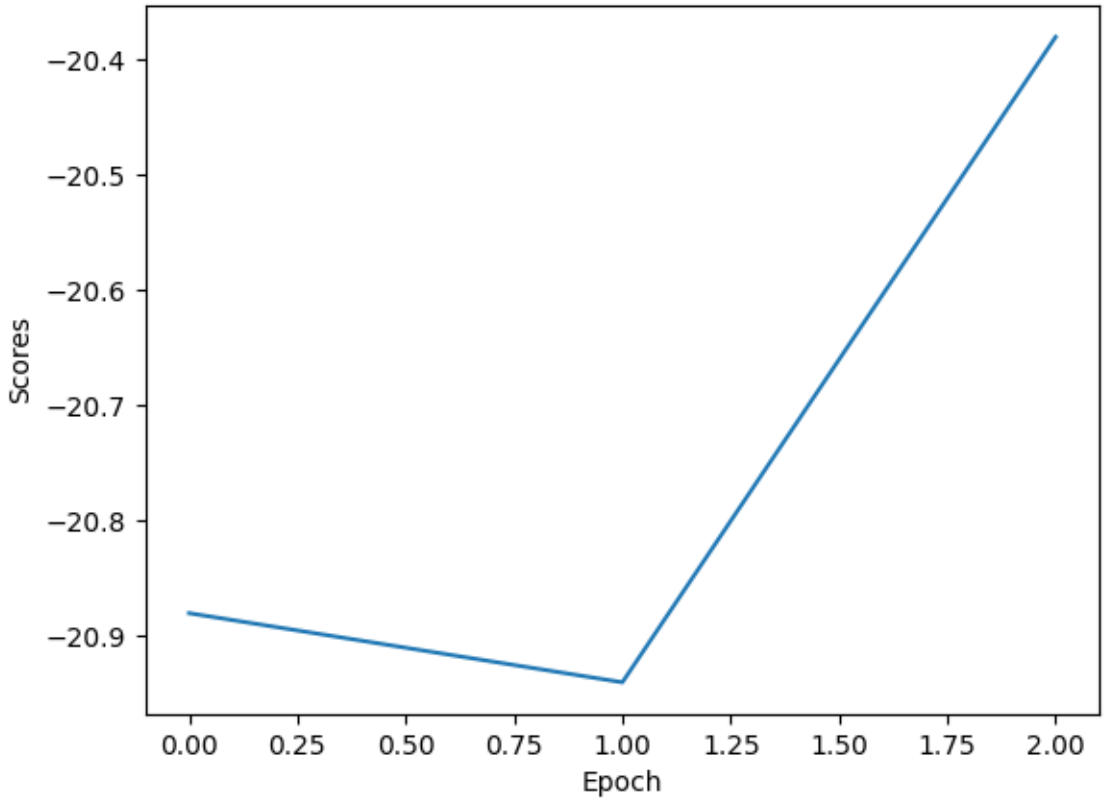
In linear approximation, it reached the optimal reward at 2nd epoch whereas in non-linear approximation it took around 5th epoch to reach optimal score of 6.2 (approximate). In both cases, the runtime was around same which is around 1 minute and both closed near the optimal reward.

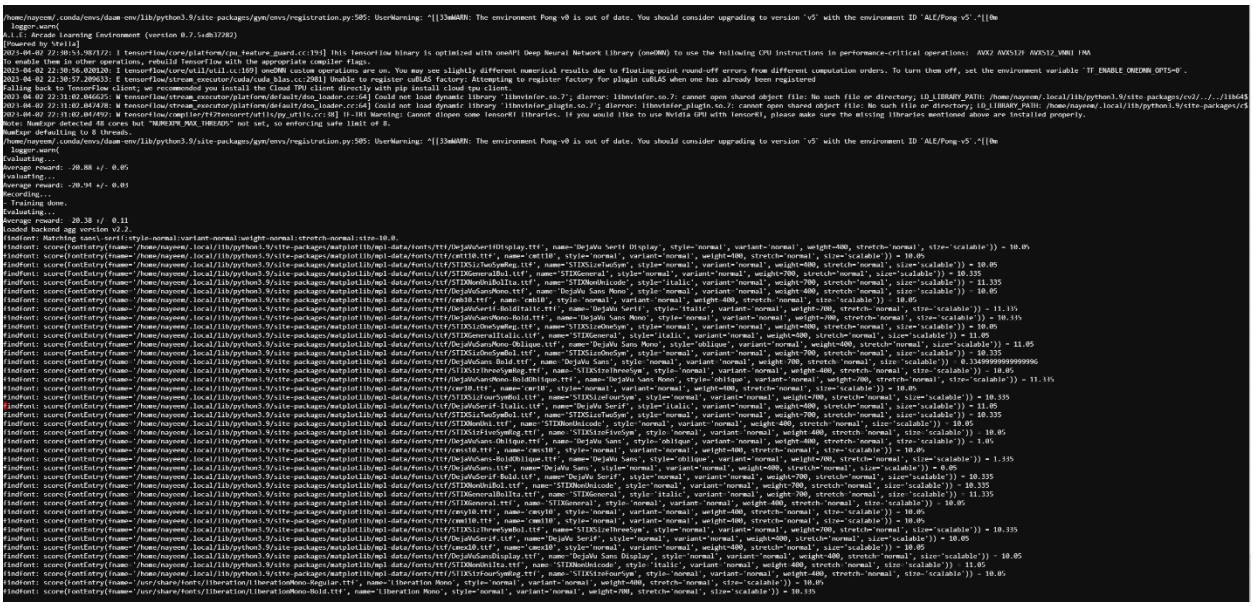
When I changed the nsteps_train from 1k to 10k, it took approximately 6 times more time to train.

It takes a little bit more time for non-linear network to reach optimal reward than linear network. In this case, linear network preformed slightly better than non-linear network.

1.4.

At first glance, the agent's performance steadily decreases for almost half of the training cycle and then it starts to rapidly increase for the rest of the training cycle. It decreased from -20.93 to -21.7 approximately and then rose up to -19.8 approximately. Since there wasn't any plateau which was observed, it is safe to predict that with a large number of training steps further improvements can be made.




/home/nayeem/.conda/envs/daam-env/lib/python3.9/site-packages/gym/envs/registration.py:505: UserWarning: ^[[33mWARN: The environment Pong v0 is out of date. You should consider upgrading to version `v5` with the environment ID `ALE/Pong v5`.^[[0m
logger.warn(
A.L.E: Arcade Learning Environment (version 0.7.5+db37282)
[Powered by Stella]
2023-04-02 22:30:53.987172: I tensorflow/core/platform/cpu_feature_guard.cc:193] This TensorFlow binary is optimized with oneAPI Deep Neural Network Library (oneDNN) to use the following CPU instructions in performance-critical operations: AVX2 AVX512F AVX512_VNNI FMA
To enable them in other operations, rebuild TensorFlow with the appropriate compiler flags.
2023-04-02 22:30:56.020120: I tensorflow/core/util/util.cc:169] oneDNN custom operations are on. You may see slightly different numerical results due to floating-point round-off errors from different computation orders. To turn them off, set the environment variable `TF_ENABLE_ONEDNN_OPTS=0`.
2023-04-02 22:30:57.209653: I tensorflow/stream_executor/cuda/cuda_blas.cc:2981] Unable to register cuBLAS factory: Attempting to register factory for plugin cuBLAS when one has already been registered
Falling back to TensorFlow client; we recommended you install the Cloud TPU client directly with pip install cloud-tpu-client.
2023-04-02 22:31:02.046625: W tensorflow/stream_executor/platform/default/dso_loader.cc:64] Could not load dynamic library 'libnvinfer.so.7'; dlerror: libnvinfer.so.7: cannot open shared object file: No such file or directory; LD_LIBRARY_PATH: /home/nayeem/.local/lib/python3.9/site-packages/cv2/../../lib64:
2023-04-02 22:31:02.047478: W tensorflow/stream_executor/platform/default/dso_loader.cc:64] Could not load dynamic library 'libnvinfer_plugin.so.7'; dlerror: libnvinfer_plugin.so.7: cannot open shared object file: No such file or directory; LD_LIBRARY_PATH: /home/nayeem/.local/lib/python3.9/site-packages/cv2/../../lib64:
2023-04-02 22:31:02.047492: W tensorflow/compiler/tf2tensorrt/utils/py_utils.cc:38] TF-TRT Warning: Cannot dlopen some tensorRT libraries. If you would like to use Nvidia GPU with tensorRT, please make sure the missing libraries mentioned above are installed properly.
Note: NumExpr detected 48 cores but "NUMEXPR_MAX_THREADS" not set, so enforcing safe limit of 8.
NumExpr defaulting to 8 threads.
/home/nayeem/.conda/envs/daam-env/lib/python3.9/site-packages/gym/envs/registration.py:505: UserWarning: ^[[33mWARN: The environment Pong-v0 is out of date. You should consider upgrading to version `v5` with the environment ID `ALE/Pong-v5`.^[[0m
logger.warn(
Evaluating...
Average reward: -20.88 +/- 0.05
Evaluating...
Average reward: -20.94 +/- 0.03
Recording...
Training done.
Evaluating...
Average reward: -20.38 +/- 0.11
Loaded backend agg version v2.2.
findfont: Matching sans\-serif:style=normal:variant=normal:weight=normal:stretch=normal:size=10.0.
findfont: score(FontEntry(fname='/home/nayeem/.local/lib/python3.9/site-packages/matplotlib/mpl-data/fonts/ttf/DejaVuSerifDisplay.ttf', name='DejaVu Serif Display', style='normal', variant='normal', weight=400, stretch='normal', size='scalable')) = 10.05
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findfont: score(FontEntry(fname='/home/nayeem/.local/lib/python3.9/site-packages/matplotlib/mpl-data/fonts/ttf/DejaVuSerif-BoldItalic.ttf', name='DejaVu Serif', style='italic', variant='normal', weight=700, stretch='normal', size='scalable')) = 11.335
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findfont: score(FontEntry(fname='/home/nayeem/.local/lib/python3.9/site-packages/matplotlib/mpl-data/fonts/ttf/DejaVuSerif.ttf', name='DejaVu Serif', style='normal', variant='normal', weight=400, stretch='normal', size='scalable')) = 10.05
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findfont: score(FontEntry(fname='/home/nayeem/.local/lib/python3.9/site-packages/matplotlib/mpl-data/fonts/ttf/STIXNonUniIta.ttf', name='STIXNonUnicode', style='italic', variant='normal', weight=400, stretch='normal', size='scalable')) = 11.05
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findfont: Matching sans\-serif:style=normal:variant=normal:weight=normal:stretch=normal:size=10.0 to DejaVu Sans ('/home/nayeem/.local/lib/python3.9/site-packages/matplotlib/mpl-data/fonts/ttf/DejaVuSans.ttf') with score of 0.050000.