PyTorch Lightning

```
!apt-get update && apt-get install -y xvfb
```

```
(Reading database ... 123621 files and directories currently installed.)
Preparing to unpack .../0-libfontenc1_1%3a1.1.4-1build3_amd64.deb ...
Unpacking libfontenc1:amd64 (1:1.1.4-1build3) ...
Selecting previously unselected package libxfont2:amd64.
Preparing to unpack .../1-libxfont2_1%3a2.0.5-1build1_amd64.deb ...
Unpacking libxfont2:amd64 (1:2.0.5-1build1) ...
Selecting previously unselected package libxkbfile1:amd64.
Preparing to unpack .../2-libxkbfile1_1%3a1.1.0-1build3_amd64.deb ...
Unpacking libxkbfile1:amd64 (1:1.1.0-1build3) ...
Selecting previously unselected package x11-xkb-utils.
Preparing to unpack .../3-x11-xkb-utils_7.7+5build4_amd64.deb ...
Unpacking x11-xkb-utils (7.7+5build4) ...
Selecting previously unselected package xfonts-encodings.
Preparing to unpack .../4-xfonts-encodings_1%3a1.0.5-0ubuntu2_all.deb ...
Unpacking xfonts-encodings (1:1.0.5-0ubuntu2) ...
Selecting previously unselected package xfonts-utils.
Preparing to unpack .../5-xfonts-utils_1%3a7.7+6build2_amd64.deb ...
Unpacking xfonts-utils (1:7.7+6build2) ...
Selecting previously unselected package xfonts-base.
Preparing to unpack .../6-xfonts-base_1%3a1.0.5_all.deb ...
Unpacking xfonts-base (1:1.0.5) ...
Selecting previously unselected package xserver-common.
Preparing to unpack .../7-xserver-common_2%3a21.1.4-2ubuntu1.7~22.04.11_all.deb ...
Unpacking xserver-common (2:21.1.4-2ubuntu1.7~22.04.11) ...
Selecting previously unselected package xvfb.
Preparing to unpack .../8-xvfb_2%3a21.1.4-2ubuntu1.7~22.04.11_amd64.deb ...
Unpacking xvfb (2:21.1.4-2ubuntu1.7~22.04.11) ...
Setting up libfontenc1:amd64 (1:1.1.4-1build3) ...
Setting up xfonts-encodings (1:1.0.5-0ubuntu2) ...
Setting up libxkbfile1:amd64 (1:1.1.0-1build3) ...
Setting up libxfont2:amd64 (1:2.0.5-1build1) ...
Setting up x11-xkb-utils (7.7+5build4) ...
Setting up xfonts-utils (1:7.7+6build2) ...
Setting up xfonts-base (1:1.0.5) ...
Setting up xserver-common (2:21.1.4-2ubuntu1.7~22.04.11) ...
Setting up xvfb (2:21.1.4-2ubuntu1.7~22.04.11) ...
Processing triggers for man-db (2.10.2-1) ...
Processing triggers for fontconfig (2.13.1-4.2ubuntu5) ...
Processing triggers for libc-bin (2.35-0ubuntu3.4) ...
/sbin/ldconfig.real: /usr/local/lib/libtbbmalloc_proxy.so.2 is not a symbolic link

/sbin/ldconfig.real: /usr/local/lib/libtbbbind_2_5.so.3 is not a symbolic link

/sbin/ldconfig.real: /usr/local/lib/libur_adapter_opencl.so.0 is not a symbolic link

/sbin/ldconfig.real: /usr/local/lib/libtbbmalloc.so.2 is not a symbolic link

/sbin/ldconfig.real: /usr/local/lib/libtbbbind_2_0.so.3 is not a symbolic link

/sbin/ldconfig.real: /usr/local/lib/libtbb.so.12 is not a symbolic link

/sbin/ldconfig.real: /usr/local/lib/libur_adapter_level_zero.so.0 is not a symbolic link

/sbin/ldconfig.real: /usr/local/lib/libur_loader.so.0 is not a symbolic link

/sbin/ldconfig.real: /usr/local/lib/libtbbbind.so.3 is not a symbolic link
```

```
!pip install swig
```

```
Collecting swig
  Downloading swig-4.2.1-py2.py3-none-manylinux_2_5_x86_64.manylinux1_x86_64.whl.metadata (3.6 kB)
Downloading swig-4.2.1-py2.py3-none-manylinux_2_5_x86_64.manylinux1_x86_64.whl (1.9 MB)
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 1.9/1.9 MB 49.7 MB/s eta 0:00:00
Installing collected packages: swig
Successfully installed swig-4.2.1
```

```
!pip install pytorch_lightning
```

```
Collecting pytorch_lightning
  Downloading pytorch_lightning-2.4.0-py3-none-any.whl.metadata (21 kB)
```

```
Requirement already satisfied: torch>=2.1.0 in /usr/local/lib/python3.10/dist-packages (from pytorch_lightning) (2.4.1+cu121)
Requirement already satisfied: tqdm>=4.57.0 in /usr/local/lib/python3.10/dist-packages (from pytorch_lightning) (4.66.5)
Requirement already satisfied: PyYAML>=5.4 in /usr/local/lib/python3.10/dist-packages (from pytorch_lightning) (6.0.2)
Requirement already satisfied: fsspec>=2022.5.0 in /usr/local/lib/python3.10/dist-packages (from fsspec[http]>=2022.5.0->pytorch_lig
Collecting torchmetrics>=0.7.0 (from pytorch_lightning)
  Downloading torchmetrics-1.4.3-py3-none-any.whl.metadata (19 kB)
Requirement already satisfied: packaging>=20.0 in /usr/local/lib/python3.10/dist-packages (from pytorch_lightning) (24.1)
Requirement already satisfied: typing-extensions>=4.4.0 in /usr/local/lib/python3.10/dist-packages (from pytorch_lightning) (4.12.2
Collecting lightning-utilities>=0.10.0 (from pytorch_lightning)
  Downloading lightning_utilities-0.11.7-py3-none-any.whl.metadata (5.2 kB)
Requirement already satisfied: aiohttp!=4.0.0a0,!=4.0.0a1 in /usr/local/lib/python3.10/dist-packages (from fsspec[http]>=2022.5.0->p
Requirement already satisfied: setuptools in /usr/local/lib/python3.10/dist-packages (from lightning-utilities>=0.10.0->pytorch_ligh
Requirement already satisfied: filelock in /usr/local/lib/python3.10/dist-packages (from torch>=2.1.0->pytorch_lightning) (3.16.1)
Requirement already satisfied: sympy in /usr/local/lib/python3.10/dist-packages (from torch>=2.1.0->pytorch_lightning) (1.13.3)
Requirement already satisfied: networkx in /usr/local/lib/python3.10/dist-packages (from torch>=2.1.0->pytorch_lightning) (3.3)
Requirement already satisfied: jinja2 in /usr/local/lib/python3.10/dist-packages (from torch>=2.1.0->pytorch_lightning) (3.1.4)
Requirement already satisfied: numpy>1.20.0 in /usr/local/lib/python3.10/dist-packages (from torchmetrics>=0.7.0->pytorch_lightning
Requirement already satisfied: aiohappyeyeballs>=2.3.0 in /usr/local/lib/python3.10/dist-packages (from aiohttp!=4.0.0a0,!=4.0.0a1->
Requirement already satisfied: aiosignal>=1.1.2 in /usr/local/lib/python3.10/dist-packages (from aiohttp!=4.0.0a0,!=4.0.0a1->fsspec
Requirement already satisfied: attrs>=17.3.0 in /usr/local/lib/python3.10/dist-packages (from aiohttp!=4.0.0a0,!=4.0.0a1->fsspec[htt
Requirement already satisfied: frozenlist>=1.1.1 in /usr/local/lib/python3.10/dist-packages (from aiohttp!=4.0.0a0,!=4.0.0a1->fsspec
Requirement already satisfied: multidict<7.0,>=4.5 in /usr/local/lib/python3.10/dist-packages (from aiohttp!=4.0.0a0,!=4.0.0a1->fssp
Requirement already satisfied: yarl<2.0,>=1.12.0 in /usr/local/lib/python3.10/dist-packages (from aiohttp!=4.0.0a0,!=4.0.0a1->fsspec
Requirement already satisfied: async-timeout<5.0,>=4.0 in /usr/local/lib/python3.10/dist-packages (from aiohttp!=4.0.0a0,!=4.0.0a1->
Requirement already satisfied: MarkupSafe>=2.0 in /usr/local/lib/python3.10/dist-packages (from jinja2->torch>=2.1.0->pytorch_lightn
Requirement already satisfied: mpmath<1.4,>=1.1.0 in /usr/local/lib/python3.10/dist-packages (from sympy->torch>=2.1.0->pytorch_ligh
Requirement already satisfied: idna>=2.0 in /usr/local/lib/python3.10/dist-packages (from yarl<2.0,>=1.12.0->aiohttp!=4.0.0a0,!=4.0
Downloading pytorch_lightning-2.4.0-py3-none-any.whl (815 kB)
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 815.2/815.2 kB 28.7 MB/s eta 0:00:00
Downloading lightning_utilities-0.11.7-py3-none-any.whl (26 kB)
Downloading torchmetrics-1.4.3-py3-none-any.whl (869 kB)
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 869.5/869.5 kB 39.7 MB/s eta 0:00:00
Installing collected packages: lightning-utilities, torchmetrics, pytorch_lightning
Successfully installed lightning-utilities-0.11.7 pytorch_lightning-2.4.0 torchmetrics-1.4.3
```

```
!pip install gym[box2d]==0.23.1
```

```
Collecting gym==0.23.1 (from gym[box2d]==0.23.1)
  Downloading gym-0.23.1.tar.gz (626 kB)
     ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 626.2/626.2 kB 23.3 MB/s eta 0:00:00
  Installing build dependencies ... done
  Getting requirements to build wheel ... done
  Preparing metadata (pyproject.toml) ... done
Requirement already satisfied: numpy>=1.18.0 in /usr/local/lib/python3.10/dist-packages (from gym==0.23.1->gym[box2d]==0.23.1) (1.26
Requirement already satisfied: cloudpickle>=1.2.0 in /usr/local/lib/python3.10/dist-packages (from gym==0.23.1->gym[box2d]==0.23.1)
Requirement already satisfied: gym-notices>=0.0.4 in /usr/local/lib/python3.10/dist-packages (from gym==0.23.1->gym[box2d]==0.23.1)
Collecting box2d-py==2.3.5 (from gym[box2d]==0.23.1)
  Downloading box2d-py-2.3.5.tar.gz (374 kB)
     ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 374.4/374.4 kB 26.8 MB/s eta 0:00:00
  Preparing metadata (setup.py) ... done
Collecting pygame==2.1.0 (from gym[box2d]==0.23.1)
  Downloading pygame-2.1.0-cp310-cp310-manylinux_2_17_x86_64.manylinux2014_x86_64.whl.metadata (9.5 kB)
Downloading pygame-2.1.0-cp310-cp310-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (18.3 MB)
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 18.3/18.3 MB 58.3 MB/s eta 0:00:00
Building wheels for collected packages: gym, box2d-py
  Building wheel for gym (pyproject.toml) ... done
  Created wheel for gym: filename=gym-0.23.1-py3-none-any.whl size=701345 sha256=9370535fab7c9586bec41471aa26446a55995c62b6679408ec4
  Stored in directory: /root/.cache/pip/wheels/1a/00/fb/fe5cf2860fb9b7bc860e28f00095a1f42c7b726dd6f42d1acc
  Building wheel for box2d-py (setup.py) ... done
  Created wheel for box2d-py: filename=box2d_py-2.3.5-cp310-cp310-linux_x86_64.whl size=2376102 sha256=fc631b42c113b4aea303db533f91c
  Stored in directory: /root/.cache/pip/wheels/db/8f/6a/eaaadf056fba10a98d986f6dce954e6201ba3126926fc5ad9e
Successfully built gym box2d-py
Installing collected packages: box2d-py, pygame, gym
  Attempting uninstall: pygame
    Found existing installation: pygame 2.6.1
    Uninstalling pygame-2.6.1:
      Successfully uninstalled pygame-2.6.1
  Attempting uninstall: gym
    Found existing installation: gym 0.25.2
    Uninstalling gym-0.25.2:
      Successfully uninstalled gym-0.25.2
Successfully installed box2d-py-2.3.5 gym-0.23.1 pygame-2.1.0
```

```
!pip install pyvirtualdisplay
```

```
Collecting pyvirtualdisplay
  Downloading PyVirtualDisplay-3.0-py3-none-any.whl.metadata (943 bytes)
Downloading PyVirtualDisplay-3.0-py3-none-any.whl (15 kB)
Installing collected packages: pyvirtualdisplay
Successfully installed pyvirtualdisplay-3.0
```

Setup virtual display

```
from pyvirtualdisplay import Display
Display(visible=False, size=(1400, 900)).start()
```

```
<pyvirtualdisplay.display.Display at 0x7a1f100899f0>
```

Import the necessary code libraries

```
import copy
import gym
import torch
import random

import numpy as np
import torch.nn.functional as F

from collections import deque, namedtuple
from IPython.display import HTML
from base64 import b64encode

from torch import Tensor, nn
from torch.utils.data import DataLoader
from torch.utils.data.dataset import IterableDataset
from torch.optim import AdamW

from pytorch_lightning import LightningModule, Trainer

from pytorch_lightning.callbacks import EarlyStopping

from gym.wrappers import RecordVideo, RecordEpisodeStatistics, TimeLimit


device = 'cuda:0' if torch.cuda.is_available() else 'cpu'
num_gpus = torch.cuda.device_count()
```

```
#for saving videos in a video folder in mp4 file, which will read and write
#return the html too
def display_video(episode=0):
  video_file = open(f'/content/videos/rl-video-episode-{episode}.mp4', "r+b").read()
  video_url = f"data:video/mp4;base64,{b64encode(video_file).decode()}"
  return HTML(f"<video width=600 controls><source src='{video_url}'></video>")
```

```
/usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283: DeprecationWarning: `should_run_async` will not call `transform_c
  and should_run_async(code)
```

Create the Deep Q-Network

```
#pytorch neural network,hidden_size-: no. of neurons
#obs_size-: vectors of each state
#n_actions-: the number of actions we can take
#prepare the resources from nn.module
#will create list of layers

#apply the layers to the unput
#float tensors for giving to the neural network

class DQN(nn.Module):

  def __init__(self, hidden_size, obs_size, n_actions):
    super().__init__()
    self.net = nn.Sequential(
        nn.Linear(obs_size, hidden_size),
        nn.ReLU(),
        nn.Linear(hidden_size, hidden_size),
        nn.ReLU(),
        nn.Linear(hidden_size, n_actions)
    )

  def forward(self, x):
    return self.net(x.float())
```

Create the policy

```
#policy-: state, env, neural network
#randomly selection for first condition else
```

```
# change state to tensor
#send this to device
#q_values from neural network
#select the higghest value with index as integer

def epsilon_greedy(state, env, net, epsilon=0.0):
  if np.random.random() < epsilon:
    action = env.action_space.sample()
  else:
    state = torch.tensor([state]).to(device)
    q_values = net(state)
    _, action = torch.max(q_values, dim=1)
    action = int(action.item())
  return action
```

Create the replay buffer

```
#will store observations and sample then with batch_size
#buffer will store the obsrvations of the states
#length of the self.buffer
#insert new info with append() method
#sample to take subset from buffer.

class ReplayBuffer:

  def __init__(self, capacity):
    self.buffer = deque(maxlen=capacity)

  def __len__(self):
    return len(self.buffer)

  def append(self, experience):
    self.buffer.append(experience)

  def sample(self, batch_size):
    return random.sample(self.buffer, batch_size)
```

```
#create RLDataset, so that pytorch can use
#sample and buffer
#going through one by one experience
#yield will experience, return the samples ony by one

class RLDataset(IterableDataset):

  def __init__(self, buffer, sample_size=400):
    self.buffer = buffer
    self.sample_size = sample_size

  def __iter__(self):
    for experience in self.buffer.sample(self.sample_size):
      yield experience
```

Create the environment

```
#name of env as parameter
# make env with gym.make()
#will recordvideo of the episodes and save as video for episode
#record episode stats from env

def create_environment(name):
  env = gym.make(name)
  env = TimeLimit(env, max_episode_steps=400)
  env = RecordVideo(env, video_folder='./videos', episode_trigger=lambda x: x % 50 == 0)
  env = RecordEpisodeStatistics(env)
  return env
```

```
#sample running of env
env = create_environment('LunarLander-v2')

for episode in range(10):
  done = False
  env.reset()
  while not done:
    action = env.action_space.sample()
    _, _, done, _ = env.step(action)
```

```
/usr/local/lib/python3.10/dist-packages/gym/wrappers/monitoring/video_recorder.py:115: DeprecationWarning: WARN: `env.metadata["vid
  logger.deprecation(
/usr/local/lib/python3.10/dist-packages/gym/wrappers/monitoring/video_recorder.py:341: DeprecationWarning: Use shutil.which instead
  if distutils.spawn.find_executable("avconv") is not None:
/usr/local/lib/python3.10/dist-packages/gym/wrappers/monitoring/video_recorder.py:421: DeprecationWarning: distutils Version classe
  if distutils.version.LooseVersion(
```

Create the Deep Q-Learning algorithm

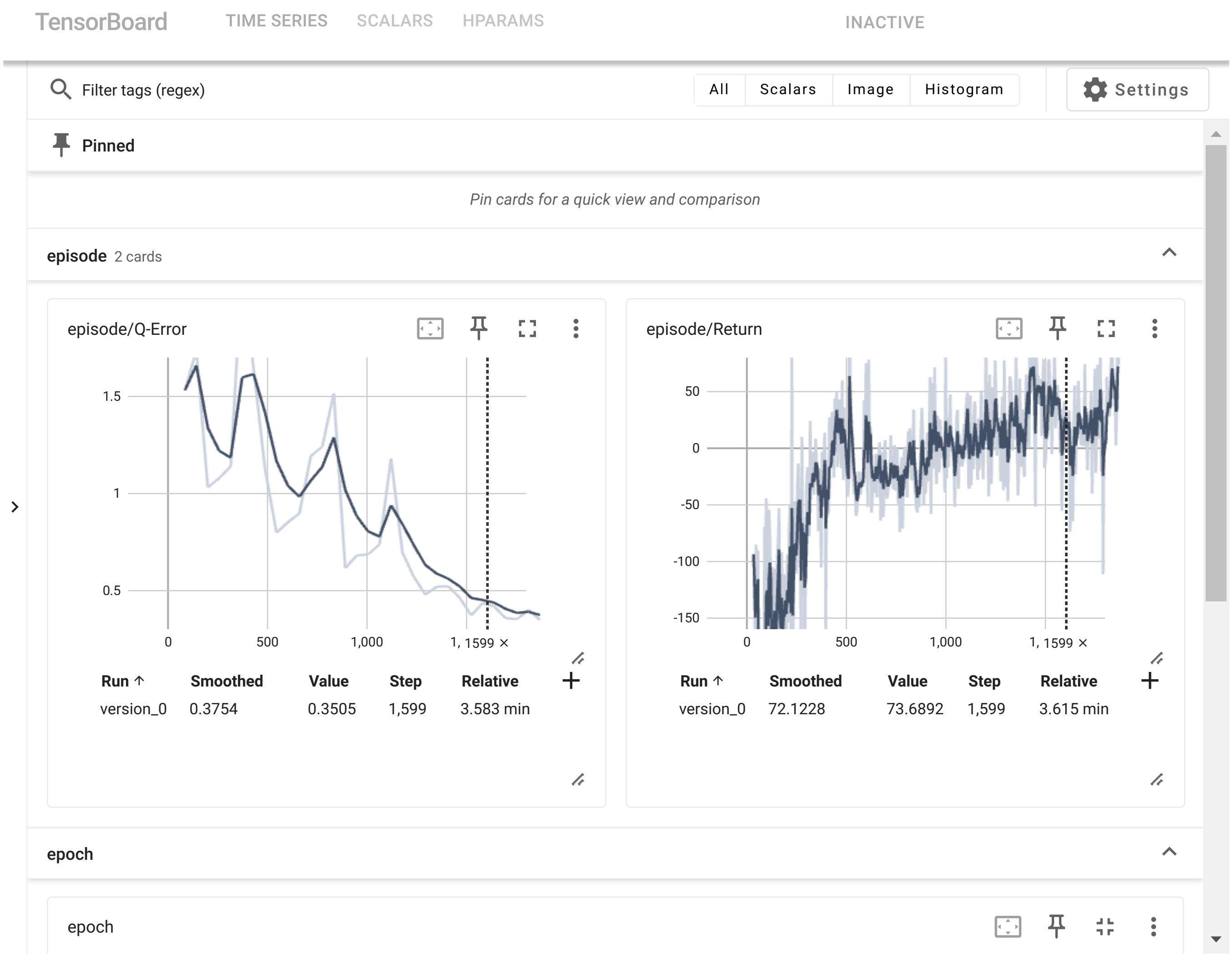
```
#extend ligthning module class
#initialize, forward_pass, configure_optimizers, create data loader, training step,training_epoch_end
#env_name, policy-: epsilon-greedy, capacity-: for experience buffer, batch_size-: batch size, learning_rate
#hidden_size of neural network, discount factor, loss_function, optim,eps_start, eps_end, ep_last_episode,
#sample_per_epoch, sync_rate-:update target neural network
#call the init of super class
#create env
#create neural network
#make target q net too with copy of nn
#policy
#replay buffer-:buffer
#save_hyperparameters-: keep in internal properties
#check len of buffer is lower than sample_per_epoch
#then we will fill the experience buffer
#play_episode method()-: action to be selected if policy is given
#exp will be appended in the buffer
#will update the state
#forward will compute the q_values
#will create a new optimizers by giving initial values
#train_dataloader-: will fetch samples from whole capacity and then batch_size will be selected and will be sent
#multiple batches will be loaded and trained
#traing_step: same as deep_q_learning
#training_epoch_end: take the epsilion value first
#cooling off value for 100 episodes
#then play the episode
#to make the target variable stable once every 10 epochs it will update.




class DeepQLearning(LightningModule):

  # Initialize.
  def __init__(self, env_name, policy=epsilon_greedy, capacity=100_000,
               batch_size=256, lr=1e-3, hidden_size=128, gamma=0.99,
               loss_fn=F.smooth_l1_loss, optim=AdamW, eps_start=1.0, eps_end=0.15,
               eps_last_episode=100, samples_per_epoch=1_000, sync_rate=10):

    super().__init__()
    self.env = create_environment(env_name)

    obs_size = self.env.observation_space.shape[0]
    n_actions = self.env.action_space.n

    self.q_net = DQN(hidden_size, obs_size, n_actions)

    self.target_q_net = copy.deepcopy(self.q_net)

    self.policy = policy
    self.buffer = ReplayBuffer(capacity=capacity)

    self.save_hyperparameters()

    while len(self.buffer) < self.hparams.samples_per_epoch:
      print(f"{len(self.buffer)} samples in experience buffer. Filling...")
      self.play_episode(epsilon=self.hparams.eps_start)

  @torch.no_grad()
  def play_episode(self, policy=None, epsilon=0.):
    state = self.env.reset()
    done = False

    while not done:
      if policy:
        action = policy(state, self.env, self.q_net, epsilon=epsilon)
      else:
        action = self.env.action_space.sample()
      next_state, reward, done, info = self.env.step(action)
      exp = (state, action, reward, done, next_state)
      self.buffer.append(exp)
      state = next_state

  # Forward.
  def forward(self, x):
    return self.q_net(x)

  # Configure optimizers.
  def configure_optimizers(self):
    q_net_optimizer = self.hparams.optim(self.q_net.parameters(), lr=self.hparams.lr)
    return [q_net_optimizer]

  # Create dataloader.
  def train_dataloader(self):
    dataset = RLDataset(self.buffer, self.hparams.samples_per_epoch)
    dataloader = DataLoader(
        dataset=dataset,
        batch_size=self.hparams.batch_size
    )
    return dataloader

  # Training step.
  def training_step(self, batch, batch_idx):
    states, actions, rewards, dones, next_states = batch
    actions = actions.unsqueeze(1)
    rewards = rewards.unsqueeze(1)
    dones = dones.unsqueeze(1)

    state_action_values = self.q_net(states).gather(1, actions)

    next_action_values, _ = self.target_q_net(next_states).max(dim=1, keepdim=True)
    next_action_values[dones] = 0.0

    expected_state_action_values = rewards + self.hparams.gamma * next_action_values

    loss = self.hparams.loss_fn(state_action_values, expected_state_action_values)
    self.log('episode/Q-Error', loss)
    return loss


  # Training epoch end.
  def on_train_epoch_end(self):
    """Called at the end of the training epoch with the outputs of all training steps."""
    # The 'outputs' argument is now included

    epsilon = max(
        self.hparams.eps_end,
        self.hparams.eps_start - self.current_epoch / self.hparams.eps_last_episode
    )

    self.play_episode(policy=self.policy, epsilon=epsilon)
    self.log('episode/Return', self.env.return_queue[-1])
    print('episode/Return', self.env.return_queue[-1])

    if self.current_epoch % self.hparams.sync_rate == 0:
        self.target_q_net.load_state_dict(self.q_net.state_dict())
```

```
/usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283: DeprecationWarning: `should_run_async` will not call `transform_c
  and should_run_async(code)
```

Purge logs and run the visualization tool (Tensorboard)

```
!rm -r /content/lightning_logs/
!rm -r /content/videos/
%load_ext tensorboard
%tensorboard --logdir /content/lightning_logs/
```

```
rm: cannot remove '/content/lightning_logs/': No such file or directory
```



episode/Q-Error

Run ↑	Smoothed	Value	Step	Relative
version_0	0.3754	0.3505	1,599	3.583 min

episode/Return

Run ↑	Smoothed	Value	Step	Relative
version_0	72.1228	73.6892	1,599	3.615 min

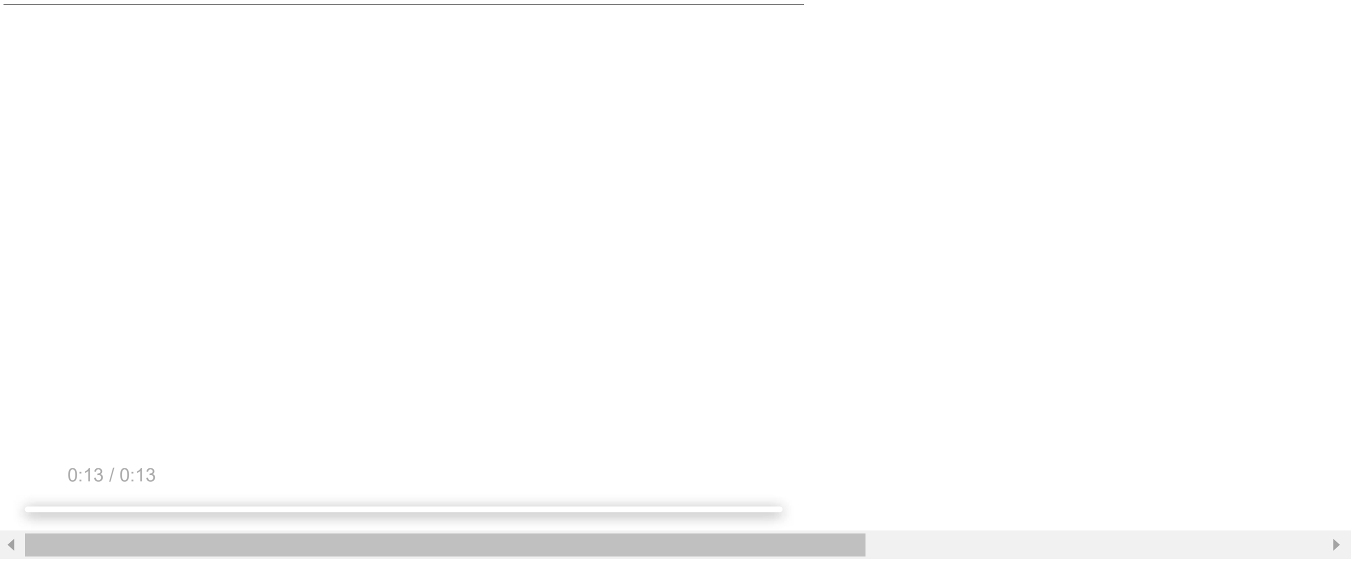
Train the policy

```
import pytorch_lightning as pl
import warnings
warnings.filterwarnings('ignore')

algo = DeepQLearning('LunarLander-v2')

# Replace 'gpus=num_gpus' with 'accelerator="gpu"' or 'devices=num_gpus'
# If num_gpus is an integer representing the number of GPUs, use:
trainer = pl.Trainer(
    accelerator="gpu" if num_gpus else "cpu", # Use 'gpu' if num_gpus is greater than 0, otherwise use 'cpu'
    devices=1, # Specify the number of GPUs or 'auto' for automatic detection
    max_epochs=400,
    callbacks=[EarlyStopping(monitor='episode/Return', mode='max', patience=500)]
)

trainer.fit(algo)
```

Show hidden output

Check the resulting policy

```
display_video(episode=400)
```



```
!zip -r /content/lightning_logs.zip /content/lightning_logs
```

```
adding: content/lightning_logs/ (stored 0%)
adding: content/lightning_logs/version_0/ (stored 0%)
adding: content/lightning_logs/version_0/events.out.tfevents.1728744153.a335900eee99.396.0 (deflated 68%)
adding: content/lightning_logs/version_0/hparams.yaml (deflated 35%)
adding: content/lightning_logs/version_0/checkpoints/ (stored 0%)
adding: content/lightning_logs/version_0/checkpoints/epoch=399-step=1600.ckpt (deflated 13%)
```

```
!zip -r /content/videos.zip /content/videos
```

```
adding: content/videos/ (stored 0%)
adding: content/videos/rl-video-episode-100.mp4 (deflated 10%)
adding: content/videos/rl-video-episode-0.meta.json (deflated 61%)
adding: content/videos/rl-video-episode-300.mp4 (deflated 11%)
adding: content/videos/rl-video-episode-200.mp4 (deflated 11%)
adding: content/videos/rl-video-episode-0.mp4 (deflated 13%)
adding: content/videos/rl-video-episode-400.meta.json (deflated 61%)
adding: content/videos/rl-video-episode-350.mp4 (deflated 12%)
adding: content/videos/rl-video-episode-50.meta.json (deflated 61%)
adding: content/videos/rl-video-episode-150.meta.json (deflated 61%)
adding: content/videos/rl-video-episode-250.mp4 (deflated 12%)
adding: content/videos/rl-video-episode-50.mp4 (deflated 12%)
adding: content/videos/rl-video-episode-350.meta.json (deflated 61%)
adding: content/videos/rl-video-episode-150.mp4 (deflated 11%)
```