Advantage Actor-Critic

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

```
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%3a21.1.4-2ubuntu1.7~22.04.12_all.deb ...
Unpacking xserver-common (2:21.1.4-2ubuntu1.7~22.04.12) ...
Selecting previously unselected package xvfb.
Preparing to unpack .../8-xvfb_2%3a21.1.4-2ubuntu1.7~22.04.12_amd64.deb ...
Unpacking xvfb (2:21.1.4-2ubuntu1.7~22.04.12) ...
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 (2:21.1.4-2ubuntu1.7~22.04.12) ...
Setting up xvfb (2:21.1.4-2ubuntu1.7~22.04.12) ...
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.so.2 is not a symbolic link

/sbin/ldconfig.real: /usr/local/lib/libhwloc.so.15 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/libtbb.so.12 is not a symbolic link

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

/sbin/ldconfig.real: /usr/local/lib/libtcm.so.1 is not a symbolic link

/sbin/ldconfig.real: /usr/local/lib/libumf.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_2_0.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_proxy.so.2 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/libtcm_debug.so.1 is not a symbolic link
```

```
!pip install swig
```

```
Collecting swig
  Downloading swig-4.3.0-py2.py3-none-manylinux_2_5_x86_64.manylinux1_x86_64.whl.metadata (3.5 kB)
Downloading swig-4.3.0-py2.py3-none-manylinux_2_5_x86_64.manylinux1_x86_64.whl (1.9 MB)
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 1.9/1.9 MB 67.4 MB/s eta 0:00:00
Installing collected packages: swig
Successfully installed swig-4.3.0
```

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

```
Collecting gym==0.23.1 (from gym[box2d]==0.23.1)
  Using cached gym-0.23.1-py3-none-any.whl
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)
  Using cached box2d-py-2.3.5.tar.gz (374 kB)
  Preparing metadata (setup.py) ... done
Collecting pygame==2.1.0 (from gym[box2d]==0.23.1)
  Using cached pygame-2.1.0-cp310-cp310-manylinux_2_17_x86_64.manylinux2014_x86_64.whl.metadata (9.5 kB)
```

```
Using cached pygame-2.1.0-cp310-cp310-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (18.3 MB)
Building wheels for collected packages: box2d-py
  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=2376421 sha256=b3970524af06fbf7e1b91a609d624
  Stored in directory: /root/.cache/pip/wheels/db/8f/6a/eaaadf056fba10a98d986f6dce954e6201ba3126926fc5ad9e
Successfully built 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 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) (2.5.1+cu121)
Requirement already satisfied: tqdm>=4.57.0 in /usr/local/lib/python3.10/dist-packages (from pytorch-lightning) (4.66.6)
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-1.6.0-py3-none-any.whl.metadata (20 kB)
Requirement already satisfied: packaging>=20.0 in /usr/local/lib/python3.10/dist-packages (from pytorch-lightning) (24.2)
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-0.11.9-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: networkx in /usr/local/lib/python3.10/dist-packages (from torch>=2.1.0->pytorch-lightning) (3.4.2)
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: sympy==1.13.1 in /usr/local/lib/python3.10/dist-packages (from torch>=2.1.0->pytorch-lightning) (1.13
Requirement already satisfied: mpmath<1.4,>=1.1.0 in /usr/local/lib/python3.10/dist-packages (from sympy==1.13.1->torch>=2.1.0->pyto
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: async-timeout<6.0,>=4.0 in /usr/local/lib/python3.10/dist-packages (from aiohttp!=4.0.0a0,!=4.0.0a1-
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: propcache>=0.2.0 in /usr/local/lib/python3.10/dist-packages (from aiohttp!=4.0.0a0,!=4.0.0a1->fsspec
Requirement already satisfied: yarl<2.0,>=1.17.0 in /usr/local/lib/python3.10/dist-packages (from aiohttp!=4.0.0a0,!=4.0.0a1->fsspec
Requirement already satisfied: MarkupSafe>=2.0 in /usr/local/lib/python3.10/dist-packages (from jinja2->torch>=2.1.0->pytorch-lightr
Requirement already satisfied: idna>=2.0 in /usr/local/lib/python3.10/dist-packages (from yarl<2.0,>=1.17.0->aiohttp!=4.0.0a0,!=4.0
Downloading pytorch_lightning-2.4.0-py3-none-any.whl (815 kB)
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 815.2/815.2 kB 40.5 MB/s eta 0:00:00
Downloading lightning_utilities-0.11.9-py3-none-any.whl (28 kB)
Downloading torchmetrics-1.6.0-py3-none-any.whl (926 kB)
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 926.4/926.4 kB 57.0 MB/s eta 0:00:00
Installing collected packages: lightning-utilities, torchmetrics, pytorch-lightning
Successfully installed lightning-utilities-0.11.9 pytorch-lightning-2.4.0 torchmetrics-1.6.0
```

```
!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

```
import os
os.environ['SDL_VIDEODRIVER']='dummy'
import pygame
pygame.display.set_mode((640,480))
```

```
pygame 2.1.0 (SDL 2.0.16, Python 3.10.12)
Hello from the pygame community. https://www.pygame.org/contribute.html
<Surface(640x480x32 SW)>
```

Import the necessary code libraries

```
import copy
import torch
```

```
import random
import gym
import matplotlib

import numpy as np
import matplotlib.pyplot as plt

import torch.nn.functional as F

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

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

from torch.distributions import Normal

from pytorch_lightning import LightningModule, Trainer

from gym.wrappers import RecordVideo, RecordEpisodeStatistics, NormalizeObservation


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

```
@torch.no_grad()
def test_env(env_name, policy, obs_rms, **kwargs):
  env = gym.make(env_name, **kwargs)
  env = RecordVideo(env, 'videos', episode_trigger=lambda e: True)
  env = NormalizeObservation(env)
  env.obs_rms = obs_rms
  policy = policy.to(device)

  for episode in range(10):
    done = False
    obs = env.reset()
    while not done:
      loc, scale = policy(obs)
      action = torch.normal(loc, scale)
      action = action.cpu().numpy()
      obs, _, done, _ = env.step(action)
  del env


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>")
```

Create the policy

```
#actor for actions
class GradientPolicy(nn.Module):

  def __init__(self, in_features, out_dims, hidden_size=128):
    super().__init__()
    self.fc1 = nn.Linear(in_features, hidden_size)
    self.fc2 = nn.Linear(hidden_size, hidden_size)
    self.fc_mu = nn.Linear(hidden_size, out_dims)
    self.fc_std = nn.Linear(hidden_size, out_dims)

  def forward(self, x):
    x = torch.tensor(x).float().to(device)
    x = F.relu(self.fc1(x))
    x = F.relu(self.fc2(x))
    loc = self.fc_mu(x)
    loc = torch.tanh(loc) * 2
    scale = self.fc_std(x)
    scale = F.softplus(scale) + 0.001
    return loc, scale
```

```
#critic state valuation, for the value of state
class ValueNet(nn.Module):

  def __init__(self, in_features, hidden_size=128):
    super().__init__()
```

```
    self.fc1 = nn.Linear(in_features, hidden_size)
    self.fc2 = nn.Linear(hidden_size, hidden_size)
    self.fc3 = nn.Linear(hidden_size, 1)

  def forward(self, x):
    x = torch.tensor(x).float().to(device)
    x = F.relu(self.fc1(x))
    x = F.relu(self.fc2(x))
    x = self.fc3(x)
    return x
```

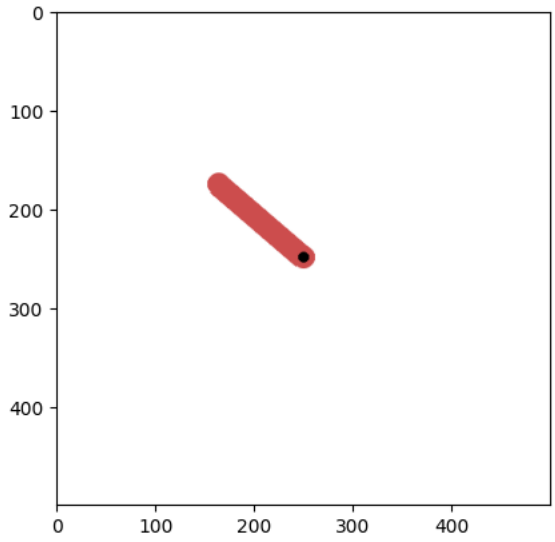
Create the environment

```
env = gym.make("Pendulum-v1")
env.reset()
```

```
array([0.65417325, 0.75634474, 0.04178484], dtype=float32)
```

```
import matplotlib.pyplot as plt
plt.imshow(env.render(mode="rgb_array"))
```

```
<matplotlib.image.AxesImage at 0x7ada1eed8580>
```




```
env = gym.vector.make("Pendulum-v1", num_envs=2)
```

```
env.reset()
```

```
array([[ 0.04307571, -0.99907184,  0.22556293],
       [ 0.63512397, -0.7724102 , -0.43355837]], dtype=float32)
```

```
env.observation_space, env.action_space
```

```
(Box([[-1. -1. -8.]
  [-1. -1. -8.]], [[1. 1. 8.]
  [1. 1. 8.]], (2, 3), float32),
 Box(-2.0, 2.0, (2, 1), float32))
```

```
next_obs, rewards, dones, infos = env.step(env.action_space.sample())
```

```
infos
```

```
({}, {})
```

```
def create_env(env_name, num_envs):
  env = gym.vector.make(env_name, num_envs)
  env = RecordEpisodeStatistics(env)
  env = NormalizeObservation(env)
  return env
```

```
Start coding or generate with AI.
```

Create the dataset

```
class RLDataset(IterableDataset):

  def __init__(self, env, policy, steps_per_epoch):
    self.env = env
    self.policy = policy
    self.steps_per_epoch = steps_per_epoch
    self.obs = env.reset()

  @torch.no_grad()
  def __iter__(self):
    for step in range(self.steps_per_epoch):
      loc, scale = self.policy(self.obs)
      action = torch.normal(loc, scale)
      action = action.cpu().numpy()
      next_obs, reward, done, info = self.env.step(action)
      yield self.obs, action, reward, done, next_obs
      self.obs = next_obs
```

Create the A2C algorithm

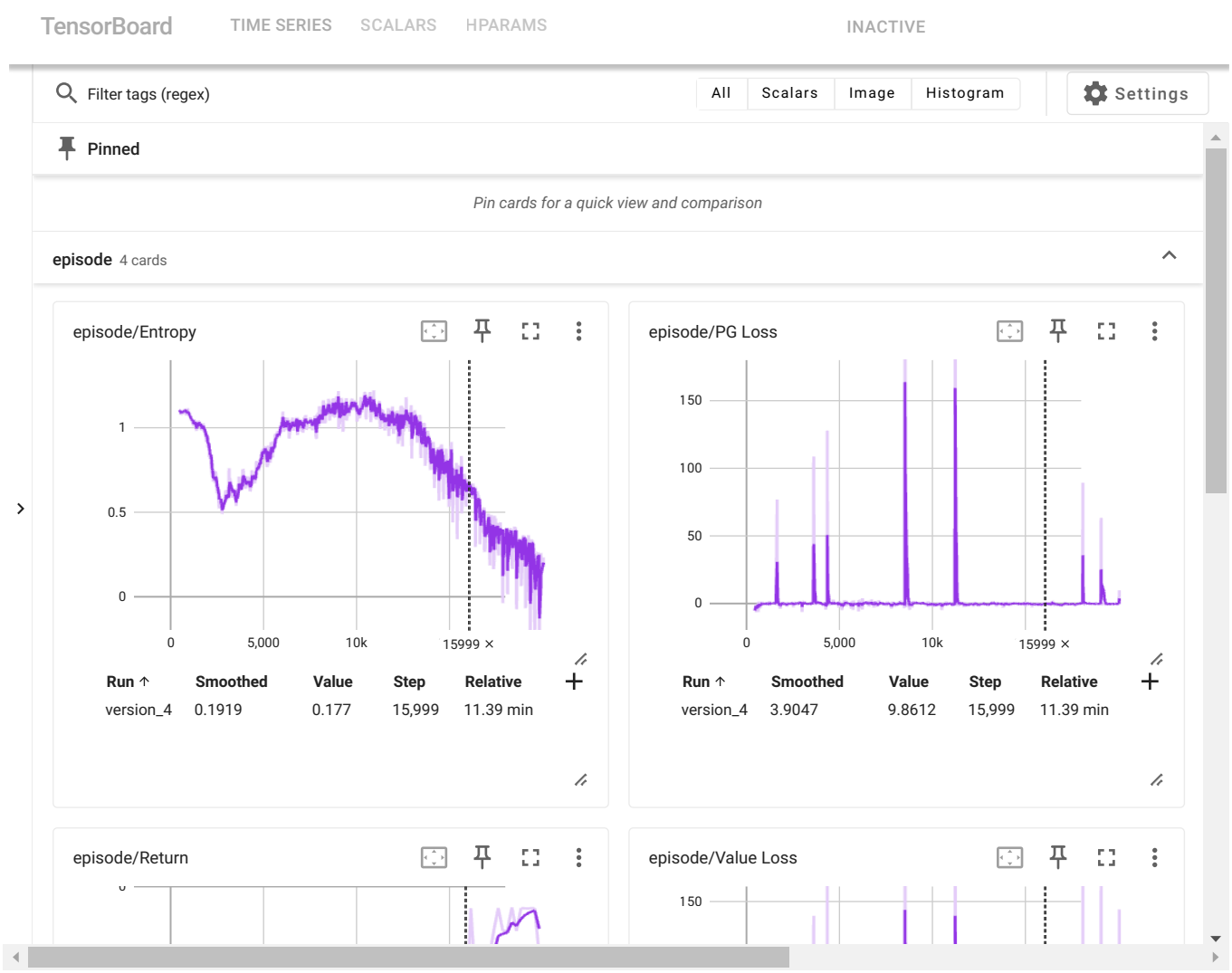
```
class A2C(LightningModule):

  def __init__(self, env_name, num_envs=64, samples_per_epoch=8,
               batch_size=1, hidden_size=64, policy_lr=1e-4, value_lr=1e-3,
               gamma=0.99, entropy_coef=0.01, optim=AdamW):

    super().__init__()

    self.env = create_env(env_name, num_envs=num_envs)

    obs_size = self.env.single_observation_space.shape[0]
    action_dims = self.env.single_action_space.shape[0]

    self.policy = GradientPolicy(obs_size, action_dims, hidden_size)
    self.value_net = ValueNet(obs_size, hidden_size)
    self.target_value_net = copy.deepcopy(self.value_net)

    self.automatic_optimization = False

    self.dataset = RLDataset(self.env, self.policy, samples_per_epoch)

    self.save_hyperparameters()

  def configure_optimizers(self):
    value_opt = self.hparams.optim(self.value_net.parameters(), lr=self.hparams.value_lr)
    policy_opt = self.hparams.optim(self.policy.parameters(), lr=self.hparams.policy_lr)
    return value_opt, policy_opt

  def train_dataloader(self):
    return DataLoader(dataset=self.dataset, batch_size=self.hparams.batch_size)

  #creating batches first
  #than from obs_b we will take out the state_values from value_net
  #than compute the target network, from target_value_net
  #we will compute value_loss first from value_opt
  #than we will compute the policy loss from policy_opt
  def training_step(self, batch, batch_idx):

    samples, envs = batch[0].shape[0:2]
    reshape_fn = lambda x: x.view(samples * envs, -1)
    obs_b, action_b, reward_b, done_b, next_obs_b = map(reshape_fn, batch)

    state_values = self.value_net(obs_b)

    with torch.no_grad():
      next_state_values = self.target_value_net(next_obs_b)
      next_state_values[done_b] = 0.0
      target = reward_b + self.hparams.gamma * next_state_values

    # Get optimizers
    value_opt, policy_opt = self.optimizers()

    # Optimize value network
    value_opt.zero_grad()
    value_loss = F.smooth_l1_loss(state_values, target)
    self.manual_backward(value_loss) # Manually backpropagate the loss
    value_opt.step()
    self.log("episode/Value Loss", value_loss)

    # Optimize policy network
```

```
    # Optimize policy network
    advantages = (target - state_values).detach()

    loc, scale = self.policy(obs_b)
    dist = Normal(loc, scale)

    log_probs = dist.log_prob(action_b).sum(dim=-1, keepdim=True)
    entropy = dist.entropy().sum(dim=-1, keepdim=True)

    pg_loss = - log_probs * advantages
    policy_loss = (pg_loss - self.hparams.entropy_coef * entropy).mean()

    policy_opt.zero_grad()
    self.manual_backward(policy_loss) # Manually backpropagate the loss
    policy_opt.step()

    self.log("episode/PG Loss", pg_loss.mean())
    self.log("episode/Entropy", entropy.mean())

  def on_train_epoch_end(self):
    if self.current_epoch > 0 and self.current_epoch % 25 == 0:
      self.log("episode/Return", self.env.return_queue[-1])

    if self.current_epoch > 0 and self.current_epoch % 10 == 0:
      self.target_value_net.load_state_dict(self.value_net.state_dict())
```

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



Train the policy

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

```
algo = A2C("Pendulum-v1")

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=2000,
    log_every_n_steps=1
)

trainer.fit(algo)
```

```
INFO:pytorch_lightning.utilities.rank_zero:GPU available: True (cuda), used: True
INFO:pytorch_lightning.utilities.rank_zero:TPU available: False, using: 0 TPU cores
INFO:pytorch_lightning.utilities.rank_zero:HPU available: False, using: 0 HPUs
INFO:pytorch_lightning.accelerators.cuda:LOCAL_RANK: 0 - CUDA_VISIBLE_DEVICES: [0]
INFO:pytorch_lightning.callbacks.model_summary:
  | Name             | Type           | Params | Mode
------------------------------------------------------------
0 | policy           | GradientPolicy | 4.5 K  | train
1 | value_net        | ValueNet       | 4.5 K  | train
2 | target_value_net | ValueNet       | 4.5 K  | train
------------------------------------------------------------
13.5 K    Trainable params
0         Non-trainable params
13.5 K    Total params
0.054     Total estimated model params size (MB)
13        Modules in train mode
0         Modules in eval mode
```

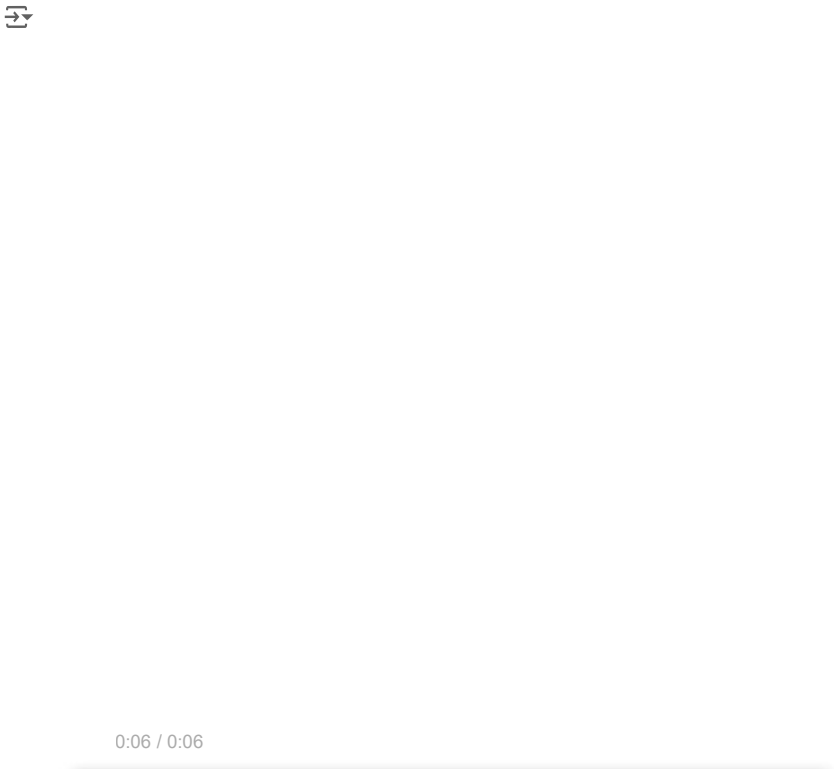
```
Epoch 1999:                                                                                    0/?  [00:00<?,  ?it/s,  v_num=4]
```

```
INFO:pytorch_lightning.utilities.rank_zero:`Trainer.fit` stopped: `max_epochs=2000` reached.
```

Check the resulting policy

```
import warnings
warnings.filterwarnings('ignore')

test_env('Pendulum-v1', algo.policy, algo.env.obs_rms)
```

```
display_video(episode=9)
```




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

```
adding: content/lightning_logs/ (stored 0%)
adding: content/lightning_logs/version_4/ (stored 0%)
adding: content/lightning_logs/version_4/checkpoints/ (stored 0%)
adding: content/lightning_logs/version_4/checkpoints/epoch=1999-step=32000.ckpt (deflated 21%)
adding: content/lightning_logs/version_4/hparams.yaml (deflated 23%)
adding: content/lightning_logs/version_4/events.out.tfevents.1734377061.cdb2554949dd.1281.4 (deflated 72%)
adding: content/lightning_logs/version_3/ (stored 0%)
adding: content/lightning_logs/version_3/events.out.tfevents.1734377012.cdb2554949dd.1281.3 (deflated 9%)
adding: content/lightning_logs/version_0/ (stored 0%)
adding: content/lightning_logs/version_0/events.out.tfevents.1734376803.cdb2554949dd.1281.0 (deflated 9%)
adding: content/lightning_logs/version_1/ (stored 0%)
adding: content/lightning_logs/version_1/events.out.tfevents.1734376928.cdb2554949dd.1281.1 (deflated 9%)
adding: content/lightning_logs/version_2/ (stored 0%)
adding: content/lightning_logs/version_2/events.out.tfevents.1734376949.cdb2554949dd.1281.2 (deflated 9%)
```

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

```
adding: content/videos/ (stored 0%)
adding: content/videos/rl-video-episode-2.mp4 (deflated 7%)
adding: content/videos/rl-video-episode-3.meta.json (deflated 61%)
adding: content/videos/rl-video-episode-6.mp4 (deflated 5%)
adding: content/videos/rl-video-episode-9.meta.json (deflated 61%)
adding: content/videos/rl-video-episode-1.meta.json (deflated 61%)
adding: content/videos/rl-video-episode-7.mp4 (deflated 6%)
adding: content/videos/rl-video-episode-0.mp4 (deflated 7%)
adding: content/videos/rl-video-episode-7.meta.json (deflated 61%)
adding: content/videos/rl-video-episode-9.mp4 (deflated 7%)
adding: content/videos/rl-video-episode-1.mp4 (deflated 3%)
adding: content/videos/rl-video-episode-2.meta.json (deflated 61%)
adding: content/videos/rl-video-episode-4.mp4 (deflated 6%)
adding: content/videos/rl-video-episode-6.meta.json (deflated 61%)
adding: content/videos/rl-video-episode-8.mp4 (deflated 6%)
adding: content/videos/rl-video-episode-3.mp4 (deflated 6%)
adding: content/videos/rl-video-episode-4.meta.json (deflated 61%)
adding: content/videos/rl-video-episode-5.meta.json (deflated 61%)
adding: content/videos/rl-video-episode-5.mp4 (deflated 10%)
adding: content/videos/rl-video-episode-0.meta.json (deflated 61%)
adding: content/videos/rl-video-episode-8.meta.json (deflated 61%)
```