# Final Project: Reinforcement Learning for Autonomous Driving in Highway-Env

# Course: CSC 580 - Artificial Intelligence II

## Group-10

Members:

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DePaul University

## Installing required poackages

```
In [1]:  !pip install highway-env
         !pip install stable-baselines3
         !pip install gymnasium
         !pip install opencv-python
         !pip install tensorboard
```

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Requirement already satisfied: highway-env in /opt/anaconda3/lib/python3.12/site-packages
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Requirement already satisfied: gymnasium>=1.0.0a2 in /opt/anaconda3/lib/python3.12/site-p
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rom torch<3.0,>=2.3->stable-baselines3) (3.13.1)
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Requirement already satisfied: mpmath<1.4,>=1.1.0 in /opt/anaconda3/lib/python3.12/site-packages (from sympy==1.13.1->torch<3.0,>=2.3->stable-baselines3) (1.3.0)
Requirement already satisfied: contourpy>=1.0.1 in /opt/anaconda3/lib/python3.12/site-packages (from matplotlib->stable-baselines3) (1.2.0)
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Requirement already satisfied: protobuf!=4.24.0,>=3.19.6 in /opt/anaconda3/lib/python3.1
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Requirement already satisfied: MarkupSafe>=2.1.1 in /opt/anaconda3/lib/python3.12/site-pa
ckages (from werkzeug>=1.0.1->tensorboard) (2.1.3)
```

In [5]:
```python
import os
import time
import glob
import io
import base64
import numpy as np
import gymnasium as gym
import highway_env
import cv2
from stable_baselines3 import DQN,A2C
from stable_baselines3.common.monitor import Monitor
from stable_baselines3.common.evaluation import evaluate_policy
from IPython import get_ipython
from IPython.display import HTML, display
from IPython import get_ipython
try:
    IN_JUPYTER = True
except ImportError:
    IN_JUPYTER = False
```

## 2) Directory Setup

In [3]:
```python
PROJECT_DIR = os.path.join(os.getcwd(), "Project_A2C")
LOG_DIR = os.path.join(PROJECT_DIR, "logs")
MODEL_DIR = os.path.join(PROJECT_DIR, "models")
VIDEO_DIR = os.path.join(PROJECT_DIR, "videos")

for folder in [PROJECT_DIR, LOG_DIR, MODEL_DIR, VIDEO_DIR]:
    os.makedirs(folder, exist_ok=True)
```

## 3) Utility: show_video in Jupyter

In [4]:
```python
def show_video(video_path_pattern):
    '''
        Display the latest video in the Notebook
    '''
    mp4_list = glob.glob(video_path_pattern)
    if not mp4_list:
        print(f"[WARN] No video found for: {video_path_pattern}")
        return
    video_path = mp4_list[0]
    with open(video_path, "rb") as f:
        video_data = f.read()
```

```
        encoded_video = base64.b64encode(video_data).decode("ascii")
        if IN_JUPYTER:
            display(HTML(data=f'''
                <video width="640" height="480" controls>
                    <source src="data:video/mp4;base64,{encoded_video}" type="video/mp4">
                </video>
            '''))
        else:
            print(f"[INFO] Video saved: {video_path}")
```

## 4) Environment Creation

```
In [5]:   def make_env(env_name="highway-fast-v0"):
              '''
              Created a Configure for the Enviornment using Gym for traning
              '''
              env = gym.make(env_name, render_mode="rgb_array")
              if hasattr(env.unwrapped, "configure"):
                  env.unwrapped.configure({
                      "lanes_count": 4,
                      "vehicles_count": 20,
                      "duration": 40,
                      "collision_reward": -2,
                      "high_speed_reward": 1,
                      "reward_speed_range": [20, 30],
                      "action": {"type": "DiscreteMetaAction"}
                  })
              return Monitor(env)
```

## 5) Video Recording with OpenCV

```
In [6]:   def record_with_opencv(frames, out_file="demo.mp4", fps=15):
              '''
              OpennCv package has been used to record the video in 3 format-MP4,AVC1,XVID
              '''
              if not frames:
                  print("[WARN] No frames to record.")
                  return
              height, width, _ = frames[0].shape
              fourcc = cv2.VideoWriter_fourcc(*'avc1')
              out = cv2.VideoWriter(out_file, fourcc, fps, (width, height))
              for frame in frames:
                  bgr_frame = cv2.cvtColor(frame, cv2.COLOR_RGB2BGR)
                  out.write(bgr_frame)
              out.release()
              print(f"[INFO] Created video: {out_file}")
```

## 6)Training A2C Model

```
In [7]:   if __name__ == "__main__":
              ENVIRONMENTS = ["highway-fast-v0", "intersection-v0", "roundabout-v0"]
              LEARNING_RATES = [0.0005, 0.001]
              GAMMAS = [0.95, 0.8]

              TOTAL_TIMESTEPS = 100000
```

```python
# dictionary to store final results
results = {}

for env_name in ENVIRONMENTS:
    for lr in LEARNING_RATES:
        for gm in GAMMAS:
            # Unique run_id
            run_id = f"{env_name}_A2C_lr{lr}_gm{gm}"
            print(f"TRAINING RUN: {run_id}")

            # Create environment
            vec_env = make_env(env_name)

            tb_log_dir = os.path.join(LOG_DIR, run_id)

            # Initialize the A2C model
            model = A2C(
                "MlpPolicy",  # Multi-layer Perceptron policy
                vec_env,         # Gym environment
                learning_rate=lr,
                gamma=gm,    # Discount factor
                n_steps=5,     # Number of steps before updating gradients
                vf_coef=0.5,  # Value function coefficient
                ent_coef=0.01,  # Entropy regularization (improves exploration)
                verbose=0,
                tensorboard_log=tb_log_dir
            )

            # Train
            model.learn(total_timesteps=TOTAL_TIMESTEPS)

            # Evaluate
            mean_reward, std_reward = evaluate_policy(model, vec_env, n_eval_episode

            if mean_reward > 0:
                success_rate = (mean_reward - std_reward) / mean_reward
            else:
                success_rate = 0

            print(f" Completed run for env={env_name}, gamma={gm}, lr={lr}")
            print(f"   Final average reward: {mean_reward:.2f}")
            print(f"   Success rate: {success_rate:.2f} \n")

            # Save model
            model_path = os.path.join(MODEL_DIR, f"{run_id}_model")
            model.save(model_path)
            print(f"[INFO] Model saved at: {model_path}\n")

            # Record short video
            demo_env = make_env(env_name)
            if hasattr(demo_env.unwrapped, "config"):
                demo_env.unwrapped.config["simulation_frequency"] = 15

            frames = []
            obs, info = demo_env.reset()
            done = truncated = False
            for step in range(300):
                action, _ = model.predict(obs, deterministic=True)
                obs, reward, done, truncated, info = demo_env.step(action)
                frames.append(demo_env.render())
                if done or truncated:
```

```python
                    obs, info = demo_env.reset()
                demo_env.close()

                video_file = os.path.join(VIDEO_DIR, f"{run_id}_{int(time.time())}.mp4")
                record_with_opencv(frames, out_file=video_file, fps=15)
                show_video(video_file)

                results[run_id] = {
                    "env": env_name,
                    "lr": lr,
                    "gamma": gm,
                    "mean_reward": mean_reward,
                    "std_reward": std_reward,
                    "success_rate": success_rate
                }

                # Display TENSORBOARD plot for this run using logs file
                if IN_JUPYTER:
                    get_ipython().run_line_magic('load_ext', 'tensorboard')
                    get_ipython().run_line_magic('tensorboard', '--logdir ./Project_A2C/

    print("\nFinal Result of All model trained Above\n")
    for i in results:
        print(i)
```

```
TRAINING RUN: highway-fast-v0_A2C_lr0.0005_gm0.95
[INFO] Completed run for env=highway-fast-v0, gamma=0.95, lr=0.0005
    Final average reward: 8.49
    Success rate: 0.30

[INFO] Model saved at: /Users/sanjayuppala/Desktop/CSC 580 AI_2/Project_A2C/Project_A2C/m
odels/highway-fast-v0_A2C_lr0.0005_gm0.95_model
```

2025-03-17 02:36:29.087 python[45071:2415797] +[IMKClient subclass]: chose IMKClient_Mode
rn
2025-03-17 02:36:29.087 python[45071:2415797] +[IMKInputSession subclass]: chose IMKInput
Session_Modern

```
[INFO] Created video: /Users/sanjayuppala/Desktop/CSC 580 AI_2/Project_A2C/Project_A2C/vi
deos/highway-fast-v0_A2C_lr0.0005_gm0.95_1742197007.mp4
```

# Index of /

| Name | Size | Date Modified |
| --- | --- | --- |
| .nofollow/ | | 3/6/25, 4:06:02 AM |
| .resolve/ | | 3/6/25, 4:06:02 AM |
| .vol/ | | 3/6/25, 4:06:02 AM |
| Applications/ | | 3/15/25, 9:12:09 AM |
| bin/ | | 3/6/25, 4:06:02 AM |
| cores/ | | 8/4/24, 5:31:41 AM |
| dev/ | | 3/14/25, 8:24:56 AM |
| etc/ | | 3/14/25, 8:26:29 AM |
| home/ | | 3/14/25, 8:26:30 AM |
| Library/ | | 3/14/25, 8:26:15 AM |
| opt/ | | 2/10/25, 5:44:30 PM |
| private/ | | 3/14/25, 8:26:26 AM |
| sbin/ | | 3/6/25, 4:06:02 AM |
| System/ | | 3/6/25, 4:06:02 AM |
| tmp/ | | 3/17/25, 10:21:46 PM |
| Users/ | | 3/14/25, 8:25:58 AM |
| usr/ | | 3/6/25, 4:06:02 AM |
| var/ | | 3/14/25, 8:26:18 AM |
| Volumes/ | | 3/14/25, 9:18:58 AM |
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```
TRAINING RUN: highway-fast-v0_A2C_lr0.0005_gm0.8
[INFO] Completed run for env=highway-fast-v0, gamma=0.8, lr=0.0005
   Final average reward: 14.10
   Success rate: 0.82

[INFO] Model saved at: /Users/sanjayuppala/Desktop/CSC 580 AI_2/Project_A2C/Project_A2C/m
odels/highway-fast-v0_A2C_lr0.0005_gm0.8_model

[INFO] Created video: /Users/sanjayuppala/Desktop/CSC 580 AI_2/Project_A2C/Project_A2C/vi
deos/highway-fast-v0_A2C_lr0.0005_gm0.8_1742198446.mp4
```
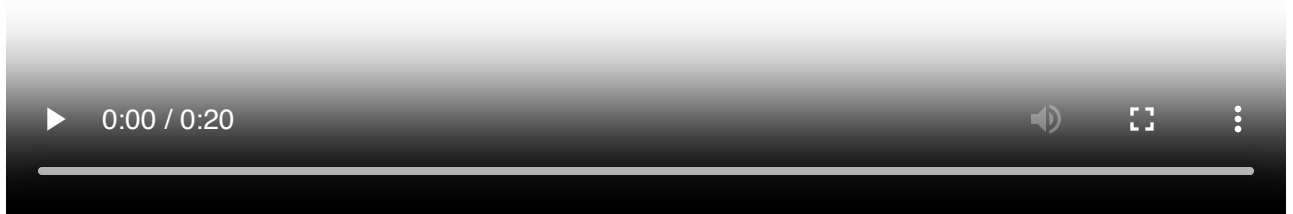
```
The tensorboard extension is already loaded. To reload it, use:
  %reload_ext tensorboard
Reusing TensorBoard on port 6007 (pid 45311), started 0:23:55 ago. (Use '!kill 45311' to
kill it.)
```

# Index of /

| Name | Size | Date Modified |
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| .nofollow/ | | 3/6/25, 4:06:02 AM |
| .resolve/ | | 3/6/25, 4:06:02 AM |
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| Applications/ | | 3/15/25, 9:12:09 AM |
| bin/ | | 3/6/25, 4:06:02 AM |
| cores/ | | 8/4/24, 5:31:41 AM |
| dev/ | | 3/14/25, 8:24:56 AM |
| etc/ | | 3/14/25, 8:26:29 AM |
| home/ | | 3/14/25, 8:26:30 AM |
| Library/ | | 3/14/25, 8:26:15 AM |
| opt/ | | 2/10/25, 5:44:30 PM |
| private/ | | 3/14/25, 8:26:26 AM |
| sbin/ | | 3/6/25, 4:06:02 AM |
| System/ | | 3/6/25, 4:06:02 AM |
| tmp/ | | 3/17/25, 10:21:46 PM |
| Users/ | | 3/14/25, 8:25:58 AM |
| usr/ | | 3/6/25, 4:06:02 AM |
| var/ | | 3/14/25, 8:26:18 AM |
| Volumes/ | | 3/14/25, 9:18:58 AM |
| .file | 0 B | 3/6/25, 4:06:02 AM |

```
TRAINING RUN: highway-fast-v0_A2C_lr0.001_gm0.95
[INFO] Completed run for env=highway-fast-v0, gamma=0.95, lr=0.001
   Final average reward: 14.25
   Success rate: 0.25

[INFO] Model saved at: /Users/sanjayuppala/Desktop/CSC 580 AI_2/Project_A2C/Project_A2C/m
odels/highway-fast-v0_A2C_lr0.001_gm0.95_model

[INFO] Created video: /Users/sanjayuppala/Desktop/CSC 580 AI_2/Project_A2C/Project_A2C/vi
deos/highway-fast-v0_A2C_lr0.001_gm0.95_1742199872.mp4
```

```
The tensorboard extension is already loaded. To reload it, use:
  %reload_ext tensorboard
Reusing TensorBoard on port 6007 (pid 45311), started 0:47:40 ago. (Use '!kill 45311' to kill it.)
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# Index of /

| Name | Size | Date Modified |
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| .resolve/ | | 3/6/25, 4:06:02 AM |
| .vol/ | | 3/6/25, 4:06:02 AM |
| Applications/ | | 3/15/25, 9:12:09 AM |
| bin/ | | 3/6/25, 4:06:02 AM |
| cores/ | | 8/4/24, 5:31:41 AM |
| dev/ | | 3/14/25, 8:24:56 AM |
| etc/ | | 3/14/25, 8:26:29 AM |
| home/ | | 3/14/25, 8:26:30 AM |
| Library/ | | 3/14/25, 8:26:15 AM |
| opt/ | | 2/10/25, 5:44:30 PM |
| private/ | | 3/14/25, 8:26:26 AM |
| sbin/ | | 3/6/25, 4:06:02 AM |
| System/ | | 3/6/25, 4:06:02 AM |
| tmp/ | | 3/17/25, 10:21:46 PM |
| Users/ | | 3/14/25, 8:25:58 AM |
| usr/ | | 3/6/25, 4:06:02 AM |
| var/ | | 3/14/25, 8:26:18 AM |
| Volumes/ | | 3/14/25, 9:18:58 AM |
| .file | 0 B | 3/6/25, 4:06:02 AM |

```
TRAINING RUN: highway-fast-v0_A2C_lr0.001_gm0.8
[INFO] Completed run for env=highway-fast-v0, gamma=0.8, lr=0.001
   Final average reward: 7.80
   Success rate: 0.48

[INFO] Model saved at: /Users/sanjayuppala/Desktop/CSC 580 AI_2/Project_A2C/Project_A2C/m
odels/highway-fast-v0_A2C_lr0.001_gm0.8_model

[INFO] Created video: /Users/sanjayuppala/Desktop/CSC 580 AI_2/Project_A2C/Project_A2C/vi
deos/highway-fast-v0_A2C_lr0.001_gm0.8_1742201308.mp4
```

```
The tensorboard extension is already loaded. To reload it, use:
  %reload_ext tensorboard
Reusing TensorBoard on port 6007 (pid 45311), started 1:11:36 ago. (Use '!kill 45311' to
kill it.)
```

# Index of /

```
TRAINING RUN: intersection-v0_A2C_lr0.0005_gm0.95
/opt/anaconda3/envs/pytorch-env/lib/python3.10/site-packages/gymnasium/envs/registration.
py:517: DeprecationWarning: WARN: The environment intersection-v0 is out of date. You sho
uld consider upgrading to version `v1`.
  logger.deprecation(
[INFO] Completed run for env=intersection-v0, gamma=0.95, lr=0.0005
   Final average reward: -0.20
   Success rate: 0.00

[INFO] Model saved at: /Users/sanjayuppala/Desktop/CSC 580 AI_2/Project_A2C/Project_A2C/m
odels/intersection-v0_A2C_lr0.0005_gm0.95_model
```

[INFO] Created video: /Users/sanjayuppala/Desktop/CSC 580 AI_2/Project_A2C/Project_A2C/videos/intersection-v0_A2C_lr0.0005_gm0.95_1742203838.mp4



The tensorboard extension is already loaded. To reload it, use:
  %reload_ext tensorboard
Reusing TensorBoard on port 6007 (pid 45311), started 1:53:47 ago. (Use '!kill 45311' to kill it.)

# Index of /

```
TRAINING RUN: intersection-v0_A2C_lr0.0005_gm0.8
/opt/anaconda3/envs/pytorch-env/lib/python3.10/site-packages/gymnasium/envs/registration.
py:517: DeprecationWarning: WARN: The environment intersection-v0 is out of date. You sho
uld consider upgrading to version `v1`.
  logger.deprecation(
[INFO] Completed run for env=intersection-v0, gamma=0.8, lr=0.0005
   Final average reward: -0.20
   Success rate: 0.00

[INFO] Model saved at: /Users/sanjayuppala/Desktop/CSC 580 AI_2/Project_A2C/Project_A2C/m
odels/intersection-v0_A2C_lr0.0005_gm0.8_model
```

[INFO] Created video: /Users/sanjayuppala/Desktop/CSC 580 AI_2/Project_A2C/Project_A2C/videos/intersection-v0_A2C_lr0.0005_gm0.8_1742206362.mp4
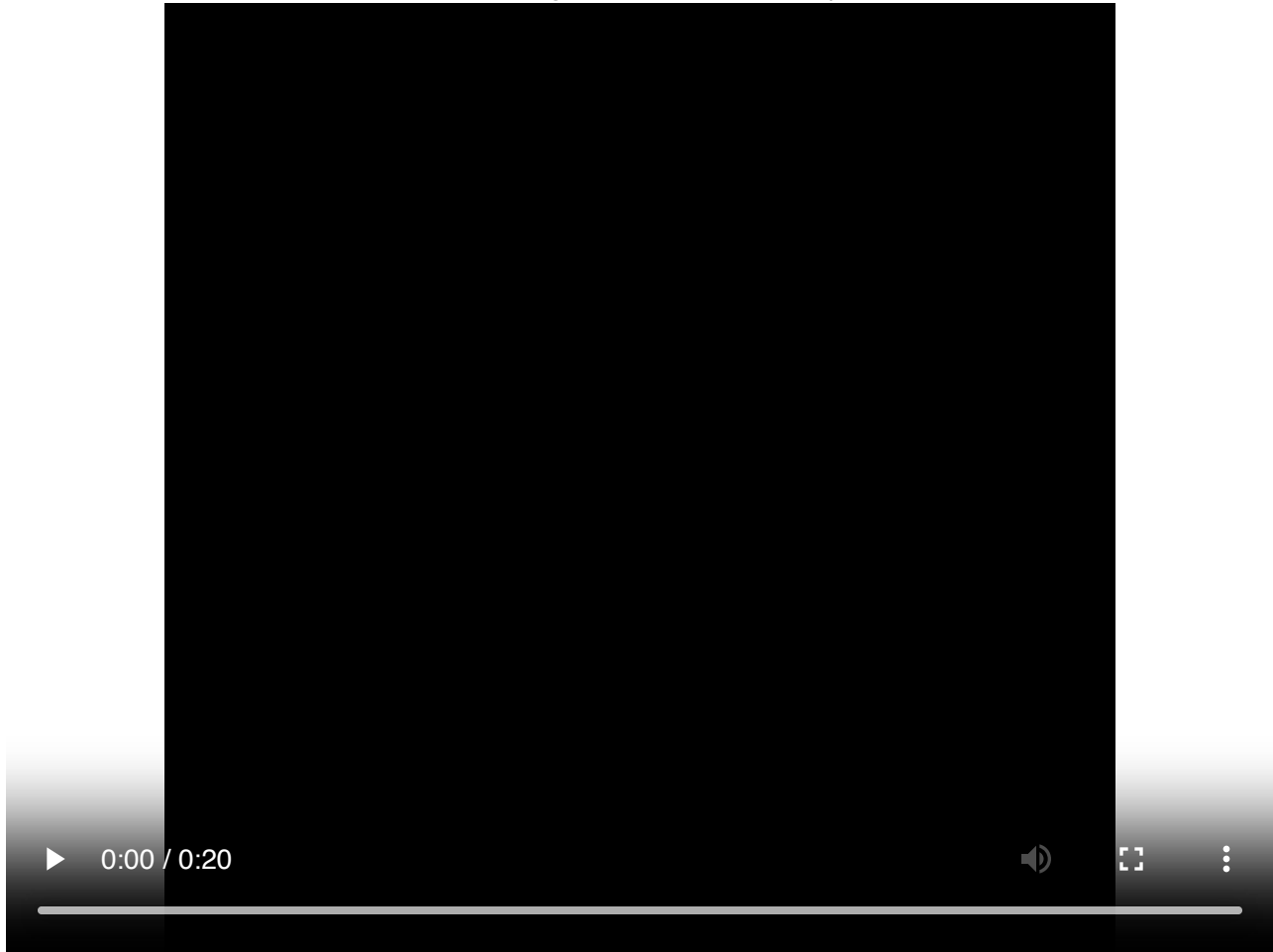


0:00 / 0:20

The tensorboard extension is already loaded. To reload it, use:
  %reload_ext tensorboard
Reusing TensorBoard on port 6007 (pid 45311), started 2:35:51 ago. (Use '!kill 45311' to kill it.)

# Index of /

| Name | Size | Date Modified |
|------|------|---------------|
| .nofollow/ | | 3/6/25, 4:06:02 AM |
| .resolve/ | | 3/6/25, 4:06:02 AM |
| .vol/ | | 3/6/25, 4:06:02 AM |
| Applications/ | | 3/15/25, 9:12:09 AM |
| bin/ | | 3/6/25, 4:06:02 AM |
| cores/ | | 8/4/24, 5:31:41 AM |
| dev/ | | 3/14/25, 8:24:56 AM |
| etc/ | | 3/14/25, 8:26:29 AM |
| home/ | | 3/14/25, 8:26:30 AM |
| Library/ | | 3/14/25, 8:26:15 AM |
| opt/ | | 2/10/25, 5:44:30 PM |
| private/ | | 3/14/25, 8:26:26 AM |
| sbin/ | | 3/6/25, 4:06:02 AM |
| System/ | | 3/6/25, 4:06:02 AM |
| tmp/ | | 3/17/25, 10:21:46 PM |
| Users/ | | 3/14/25, 8:25:58 AM |
| usr/ | | 3/6/25, 4:06:02 AM |
| var/ | | 3/14/25, 8:26:18 AM |
| Volumes/ | | 3/14/25, 9:18:58 AM |
| .file | 0 B | 3/6/25, 4:06:02 AM |

```
TRAINING RUN: intersection-v0_A2C_lr0.001_gm0.95
/opt/anaconda3/envs/pytorch-env/lib/python3.10/site-packages/gymnasium/envs/registration.
py:517: DeprecationWarning: WARN: The environment intersection-v0 is out of date. You sho
uld consider upgrading to version `v1`.
  logger.deprecation(
[INFO] Completed run for env=intersection-v0, gamma=0.95, lr=0.001
   Final average reward: 0.40
   Success rate: -2.00

[INFO] Model saved at: /Users/sanjayuppala/Desktop/CSC 580 AI_2/Project_A2C/Project_A2C/m
odels/intersection-v0_A2C_lr0.001_gm0.95_model
```
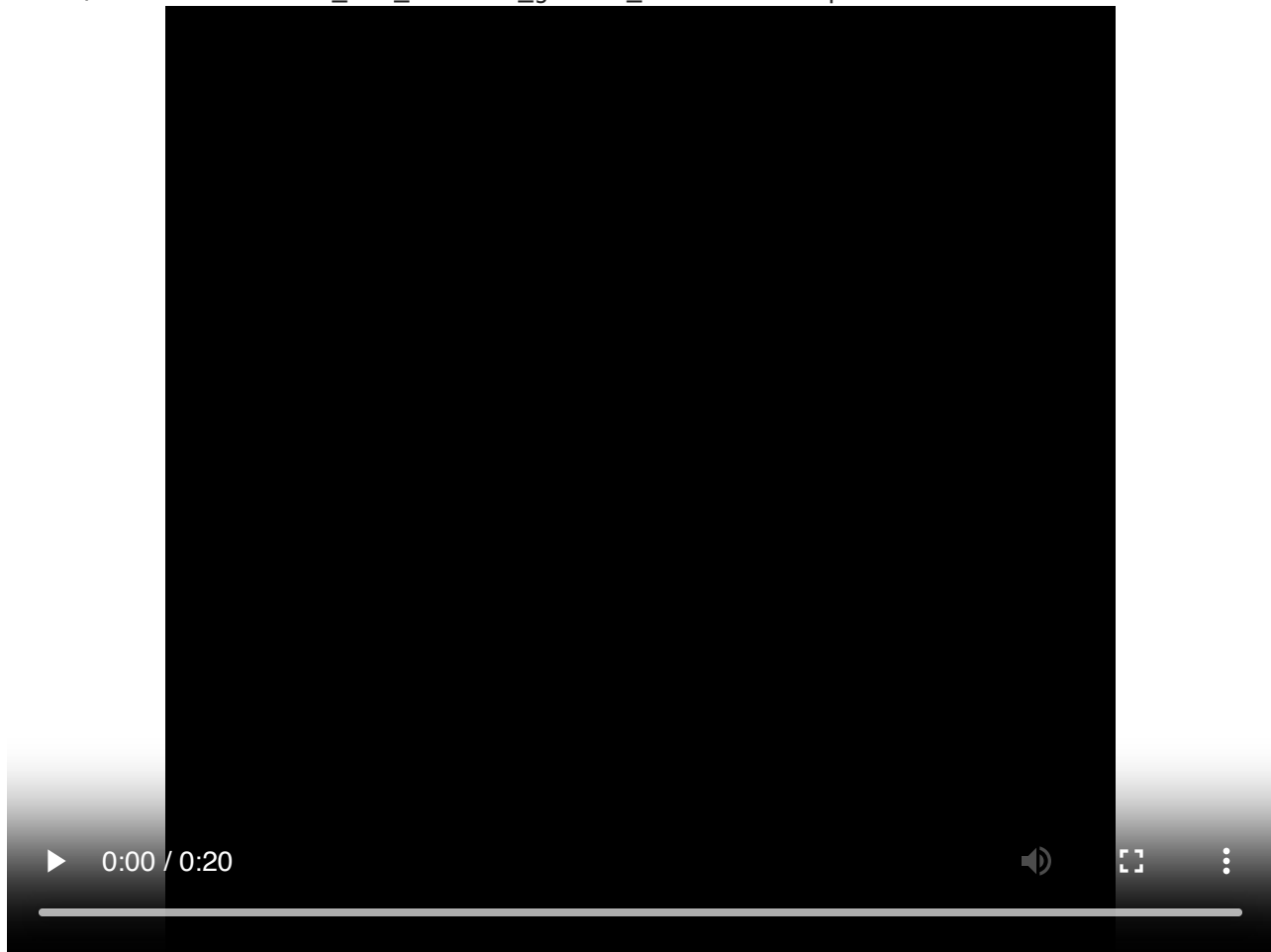
[INFO] Created video: /Users/sanjayuppala/Desktop/CSC 580 AI_2/Project_A2C/Project_A2C/videos/intersection-v0_A2C_lr0.001_gm0.95_1742208888.mp4



0:00 / 0:20

The tensorboard extension is already loaded. To reload it, use:
  %reload_ext tensorboard
Reusing TensorBoard on port 6007 (pid 45311), started 3:17:57 ago. (Use '!kill 45311' to kill it.)

# Index of /

```
TRAINING RUN: intersection-v0_A2C_lr0.001_gm0.8
/opt/anaconda3/envs/pytorch-env/lib/python3.10/site-packages/gymnasium/envs/registration.
py:517: DeprecationWarning: WARN: The environment intersection-v0 is out of date. You sho
uld consider upgrading to version `v1`.
  logger.deprecation(
[INFO] Completed run for env=intersection-v0, gamma=0.8, lr=0.001
   Final average reward: -0.20
   Success rate: 0.00

[INFO] Model saved at: /Users/sanjayuppala/Desktop/CSC 580 AI_2/Project_A2C/Project_A2C/m
odels/intersection-v0_A2C_lr0.001_gm0.8_model
```
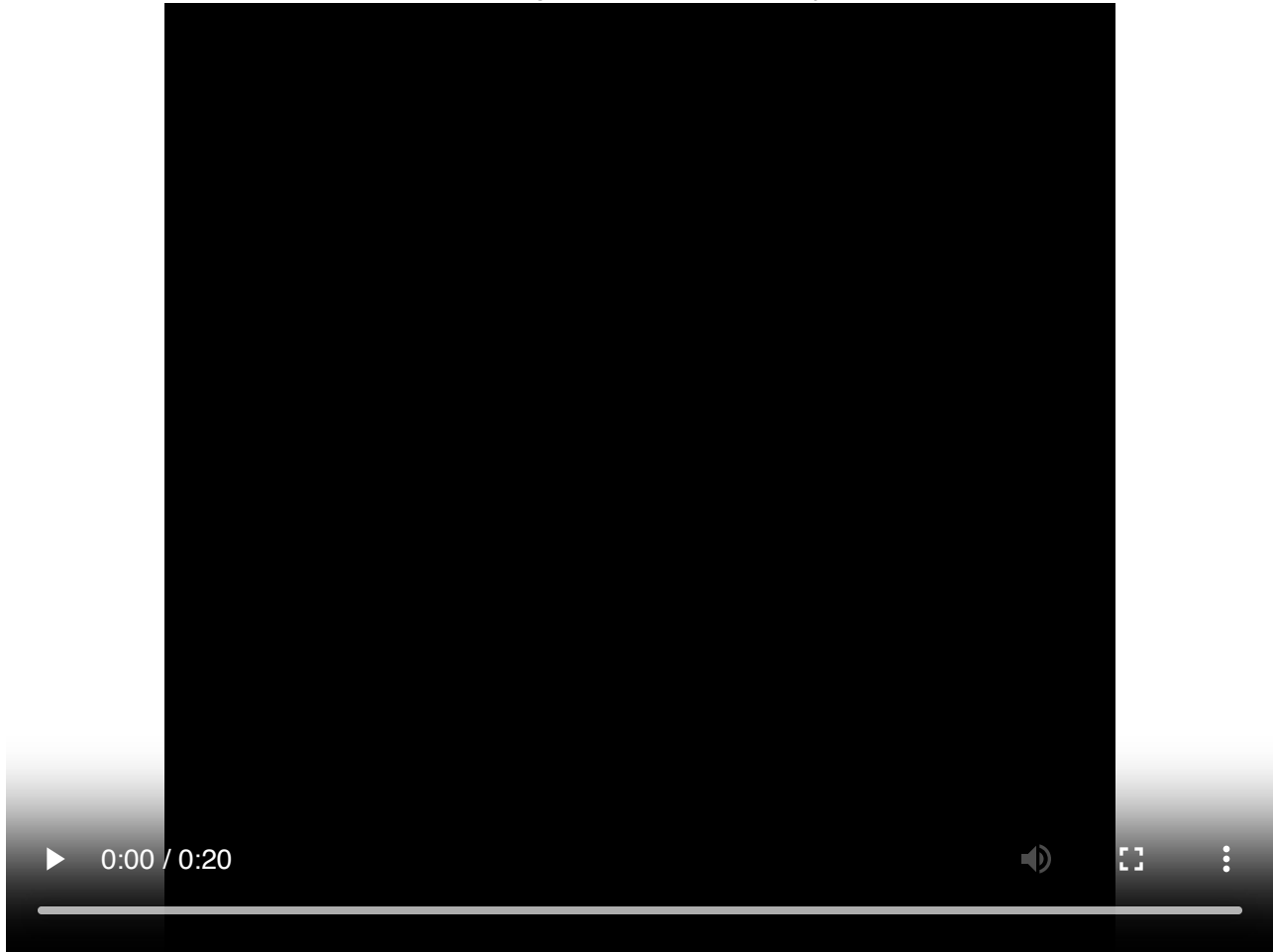
[INFO] Created video: /Users/sanjayuppala/Desktop/CSC 580 AI_2/Project_A2C/Project_A2C/vi
deos/intersection—v0_A2C_lr0.001_gm0.8_1742211425.mp4



The tensorboard extension is already loaded. To reload it, use:
  %reload_ext tensorboard
Reusing TensorBoard on port 6007 (pid 45311), started 4:00:14 ago. (Use '!kill 45311' to
kill it.)

# Index of /

| Name | Size | Date Modified |
|------|------|---------------|
| .nofollow/ | | 3/6/25, 4:06:02 AM |
| .resolve/ | | 3/6/25, 4:06:02 AM |
| .vol/ | | 3/6/25, 4:06:02 AM |
| Applications/ | | 3/15/25, 9:12:09 AM |
| bin/ | | 3/6/25, 4:06:02 AM |
| cores/ | | 8/4/24, 5:31:41 AM |
| dev/ | | 3/14/25, 8:24:56 AM |
| etc/ | | 3/14/25, 8:26:29 AM |
| home/ | | 3/14/25, 8:26:30 AM |
| Library/ | | 3/14/25, 8:26:15 AM |
| opt/ | | 2/10/25, 5:44:30 PM |
| private/ | | 3/14/25, 8:26:26 AM |
| sbin/ | | 3/6/25, 4:06:02 AM |
| System/ | | 3/6/25, 4:06:02 AM |
| tmp/ | | 3/17/25, 10:21:46 PM |
| Users/ | | 3/14/25, 8:25:58 AM |
| usr/ | | 3/6/25, 4:06:02 AM |
| var/ | | 3/14/25, 8:26:18 AM |
| Volumes/ | | 3/14/25, 9:18:58 AM |
| .file | 0 B | 3/6/25, 4:06:02 AM |

```
TRAINING RUN: roundabout-v0_A2C_lr0.0005_gm0.95
[INFO] Completed run for env=roundabout-v0, gamma=0.95, lr=0.0005
   Final average reward: 6.73
   Success rate: 0.72

[INFO] Model saved at: /Users/sanjayuppala/Desktop/CSC 580 AI_2/Project_A2C/Project_A2C/m
odels/roundabout-v0_A2C_lr0.0005_gm0.95_model

[INFO] Created video: /Users/sanjayuppala/Desktop/CSC 580 AI_2/Project_A2C/Project_A2C/vi
deos/roundabout-v0_A2C_lr0.0005_gm0.95_1742212954.mp4
```
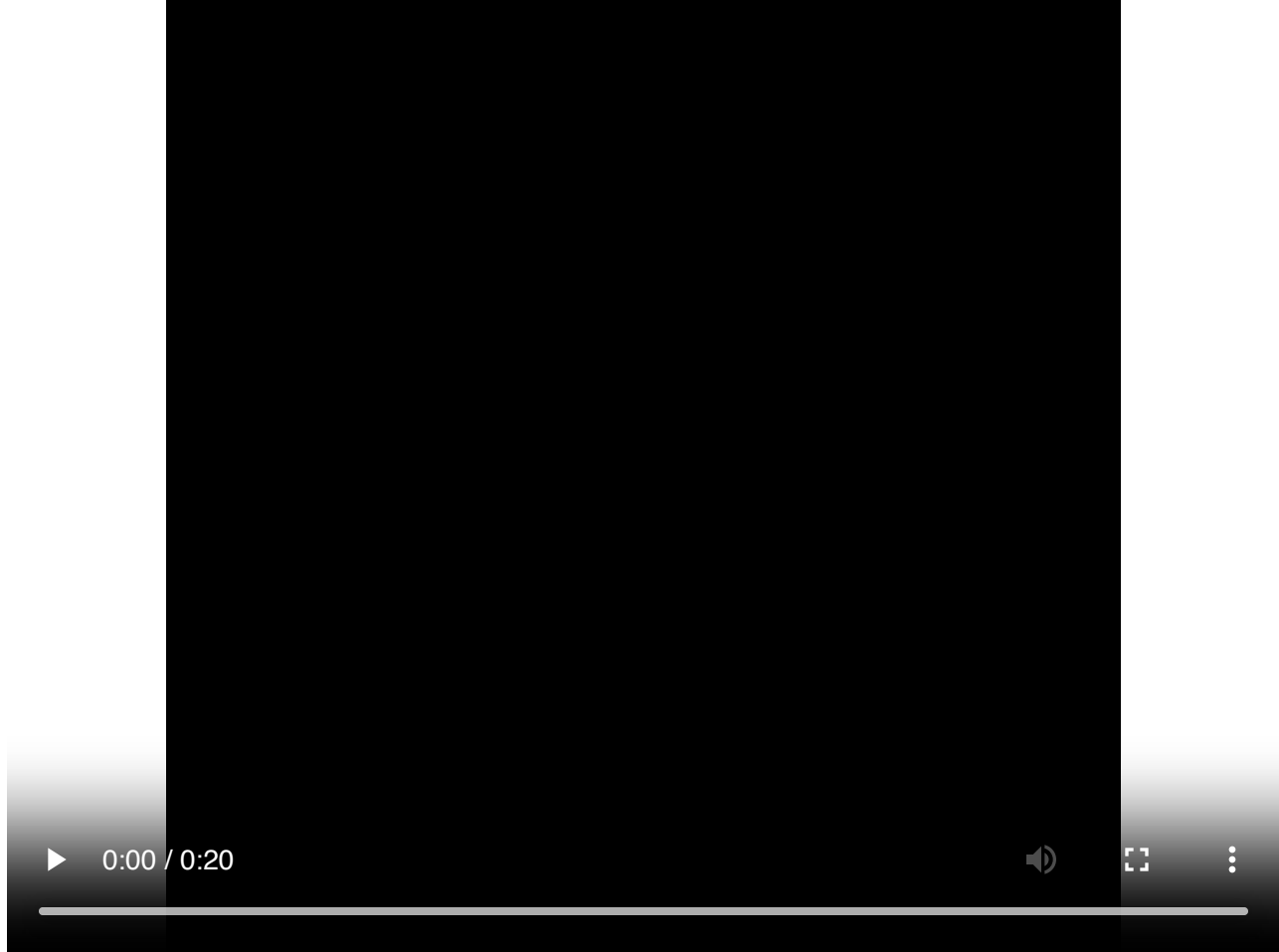
The tensorboard extension is already loaded. To reload it, use:
  %reload_ext tensorboard
Reusing TensorBoard on port 6007 (pid 45311), started 4:25:43 ago. (Use '!kill 45311' to kill it.)

# Index of /

| Name | Size | Date Modified |
| --- | --- | --- |
| .nofollow/ | | 3/6/25, 4:06:02 AM |
| .resolve/ | | 3/6/25, 4:06:02 AM |
| .vol/ | | 3/6/25, 4:06:02 AM |
| Applications/ | | 3/15/25, 9:12:09 AM |
| bin/ | | 3/6/25, 4:06:02 AM |
| cores/ | | 8/4/24, 5:31:41 AM |
| dev/ | | 3/14/25, 8:24:56 AM |
| etc/ | | 3/14/25, 8:26:29 AM |
| home/ | | 3/14/25, 8:26:30 AM |
| Library/ | | 3/14/25, 8:26:15 AM |
| opt/ | | 2/10/25, 5:44:30 PM |
| private/ | | 3/14/25, 8:26:26 AM |
| sbin/ | | 3/6/25, 4:06:02 AM |
| System/ | | 3/6/25, 4:06:02 AM |
| tmp/ | | 3/17/25, 10:21:46 PM |
| Users/ | | 3/14/25, 8:25:58 AM |
| usr/ | | 3/6/25, 4:06:02 AM |
| var/ | | 3/14/25, 8:26:18 AM |
| Volumes/ | | 3/14/25, 9:18:58 AM |
| .file | 0 B | 3/6/25, 4:06:02 AM |

```
TRAINING RUN: roundabout-v0_A2C_lr0.0005_gm0.8
[INFO] Completed run for env=roundabout-v0, gamma=0.8, lr=0.0005
   Final average reward: 4.25
   Success rate: 0.33

[INFO] Model saved at: /Users/sanjayuppala/Desktop/CSC 580 AI_2/Project_A2C/Project_A2C/m
odels/roundabout-v0_A2C_lr0.0005_gm0.8_model

[INFO] Created video: /Users/sanjayuppala/Desktop/CSC 580 AI_2/Project_A2C/Project_A2C/vi
deos/roundabout-v0_A2C_lr0.0005_gm0.8_1742214479.mp4
```
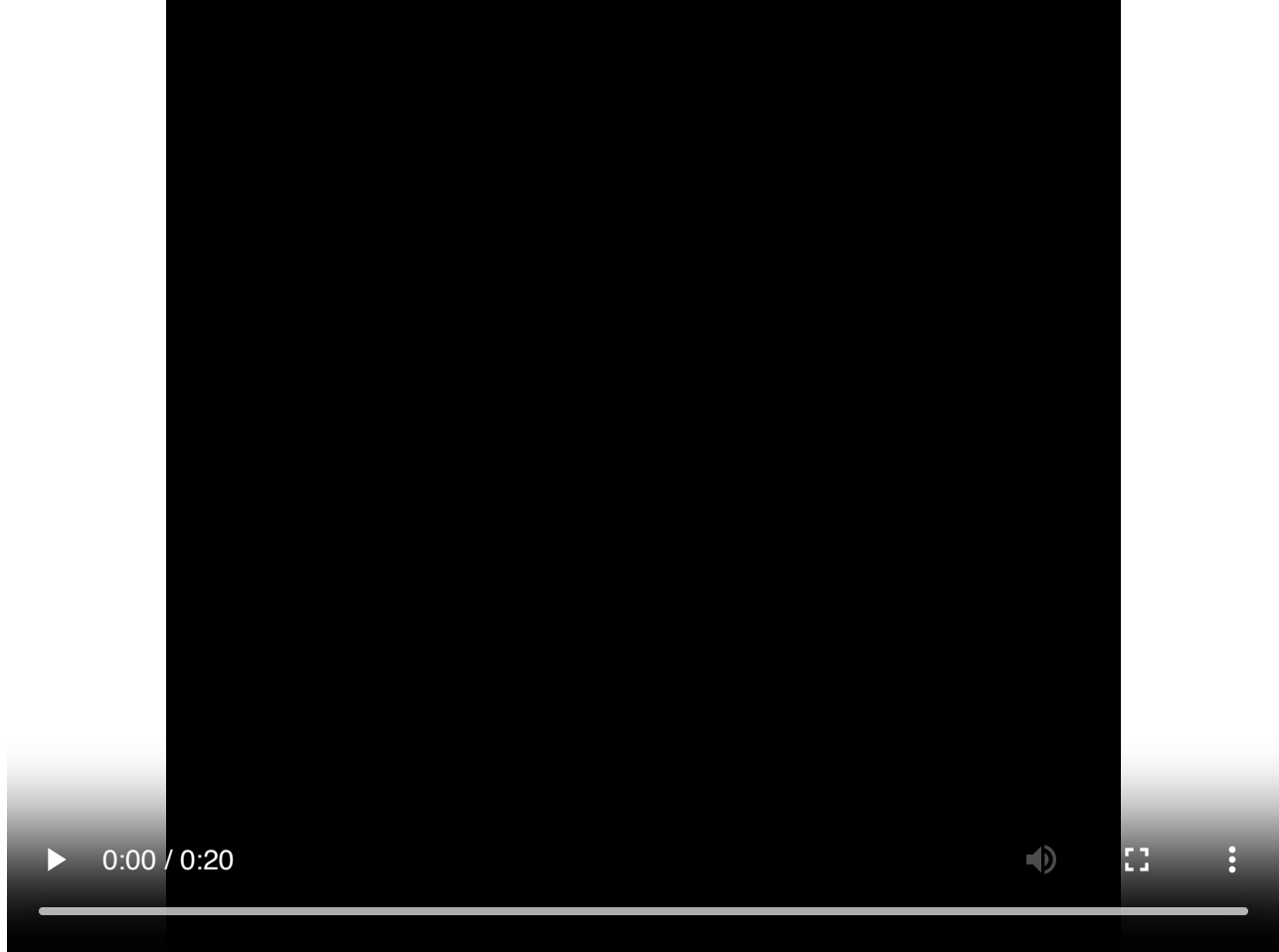
▶ 0:00 / 0:20

```
The tensorboard extension is already loaded. To reload it, use:
  %reload_ext tensorboard
Reusing TensorBoard on port 6007 (pid 45311), started 4:51:08 ago. (Use '!kill 45311' to
kill it.)
```

# Index of /

| Name | Size | Date Modified |
|------|------|---------------|
| .nofollow/ | | 3/6/25, 4:06:02 AM |
| .resolve/ | | 3/6/25, 4:06:02 AM |
| .vol/ | | 3/6/25, 4:06:02 AM |
| Applications/ | | 3/15/25, 9:12:09 AM |
| bin/ | | 3/6/25, 4:06:02 AM |
| cores/ | | 8/4/24, 5:31:41 AM |
| dev/ | | 3/14/25, 8:24:56 AM |
| etc/ | | 3/14/25, 8:26:29 AM |
| home/ | | 3/14/25, 8:26:30 AM |
| Library/ | | 3/14/25, 8:26:15 AM |
| opt/ | | 2/10/25, 5:44:30 PM |
| private/ | | 3/14/25, 8:26:26 AM |
| sbin/ | | 3/6/25, 4:06:02 AM |
| System/ | | 3/6/25, 4:06:02 AM |
| tmp/ | | 3/17/25, 10:21:46 PM |
| Users/ | | 3/14/25, 8:25:58 AM |
| usr/ | | 3/6/25, 4:06:02 AM |
| var/ | | 3/14/25, 8:26:18 AM |
| Volumes/ | | 3/14/25, 9:18:58 AM |
| .file | 0 B | 3/6/25, 4:06:02 AM |

```
TRAINING RUN: roundabout-v0_A2C_lr0.001_gm0.95
[INFO] Completed run for env=roundabout-v0, gamma=0.95, lr=0.001
   Final average reward: 6.33
   Success rate: 0.58

[INFO] Model saved at: /Users/sanjayuppala/Desktop/CSC 580 AI_2/Project_A2C/Project_A2C/m
odels/roundabout-v0_A2C_lr0.001_gm0.95_model

[INFO] Created video: /Users/sanjayuppala/Desktop/CSC 580 AI_2/Project_A2C/Project_A2C/vi
deos/roundabout-v0_A2C_lr0.001_gm0.95_1742216015.mp4
```
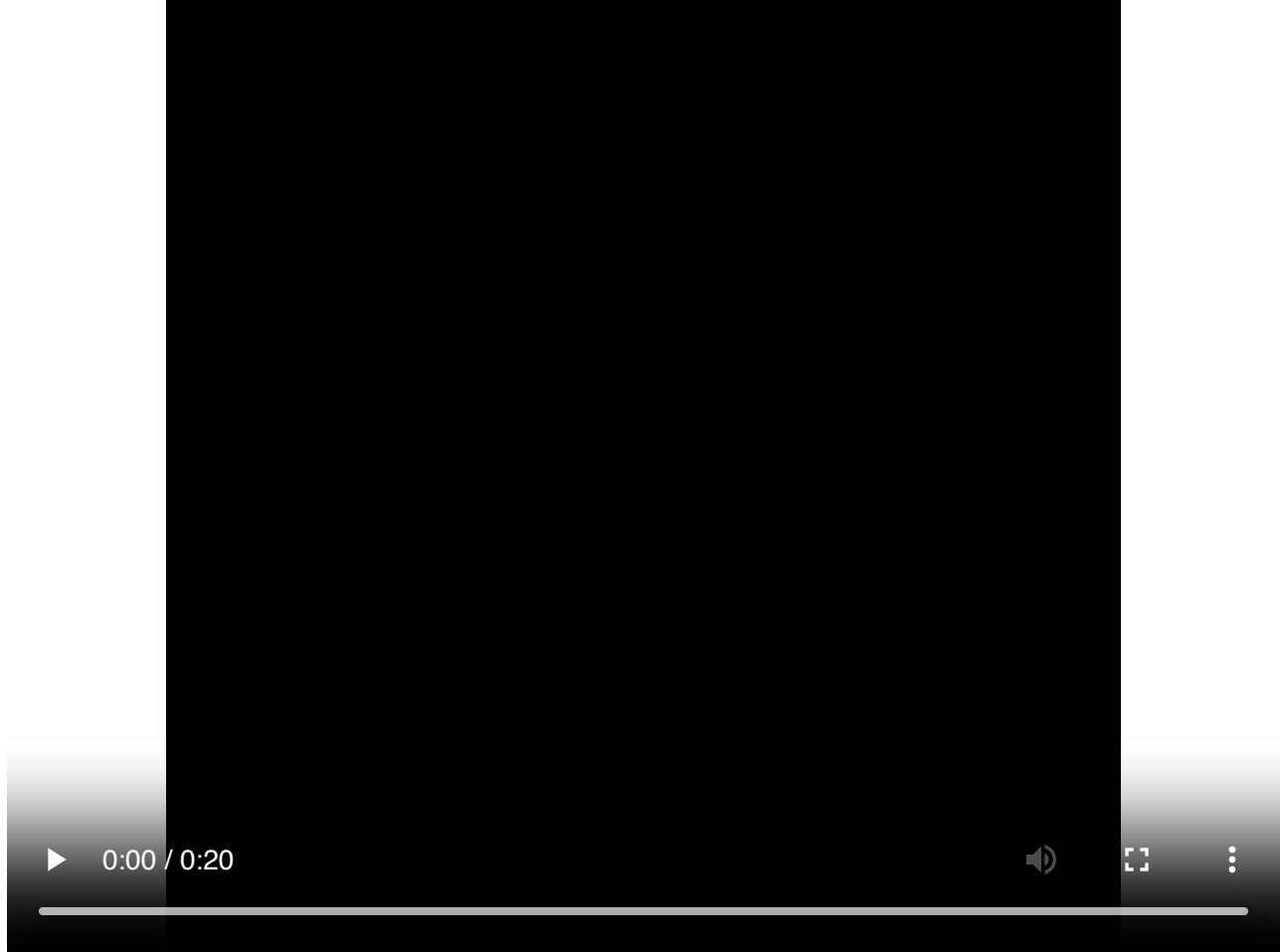
```
The tensorboard extension is already loaded. To reload it, use:
  %reload_ext tensorboard
Reusing TensorBoard on port 6007 (pid 45311), started 5:16:44 ago. (Use '!kill 45311' to
kill it.)
```

# Index of /

| Name | Size | Date Modified |
| --- | --- | --- |
| .nofollow/ | | 3/6/25, 4:06:02 AM |
| .resolve/ | | 3/6/25, 4:06:02 AM |
| .vol/ | | 3/6/25, 4:06:02 AM |
| Applications/ | | 3/15/25, 9:12:09 AM |
| bin/ | | 3/6/25, 4:06:02 AM |
| cores/ | | 8/4/24, 5:31:41 AM |
| dev/ | | 3/14/25, 8:24:56 AM |
| etc/ | | 3/14/25, 8:26:29 AM |
| home/ | | 3/14/25, 8:26:30 AM |
| Library/ | | 3/14/25, 8:26:15 AM |
| opt/ | | 2/10/25, 5:44:30 PM |
| private/ | | 3/14/25, 8:26:26 AM |
| sbin/ | | 3/6/25, 4:06:02 AM |
| System/ | | 3/6/25, 4:06:02 AM |
| tmp/ | | 3/17/25, 10:21:46 PM |
| Users/ | | 3/14/25, 8:25:58 AM |
| usr/ | | 3/6/25, 4:06:02 AM |
| var/ | | 3/14/25, 8:26:18 AM |
| Volumes/ | | 3/14/25, 9:18:58 AM |
| .file | 0 B | 3/6/25, 4:06:02 AM |

```
TRAINING RUN: roundabout-v0_A2C_lr0.001_gm0.8
[INFO] Completed run for env=roundabout-v0, gamma=0.8, lr=0.001
   Final average reward: 5.20
   Success rate: 0.42

[INFO] Model saved at: /Users/sanjayuppala/Desktop/CSC 580 AI_2/Project_A2C/Project_A2C/m
odels/roundabout-v0_A2C_lr0.001_gm0.8_model

[INFO] Created video: /Users/sanjayuppala/Desktop/CSC 580 AI_2/Project_A2C/Project_A2C/vi
deos/roundabout-v0_A2C_lr0.001_gm0.8_1742217545.mp4
```
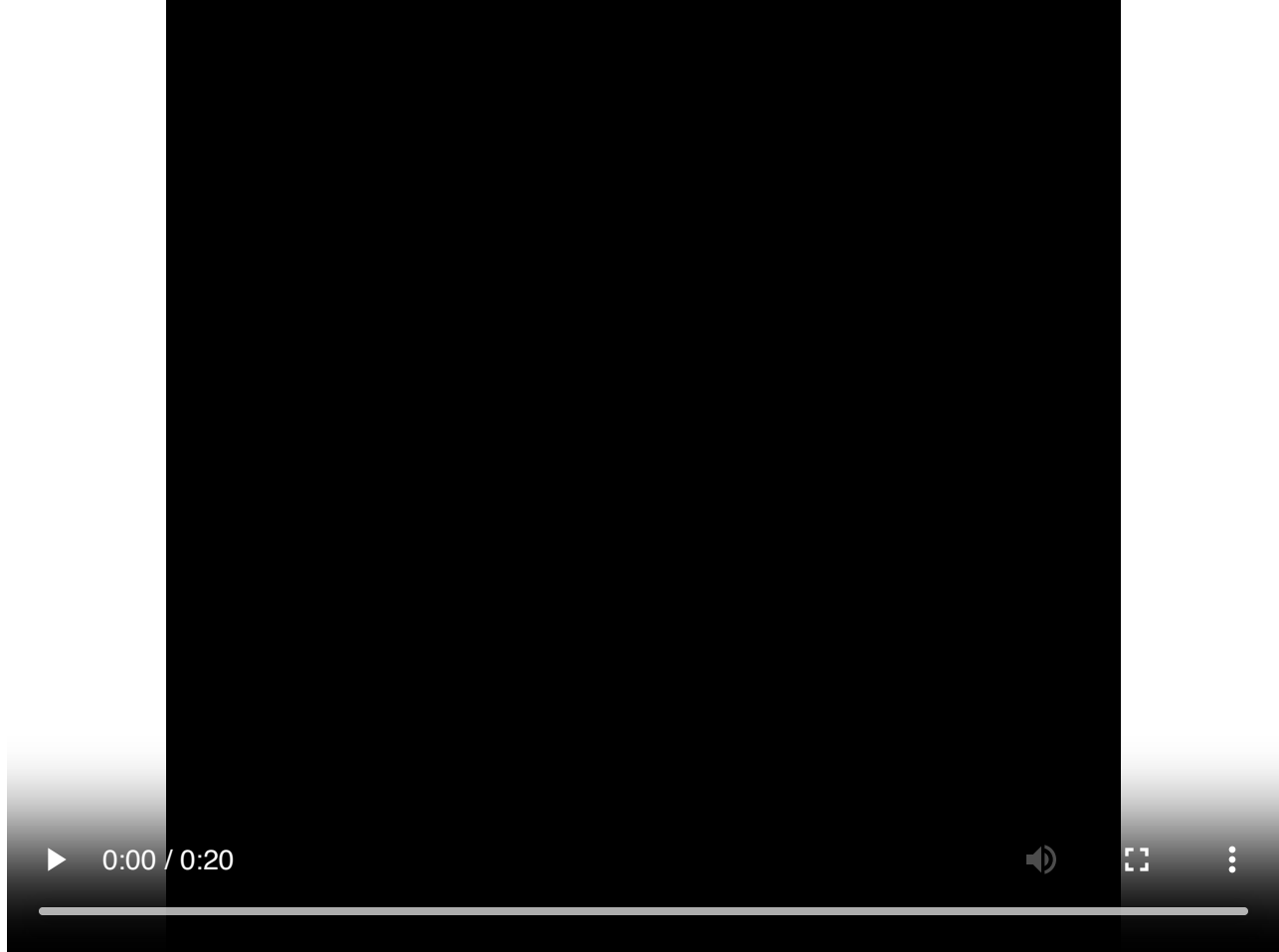
```
The tensorboard extension is already loaded. To reload it, use:
  %reload_ext tensorboard
Reusing TensorBoard on port 6007 (pid 45311), started 5:42:14 ago. (Use '!kill 45311' to
kill it.)
```

# Index of /

| Name | Size | Date Modified |
|------|------|---------------|
| .nofollow/ | | 3/6/25, 4:06:02 AM |
| .resolve/ | | 3/6/25, 4:06:02 AM |
| .vol/ | | 3/6/25, 4:06:02 AM |
| Applications/ | | 3/15/25, 9:12:09 AM |
| bin/ | | 3/6/25, 4:06:02 AM |
| cores/ | | 8/4/24, 5:31:41 AM |
| dev/ | | 3/14/25, 8:24:56 AM |
| etc/ | | 3/14/25, 8:26:29 AM |
| home/ | | 3/14/25, 8:26:30 AM |
| Library/ | | 3/14/25, 8:26:15 AM |
| opt/ | | 2/10/25, 5:44:30 PM |
| private/ | | 3/14/25, 8:26:26 AM |
| sbin/ | | 3/6/25, 4:06:02 AM |
| System/ | | 3/6/25, 4:06:02 AM |
| tmp/ | | 3/17/25, 10:21:46 PM |
| Users/ | | 3/14/25, 8:25:58 AM |
| usr/ | | 3/6/25, 4:06:02 AM |
| var/ | | 3/14/25, 8:26:18 AM |
| Volumes/ | | 3/14/25, 9:18:58 AM |
| .file | 0 B | 3/6/25, 4:06:02 AM |

```
Final Result of All model trained Above

highway-fast-v0_A2C_lr0.0005_gm0.95
highway-fast-v0_A2C_lr0.0005_gm0.8
highway-fast-v0_A2C_lr0.001_gm0.95
highway-fast-v0_A2C_lr0.001_gm0.8
intersection-v0_A2C_lr0.0005_gm0.95
intersection-v0_A2C_lr0.0005_gm0.8
intersection-v0_A2C_lr0.001_gm0.95
intersection-v0_A2C_lr0.001_gm0.8
roundabout-v0_A2C_lr0.0005_gm0.95
roundabout-v0_A2C_lr0.0005_gm0.8
roundabout-v0_A2C_lr0.001_gm0.95
roundabout-v0_A2C_lr0.001_gm0.8
```

```
In [10]: #To kill the prvious tensboard
         os.system("pkill -f tensorboard")
         # Display TENSORBOARD plot for this run
         if IN_JUPYTER:
             get_ipython().run_line_magic('load_ext', 'tensorboard')
             get_ipython().run_line_magic('tensorboard', '--logdir ./Project_A2C/logs')
```

The tensorboard extension is already loaded. To reload it, use:
  %reload_ext tensorboard

# Index of /

| Name | Size | Date Modified |
|---|---|---|
| .nofollow/ | | 3/6/25, 4:06:02 AM |
| .resolve/ | | 3/6/25, 4:06:02 AM |
| .vol/ | | 3/6/25, 4:06:02 AM |
| Applications/ | | 3/15/25, 9:12:09 AM |
| bin/ | | 3/6/25, 4:06:02 AM |
| cores/ | | 8/4/24, 5:31:41 AM |
| dev/ | | 3/14/25, 8:24:56 AM |
| etc/ | | 3/14/25, 8:26:29 AM |
| home/ | | 3/14/25, 8:26:30 AM |
| Library/ | | 3/14/25, 8:26:15 AM |
| opt/ | | 2/10/25, 5:44:30 PM |
| private/ | | 3/14/25, 8:26:26 AM |
| sbin/ | | 3/6/25, 4:06:02 AM |
| System/ | | 3/6/25, 4:06:02 AM |
| tmp/ | | 3/17/25, 10:21:46 PM |
| Users/ | | 3/14/25, 8:25:58 AM |
| usr/ | | 3/6/25, 4:06:02 AM |
| var/ | | 3/14/25, 8:26:18 AM |
| Volumes/ | | 3/14/25, 9:18:58 AM |
| .file | 0 B | 3/6/25, 4:06:02 AM |

🚀 TensorBoard is running at http://localhost:6015/

In [ ]: