

Final_DQN_acrobot

March 26, 2023

```
[ ]: from google.colab import drive  
drive.mount('/content/drive')  
import os
```

Mounted at /content/drive

```
[ ]: '''  
Installing packages for rendering the game on Colab  
'''  
  
!pip install gym pyvirtualdisplay > /dev/null 2>&1  
!apt-get install -y xvfb python-opengl ffmpeg > /dev/null 2>&1  
!apt-get update > /dev/null 2>&1  
!apt-get install cmake > /dev/null 2>&1  
!pip install --upgrade setuptools 2>&1  
!pip install ez_setup > /dev/null 2>&1  
!pip install gym[atari] > /dev/null 2>&1  
!pip install git+https://github.com/tensorflow/docs > /dev/null 2>&1  
!pip install gym[classic_control]
```

```
Looking in indexes: https://pypi.org/simple, https://us-python.pkg.dev/colab-wheels/public/simple/  
Requirement already satisfied: setuptools in /usr/local/lib/python3.9/dist-packages (67.6.0)  
Looking in indexes: https://pypi.org/simple, https://us-python.pkg.dev/colab-wheels/public/simple/  
Requirement already satisfied: gym[classic_control] in /usr/local/lib/python3.9/dist-packages (0.25.2)  
Requirement already satisfied: gym-notices>=0.0.4 in /usr/local/lib/python3.9/dist-packages (from gym[classic_control]) (0.0.8)  
Requirement already satisfied: numpy>=1.18.0 in /usr/local/lib/python3.9/dist-packages (from gym[classic_control]) (1.22.4)  
Requirement already satisfied: cloudpickle>=1.2.0 in /usr/local/lib/python3.9/dist-packages (from gym[classic_control]) (2.2.1)  
Requirement already satisfied: importlib-metadata>=4.8.0 in /usr/local/lib/python3.9/dist-packages (from gym[classic_control]) (6.1.0)  
Collecting pygame==2.1.0  
    Downloading
```

```

pygame-2.1.0-cp39-cp39-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (18.3 MB)
  18.3/18.3 MB
59.8 MB/s eta 0:00:00
Requirement already satisfied: zipp>=0.5 in /usr/local/lib/python3.9/dist-
packages (from importlib-metadata>=4.8.0->gym[classic_control]) (3.15.0)
Installing collected packages: pygame
  Attempting uninstall: pygame
    Found existing installation: pygame 2.3.0
    Uninstalling pygame-2.3.0:
      Successfully uninstalled pygame-2.3.0
Successfully installed pygame-2.1.0

```

```

[ ]: """
A bunch of necessary imports
"""

import numpy as np
import seaborn as sns
import torch
import torch.nn as nn
import torch.nn.functional as F
from collections import namedtuple, deque
import torch.optim as optim
import datetime
import gym
from gym.wrappers.record_video import RecordVideo
import glob
import io
import base64
import matplotlib.pyplot as plt
from IPython.display import HTML
from pyvirtualdisplay import Display
import tensorflow_docs.vis.embed as embed
from IPython import display as ipythondisplay
from PIL import Image
import uuid
import warnings
warnings.filterwarnings("ignore", category=DeprecationWarning)

device = torch.device("cuda:0" if torch.cuda.is_available() else "cpu")

```

0.0.1 Q-Network Code

```

[ ]: """
Bunch of Hyper parameters (Which you might have to tune later **wink wink**)
"""

BUFFER_SIZE = int(1e5) # replay buffer size

```

```

BATCH_SIZE = 64          # minibatch size
GAMMA = 0.99             # discount factor
LR = 5e-4                # learning rate
UPDATE_EVERY = 20         # how often to update the network (When Q target is ↵present)
NUM_HLAYERS = 2
HLAYER_SIZES = [128, 64]
TRUNC_LIM = 1

class QNetwork(nn.Module):

    def __init__(self, state_size, action_size, seed, fc1_units=128, fc2_units=64):
        """Initialize parameters and build model.
        Params
        ======
            state_size (int): Dimension of each state
            action_size (int): Dimension of each action
            seed (int): Random seed
            fc1_units (int): Number of nodes in first hidden layer
            fc2_units (int): Number of nodes in second hidden layer
        """
        super(QNetwork, self).__init__()
        self.seed = torch.manual_seed(seed)
        self.fcls = nn.ModuleList()
        for i in range(NUM_HLAYERS+1):
            if (i == 0):
                fc = nn.Linear(state_size, HLAYER_SIZES[0])
            elif (i == NUM_HLAYERS):
                fc = nn.Linear(HLAYER_SIZES[i-1], action_size)
            else:
                fc = nn.Linear(HLAYER_SIZES[i-1], HLAYER_SIZES[i])
            self.fcls.append(fc)

    def forward(self, state):
        """Build a network that maps state -> action values."""
        for i in range(len(self.fcls)-1):
            fc = self.fcls[i]
            if i == 0:
                x = F.relu(fc(state))
            else:
                x = F.relu(fc(x))
        fc = self.fcls[len(self.fcls) - 1]
        return fc(x)

```

0.0.2 Replay Buffer:

This is a ‘deque’ that helps us store experiences. Recall why we use such a technique.

```
[ ]: from collections import deque, namedtuple

class ReplayBuffer:
    """Fixed-size buffer to store experience tuples."""

    def __init__(self, action_size, buffer_size, batch_size, seed):
        self.action_size = action_size
        self.memory = deque(maxlen=buffer_size)
        self.batch_size = batch_size
        self.experience = namedtuple("Experience", field_names=["state", "action", "reward", "next_state", "done"])
        self.rsg = np.random.RandomState(seed)

    def add(self, state, action, reward, next_state, done):
        """Add a new experience to memory."""
        e = self.experience(state, action, reward, next_state, done)
        self.memory.append(e)

    def sample(self):
        """Randomly sample a batch of experiences from memory."""
        idxs = self.rsg.choice(len(self.memory), size=self.batch_size, replace=False)
        mem = self.memory
        states = torch.from_numpy(np.vstack([mem[i].state for i in idxs if mem[i] is not None])).float().to(device)
        actions = torch.from_numpy(np.vstack([mem[i].action for i in idxs if mem[i] is not None])).long().to(device)
        rewards = torch.from_numpy(np.vstack([mem[i].reward for i in idxs if mem[i] is not None])).float().to(device)
        next_states = torch.from_numpy(np.vstack([mem[i].next_state for i in idxs if mem[i] is not None])).float().to(device)
        dones = torch.from_numpy(np.vstack([mem[i].done for i in idxs if mem[i] is not None]).astype(np.uint8)).float().to(device)

        return (states, actions, rewards, next_states, dones)

    def __len__(self):
        """Return the current size of internal memory."""
        return len(self.memory)
```

0.0.3 DQN Agent Code:

Truncation is done optionally with the hope that it improves stability.

```
[ ]: from scipy.special import softmax
class dqn_agent():
    def __init__(self, state_size, action_size, seed, atype='epsilon-greedy'):

        ''' Agent Environment Interaction '''
        self.state_size = state_size
        self.action_size = action_size
        self.rsg = np.random.RandomState(seed)

        ''' Q-Network '''
        self.qnetwork_local = QNetwork(state_size, action_size, seed).to(device)
        self.qnetwork_target = QNetwork(state_size, action_size, seed).
        ↪to(device)
        self.optimizer = optim.Adam(self.qnetwork_local.parameters(), lr=LR)

        ''' Replay memory '''
        self.memory = ReplayBuffer(action_size, BUFFER_SIZE, BATCH_SIZE, seed)
        ''' Initialize time step (for updating every UPDATE_EVERY steps) □
        ↪ -Needed for Q Targets '''
        self.t_step = 0

        if atype == 'epsilon-greedy':
            self.act = self.eps_act
        else:
            self.act = self.soft_act

    def step(self, state, action, reward, next_state, done):

        ''' Save experience in replay memory '''
        self.memory.add(state, action, reward, next_state, done)

        ''' If enough samples are available in memory, get random subset and learn □
        ↪learn '''
        if len(self.memory) >= BATCH_SIZE:
            experiences = self.memory.sample()
            self.learn(experiences, GAMMA)

        """ +Q TARGETS PRESENT """
        ''' Updating the Network every 'UPDATE_EVERY' steps taken '''
        self.t_step = (self.t_step + 1) % UPDATE_EVERY
        if self.t_step == 0:

            self.qnetwork_target.load_state_dict(self.qnetwork_local.
        ↪state_dict())

    def eps_act(self, state, eps=0.):
```

```

state = torch.from_numpy(state).float().unsqueeze(0).to(device)
self.qnetwork_local.eval()
with torch.no_grad():
    action_values = self.qnetwork_local(state)
self.qnetwork_local.train()

''' Epsilon-greedy action selection (Already Present) '''
if self.rsg.random() < eps:
    return self.rsg.choice(np.arange(self.action_size))
else:
    return np.argmax(action_values.cpu().data.numpy())

def soft_act(self, state, beta=1.0):

    state = torch.from_numpy(state).float().unsqueeze(0).to(device)
    self.qnetwork_local.eval()
    with torch.no_grad():
        action_values = self.qnetwork_local(state)
    self.qnetwork_local.train()

    ''' Softmax action selection (Implemented) '''
    a_values = torch.squeeze(action_values).cpu().squeeze().data.numpy()
    return self.rsg.choice(np.arange(self.action_size), size=1, □
    ↵p=softmax(a_values/beta))[0]

def learn(self, experiences, gamma):
    """ +E EXPERIENCE REPLAY PRESENT """
    states, actions, rewards, next_states, dones = experiences

    ''' Get max predicted Q values (for next states) from target model'''
    Q_targets_next = self.qnetwork_target(next_states).detach().max(1)[0].
    ↵unsqueeze(1)

    ''' Compute Q targets for current states '''
    Q_targets = rewards + (gamma * Q_targets_next * (1 - dones))

    ''' Get expected Q values from local model '''
    Q_expected = self.qnetwork_local(states).gather(1, actions)

    ''' Compute loss '''
    loss = F.mse_loss(Q_expected, Q_targets)

    ''' Minimize the loss '''
    self.optimizer.zero_grad()
    loss.backward()

    ''' Gradient Clipping '''

```

```

""" +T TRUNCATION PRESENT """
for param in self.qnetwork_local.parameters():
    param.grad.data.clamp_(-TRUNC_LIM, +TRUNC_LIM)

self.optimizer.step()

```

0.0.4 DQN algorithm

```

[ ]: ''' Defining DQN Algorithm with epsilon annealing'''

def dqn(env, agent, env_score_req, use_eps = True, n_episodes=2000, max_t=1000, ↴
    ↴eps_start=1.0, eps_end=0.05, decay_factor=0.995, beta_start=1.5, beta_end=0. ↴5):

    scores = []
    num_steps = []
    ''' list containing scores from each episode '''

    scores_window= deque(maxlen=100)
    ''' last 100 scores for checking if the avg is more than -110 '''

    eps = eps_start
    beta = beta_start

    ''' initialize epsilon '''
    for i_episode in range(1, n_episodes+1):
        state = env.reset()
        score = 0
        for t in range(max_t):
            if use_eps:
                action = agent.act(state, eps)
            else:
                action = agent.act(state, beta)
            next_state, reward, done, _ = env.step(action)
            agent.step(state, action, reward, next_state, done)
            state = next_state
            score += reward
            if done:
                break
        num_steps.append(t)
        scores.append(score)
        scores_window.append(score)
        ''' save most recent score '''

        eps = max(eps_end, eps * decay_factor)
        beta = max(beta_end, beta * decay_factor)
        ''' decrease epsilon, beta '''

```

```

        print('\rEpisode {} \tAverage Score: {:.2f} \tsteps {}'.format(i_episode, np.mean(scores_window), eps) ,end="")
    if i_episode % 100 == 0:
        print('\rEpisode {} \tAverage Score: {:.2f}'.format(i_episode, np.mean(scores_window)))
    if np.mean(scores_window)>=env_score_req:
        print('\nEnvironment solved in {:d} episodes!\tAverage Score: {:.2f}'.format(i_episode, np.mean(scores_window)))
        break
    return [np.array(scores), np.array(num_steps), i_episode]

```

0.0.5 Plotting and Rendering

```
[ ]: PATH = '/content/drive/MyDrive/Colab Notebooks/CS6700/Assignments/Assignment2/'  
↪DQN/AB/'

def gen_plots(fname, run_scores, run_steps, avg_num=10):  

    run_count = len(run_scores)  

    labels = [f'run {i+1}; epcount {len(run_scores[i])}' for i in  
↪range(run_count)]  

    sc_fig, sc_ax = plt.subplots(figsize=(10,10))  

    st_fig, st_ax = plt.subplots(figsize=(10,10))  

    sc_ax.set_title(f'Running average of previous {avg_num} rewards;')  

    sc_ax.set_xlabel('Episodes')  

    sc_ax.set_ylabel('Reward')  

    st_ax.set_title(f'Number of steps curve')  

    st_ax.set_xlabel('Episodes')  

    st_ax.set_ylabel('Steps')  

    for idx in range(run_count):  

        score_list = run_scores[idx]  

        step_list = run_steps[idx]  

        average_score_list = np.zeros_like(score_list)  

        for i in range(0, len(score_list)):  

            if i < avg_num:  

                average_score_list[i] = np.mean(score_list[:i+1])  

            else:  

                average_score_list[i] = np.mean(score_list[(i-avg_num+1):(i+1)])  

        sns.lineplot(data=average_score_list, label=labels[idx], ax=sc_ax)  

        sns.lineplot(data=step_list, label=labels[idx], ax=st_ax)
```

```

sc_fig.savefig(PATH+'/'+fname+'/sc_fig.png')
st_fig.savefig(PATH+'/'+fname+'/st_fig.png')

def render_episode(env_name, agent, max_steps: int):
    env = gym.make(env_name)
    env.reset()
    screen = env.render(mode='rgb_array')
    im = Image.fromarray(screen)

    images = [im]
    state = env.reset()
    for i in range(1, max_steps + 1):
        action = agent.act(state, 0.0)
        state, _, done, _ = env.step(action)

        # Render screen every 2 steps
        if i % 2 == 0:
            screen = env.render(mode='rgb_array')
            images.append(Image.fromarray(screen))

        if done:
            break

    return images

def save_gif(fname, env_name, torchagent, max_steps=800):
    display = Display(visible=0, size=(400, 300))
    display.start()
    # Save GIF image
    images = render_episode(env_name, torchagent, max_steps)
    image_file = PATH+'/'+fname+f'/render.gif'
    # loop=0: loop forever, duration=1: play each frame for 1ms
    images[0].save(image_file, save_all=True, append_images=images[1:], loop=0, duration=1)

```

```

[ ]: # code for running the dqn for multiple to account for stochasticity. averaged
      ↴performance is computed and returned
def dqn_exp_runner(env_name, num_runs, env_score_req, use_eps, start, end, ↴
                   ↴decay_factor, n_episodes=800, max_t=1000):
    run_scores = []
    ep_counts = []
    run_steps = []
    agents = []
    env = gym.make(env_name)
    env.seed(42)
    if (use_eps):
        eps_start, eps_end = start, end

```

```

else:
    beta_start, beta_end = start, end
state_shape = env.observation_space.shape[0]
action_shape = env.action_space.n
for i in range(num_runs):
    begin_time = datetime.datetime.now()
    if use_eps:
        agent = dqn_agent(state_size=state_shape, action_size = action_shape, seed = 42, atype='epsilon-greedy')
        score_list, num_steps, ep_count = dqn(env, agent, env_score_req, use_eps = True, n_episodes=n_episodes, max_t=max_t, decay_factor=decay_factor, eps_start=eps_start, eps_end=eps_end)
    else:
        agent = dqn_agent(state_size=state_shape, action_size = action_shape, seed = 42, atype='softmax')
        score_list, num_steps, ep_count = dqn(env, agent, env_score_req, use_eps = False, n_episodes=n_episodes, max_t=max_t, decay_factor=decay_factor, beta_start=beta_start, beta_end=beta_end)
    time_taken = datetime.datetime.now() - begin_time
    run_scores.append(score_list)
    run_steps.append(num_steps)
    ep_counts.append(ep_count)
    agents.append(agent)
ep_counts = np.array(ep_counts)
# we use the median score getting the agent for render
best_res = np.argsort(ep_counts)[len(ep_counts)//2]
return run_scores, run_steps, np.mean(ep_counts), agents[best_res]

```

0.1 Acrobot-v1

Default setting

```

]: BUFFER_SIZE = int(40000)
BATCH_SIZE = 64
GAMMA = 0.99
LR = 5e-4
UPDATE_EVERY = 100
NUM_HLAYERS = 2
HLAYER_SIZES = [64, 128]
TRUNC_LIM = 1e32

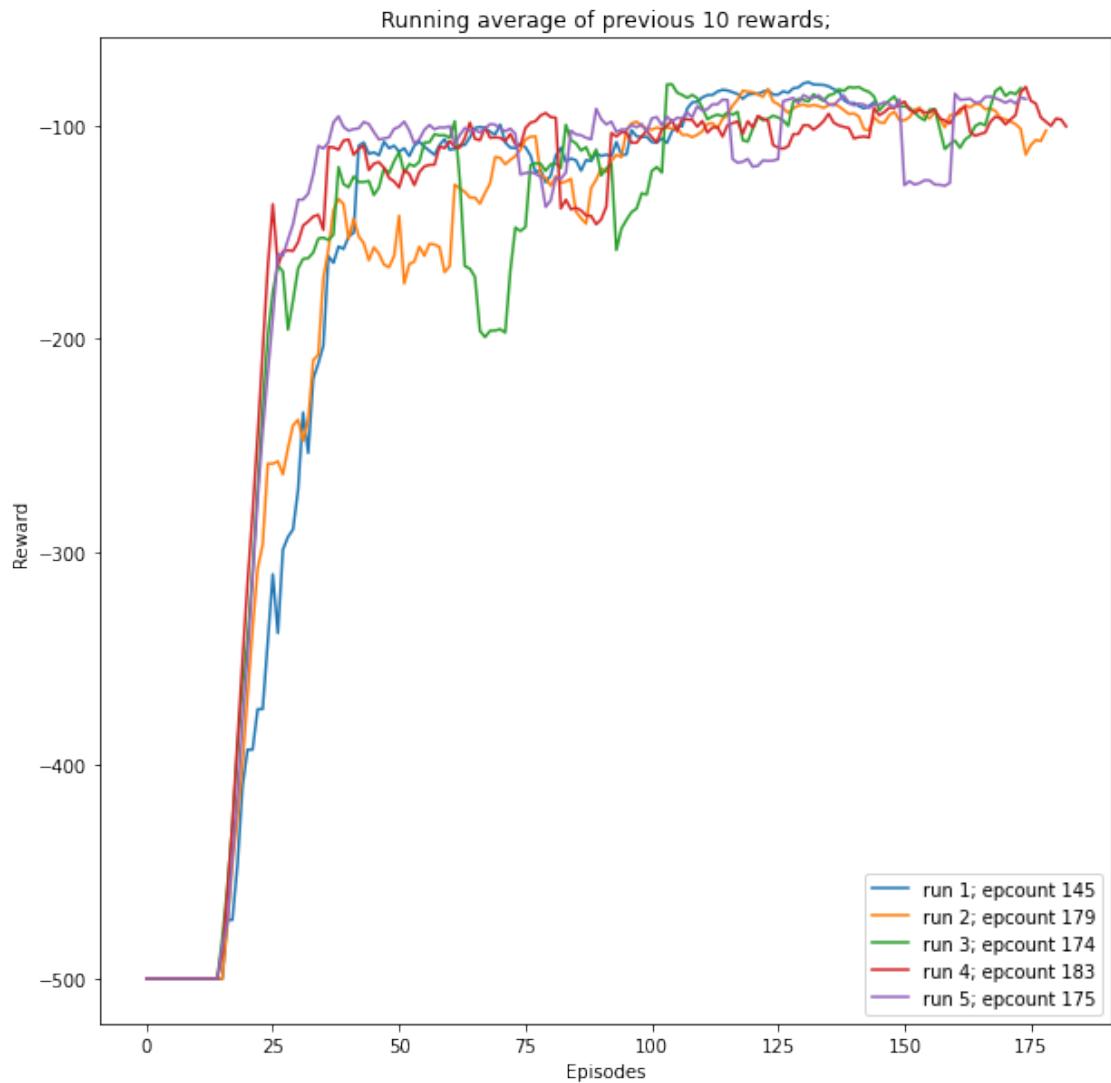
fname = str(uuid.uuid4())
print(f'Saved to folder {fname}')
os.mkdir(PATH+'/'+fname)
run_scores, run_steps, ep_count_average, median_agent = dqn_exp_runner('Acrobot-v1', num_runs=5, env_score_req=-100,

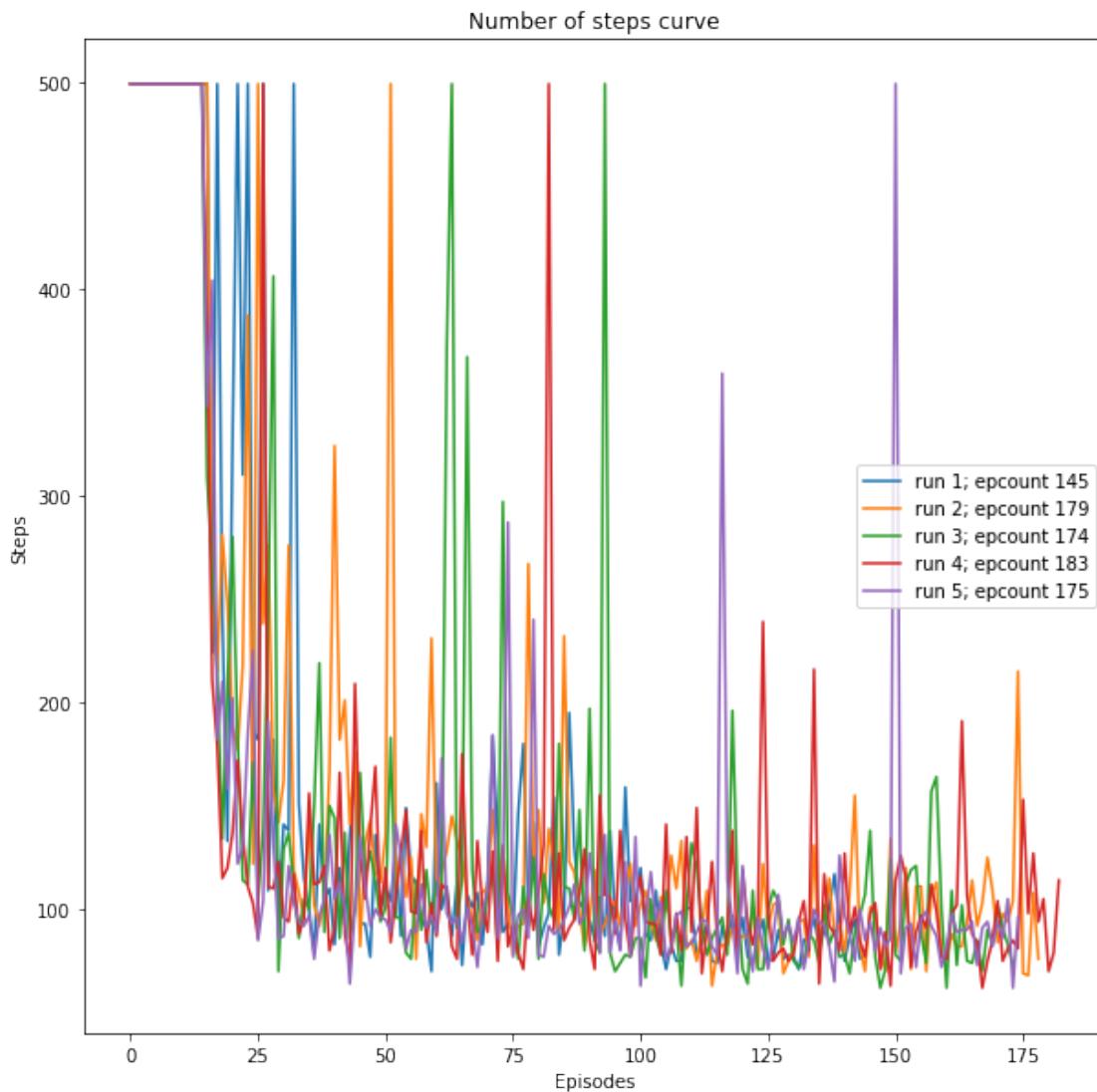
```

```
    ↵use_eps=True, start=20, end=0.0001, decay_factor=0.8)
print(f'Performance {ep_count_average}!')
gen_plots(fname, run_scores, run_steps)
save_gif(fname, 'Acrobot-v1', median_agent,max_steps=800)
```

Saved to folder 41b79301-2625-4b53-beea-2daf80a8384a

Episode 100 Average Score: -202.31
Episode 145 Average Score: -99.37 eps 0.0001
Environment solved in 145 episodes! Average Score: -99.37
Episode 100 Average Score: -207.37
Episode 179 Average Score: -99.46 eps 0.0001
Environment solved in 179 episodes! Average Score: -99.46
Episode 100 Average Score: -195.57
Episode 174 Average Score: -98.67 eps 0.0001
Environment solved in 174 episodes! Average Score: -98.67
Episode 100 Average Score: -180.28
Episode 183 Average Score: -99.21 eps 0.0001
Environment solved in 183 episodes! Average Score: -99.21
Episode 100 Average Score: -176.32
Episode 175 Average Score: -98.87 eps 0.0001
Environment solved in 175 episodes! Average Score: -98.87
Performance 171.2





```
[ ]: # From defaults : Gamma changed to 0.97
BUFFER_SIZE = int(40000)
BATCH_SIZE = 64
GAMMA = 0.97
LR = 5e-4
UPDATE_EVERY = 100
NUM_HLAYERS = 2
HLAYER_SIZES = [64, 128]
TRUNC_LIM = 1e32

fname = str(uuid.uuid4())
print(f'Saved to folder {fname}')
os.mkdir(PATH+'/'+fname)
```

```

run_scores, run_steps, ep_count_average, median_agent =_
    ↪dqn_exp_runner('Acrobot-v1', num_runs=5, env_score_req=-100,
                    ↪use_eps=True, start=20, end=0.0001, decay_factor=0.8)
print(f'Performance {ep_count_average}')
gen_plots(fname, run_scores, run_steps)
save_gif(fname, 'Acrobot-v1', median_agent, max_steps=800)

```

Saved to folder 3ae9566e-81a3-4cd6-aa08-65606db0f53e

Episode 100	Average Score:	-217.06
Episode 200	Average Score:	-106.02
Episode 300	Average Score:	-105.32
Episode 400	Average Score:	-99.79

Environment solved in 400 episodes! Average Score: -99.79

Episode 100	Average Score:	-217.40
Episode 200	Average Score:	-116.24
Episode 300	Average Score:	-115.40
Episode 364	Average Score:	-99.87

eps 0.0001

Environment solved in 364 episodes! Average Score: -99.87

Episode 100	Average Score:	-227.56
Episode 200	Average Score:	-105.78
Episode 300	Average Score:	-103.07
Episode 313	Average Score:	-99.63

eps 0.0001

Environment solved in 313 episodes! Average Score: -99.63

Episode 100	Average Score:	-169.36
Episode 200	Average Score:	-111.15
Episode 287	Average Score:	-100.00

eps 0.0001

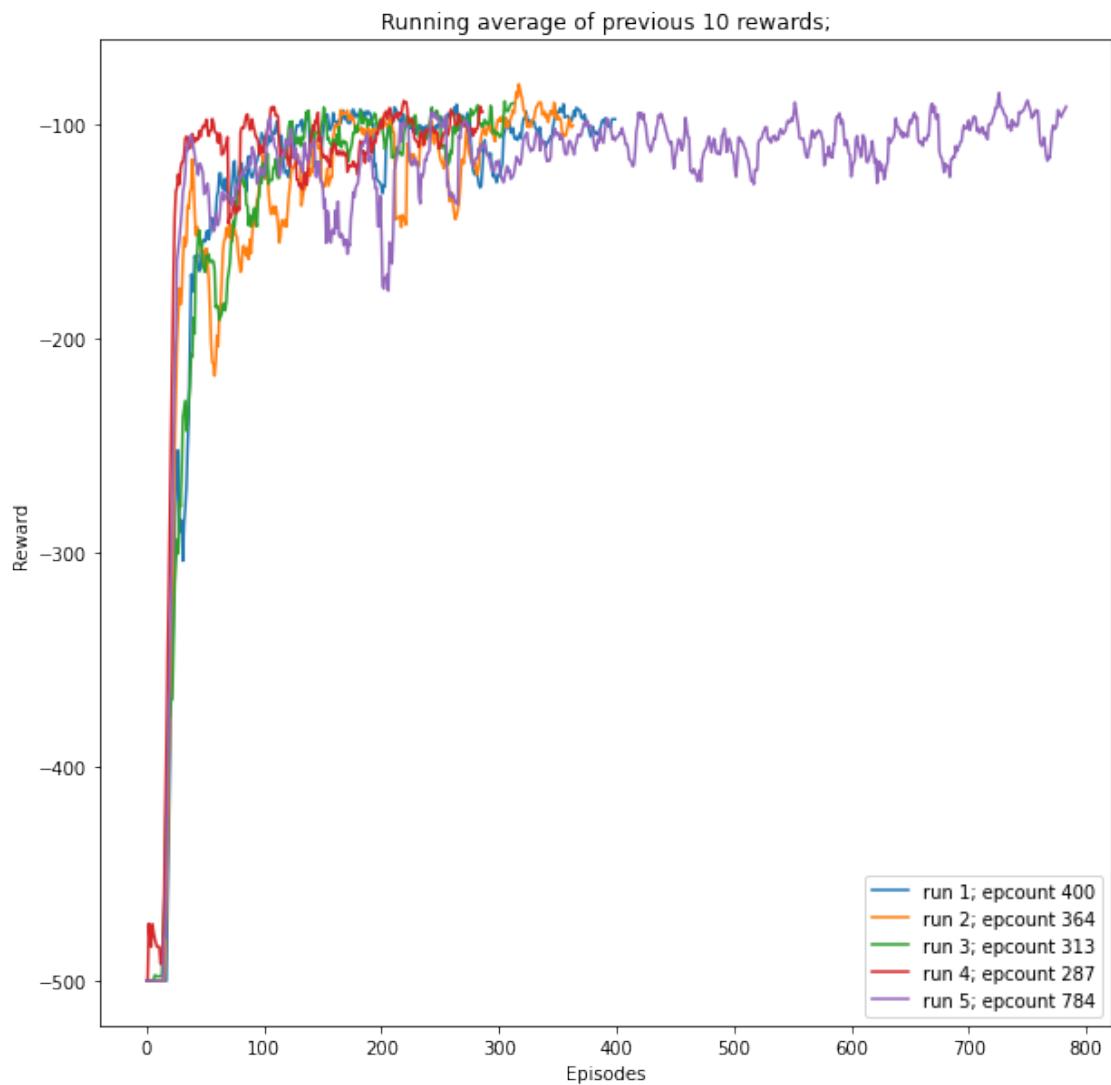
Environment solved in 287 episodes! Average Score: -100.00

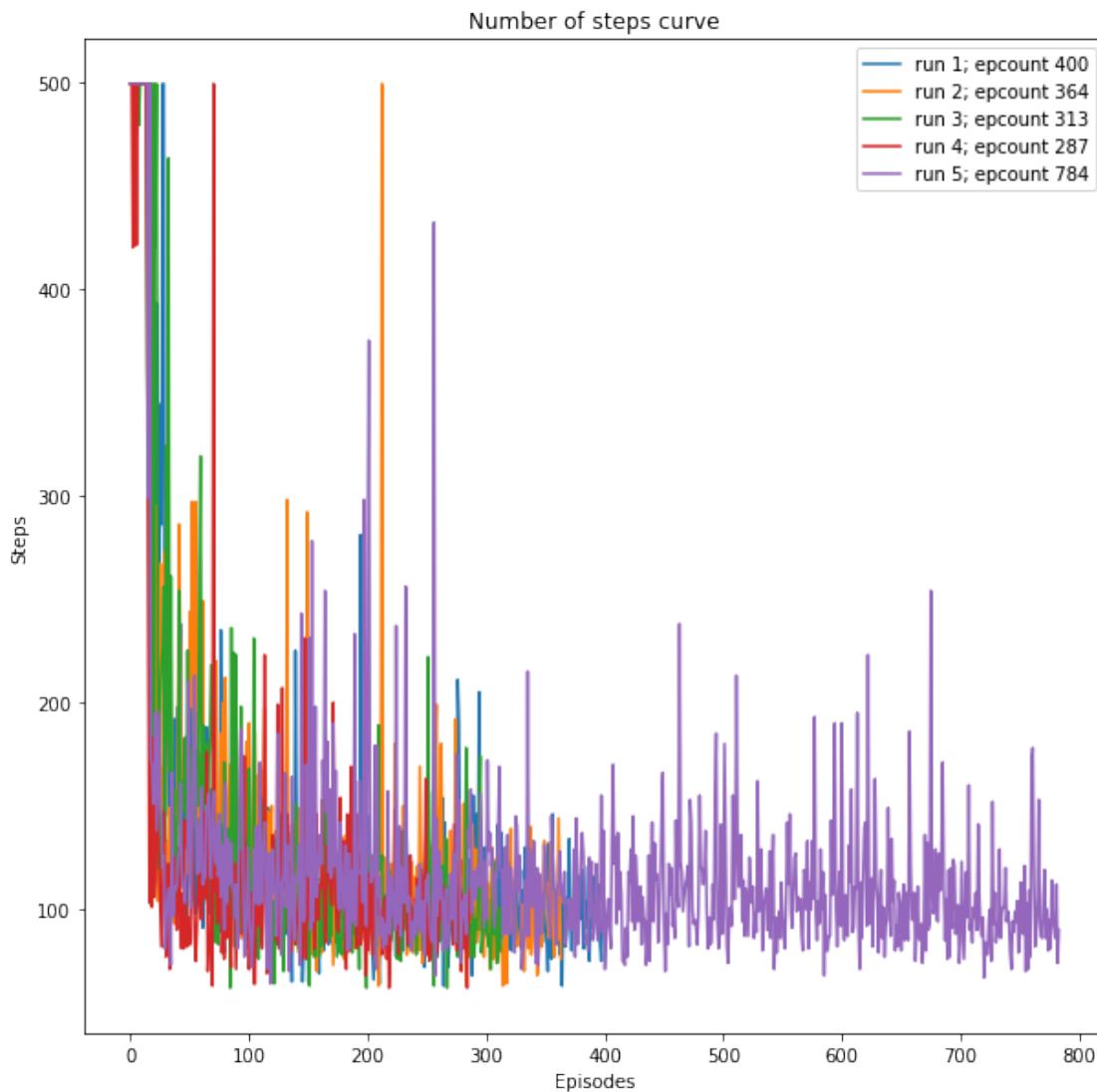
Episode 100	Average Score:	-190.84
Episode 200	Average Score:	-125.76
Episode 300	Average Score:	-117.71
Episode 400	Average Score:	-109.74
Episode 500	Average Score:	-108.83
Episode 600	Average Score:	-107.84
Episode 700	Average Score:	-108.58
Episode 784	Average Score:	-99.86

eps 0.0001

Environment solved in 784 episodes! Average Score: -99.86

Performance 429.6





```
[ ]: # From defaults : Learning rate changed to 9e-4
BUFFER_SIZE = int(40000)
BATCH_SIZE = 64
GAMMA = 0.99
LR = 9e-4
UPDATE_EVERY = 100
NUM_HLAYERS = 2
HLAYER_SIZES = [64, 128]
TRUNC_LIM = 1e32

fname = str(uuid.uuid4())
print(f'Saved to folder {fname}')
os.mkdir(PATH+'/'+fname)
```

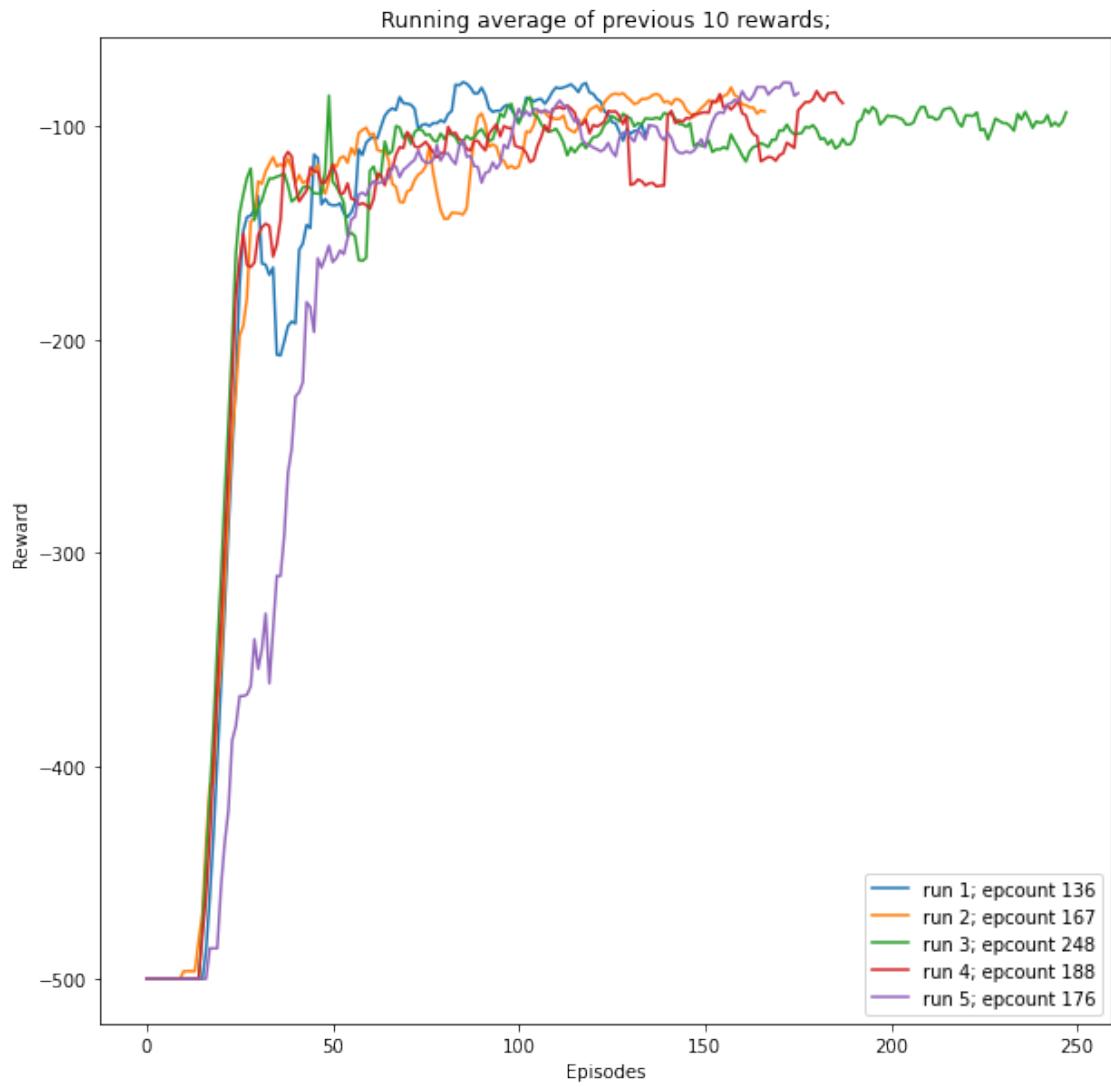
```

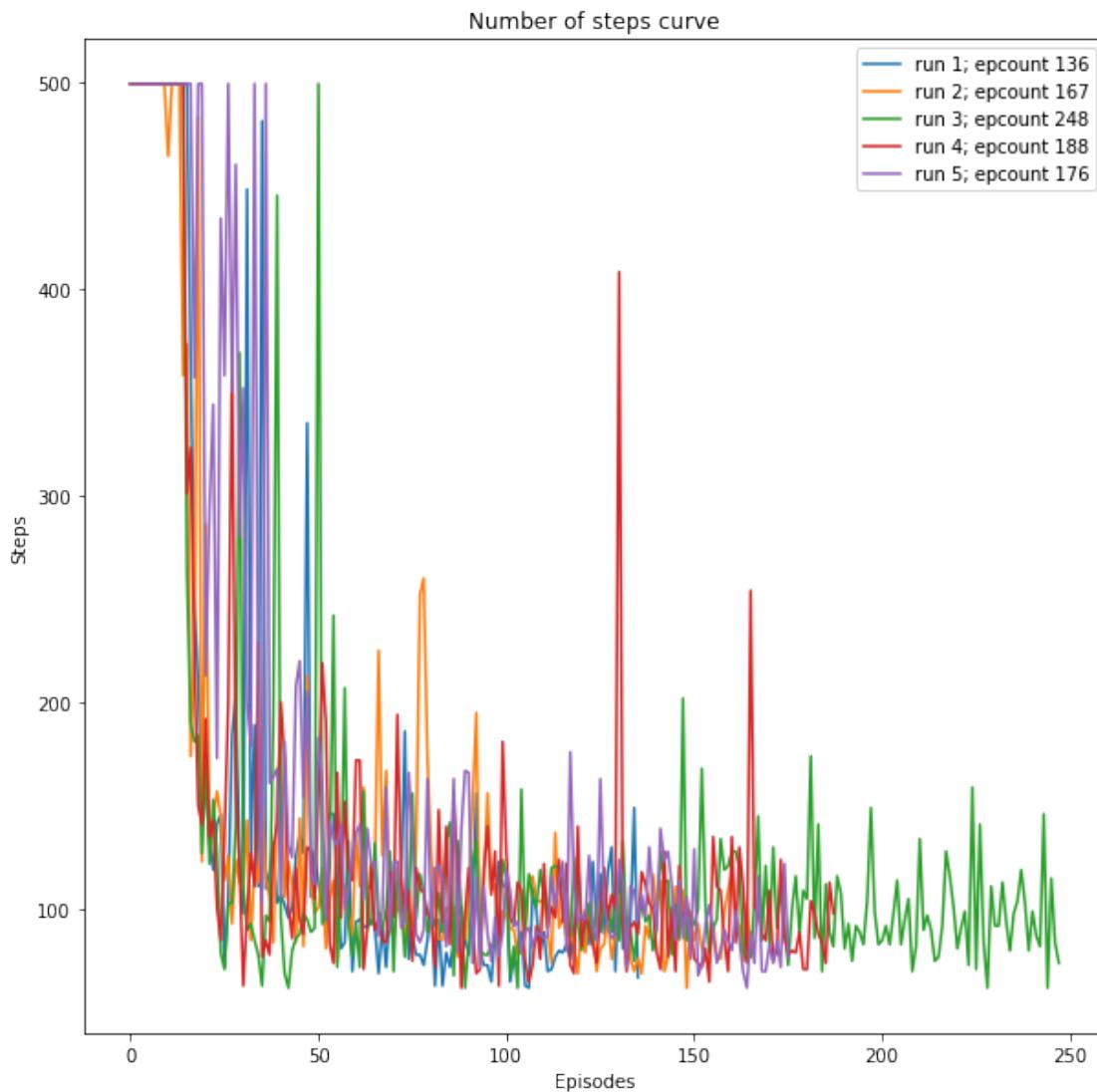
run_scores, run_steps, ep_count_average, median_agent =_
    ↪dqn_exp_runner('Acrobot-v1', num_runs=5, env_score_req=-100,
    ↪use_eps=True, start=20, end=0.0001, decay_factor=0.8)
print(f'Performance {ep_count_average}')
gen_plots(fname, run_scores, run_steps)
save_gif(fname, 'Acrobot-v1', median_agent, max_steps=800)

```

Saved to folder 620171f9-8720-4747-9d3c-b76ebe5188b2

Episode 100	Average Score: -183.72	
Episode 136	Average Score: -98.30	eps 0.0001
Environment solved in 136 episodes!	Average Score: -98.30	
Episode 100	Average Score: -184.87	
Episode 167	Average Score: -99.77	eps 0.0001
Environment solved in 167 episodes!	Average Score: -99.77	
Episode 100	Average Score: -177.71	
Episode 200	Average Score: -102.62	
Episode 248	Average Score: -99.66	eps 0.0001
Environment solved in 248 episodes!	Average Score: -99.66	
Episode 100	Average Score: -183.88	
Episode 188	Average Score: -99.99	eps 0.0001
Environment solved in 188 episodes!	Average Score: -99.99	
Episode 100	Average Score: -231.70	
Episode 176	Average Score: -99.53	eps 0.0001
Environment solved in 176 episodes!	Average Score: -99.53	
Performance 183.0		





```
[ ]: # From defaults : Buffer size decreased to 10000
BUFFER_SIZE = int(10000)
BATCH_SIZE = 64
GAMMA = 0.99
LR = 5e-4
UPDATE_EVERY = 100
NUM_HLAYERS = 2
HLAYER_SIZES = [64, 128]
TRUNC_LIM = 1e32

fname = str(uuid.uuid4())
print(f'Saved to folder {fname}')
os.mkdir(PATH+'/'+fname)
```

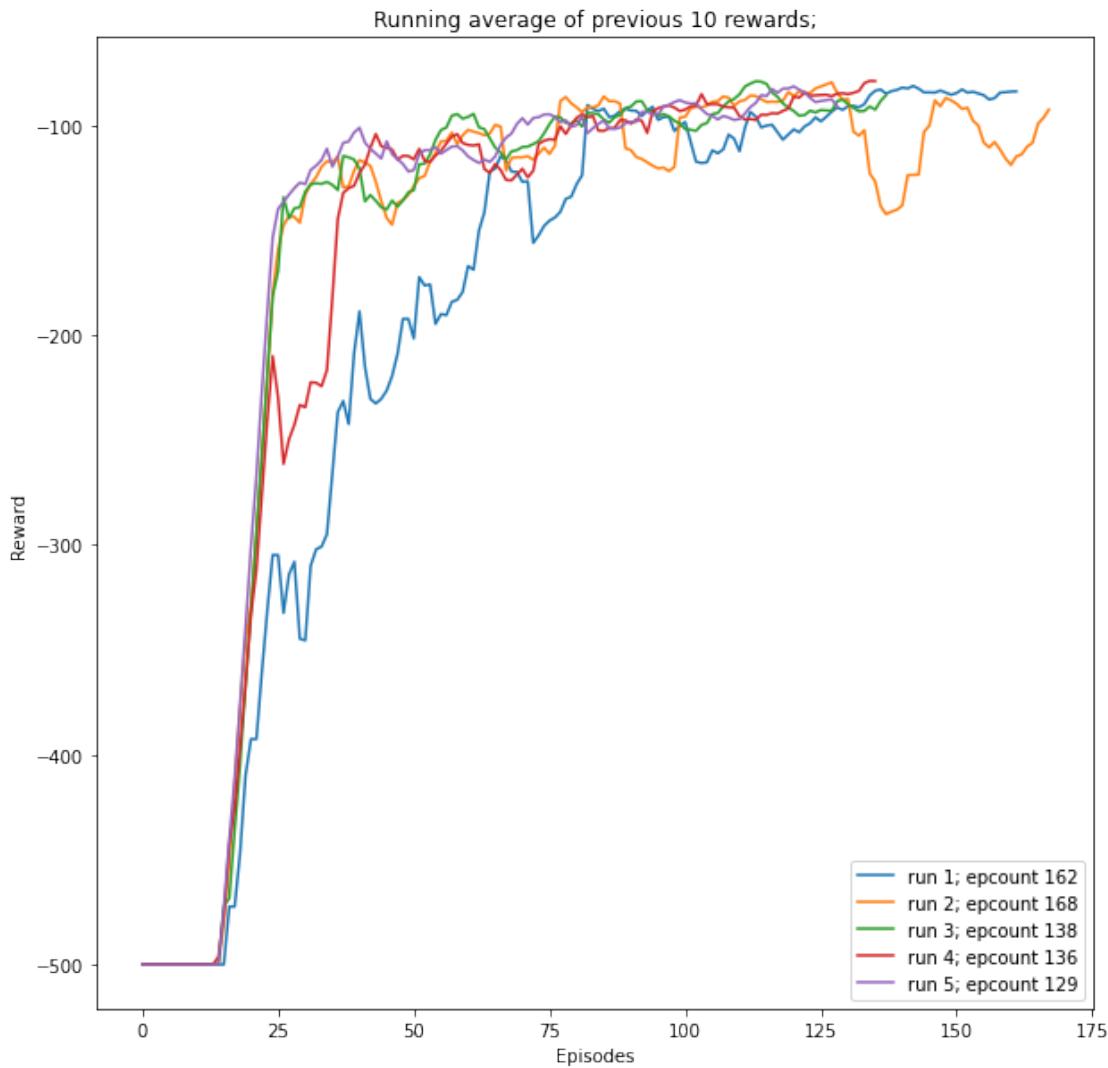
```

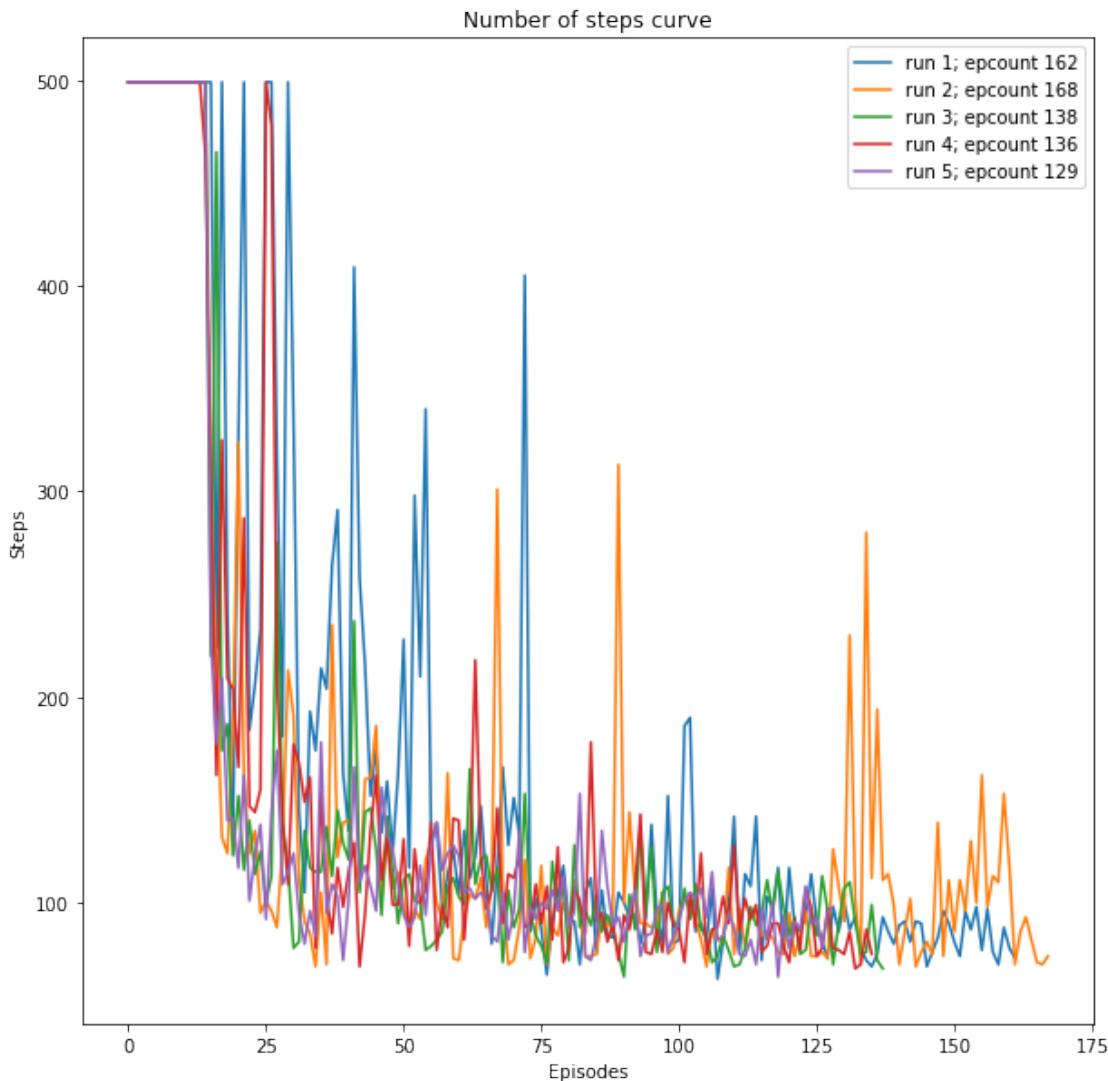
run_scores, run_steps, ep_count_average, median_agent =_
    ↪dqn_exp_runner('Acrobot-v1', num_runs=5, env_score_req=-100,
    ↪use_eps=True, start=20, end=0.0001, decay_factor=0.8)
print(f'Performance {ep_count_average}')
gen_plots(fname, run_scores, run_steps)
save_gif(fname, 'Acrobot-v1', median_agent, max_steps=800)

```

Saved to folder db2944dc-3df1-46ab-86cf-ee14d024d91a

Episode 100	Average Score: -228.47	
Episode 162	Average Score: -99.76	eps 0.0001
Environment solved in 162 episodes!	Average Score: -99.76	
Episode 100	Average Score: -176.53	
Episode 168	Average Score: -98.88	eps 0.0001
Environment solved in 168 episodes!	Average Score: -98.88	
Episode 100	Average Score: -175.43	
Episode 138	Average Score: -99.62	eps 0.0001
Environment solved in 138 episodes!	Average Score: -99.62	
Episode 100	Average Score: -186.74	
Episode 136	Average Score: -99.35	eps 0.0001
Environment solved in 136 episodes!	Average Score: -99.35	
Episode 100	Average Score: -169.27	
Episode 129	Average Score: -99.92	eps 0.0001
Environment solved in 129 episodes!	Average Score: -99.92	
Performance 146.6		





```
[ ]: # From defaults : Buffer size decreased to 10000 ,batch size=128
BUFFER_SIZE = int(10000)
BATCH_SIZE = 128
GAMMA = 0.99
LR = 5e-4
UPDATE_EVERY = 100
NUM_HLAYERS = 2
HLAYER_SIZES = [64, 128]
TRUNC_LIM = 1e32

fname = str(uuid.uuid4())
print(f'Saved to folder {fname}')
os.mkdir(PATH+'/'+fname)
```

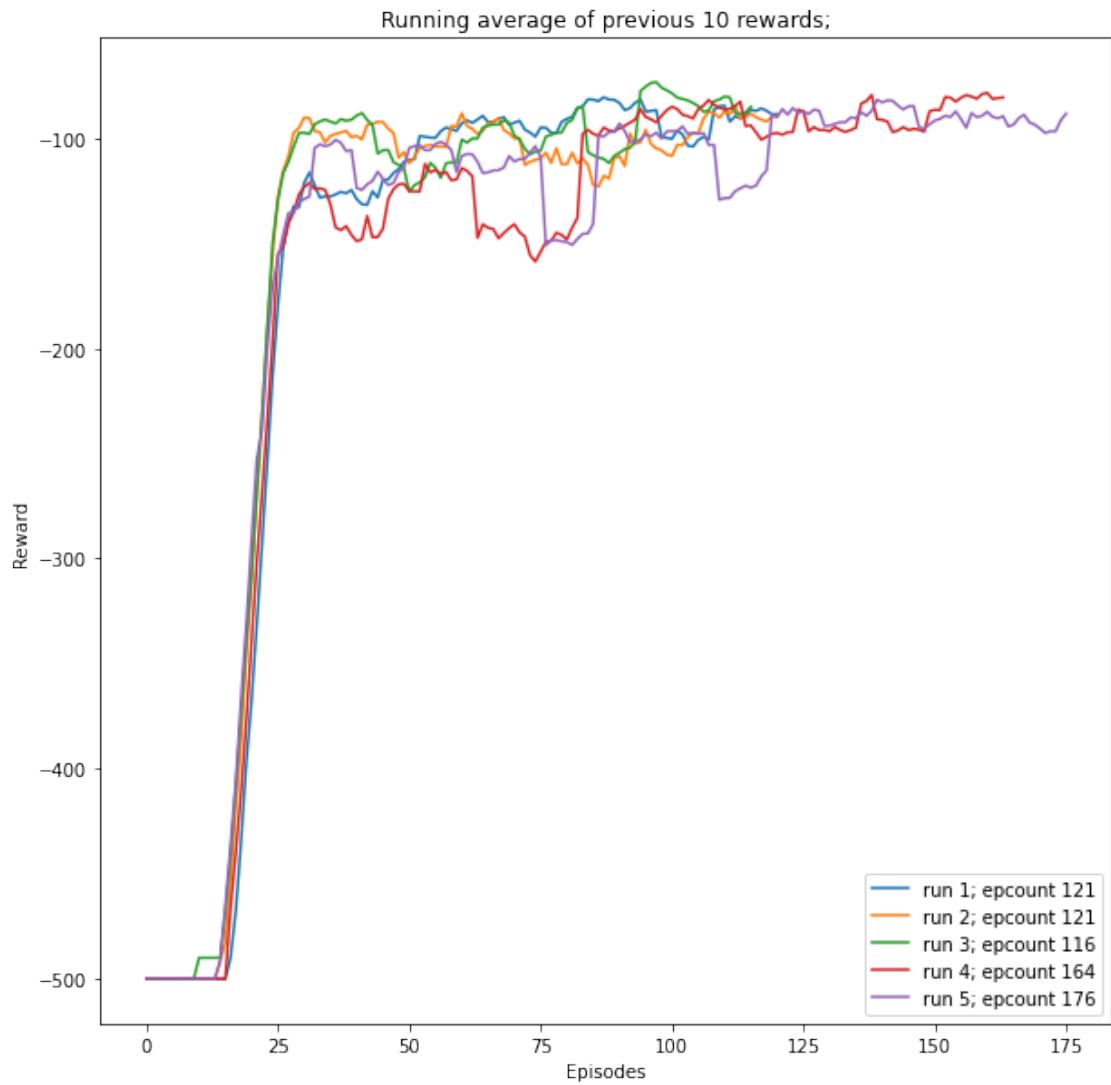
```

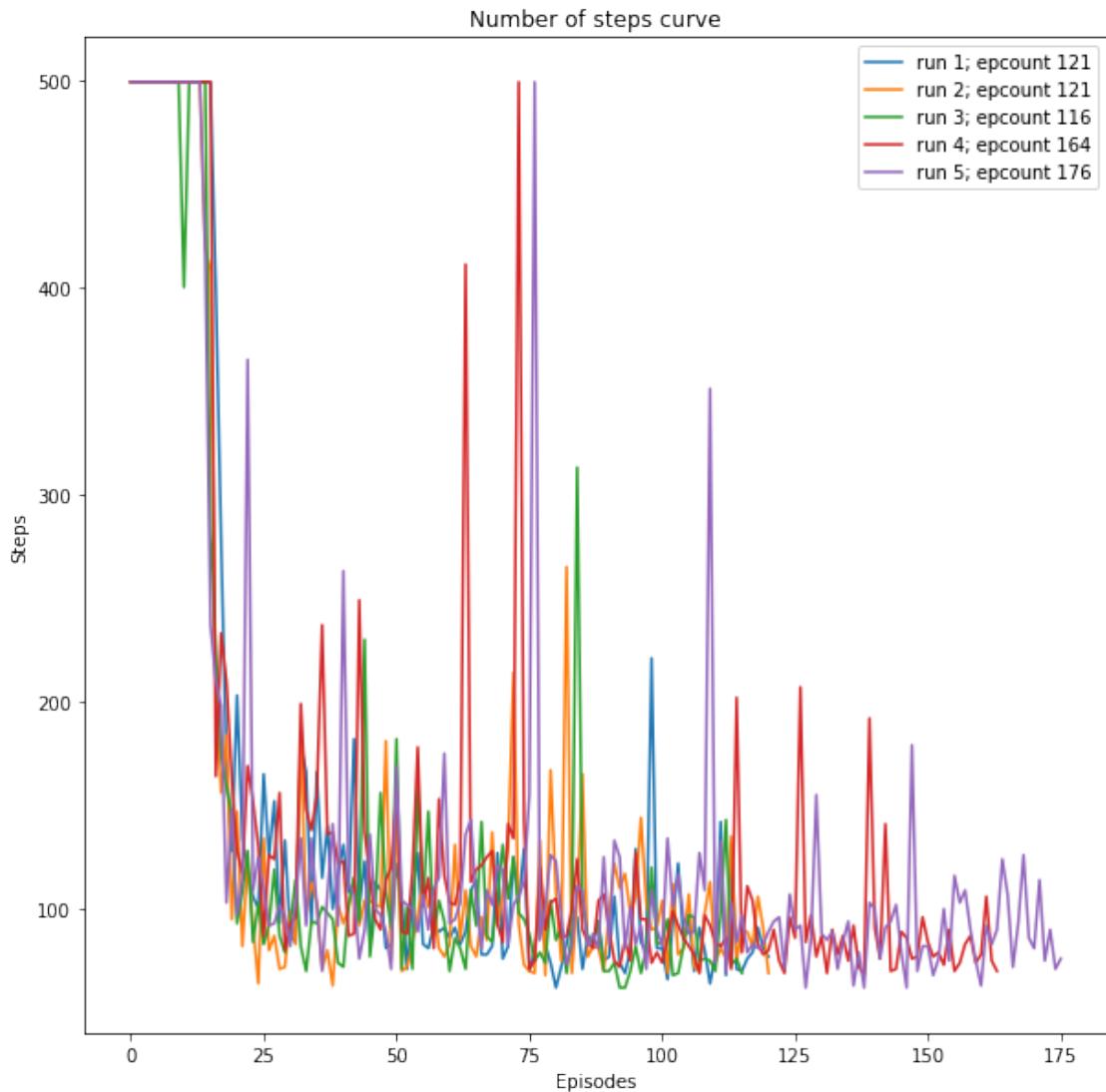
run_scores, run_steps, ep_count_average, median_agent =_
    ↪dqn_exp_runner('Acrobot-v1', num_runs=5, env_score_req=-100,
    ↪use_eps=True, start=20, end=0.0001, decay_factor=0.8)
print(f'Performance {ep_count_average}')
gen_plots(fname, run_scores, run_steps)
save_gif(fname, 'Acrobot-v1', median_agent, max_steps=800)

```

Saved to folder d21f151a-2ef6-4475-9abb-be7adf4b0f67

Episode 100	Average Score: -173.06	
Episode 121	Average Score: -99.44	eps 0.0001
Environment solved in 121 episodes!	Average Score: -99.44	
Episode 100	Average Score: -167.00	
Episode 121	Average Score: -99.61	eps 0.0001
Environment solved in 121 episodes!	Average Score: -99.61	
Episode 100	Average Score: -162.95	
Episode 116	Average Score: -99.59	eps 0.0001
Environment solved in 116 episodes!	Average Score: -99.59	
Episode 100	Average Score: -186.40	
Episode 164	Average Score: -96.94	eps 0.0001
Environment solved in 164 episodes!	Average Score: -96.94	
Episode 100	Average Score: -174.92	
Episode 176	Average Score: -99.64	eps 0.0001
Environment solved in 176 episodes!	Average Score: -99.64	
Performance 139.6		





```
[ ]: # From defaults : Buffer size decreased to 10000 ,batch size=256
BUFFER_SIZE = int(10000)
BATCH_SIZE = 256
GAMMA = 0.99
LR = 5e-4
UPDATE_EVERY = 100
NUM_HLAYERS = 2
HLAYER_SIZES = [64, 128]
TRUNC_LIM = 1e32

fname = str(uuid.uuid4())
print(f'Saved to folder {fname}')
os.mkdir(PATH+'/'+fname)
```

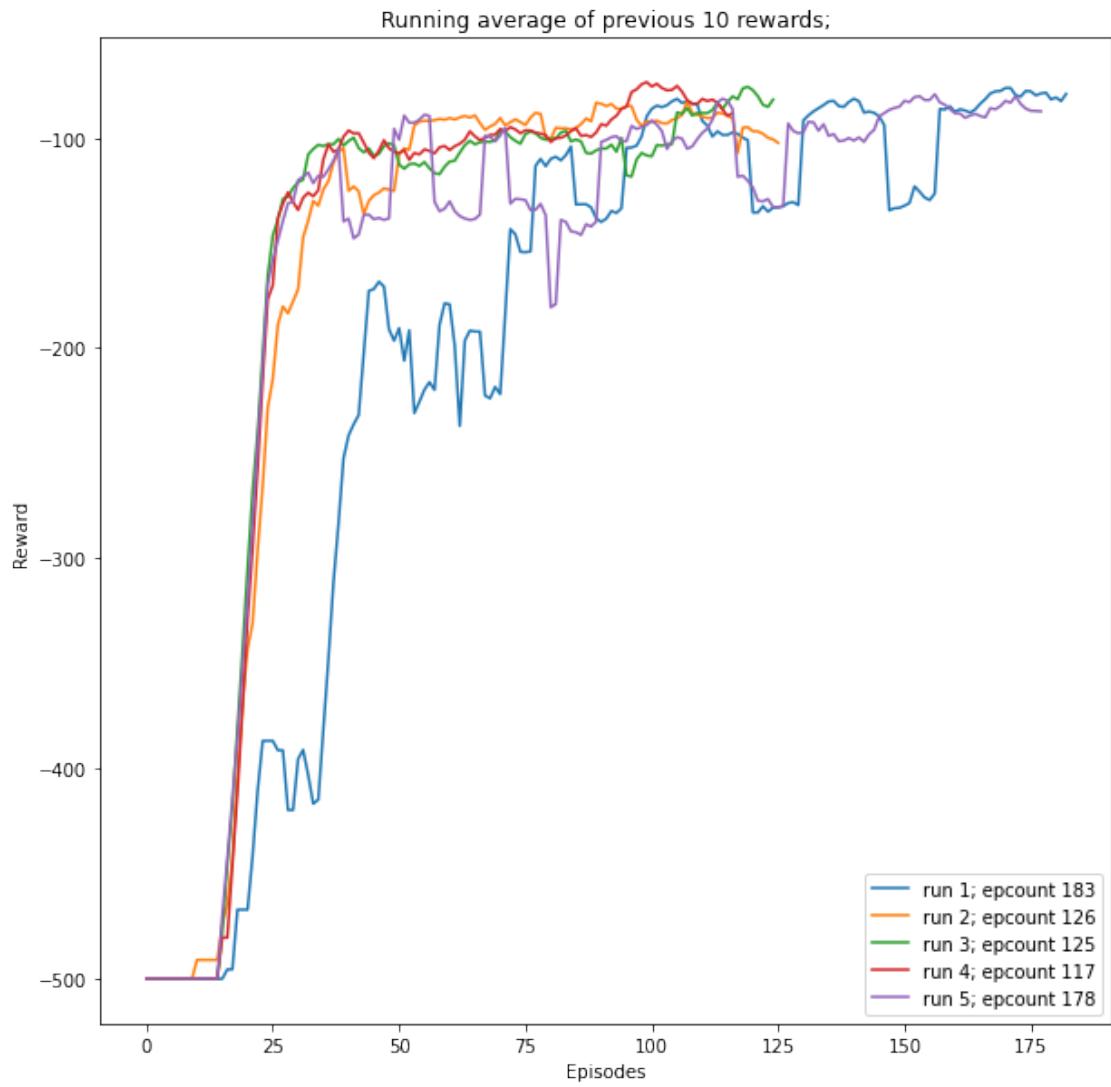
```

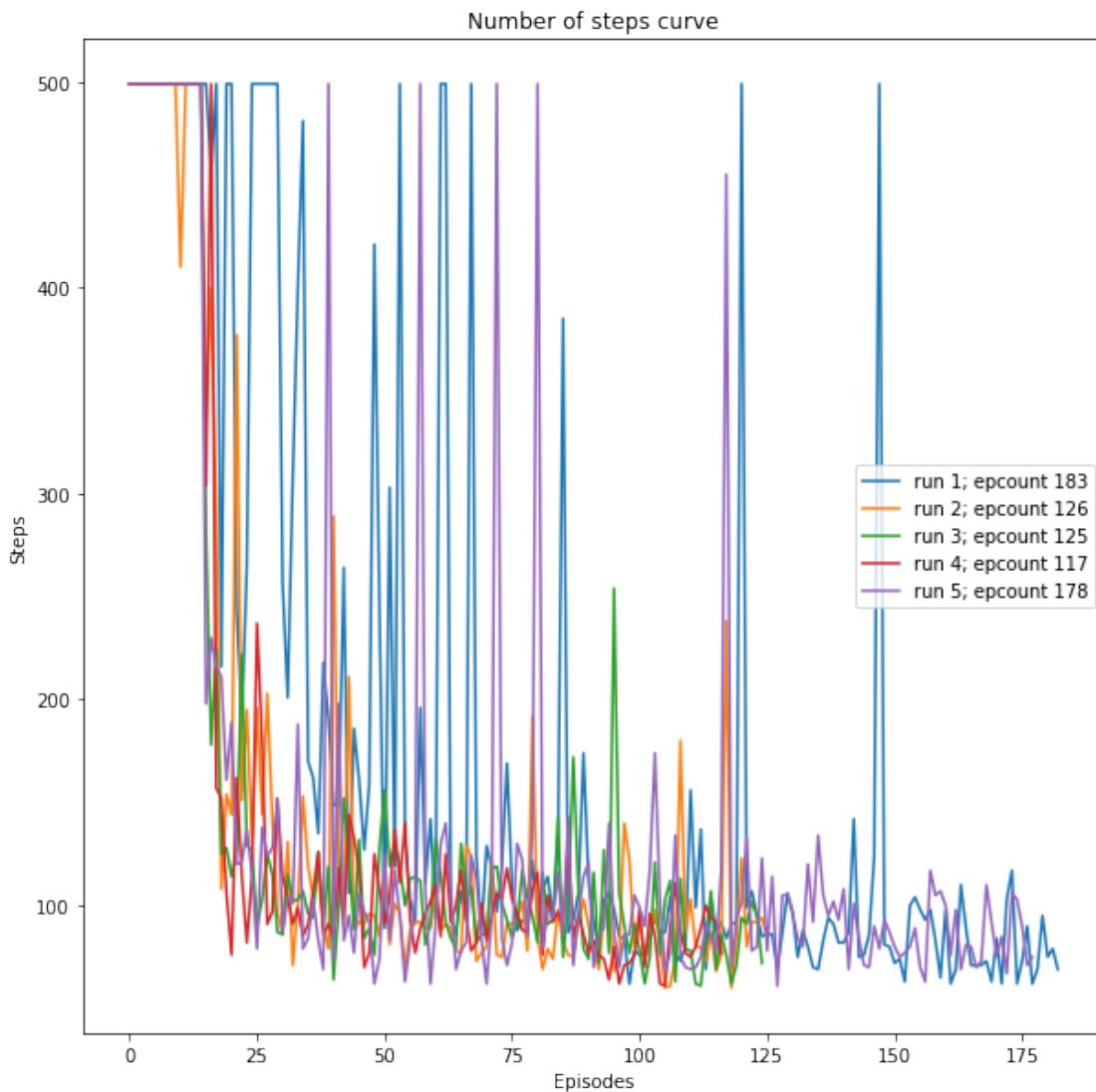
run_scores, run_steps, ep_count_average, median_agent =_
    ↪dqn_exp_runner('Acrobot-v1', num_runs=5, env_score_req=-100,
    ↪use_eps=True, start=20, end=0.0001, decay_factor=0.8)
print(f'Performance {ep_count_average}')
gen_plots(fname, run_scores, run_steps)
save_gif(fname, 'Acrobot-v1', median_agent, max_steps=800)

```

Saved to folder 7155e6a5-aec3-4c47-9032-bfffd56d458b7

Episode 100	Average Score: -257.42	
Episode 183	Average Score: -99.64	eps 0.0001
Environment solved in 183 episodes!	Average Score: -99.64	
Episode 100	Average Score: -173.79	
Episode 126	Average Score: -98.94	eps 0.0001
Environment solved in 126 episodes!	Average Score: -98.94	
Episode 100	Average Score: -170.49	
Episode 125	Average Score: -99.87	eps 0.0001
Environment solved in 125 episodes!	Average Score: -99.87	
Episode 100	Average Score: -168.05	
Episode 117	Average Score: -99.46	eps 0.0001
Environment solved in 117 episodes!	Average Score: -99.46	
Episode 100	Average Score: -182.33	
Episode 178	Average Score: -99.85	eps 0.0001
Environment solved in 178 episodes!	Average Score: -99.85	
Performance 145.8		





```
[ ]: # From defaults : Buffer size decreased to 10000 ,batch size=128, Update every=20
BUFFER_SIZE = int(10000)
BATCH_SIZE = 128
GAMMA = 0.99
LR = 5e-4
UPDATE_EVERY = 20
NUM_HLAYERS = 2
HLAYER_SIZES = [64, 128]
TRUNC_LIM = 1e32

fname = str(uuid.uuid4())
print(f'Saved to folder {fname}')
```

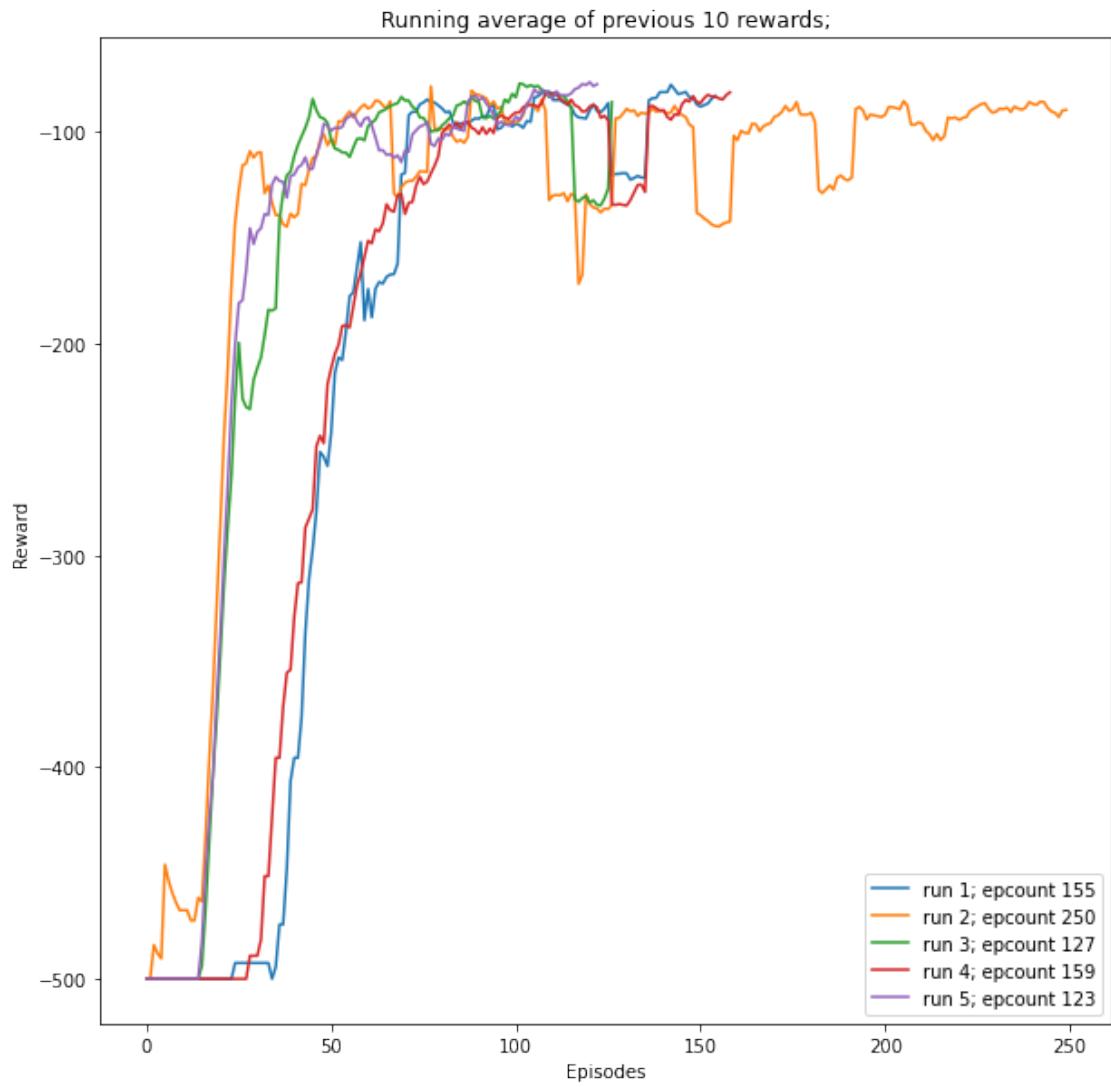
```

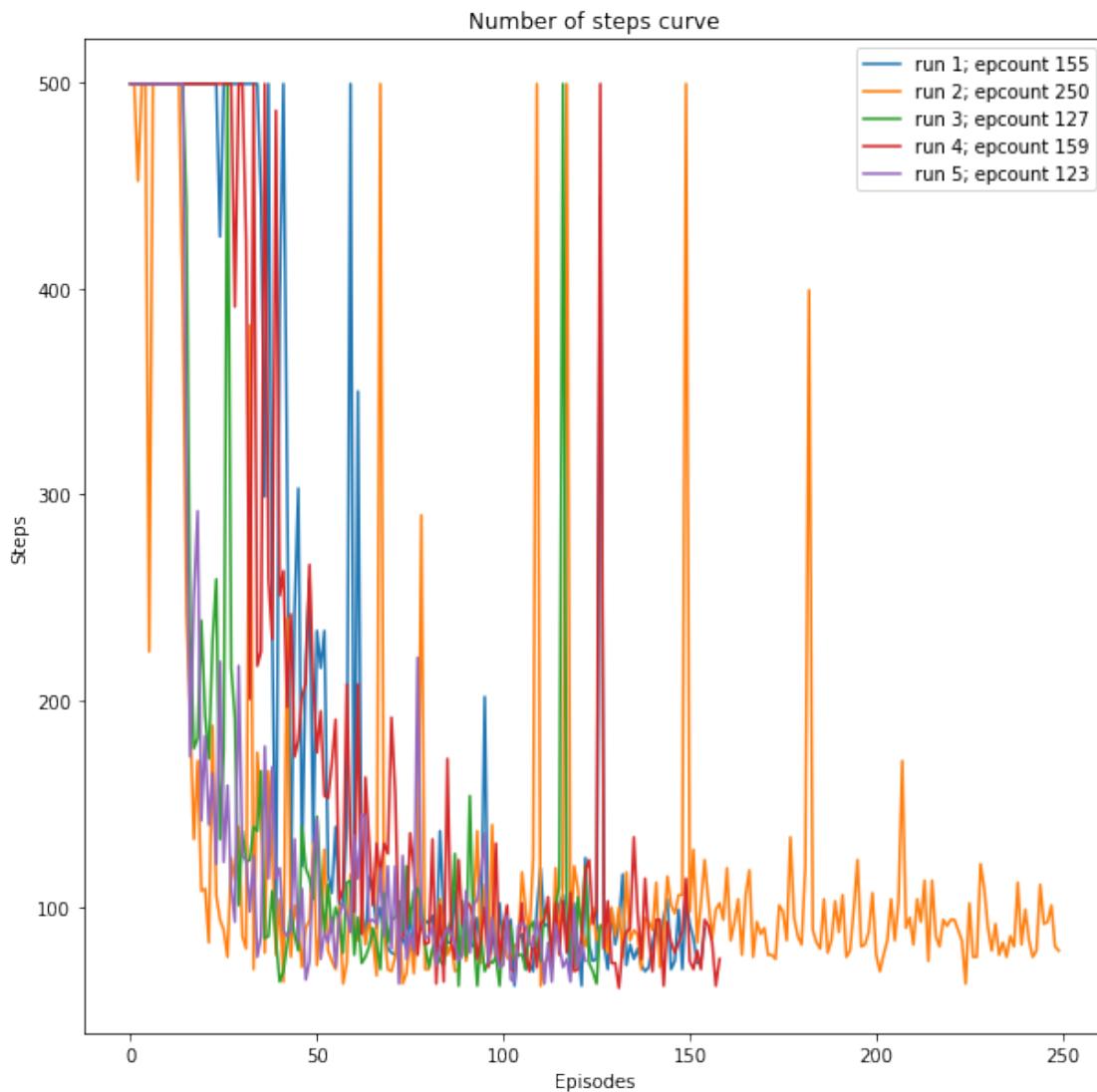
os.mkdir(PATH+'/' + fname)
run_scores, run_steps, ep_count_average, median_agent =
    ↪dqn_exp_runner('Acrobot-v1', num_runs=5, env_score_req=-100,
                    ↪use_eps=True, start=20, end=0.0001, decay_factor=0.8)
print(f'Performance {ep_count_average}')
gen_plots(fname, run_scores, run_steps)
save_gif(fname, 'Acrobot-v1', median_agent, max_steps=800)

```

Saved to folder de65c5be-41a9-462d-be57-d38bfad8a5e8

Episode 100	Average Score:	-274.43	
Episode 155	Average Score:	-99.99	eps 0.0001
Environment solved in 155 episodes!		Average Score: -99.99	
Episode 100	Average Score:	-163.65	
Episode 200	Average Score:	-108.51	
Episode 250	Average Score:	-95.88	eps 0.0001
Environment solved in 250 episodes!		Average Score: -95.88	
Episode 100	Average Score:	-176.23	
Episode 127	Average Score:	-99.35	eps 0.0001
Environment solved in 127 episodes!		Average Score: -99.35	
Episode 100	Average Score:	-265.30	
Episode 159	Average Score:	-99.67	eps 0.0001
Environment solved in 159 episodes!		Average Score: -99.67	
Episode 100	Average Score:	-172.84	
Episode 123	Average Score:	-99.51	eps 0.0001
Environment solved in 123 episodes!		Average Score: -99.51	
Performance 162.8			





```
[ ]: # From defaults : Buffer size decreased to 10000 ,batch size=128, Update every=50
BUFFER_SIZE = int(10000)
BATCH_SIZE = 128
GAMMA = 0.99
LR = 5e-4
UPDATE_EVERY = 50
NUM_HLAYERS = 2
HLAYER_SIZES = [64, 128]
TRUNC_LIM = 1e32

fname = str(uuid.uuid4())
print(f'Saved to folder {fname}')
```

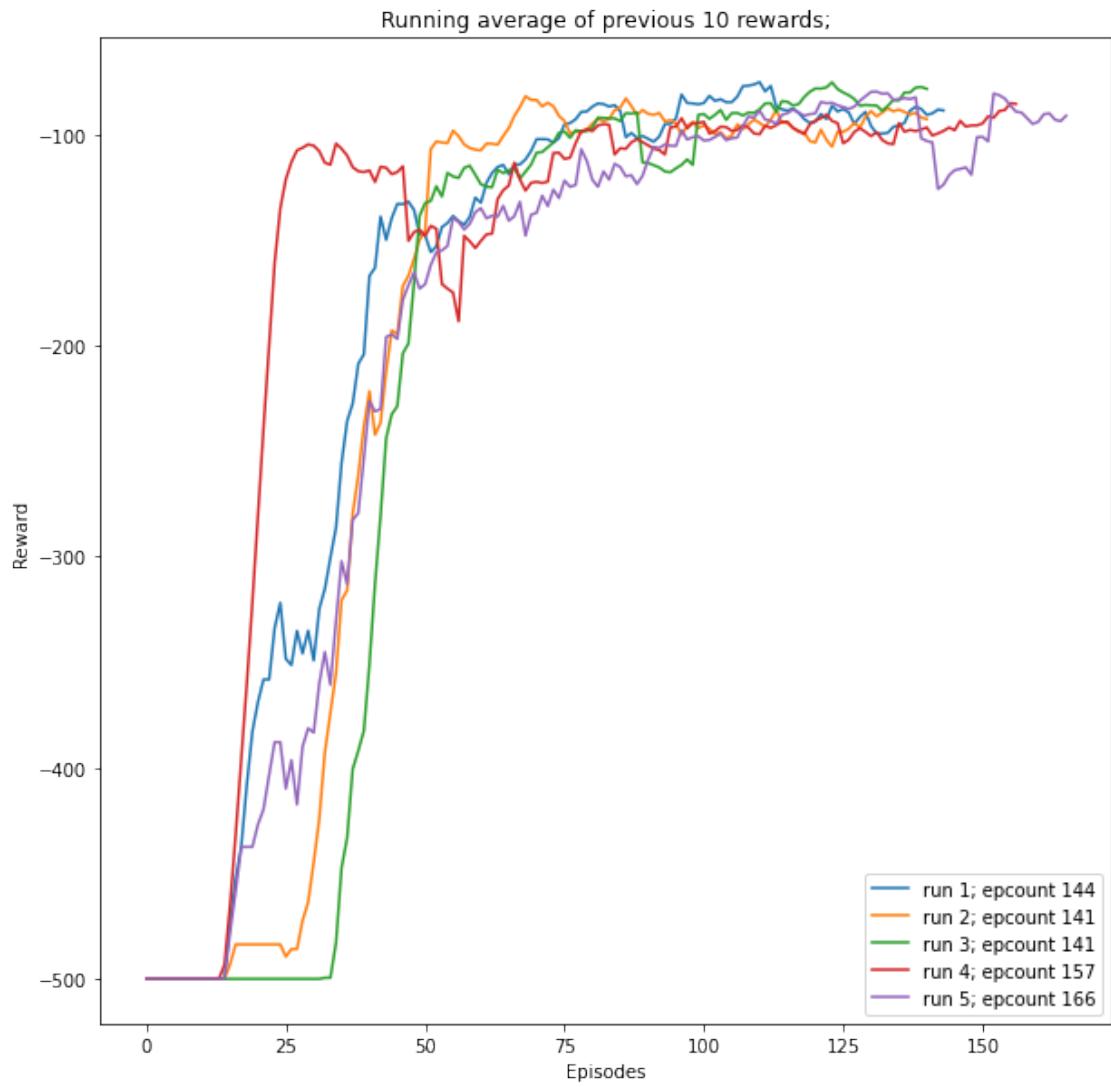
```

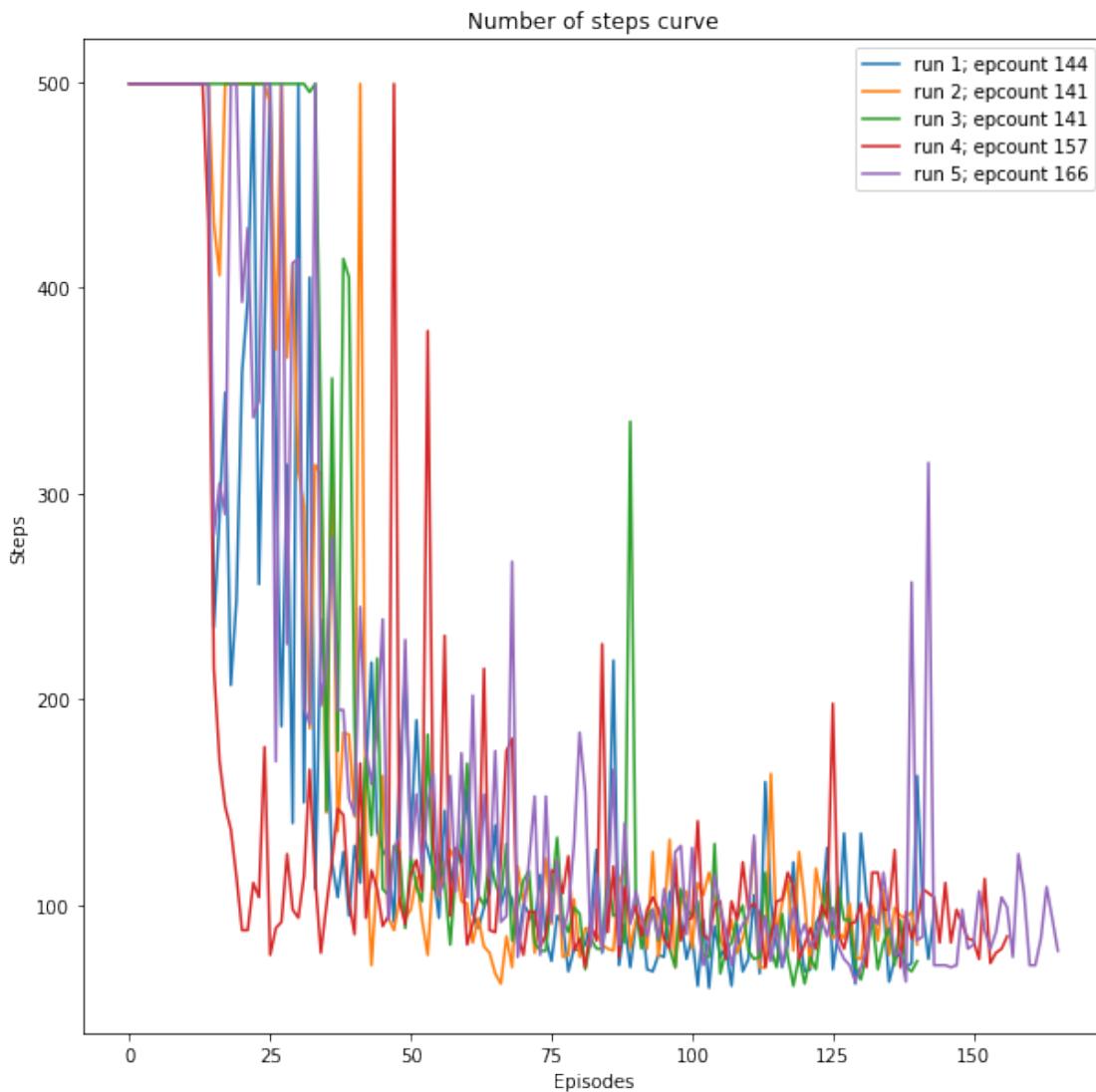
os.mkdir(PATH+'/' + fname)
run_scores, run_steps, ep_count_average, median_agent = ↴
    ↪dqn_exp_runner('Acrobot-v1', num_runs=5, env_score_req=-100,
                    ↴
                    ↪use_eps=True, start=20, end=0.0001, decay_factor=0.8)
print(f'Performance {ep_count_average}!')
gen_plots(fname, run_scores, run_steps)
save_gif(fname, 'Acrobot-v1', median_agent, max_steps=800)

```

Saved to folder ca949506-f2ce-4520-bee0-5a27cba878a8

Episode 100	Average Score:	-208.34	
Episode 144	Average Score:	-99.06	eps 0.0001
Environment solved in 144 episodes!			
Episode 100	Average Score:	-231.03	
Episode 141	Average Score:	-99.83	eps 0.0001
Environment solved in 141 episodes!			
Episode 100	Average Score:	-255.74	
Episode 141	Average Score:	-99.71	eps 0.0001
Environment solved in 141 episodes!			
Episode 100	Average Score:	-176.25	
Episode 157	Average Score:	-99.93	eps 0.0001
Environment solved in 157 episodes!			
Episode 100	Average Score:	-235.35	
Episode 166	Average Score:	-99.98	eps 0.0001
Environment solved in 166 episodes!			
Performance 149.8			





```
[ ]: # From defaults : Buffer size decreased to 10000 ,batch size=128, decay factor ↴=0.6
BUFFER_SIZE = int(10000)
BATCH_SIZE = 128
GAMMA = 0.99
LR = 5e-4
UPDATE_EVERY = 100
NUM_HLAYERS = 2
HLAYER_SIZES = [64, 128]
TRUNC_LIM = 1e32

fname = str(uuid.uuid4())
print(f'Saved to folder {fname}')
```

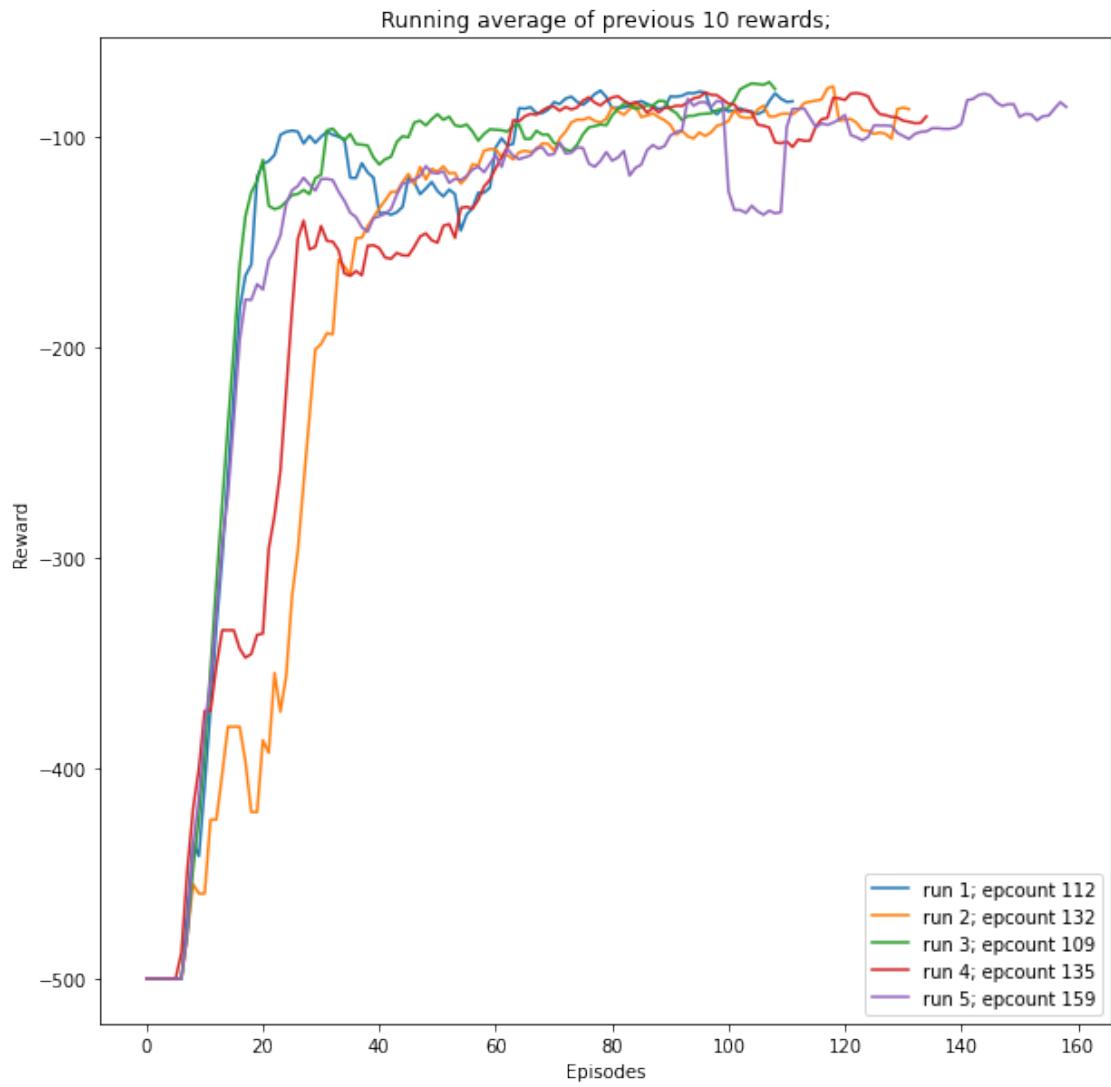
```

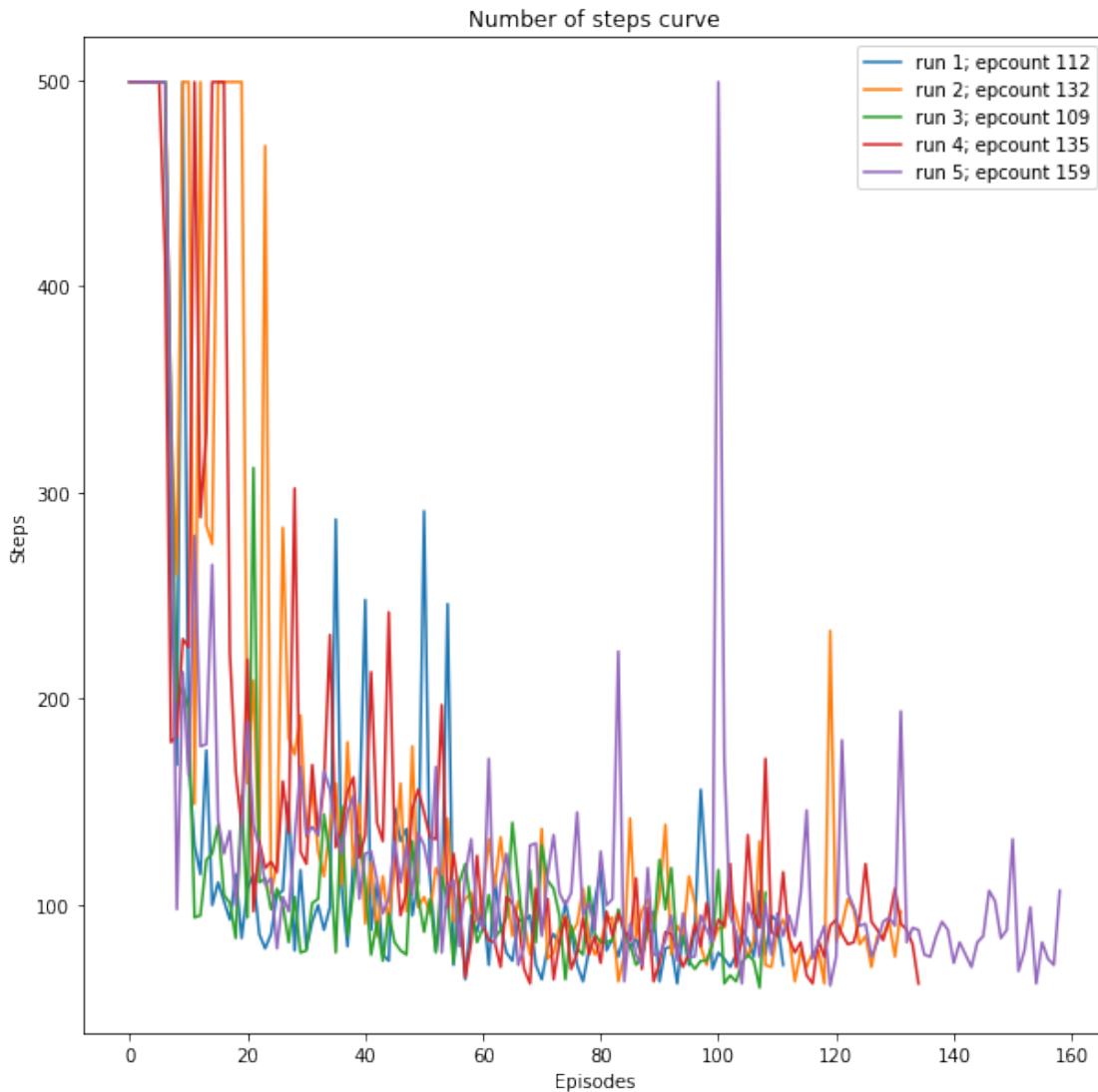
os.mkdir(PATH+'/' + fname)
run_scores, run_steps, ep_count_average, median_agent = ↴
    ↪dqn_exp_runner('Acrobot-v1', num_runs=5, env_score_req=-100,
                    ↴
                    ↪use_eps=True, start=20, end=0.0001, decay_factor=0.6)
print(f'Performance {ep_count_average}!')
gen_plots(fname, run_scores, run_steps)
save_gif(fname, 'Acrobot-v1', median_agent, max_steps=800)

```

Saved to folder e745c41a-ea07-4960-babb-b47e33f50914

Episode 100	Average Score:	-137.20	
Episode 112	Average Score:	-99.90	eps 0.0001
Environment solved in 112 episodes!		Average Score: -99.90	
Episode 100	Average Score:	-182.34	
Episode 132	Average Score:	-99.91	eps 0.0001
Environment solved in 132 episodes!		Average Score: -99.91	
Episode 100	Average Score:	-132.81	
Episode 109	Average Score:	-99.43	eps 0.0001
Environment solved in 109 episodes!		Average Score: -99.43	
Episode 100	Average Score:	-164.95	
Episode 135	Average Score:	-99.82	eps 0.0001
Environment solved in 135 episodes!		Average Score: -99.82	
Episode 100	Average Score:	-148.42	
Episode 159	Average Score:	-99.87	eps 0.0001
Environment solved in 159 episodes!		Average Score: -99.87	
Performance 129.4			





```
[ ]: # From defaults : Buffer size decreased to 10000 ,batch size=128,decay factor=0.
    ↵6,epsilon=0.00001
BUFFER_SIZE = int(10000)
BATCH_SIZE = 128
GAMMA = 0.99
LR = 5e-4
UPDATE_EVERY = 100
NUM_HLAYERS = 2
HLAYER_SIZES = [64, 128]
TRUNC_LIM = 1e32

fname = str(uuid.uuid4())
print(f'Saved to folder {fname}')
```

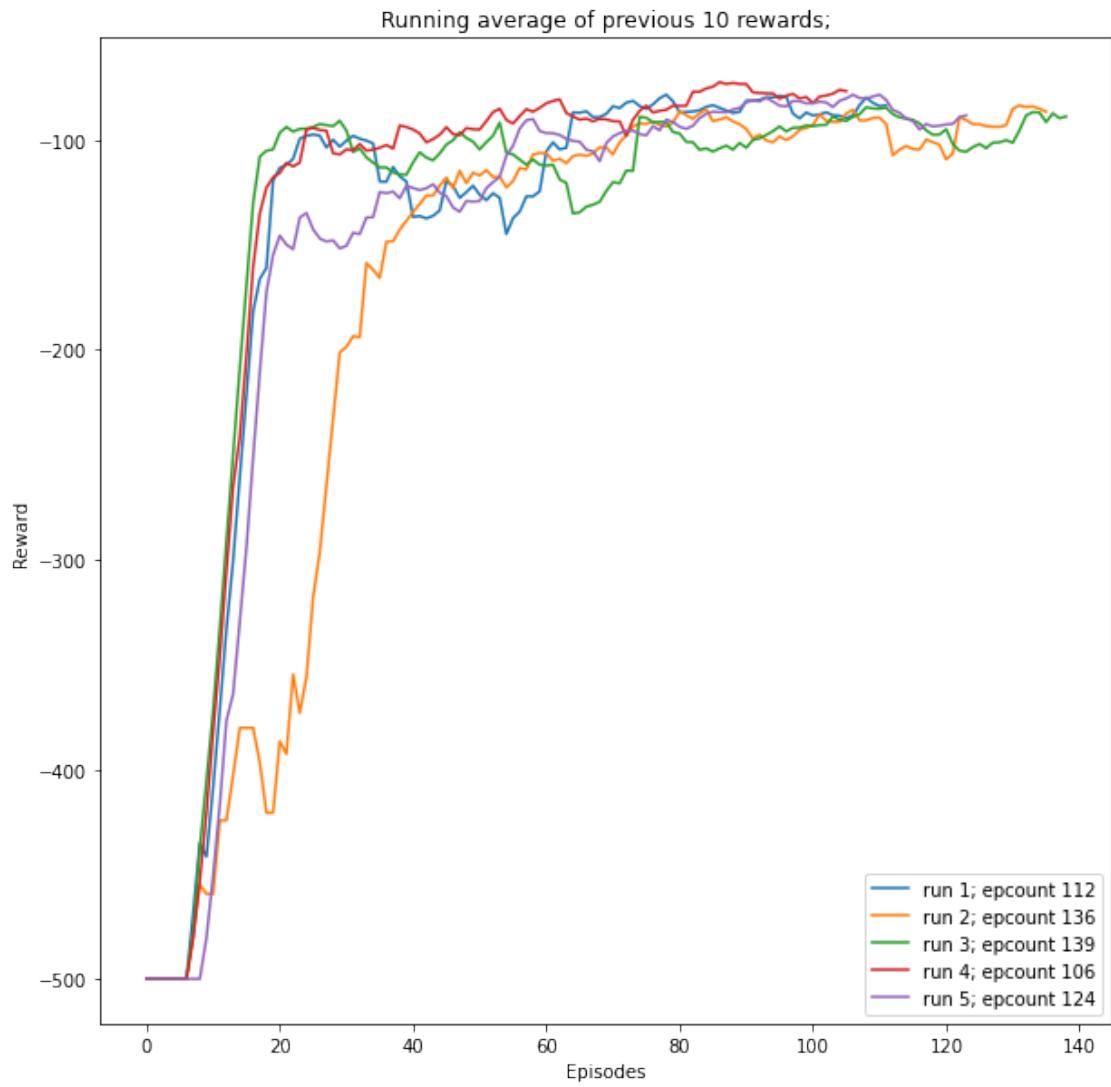
```

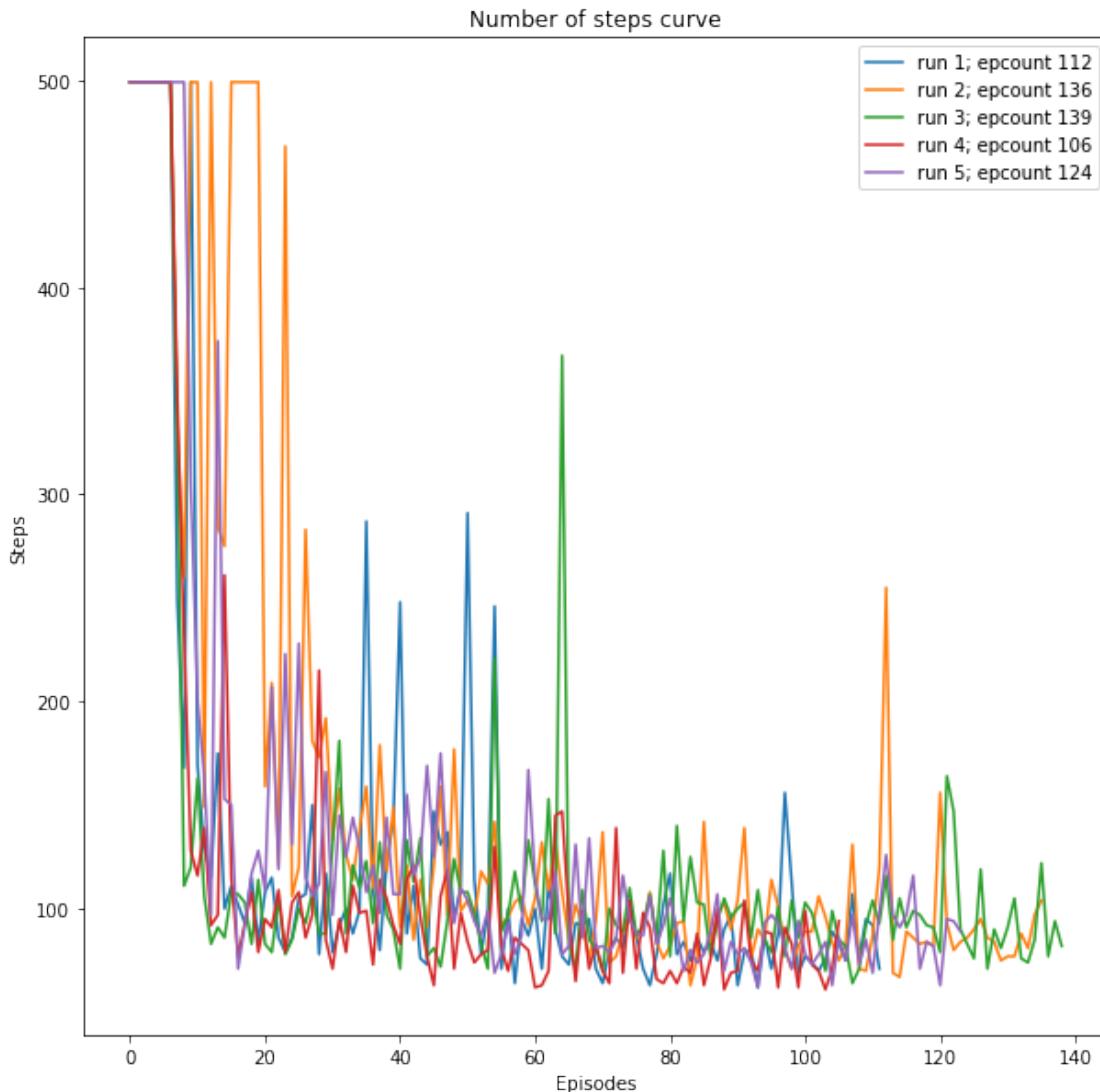
os.mkdir(PATH+'/' + fname)
run_scores, run_steps, ep_count_average, median_agent = ↴
    ↪dqn_exp_runner('Acrobot-v1', num_runs=5, env_score_req=-100,
                    ↴
                    ↪use_eps=True, start=20, end=0.00001, decay_factor=0.6)
print(f'Performance {ep_count_average}!')
gen_plots(fname, run_scores, run_steps)
save_gif(fname, 'Acrobot-v1', median_agent, max_steps=800)

```

Saved to folder a762c287-813d-4f20-8c02-6c6f204ae67c

Episode 100	Average Score:	-137.20	
Episode 112	Average Score:	-99.90	eps 1e-05
Environment solved in 112 episodes!			
Episode 100	Average Score:	-182.34	
Episode 136	Average Score:	-99.60	eps 1e-05
Environment solved in 136 episodes!			
Episode 100	Average Score:	-134.43	
Episode 139	Average Score:	-99.88	eps 1e-05
Environment solved in 139 episodes!			
Episode 100	Average Score:	-124.47	
Episode 106	Average Score:	-99.15	eps 1e-05
Environment solved in 106 episodes!			
Episode 100	Average Score:	-149.32	
Episode 124	Average Score:	-99.86	eps 1e-05
Environment solved in 124 episodes!			
Performance 123.4			





```
[ ]: # From defaults : Buffer size decreased to 10000 ,batch size=128,decay factor=0.
    ↵9,epsilon=0.00001,epsilon end=0.000001,softmax
BUFFER_SIZE = int(10000)
BATCH_SIZE = 128
GAMMA = 0.99
LR = 5e-4
UPDATE_EVERY = 100
NUM_HLAYERS = 2
HLAYER_SIZES = [64, 128]
TRUNC_LIM = 1e32

fname = str(uuid.uuid4())
print(f'Saved to folder {fname}')
```

```

os.mkdir(PATH+'/'+fname)
run_scores, run_steps, ep_count_average, median_agent =
    ↪dqn_exp_runner('Acrobot-v1', num_runs=5, env_score_req=-100,
                    ↪use_eps=False, start=40, end=0.00001, decay_factor=0.9)
print(f'Performance {ep_count_average}')
gen_plots(fname, run_scores, run_steps)
save_gif(fname, 'Acrobot-v1', median_agent, max_steps=800)

```

Saved to folder ca584ca1-2e01-4bf5-9acf-aa664ebce2bf

Episode 100	Average Score:	-216.19
Episode 132	Average Score:	-99.76
Environment solved in 132 episodes!	Average Score:	-99.76
Episode 100	Average Score:	-228.48
Episode 135	Average Score:	-99.87
Environment solved in 135 episodes!	Average Score:	-99.87
Episode 100	Average Score:	-222.81
Episode 184	Average Score:	-98.69
Environment solved in 184 episodes!	Average Score:	-98.69
Episode 100	Average Score:	-220.85
Episode 132	Average Score:	-99.35
Environment solved in 132 episodes!	Average Score:	-99.35
Episode 100	Average Score:	-226.82
Episode 142	Average Score:	-99.12
Environment solved in 142 episodes!	Average Score:	-99.12
Performance	145.0	

<ipython-input-6-4c3fc3a85a06>:66: RuntimeWarning: divide by zero encountered in true_divide

```

    return self.rsg.choice(np.arange(self.action_size), size=1,
p=softmax(a_values/beta))[0]
/usr/local/lib/python3.9/dist-packages/scipy/special/_logsumexp.py:224:
RuntimeWarning: invalid value encountered in subtract
    exp_x_shifted = np.exp(x - x_max)

```

ValueError	Traceback (most recent call last)
<ipython-input-10-dd782a00d70a> in <module>	
16 print(f'Performance {ep_count_average}') 17 gen_plots(fname, run_scores, run_steps) --> 18 save_gif(fname, 'Acrobot-v1', median_agent, max_steps=800)	

<ipython-input-8-607501eb93ae> in save_gif(fname, env_name, torchagent, ↪max_steps)	
58 display.start() 59 # Save GIF image --> 60 images = render_episode(env_name, torchagent, max_steps) 61 image_file = PATH+'/'+fname+f'/render.gif'	

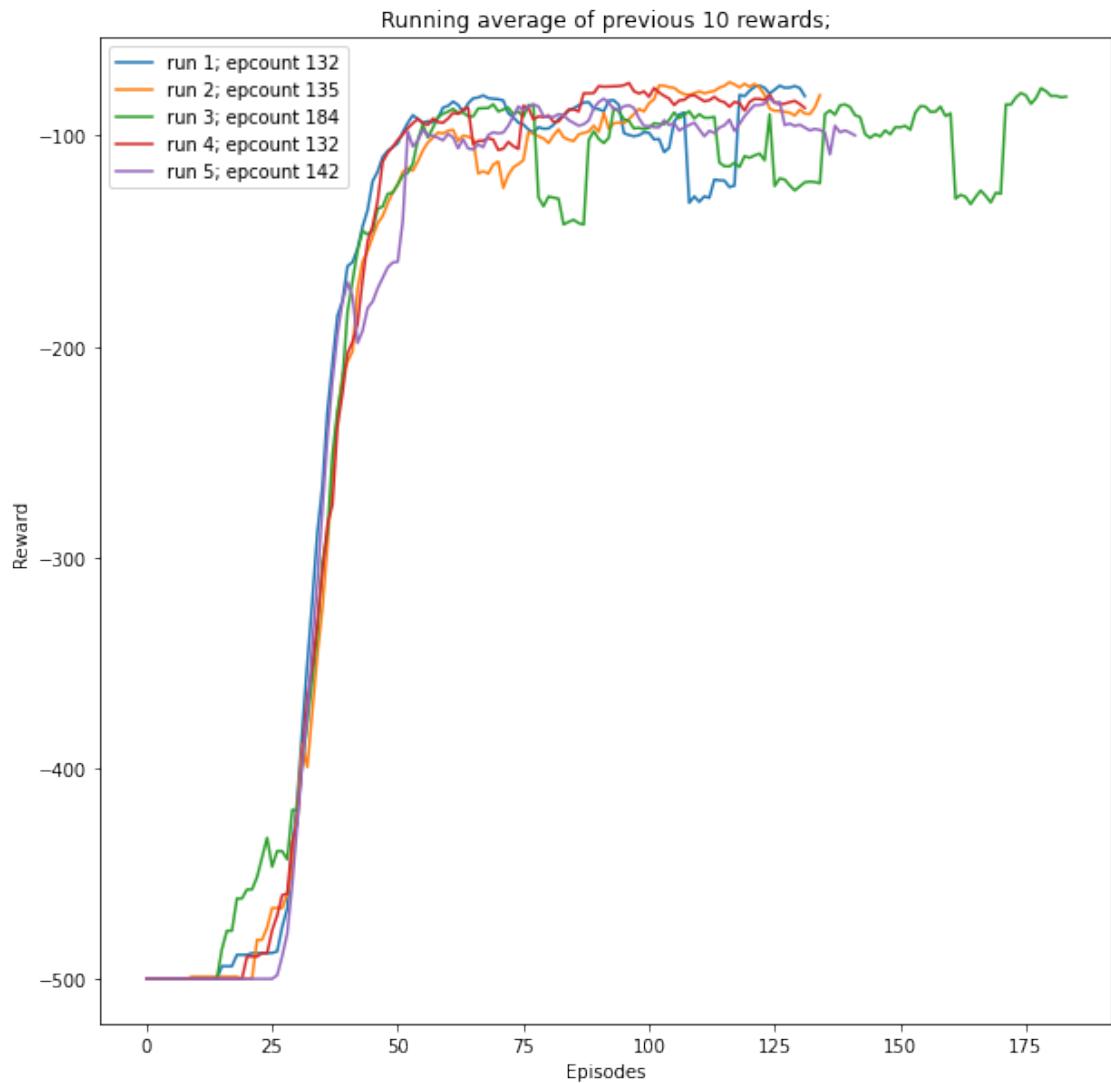
```
62      # loop=0: loop forever, duration=1: play each frame for 1ms

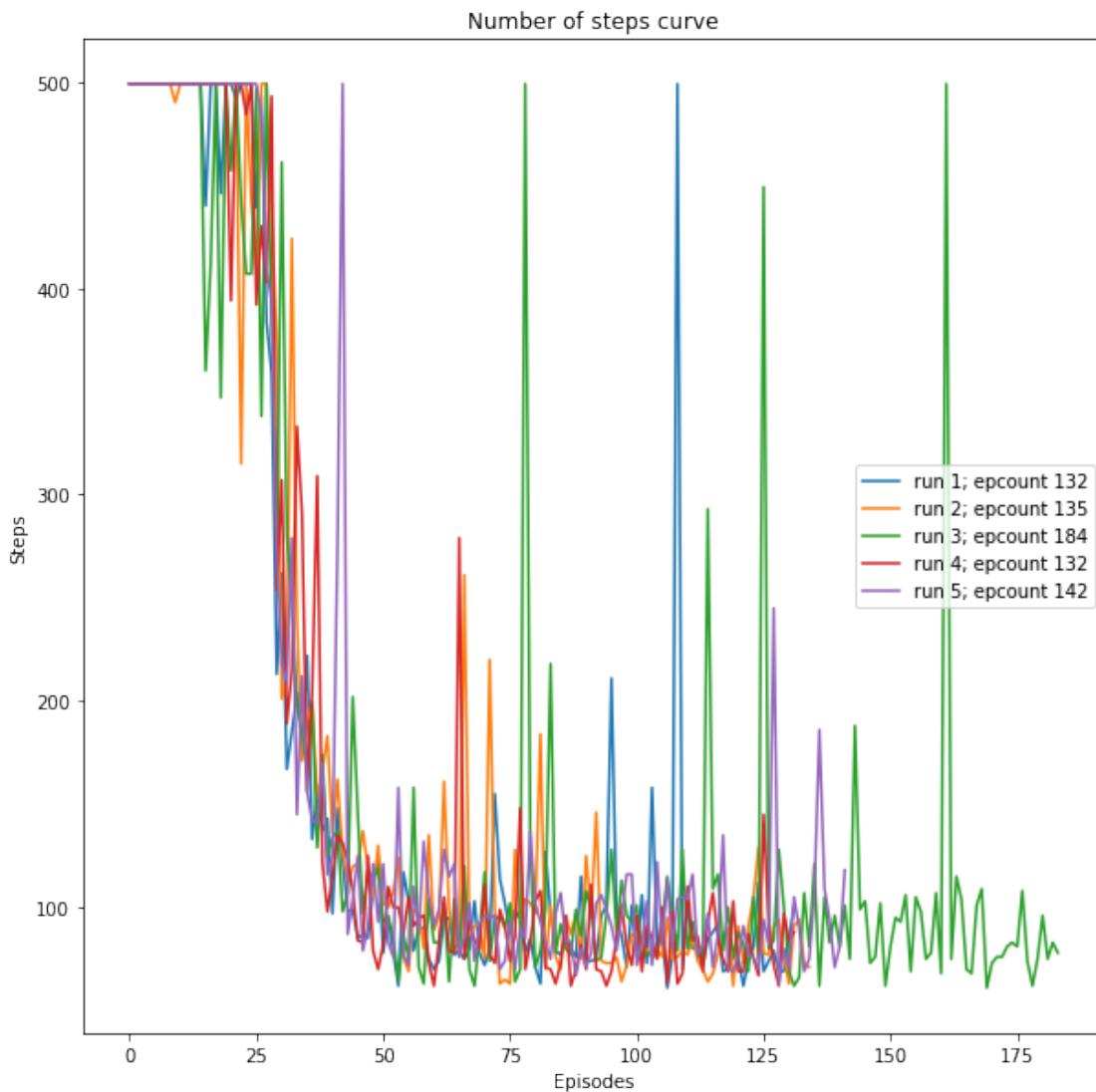
<ipython-input-8-607501eb93ae> in render_episode(env_name, agent, max_steps)
    41      state = env.reset()
    42      for i in range(1, max_steps + 1):
---> 43          action = agent.act(state, 0.0)
    44          state, _, done, _ = env.step(action)
    45

<ipython-input-6-4c3fc3a85a06> in soft_act(self, state, beta)
    64      ''' Softmax action selection (Implemented) '''
    65      a_values = torch.squeeze(action_values).cpu().squeeze().data.
->numpy()
---> 66          return self.rsg.choice(np.arange(self.action_size), size=1, u
->p=softmax(a_values/beta))[0]
    67
    68      def learn(self, experiences, gamma):
```

mtrand.pyx in numpy.random.mtrand.RandomState.choice()

ValueError: probabilities contain NaN





```
[ ]: # From defaults : Buffer size decreased to 10000 ,batch size=128,decay factor=0.
    ↵6,epsilon=0.00001,epsilon end=0.000001,softmax
BUFFER_SIZE = int(10000)
BATCH_SIZE = 128
GAMMA = 0.99
LR = 5e-4
UPDATE_EVERY = 100
NUM_HLAYERS = 2
HLAYER_SIZES = [64, 128]
TRUNC_LIM = 1e32

fname = str(uuid.uuid4())
print(f'Saved to folder {fname}')
```

```

os.mkdir(PATH+'/' + fname)
run_scores, run_steps, ep_count_average, median_agent =
    ↪dqn_exp_runner('Acrobot-v1', num_runs=5, env_score_req=-100,
    ↪use_eps=False, start=40, end=0.00001, decay_factor=0.6)
print(f'Performance {ep_count_average}')
gen_plots(fname, run_scores, run_steps)
save_gif(fname, 'Acrobot-v1', median_agent, max_steps=800)

```

Saved to folder 06fedacf-78c3-44d6-b843-4e1771439c80

Episode 100	Average Score:	-143.99
Episode 140	Average Score:	-99.85
Environment solved in 140 episodes!	Average Score:	-99.85
Episode 100	Average Score:	-163.85
Episode 164	Average Score:	-99.71
Environment solved in 164 episodes!	Average Score:	-99.71
Episode 100	Average Score:	-142.77
Episode 144	Average Score:	-99.78
Environment solved in 144 episodes!	Average Score:	-99.78
Episode 100	Average Score:	-167.88
Episode 157	Average Score:	-99.61
Environment solved in 157 episodes!	Average Score:	-99.61
Episode 100	Average Score:	-183.30
Episode 188	Average Score:	-97.72
Environment solved in 188 episodes!	Average Score:	-97.72
Performance 158.6		

```

<ipython-input-6-4c3fc3a85a06>:66: RuntimeWarning: divide by zero encountered in
true_divide
    return self.rsg.choice(np.arange(self.action_size), size=1,
p=softmax(a_values/beta))[0]
/usr/local/lib/python3.9/dist-packages/scipy/special/_logsumexp.py:224:
RuntimeWarning: invalid value encountered in subtract
    exp_x_shifted = np.exp(x - x_max)

```

ValueError	Traceback (most recent call last)
<ipython-input-11-9d84336cc00b> in <module>	
16 print(f'Performance {ep_count_average}') 17 gen_plots(fname, run_scores, run_steps) --> 18 save_gif(fname, 'Acrobot-v1', median_agent, max_steps=800)	
<ipython-input-8-607501eb93ae> in save_gif(fname, env_name, torchagent, ↪ max_steps)	
58 display.start() 59 # Save GIF image --> 60 images = render_episode(env_name, torchagent, max_steps) 61 image_file = PATH+'/'+fname+f'/render.gif'	

```

62      # loop=0: loop forever, duration=1: play each frame for 1ms

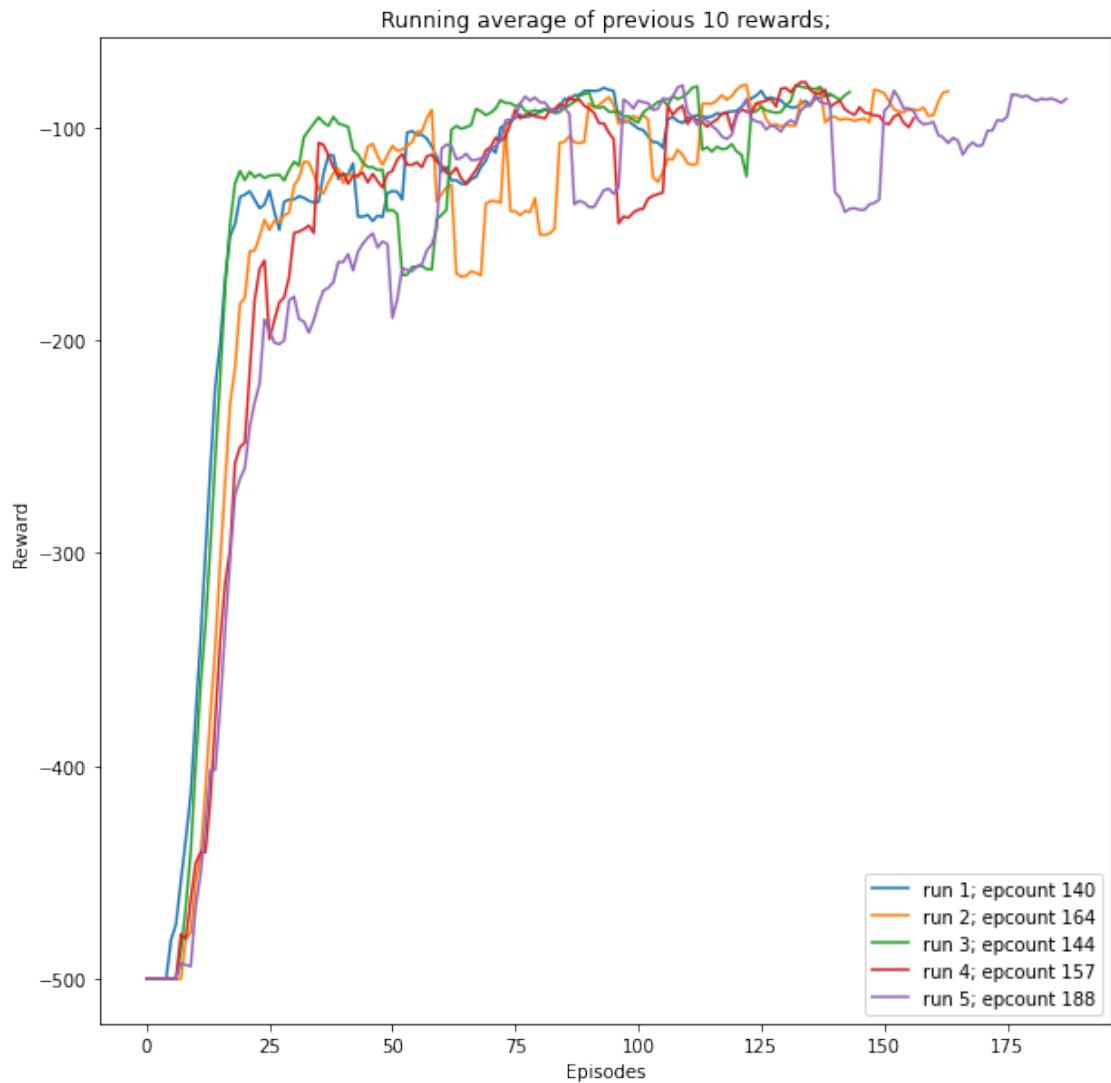
<ipython-input-8-607501eb93ae> in render_episode(env_name, agent, max_steps)
    41      state = env.reset()
    42      for i in range(1, max_steps + 1):
---> 43          action = agent.act(state, 0.0)
    44          state, _, done, _ = env.step(action)
    45

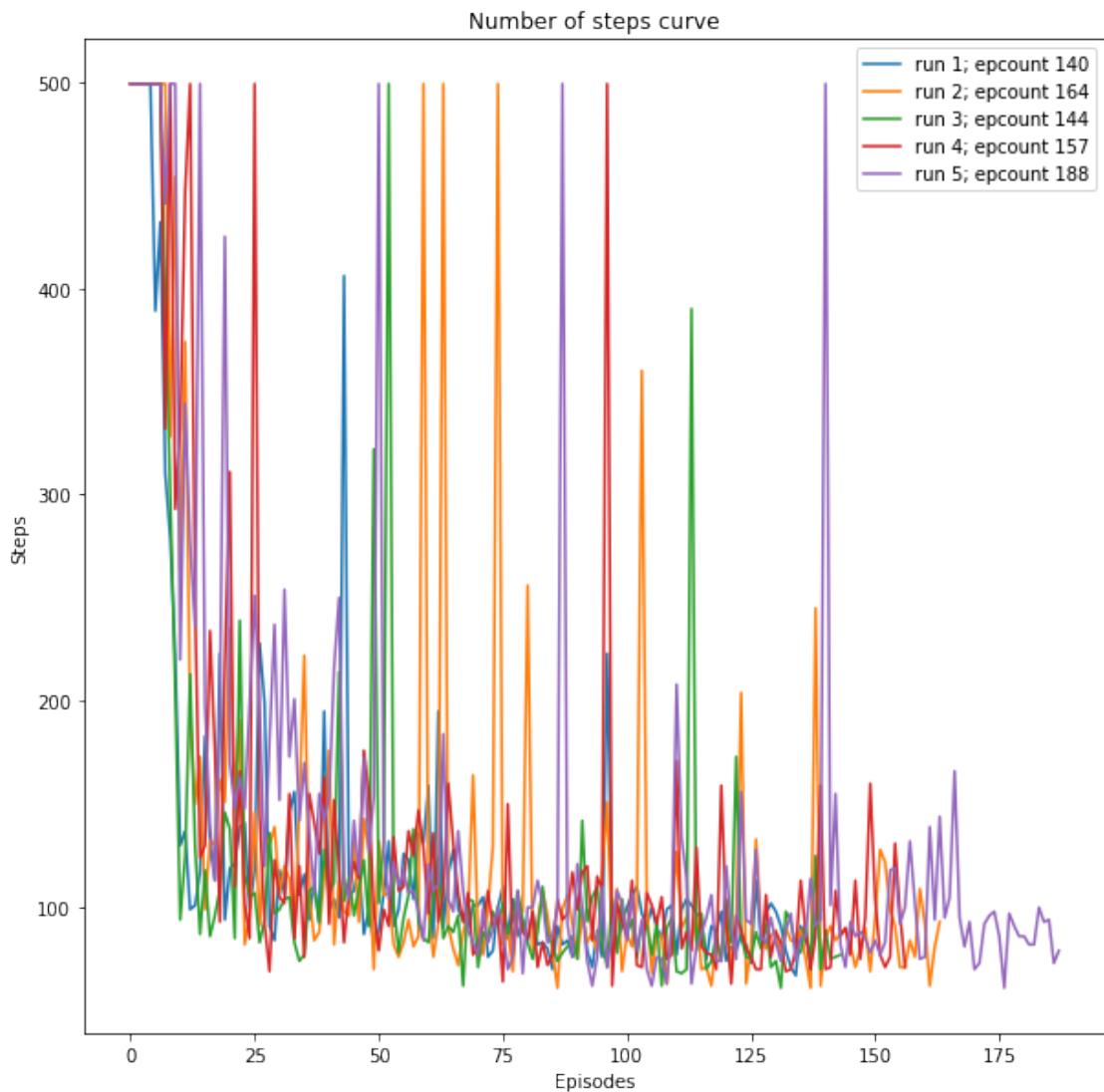
<ipython-input-6-4c3fc3a85a06> in soft_act(self, state, beta)
    64      ''' Softmax action selection (Implemented) '''
    65      a_values = torch.squeeze(action_values).cpu().squeeze().data.
->numpy()
---> 66          return self.rsg.choice(np.arange(self.action_size), size=1, u
->p=softmax(a_values/beta))[0]
    67
    68      def learn(self, experiences, gamma):

mtrand.pyx in numpy.random.mtrand.RandomState.choice()

ValueError: probabilities contain NaN

```





[]:

FinalDQN_cartpole

March 26, 2023

```
[ ]: from google.colab import drive  
drive.mount('/content/drive')  
import os
```

Mounted at /content/drive

```
[ ]: '''  
Installing packages for rendering the game on Colab  
'''  
  
!pip install gym pyvirtualdisplay > /dev/null 2>&1  
!apt-get install -y xvfb python-opengl ffmpeg > /dev/null 2>&1  
!apt-get update > /dev/null 2>&1  
!apt-get install cmake > /dev/null 2>&1  
!pip install --upgrade setuptools 2>&1  
!pip install ez_setup > /dev/null 2>&1  
!pip install gym[atari] > /dev/null 2>&1  
!pip install git+https://github.com/tensorflow/docs > /dev/null 2>&1  
!pip install gym[classic_control]
```

```
Looking in indexes: https://pypi.org/simple, https://us-python.pkg.dev/colab-wheels/public/simple/  
Requirement already satisfied: setuptools in /usr/local/lib/python3.9/dist-packages (67.6.0)  
Looking in indexes: https://pypi.org/simple, https://us-python.pkg.dev/colab-wheels/public/simple/  
Requirement already satisfied: gym[classic_control] in /usr/local/lib/python3.9/dist-packages (0.25.2)  
Requirement already satisfied: numpy>=1.18.0 in /usr/local/lib/python3.9/dist-packages (from gym[classic_control]) (1.22.4)  
Requirement already satisfied: importlib-metadata>=4.8.0 in /usr/local/lib/python3.9/dist-packages (from gym[classic_control]) (6.1.0)  
Requirement already satisfied: gym-notices>=0.0.4 in /usr/local/lib/python3.9/dist-packages (from gym[classic_control]) (0.0.8)  
Requirement already satisfied:云pickle>=1.2.0 in /usr/local/lib/python3.9/dist-packages (from gym[classic_control]) (2.2.1)  
Collecting pygame==2.1.0  
    Downloading
```

```

pygame-2.1.0-cp39-cp39-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (18.3 MB)
  18.3/18.3 MB
91.2 MB/s eta 0:00:00
Requirement already satisfied: zipp>=0.5 in /usr/local/lib/python3.9/dist-
packages (from importlib-metadata>=4.8.0->gym[classic_control]) (3.15.0)
Installing collected packages: pygame
  Attempting uninstall: pygame
    Found existing installation: pygame 2.3.0
    Uninstalling pygame-2.3.0:
      Successfully uninstalled pygame-2.3.0
Successfully installed pygame-2.1.0

```

```

[ ]: """
A bunch of necessary imports
"""

import numpy as np
import seaborn as sns
import torch
import torch.nn as nn
import torch.nn.functional as F
from collections import namedtuple, deque
import torch.optim as optim
import datetime
import gym
from gym.wrappers.record_video import RecordVideo
import glob
import io
import base64
import matplotlib.pyplot as plt
from IPython.display import HTML
from pyvirtualdisplay import Display
import tensorflow_docs.vis.embed as embed
from IPython import display as ipythondisplay
from PIL import Image
import uuid
import warnings
warnings.filterwarnings("ignore", category=DeprecationWarning)

device = torch.device("cuda:0" if torch.cuda.is_available() else "cpu")

```

0.0.1 Q-Network Code

```

[ ]: """
Bunch of Hyper parameters (Which you might have to tune later **wink wink**)
"""

BUFFER_SIZE = int(1e5) # replay buffer size

```

```

BATCH_SIZE = 64          # minibatch size
GAMMA = 0.99             # discount factor
LR = 5e-4                # learning rate
UPDATE_EVERY = 20         # how often to update the network (When Q target is ↵present)
NUM_HLAYERS = 2
HLAYER_SIZES = [128, 64]
TRUNC_LIM = 1

class QNetwork(nn.Module):

    def __init__(self, state_size, action_size, seed, fc1_units=128, fc2_units=64):
        """Initialize parameters and build model.
        Params
        ======
            state_size (int): Dimension of each state
            action_size (int): Dimension of each action
            seed (int): Random seed
            fc1_units (int): Number of nodes in first hidden layer
            fc2_units (int): Number of nodes in second hidden layer
        """
        super(QNetwork, self).__init__()
        self.seed = torch.manual_seed(seed)
        self.fcls = nn.ModuleList()
        for i in range(NUM_HLAYERS+1):
            if (i == 0):
                fc = nn.Linear(state_size, HLAYER_SIZES[0])
            elif (i == NUM_HLAYERS):
                fc = nn.Linear(HLAYER_SIZES[i-1], action_size)
            else:
                fc = nn.Linear(HLAYER_SIZES[i-1], HLAYER_SIZES[i])
            self.fcls.append(fc)

    def forward(self, state):
        """Build a network that maps state -> action values."""
        for i in range(len(self.fcls)-1):
            fc = self.fcls[i]
            if i == 0:
                x = F.relu(fc(state))
            else:
                x = F.relu(fc(x))
        fc = self.fcls[len(self.fcls) - 1]
        return fc(x)

```

0.0.2 Replay Buffer:

This is a ‘deque’ that helps us store experiences. Recall why we use such a technique.

```
[ ]: from collections import deque, namedtuple

class ReplayBuffer:
    """Fixed-size buffer to store experience tuples."""

    def __init__(self, action_size, buffer_size, batch_size, seed):
        self.action_size = action_size
        self.memory = deque(maxlen=buffer_size)
        self.batch_size = batch_size
        self.experience = namedtuple("Experience", field_names=["state", "action", "reward", "next_state", "done"])
        self.rsg = np.random.RandomState(seed)

    def add(self, state, action, reward, next_state, done):
        """Add a new experience to memory."""
        e = self.experience(state, action, reward, next_state, done)
        self.memory.append(e)

    def sample(self):
        """Randomly sample a batch of experiences from memory."""
        idxs = self.rsg.choice(len(self.memory), size=self.batch_size, replace=False)
        mem = self.memory
        states = torch.from_numpy(np.vstack([mem[i].state for i in idxs if mem[i] is not None])).float().to(device)
        actions = torch.from_numpy(np.vstack([mem[i].action for i in idxs if mem[i] is not None])).long().to(device)
        rewards = torch.from_numpy(np.vstack([mem[i].reward for i in idxs if mem[i] is not None])).float().to(device)
        next_states = torch.from_numpy(np.vstack([mem[i].next_state for i in idxs if mem[i] is not None])).float().to(device)
        dones = torch.from_numpy(np.vstack([mem[i].done for i in idxs if mem[i] is not None]).astype(np.uint8)).float().to(device)

        return (states, actions, rewards, next_states, dones)

    def __len__(self):
        """Return the current size of internal memory."""
        return len(self.memory)
```

0.0.3 DQN Agent Code:

Truncation is done optionally with the hope that it improves stability.

```
[ ]: from scipy.special import softmax
class dqn_agent():
    def __init__(self, state_size, action_size, seed, atype='epsilon-greedy'):

        ''' Agent Environment Interaction '''
        self.state_size = state_size
        self.action_size = action_size
        self.rsg = np.random.RandomState(seed)

        ''' Q-Network '''
        self.qnetwork_local = QNetwork(state_size, action_size, seed).to(device)
        self.qnetwork_target = QNetwork(state_size, action_size, seed).
        ↪to(device)
        self.optimizer = optim.Adam(self.qnetwork_local.parameters(), lr=LR)

        ''' Replay memory '''
        self.memory = ReplayBuffer(action_size, BUFFER_SIZE, BATCH_SIZE, seed)
        ''' Initialize time step (for updating every UPDATE_EVERY steps) □
        ↪ -Needed for Q Targets '''
        self.t_step = 0

        if atype == 'epsilon-greedy':
            self.act = self.eps_act
        else:
            self.act = self.soft_act

    def step(self, state, action, reward, next_state, done):

        ''' Save experience in replay memory '''
        self.memory.add(state, action, reward, next_state, done)

        ''' If enough samples are available in memory, get random subset and learn □
        ↪learn '''
        if len(self.memory) >= BATCH_SIZE:
            experiences = self.memory.sample()
            self.learn(experiences, GAMMA)

        """ +Q TARGETS PRESENT """
        ''' Updating the Network every 'UPDATE_EVERY' steps taken '''
        self.t_step = (self.t_step + 1) % UPDATE_EVERY
        if self.t_step == 0:

            self.qnetwork_target.load_state_dict(self.qnetwork_local.
        ↪state_dict())

    def eps_act(self, state, eps=0.):
```

```

state = torch.from_numpy(state).float().unsqueeze(0).to(device)
self.qnetwork_local.eval()
with torch.no_grad():
    action_values = self.qnetwork_local(state)
self.qnetwork_local.train()

''' Epsilon-greedy action selection (Already Present) '''
if self.rsg.random() < eps:
    return self.rsg.choice(np.arange(self.action_size))
else:
    return np.argmax(action_values.cpu().data.numpy())

def soft_act(self, state, beta=1.0):

    state = torch.from_numpy(state).float().unsqueeze(0).to(device)
    self.qnetwork_local.eval()
    with torch.no_grad():
        action_values = self.qnetwork_local(state)
    self.qnetwork_local.train()

    ''' Softmax action selection (Implemented) '''
    a_values = torch.squeeze(action_values).cpu().squeeze().data.numpy()
    return self.rsg.choice(np.arange(self.action_size), size=1, □
    ↵p=softmax(a_values/beta))[0]

def learn(self, experiences, gamma):
    """ +E EXPERIENCE REPLAY PRESENT """
    states, actions, rewards, next_states, dones = experiences

    ''' Get max predicted Q values (for next states) from target model'''
    Q_targets_next = self.qnetwork_target(next_states).detach().max(1)[0].
    ↵unsqueeze(1)

    ''' Compute Q targets for current states '''
    Q_targets = rewards + (gamma * Q_targets_next * (1 - dones))

    ''' Get expected Q values from local model '''
    Q_expected = self.qnetwork_local(states).gather(1, actions)

    ''' Compute loss '''
    loss = F.mse_loss(Q_expected, Q_targets)

    ''' Minimize the loss '''
    self.optimizer.zero_grad()
    loss.backward()

    ''' Gradient Clipping '''

```

```

""" +T TRUNCATION PRESENT """
for param in self.qnetwork_local.parameters():
    param.grad.data.clamp_(-TRUNC_LIM, +TRUNC_LIM)

self.optimizer.step()

```

0.0.4 DQN algorithm

```

[ ]: def reward_shaping(state, next_state):
       return -100*(np.abs(next_state[2])- np.abs(state[2]))

[ ]: ''' Defining DQN Algorithm with epsilon annealing'''

def dqn(env, agent, env_score_req, use_eps = True, n_episodes=2000, max_t=1000, ↴
        ↴eps_start=1.0, eps_end=0.05, decay_factor=0.995, beta_start=1.5, beta_end=0. ↴5):

    scores = []
    num_steps = []
    ''' list containing scores from each episode '''

    scores_window= deque(maxlen=100)
    ''' last 100 scores for checking if the avg is more than -110 '''

    eps = eps_start
    beta = beta_start

    ''' initialize epsilon '''
    for i_episode in range(1, n_episodes+1):
        state = env.reset()
        score = 0
        for t in range(max_t):
            if use_eps:
                action = agent.act(state, eps)
            else:
                action = agent.act(state, beta)
            next_state, reward, done, _ = env.step(action)
            shaped_reward = reward_shaping(state, next_state)
            agent.step(state, action, shaped_reward, next_state, done)
            state = next_state
            score += reward
            if done:
                break
        num_steps.append(t)
        scores.append(score)
        scores_window.append(score)

```

```

''' save most recent score '''

eps = max(eps_end, eps * decay_factor)
beta = max(beta_end, beta * decay_factor)
''' decrease epsilon, beta '''

print('\rEpisode {}\tAverage Score: {:.2f}\tsteps {}'.format(i_episode, np.mean(scores_window),eps) ,end="")
if i_episode % 100 == 0:
    print('\rEpisode {}\tAverage Score: {:.2f}'.format(i_episode, np.mean(scores_window)))
    if np.mean(scores_window)>=env_score_req:
        print('\nEnvironment solved in {:d} episodes!\tAverage Score: {:.2f}'.format(i_episode, np.mean(scores_window)))
        break
return [np.array(scores), np.array(num_steps), i_episode]

```

0.0.5 Plotting and Rendering

```

[ ]: PATH = '/content/drive/MyDrive/Colab Notebooks/CS6700/Assignments/Assignment2/
      ↪DQN/CP/'

def gen_plots(fname, run_scores, run_steps, avg_num=10):

    run_count = len(run_scores)
    labels = [f'run {i+1}; epcount {len(run_scores[i])}' for i in range(run_count)]

    sc_fig, sc_ax = plt.subplots(figsize=(10,10))
    st_fig, st_ax = plt.subplots(figsize=(10,10))
    sc_ax.set_title(f'Running average of previous {avg_num} rewards;')
    sc_ax.set_xlabel('Episodes')
    sc_ax.set_ylabel('Reward')
    st_ax.set_title(f'Number of steps curve')
    st_ax.set_xlabel('Episodes')
    st_ax.set_ylabel('Steps')

    for idx in range(run_count):

        score_list = run_scores[idx]
        step_list = run_steps[idx]
        average_score_list = np.zeros_like(score_list)
        for i in range(0, len(score_list)):
            if i < avg_num:
                average_score_list[i] = np.mean(score_list[:i+1])
            else:

```

```

        average_score_list[i] = np.mean(score_list[(i-avg_num+1):(i+1)])

    sns.lineplot(data=average_score_list, label=labels[idx], ax=sc_ax)
    sns.lineplot(data=step_list, label=labels[idx], ax=st_ax)

sc_fig.savefig(PATH+'/'+fname+'/sc_fig.png')
st_fig.savefig(PATH+'/'+fname+'/st_fig.png')

def render_episode(env_name, agent, max_steps: int):
    env = gym.make(env_name)
    env.reset()
    screen = env.render(mode='rgb_array')
    im = Image.fromarray(screen)

    images = [im]
    state = env.reset()
    for i in range(1, max_steps + 1):
        action = agent.act(state, 0.0)
        state, _, done, _ = env.step(action)

        # Render screen every 2 steps
        if i % 2 == 0:
            screen = env.render(mode='rgb_array')
            images.append(Image.fromarray(screen))

        if done:
            break

    return images

def save_gif(fname, env_name, torchagent, max_steps=800):
    display = Display(visible=0, size=(400, 300))
    display.start()
    # Save GIF image
    images = render_episode(env_name, torchagent, max_steps)
    image_file = PATH+'/'+fname+f'/render.gif'
    # loop=0: loop forever, duration=1: play each frame for 1ms
    images[0].save(image_file, save_all=True, append_images=images[1:], loop=0, duration=1)

```

```

[ ]: # code for running the dqn for multiple to account for stochasticity. averaged
      ↵performance is computed and returned
def dqn_exp_runner(env_name, num_runs, env_score_req, use_eps, start, end,
                   ↵decay_factor, n_episodes=800, max_t=1000):
    run_scores = []
    ep_counts = []
    run_steps = []

```

```

agents = []
env = gym.make(env_name)
env.seed(42)
if (use_eps):
    eps_start, eps_end = start, end
else:
    beta_start, beta_end = start, end
state_shape = env.observation_space.shape[0]
action_shape = env.action_space.n
for i in range(num_runs):
    begin_time = datetime.datetime.now()
    if use_eps:
        agent = dqn_agent(state_size=state_shape, action_size = action_shape, seed = 42, atype='epsilon-greedy')
        score_list, num_steps, ep_count = dqn(env, agent, env_score_req, use_eps = True, n_episodes=n_episodes, max_t=max_t, decay_factor=decay_factor, eps_start=eps_start, eps_end=eps_end)
    else:
        agent = dqn_agent(state_size=state_shape, action_size = action_shape, seed = 42, atype='softmax')
        score_list, num_steps, ep_count = dqn(env, agent, env_score_req, use_eps = False, n_episodes=n_episodes, max_t=max_t, decay_factor=decay_factor, beta_start=beta_start, beta_end=beta_end)
    time_taken = datetime.datetime.now() - begin_time
    run_scores.append(score_list)
    run_steps.append(num_steps)
    ep_counts.append(ep_count)
    agents.append(agent)
ep_counts = np.array(ep_counts)
# we use the median score getting the agent for render
best_res = np.argsort(ep_counts)[len(ep_counts)//2]
return run_scores, run_steps, np.mean(ep_counts), agents[best_res]

```

0.1 CartPole-v1

```
[ ]: # Default
BUFFER_SIZE = int(40000)
BATCH_SIZE = 128
GAMMA = 0.99
LR = 5e-4
UPDATE_EVERY = 100
NUM_HLAYERS = 2
HLAYER_SIZES = [64, 128]
TRUNC_LIM = 1e32

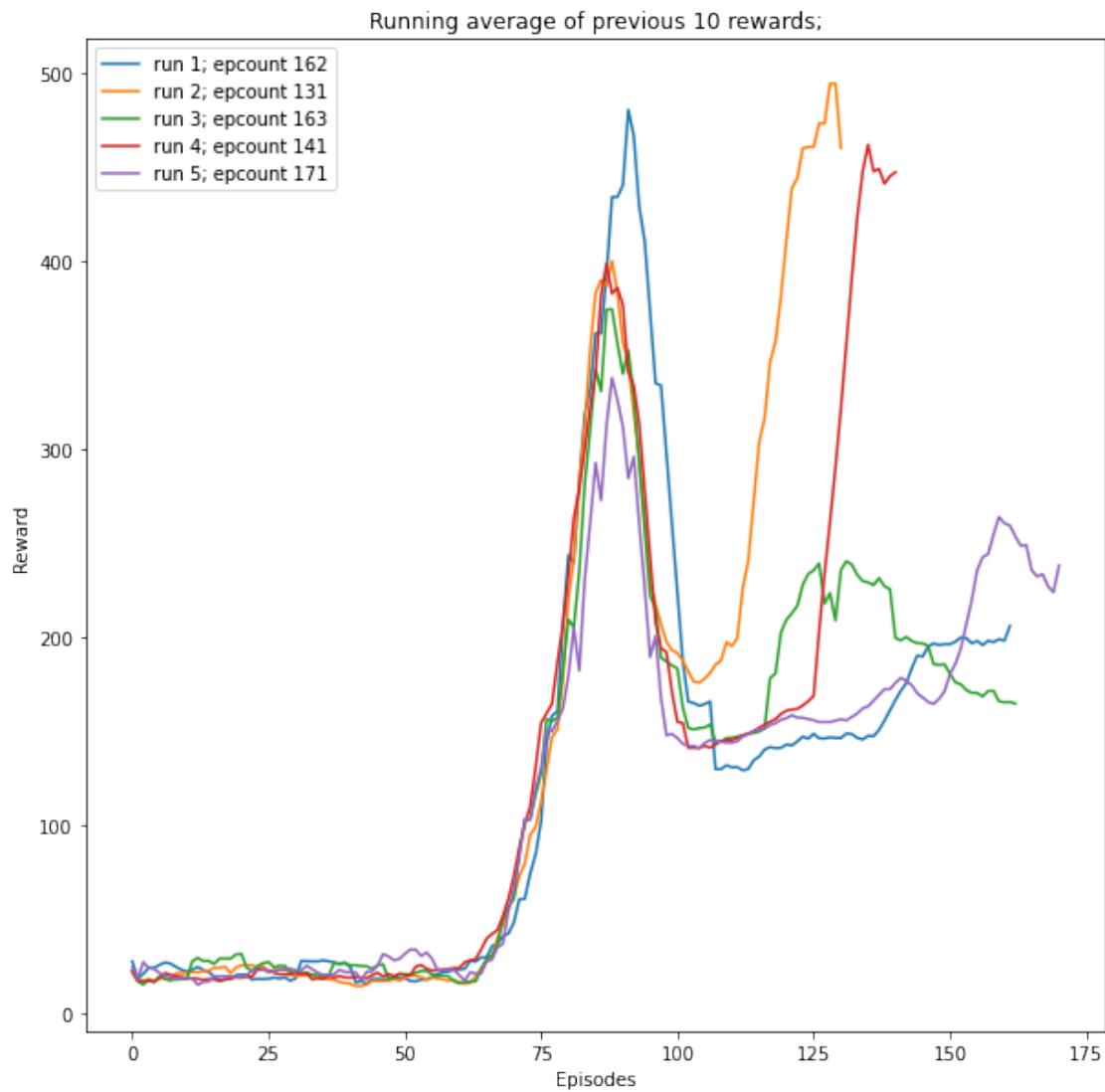
fname = str(uuid.uuid4())
```

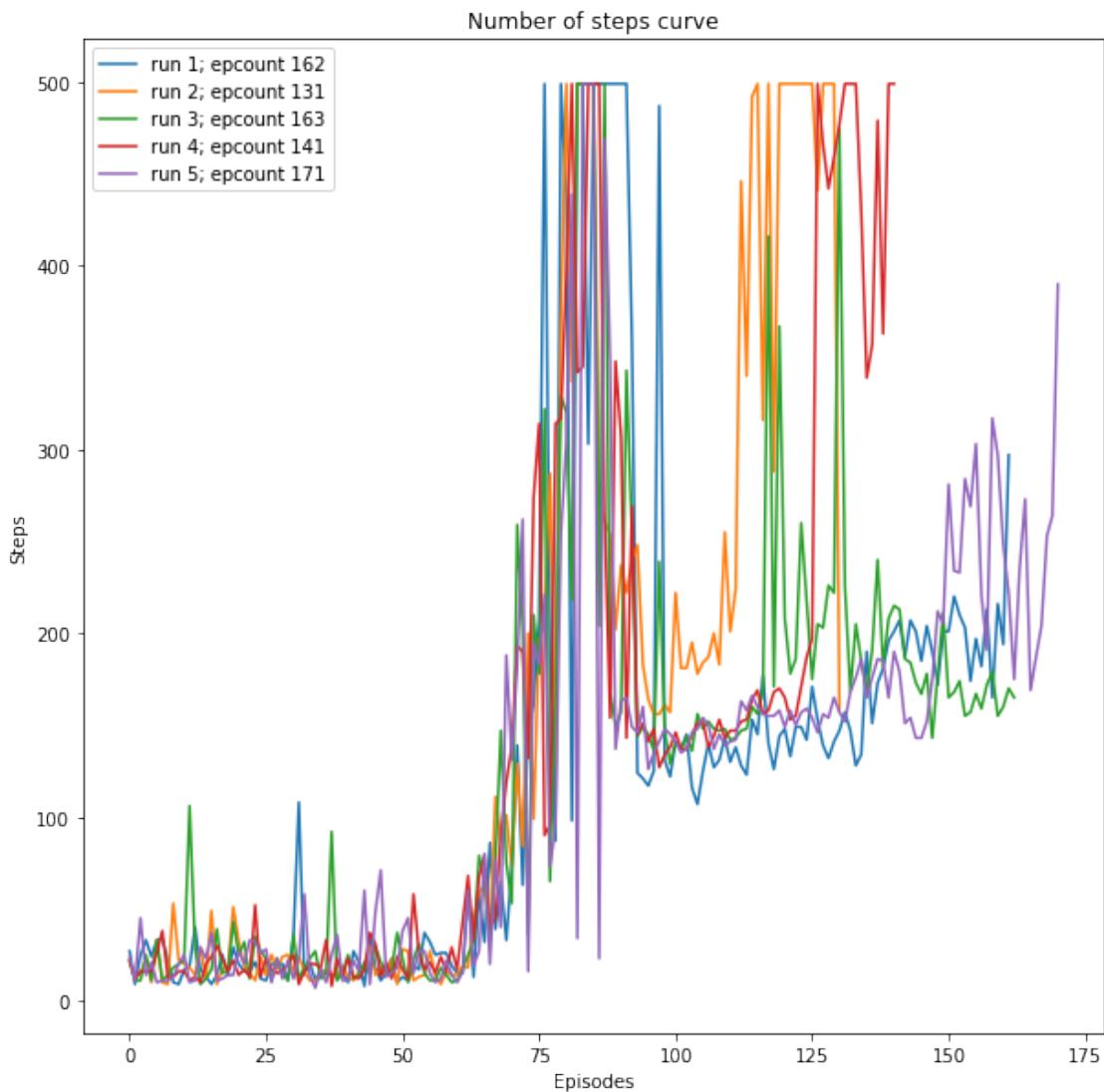
```

print(f'Saved to folder {fname}')
os.mkdir(PATH+'/'+fname)
run_scores, run_steps, ep_count_average, median_agent =
    ↪dqn_exp_runner('CartPole-v1', num_runs=5, env_score_req=195,
    ↪use_eps=True, start=20, end=0.0001, decay_factor=0.95)
print(f'Performance {ep_count_average}')
gen_plots(fname, run_scores, run_steps)
save_gif(fname, 'CartPole-v1', median_agent, max_steps=800)

```

Saved to folder 16e466f3-3328-4bc4-862b-bff5437c3a77
 Episode 100 Average Score: 107.53
 Episode 162 Average Score: 196.70 eps 0.004923274518942783
 Environment solved in 162 episodes! Average Score: 196.70
 Episode 100 Average Score: 93.15
 Episode 131 Average Score: 195.08 eps 0.02414472640107009
 Environment solved in 131 episodes! Average Score: 195.08
 Episode 100 Average Score: 92.03
 Episode 163 Average Score: 196.19 eps 0.004677110792995644
 Environment solved in 163 episodes! Average Score: 196.19
 Episode 100 Average Score: 95.08
 Episode 141 Average Score: 195.90 eps 0.014456339584124778
 Environment solved in 141 episodes! Average Score: 195.90
 Episode 100 Average Score: 83.01
 Episode 171 Average Score: 195.16 eps 0.0031028908594758976
 Environment solved in 171 episodes! Average Score: 195.16
 Performance 153.6





```
[ ]: # From defaults : Learning rate changed to 9e-4
BUFFER_SIZE = int(40000)
BATCH_SIZE = 128
GAMMA = 0.99
LR = 9e-4
UPDATE_EVERY = 100
NUM_HLAYERS = 2
HLAYER_SIZES = [64, 128]
TRUNC_LIM = 1e32

fname = str(uuid.uuid4())
print(f'Saved to folder {fname}')
os.mkdir(PATH+'/'+fname)
```

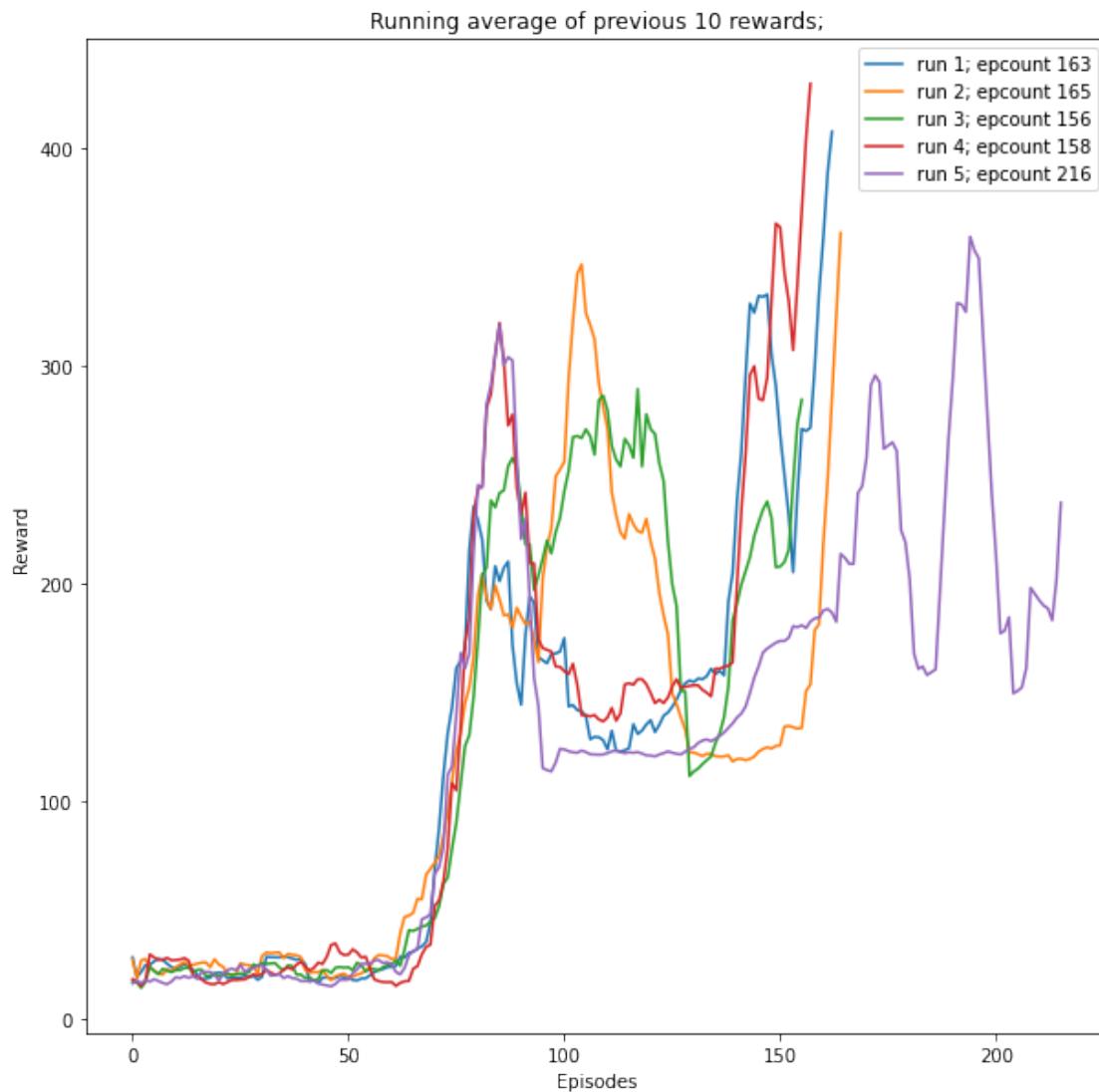
```

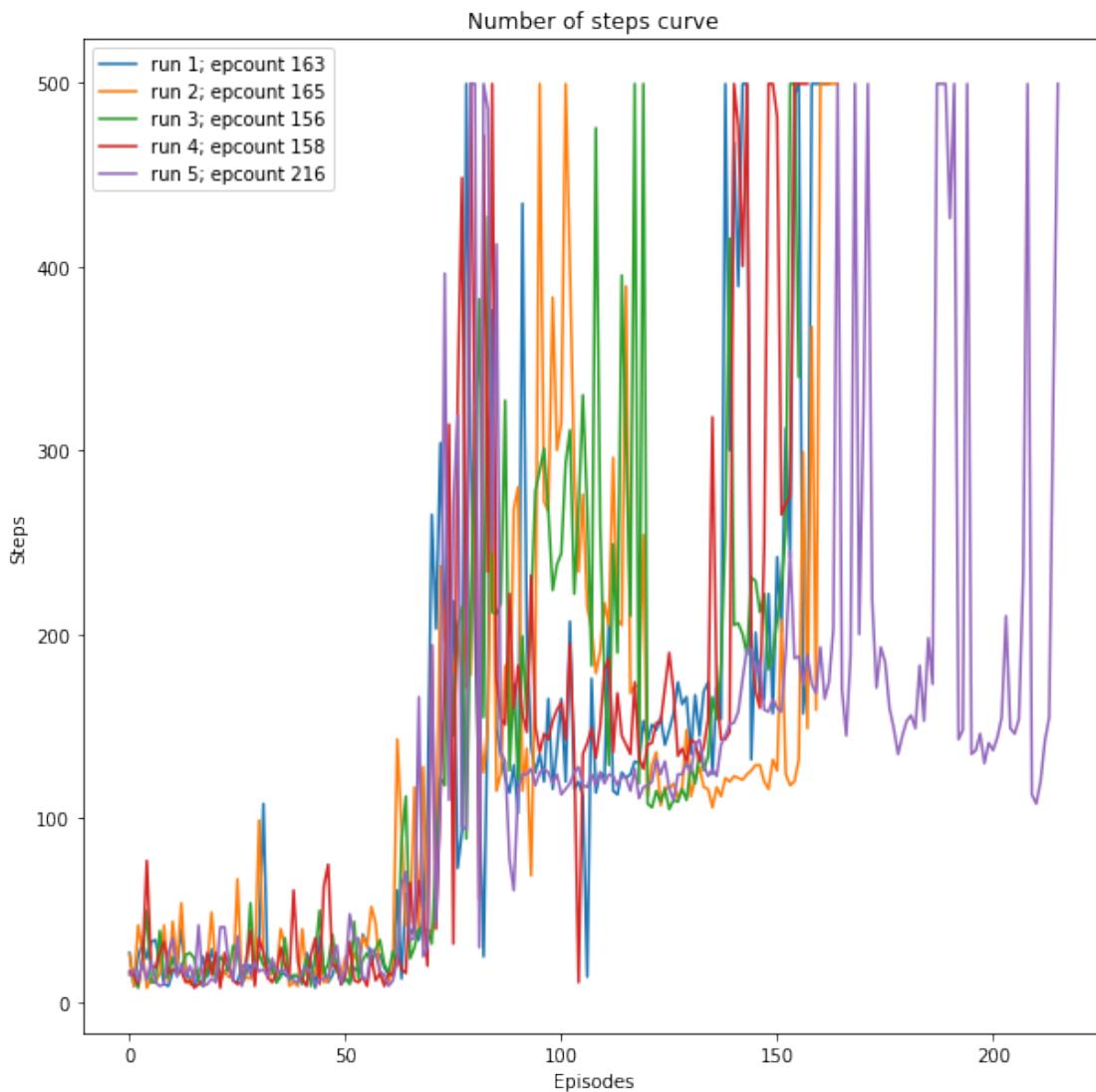
run_scores, run_steps, ep_count_average, median_agent =_
dqn_exp_runner('CartPole-v1', num_runs=5, env_score_req=195,
                use_eps=True, start=20, end=0.0001, decay_factor=0.95)
print(f'Performance {ep_count_average}')
gen_plots(fname, run_scores, run_steps)
save_gif(fname, 'CartPole-v1', median_agent,max_steps=800)

```

Saved to folder 5e98d239-f2bd-4394-9149-268053573e36

Episode 100	Average Score: 73.33	
Episode 163	Average Score: 198.95	eps 0.004677110792995644
Environment solved in 163 episodes!		Average Score: 198.95
Episode 100	Average Score: 82.28	
Episode 165	Average Score: 195.17	eps 0.004221092490678568
Environment solved in 165 episodes!		Average Score: 195.17
Episode 100	Average Score: 80.93	
Episode 156	Average Score: 195.59	eps 0.006697495349536301
Environment solved in 156 episodes!		Average Score: 195.59
Episode 100	Average Score: 80.51	
Episode 158	Average Score: 197.57	eps 0.006044489552956511
Environment solved in 158 episodes!		Average Score: 197.57
Episode 100	Average Score: 76.65	
Episode 200	Average Score: 183.08	
Episode 216	Average Score: 196.77	eps 0.0003085522644691827
Environment solved in 216 episodes!		Average Score: 196.77
Performance 171.6		





```
[ ]: # Changed from defaults: Buffer size to 80000
BUFFER_SIZE = int(80000)
BATCH_SIZE = 128
GAMMA = 0.99
LR = 5e-4
UPDATE_EVERY = 100
NUM_HLAYERS = 2
HLAYER_SIZES = [64, 128]
TRUNC_LIM = 1e32

fname = str(uuid.uuid4())
print(f'Saved to folder {fname}')
os.mkdir(PATH+'/'+fname)
```

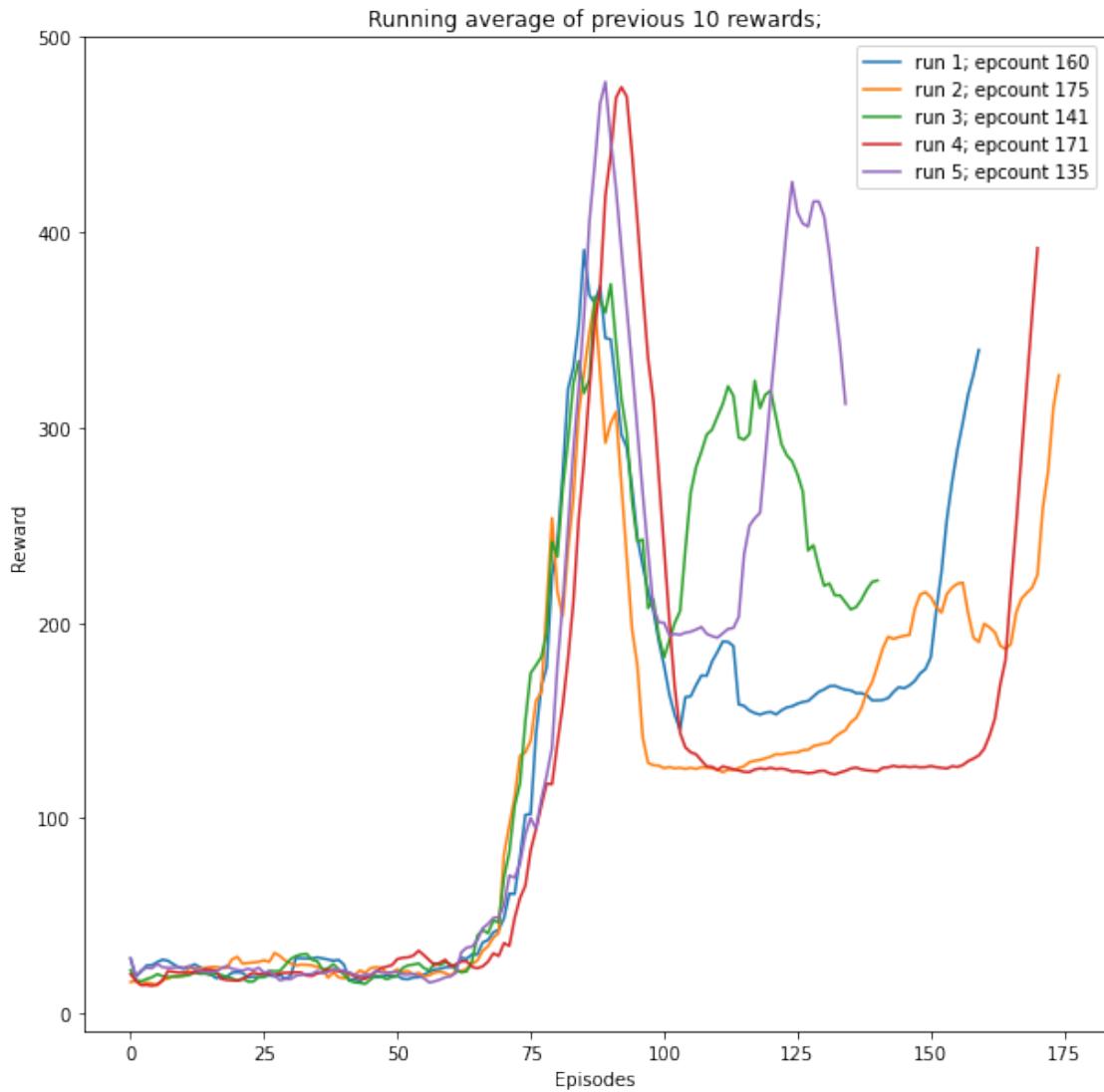
```

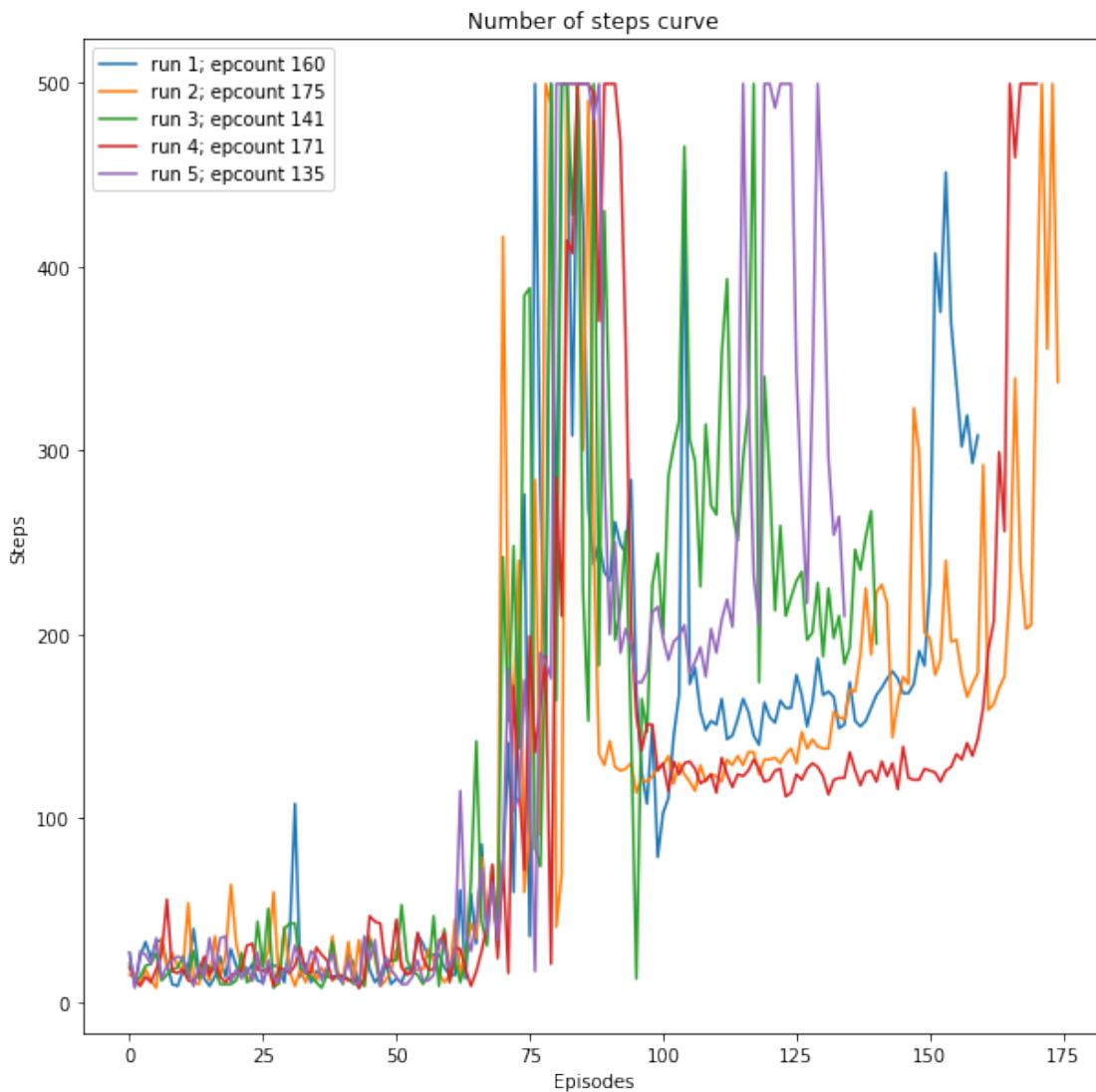
run_scores, run_steps, ep_count_average, median_agent =_
    ↪dqn_exp_runner('CartPole-v1', num_runs=5, env_score_req=195,
    ↪use_eps=True, start=20, end=0.0001, decay_factor=0.95)
print(f'Performance {ep_count_average}')
gen_plots(fname, run_scores, run_steps)
save_gif(fname, 'CartPole-v1', median_agent,max_steps=800)

```

Saved to folder 60e8e448-04f8-41c8-9b60-0dacc9a35399

Episode 100	Average Score: 93.49	
Episode 160	Average Score: 197.81	eps 0.005455151821543251
Environment solved in 160 episodes!	Average Score: 197.81	
Episode 100	Average Score: 84.68	
Episode 175	Average Score: 195.69	eps 0.00252732399811099
Environment solved in 175 episodes!	Average Score: 195.69	
Episode 100	Average Score: 96.85	
Episode 141	Average Score: 196.79	eps 0.014456339584124778
Environment solved in 141 episodes!	Average Score: 196.79	
Episode 100	Average Score: 97.32	
Episode 171	Average Score: 196.95	eps 0.0031028908594758976
Environment solved in 171 episodes!	Average Score: 196.95	
Episode 100	Average Score: 98.78	
Episode 135	Average Score: 195.17	eps 0.01966603055821159
Environment solved in 135 episodes!	Average Score: 195.17	
Performance 156.4		





```
[ ]: # Changed from defaults: Buffer size to 10000
BUFFER_SIZE = int(10000)
BATCH_SIZE = 128
GAMMA = 0.99
LR = 5e-4
UPDATE_EVERY = 100
NUM_HLAYERS = 2
HLAYER_SIZES = [64, 128]
TRUNC_LIM = 1e32

fname = str(uuid.uuid4())
print(f'Saved to folder {fname}')
os.mkdir(PATH+'/'+fname)
```

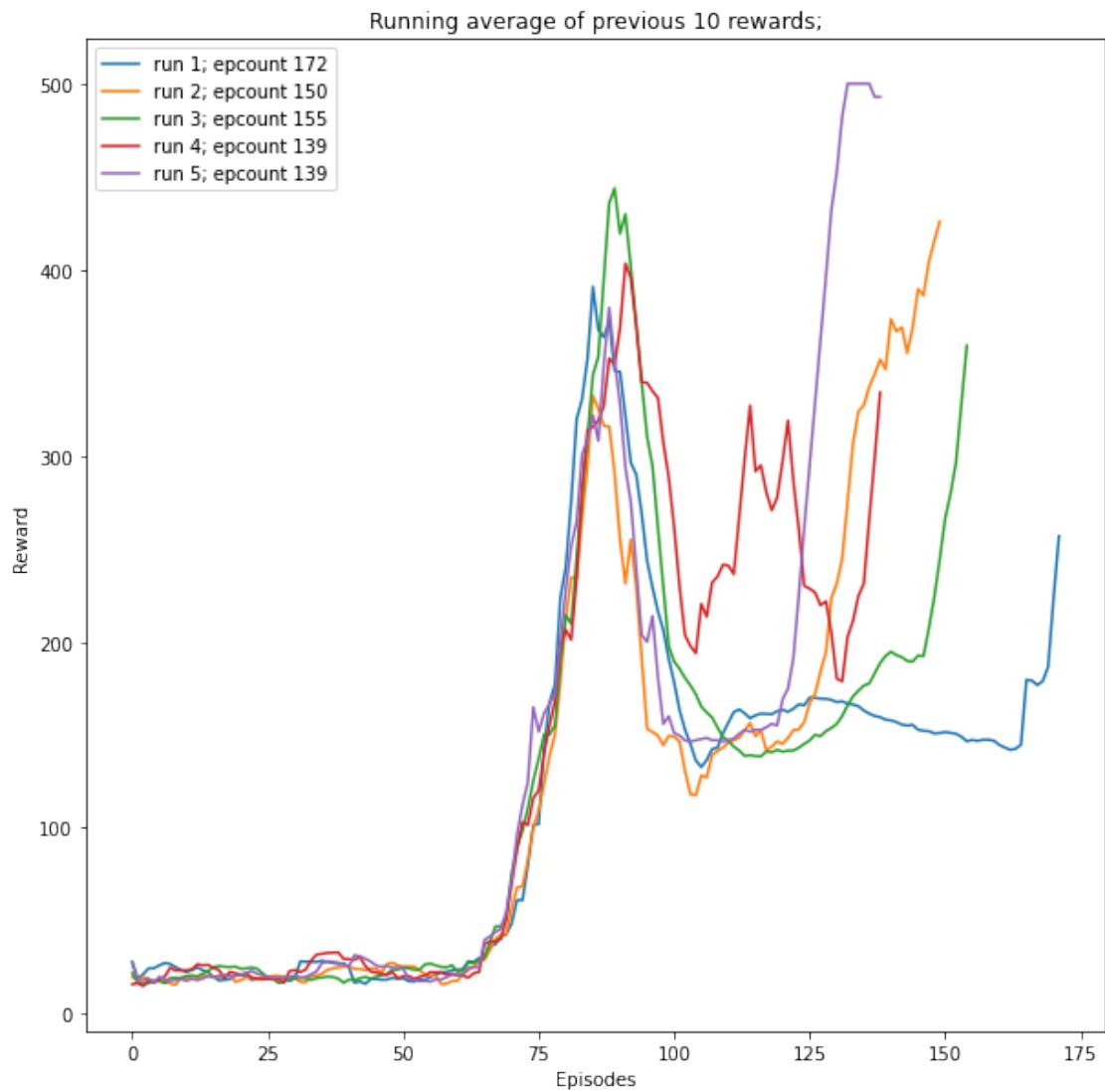
```

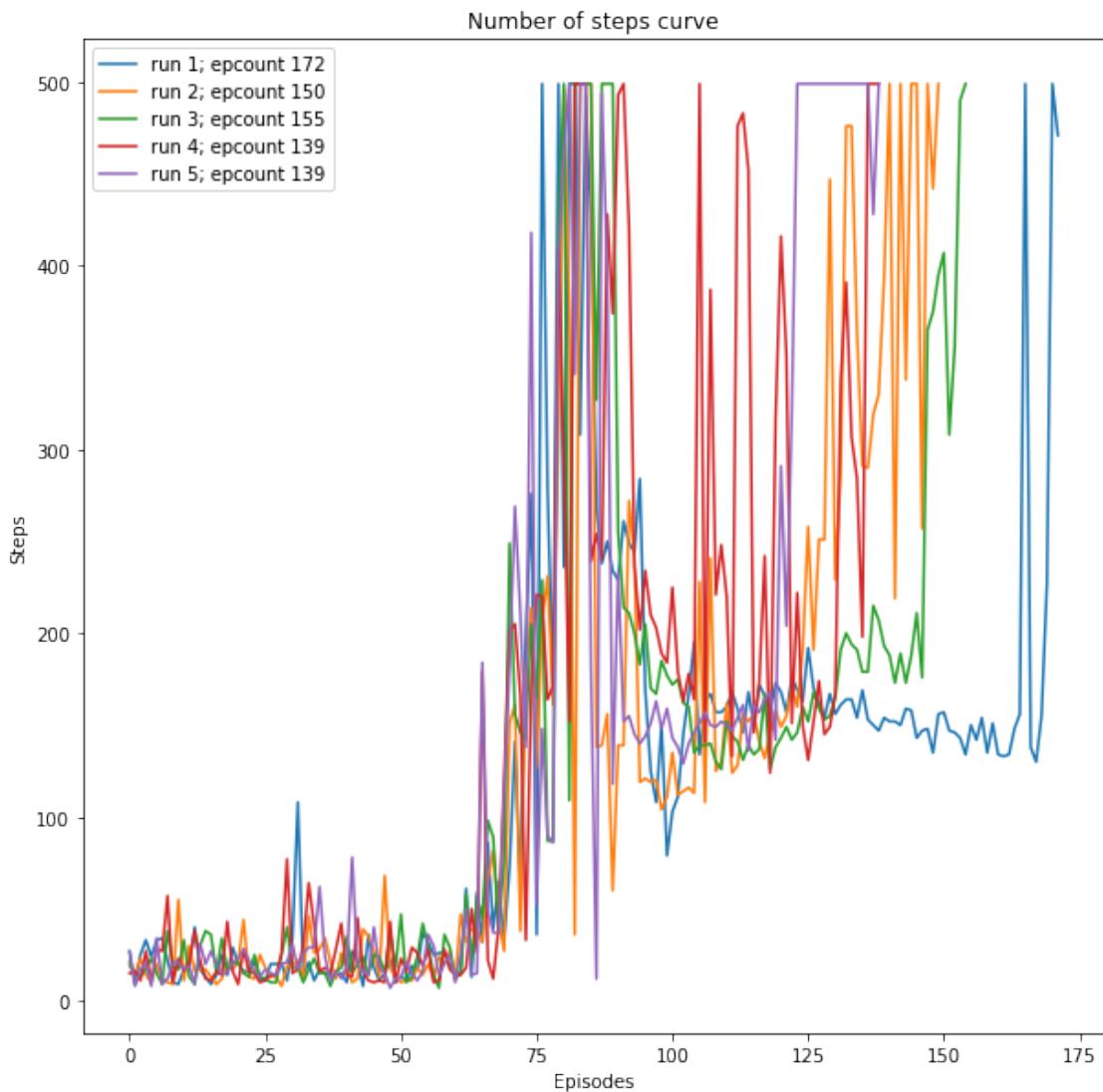
run_scores, run_steps, ep_count_average, median_agent =_
    ↪dqn_exp_runner('CartPole-v1', num_runs=5, env_score_req=195,
                    ↪use_eps=True, start=20, end=0.0001, decay_factor=0.95)
print(f'Performance {ep_count_average}')
gen_plots(fname, run_scores, run_steps)
save_gif(fname, 'CartPole-v1', median_agent,max_steps=800)

```

Saved to folder e1bc46f9-923c-401c-9fc8-2f87e139ef62

Episode 100	Average Score: 93.49	
Episode 172	Average Score: 196.10	eps 0.0029477463165021025
Environment solved in 172 episodes!		Average Score: 196.10
Episode 100	Average Score: 78.75	
Episode 150	Average Score: 196.48	eps 0.009111099489673142
Environment solved in 150 episodes!		Average Score: 196.48
Episode 100	Average Score: 101.37	
Episode 155	Average Score: 198.24	eps 0.007049995104775054
Environment solved in 155 episodes!		Average Score: 198.24
Episode 100	Average Score: 102.36	
Episode 139	Average Score: 197.31	eps 0.016018104802354327
Environment solved in 139 episodes!		Average Score: 197.31
Episode 100	Average Score: 89.81	
Episode 139	Average Score: 198.99	eps 0.016018104802354327
Environment solved in 139 episodes!		Average Score: 198.99
Performance 151.0		





```
[ ]: # Changed from defaults: Buffer size to 10000 and batch size to 64
BUFFER_SIZE = int(10000)
BATCH_SIZE = 64
GAMMA = 0.99
LR = 5e-4
UPDATE_EVERY = 100
NUM_HLAYERS = 2
HLAYER_SIZES = [64, 128]
TRUNC_LIM = 1e32

fname = str(uuid.uuid4())
print(f'Saved to folder {fname}')
os.mkdir(PATH+'/'+fname)
```

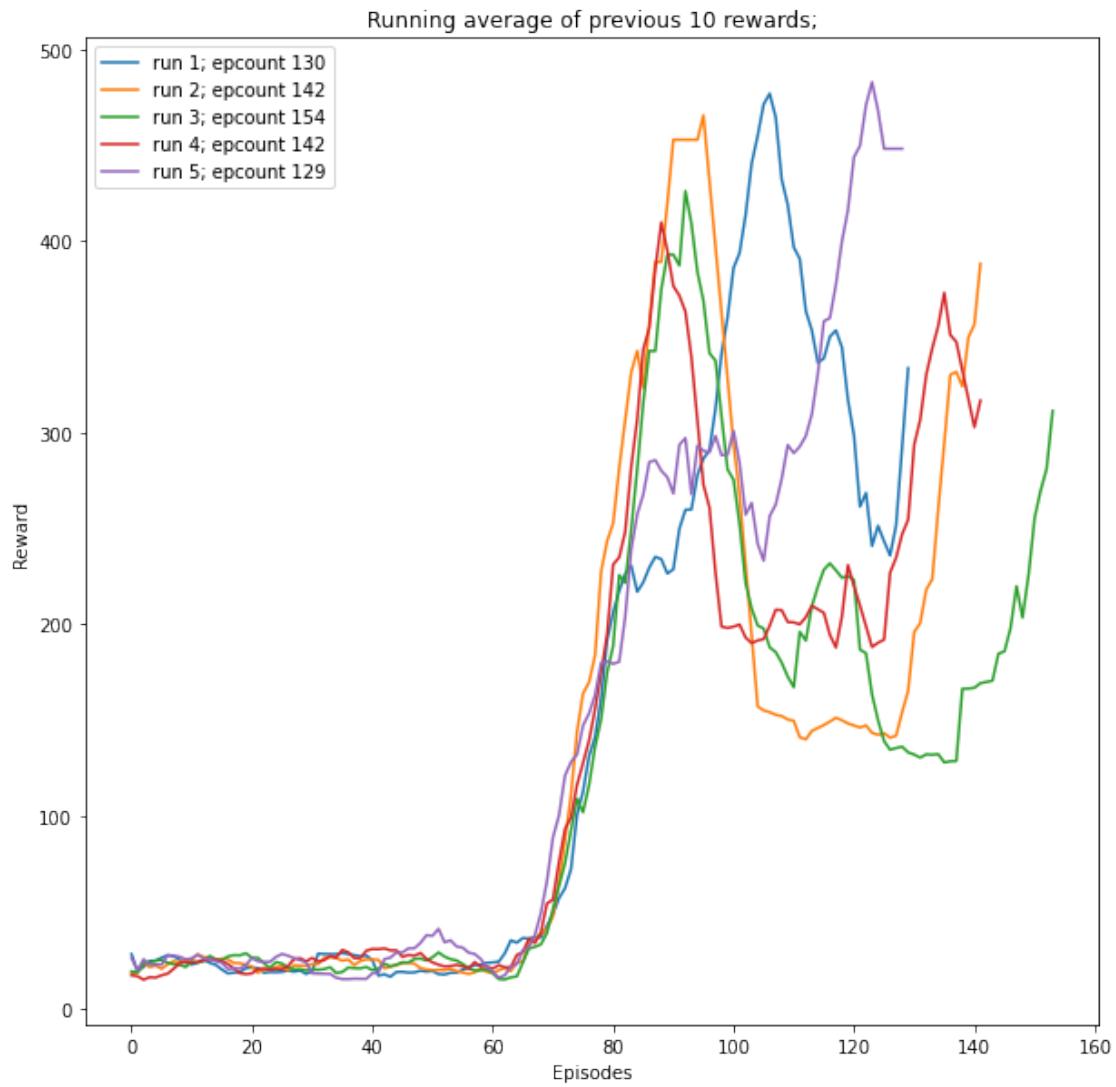
```

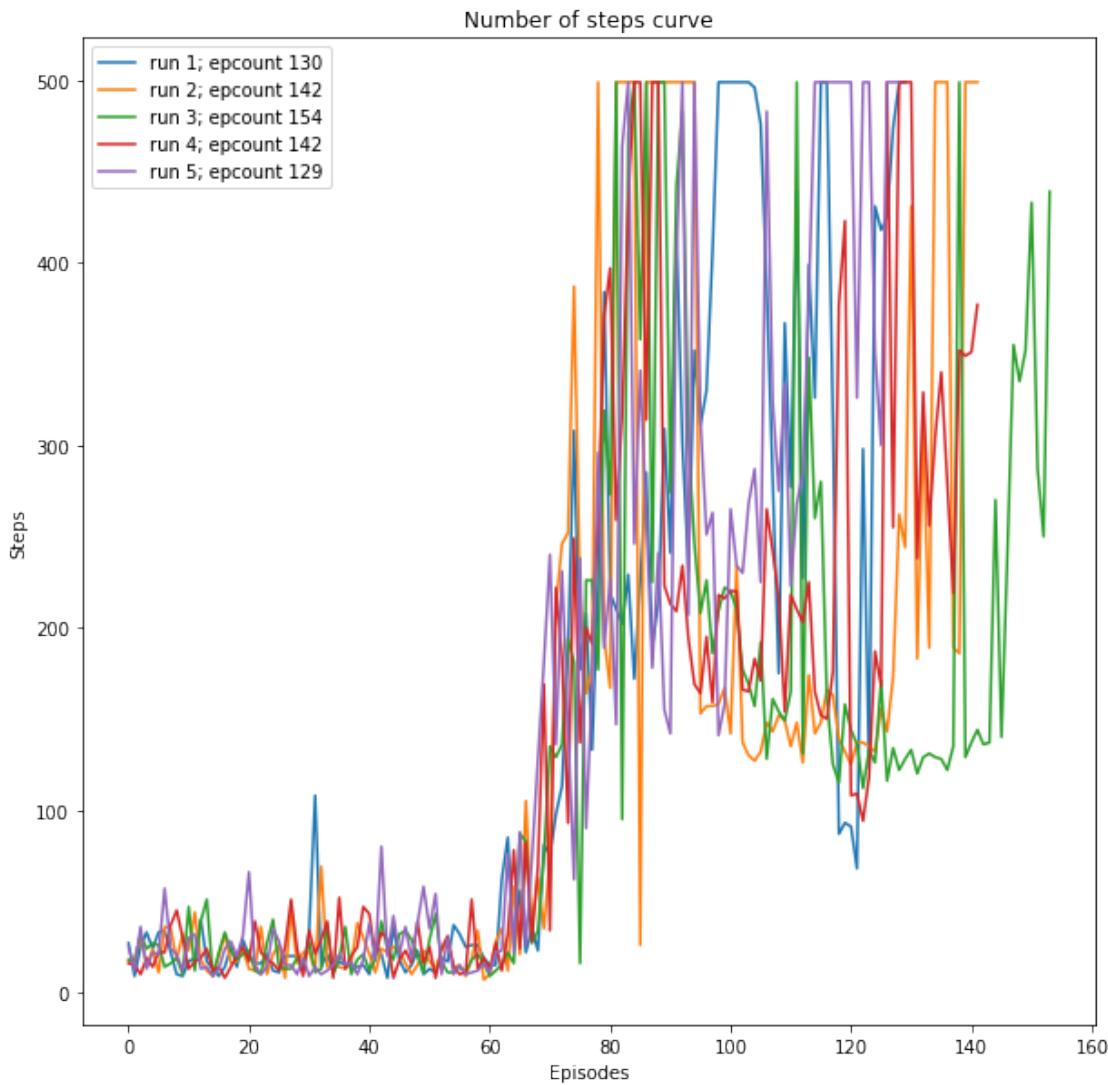
run_scores, run_steps, ep_count_average, median_agent =_
    ↪dqn_exp_runner('CartPole-v1', num_runs=5, env_score_req=195,
                    ↪use_eps=True, start=20, end=0.0001, decay_factor=0.95)
print(f'Performance {ep_count_average}')
gen_plots(fname, run_scores, run_steps)
save_gif(fname, 'CartPole-v1', median_agent,max_steps=800)

```

Saved to folder 65b39ced-29ad-4eef-a02f-968b85903551

Episode 100	Average Score: 95.30	
Episode 130	Average Score: 196.05	eps 0.02541550147481062
Environment solved in 130 episodes!	Average Score: 196.05	
Episode 100	Average Score: 116.71	
Episode 142	Average Score: 198.30	eps 0.013733522604918539
Environment solved in 142 episodes!	Average Score: 198.30	
Episode 100	Average Score: 102.28	
Episode 154	Average Score: 196.18	eps 0.007421047478710583
Environment solved in 154 episodes!	Average Score: 196.18	
Episode 100	Average Score: 98.50	
Episode 142	Average Score: 196.01	eps 0.013733522604918539
Environment solved in 142 episodes!	Average Score: 196.01	
Episode 100	Average Score: 95.76	
Episode 129	Average Score: 199.58	eps 0.026753159447169078
Environment solved in 129 episodes!	Average Score: 199.58	
Performance 139.4		





```
[ ]: # Changed from defaults: Buffer size to 10000 and batch size to 256
BUFFER_SIZE = int(10000)
BATCH_SIZE = 256
GAMMA = 0.99
LR = 5e-4
UPDATE_EVERY = 100
NUM_HLAYERS = 2
HLAYER_SIZES = [64, 128]
TRUNC_LIM = 1e32

fname = str(uuid.uuid4())
print(f'Saved to folder {fname}')
os.mkdir(PATH+'/'+fname)
```

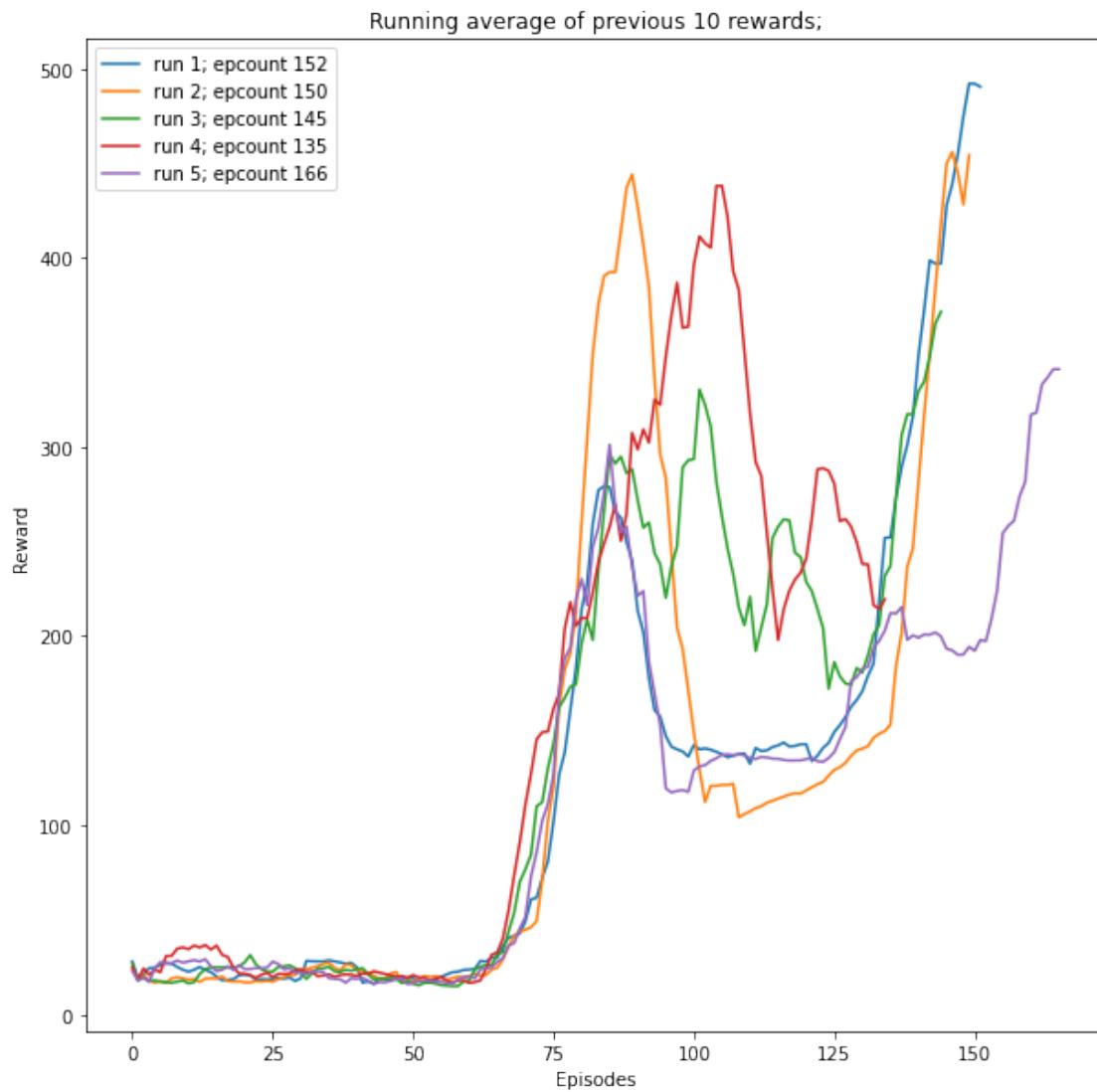
```

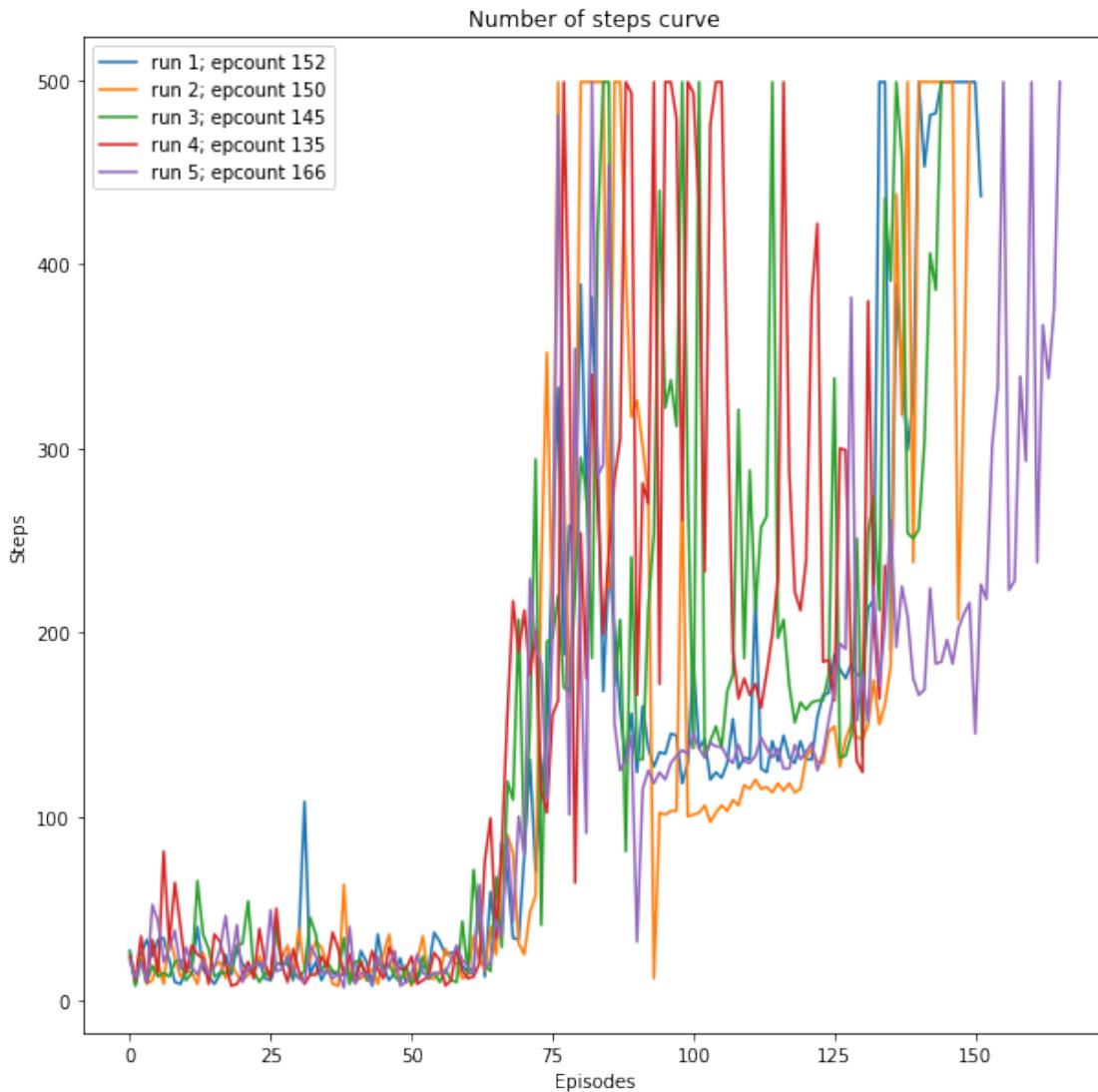
run_scores, run_steps, ep_count_average, median_agent =_
    ↪dqn_exp_runner('CartPole-v1', num_runs=5, env_score_req=195,
                    ↪use_eps=True, start=20, end=0.0001, decay_factor=0.95)
print(f'Performance {ep_count_average}')
gen_plots(fname, run_scores, run_steps)
save_gif(fname, 'CartPole-v1', median_agent,max_steps=800)

```

Saved to folder a31ab355-03af-4307-a56a-31abde36ab97

Episode 100	Average Score: 73.36	
Episode 152	Average Score: 197.14	eps 0.00822276728943001
Environment solved in 152 episodes!	Average Score: 197.14	
Episode 100	Average Score: 99.24	
Episode 150	Average Score: 195.35	eps 0.009111099489673142
Environment solved in 150 episodes!	Average Score: 195.35	
Episode 100	Average Score: 95.15	
Episode 145	Average Score: 198.49	eps 0.01177477894339203
Environment solved in 145 episodes!	Average Score: 198.49	
Episode 100	Average Score: 110.61	
Episode 135	Average Score: 196.25	eps 0.01966603055821159
Environment solved in 135 episodes!	Average Score: 196.25	
Episode 100	Average Score: 74.94	
Episode 166	Average Score: 195.88	eps 0.00401003786614464
Environment solved in 166 episodes!	Average Score: 195.88	
Performance 149.6		





```
[ ]: # Changed from defaults: Buffer size to 10000 and batch size to 64, update every=20
BUFFER_SIZE = int(10000)
BATCH_SIZE = 64
GAMMA = 0.99
LR = 5e-4
UPDATE_EVERY = 20
NUM_HLAYERS = 2
HLAYER_SIZES = [64, 128]
TRUNC_LIM = 1e32

fname = str(uuid.uuid4())
print(f'Saved to folder {fname}')
```

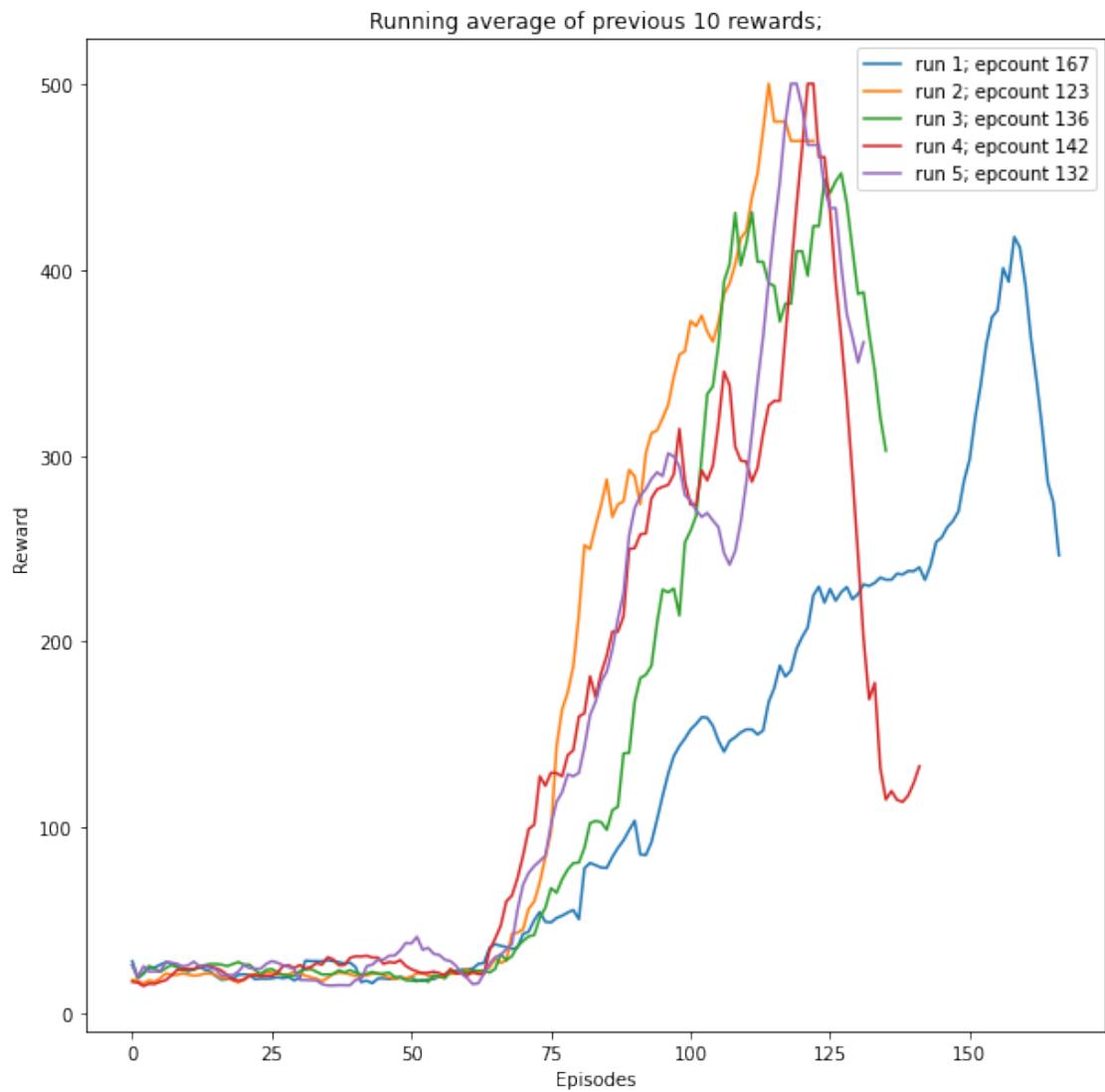
```

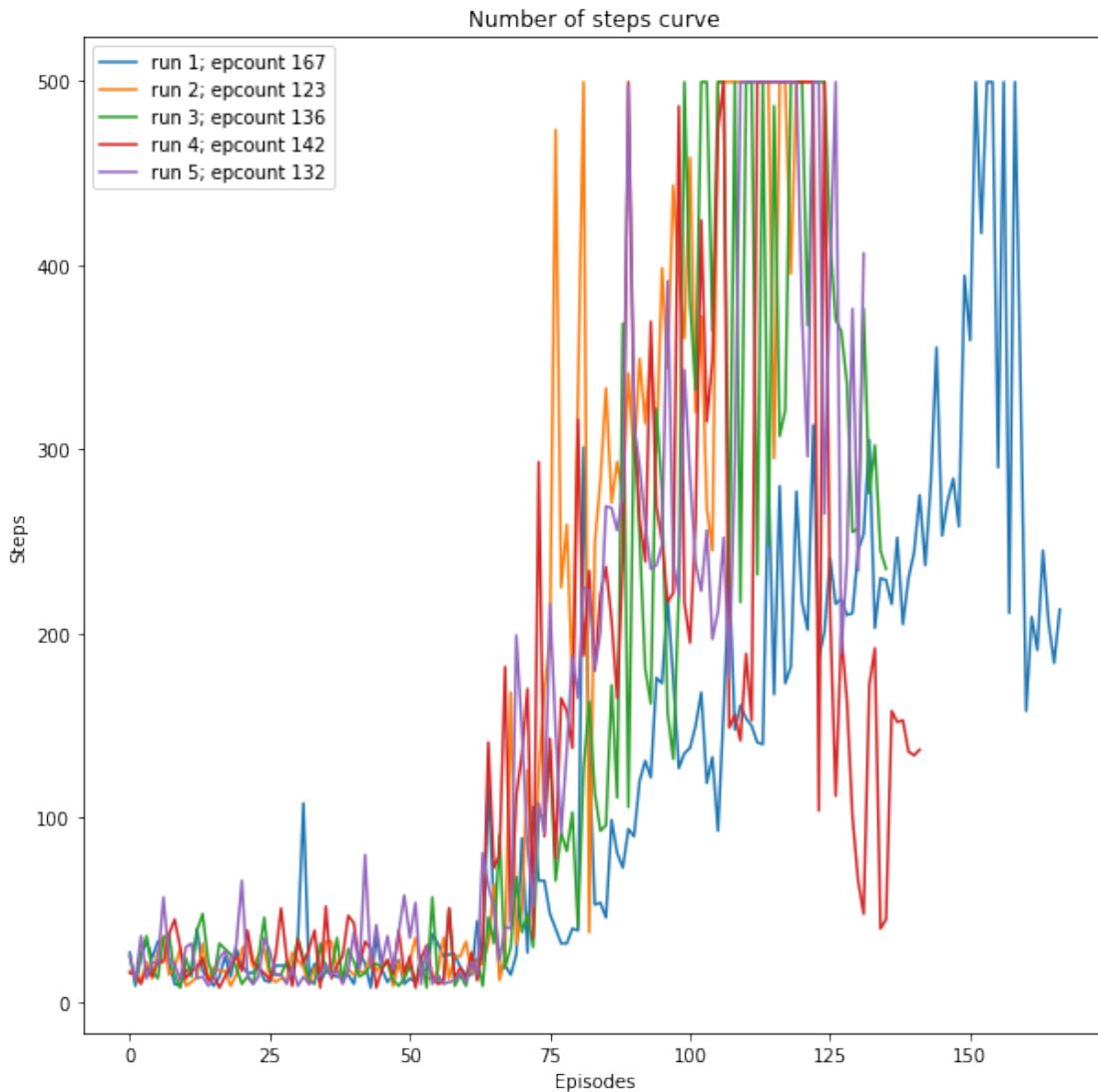
os.mkdir(PATH+'/' + fname)
run_scores, run_steps, ep_count_average, median_agent =
    ↪dqn_exp_runner('CartPole-v1', num_runs=5, env_score_req=195,
                    ↪use_eps=True, start=20, end=0.0001, decay_factor=0.95)
print(f'Performance {ep_count_average}')
gen_plots(fname, run_scores, run_steps)
save_gif(fname, 'CartPole-v1', median_agent, max_steps=800)

```

Saved to folder 14c0cf8e-a20e-4af2-8c09-6b99dd0bba1e

Episode 100	Average Score: 46.89	
Episode 167	Average Score: 195.57	eps 0.0038095359728374076
Environment solved in 167 episodes!	Average Score: 195.57	
Episode 100	Average Score: 100.12	
Episode 123	Average Score: 199.08	eps 0.036394306328726665
Environment solved in 123 episodes!	Average Score: 199.08	
Episode 100	Average Score: 64.51	
Episode 136	Average Score: 195.35	eps 0.01868272903030101
Environment solved in 136 episodes!	Average Score: 195.35	
Episode 100	Average Score: 89.28	
Episode 142	Average Score: 195.68	eps 0.013733522604918539
Environment solved in 142 episodes!	Average Score: 195.68	
Episode 100	Average Score: 86.44	
Episode 132	Average Score: 198.27	eps 0.022937490081016584
Environment solved in 132 episodes!	Average Score: 198.27	
Performance	140.0	





```
[ ]: # Changed from defaults: Buffer size to 10000 and batch size to 64, update
      ↵every=50
BUFFER_SIZE = int(10000)
BATCH_SIZE = 64
GAMMA = 0.99
LR = 5e-4
UPDATE_EVERY = 50
NUM_HLAYERS = 2
HLAYER_SIZES = [64, 128]
TRUNC_LIM = 1e32

fname = str(uuid.uuid4())
print(f'Saved to folder {fname}')
```

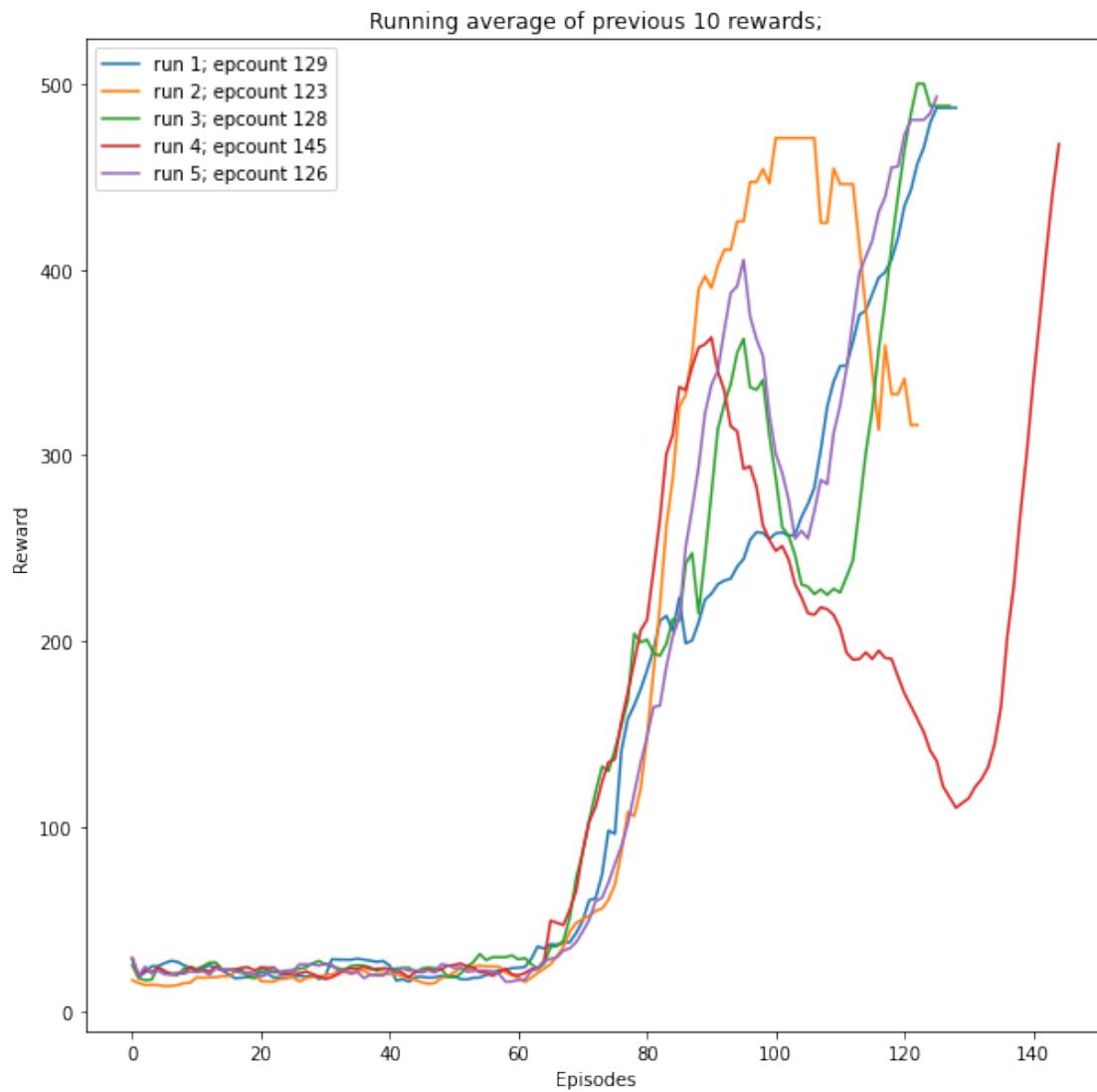
```

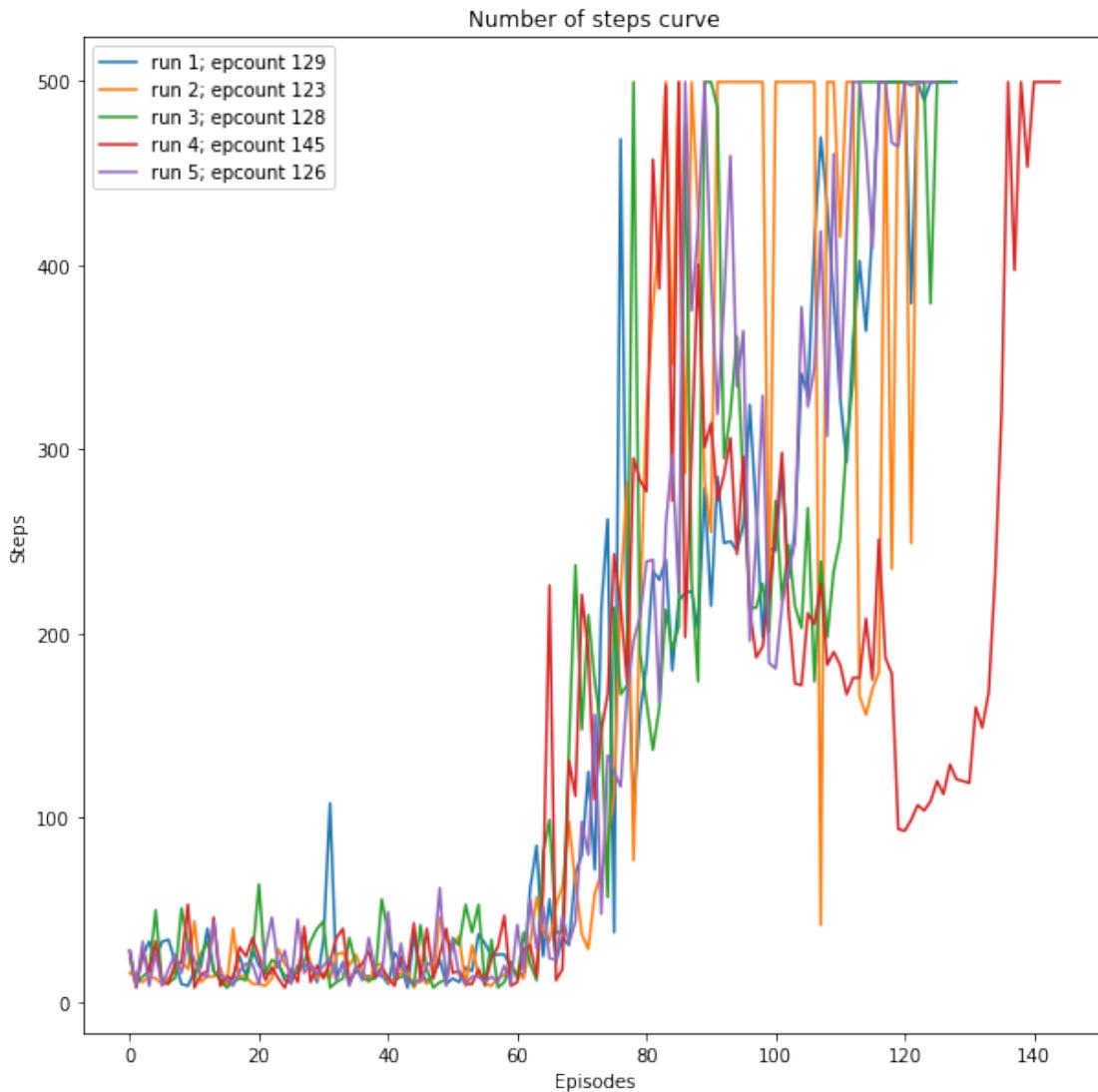
os.mkdir(PATH+'/' + fname)
run_scores, run_steps, ep_count_average, median_agent =
    ↪dqn_exp_runner('CartPole-v1', num_runs=5, env_score_req=195,
                    ↪use_eps=True, start=20, end=0.0001, decay_factor=0.95)
print(f'Performance {ep_count_average}')
gen_plots(fname, run_scores, run_steps)
save_gif(fname, 'CartPole-v1', median_agent, max_steps=800)

```

Saved to folder ec3da963-0a68-4ebf-875d-8a5d2df290a4

Episode 100	Average Score: 82.47	
Episode 129	Average Score: 195.75	eps 0.026753159447169078
Environment solved in 129 episodes!	Average Score: 195.75	
Episode 100	Average Score: 112.50	
Episode 123	Average Score: 199.79	eps 0.036394306328726665
Environment solved in 123 episodes!	Average Score: 199.79	
Episode 100	Average Score: 96.97	
Episode 128	Average Score: 196.29	eps 0.028161220470704296
Environment solved in 128 episodes!	Average Score: 196.29	
Episode 100	Average Score: 101.78	
Episode 145	Average Score: 197.59	eps 0.01177477894339203
Environment solved in 145 episodes!	Average Score: 197.59	
Episode 100	Average Score: 94.36	
Episode 126	Average Score: 195.38	eps 0.03120356838859202
Environment solved in 126 episodes!	Average Score: 195.38	
Performance 130.2		





```
[ ]: # Changed from defaults: Buffer size to 10000 and batch size to 64, update every=50, decay factor=0.9
BUFFER_SIZE = int(10000)
BATCH_SIZE = 64
GAMMA = 0.99
LR = 5e-4
UPDATE_EVERY = 50
NUM_HLAYERS = 2
HLAYER_SIZES = [64, 128]
TRUNC_LIM = 1e32

fname = str(uuid.uuid4())
print(f'Saved to folder {fname}')
```

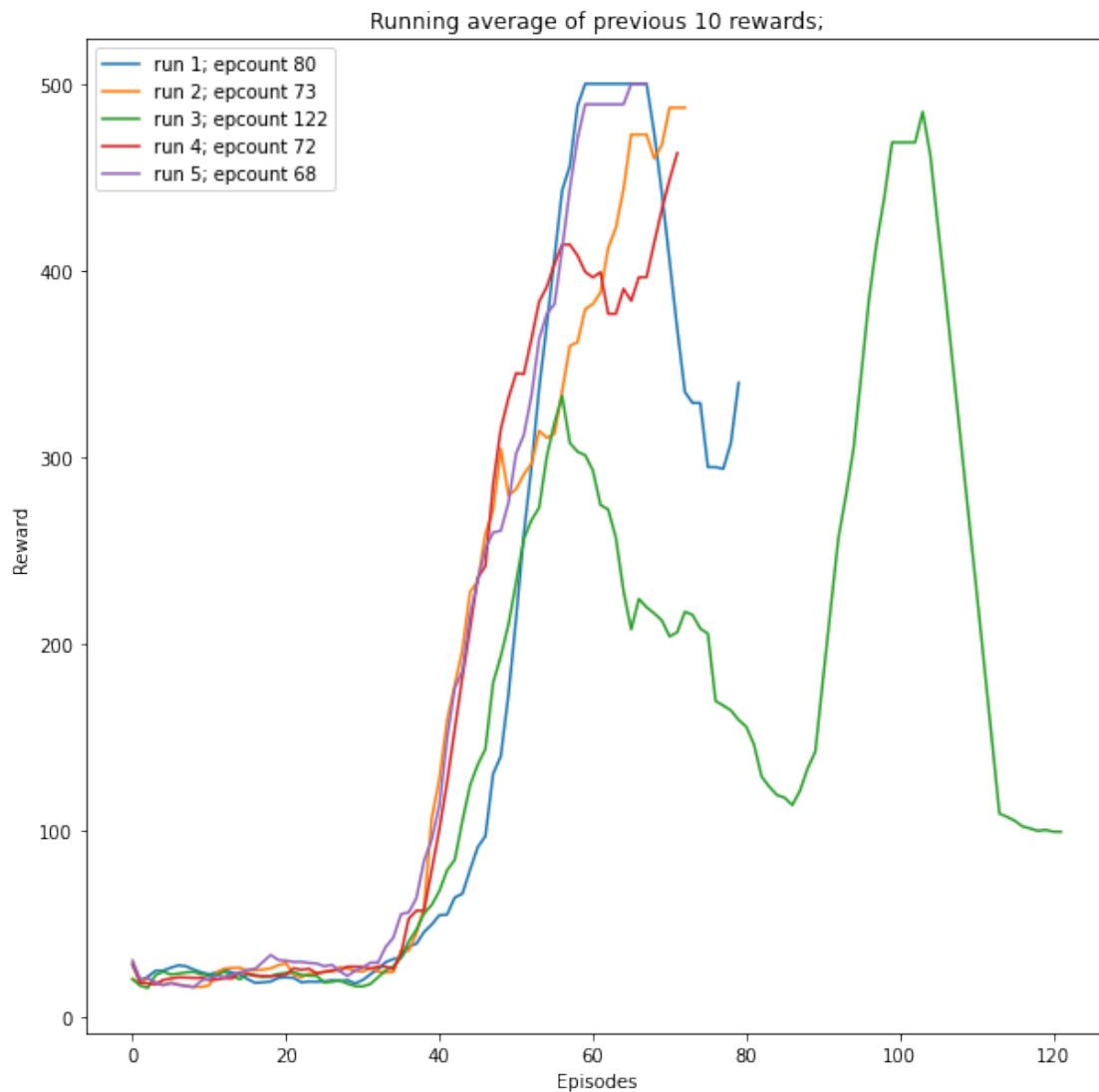
```

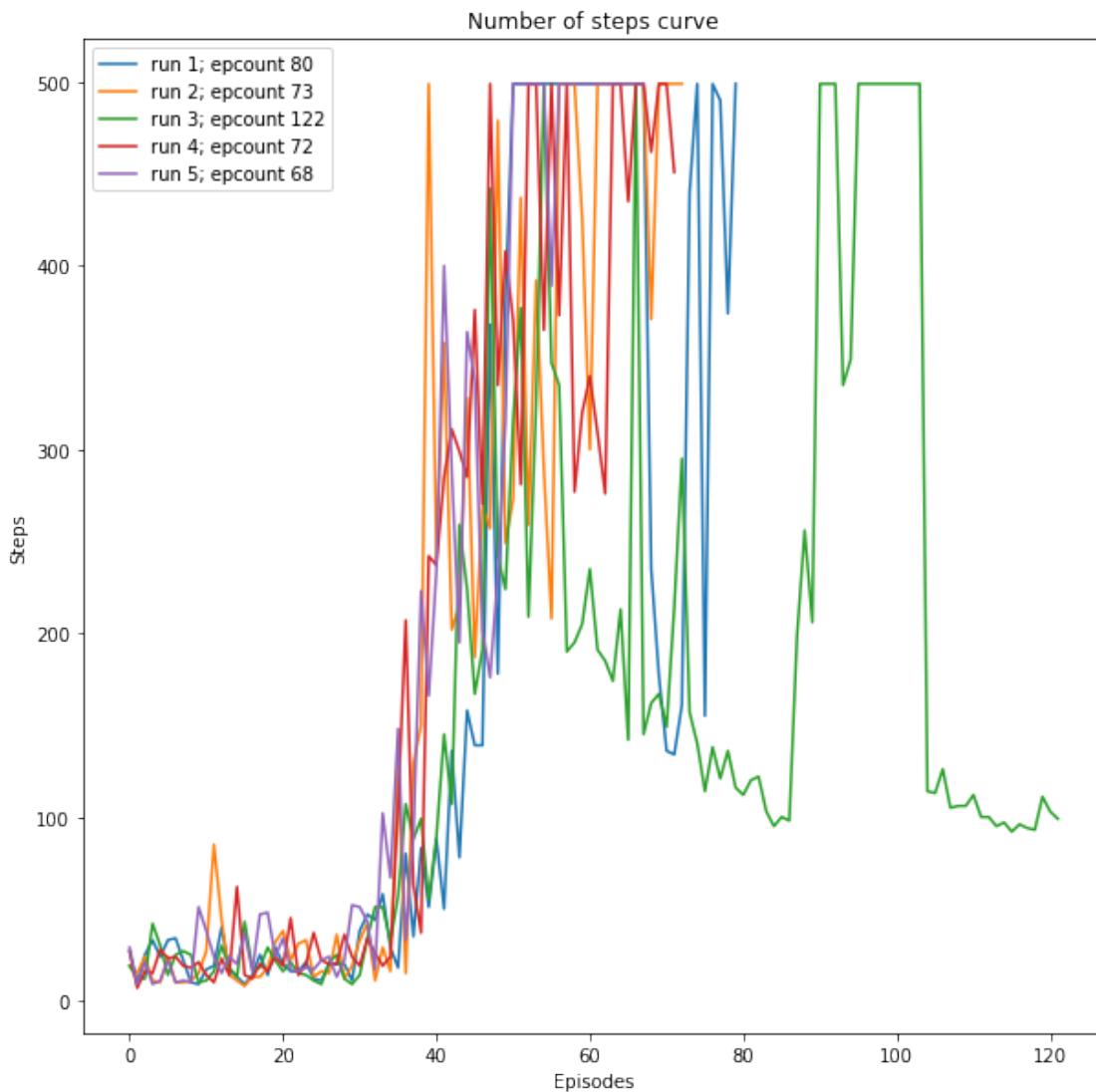
os.mkdir(PATH+'/' + fname)
run_scores, run_steps, ep_count_average, median_agent =
    ↪dqn_exp_runner('CartPole-v1', num_runs=5, env_score_req=195,
                    ↪use_eps=True, start=20, end=0.0001, decay_factor=0.9)
print(f'Performance {ep_count_average}')
gen_plots(fname, run_scores, run_steps)
save_gif(fname, 'CartPole-v1', median_agent, max_steps=800)

```

Saved to folder 82d7638a-47a9-405a-b605-0374d461d603

Episode 80	Average Score: 195.60	eps 0.004369490010567851
Environment solved in 80 episodes!		Average Score: 195.60
Episode 73	Average Score: 198.66	eps 0.009135518149015497
Environment solved in 73 episodes!		Average Score: 198.66
Episode 100	Average Score: 161.43	
Episode 122	Average Score: 195.30	eps 0.0001
Environment solved in 122 episodes!		Average Score: 195.30
Episode 72	Average Score: 195.36	eps 0.01015057572112833
Environment solved in 72 episodes!		Average Score: 195.36
Episode 68	Average Score: 196.07	eps 0.015471080202908593
Environment solved in 68 episodes!		Average Score: 196.07
Performance	83.0	





```
[ ]: # Changed from defaults: Buffer size to 10000 and batch size to 64, update
    ↵every=50, decay factor=0.9, epsilon_end=0.00001
BUFFER_SIZE = int(10000)
BATCH_SIZE = 64
GAMMA = 0.99
LR = 5e-4
UPDATE_EVERY = 50
NUM_HLAYERS = 2
HLAYER_SIZES = [64, 128]
TRUNC_LIM = 1e32

fname = str(uuid.uuid4())
print(f'Saved to folder {fname}')
```

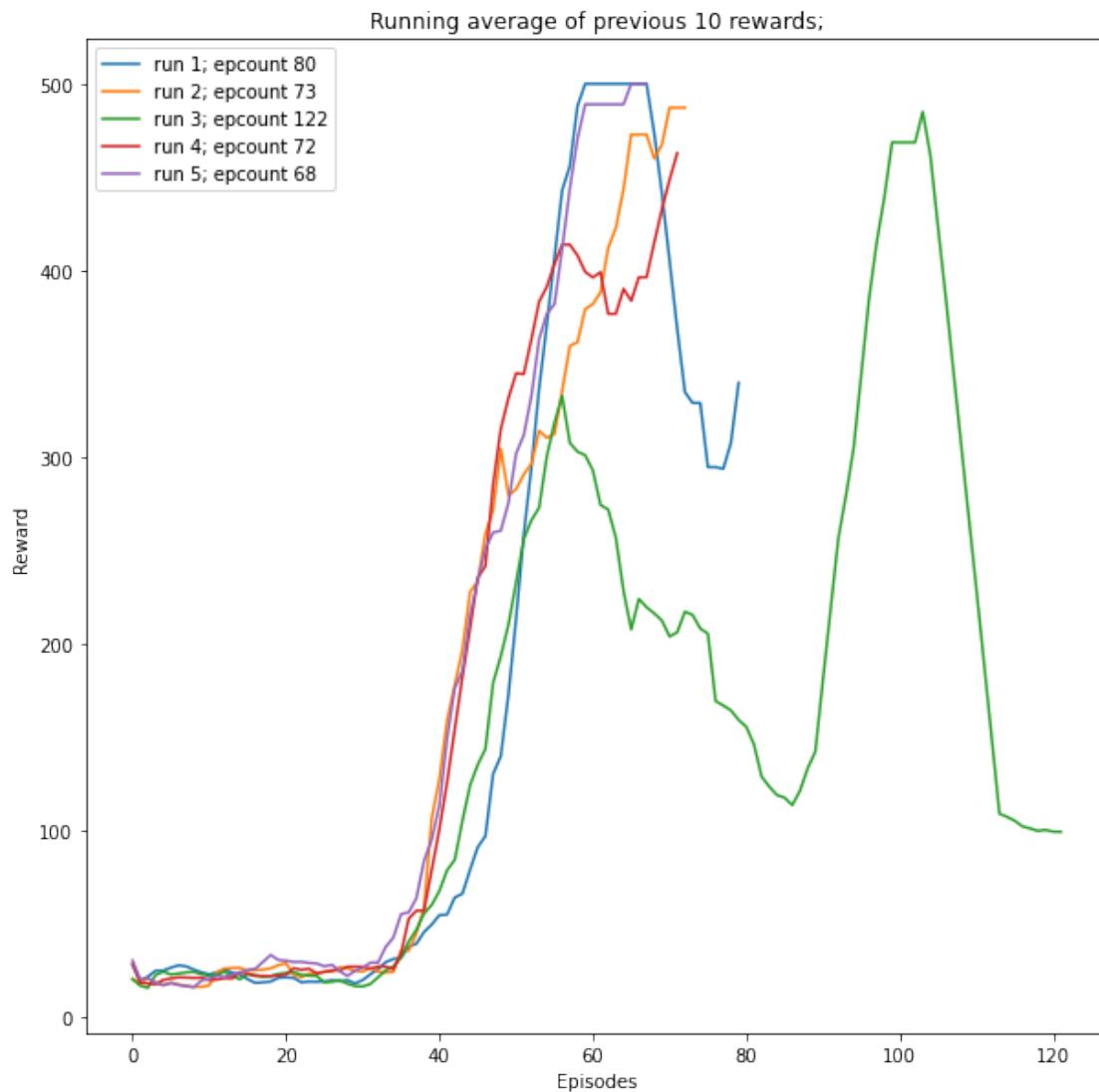
```

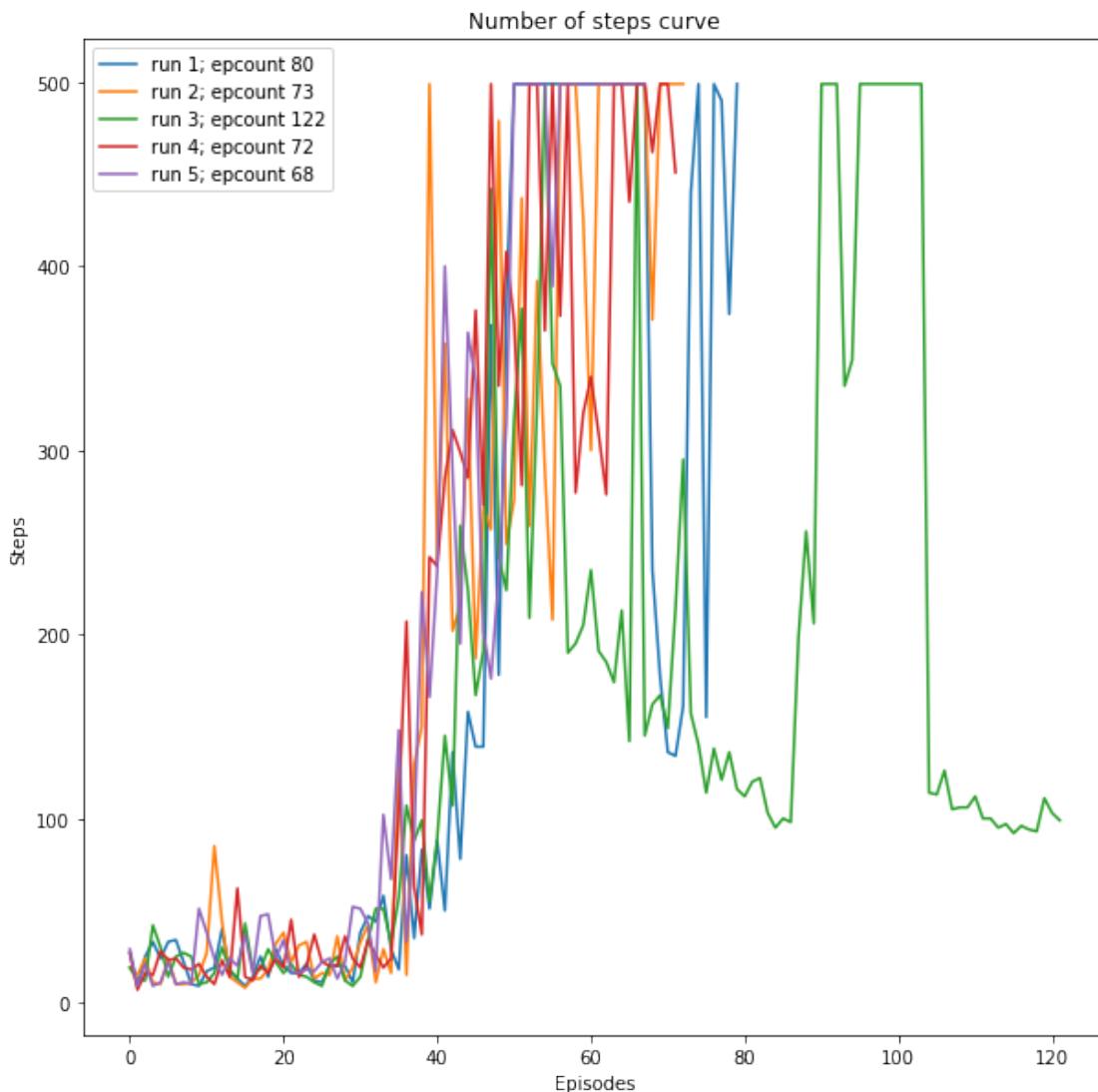
os.mkdir(PATH+'/'+fname)
run_scores, run_steps, ep_count_average, median_agent =
    ↪dqn_exp_runner('CartPole-v1', num_runs=5, env_score_req=195,
                    ↪use_eps=True, start=20, end=0.00001, decay_factor=0.9)
print(f'Performance {ep_count_average}')
gen_plots(fname, run_scores, run_steps)
save_gif(fname, 'CartPole-v1', median_agent, max_steps=800)

```

Saved to folder 27908954-2dde-4bca-aa52-b3882190d74a

Episode 80	Average Score: 195.60	eps 0.004369490010567851
Environment solved in 80 episodes!		Average Score: 195.60
Episode 73	Average Score: 198.66	eps 0.009135518149015497
Environment solved in 73 episodes!		Average Score: 198.66
Episode 100	Average Score: 161.43	
Episode 122	Average Score: 195.30	eps 5.231378549157673e-05
Environment solved in 122 episodes!		Average Score: 195.30
Episode 72	Average Score: 195.36	eps 0.01015057572112833
Environment solved in 72 episodes!		Average Score: 195.36
Episode 68	Average Score: 196.07	eps 0.015471080202908593
Environment solved in 68 episodes!		Average Score: 196.07
Performance 83.0		





```
[ ]: # Changed from defaults: Buffer size to 10000 and batch size to 64, update every=50, decay factor=0.9, epsilon_end=0.000001, softmax
BUFFER_SIZE = int(10000)
BATCH_SIZE = 64
GAMMA = 0.99
LR = 5e-4
UPDATE_EVERY = 50
NUM_HLAYERS = 2
HLAYER_SIZES = [64, 128]
TRUNC_LIM = 1e32

fname = str(uuid.uuid4())
print(f'Saved to folder {fname}')
```

```

os.mkdir(PATH+'/' + fname)
run_scores, run_steps, ep_count_average, median_agent =
    ↪dqn_exp_runner('CartPole-v1', num_runs=5, env_score_req=195,
                    ↪use_eps=False, start=40, end=0.00001, decay_factor=0.9)
print(f'Performance {ep_count_average}!')
gen_plots(fname, run_scores, run_steps)
save_gif(fname, 'CartPole-v1', median_agent, max_steps=800)

```

Saved to folder 999fdc2b-77ec-4867-9976-5dfac0bfbc3f

Episode 82	Average Score: 195.66	eps 0.05
Environment solved in 82 episodes!	Average Score: 195.66	
Episode 92	Average Score: 195.25	eps 0.05
Environment solved in 92 episodes!	Average Score: 195.25	
Episode 81	Average Score: 196.16	eps 0.05
Environment solved in 81 episodes!	Average Score: 196.16	
Episode 82	Average Score: 195.94	eps 0.05
Environment solved in 82 episodes!	Average Score: 195.94	
Episode 92	Average Score: 195.82	eps 0.05
Environment solved in 92 episodes!	Average Score: 195.82	
Performance	85.8	

<ipython-input-6-4c3fc3a85a06>:66: RuntimeWarning: divide by zero encountered in true_divide

```

    return self.rsg.choice(np.arange(self.action_size), size=1,
p=softmax(a_values/beta))[0]
/usr/local/lib/python3.9/dist-packages/scipy/special/_logsumexp.py:224:
RuntimeWarning: invalid value encountered in subtract
    exp_x_shifted = np.exp(x - x_max)

```

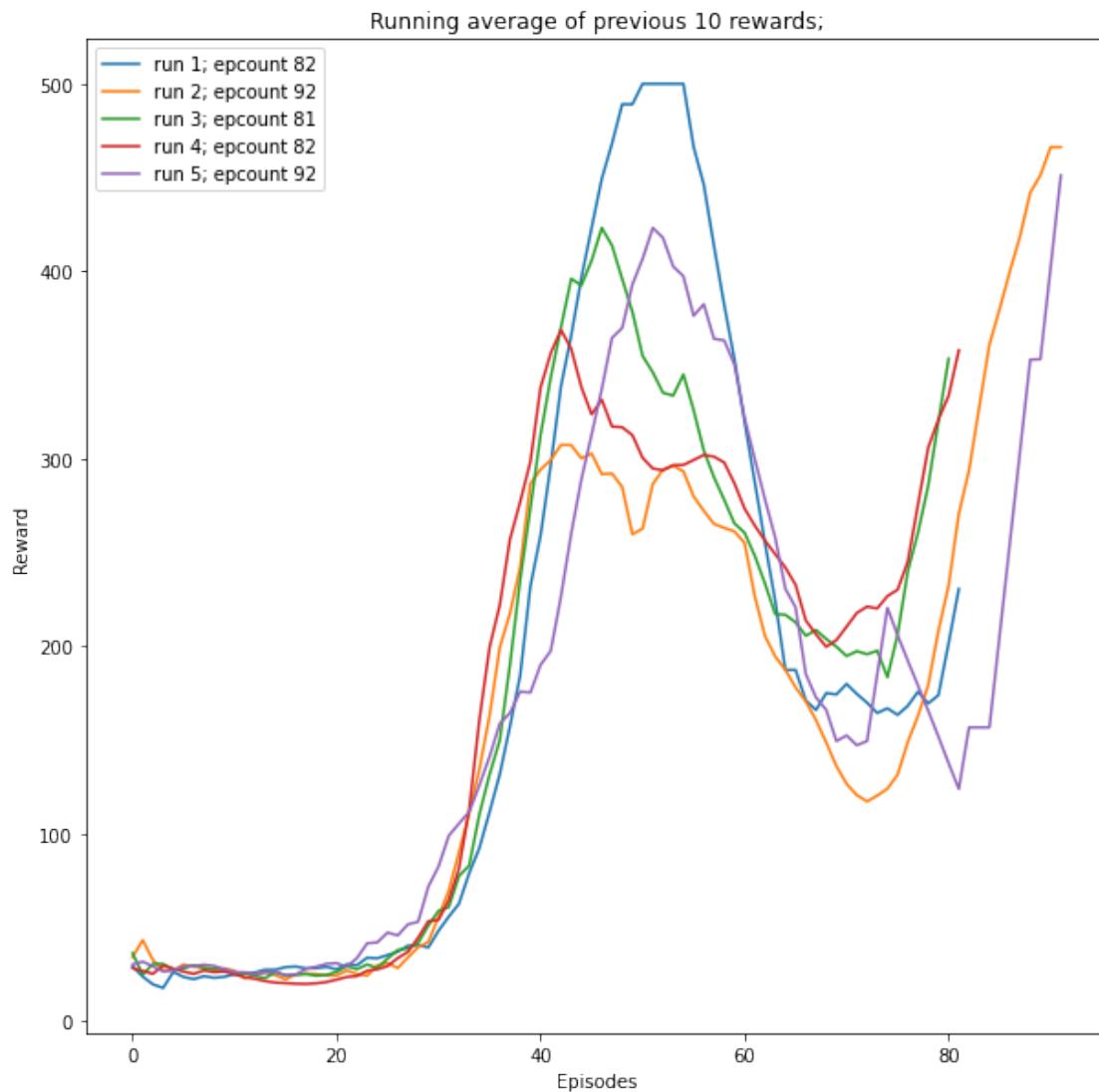
ValueError	Traceback (most recent call last)
<ipython-input-11-70756eb2c4cd> in <module>	
16 print(f'Performance {ep_count_average}!')	
17 gen_plots(fname, run_scores, run_steps)	
---> 18 save_gif(fname, 'CartPole-v1', median_agent, max_steps=800)	
<ipython-input-9-9b7c789d8c41> in save_gif(fname, env_name, torchagent, ↪max_steps)	
58 display.start()	
59 # Save GIF image	
---> 60 images = render_episode(env_name, torchagent, max_steps)	
61 image_file = PATH+'/' + fname + f'/render.gif'	
62 # loop=0: loop forever, duration=1: play each frame for 1ms	
<ipython-input-9-9b7c789d8c41> in render_episode(env_name, agent, max_steps)	
41 state = env.reset()	
42 for i in range(1, max_steps + 1):	

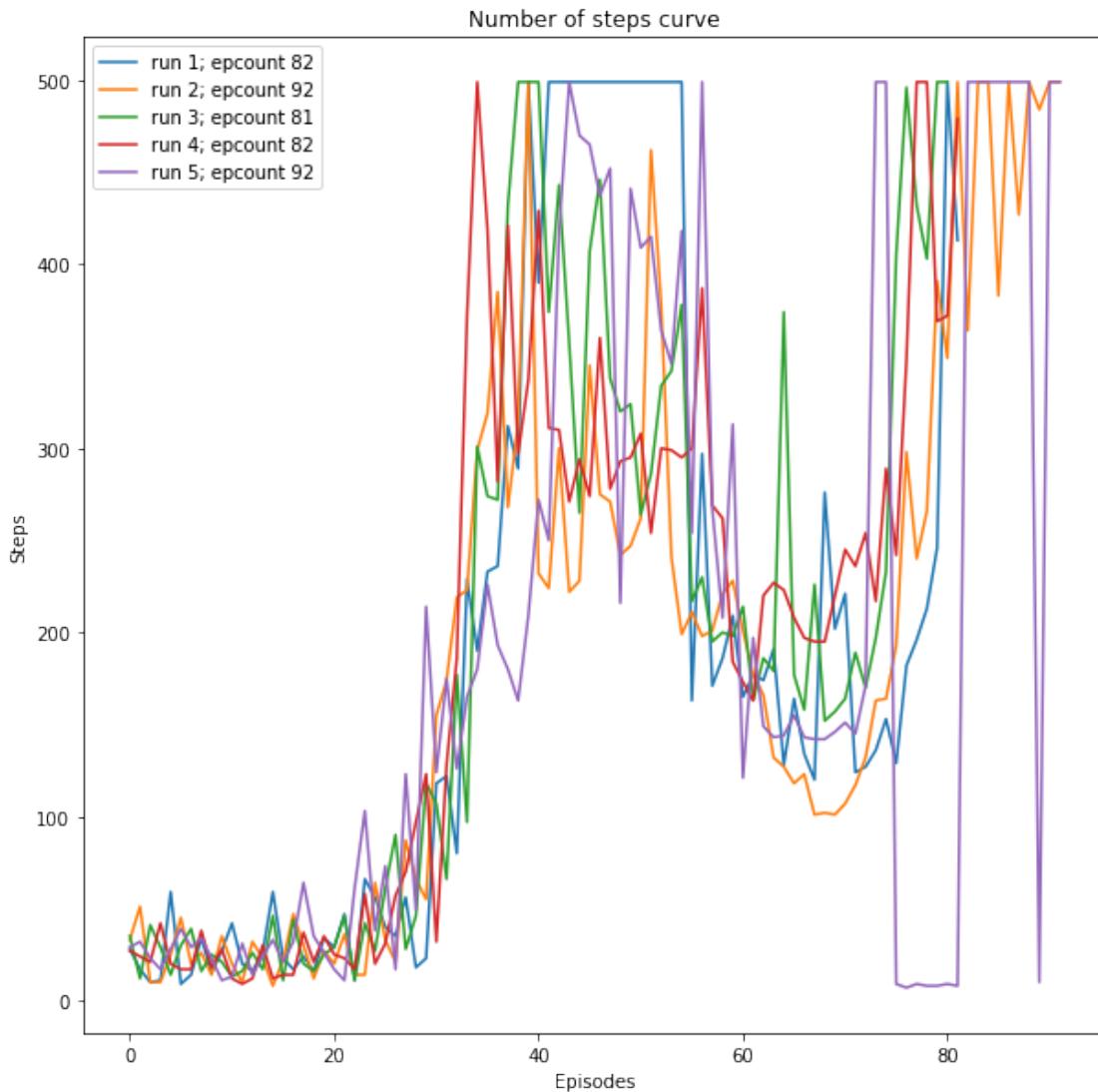
```
--> 43         action = agent.act(state, 0.0)
44         state, _, done, _ = env.step(action)
45

<ipython-input-6-4c3fc3a85a06> in soft_act(self, state, beta)
    64         ''' Softmax action selection (Implemented) '''
    65         a_values = torch.squeeze(action_values).cpu().squeeze().data.
->numpy()
--> 66         return self.rsg.choice(np.arange(self.action_size), size=1, u
->p=softmax(a_values/beta))[0]
    67
    68     def learn(self, experiences, gamma):
```

mtrand.pyx in numpy.random.mtrand.RandomState.choice()

ValueError: probabilities contain NaN





```
[ ]: # Changed from defaults: Buffer size to 10000 and batch size to 64, update every=50, decay factor=0.6, epsilon_end=0.00001, softmax
BUFFER_SIZE = int(10000)
BATCH_SIZE = 64
GAMMA = 0.99
LR = 5e-4
UPDATE_EVERY = 50
NUM_HLAYERS = 2
HLAYER_SIZES = [64, 128]
TRUNC_LIM = 1e32

fname = str(uuid.uuid4())
print(f'Saved to folder {fname}')
```

```

os.mkdir(PATH+'/' + fname)
run_scores, run_steps, ep_count_average, median_agent =
    ↪dqn_exp_runner('CartPole-v1', num_runs=5, env_score_req=195,
                    ↪use_eps=False, start=40, end=0.00001, decay_factor=0.6)
print(f'Performance {ep_count_average}')
gen_plots(fname, run_scores, run_steps)
save_gif(fname, 'CartPole-v1', median_agent, max_steps=800)

```

Saved to folder 6fa6014e-2af5-402d-81ec-0f1a27b807f3

Episode 31	Average Score: 201.32	eps 0.05
Environment solved in 31 episodes!	Average Score: 201.32	
Episode 32	Average Score: 201.62	eps 0.05
Environment solved in 32 episodes!	Average Score: 201.62	
Episode 34	Average Score: 202.38	eps 0.05
Environment solved in 34 episodes!	Average Score: 202.38	
Episode 30	Average Score: 197.00	eps 0.05
Environment solved in 30 episodes!	Average Score: 197.00	
Episode 19	Average Score: 200.32	eps 0.05
Environment solved in 19 episodes!	Average Score: 200.32	
Performance 29.2		

<ipython-input-6-4c3fc3a85a06>:66: RuntimeWarning: divide by zero encountered in true_divide

```

    return self.rsg.choice(np.arange(self.action_size), size=1,
p=softmax(a_values/beta))[0]
/usr/local/lib/python3.9/dist-packages/scipy/special/_logsumexp.py:224:
RuntimeWarning: invalid value encountered in subtract
    exp_x_shifted = np.exp(x - x_max)

```

ValueError	Traceback (most recent call last)
<ipython-input-12-a19c0bc95a66> in <module>	
16 print(f'Performance {ep_count_average}') 17 gen_plots(fname, run_scores, run_steps) ---> 18 save_gif(fname, 'CartPole-v1', median_agent, max_steps=800)	

<ipython-input-9-9b7c789d8c41> in save_gif(fname, env_name, torchagent, ↪max_steps)

```

    58     display.start()
    59     # Save GIF image
---> 60     images = render_episode(env_name, torchagent, max_steps)
    61     image_file = PATH+'/'+fname+f'/render.gif'
    62     # loop=0: loop forever, duration=1: play each frame for 1ms

```

<ipython-input-9-9b7c789d8c41> in render_episode(env_name, agent, max_steps)

```

    41     state = env.reset()
    42     for i in range(1, max_steps + 1):

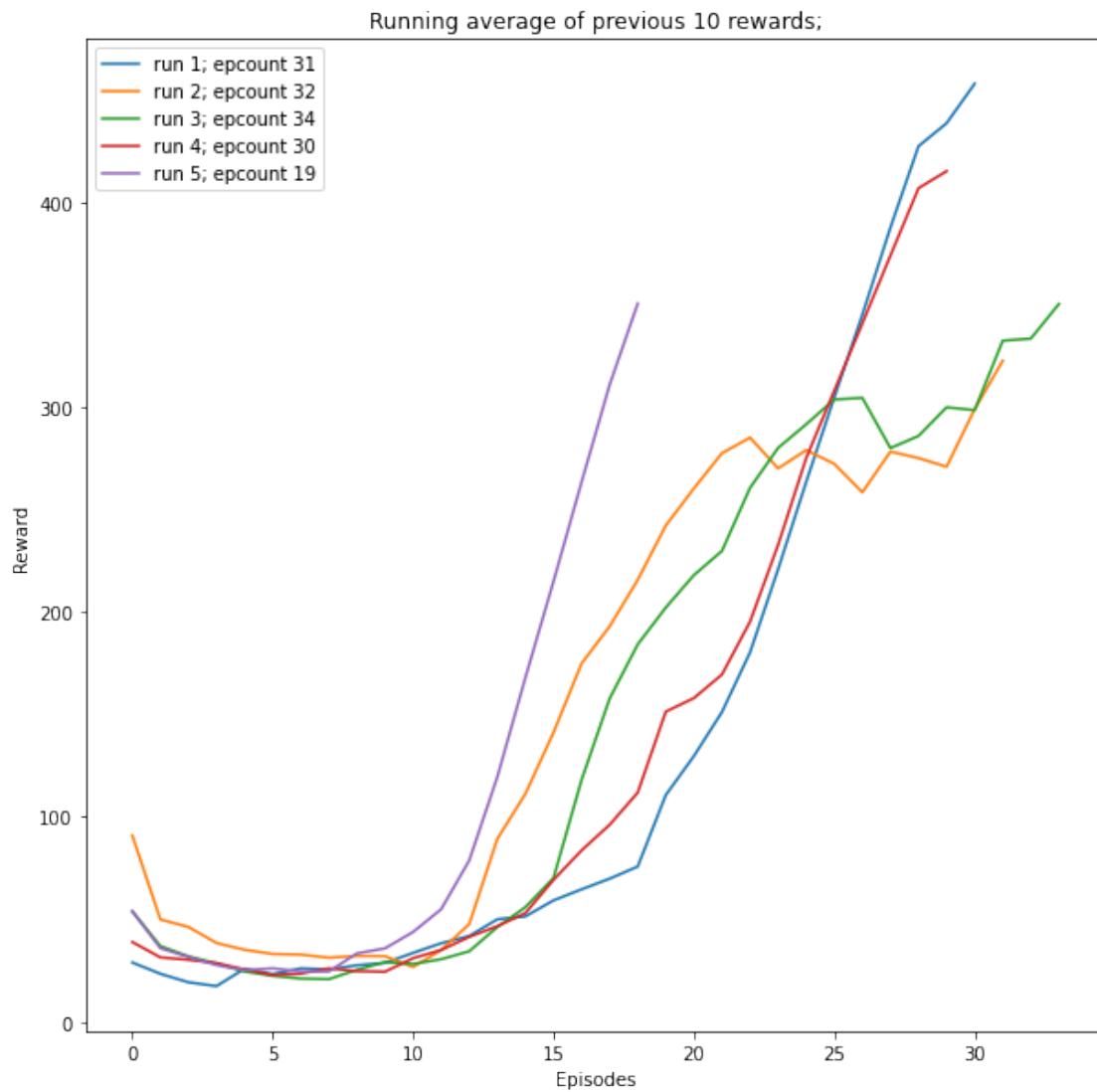
```

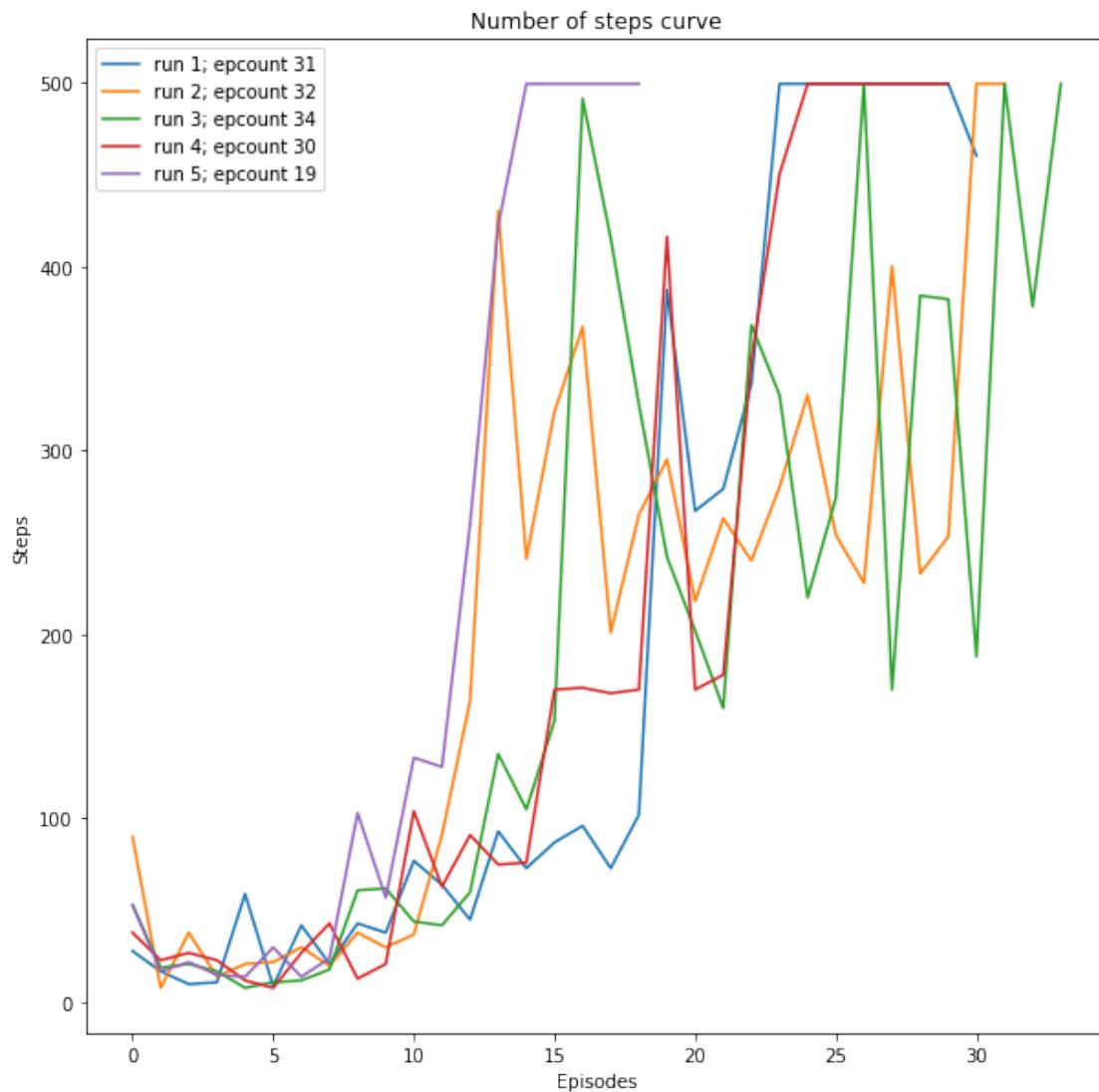
```
--> 43         action = agent.act(state, 0.0)
44         state, _, done, _ = env.step(action)
45

<ipython-input-6-4c3fc3a85a06> in soft_act(self, state, beta)
    64         ''' Softmax action selection (Implemented) '''
    65         a_values = torch.squeeze(action_values).cpu().squeeze().data.
--> 66             return self.rsg.choice(np.arange(self.action_size), size=1, u
   p=softmax(a_values/beta))[0]
    67
    68     def learn(self, experiences, gamma):
```

mtrand.pyx in numpy.random.mtrand.RandomState.choice()

ValueError: probabilities contain NaN





Final_DQN_mountaincar

March 26, 2023

```
[ ]: from google.colab import drive  
drive.mount('/content/drive')  
import os
```

Mounted at /content/drive

```
[ ]: '''  
Installing packages for rendering the game on Colab  
'''  
  
!pip install gym pyvirtualdisplay > /dev/null 2>&1  
!apt-get install -y xvfb python-opengl ffmpeg > /dev/null 2>&1  
!apt-get update > /dev/null 2>&1  
!apt-get install cmake > /dev/null 2>&1  
!pip install --upgrade setuptools 2>&1  
!pip install ez_setup > /dev/null 2>&1  
!pip install gym[atari] > /dev/null 2>&1  
!pip install git+https://github.com/tensorflow/docs > /dev/null 2>&1  
!pip install gym[classic_control]
```

```
Looking in indexes: https://pypi.org/simple, https://us-python.pkg.dev/colab-wheels/public/simple/  
Requirement already satisfied: setuptools in /usr/local/lib/python3.9/dist-packages (67.6.0)  
Looking in indexes: https://pypi.org/simple, https://us-python.pkg.dev/colab-wheels/public/simple/  
Requirement already satisfied: gym[classic_control] in /usr/local/lib/python3.9/dist-packages (0.25.2)  
Requirement already satisfied: gym-notices>=0.0.4 in /usr/local/lib/python3.9/dist-packages (from gym[classic_control]) (0.0.8)  
Requirement already satisfied: cloudpickle>=1.2.0 in /usr/local/lib/python3.9/dist-packages (from gym[classic_control]) (2.2.1)  
Requirement already satisfied: importlib-metadata>=4.8.0 in /usr/local/lib/python3.9/dist-packages (from gym[classic_control]) (6.1.0)  
Requirement already satisfied: numpy>=1.18.0 in /usr/local/lib/python3.9/dist-packages (from gym[classic_control]) (1.22.4)  
Collecting pygame==2.1.0  
  Downloading
```

```

pygame-2.1.0-cp39-cp39-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (18.3 MB)
      18.3/18.3 MB
56.8 MB/s eta 0:00:00
Requirement already satisfied: zipp>=0.5 in /usr/local/lib/python3.9/dist-
packages (from importlib-metadata>=4.8.0->gym[classic_control]) (3.15.0)
Installing collected packages: pygame
  Attempting uninstall: pygame
    Found existing installation: pygame 2.3.0
    Uninstalling pygame-2.3.0:
      Successfully uninstalled pygame-2.3.0
Successfully installed pygame-2.1.0

```

```

[ ]: '''
A bunch of necessary imports
'''

import numpy as np
import seaborn as sns
import torch
import torch.nn as nn
import torch.nn.functional as F
from collections import namedtuple, deque
import torch.optim as optim
import datetime
import gym
from gym.wrappers.record_video import RecordVideo
import glob
import io
import base64
import matplotlib.pyplot as plt
from IPython.display import HTML
from pyvirtualdisplay import Display
import tensorflow_docs.vis.embed as embed
from IPython import display as ipythondisplay
from PIL import Image
import uuid
import warnings
warnings.filterwarnings("ignore", category=DeprecationWarning)

device = torch.device("cuda:0" if torch.cuda.is_available() else "cpu")

```

0.0.1 Q-Network Code

```

[ ]: '''
Bunch of Hyper parameters (Which you might have to tune later **wink wink**)
'''

BUFFER_SIZE = int(1e5) # replay buffer size

```

```

BATCH_SIZE = 64          # minibatch size
GAMMA = 0.99             # discount factor
LR = 5e-4                # learning rate
UPDATE_EVERY = 20         # how often to update the network (When Q target is ↵present)
NUM_HLAYERS = 2
HLAYER_SIZES = [128, 64]
TRUNC_LIM = 1

class QNetwork(nn.Module):

    def __init__(self, state_size, action_size, seed, fc1_units=128, fc2_units=64):
        """Initialize parameters and build model.
        Params
        ======
            state_size (int): Dimension of each state
            action_size (int): Dimension of each action
            seed (int): Random seed
            fc1_units (int): Number of nodes in first hidden layer
            fc2_units (int): Number of nodes in second hidden layer
        """
        super(QNetwork, self).__init__()
        self.seed = torch.manual_seed(seed)
        self.fcls = nn.ModuleList()
        for i in range(NUM_HLAYERS+1):
            if (i == 0):
                fc = nn.Linear(state_size, HLAYER_SIZES[0])
            elif (i == NUM_HLAYERS):
                fc = nn.Linear(HLAYER_SIZES[i-1], action_size)
            else:
                fc = nn.Linear(HLAYER_SIZES[i-1], HLAYER_SIZES[i])
            self.fcls.append(fc)

    def forward(self, state):
        """Build a network that maps state -> action values."""
        for i in range(len(self.fcls)-1):
            fc = self.fcls[i]
            if i == 0:
                x = F.relu(fc(state))
            else:
                x = F.relu(fc(x))
        fc = self.fcls[len(self.fcls) - 1]
        return fc(x)

```

0.0.2 Replay Buffer:

This is a ‘deque’ that helps us store experiences. Recall why we use such a technique.

```
[ ]: from collections import deque, namedtuple

class ReplayBuffer:
    """Fixed-size buffer to store experience tuples."""

    def __init__(self, action_size, buffer_size, batch_size, seed):
        self.action_size = action_size
        self.memory = deque(maxlen=buffer_size)
        self.batch_size = batch_size
        self.experience = namedtuple("Experience", field_names=["state", "action", "reward", "next_state", "done"])
        self.rsg = np.random.RandomState(seed)

    def add(self, state, action, reward, next_state, done):
        """Add a new experience to memory."""
        e = self.experience(state, action, reward, next_state, done)
        self.memory.append(e)

    def sample(self):
        """Randomly sample a batch of experiences from memory."""
        idxs = self.rsg.choice(len(self.memory), size=self.batch_size, replace=False)
        mem = self.memory
        states = torch.from_numpy(np.vstack([mem[i].state for i in idxs if mem[i] is not None])).float().to(device)
        actions = torch.from_numpy(np.vstack([mem[i].action for i in idxs if mem[i] is not None])).long().to(device)
        rewards = torch.from_numpy(np.vstack([mem[i].reward for i in idxs if mem[i] is not None])).float().to(device)
        next_states = torch.from_numpy(np.vstack([mem[i].next_state for i in idxs if mem[i] is not None])).float().to(device)
        dones = torch.from_numpy(np.vstack([mem[i].done for i in idxs if mem[i] is not None]).astype(np.uint8)).float().to(device)

        return (states, actions, rewards, next_states, dones)

    def __len__(self):
        """Return the current size of internal memory."""
        return len(self.memory)
```

0.0.3 DQN Agent Code:

Truncation is done optionally with the hope that it improves stability.

```
[ ]: from scipy.special import softmax
class dqn_agent():
    def __init__(self, state_size, action_size, seed, atype='epsilon-greedy'):

        ''' Agent Environment Interaction '''
        self.state_size = state_size
        self.action_size = action_size
        self.rsg = np.random.RandomState(seed)

        ''' Q-Network '''
        self.qnetwork_local = QNetwork(state_size, action_size, seed).to(device)
        self.qnetwork_target = QNetwork(state_size, action_size, seed).
        ↪to(device)
        self.optimizer = optim.Adam(self.qnetwork_local.parameters(), lr=LR)

        ''' Replay memory '''
        self.memory = ReplayBuffer(action_size, BUFFER_SIZE, BATCH_SIZE, seed)
        ''' Initialize time step (for updating every UPDATE_EVERY steps) □
        ↪ -Needed for Q Targets '''
        self.t_step = 0

        if atype == 'epsilon-greedy':
            self.act = self.eps_act
        else:
            self.act = self.soft_act

    def step(self, state, action, reward, next_state, done):

        ''' Save experience in replay memory '''
        self.memory.add(state, action, reward, next_state, done)

        ''' If enough samples are available in memory, get random subset and learn □
        ↪learn '''
        if len(self.memory) >= BATCH_SIZE:
            experiences = self.memory.sample()
            self.learn(experiences, GAMMA)

        """ +Q TARGETS PRESENT """
        ''' Updating the Network every 'UPDATE_EVERY' steps taken '''
        self.t_step = (self.t_step + 1) % UPDATE_EVERY
        if self.t_step == 0:

            self.qnetwork_target.load_state_dict(self.qnetwork_local.
        ↪state_dict())

    def eps_act(self, state, eps=0.):
```

```

state = torch.from_numpy(state).float().unsqueeze(0).to(device)
self.qnetwork_local.eval()
with torch.no_grad():
    action_values = self.qnetwork_local(state)
self.qnetwork_local.train()

''' Epsilon-greedy action selection (Already Present) '''
if self.rsg.random() < eps:
    return self.rsg.choice(np.arange(self.action_size))
else:
    return np.argmax(action_values.cpu().data.numpy())

def soft_act(self, state, beta=1.0):

    state = torch.from_numpy(state).float().unsqueeze(0).to(device)
    self.qnetwork_local.eval()
    with torch.no_grad():
        action_values = self.qnetwork_local(state)
    self.qnetwork_local.train()

    ''' Softmax action selection (Implemented) '''
    a_values = torch.squeeze(action_values).cpu().squeeze().data.numpy()
    return self.rsg.choice(np.arange(self.action_size), size=1, □
    ↵p=softmax(a_values/beta))[0]

def learn(self, experiences, gamma):
    """ +E EXPERIENCE REPLAY PRESENT """
    states, actions, rewards, next_states, dones = experiences

    ''' Get max predicted Q values (for next states) from target model'''
    Q_targets_next = self.qnetwork_target(next_states).detach().max(1)[0].
    ↵unsqueeze(1)

    ''' Compute Q targets for current states '''
    Q_targets = rewards + (gamma * Q_targets_next * (1 - dones))

    ''' Get expected Q values from local model '''
    Q_expected = self.qnetwork_local(states).gather(1, actions)

    ''' Compute loss '''
    loss = F.mse_loss(Q_expected, Q_targets)

    ''' Minimize the loss '''
    self.optimizer.zero_grad()
    loss.backward()

    ''' Gradient Clipping '''

```

```

""" +T TRUNCATION PRESENT """
for param in self.qnetwork_local.parameters():
    param.grad.data.clamp_(-TRUNC_LIM, +TRUNC_LIM)

self.optimizer.step()

```

0.0.4 DQN algorithm

```

[ ]: def reward_shaping(state, next_state):
    sreward = 0
    if (next_state[0] >= 0.5):
        sreward += 400
    sreward += 400*((np.sin(3*next_state[0]) * 0.0025 + 0.5 * next_state[1] *_
    ↪next_state[1]) - (np.sin(3*state[0]) * 0.0025 + 0.5 * state[1] * state[1]))
    return sreward

[ ]: ''' Defining DQN Algorithm with epsilon annealing'''

def dqn(env, agent, env_score_req, use_eps = True, n_episodes=2000, max_t=1000,_
    ↪eps_start=1.0, eps_end=0.05, decay_factor=0.995, beta_start=1.5, beta_end=0.-
    ↪5):
    scores = []
    num_steps = []
    ''' list containing scores from each episode '''

    scores_window= deque(maxlen=100)
    ''' last 100 scores for checking if the avg is more than -110 '''

    eps = eps_start
    beta = beta_start

    ''' initialize epsilon '''
    for i_episode in range(1, n_episodes+1):
        state = env.reset()
        score = 0
        for t in range(max_t):
            if use_eps:
                action = agent.act(state, eps)
            else:
                action = agent.act(state, beta)
            next_state, reward, done, _ = env.step(action)
            shaped_reward = reward_shaping(state, next_state)
            agent.step(state, action, shaped_reward, next_state, done)
            state = next_state
            score += reward

```

```

        if done:
            break
        num_steps.append(t)
        scores.append(score)
        scores_window.append(score)
        ''' save most recent score '''

        eps = max(eps_end, eps * decay_factor)
        beta = max(beta_end, beta * decay_factor)
        ''' decrease epsilon, beta '''

    print('\rEpisode {} \tAverage Score: {:.2f}'.format(i_episode, np.mean(scores_window), eps), end="")
    if i_episode % 100 == 0:
        print('\rEpisode {} \tAverage Score: {:.2f}'.format(i_episode, np.mean(scores_window)))
    if np.mean(scores_window) >= env_score_req:
        print('\nEnvironment solved in {} episodes!\tAverage Score: {:.2f}'.format(i_episode, np.mean(scores_window)))
        break
return [np.array(scores), np.array(num_steps), i_episode]

```

0.0.5 Plotting and Rendering

```

[ ]: PATH = '/content/drive/MyDrive/Colab Notebooks/CS6700/Assignments/Assignment2/
      ↵DQN/MC/'

def gen_plots(fname, run_scores, run_steps, avg_num=10):

    run_count = len(run_scores)
    labels = [f'run {i+1}; epcount {len(run_scores[i])}' for i in
      ↵range(run_count)]

    sc_fig, sc_ax = plt.subplots(figsize=(10,10))
    st_fig, st_ax = plt.subplots(figsize=(10,10))
    sc_ax.set_title(f'Running average of previous {avg_num} rewards;')
    sc_ax.set_xlabel('Episodes')
    sc_ax.set_ylabel('Reward')
    st_ax.set_title(f'Number of steps curve')
    st_ax.set_xlabel('Episodes')
    st_ax.set_ylabel('Steps')

    for idx in range(run_count):

        score_list = run_scores[idx]
        step_list = run_steps[idx]

```

```

average_score_list = np.zeros_like(score_list)
for i in range(0, len(score_list)):
    if i < avg_num:
        average_score_list[i] = np.mean(score_list[:i+1])
    else:
        average_score_list[i] = np.mean(score_list[(i-avg_num+1):(i+1)])

sbn.lineplot(data=average_score_list, label=labels[idx], ax=sc_ax)
sbn.lineplot(data=step_list, label=labels[idx], ax=st_ax)

sc_fig.savefig(PATH+'/'+fname+'/sc_fig.png')
st_fig.savefig(PATH+'/'+fname+'/st_fig.png')

def render_episode(env_name, agent, max_steps: int):
    env = gym.make(env_name)
    env.reset()
    screen = env.render(mode='rgb_array')
    im = Image.fromarray(screen)

    images = [im]
    state = env.reset()
    for i in range(1, max_steps + 1):
        action = agent.act(state, 0.0)
        state, _, done, _ = env.step(action)

        # Render screen every 2 steps
        if i % 2 == 0:
            screen = env.render(mode='rgb_array')
            images.append(Image.fromarray(screen))

        if done:
            break

    return images

def save_gif(fname, env_name, torchagent, max_steps=800):
    display = Display(visible=0, size=(400, 300))
    display.start()
    # Save GIF image
    images = render_episode(env_name, torchagent, max_steps)
    image_file = PATH+'/'+fname+f'/render.gif'
    # loop=0: loop forever, duration=1: play each frame for 1ms
    images[0].save(image_file, save_all=True, append_images=images[1:], loop=0, duration=1)

```

[]:

```

# code for running the dqn for multiple to account for stochasticity. averaged
→ performance is computed and returned
def dqn_exp_runner(env_name, num_runs, env_score_req, use_eps, start, end,
→ decay_factor, n_episodes=800, max_t=1000):
    run_scores = []
    ep_counts = []
    run_steps = []
    agents = []
    env = gym.make(env_name)
    env.seed(42)
    if (use_eps):
        eps_start, eps_end = start, end
    else:
        beta_start, beta_end = start, end
    state_shape = env.observation_space.shape[0]
    action_shape = env.action_space.n
    for i in range(num_runs):
        begin_time = datetime.datetime.now()
        if use_eps:
            agent = dqn_agent(state_size=state_shape, action_size =
→ action_shape, seed = 42, atype='epsilon-greedy')
            score_list, num_steps, ep_count = dqn(env, agent, env_score_req,
→ use_eps = True, n_episodes=n_episodes, max_t=max_t,
→ decay_factor=decay_factor, eps_start=eps_start, eps_end=eps_end)
        else:
            agent = dqn_agent(state_size=state_shape, action_size =
→ action_shape, seed = 42, atype='softmax')
            score_list, num_steps, ep_count = dqn(env, agent, env_score_req,
→ use_eps = False, n_episodes=n_episodes, max_t=max_t,
→ decay_factor=decay_factor, beta_start=beta_start, beta_end=beta_end)
        time_taken = datetime.datetime.now() - begin_time
        run_scores.append(score_list)
        run_steps.append(num_steps)
        ep_counts.append(ep_count)
        agents.append(agent)
    ep_counts = np.array(ep_counts)
    # we use the median score getting the agent for render
    best_res = np.argsort(ep_counts)[len(ep_counts)//2]
    return run_scores, run_steps, np.mean(ep_counts), agents[best_res]

```

0.1 MountainCar-v0

```
[ ]: # Defaults
BUFFER_SIZE = int(10000)
BATCH_SIZE = 64
GAMMA = 0.99
```

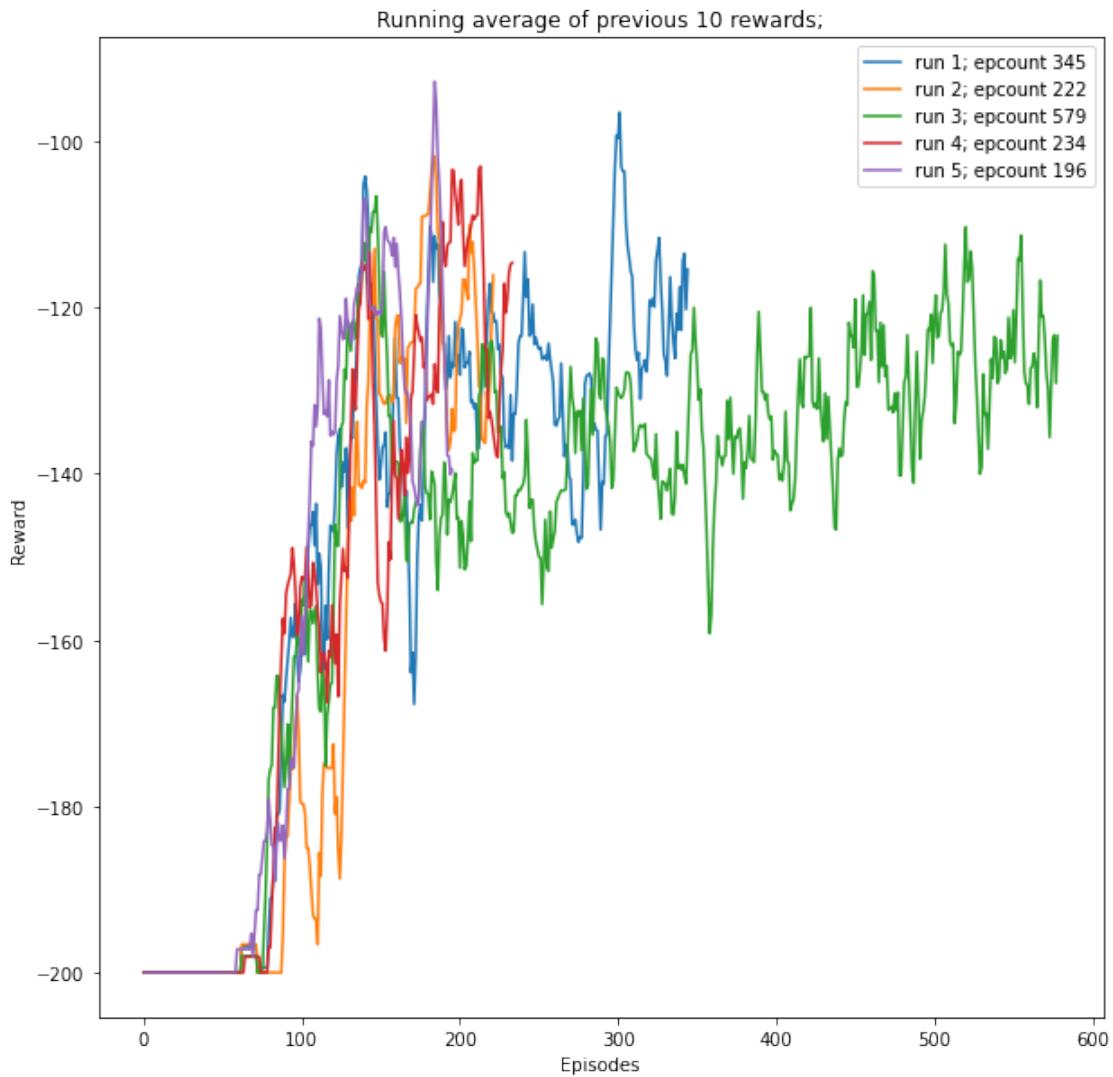
```

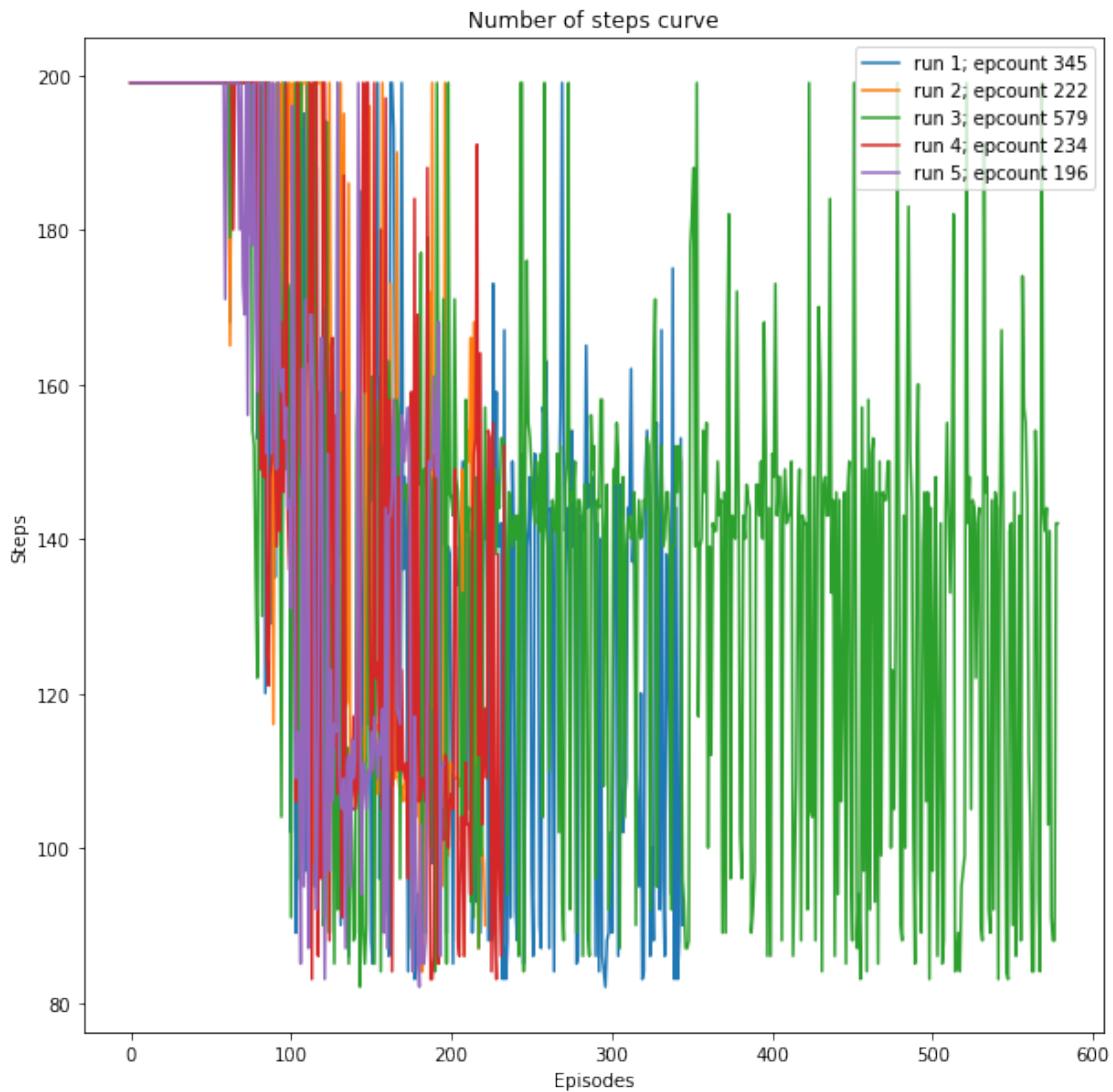
LR = 5e-4
UPDATE_EVERY = 20
NUM_HLAYERS = 3
HLAYER_SIZES = [64,64, 128]
TRUNC_LIM = 1e32

fname = str(uuid.uuid4())
print(f'Saved to folder {fname}')
os.mkdir(PATH+'/'+fname)
run_scores, run_steps, ep_count_average, median_agent =
    ↪dqn_exp_runner('MountainCar-v0', num_runs=5, env_score_req=-125,
    ↪use_eps=True, start=10, end=0.0005, decay_factor=0.95)
print(f'Performance {ep_count_average}')
gen_plots(fname, run_scores, run_steps)
save_gif(fname, 'MountainCar-v0', median_agent,max_steps=800)

```

Saved to folder 0669668e-4518-4d19-b8d0-a7e1e128ab6d
Episode 100 Average Score: -192.27
Episode 200 Average Score: -134.17
Episode 300 Average Score: -127.83
Episode 345 Average Score: -124.78 eps 0.0005
Environment solved in 345 episodes! Average Score: -124.78
Episode 100 Average Score: -196.30
Episode 200 Average Score: -139.03
Episode 222 Average Score: -124.90 eps 0.0005
Environment solved in 222 episodes! Average Score: -124.90
Episode 100 Average Score: -191.39
Episode 200 Average Score: -139.09
Episode 300 Average Score: -137.49
Episode 400 Average Score: -136.38
Episode 500 Average Score: -130.76
Episode 579 Average Score: -124.96 eps 0.0005
Environment solved in 579 episodes! Average Score: -124.96
Episode 100 Average Score: -190.79
Episode 200 Average Score: -135.41
Episode 234 Average Score: -124.81 eps 0.0005
Environment solved in 234 episodes! Average Score: -124.81
Episode 100 Average Score: -192.12
Episode 196 Average Score: -124.96 eps 0.0005
Environment solved in 196 episodes! Average Score: -124.96
Performance 315.2





```
[ ]: # Defaults, gamma=0.97
BUFFER_SIZE = int(10000)
BATCH_SIZE = 64
GAMMA = 0.97
LR = 5e-4
UPDATE_EVERY = 20
NUM_HLAYERS = 3
HLAYER_SIZES = [64,64, 128]
TRUNC_LIM = 1e32

fname = str(uuid.uuid4())
print(f'Saved to folder {fname}')
```

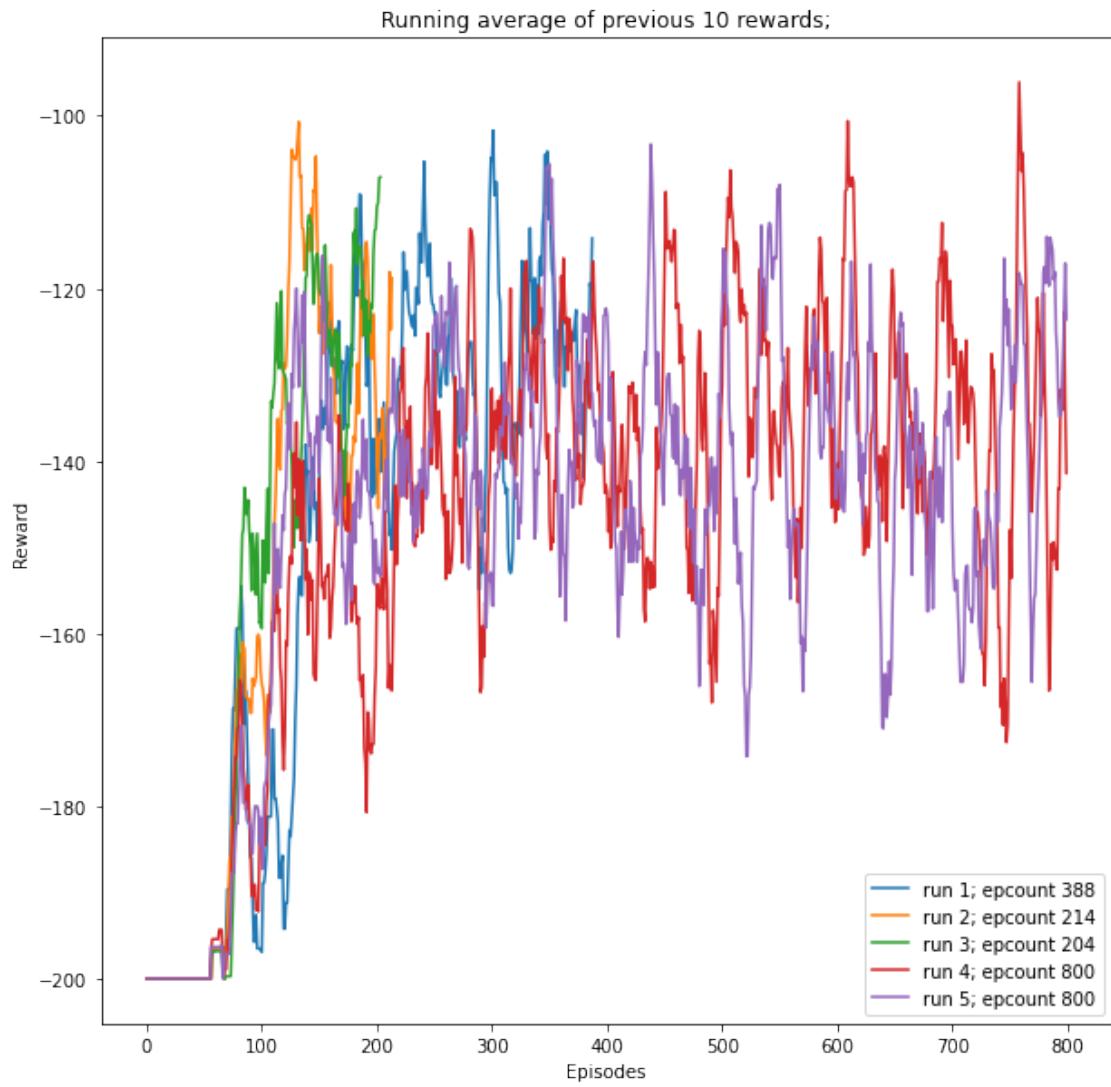
```

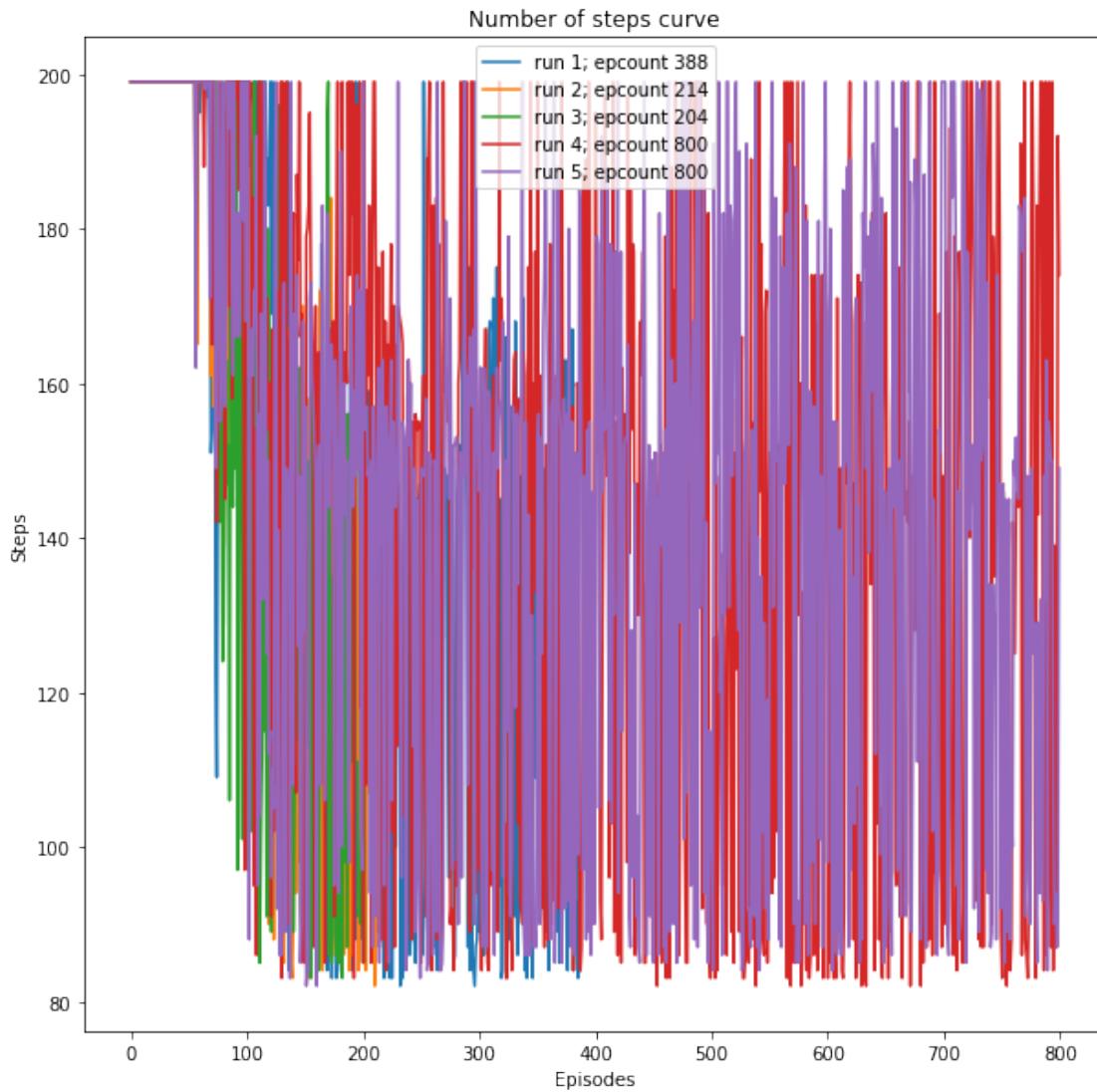
os.mkdir(PATH+'/' + fname)
run_scores, run_steps, ep_count_average, median_agent =
    ↪dqn_exp_runner('MountainCar-v0', num_runs=5, env_score_req=-125,
                    ↪use_eps=True, start=10, end=0.0005, decay_factor=0.95)
print(f'Performance {ep_count_average}')
gen_plots(fname, run_scores, run_steps)
save_gif(fname, 'MountainCar-v0', median_agent, max_steps=800)

```

Saved to folder b9f56ac6-b84f-47e1-8c7d-ceeb75608345

Episode 100	Average Score:	-192.83
Episode 200	Average Score:	-146.86
Episode 300	Average Score:	-127.63
Episode 388	Average Score:	-124.29 eps 0.0005
Environment solved in 388 episodes!		Average Score: -124.29
Episode 100	Average Score:	-189.12
Episode 200	Average Score:	-127.92
Episode 214	Average Score:	-124.82 eps 0.0005
Environment solved in 214 episodes!		Average Score: -124.82
Episode 100	Average Score:	-187.23
Episode 200	Average Score:	-126.30
Episode 204	Average Score:	-124.88 eps 0.0005
Environment solved in 204 episodes!		Average Score: -124.88
Episode 100	Average Score:	-193.04
Episode 200	Average Score:	-156.97
Episode 300	Average Score:	-141.92
Episode 400	Average Score:	-132.90
Episode 500	Average Score:	-139.36
Episode 600	Average Score:	-131.51
Episode 700	Average Score:	-131.11
Episode 800	Average Score:	-139.29
Episode 100	Average Score:	-193.86
Episode 200	Average Score:	-141.97
Episode 300	Average Score:	-139.16
Episode 400	Average Score:	-133.07
Episode 500	Average Score:	-140.49
Episode 600	Average Score:	-138.99
Episode 700	Average Score:	-141.51
Episode 800	Average Score:	-137.74
Performance		481.2





```
[ ]: # From defaults : Learning rate changed to 9e-4
BUFFER_SIZE = int(10000)
BATCH_SIZE = 64
GAMMA = 0.99
LR = 9e-4
UPDATE_EVERY = 20
NUM_HLAYERS = 3
Hlayer_SIZES = [64, 64, 128]
TRUNC_LIM = 1e32

fname = str(uuid.uuid4())
print(f'Saved to folder {fname}')
```

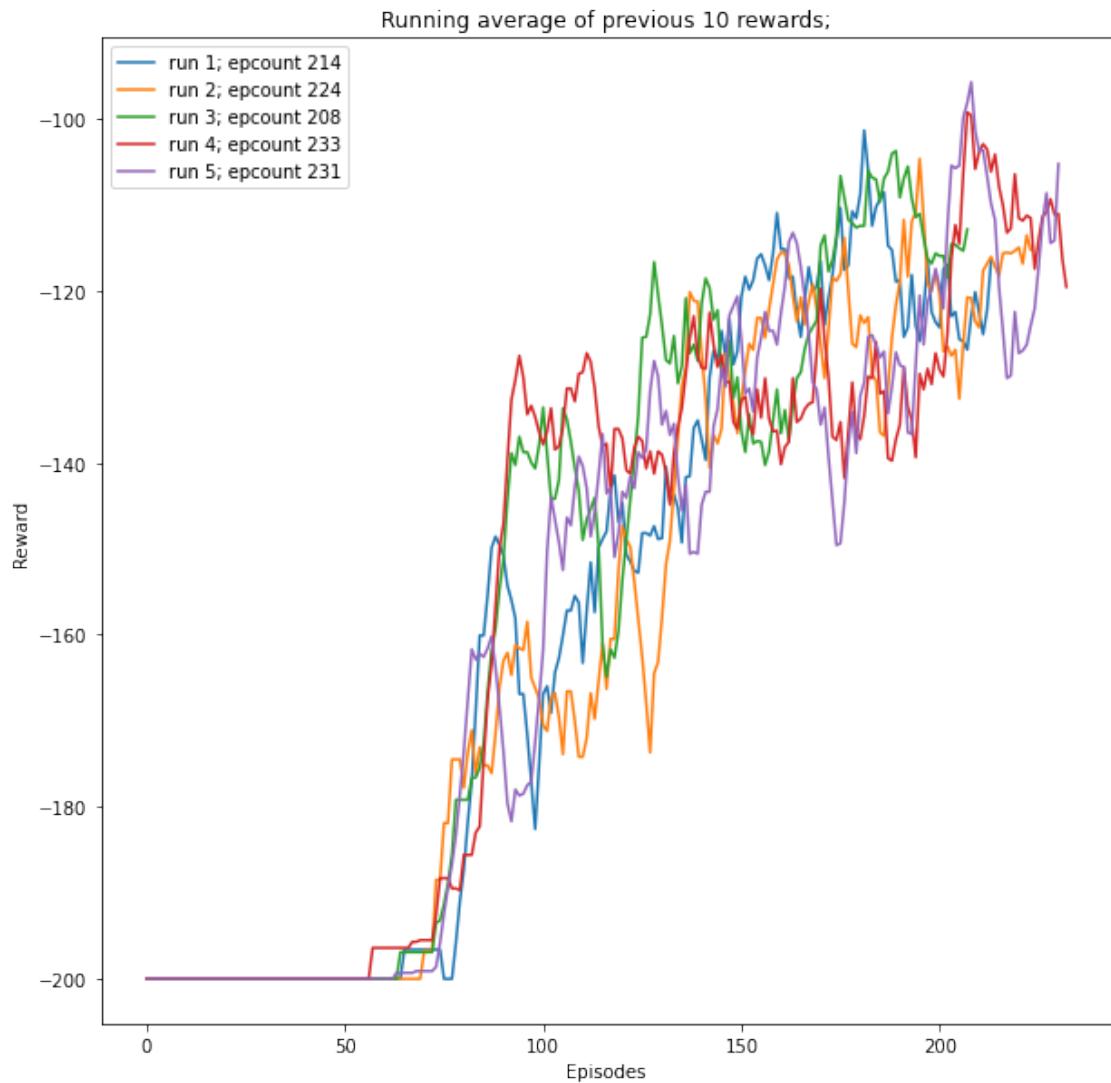
```

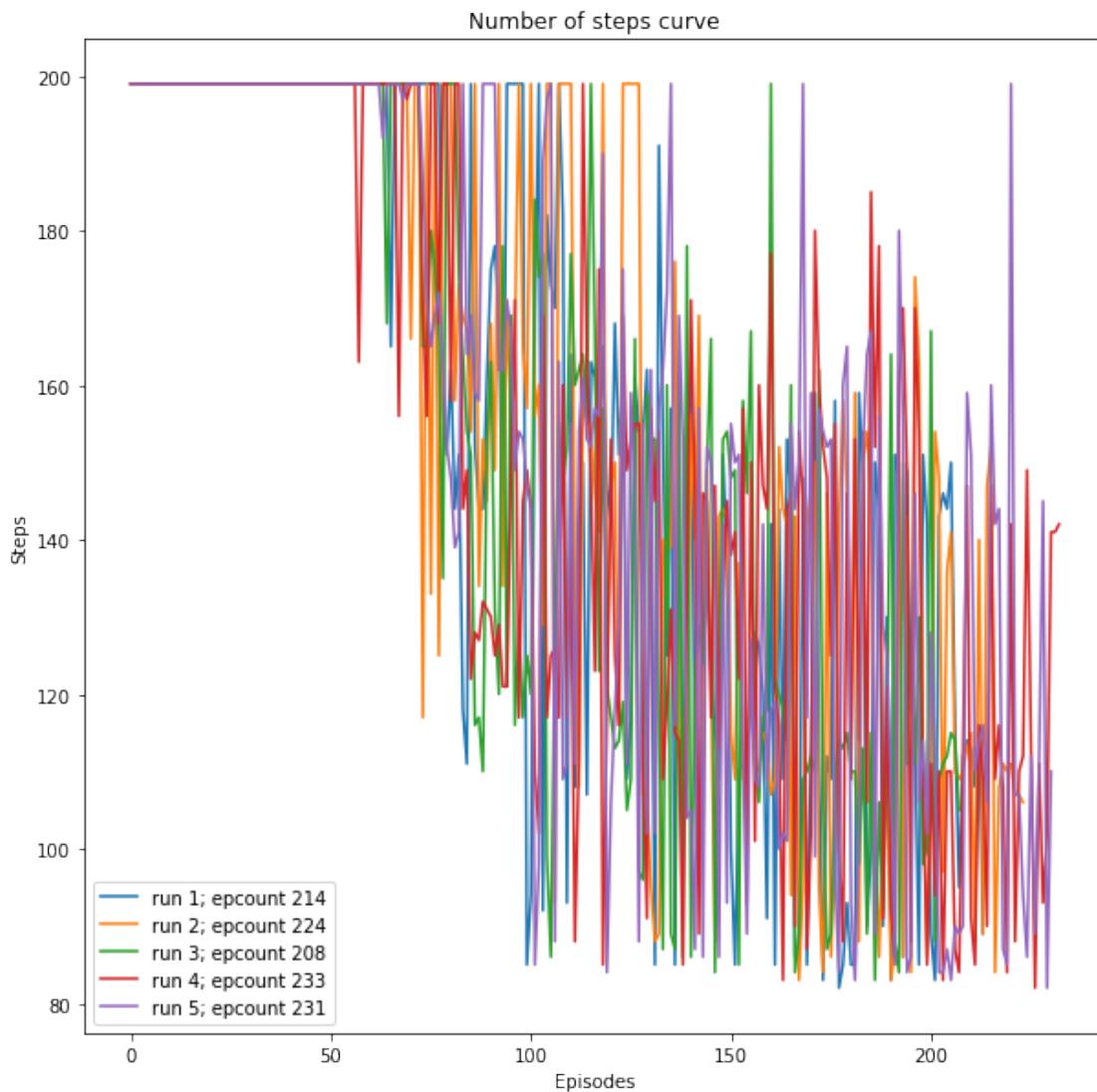
os.mkdir(PATH+'/' + fname)
run_scores, run_steps, ep_count_average, median_agent =
    ↪dqn_exp_runner('MountainCar-v0', num_runs=5, env_score_req=-125,
    ↪use_eps=True, start=10, end=0.0005, decay_factor=0.95)
print(f'Performance {ep_count_average}')
gen_plots(fname, run_scores, run_steps)
save_gif(fname, 'MountainCar-v0', median_agent, max_steps=800)

```

Saved to folder 4d441f6f-9aeb-45ef-a15b-6860aeee3f6ee

Episode 100	Average Score:	-191.22
Episode 200	Average Score:	-129.91
Episode 214	Average Score:	-124.90 eps 0.0005
Environment solved in 214 episodes!	Average Score:	-124.90
Episode 100	Average Score:	-190.80
Episode 200	Average Score:	-135.26
Episode 224	Average Score:	-124.67 eps 0.0005
Environment solved in 224 episodes!	Average Score:	-124.67
Episode 100	Average Score:	-186.87
Episode 200	Average Score:	-126.89
Episode 208	Average Score:	-124.86 eps 0.0005
Environment solved in 208 episodes!	Average Score:	-124.86
Episode 100	Average Score:	-186.80
Episode 200	Average Score:	-133.30
Episode 233	Average Score:	-124.89 eps 0.0005
Environment solved in 233 episodes!	Average Score:	-124.89
Episode 100	Average Score:	-191.35
Episode 200	Average Score:	-133.03
Episode 231	Average Score:	-124.57 eps 0.0005
Environment solved in 231 episodes!	Average Score:	-124.57
Performance	222.0	





```
[ ]: # From defaults : Learning rate changed to 9e-4, Buffer size=40000
BUFFER_SIZE = int(40000)
BATCH_SIZE = 64
GAMMA = 0.99
LR = 9e-4
UPDATE_EVERY = 20
NUM_HLAYERS = 3
HLAYER_SIZES = [64, 64, 128]
TRUNC_LIM = 1e32

fname = str(uuid.uuid4())
print(f'Saved to folder {fname}')
```

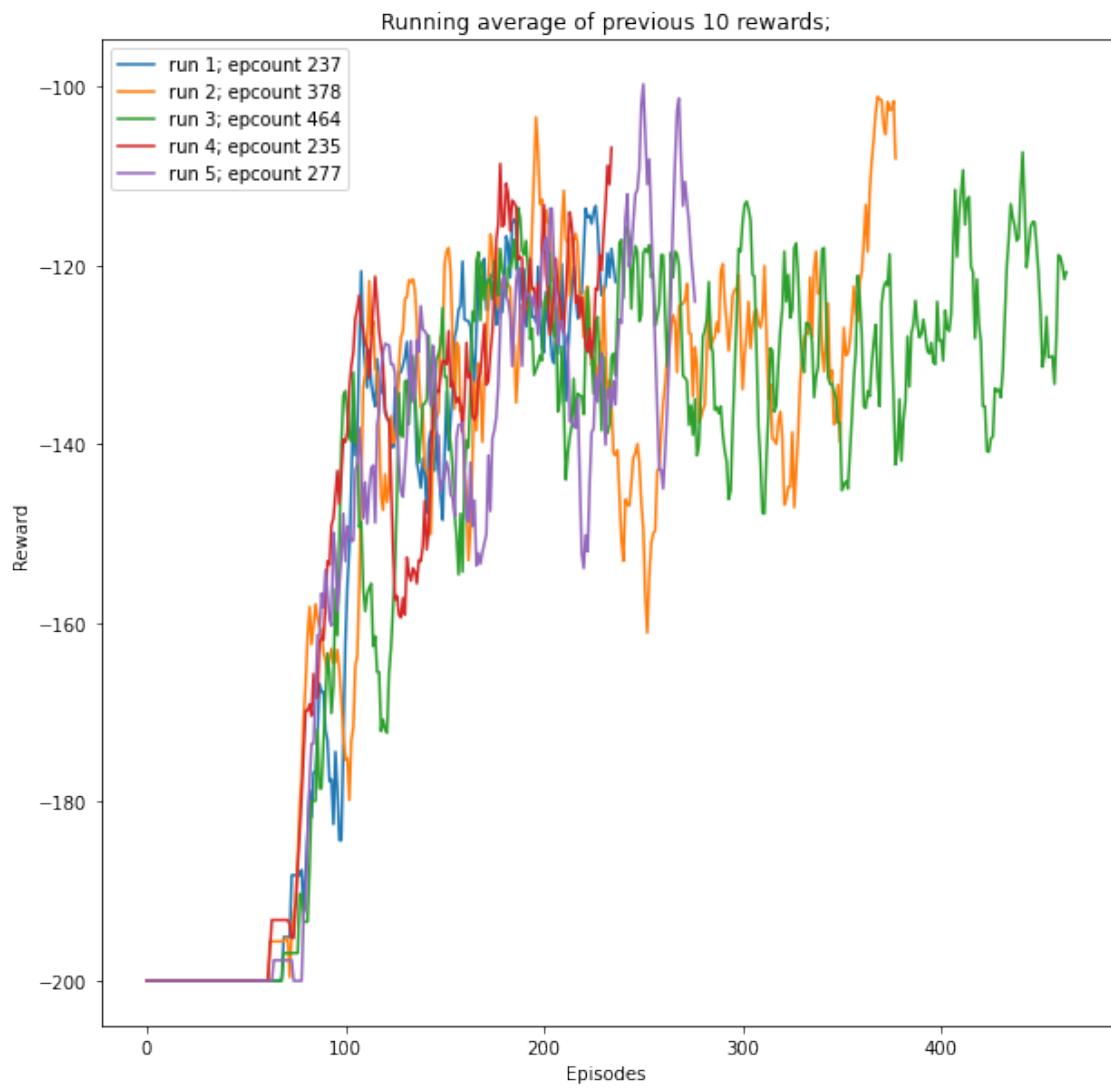
```

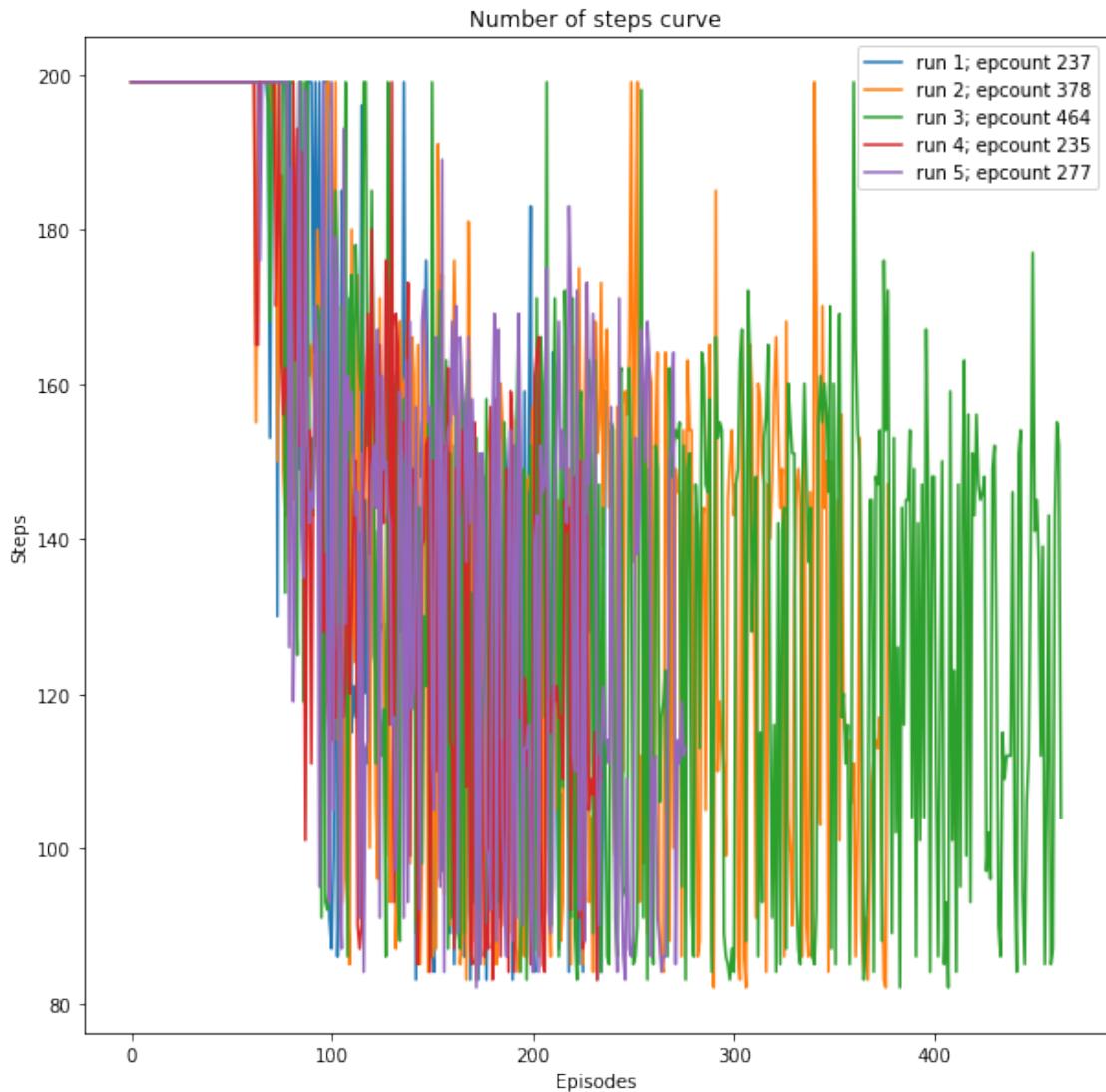
os.mkdir(PATH+'/' + fname)
run_scores, run_steps, ep_count_average, median_agent =
    ↪dqn_exp_runner('MountainCar-v0', num_runs=5, env_score_req=-125,
                    ↪use_eps=True, start=10, end=0.0005, decay_factor=0.95)
print(f'Performance {ep_count_average}')
gen_plots(fname, run_scores, run_steps)
save_gif(fname, 'MountainCar-v0', median_agent, max_steps=800)

```

Saved to folder 70b7f373-bcfe-4412-af28-ec5a0b0a3c41

Episode 100	Average Score:	-192.85
Episode 200	Average Score:	-130.04
Episode 237	Average Score:	-124.69 eps 0.0005
Environment solved in 237 episodes!	Average Score:	-124.69
Episode 100	Average Score:	-190.19
Episode 200	Average Score:	-130.76
Episode 300	Average Score:	-131.59
Episode 378	Average Score:	-124.93 eps 0.0005
Environment solved in 378 episodes!	Average Score:	-124.93
Episode 100	Average Score:	-189.85
Episode 200	Average Score:	-137.01
Episode 300	Average Score:	-127.86
Episode 400	Average Score:	-131.08
Episode 464	Average Score:	-124.78 eps 0.0005
Environment solved in 464 episodes!	Average Score:	-124.78
Episode 100	Average Score:	-186.92
Episode 200	Average Score:	-131.79
Episode 235	Average Score:	-124.85 eps 0.0005
Environment solved in 235 episodes!	Average Score:	-124.85
Episode 100	Average Score:	-189.65
Episode 200	Average Score:	-135.66
Episode 277	Average Score:	-124.96 eps 0.0005
Environment solved in 277 episodes!	Average Score:	-124.96
Performance	318.2	





```
[ ]: # From defaults : Learning rate changed to 9e-4,batch size=128
BUFFER_SIZE = int(10000)
BATCH_SIZE = 128
GAMMA = 0.99
LR = 9e-4
UPDATE_EVERY = 20
NUM_HLAYERS = 3
HLAYER_SIZES = [64, 64, 128]
TRUNC_LIM = 1e32

fname = str(uuid.uuid4())
print(f'Saved to folder {fname}')
```

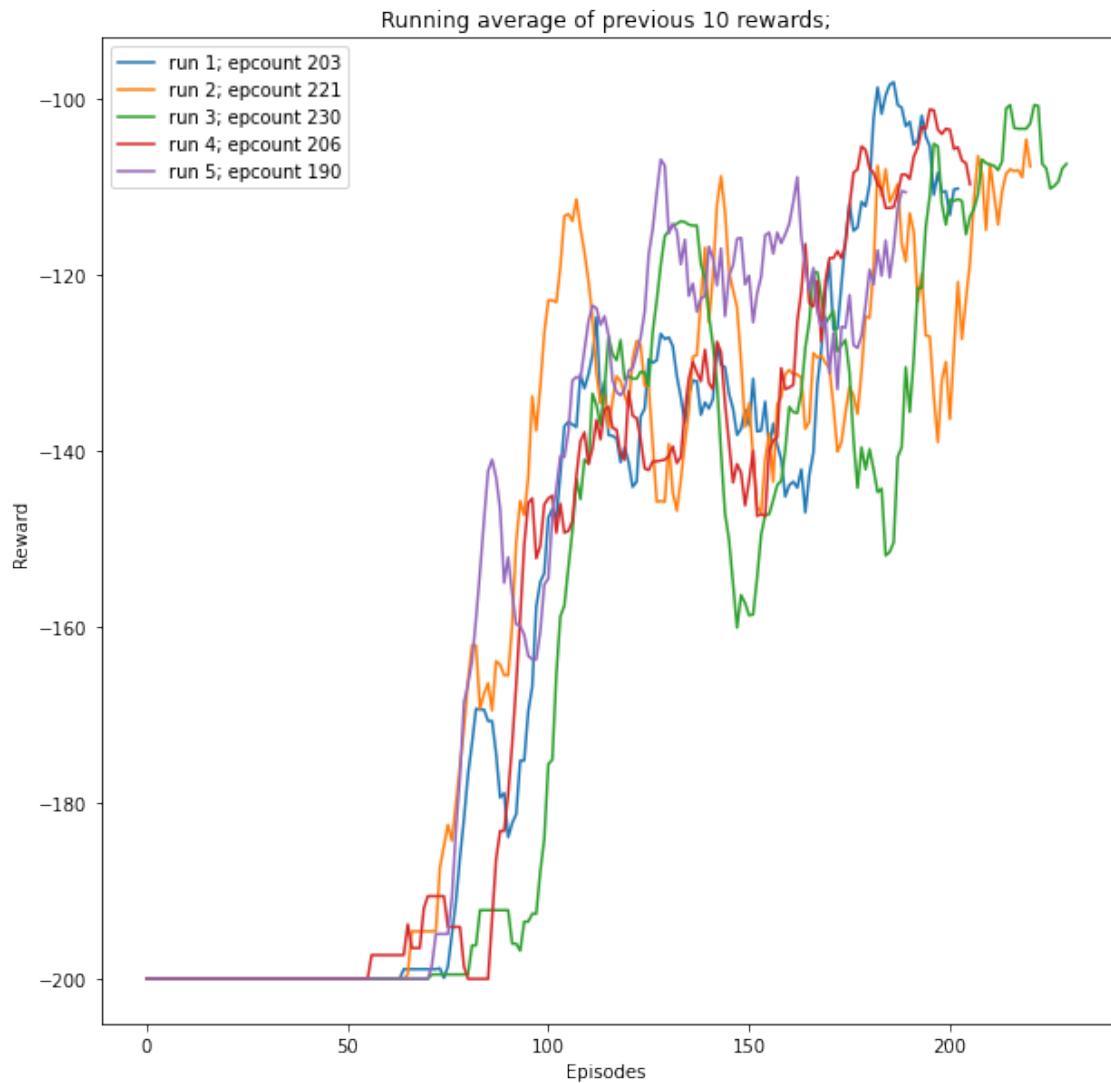
```

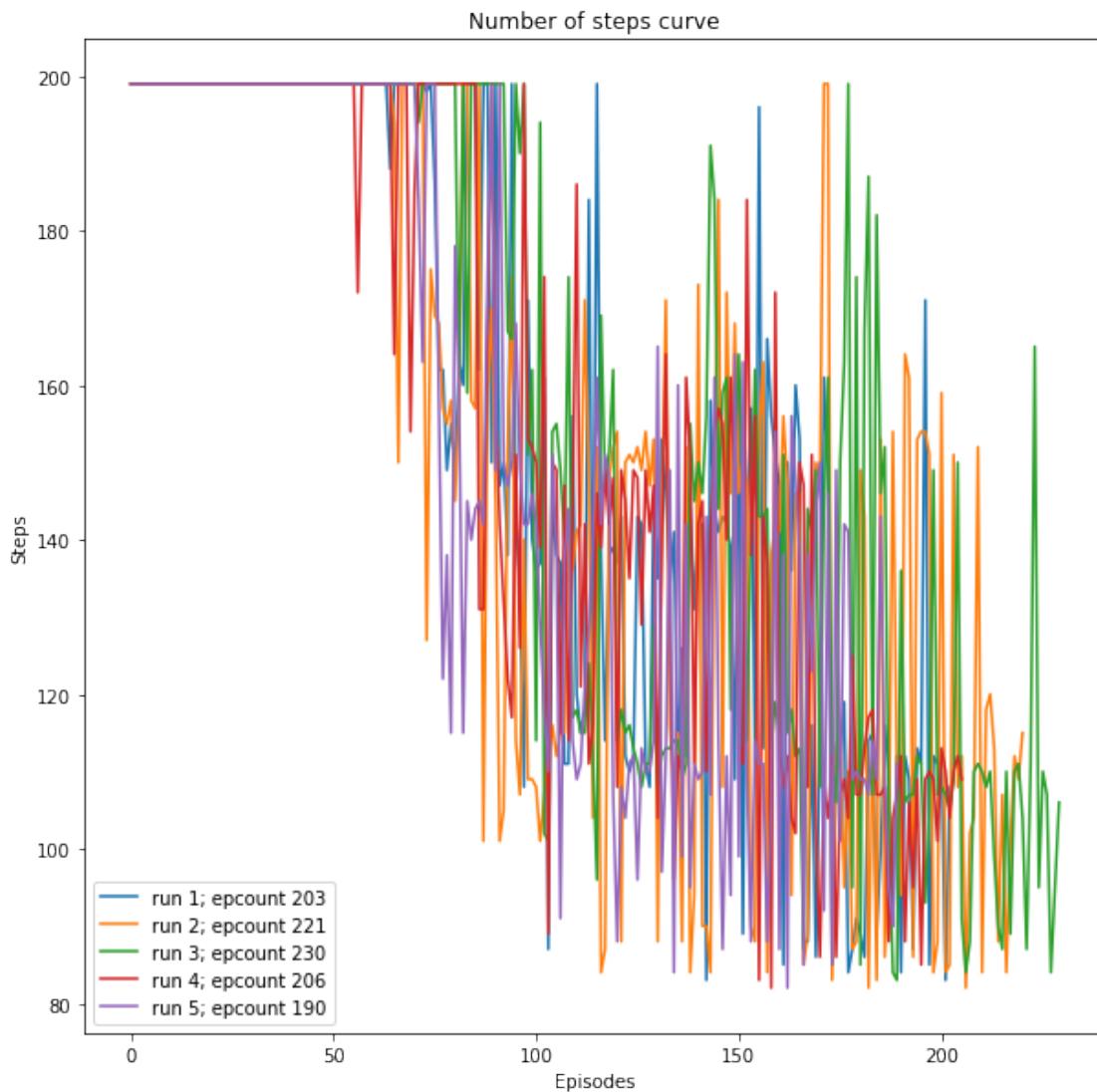
os.mkdir(PATH+'/' + fname)
run_scores, run_steps, ep_count_average, median_agent =
    ↪dqn_exp_runner('MountainCar-v0', num_runs=5, env_score_req=-125,
                    ↪use_eps=True, start=10, end=0.0005, decay_factor=0.95)
print(f'Performance {ep_count_average}')
gen_plots(fname, run_scores, run_steps)
save_gif(fname, 'MountainCar-v0', median_agent, max_steps=800)

```

Saved to folder a4cc0da5-b2b1-49b1-a61f-f0afb6309292

Episode 100	Average Score:	-191.35
Episode 200	Average Score:	-126.25
Episode 203	Average Score:	-124.93 eps 0.0005
Environment solved in 203 episodes!	Average Score:	-124.93
Episode 100	Average Score:	-185.83
Episode 200	Average Score:	-128.55
Episode 221	Average Score:	-125.00 eps 0.0005
Environment solved in 221 episodes!	Average Score:	-125.00
Episode 100	Average Score:	-197.58
Episode 200	Average Score:	-131.85
Episode 230	Average Score:	-124.81 eps 0.0005
Environment solved in 230 episodes!	Average Score:	-124.81
Episode 100	Average Score:	-191.72
Episode 200	Average Score:	-126.61
Episode 206	Average Score:	-124.68 eps 0.0005
Environment solved in 206 episodes!	Average Score:	-124.68
Episode 100	Average Score:	-187.88
Episode 190	Average Score:	-124.23 eps 0.0005854435220485529
Environment solved in 190 episodes!	Average Score:	-124.23
Performance 210.0		





```
[ ]: # From defaults : Learning rate changed to 9e-4,batch size=256
BUFFER_SIZE = int(10000)
BATCH_SIZE = 256
GAMMA = 0.99
LR = 9e-4
UPDATE_EVERY = 20
NUM_HLAYERS = 3
Hlayer_SIZES = [64,64, 128]
TRUNC_LIM = 1e32

fname = str(uuid.uuid4())
print(f'Saved to folder {fname}')
```

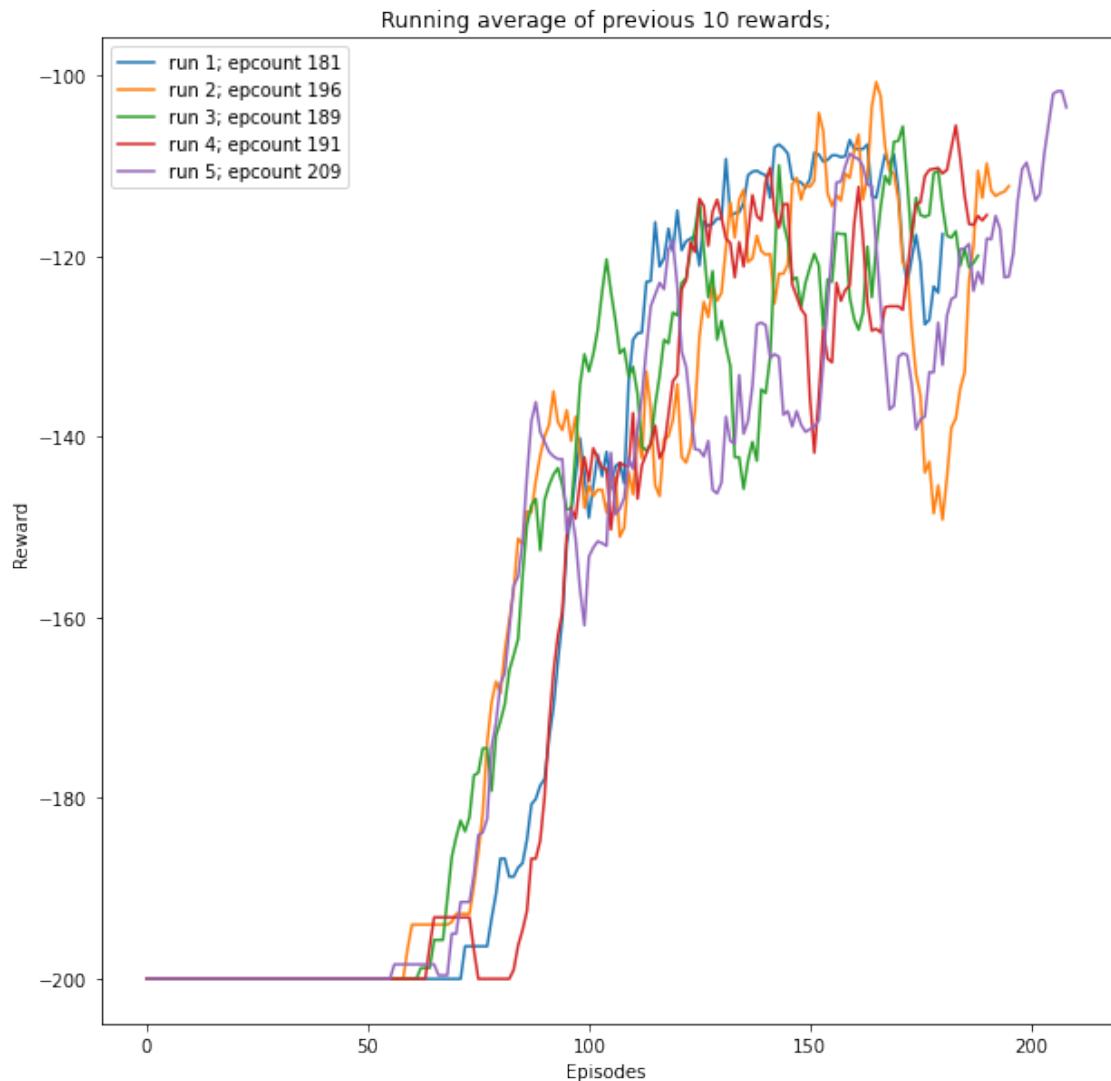
```

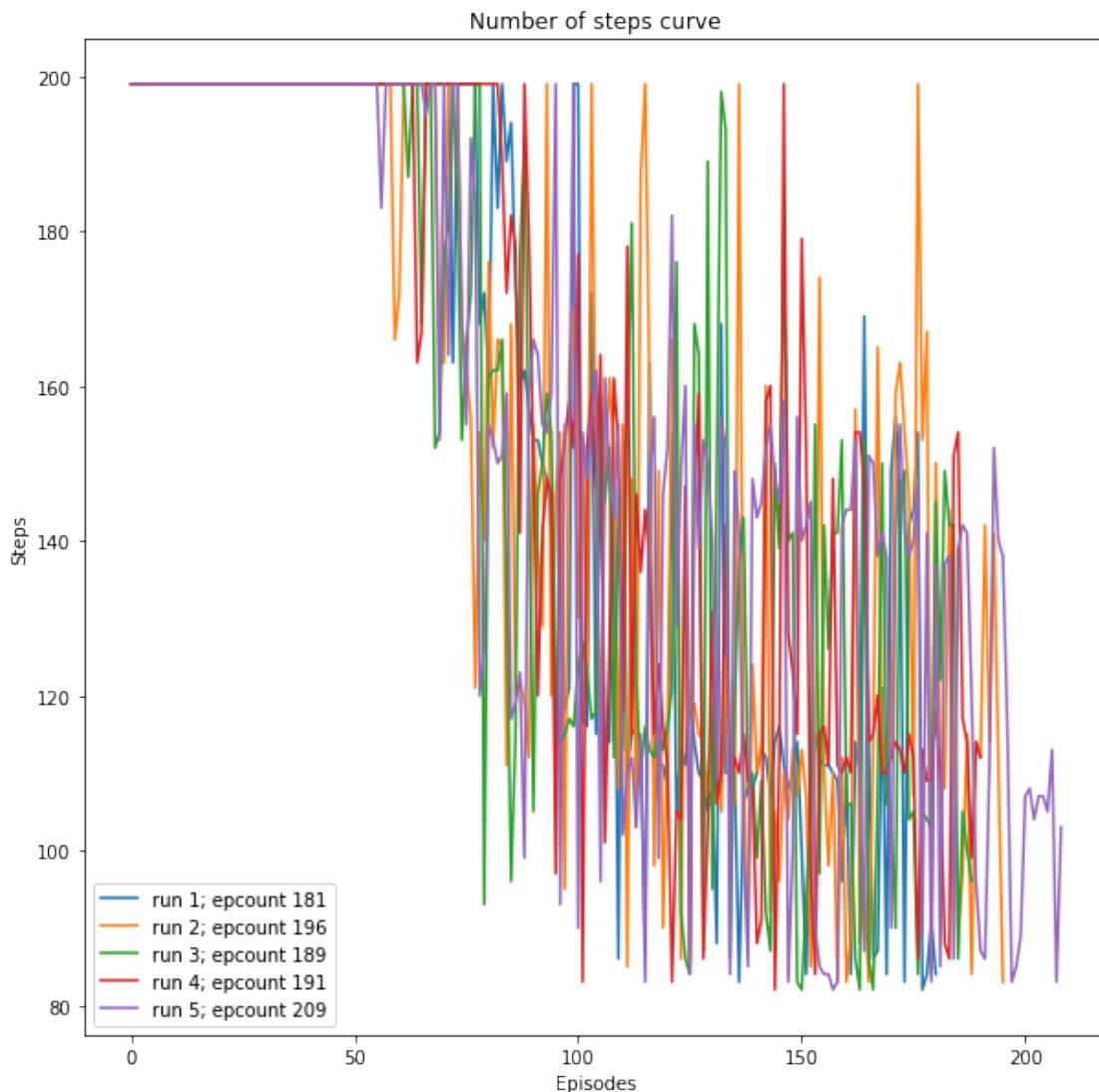
os.mkdir(PATH+'/' + fname)
run_scores, run_steps, ep_count_average, median_agent =
    ↪dqn_exp_runner('MountainCar-v0', num_runs=5, env_score_req=-125,
                    ↪use_eps=True, start=10, end=0.0005, decay_factor=0.95)
print(f'Performance {ep_count_average}')
gen_plots(fname, run_scores, run_steps)
save_gif(fname, 'MountainCar-v0', median_agent, max_steps=800)

```

Saved to folder 03a772cb-8d43-4128-82b9-18b78bc3fcf5

Episode 100	Average Score:	-191.36	
Episode 181	Average Score:	-124.82	eps 0.0009289076879966705
Environment solved in 181 episodes!		Average Score:	-124.82
Episode 100	Average Score:	-184.75	
Episode 196	Average Score:	-124.94	eps 0.0005
Environment solved in 196 episodes!		Average Score:	-124.94
Episode 100	Average Score:	-184.31	
Episode 189	Average Score:	-124.50	eps 0.0006162563389984768
Environment solved in 189 episodes!		Average Score:	-124.50
Episode 100	Average Score:	-192.02	
Episode 191	Average Score:	-124.75	eps 0.0005561713459461252
Environment solved in 191 episodes!		Average Score:	-124.75
Episode 100	Average Score:	-186.55	
Episode 200	Average Score:	-127.95	
Episode 209	Average Score:	-124.73	eps 0.0005
Environment solved in 209 episodes!		Average Score:	-124.73
Performance 193.2			





```
[ ]: # From defaults : Learning rate changed to 9e-4, batch size=256, update every=50
BUFFER_SIZE = int(10000)
BATCH_SIZE = 256
GAMMA = 0.99
LR = 9e-4
UPDATE_EVERY = 50
NUM_HLAYERS = 3
HLAYER_SIZES = [64, 64, 128]
TRUNC_LIM = 1e32

fname = str(uuid.uuid4())
print(f'Saved to folder {fname}')
```

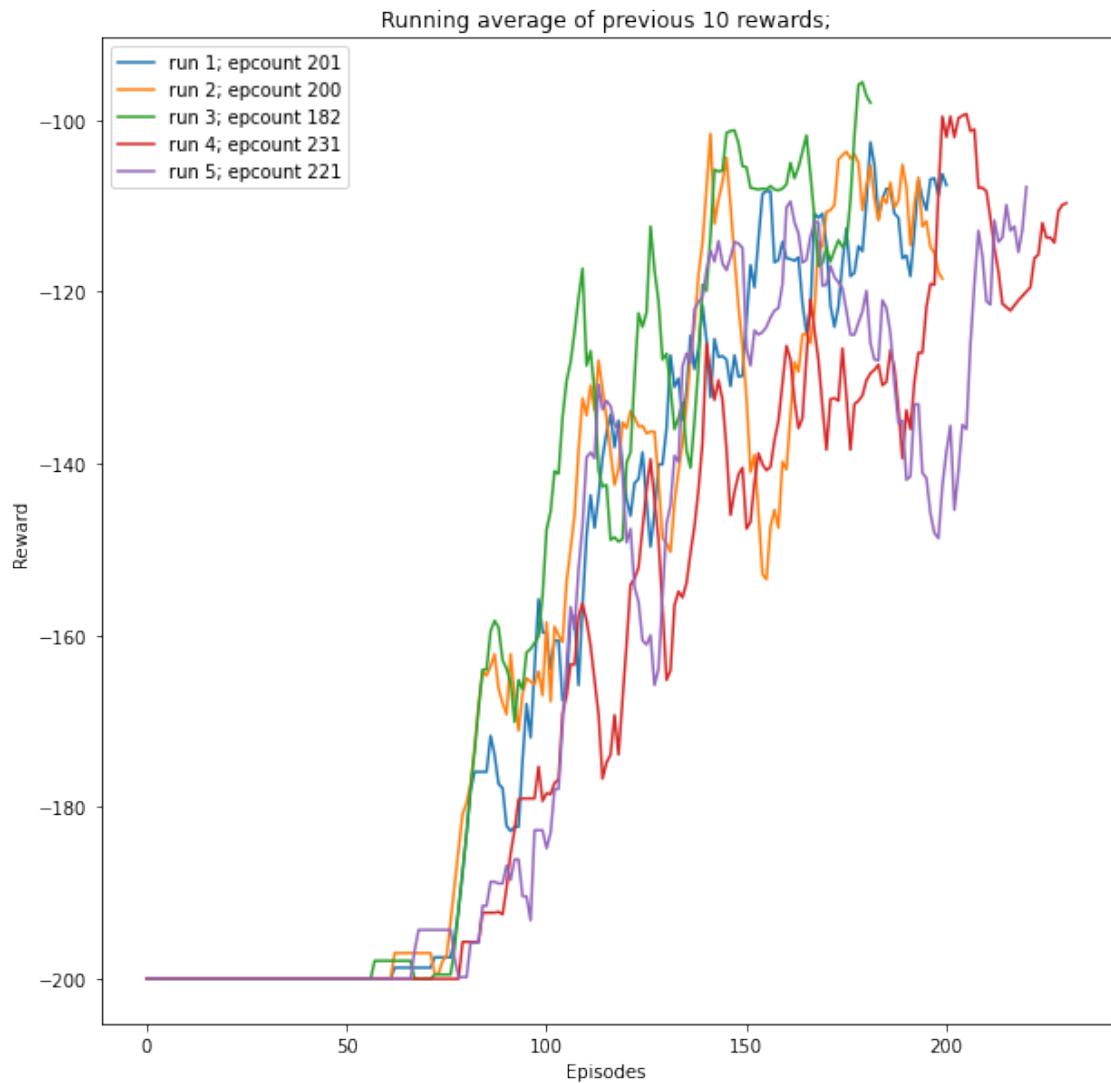
```

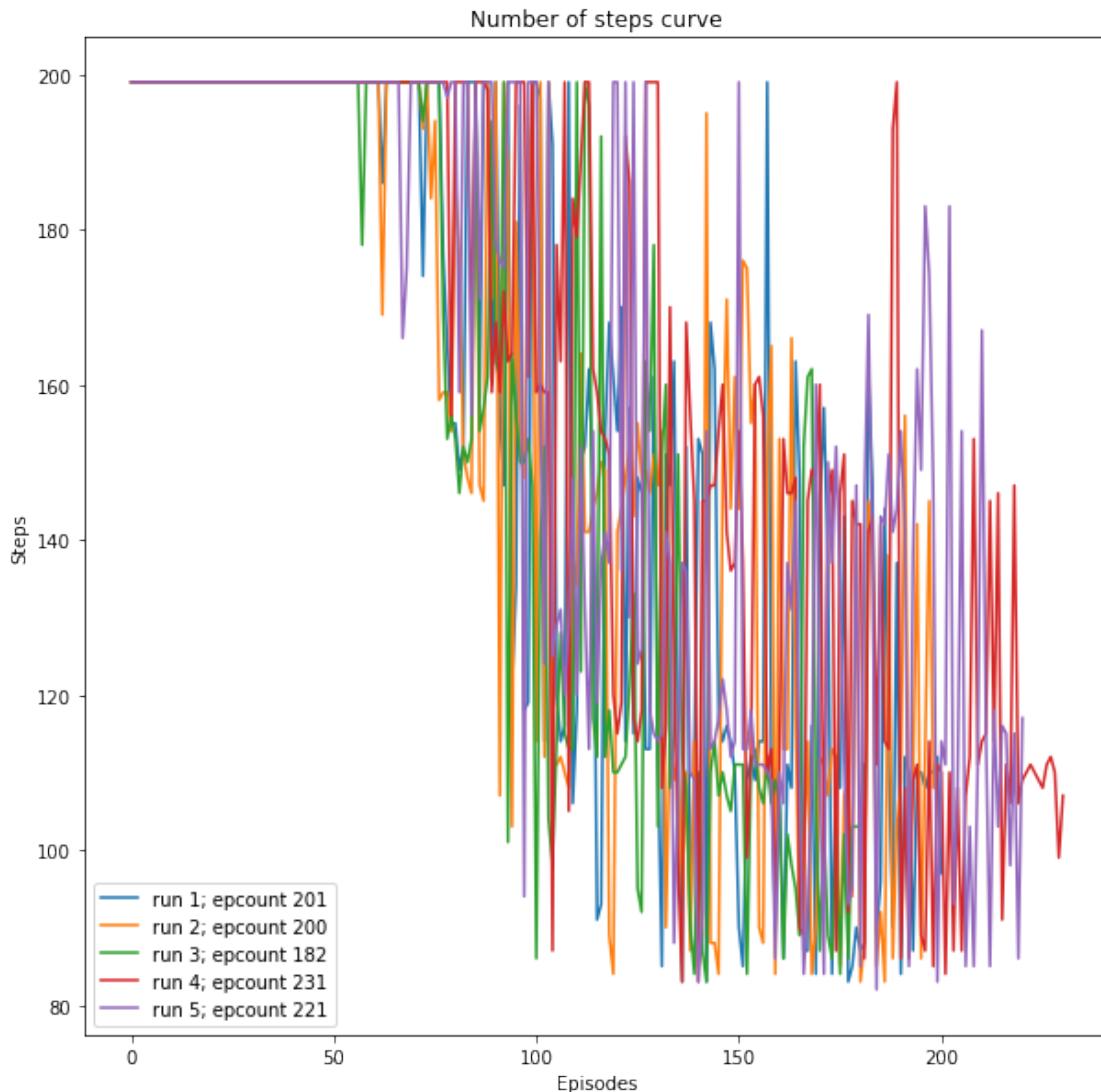
os.mkdir(PATH+'/' + fname)
run_scores, run_steps, ep_count_average, median_agent =
    ↪dqn_exp_runner('MountainCar-v0', num_runs=5, env_score_req=-125,
    ↪use_eps=True, start=10, end=0.0005, decay_factor=0.95)
print(f'Performance {ep_count_average}')
gen_plots(fname, run_scores, run_steps)
save_gif(fname, 'MountainCar-v0', median_agent, max_steps=800)

```

Saved to folder e84ca841-d473-4609-b3ff-4d1a23e8ff5f

Episode 100	Average Score:	-192.37
Episode 200	Average Score:	-125.13
Episode 201	Average Score:	-124.11 eps 0.0005
Environment solved in 201 episodes!		Average Score: -124.11
Episode 100	Average Score:	-191.27
Episode 200	Average Score:	-124.58
Environment solved in 200 episodes!		Average Score: -124.58
Episode 100	Average Score:	-190.38
Episode 182	Average Score:	-124.87 eps 0.0008824623035968369
Environment solved in 182 episodes!		Average Score: -124.87
Episode 100	Average Score:	-196.75
Episode 200	Average Score:	-139.39
Episode 231	Average Score:	-124.24 eps 0.0005
Environment solved in 231 episodes!		Average Score: -124.24
Episode 100	Average Score:	-196.57
Episode 200	Average Score:	-131.78
Episode 221	Average Score:	-124.97 eps 0.0005
Environment solved in 221 episodes!		Average Score: -124.97
Performance 207.0		





```
[ ]: # From defaults : Learning rate changed to 9e-4, batch size=256, update every=100
BUFFER_SIZE = int(10000)
BATCH_SIZE = 256
GAMMA = 0.99
LR = 9e-4
UPDATE_EVERY = 100
NUM_HLAYERS = 3
HLAYER_SIZES = [64, 64, 128]
TRUNC_LIM = 1e32

fname = str(uuid.uuid4())
print(f'Saved to folder {fname}')
```

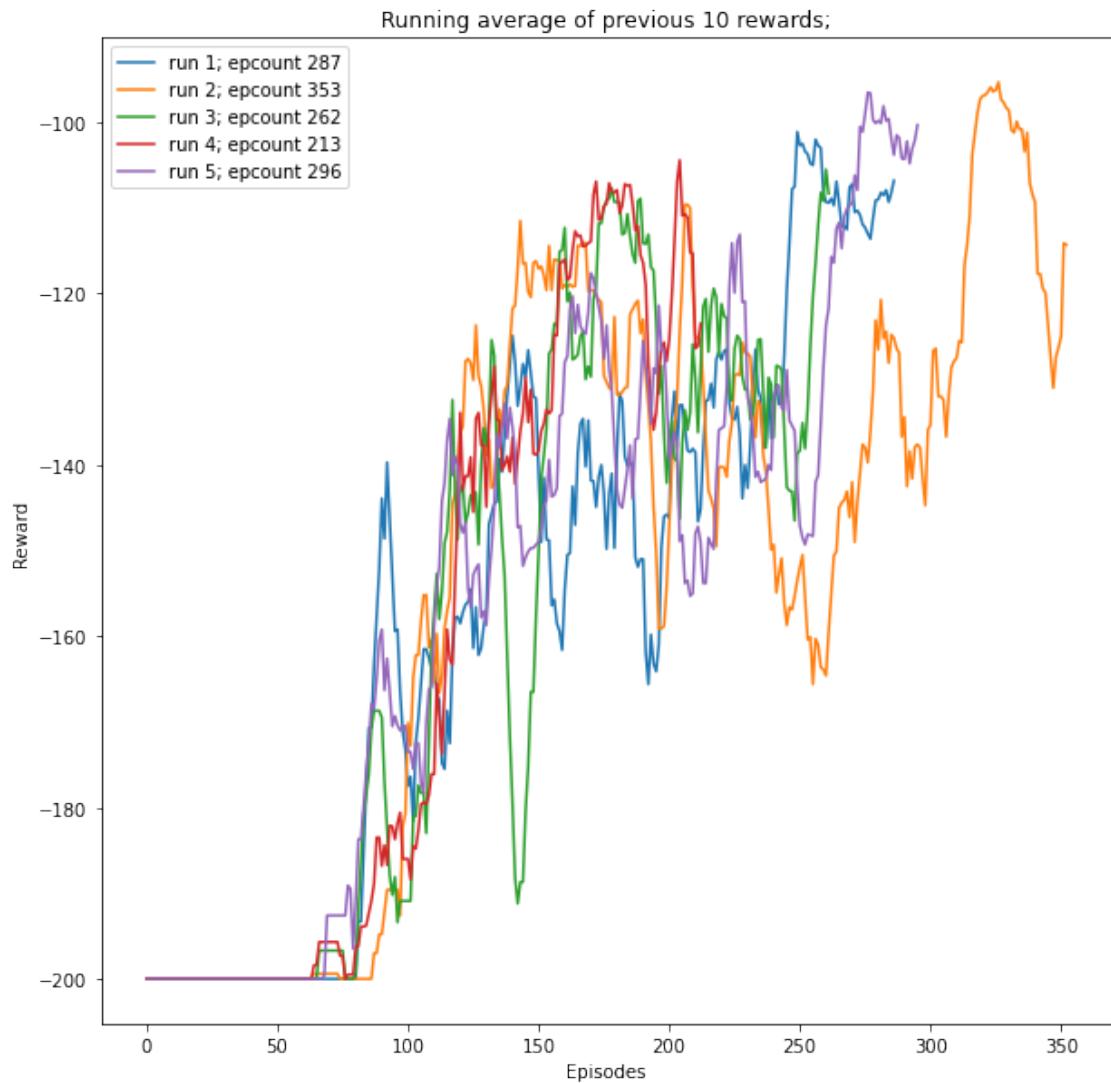
```

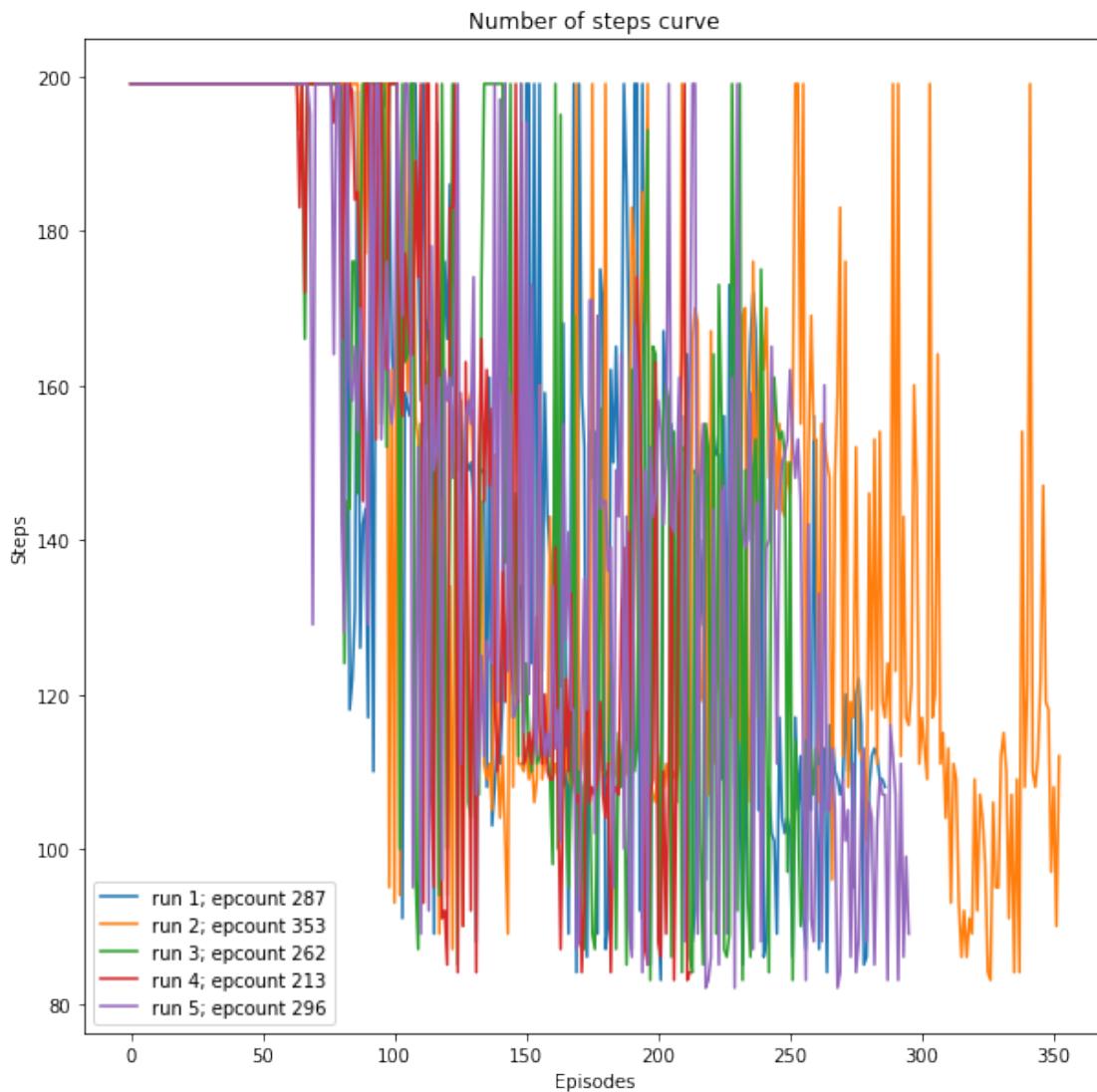
os.mkdir(PATH+'/' + fname)
run_scores, run_steps, ep_count_average, median_agent =
    ↪dqn_exp_runner('MountainCar-v0', num_runs=5, env_score_req=-125,
                    ↪use_eps=True, start=10, end=0.0005, decay_factor=0.95)
print(f'Performance {ep_count_average}')
gen_plots(fname, run_scores, run_steps)
save_gif(fname, 'MountainCar-v0', median_agent, max_steps=800)

```

Saved to folder bbc2aebf-d1ca-4735-87e4-e8c7634d54be

Episode 100	Average Score:	-192.53
Episode 200	Average Score:	-148.38
Episode 287	Average Score:	-124.64 eps 0.0005
Environment solved in 287 episodes!	Average Score:	-124.64
Episode 100	Average Score:	-197.49
Episode 200	Average Score:	-131.80
Episode 300	Average Score:	-139.56
Episode 353	Average Score:	-124.48 eps 0.0005
Environment solved in 353 episodes!	Average Score:	-124.48
Episode 100	Average Score:	-195.63
Episode 200	Average Score:	-137.91
Episode 262	Average Score:	-124.43 eps 0.0005
Environment solved in 262 episodes!	Average Score:	-124.43
Episode 100	Average Score:	-196.47
Episode 200	Average Score:	-132.07
Episode 213	Average Score:	-124.74 eps 0.0005
Environment solved in 213 episodes!	Average Score:	-124.74
Episode 100	Average Score:	-192.01
Episode 200	Average Score:	-140.26
Episode 296	Average Score:	-124.87 eps 0.0005
Environment solved in 296 episodes!	Average Score:	-124.87
Performance 282.2		





```
[ ]: # From defaults : Learning rate changed to 9e-4, batch size=256, decay factor=0.8
BUFFER_SIZE = int(10000)
BATCH_SIZE = 256
GAMMA = 0.99
LR = 9e-4
UPDATE_EVERY = 20
NUM_HLAYERS = 3
HLAYER_SIZES = [64, 64, 128]
TRUNC_LIM = 1e32

fname = str(uuid.uuid4())
print(f'Saved to folder {fname}')
```

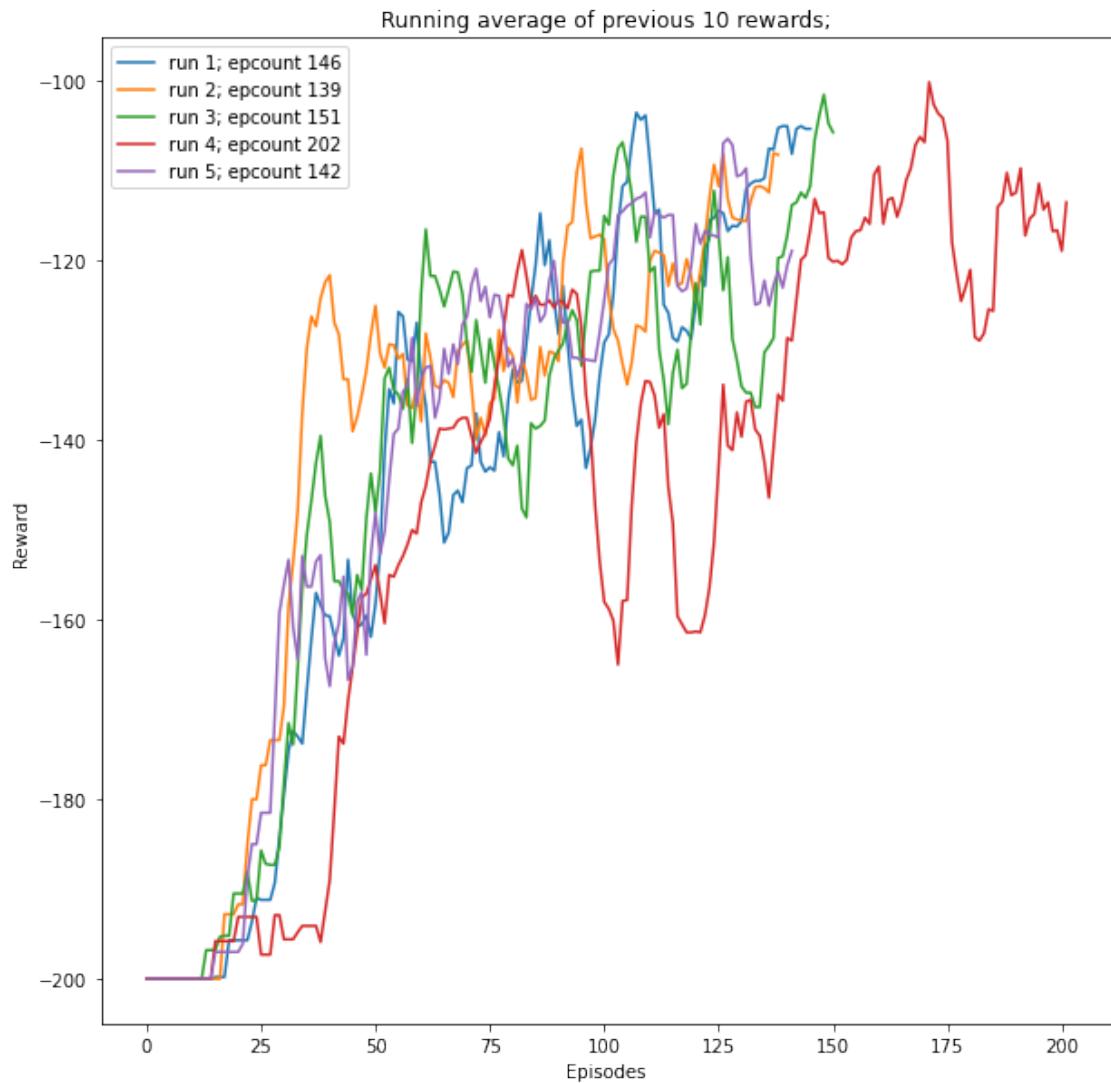
```

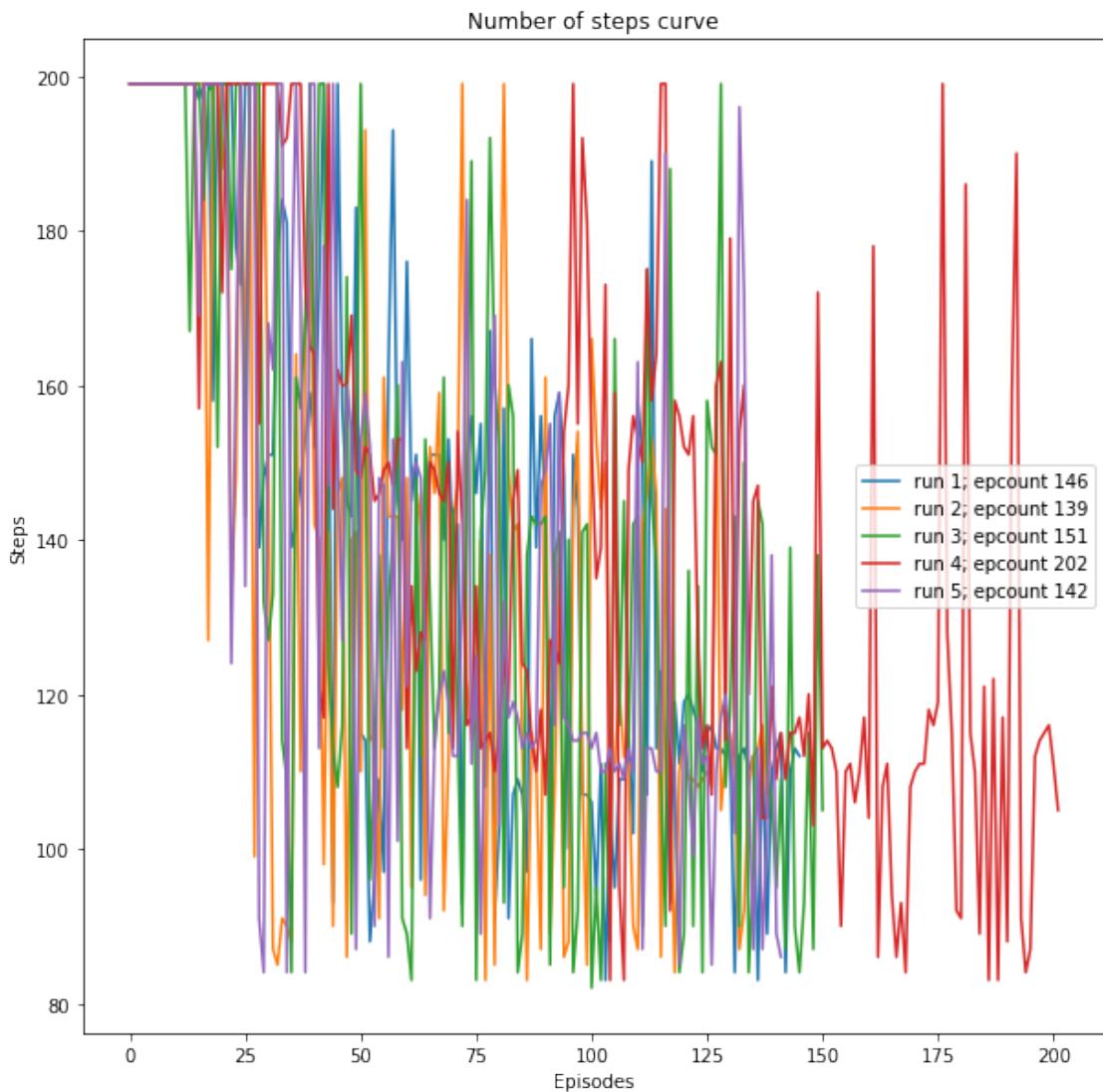
os.mkdir(PATH+'/' + fname)
run_scores, run_steps, ep_count_average, median_agent =
    ↪dqn_exp_runner('MountainCar-v0', num_runs=5, env_score_req=-125,
                    ↪use_eps=True, start=10, end=0.0005, decay_factor=0.8)
print(f'Performance {ep_count_average}')
gen_plots(fname, run_scores, run_steps)
save_gif(fname, 'MountainCar-v0', median_agent, max_steps=800)

```

Saved to folder 1fa6045d-759d-4a77-85fb-8e962cc23193

Episode 100	Average Score:	-156.77
Episode 146	Average Score:	-124.86
Environment solved in 146 episodes!	Average Score:	-124.86
Episode 100	Average Score:	-145.74
Episode 139	Average Score:	-124.90
Environment solved in 139 episodes!	Average Score:	-124.90
Episode 100	Average Score:	-151.79
Episode 151	Average Score:	-124.11
Environment solved in 151 episodes!	Average Score:	-124.11
Episode 100	Average Score:	-162.71
Episode 200	Average Score:	-125.58
Episode 202	Average Score:	-124.87
Environment solved in 202 episodes!	Average Score:	-124.87
Episode 100	Average Score:	-151.63
Episode 142	Average Score:	-124.87
Environment solved in 142 episodes!	Average Score:	-124.87
Performance 156.0		





```
[ ]: # From defaults : Learning rate changed to 9e-4, batch size=256, decay factor=0.
      ↵8, epsilon_end=0.00001
BUFFER_SIZE = int(10000)
BATCH_SIZE = 256
GAMMA = 0.99
LR = 9e-4
UPDATE_EVERY = 20
NUM_HLAYERS = 3
HLAYER_SIZES = [64, 64, 128]
TRUNC_LIM = 1e32

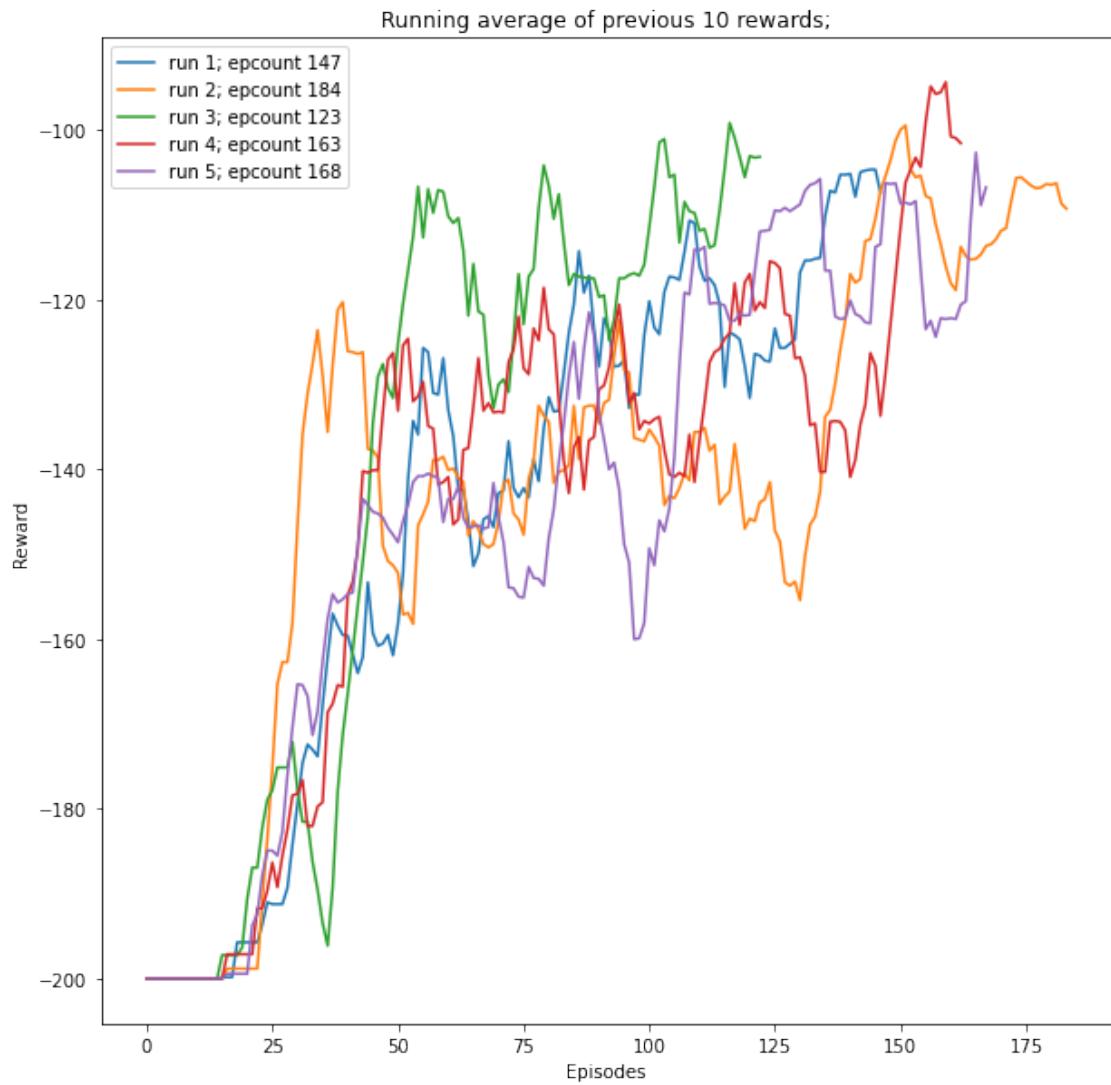
fname = str(uuid.uuid4())
```

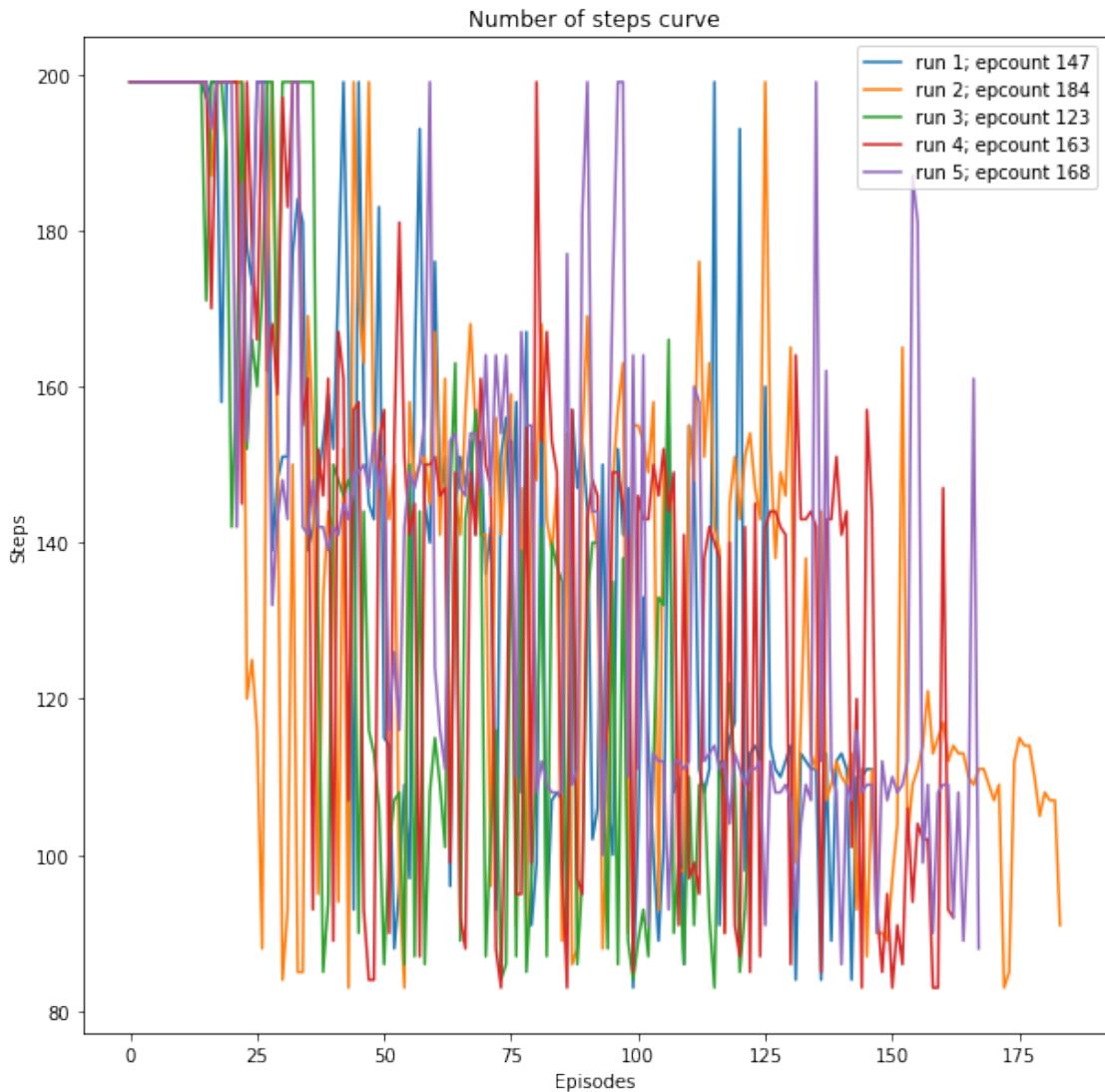
```

print(f'Saved to folder {fname}')
os.mkdir(PATH+'/'+fname)
run_scores, run_steps, ep_count_average, median_agent =
    ↪dqn_exp_runner('MountainCar-v0', num_runs=5, env_score_req=-125,
    ↪use_eps=True, start=10, end=0.00001, decay_factor=0.8)
print(f'Performance {ep_count_average}')
gen_plots(fname, run_scores, run_steps)
save_gif(fname, 'MountainCar-v0', median_agent,max_steps=800)

```

Saved to folder ca92f8da-5c7f-429d-8206-961487c01341
 Episode 100 Average Score: -155.78
 Episode 147 Average Score: -124.84 eps 1e-05
 Environment solved in 147 episodes! Average Score: -124.84
 Episode 100 Average Score: -151.87
 Episode 184 Average Score: -124.57 eps 1e-05
 Environment solved in 184 episodes! Average Score: -124.57
 Episode 100 Average Score: -144.90
 Episode 123 Average Score: -124.64 eps 1e-05
 Environment solved in 123 episodes! Average Score: -124.64
 Episode 100 Average Score: -153.13
 Episode 163 Average Score: -124.47 eps 1e-05
 Environment solved in 163 episodes! Average Score: -124.47
 Episode 100 Average Score: -159.66
 Episode 168 Average Score: -124.91 eps 1e-05
 Environment solved in 168 episodes! Average Score: -124.91
 Performance 157.0





```
[ ]: # From defaults : Learning rate changed to 9e-4, batch size=256, decay factor=0.
      ↵8, epsilon_end=0.00001, eps_start=40, softmax
BUFFER_SIZE = int(10000)
BATCH_SIZE = 256
GAMMA = 0.99
LR = 9e-4
UPDATE_EVERY = 20
NUM_HLAYERS = 3
HLAYER_SIZES = [64, 64, 128]
TRUNC_LIM = 1e32

fname = str(uuid.uuid4())
```

```

print(f'Saved to folder {fname}')
os.mkdir(PATH+'/'+fname)
run_scores, run_steps, ep_count_average, median_agent =
    ↪dqn_exp_runner('MountainCar-v0', num_runs=5, env_score_req=-125,
    ↪use_eps=False, start=40, end=0.00001, decay_factor=0.8)
print(f'Performance {ep_count_average}')
gen_plots(fname, run_scores, run_steps)
save_gif(fname, 'MountainCar-v0', median_agent, max_steps=800)

```

```

Saved to folder bca7894b-2d38-4254-8920-e844510acfd0
Episode 100      Average Score: -187.21
Episode 200      Average Score: -133.73
Episode 227      Average Score: -124.96  eps 0.05
Environment solved in 227 episodes!      Average Score: -124.96
Episode 100      Average Score: -163.97
Episode 149      Average Score: -124.44  eps 0.05
Environment solved in 149 episodes!      Average Score: -124.44
Episode 100      Average Score: -158.86
Episode 172      Average Score: -124.81  eps 0.05
Environment solved in 172 episodes!      Average Score: -124.81
Episode 100      Average Score: -156.14
Episode 146      Average Score: -124.61  eps 0.05
Environment solved in 146 episodes!      Average Score: -124.61
Episode 100      Average Score: -174.40
Episode 200      Average Score: -132.04
Episode 244      Average Score: -124.42  eps 0.05
Environment solved in 244 episodes!      Average Score: -124.42
Performance 187.6

<ipython-input-6-4c3fc3a85a06>:66: RuntimeWarning: divide by zero encountered in
true_divide
    return self.rsg.choice(np.arange(self.action_size), size=1,
p=softmax(a_values/beta))[0]
/usr/local/lib/python3.9/dist-packages/scipy/special/_logsumexp.py:224:
RuntimeWarning: invalid value encountered in subtract
    exp_x_shifted = np.exp(x - x_max)

```

```

ValueError                                     Traceback (most recent call last)
<ipython-input-11-2f9cfdaad50c> in <module>
    17 print(f'Performance {ep_count_average}')
    18 gen_plots(fname, run_scores, run_steps)
--> 19 save_gif(fname, 'MountainCar-v0', median_agent, max_steps=800)

<ipython-input-9-263e050ea415> in save_gif(fname, env_name, torchagent, ↪
    ↪max_steps)
    58     display.start()

```

```

  59      # Save GIF image
---> 60      images = render_episode(env_name, torchagent, max_steps)
  61      image_file = PATH+'/'+fname+f'/render.gif'
  62      # loop=0: loop forever, duration=1: play each frame for 1ms

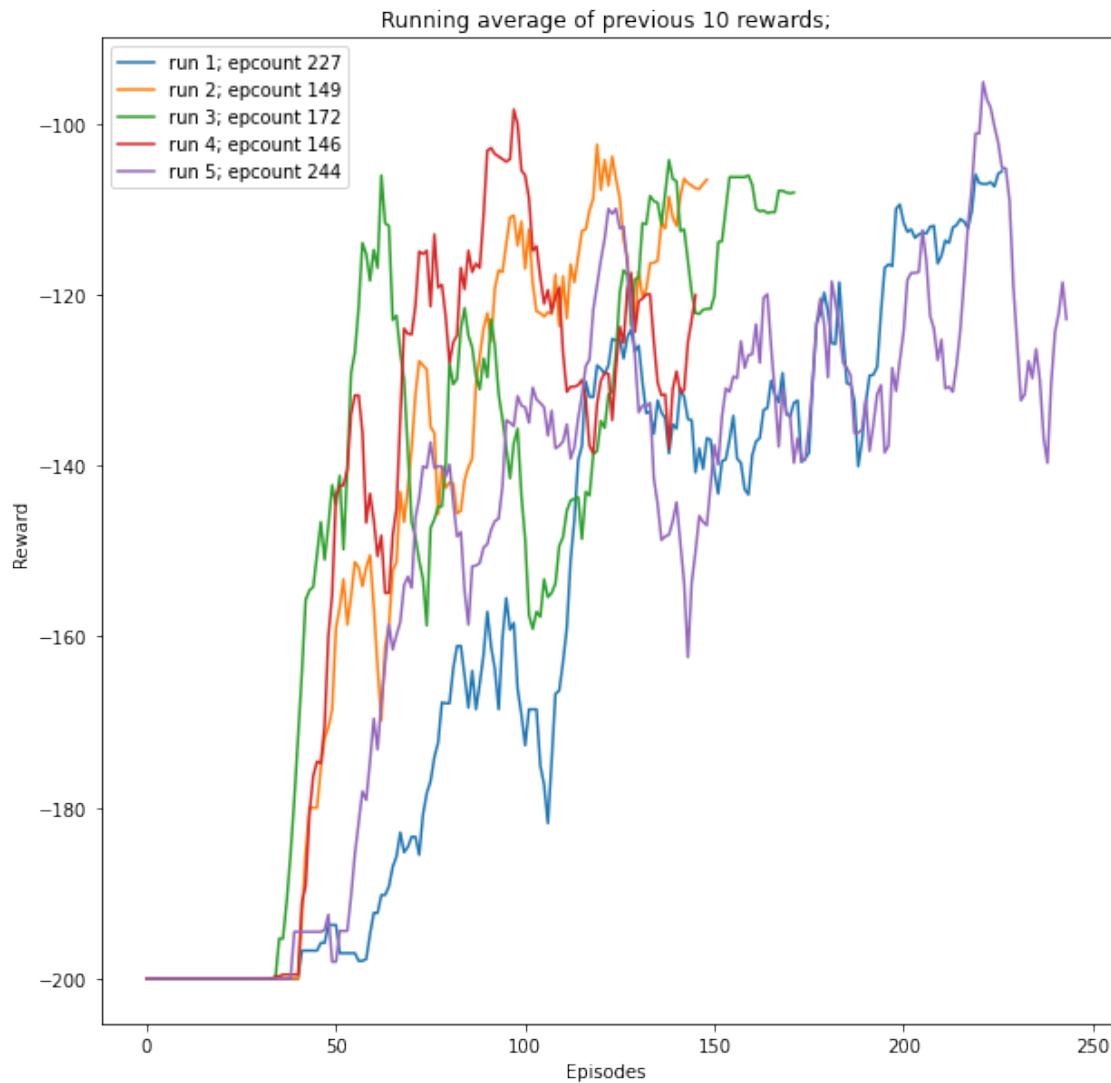
<ipython-input-9-263e050ea415> in render_episode(env_name, agent, max_steps)
    41      state = env.reset()
    42      for i in range(1, max_steps + 1):
---> 43          action = agent.act(state, 0.0)
    44          state, _, done, _ = env.step(action)
    45

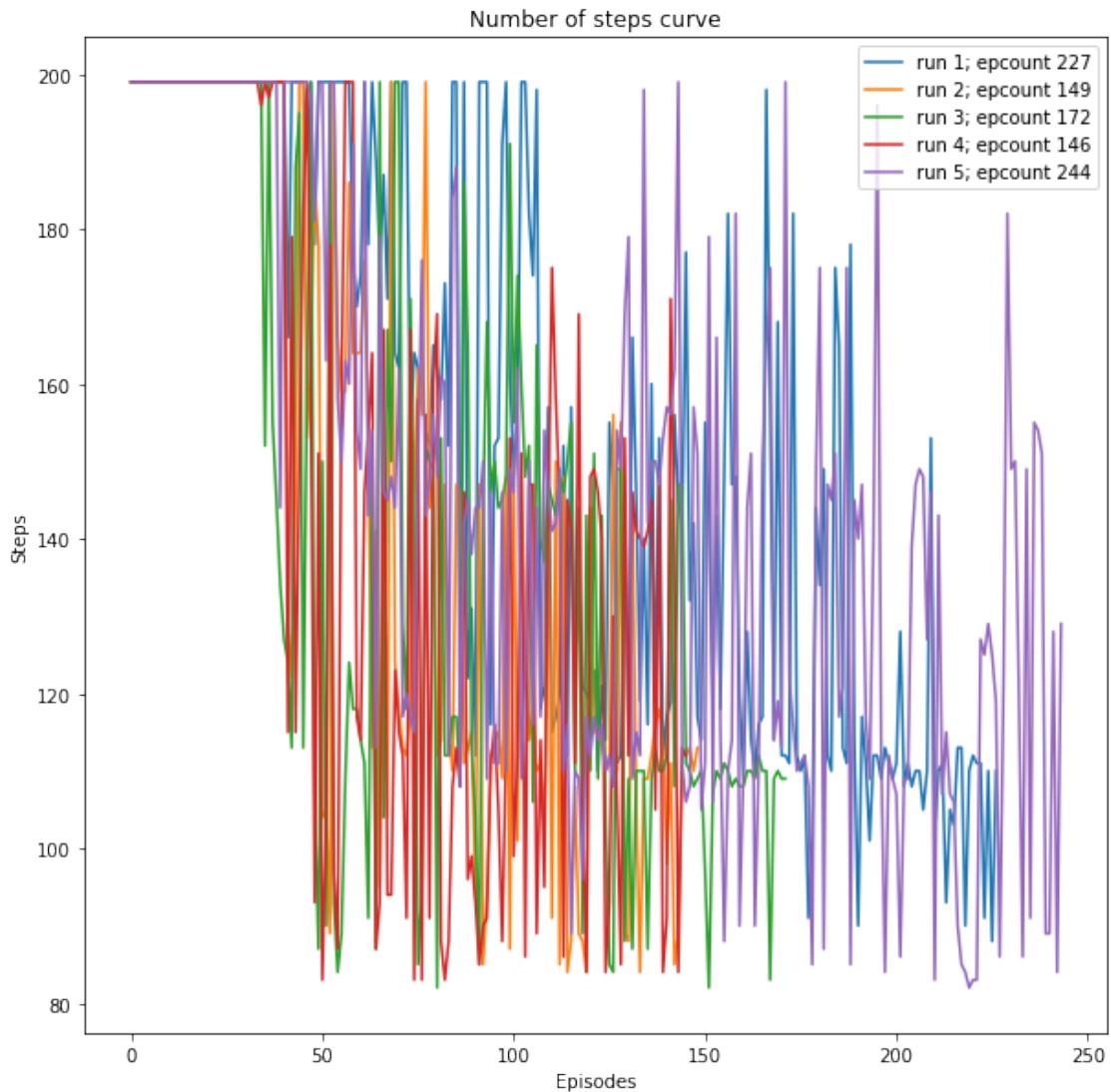
<ipython-input-6-4c3fc3a85a06> in soft_act(self, state, beta)
    64      ''' Softmax action selection (Implemented) '''
    65      a_values = torch.squeeze(action_values).cpu().squeeze().data.
->numpy()
---> 66      return self.rsg.choice(np.arange(self.action_size), size=1, u
->p=softmax(a_values/beta))[0]
    67
    68      def learn(self, experiences, gamma):

mtrand.pyx in numpy.random.mtrand.RandomState.choice()

ValueError: probabilities contain NaN

```





```
[ ]: # From defaults : Learning rate changed to 9e-4,batch size=256,decay factor=0.
      ↵6,epsilon_end=0.00001,eps start=40,softmax
BUFFER_SIZE = int(10000)
BATCH_SIZE = 256
GAMMA = 0.99
LR = 9e-4
UPDATE_EVERY = 20
NUM_HLAYERS = 3
HLAYER_SIZES = [64,64, 128]
TRUNC_LIM = 1e32

fname = str(uuid.uuid4())
```

```

print(f'Saved to folder {fname}')
os.mkdir(PATH+'/' + fname)
run_scores, run_steps, ep_count_average, median_agent = 
    ↪dqn_exp_runner('MountainCar-v0', num_runs=5, env_score_req=-125,
    ↪use_eps=False, start=40, end=0.00001, decay_factor=0.6)
print(f'Performance {ep_count_average}')
gen_plots(fname, run_scores, run_steps)
save_gif(fname, 'MountainCar-v0', median_agent, max_steps=800)

```

```

Saved to folder 762cfa7c-21b7-4969-a369-6c6605862464
Episode 100      Average Score: -152.92
Episode 155      Average Score: -124.65  eps 0.05
Environment solved in 155 episodes!      Average Score: -124.65
Episode 100      Average Score: -148.94
Episode 142      Average Score: -124.71  eps 0.05
Environment solved in 142 episodes!      Average Score: -124.71
Episode 100      Average Score: -150.10
Episode 145      Average Score: -124.34  eps 0.05
Environment solved in 145 episodes!      Average Score: -124.34
Episode 100      Average Score: -150.29
Episode 131      Average Score: -124.85  eps 0.05
Environment solved in 131 episodes!      Average Score: -124.85
Episode 100      Average Score: -147.13
Episode 157      Average Score: -124.77  eps 0.05
Environment solved in 157 episodes!      Average Score: -124.77
Performance 146.0

<ipython-input-6-4c3fc3a85a06>:66: RuntimeWarning: divide by zero encountered in
true_divide
    return self.rsg.choice(np.arange(self.action_size), size=1,
p=softmax(a_values/beta))[0]
/usr/local/lib/python3.9/dist-packages/scipy/special/_logsumexp.py:224:
RuntimeWarning: invalid value encountered in subtract
    exp_x_shifted = np.exp(x - x_max)

```

ValueError <ipython-input-12-c205fe7702cf> in <module> 17 print(f'Performance {ep_count_average}') 18 gen_plots(fname, run_scores, run_steps) ---> 19 save_gif(fname, 'MountainCar-v0', median_agent, max_steps=800) <ipython-input-9-263e050ea415> in save_gif(fname, env_name, torchagent, max_steps) 58 display.start() 59 # Save GIF image ---> 60 images = render_episode(env_name, torchagent, max_steps)	Traceback (most recent call last)
--	--

```

61     image_file = PATH+'/' + fname+f'/render.gif'
62     # loop=0: loop forever, duration=1: play each frame for 1ms

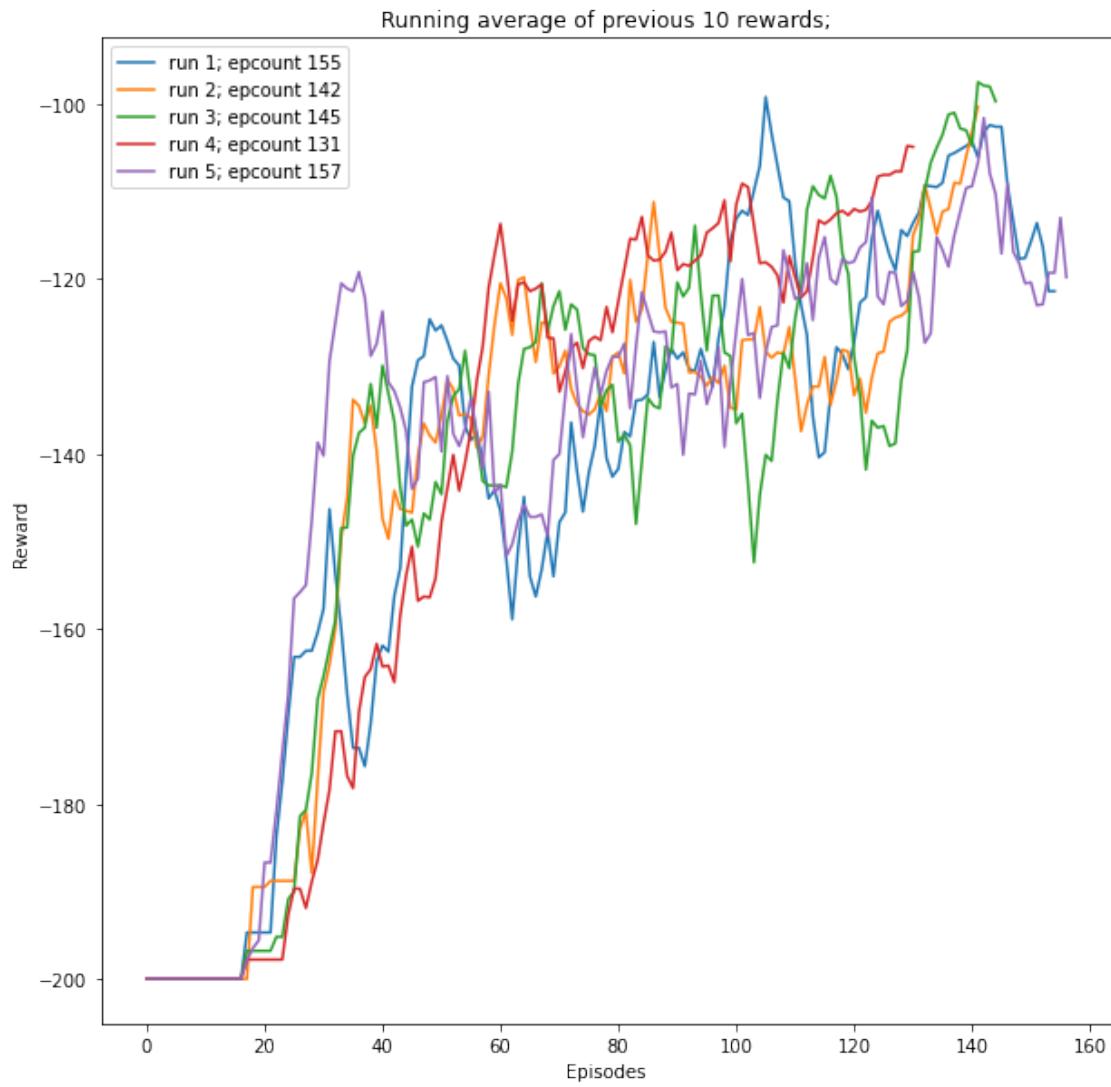
<ipython-input-9-263e050ea415> in render_episode(env_name, agent, max_steps)
41     state = env.reset()
42     for i in range(1, max_steps + 1):
--> 43         action = agent.act(state, 0.0)
44         state, _, done, _ = env.step(action)
45

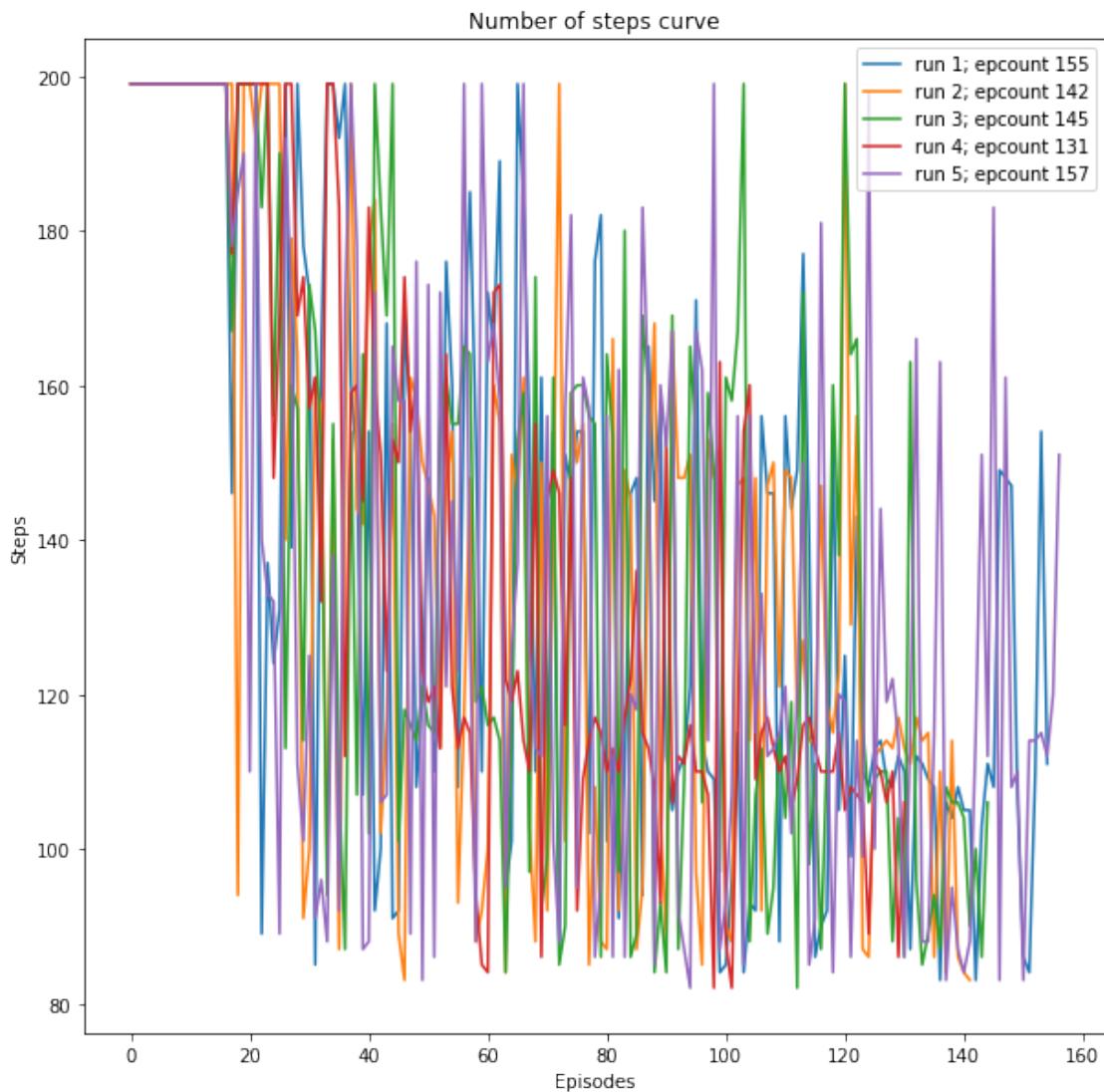
<ipython-input-6-4c3fc3a85a06> in soft_act(self, state, beta)
64         ''' Softmax action selection (Implemented) '''
65         a_values = torch.squeeze(action_values).cpu().squeeze().data.
--> 66             numpy()
--> 66             return self.rsg.choice(np.arange(self.action_size), size=1, u
--> p=softmax(a_values/beta))[0]
67
68     def learn(self, experiences, gamma):

mtrand.pyx in numpy.random.mtrand.RandomState.choice()

ValueError: probabilities contain NaN

```





[]:

OneStepACmainrun

March 26, 2023

```
[ ]: import numpy as np
from collections import namedtuple, deque
import datetime
import gym
import glob
import io
import base64
import matplotlib.pyplot as plt
import tensorflow as tf
from PIL import Image
import tensorflow_probability as tfp
import seaborn as sns
import os
```

```
[ ]: from google.colab import drive
drive.mount('/content/drive')
```

Mounted at /content/drive

0.1 One-Step Actor-Critic Algorithm

Actor-Critic methods learn both a policy $\pi(a|s; \theta)$ and a state-value function $v(s; w)$ simultaneously. The policy is referred to as the actor that suggests actions given a state. The estimated value function is referred to as the critic. It evaluates actions taken by the actor based on the given policy. In this exercise, both functions are approximated by feedforward neural networks.

- The policy network is parametrized by θ - it takes a state s as input and outputs the probabilities $\pi(a|s; \theta) \forall a$
- The value network is parametrized by w - it takes a state s as input and outputs a scalar value associated with the state, i.e., $v(s; w)$
- The single step TD error can be defined as follows:

$$\delta_t = R_{t+1} + \gamma v(s_{t+1}; w) - v(s_t; w)$$

- The loss function to be minimized at every step ($L_{tot}^{(t)}$) is a summation of two terms, as follows:

$$L_{tot}^{(t)} = L_{actor}^{(t)} + L_{critic}^{(t)}$$

where,

$$L_{actor}^{(t)} = -\log \pi(a_t|s_t; \theta) \delta_t$$

$$L_{critic}^{(t)} = \delta_t^2$$

- NOTE: Here, weights of the first two hidden layers are shared by the policy and the value network
 - First two hidden layer sizes: [1024, 512]
 - Output size of policy network: 2 (Softmax activation)
 - Output size of value network: 1 (Linear activation)

0.1.1 Actor-Critic Network

```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [1024, 512]
LR = 1e-4
NUM_EPISODES = 1800
AVG_NUM = 50
SOLVE_CUTOFF = 195

class ActorCriticModel(tf.keras.Model):
    """
    Defining policy and value networks
    """
    def __init__(self, action_size):
        super(ActorCriticModel, self).__init__()

        self.fcls = []
        for i in range(NUM_HIDDEN):
            fc = tf.keras.layers.Dense(HIDDEN_SIZES[i], activation='relu')
            self.fcls.append(fc)

        self.pi_out = tf.keras.layers.Dense(action_size, activation='softmax') #Output Layer for policy
        self.v_out = tf.keras.layers.Dense(1) #Output Layer for state-value

    def call(self, state):
        """
        Computes policy distribution and state-value for a given state
        """
        out = state

        for l in self.fcls:
            out = l(out)

        pi = self.pi_out(out)
        v = self.v_out(out)

        return pi, v
```

0.1.2 Agent Class

```
[ ]: class Agent:  
    """  
        Agent class  
    """  
  
    def __init__(self, action_size, gamma=0.99):  
        self.gamma = gamma  
        self.ac_model = ActorCriticModel(action_size=action_size)  
        self.ac_model.compile(tf.keras.optimizers.Adam(learning_rate=LR))  
  
    def sample_action(self, state):  
        """  
            Given a state, compute the policy distribution over all actions and  
            sample one action  
        """  
        pi, _ = self.ac_model(state)  
  
        action_probabilities = tfp.distributions.Categorical(probs=pi)  
        sample = action_probabilities.sample()  
        return int(sample.numpy()[0])  
  
    def actor_loss(self, action, pi, delta):  
        """  
            Compute Actor Loss  
        """  
        return -tf.math.log(pi[0,action]) * delta  
  
    def critic_loss(self, delta):  
        """  
            Critic loss aims to minimize TD error  
        """  
        return delta**2  
  
    @tf.function  
    def learn(self, state, action, reward, next_state, done):  
        """  
            For a given transition (s,a,s',r) update the parameters by computing the  
            gradient of the total loss  
        """  
        with tf.GradientTape(persistent=True) as tape:  
            pi, V_s = self.ac_model(state)  
            _, V_s_next = self.ac_model(next_state)  
  
            V_s = tf.squeeze(V_s)  
            V_s_next = tf.squeeze(V_s_next)
```

```

##### TO DO: Write the equation for delta (TD error)
## Write code below
delta = reward + (self.gamma * V_s_next) - V_s
loss_a = self.actor_loss(action, pi, delta)
loss_c = self.critic_loss(delta)
loss_total = loss_a + loss_c

gradient = tape.gradient(loss_total, self.ac_model.trainable_variables)
self.ac_model.optimizer.apply_gradients(zip(gradient, self.ac_model.
↪trainable_variables))

```

0.1.3 Code to train the agent

```

[ ]: # do 1 run of the AC-agent in an environment for num_episodes
def run_ac_net(env, tf_seed=42):

    agent = Agent(action_size=env.action_space.n)
    tf.keras.utils.set_random_seed(tf_seed)
    tf.compat.v1.reset_default_graph()

    reward_list = []
    step_list = []
    begin_time = datetime.datetime.now()
    ep_count = NUM_EPISODES

    for ep in range(1, NUM_EPISODES + 1):
        state = env.reset().reshape(1,-1)
        done = False
        ep_rew = 0
        steps = 0
        while not done:
            action = agent.sample_action(state) ##Sample Action
            next_state, reward, done, info = env.step(action) ##Take action
            next_state = next_state.reshape(1,-1)
            ep_rew += reward ##Updating episode reward
            agent.learn(state, action, reward, next_state, done) ##Update
        ↪Parameters
            state = next_state ##Updating State
            steps += 1
            reward_list.append(ep_rew)
            step_list.append(steps)

        if ep % 10 == 0:
            avg_rew = np.mean(reward_list[-10:])
            print('Episode ', ep, 'Reward %f' % ep_rew, 'Average Reward %f' %
        ↪avg_rew)

```

```

if ep % 100:
    avg_100 = np.mean(reward_list[-100:])
    if avg_100 > SOLVE_CUTOFF:
        ep_count = min(ep_count, ep) # keep track of number of episodes
    ↵to solve environment

time_taken = datetime.datetime.now() - begin_time
print(time_taken)
return reward_list, step_list, ep_count

```

```
[ ]: def rolling_average(reward_list, avg_num=AVG_NUM):
    average_reward_list = np.zeros_like(reward_list)
    for i in range(0, len(reward_list)):
        if i < avg_num:
            average_reward_list[i] = np.mean(reward_list[:i+1])
        else:
            average_reward_list[i] = np.mean(reward_list[(i-avg_num+1):(i+1)])
    return average_reward_list
```

```
[ ]: def do_multiple_runs(env_name, num_runs):
    reward_lists, step_lists, comp_list = [], [], []
    env = gym.make(env_name)
    env.seed(42)

    for r in range(num_runs):
        r, s, c = run_ac_net(env)
        reward_lists.append(r)
        step_lists.append(list(map(int,s)))
        comp_list.append(c)

    mean_rewards = np.mean(reward_lists, axis=0)
    var_rewards = np.sqrt(np.var(reward_lists, axis=0))

    return mean_rewards, var_rewards, comp_list, reward_lists, step_lists
```

0.2 Plotting Functions and Other Helpers

```
[ ]: PATH = '/content/drive/MyDrive/Colab Notebooks/CS6700/Assignments/Assignment2/
    ↵AC1/'

def gen_plots_and_save_data(fname, data, mean_rewards, var_rewards,
    ↵reward_lists, step_lists):

    m_fig, m_ax = plt.subplots(figsize=(10,10))
    v_fig, v_ax = plt.subplots(figsize=(10,10))
```

```

m_ax.set_title(f'Mean Reward over 10 runs')
m_ax.set_xlabel('Episodes')
m_ax.set_ylabel('Mean Reward')
v_ax.set_title(f'Variance of Reward over 10 runs')
v_ax.set_xlabel('Episodes')
v_ax.set_ylabel('Variance')

sns.lineplot(data=mean_rewards, ax=m_ax)
sns.lineplot(data=var_rewards, ax=v_ax)

m_fig.savefig(PATH+'/'+fname+'/mean_reward.png')
v_fig.savefig(PATH+'/'+fname+'/var_reward.png')

sc_fig, sc_ax = plt.subplots(figsize=(10,10))
st_fig, st_ax = plt.subplots(figsize=(10,10))
sc_ax.set_title(f'Running average of previous {AVG_NUM} rewards')
sc_ax.set_xlabel('Episodes')
sc_ax.set_ylabel('Reward')
st_ax.set_title(f'Number of steps curve')
st_ax.set_xlabel('Episodes')
st_ax.set_ylabel('Steps')

run_count = len(reward_lists)
labels = [f'run {i+1}' for i in range(3)]
for idx in range(min(run_count, 3)):

    score_list = rolling_average(reward_lists[idx])
    step_list = step_lists[idx]
    sns.lineplot(data=score_list, label=labels[idx], ax=sc_ax)
    sns.lineplot(data=step_list, label=labels[idx], ax=st_ax)

sc_fig.savefig(PATH+'/'+fname+'/sc_fig.png')
st_fig.savefig(PATH+'/'+fname+'/st_fig.png')

with open(PATH+'/'+fname+'/'+'config.txt', 'w') as f:
    for s in data:
        f.write(s + '\n')

```

0.2.1 Experiments

[]: # STEP = 0 does not mean anything. We are running 1 step AC.

CartPole

[]: NUM_HIDDEN = 1
HIDDEN_SIZES = [1024]
LR = 1e-4

```

NUM_EPISODES = 600
AVG_NUM = 50
ENV_NAME = 'CartPole-v1'
SOLVE_CUTOFF = 195.0
STEP = 0

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = ↴
    ↪do_multiple_runs(env_name=ENV_NAME, num_runs=10)

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes -' ↴
    ↪{HIDDEN_SIZES}, f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of' ↴
    ↪episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name -' ↴
    ↪{ENV_NAME}', f'NSTEP = {STEP}']

fname = ↴
    ↪f'hl={NUM_HIDDEN}_hs={HIDDEN_SIZES}_lr={LR}_env={ENV_NAME}_numep={NUM_EPISODES}_nstep={STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, ↴
    ↪step_lists)

```

```

/usr/local/lib/python3.9/dist-packages/gym/core.py:317: DeprecationWarning:
WARN: Initializing wrapper in old step API which returns one bool instead
of two. It is recommended to set `new_step_api=True` to use new step API. This
will be the default behaviour in future.

deprecation(
/usr/local/lib/python3.9/dist-
packages/gym/wrappers/step_api_compatibility.py:39: DeprecationWarning:
WARN: Initializing environment in old step API which returns one bool
instead of two. It is recommended to set `new_step_api=True` to use new step
API. This will be the default behaviour in future.

deprecation(
/usr/local/lib/python3.9/dist-packages/gym/core.py:256: DeprecationWarning:
WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
in the future. Please use `env.reset(seed=seed)` instead.

deprecation(
Episode 10 Reward 29.000000 Average Reward 22.800000
Episode 20 Reward 24.000000 Average Reward 26.200000
Episode 30 Reward 29.000000 Average Reward 31.700000
Episode 40 Reward 12.000000 Average Reward 27.900000
Episode 50 Reward 30.000000 Average Reward 32.100000
Episode 60 Reward 44.000000 Average Reward 37.400000

```

Episode 70 Reward 38.000000 Average Reward 37.500000
Episode 80 Reward 25.000000 Average Reward 34.900000
Episode 90 Reward 102.000000 Average Reward 57.900000
Episode 100 Reward 110.000000 Average Reward 51.900000
Episode 110 Reward 90.000000 Average Reward 52.300000
Episode 120 Reward 50.000000 Average Reward 60.300000
Episode 130 Reward 37.000000 Average Reward 72.600000
Episode 140 Reward 81.000000 Average Reward 67.600000
Episode 150 Reward 43.000000 Average Reward 61.100000
Episode 160 Reward 103.000000 Average Reward 72.900000
Episode 170 Reward 146.000000 Average Reward 86.600000
Episode 180 Reward 68.000000 Average Reward 74.200000
Episode 190 Reward 101.000000 Average Reward 95.500000
Episode 200 Reward 82.000000 Average Reward 84.900000
Episode 210 Reward 92.000000 Average Reward 87.700000
Episode 220 Reward 63.000000 Average Reward 86.200000
Episode 230 Reward 102.000000 Average Reward 96.500000
Episode 240 Reward 112.000000 Average Reward 93.000000
Episode 250 Reward 152.000000 Average Reward 105.000000
Episode 260 Reward 77.000000 Average Reward 87.800000
Episode 270 Reward 79.000000 Average Reward 89.500000
Episode 280 Reward 89.000000 Average Reward 84.500000
Episode 290 Reward 70.000000 Average Reward 91.900000
Episode 300 Reward 58.000000 Average Reward 76.700000
Episode 310 Reward 63.000000 Average Reward 87.600000
Episode 320 Reward 108.000000 Average Reward 79.500000
Episode 330 Reward 108.000000 Average Reward 85.000000
Episode 340 Reward 79.000000 Average Reward 98.200000
Episode 350 Reward 232.000000 Average Reward 151.400000
Episode 360 Reward 73.000000 Average Reward 146.200000
Episode 370 Reward 79.000000 Average Reward 100.800000
Episode 380 Reward 183.000000 Average Reward 157.500000
Episode 390 Reward 90.000000 Average Reward 138.900000
Episode 400 Reward 107.000000 Average Reward 126.000000
Episode 410 Reward 111.000000 Average Reward 125.600000
Episode 420 Reward 59.000000 Average Reward 88.500000
Episode 430 Reward 73.000000 Average Reward 72.500000
Episode 440 Reward 62.000000 Average Reward 70.900000
Episode 450 Reward 63.000000 Average Reward 65.900000
Episode 460 Reward 45.000000 Average Reward 70.000000
Episode 470 Reward 65.000000 Average Reward 62.200000
Episode 480 Reward 52.000000 Average Reward 76.500000
Episode 490 Reward 51.000000 Average Reward 62.000000
Episode 500 Reward 58.000000 Average Reward 69.200000
Episode 510 Reward 57.000000 Average Reward 71.000000
Episode 520 Reward 87.000000 Average Reward 57.800000
Episode 530 Reward 78.000000 Average Reward 61.400000
Episode 540 Reward 64.000000 Average Reward 57.000000

Episode 550 Reward 63.000000 Average Reward 54.100000
Episode 560 Reward 50.000000 Average Reward 44.700000
Episode 570 Reward 36.000000 Average Reward 48.500000
Episode 580 Reward 42.000000 Average Reward 49.900000
Episode 590 Reward 40.000000 Average Reward 54.000000
Episode 600 Reward 106.000000 Average Reward 64.300000
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Episode 10 Reward 26.000000 Average Reward 22.500000
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Episode 50 Reward 65.000000 Average Reward 40.200000
Episode 60 Reward 47.000000 Average Reward 45.000000
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Episode 150 Reward 50.000000 Average Reward 68.500000
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Episode 170 Reward 55.000000 Average Reward 80.000000
Episode 180 Reward 82.000000 Average Reward 76.600000
Episode 190 Reward 87.000000 Average Reward 68.100000
Episode 200 Reward 62.000000 Average Reward 66.500000
Episode 210 Reward 129.000000 Average Reward 83.300000
Episode 220 Reward 146.000000 Average Reward 74.700000
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Episode 340 Reward 83.000000 Average Reward 100.000000
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Episode 370 Reward 94.000000 Average Reward 123.200000
Episode 380 Reward 76.000000 Average Reward 112.700000
Episode 390 Reward 246.000000 Average Reward 142.600000
Episode 400 Reward 141.000000 Average Reward 140.300000
Episode 410 Reward 124.000000 Average Reward 193.700000

Episode 420 Reward 217.000000 Average Reward 145.000000
Episode 430 Reward 100.000000 Average Reward 102.800000
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Episode 450 Reward 113.000000 Average Reward 78.500000
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Episode 470 Reward 83.000000 Average Reward 72.300000
Episode 480 Reward 92.000000 Average Reward 93.300000
Episode 490 Reward 139.000000 Average Reward 119.500000
Episode 500 Reward 119.000000 Average Reward 121.300000
Episode 510 Reward 143.000000 Average Reward 140.000000
Episode 520 Reward 66.000000 Average Reward 111.100000
Episode 530 Reward 138.000000 Average Reward 123.100000
Episode 540 Reward 180.000000 Average Reward 172.500000
Episode 550 Reward 93.000000 Average Reward 97.400000
Episode 560 Reward 116.000000 Average Reward 80.000000
Episode 570 Reward 99.000000 Average Reward 79.600000
Episode 580 Reward 71.000000 Average Reward 78.300000
Episode 590 Reward 106.000000 Average Reward 78.700000
Episode 600 Reward 50.000000 Average Reward 68.100000
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Episode 10 Reward 19.000000 Average Reward 25.700000
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Episode 60 Reward 28.000000 Average Reward 40.400000
Episode 70 Reward 25.000000 Average Reward 37.400000
Episode 80 Reward 26.000000 Average Reward 46.400000
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Episode 110 Reward 88.000000 Average Reward 52.400000
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Episode 150 Reward 115.000000 Average Reward 78.900000
Episode 160 Reward 53.000000 Average Reward 76.300000
Episode 170 Reward 117.000000 Average Reward 88.600000
Episode 180 Reward 60.000000 Average Reward 103.900000
Episode 190 Reward 93.000000 Average Reward 99.000000
Episode 200 Reward 157.000000 Average Reward 122.900000
Episode 210 Reward 155.000000 Average Reward 97.100000
Episode 220 Reward 65.000000 Average Reward 96.500000
Episode 230 Reward 186.000000 Average Reward 113.600000
Episode 240 Reward 158.000000 Average Reward 135.400000
Episode 250 Reward 110.000000 Average Reward 145.000000
Episode 260 Reward 202.000000 Average Reward 202.400000
Episode 270 Reward 169.000000 Average Reward 152.200000
Episode 280 Reward 186.000000 Average Reward 169.300000

Episode 290 Reward 74.000000 Average Reward 120.100000
Episode 300 Reward 173.000000 Average Reward 88.900000
Episode 310 Reward 73.000000 Average Reward 99.500000
Episode 320 Reward 77.000000 Average Reward 101.100000
Episode 330 Reward 171.000000 Average Reward 127.100000
Episode 340 Reward 104.000000 Average Reward 133.500000
Episode 350 Reward 65.000000 Average Reward 99.100000
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Episode 400 Reward 66.000000 Average Reward 58.500000
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Episode 540 Reward 45.000000 Average Reward 52.100000
Episode 550 Reward 85.000000 Average Reward 58.900000
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Episode 570 Reward 54.000000 Average Reward 60.200000
Episode 580 Reward 45.000000 Average Reward 71.100000
Episode 590 Reward 66.000000 Average Reward 66.500000
Episode 600 Reward 105.000000 Average Reward 87.600000

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Episode 10 Reward 23.000000 Average Reward 19.700000
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Episode 60 Reward 23.000000 Average Reward 30.300000
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Episode 100 Reward 95.000000 Average Reward 58.400000
Episode 110 Reward 75.000000 Average Reward 63.700000
Episode 120 Reward 94.000000 Average Reward 80.200000
Episode 130 Reward 35.000000 Average Reward 59.100000
Episode 140 Reward 109.000000 Average Reward 78.700000
Episode 150 Reward 76.000000 Average Reward 89.800000

Episode 160 Reward 37.000000 Average Reward 64.500000
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Episode 560 Reward 54.000000 Average Reward 55.100000
Episode 570 Reward 56.000000 Average Reward 52.100000
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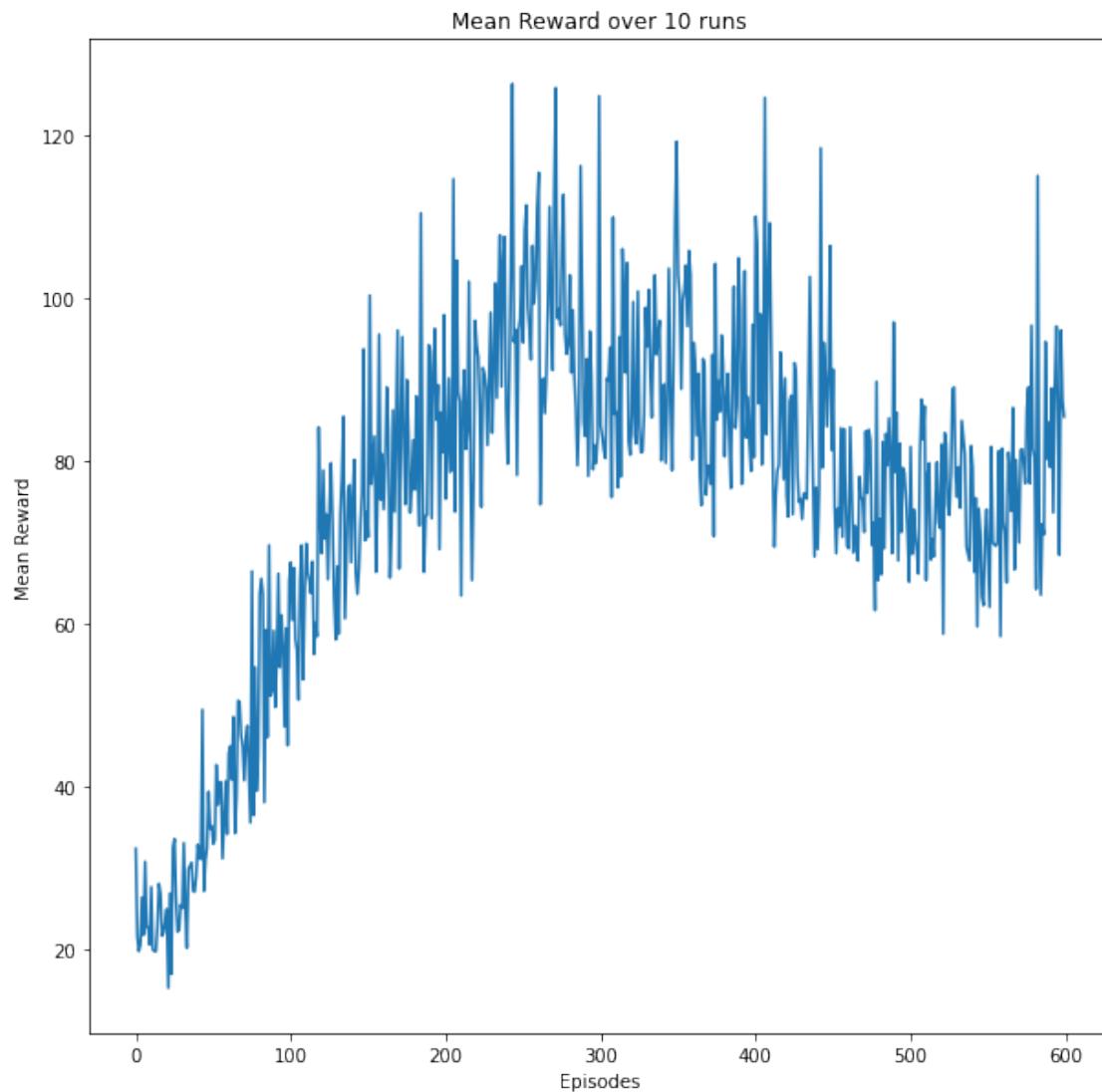
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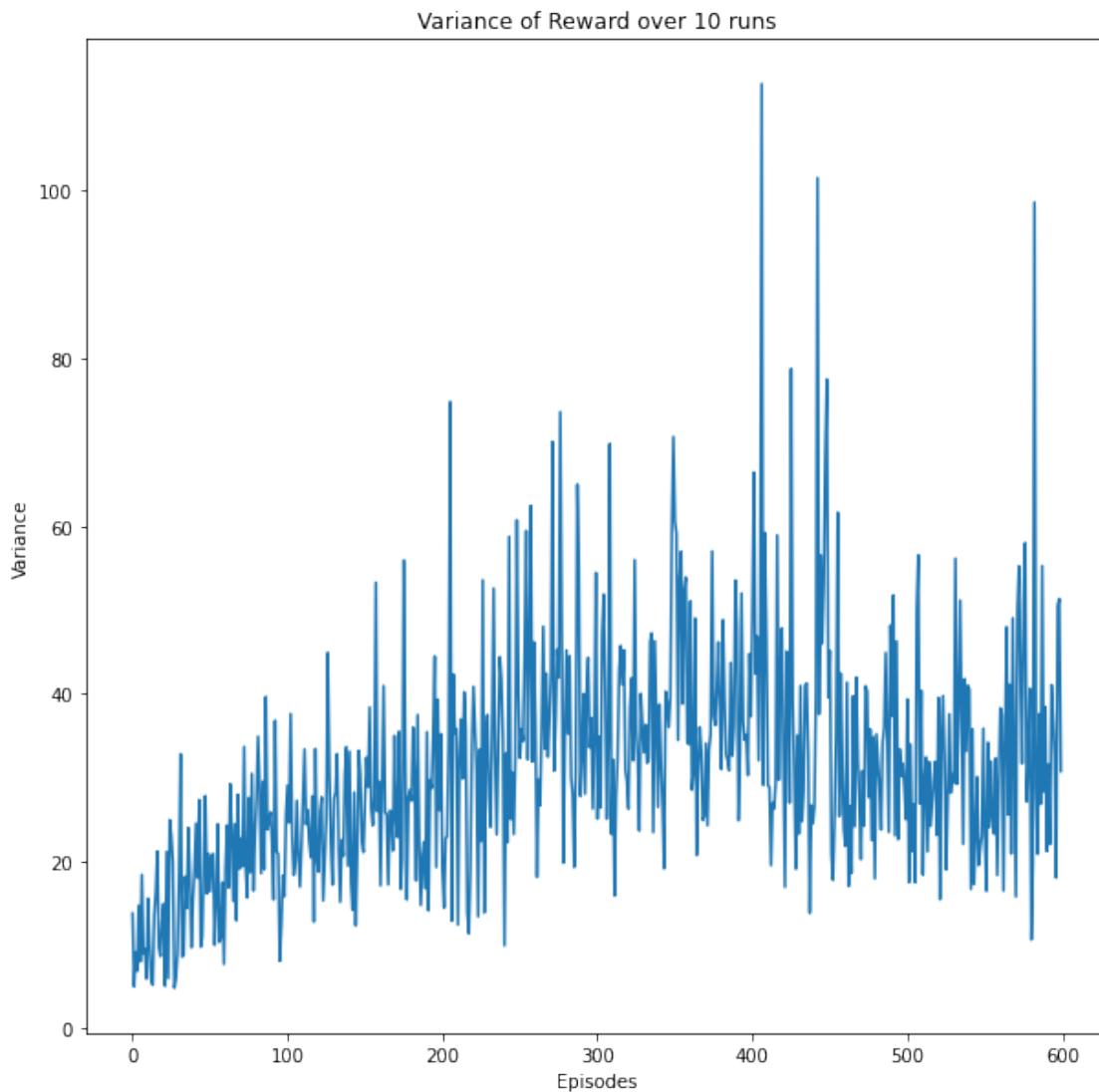
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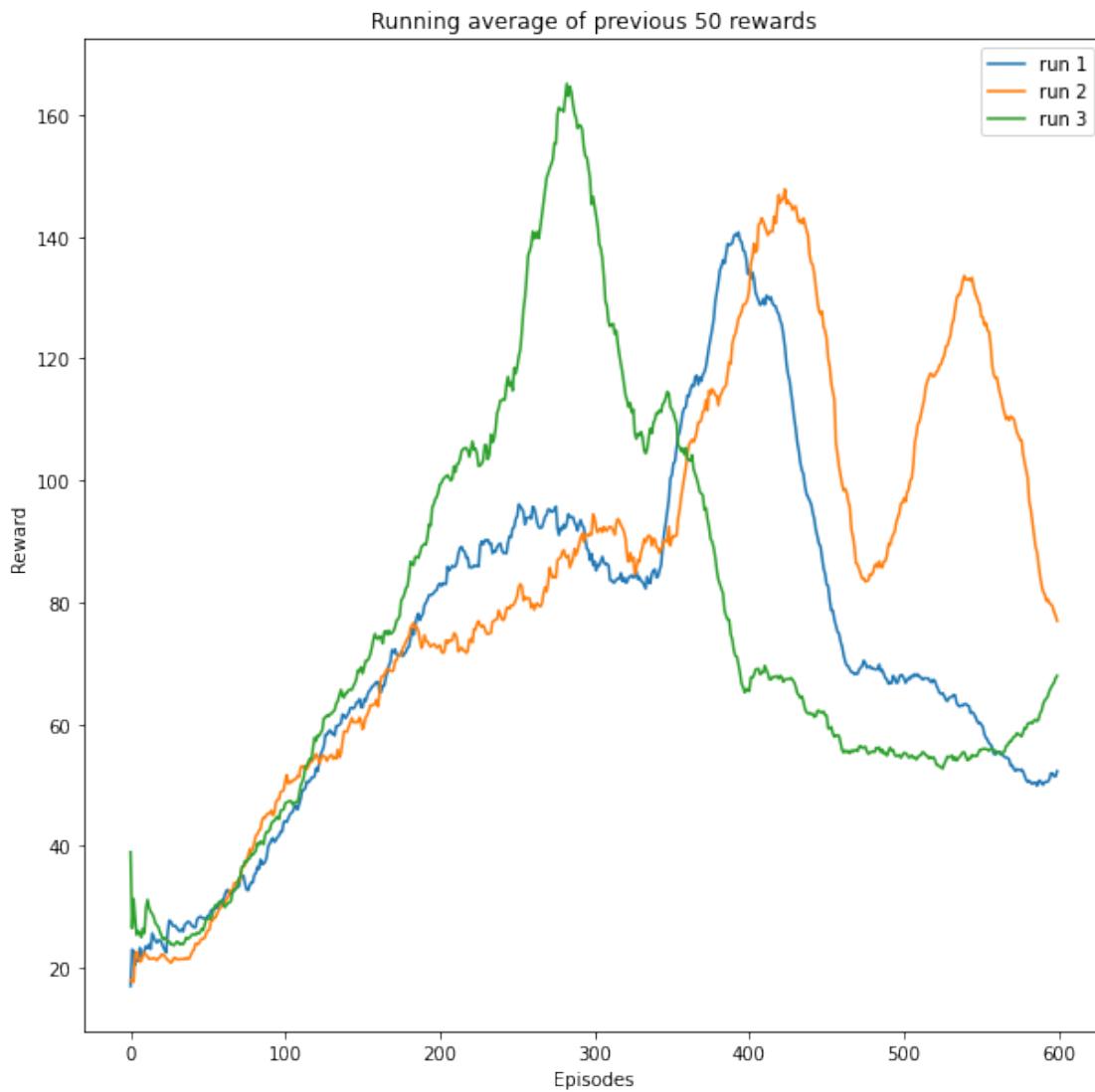
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Episode 210 Reward 50.000000 Average Reward 75.400000
Episode 220 Reward 124.000000 Average Reward 77.600000
Episode 230 Reward 94.000000 Average Reward 91.900000
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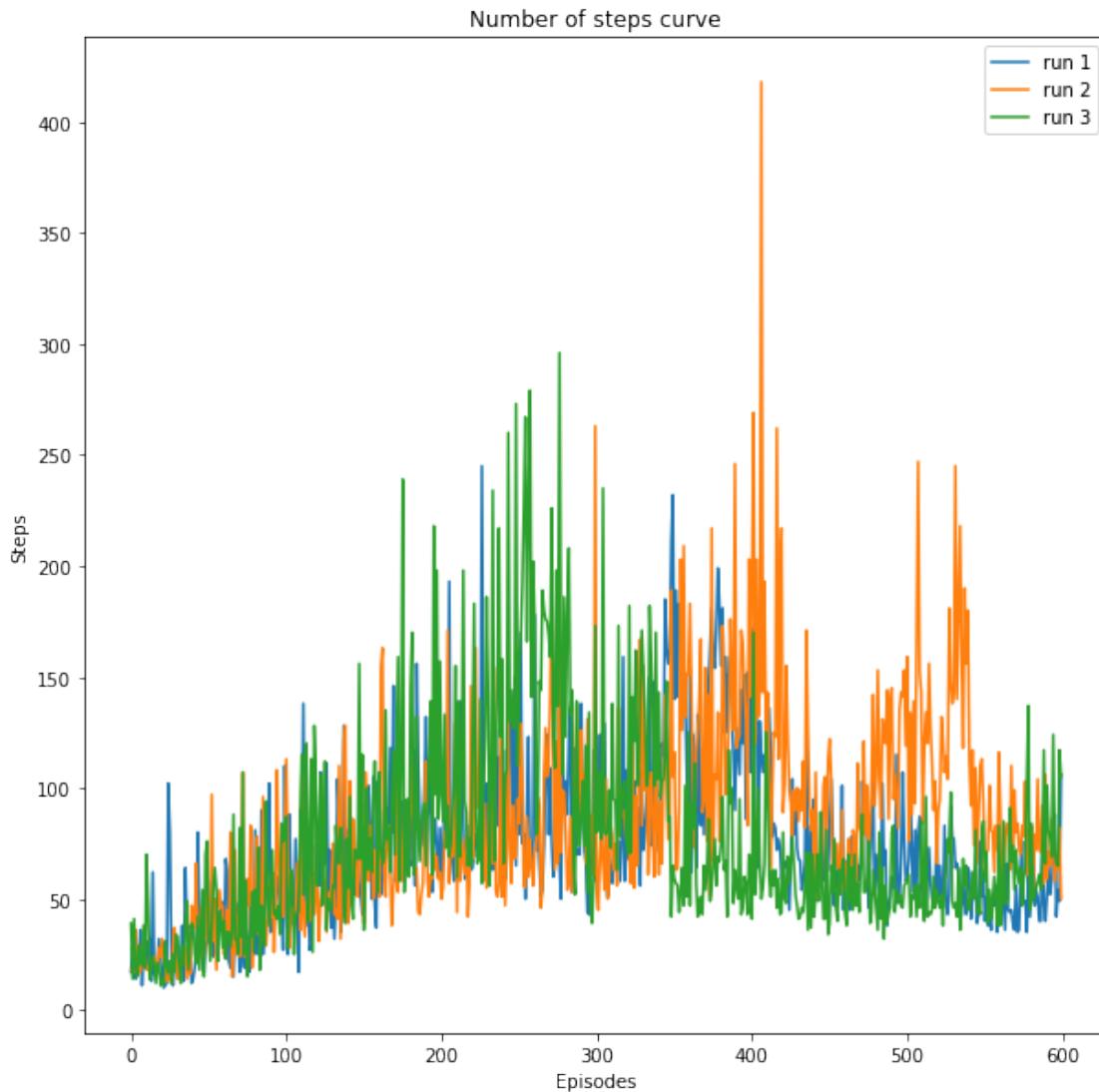
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Episode 590 Reward 155.000000 Average Reward 113.800000
Episode 600 Reward 95.000000 Average Reward 122.400000

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```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [512, 512]
LR = 0.5e-4
NUM_EPISODES = 600
AVG_NUM = 50
ENV_NAME = 'CartPole-v1'
SOLVE_CUTOFF = 195.0
STEP = 0

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{NUM_HIDDEN}_{hs}-{HIDDEN_SIZES}_{lr}-{LR}_{env}-{ENV_NAME}_{numep}-{NUM_EPISODES}_{nstep}-{STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

```

/usr/local/lib/python3.9/dist-packages/gym/core.py:317: DeprecationWarning:
WARN: Initializing wrapper in old step API which returns one bool instead
of two. It is recommended to set `new_step_api=True` to use new step API. This
will be the default behaviour in future.

```

```

deprecation(
/usr/local/lib/python3.9/dist-
packages/gym/wrappers/step_api_compatibility.py:39: DeprecationWarning:
WARN: Initializing environment in old step API which returns one bool
instead of two. It is recommended to set `new_step_api=True` to use new step
API. This will be the default behaviour in future.
deprecation(

```

```

/usr/local/lib/python3.9/dist-packages/gym/core.py:256: DeprecationWarning:
WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
in the future. Please use `env.reset(seed=seed)` instead.

```

```

deprecation(
Episode 10 Reward 10.000000 Average Reward 36.500000
Episode 20 Reward 26.000000 Average Reward 28.400000
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Episode 90 Reward 157.000000 Average Reward 89.400000
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Episode 120 Reward 68.000000 Average Reward 77.600000
Episode 130 Reward 120.000000 Average Reward 96.900000
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Episode 150 Reward 47.000000 Average Reward 85.300000
Episode 160 Reward 75.000000 Average Reward 68.300000

```

Episode 170 Reward 116.000000 Average Reward 89.900000
Episode 180 Reward 80.000000 Average Reward 77.500000
Episode 190 Reward 63.000000 Average Reward 91.600000
Episode 200 Reward 58.000000 Average Reward 81.900000
Episode 210 Reward 125.000000 Average Reward 109.000000
Episode 220 Reward 106.000000 Average Reward 121.300000
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Episode 260 Reward 93.000000 Average Reward 110.000000
Episode 270 Reward 152.000000 Average Reward 124.900000
Episode 280 Reward 288.000000 Average Reward 121.300000
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Episode 360 Reward 136.000000 Average Reward 118.400000
Episode 370 Reward 92.000000 Average Reward 119.700000
Episode 380 Reward 173.000000 Average Reward 165.000000
Episode 390 Reward 209.000000 Average Reward 193.600000
Episode 400 Reward 236.000000 Average Reward 181.600000
Episode 410 Reward 289.000000 Average Reward 204.600000
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Episode 430 Reward 157.000000 Average Reward 189.600000
Episode 440 Reward 127.000000 Average Reward 169.000000
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Episode 480 Reward 254.000000 Average Reward 251.200000
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Episode 550 Reward 500.000000 Average Reward 473.100000
Episode 560 Reward 148.000000 Average Reward 317.600000
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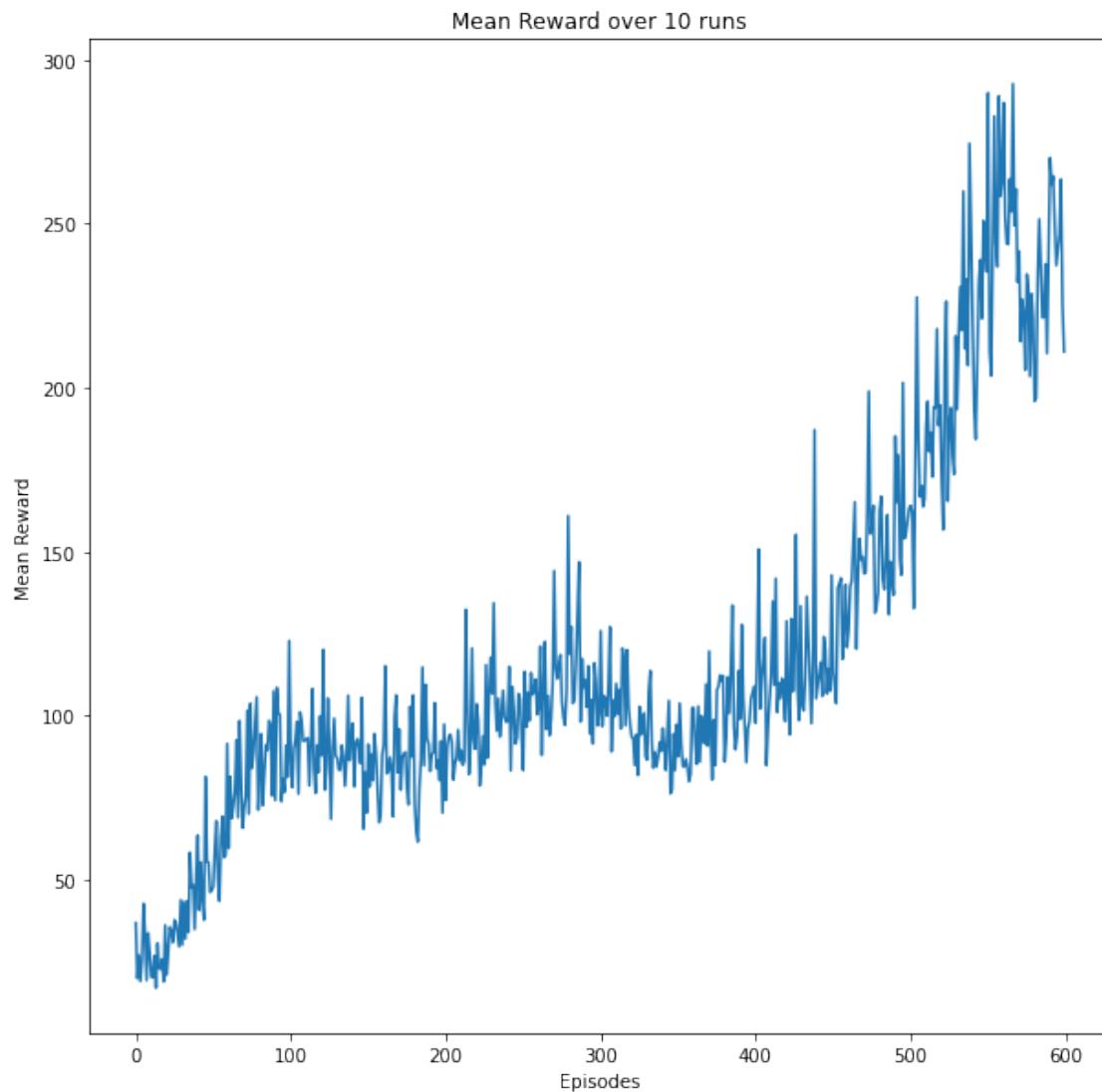
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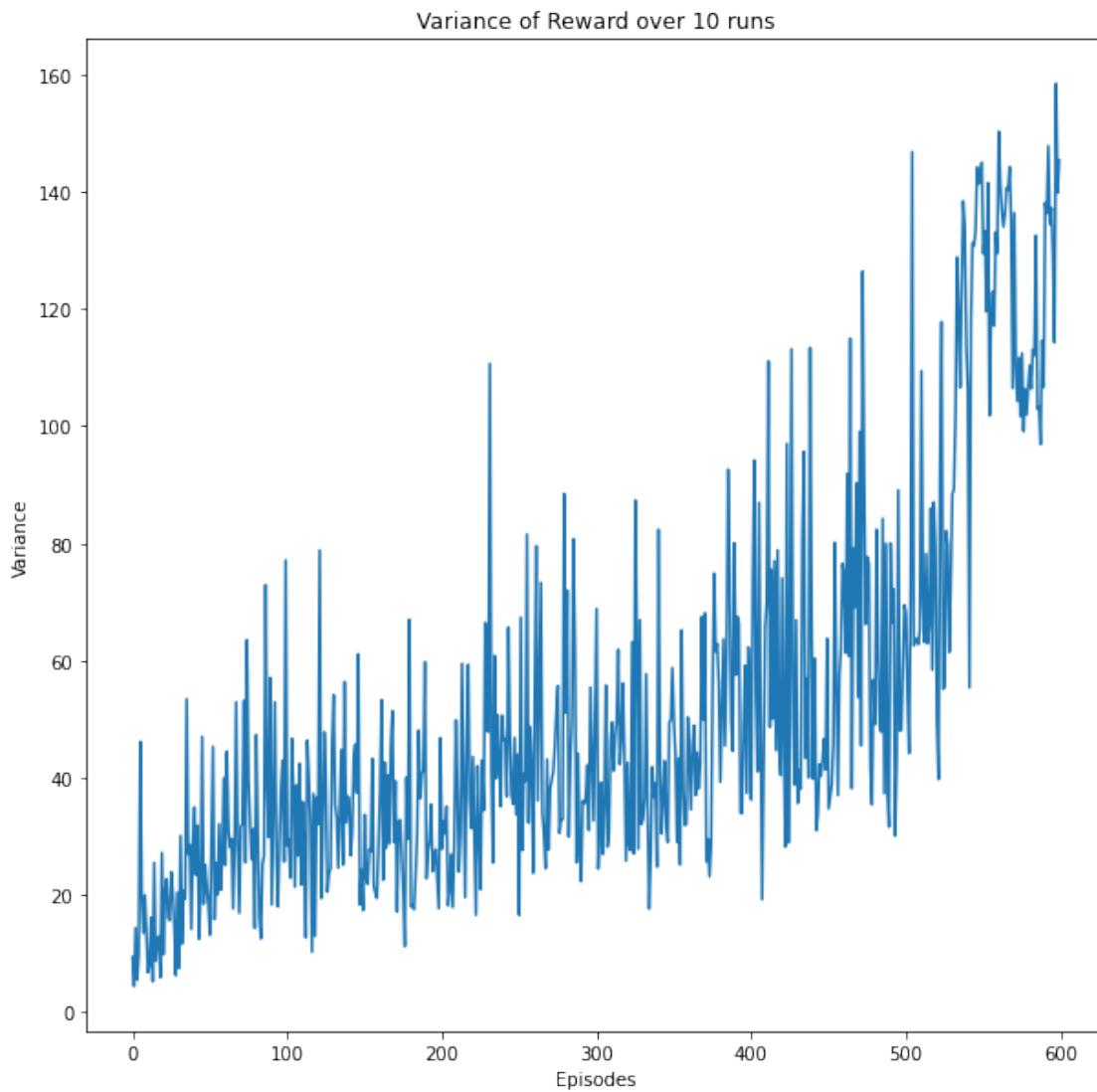
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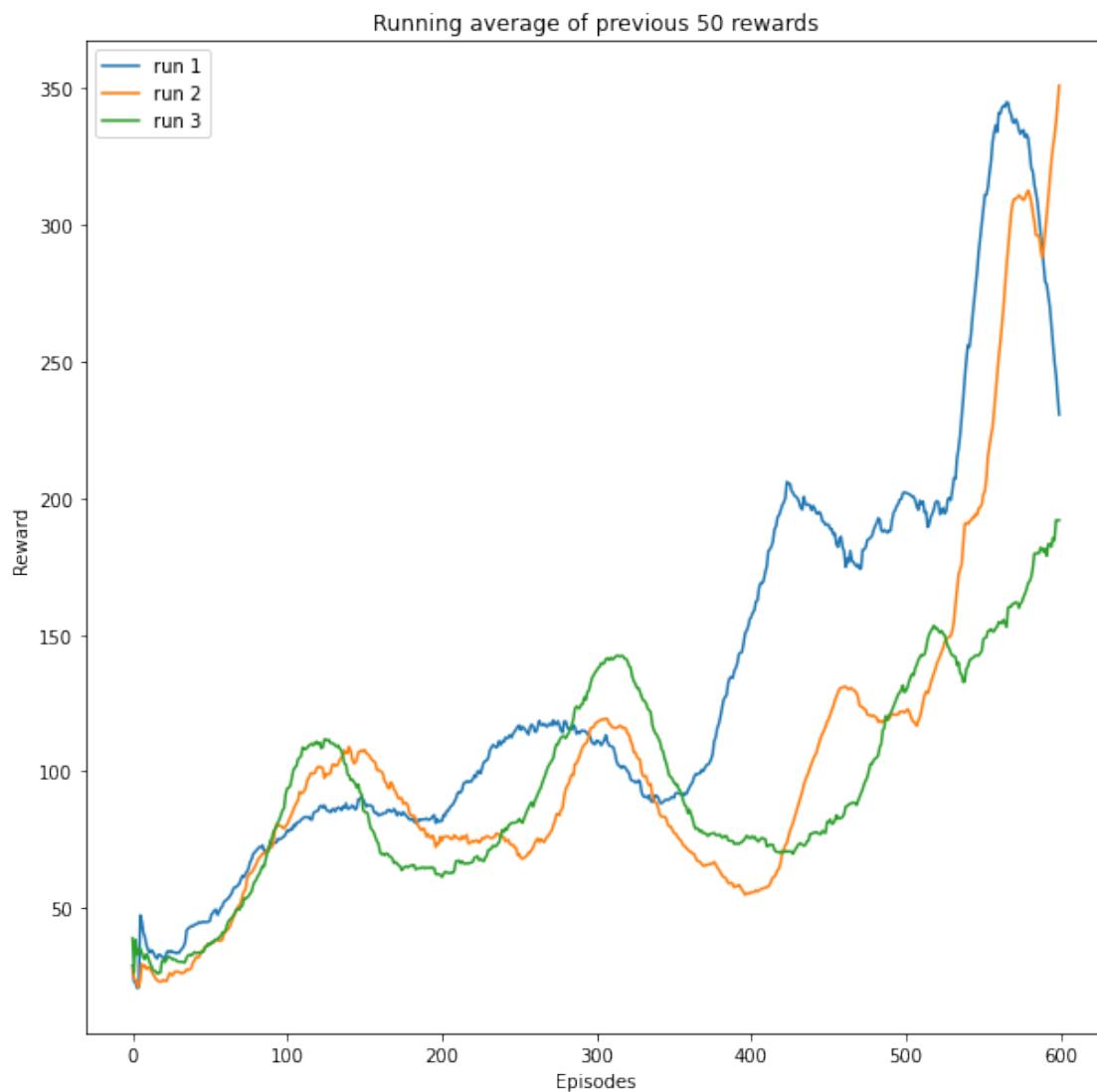
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Episode 460 Reward 64.000000 Average Reward 89.400000
Episode 470 Reward 98.000000 Average Reward 98.000000
Episode 480 Reward 72.000000 Average Reward 118.300000
Episode 490 Reward 137.000000 Average Reward 102.700000
Episode 500 Reward 87.000000 Average Reward 165.700000
Episode 510 Reward 146.000000 Average Reward 164.200000
Episode 520 Reward 255.000000 Average Reward 192.200000
Episode 530 Reward 209.000000 Average Reward 196.800000
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Episode 560 Reward 327.000000 Average Reward 238.200000

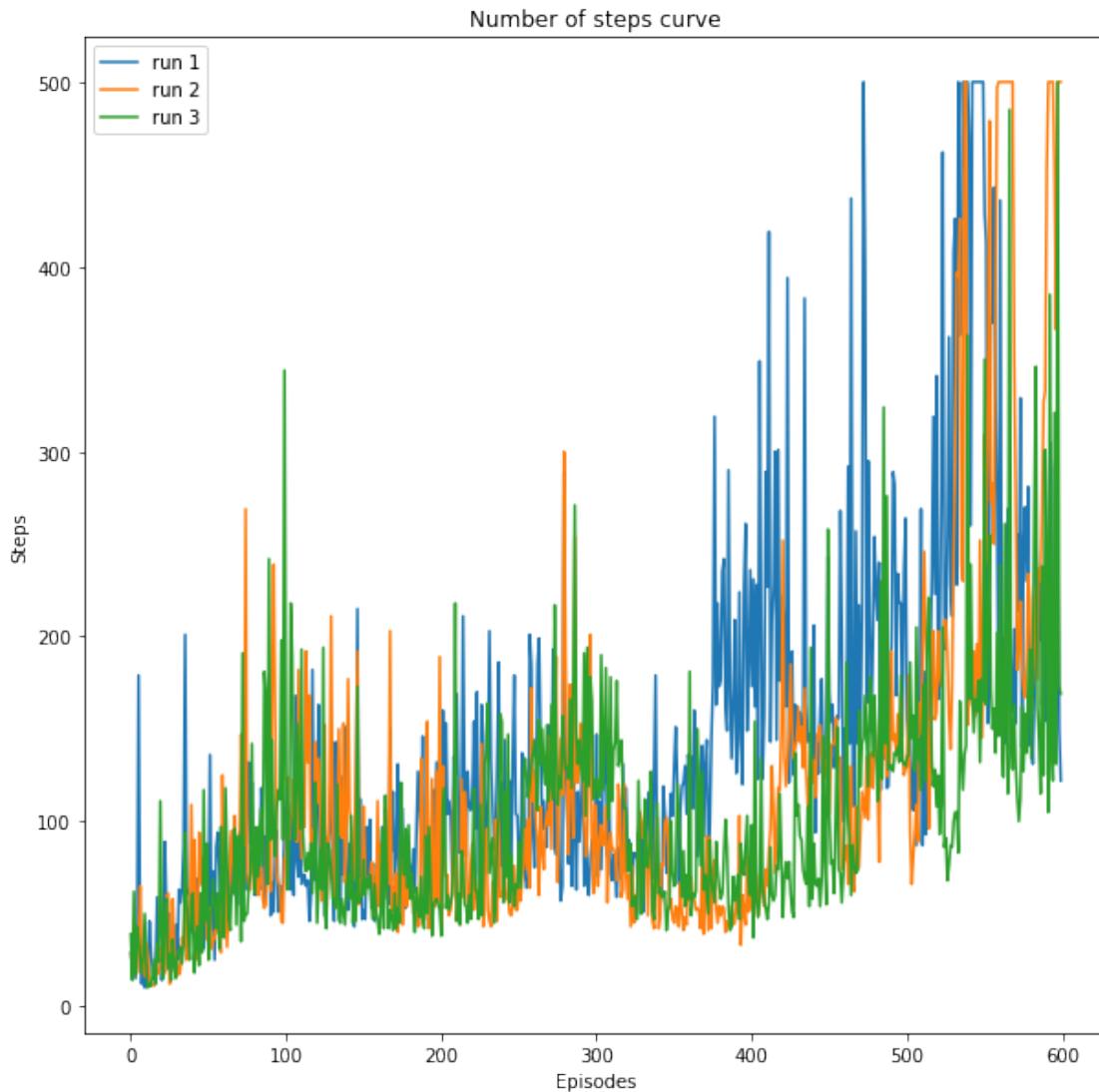
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Episode 410 Reward 118.000000 Average Reward 153.900000
Episode 420 Reward 135.000000 Average Reward 163.500000
Episode 430 Reward 212.000000 Average Reward 153.800000

Episode 440 Reward 286.000000 Average Reward 203.500000
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Episode 460 Reward 226.000000 Average Reward 123.900000
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Episode 480 Reward 124.000000 Average Reward 112.300000
Episode 490 Reward 152.000000 Average Reward 138.700000
Episode 500 Reward 140.000000 Average Reward 180.800000
Episode 510 Reward 243.000000 Average Reward 235.000000
Episode 520 Reward 151.000000 Average Reward 223.500000
Episode 530 Reward 149.000000 Average Reward 222.900000
Episode 540 Reward 173.000000 Average Reward 178.900000
Episode 550 Reward 236.000000 Average Reward 222.200000
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Episode 570 Reward 248.000000 Average Reward 258.900000
Episode 580 Reward 195.000000 Average Reward 227.900000
Episode 590 Reward 169.000000 Average Reward 204.400000
Episode 600 Reward 162.000000 Average Reward 162.500000
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```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [512, 512]
LR = 1e-4
NUM_EPISODES = 600
AVG_NUM = 50
ENV_NAME = 'CartPole-v1'
SOLVE_CUTOFF = 195.0
STEP = 0

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{NUM_HIDDEN}_{hs}-{HIDDEN_SIZES}_{lr}-{LR}_{env}-{ENV_NAME}_{numep}-{NUM_EPISODES}_{nstep}-{STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

```

/usr/local/lib/python3.9/dist-packages/gym/core.py:317: DeprecationWarning:
WARN: Initializing wrapper in old step API which returns one bool instead
of two. It is recommended to set `new_step_api=True` to use new step API. This
will be the default behaviour in future.

deprecation(
/usr/local/lib/python3.9/dist-
packages/gym/wrappers/step_api_compatibility.py:39: DeprecationWarning:
WARN: Initializing environment in old step API which returns one bool
instead of two. It is recommended to set `new_step_api=True` to use new step
API. This will be the default behaviour in future.

deprecation(
/usr/local/lib/python3.9/dist-packages/gym/core.py:256: DeprecationWarning:
WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
in the future. Please use `env.reset(seed=seed)` instead.

deprecation(
Episode 10 Reward 25.000000 Average Reward 22.700000
Episode 20 Reward 21.000000 Average Reward 26.200000
Episode 30 Reward 56.000000 Average Reward 48.000000
Episode 40 Reward 96.000000 Average Reward 75.600000
Episode 50 Reward 139.000000 Average Reward 81.800000
Episode 60 Reward 125.000000 Average Reward 81.500000
Episode 70 Reward 52.000000 Average Reward 104.200000
Episode 80 Reward 89.000000 Average Reward 82.800000
Episode 90 Reward 60.000000 Average Reward 56.800000
Episode 100 Reward 64.000000 Average Reward 67.500000
Episode 110 Reward 48.000000 Average Reward 66.800000
Episode 120 Reward 45.000000 Average Reward 64.900000
Episode 130 Reward 129.000000 Average Reward 66.100000
Episode 140 Reward 60.000000 Average Reward 90.300000
Episode 150 Reward 47.000000 Average Reward 72.600000
Episode 160 Reward 130.000000 Average Reward 111.800000

```

Episode 170 Reward 78.000000 Average Reward 83.200000
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Episode 210 Reward 102.000000 Average Reward 158.600000
Episode 220 Reward 93.000000 Average Reward 108.800000
Episode 230 Reward 140.000000 Average Reward 131.400000
Episode 240 Reward 71.000000 Average Reward 81.700000
Episode 250 Reward 61.000000 Average Reward 74.000000
Episode 260 Reward 84.000000 Average Reward 72.000000
Episode 270 Reward 83.000000 Average Reward 85.500000
Episode 280 Reward 73.000000 Average Reward 89.600000
Episode 290 Reward 159.000000 Average Reward 96.900000
Episode 300 Reward 94.000000 Average Reward 148.900000
Episode 310 Reward 242.000000 Average Reward 127.000000
Episode 320 Reward 162.000000 Average Reward 239.700000
Episode 330 Reward 179.000000 Average Reward 180.800000
Episode 340 Reward 296.000000 Average Reward 223.900000
Episode 350 Reward 305.000000 Average Reward 320.400000
Episode 360 Reward 88.000000 Average Reward 192.800000
Episode 370 Reward 250.000000 Average Reward 339.300000
Episode 380 Reward 500.000000 Average Reward 428.900000
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Episode 400 Reward 500.000000 Average Reward 497.700000
Episode 410 Reward 126.000000 Average Reward 222.700000
Episode 420 Reward 365.000000 Average Reward 344.900000
Episode 430 Reward 500.000000 Average Reward 278.200000
Episode 440 Reward 500.000000 Average Reward 480.500000
Episode 450 Reward 500.000000 Average Reward 500.000000
Episode 460 Reward 500.000000 Average Reward 491.800000
Episode 470 Reward 122.000000 Average Reward 319.800000
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Episode 570 Reward 185.000000 Average Reward 176.900000
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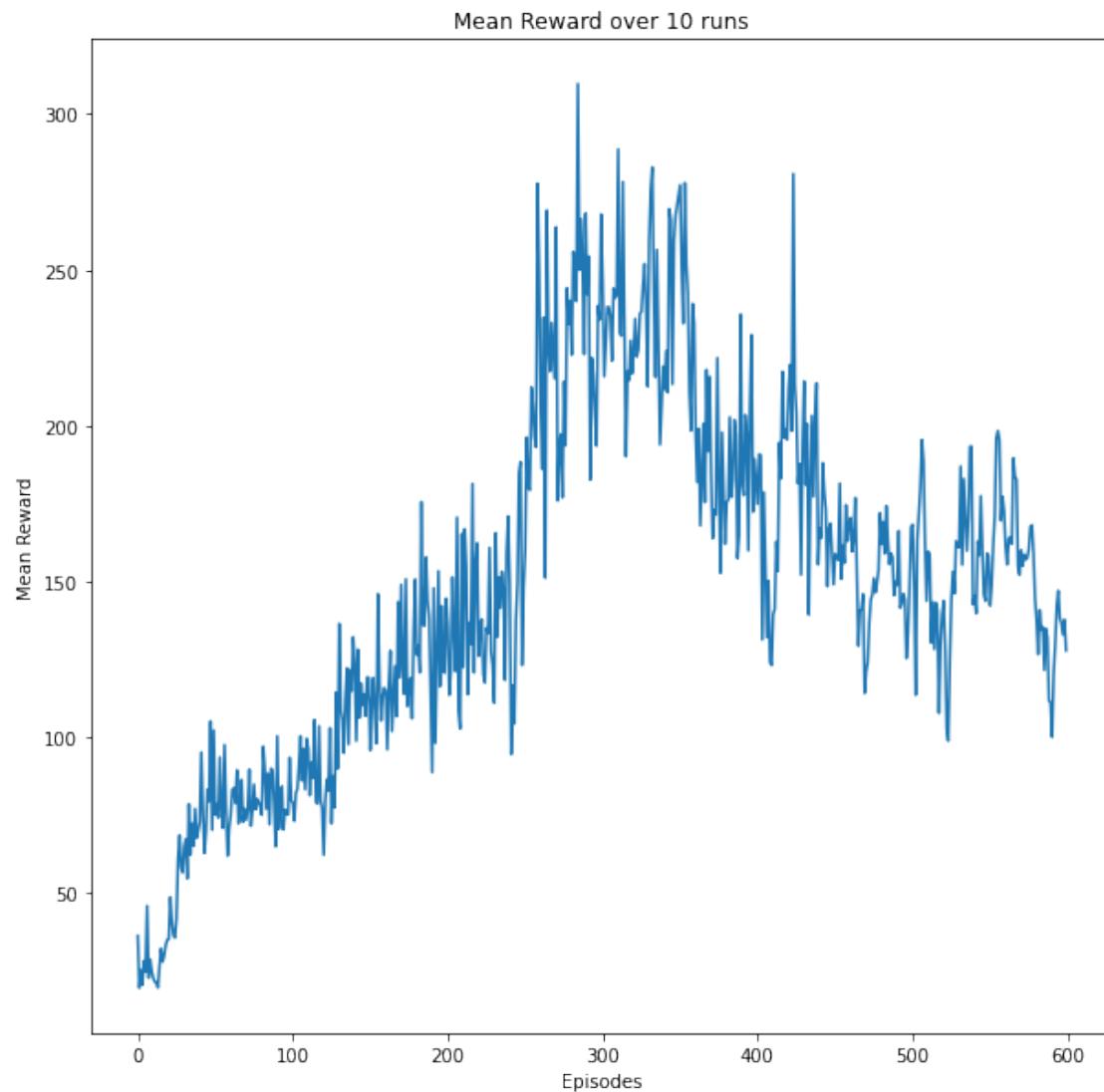
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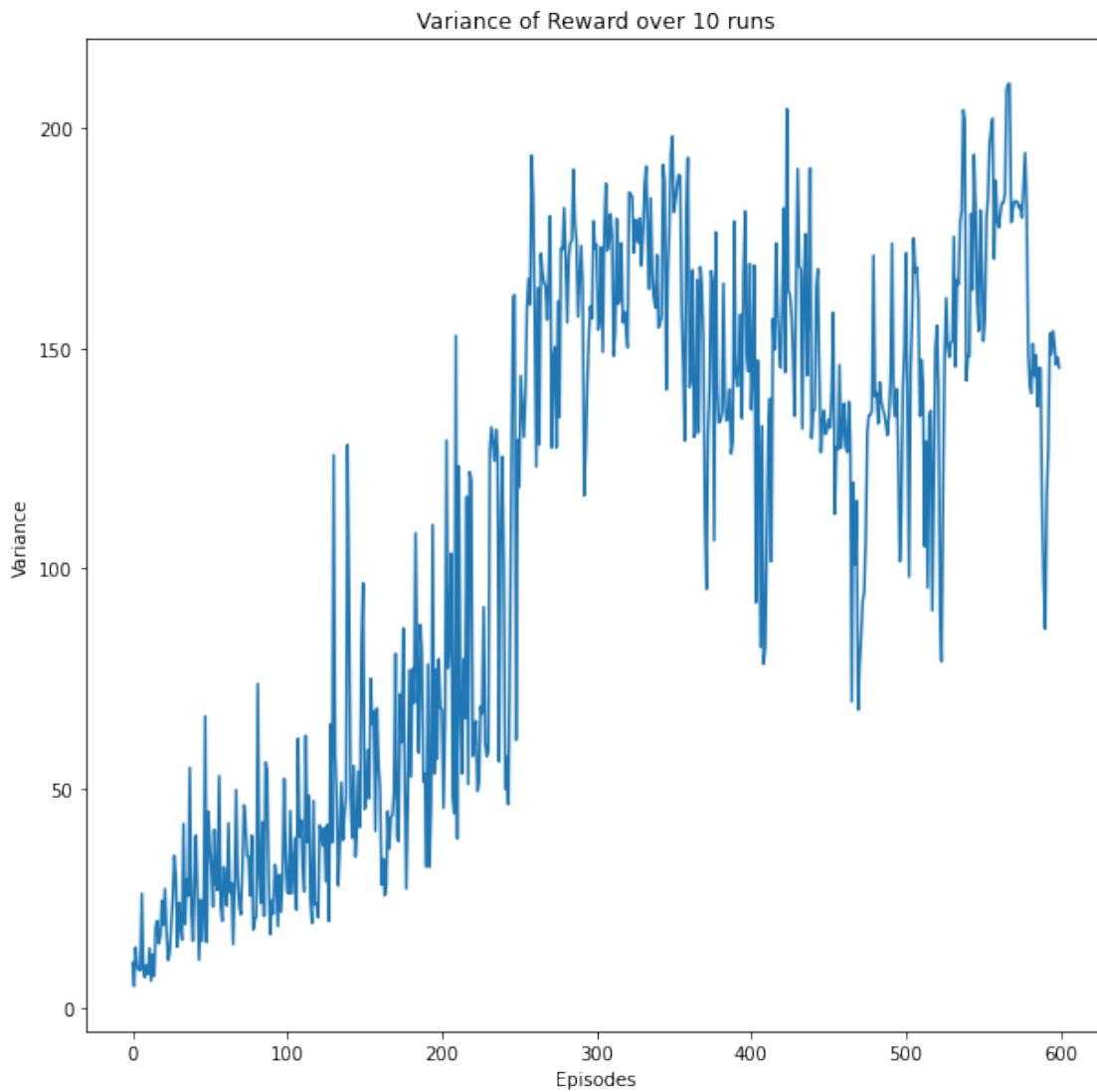
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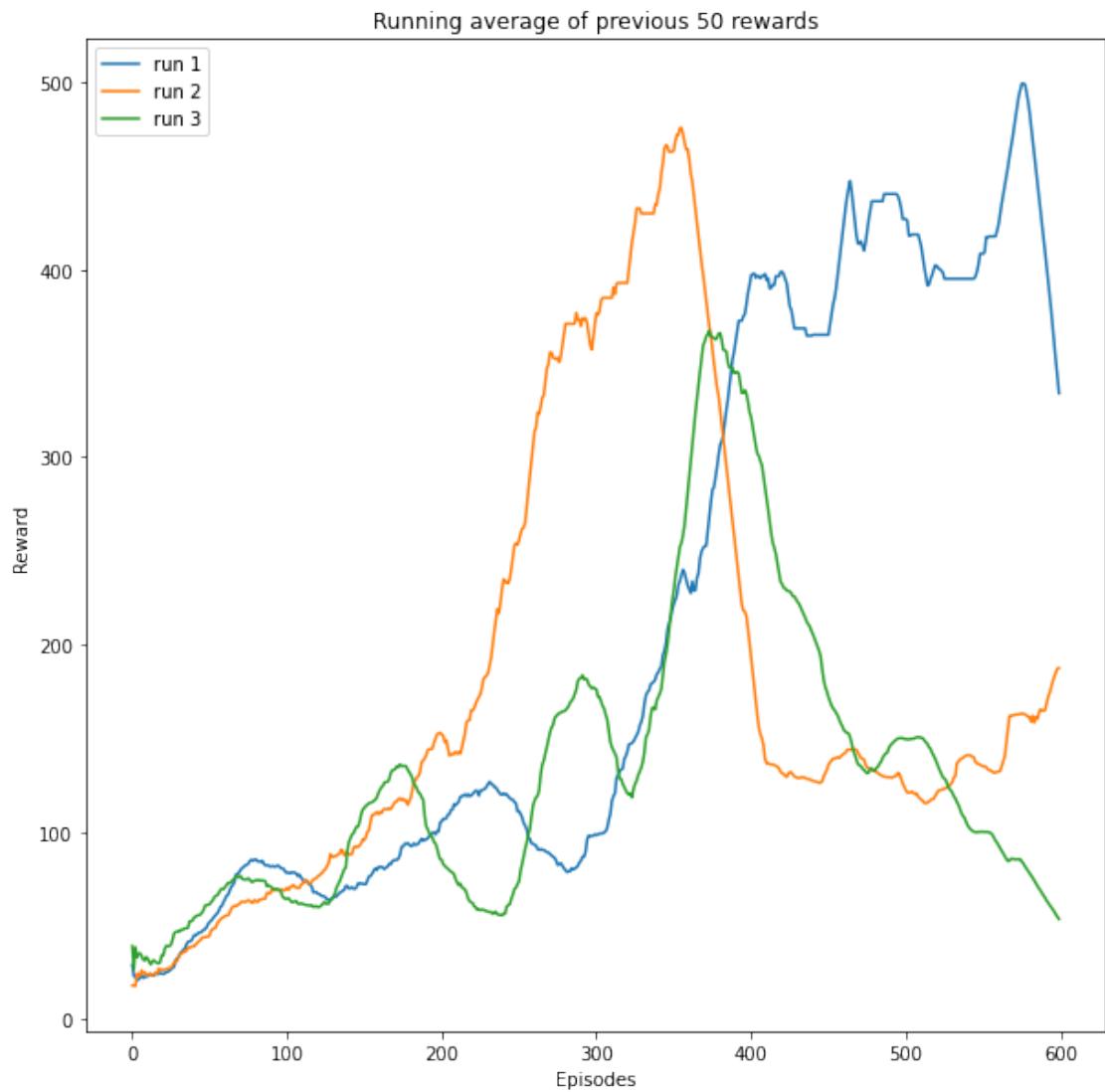
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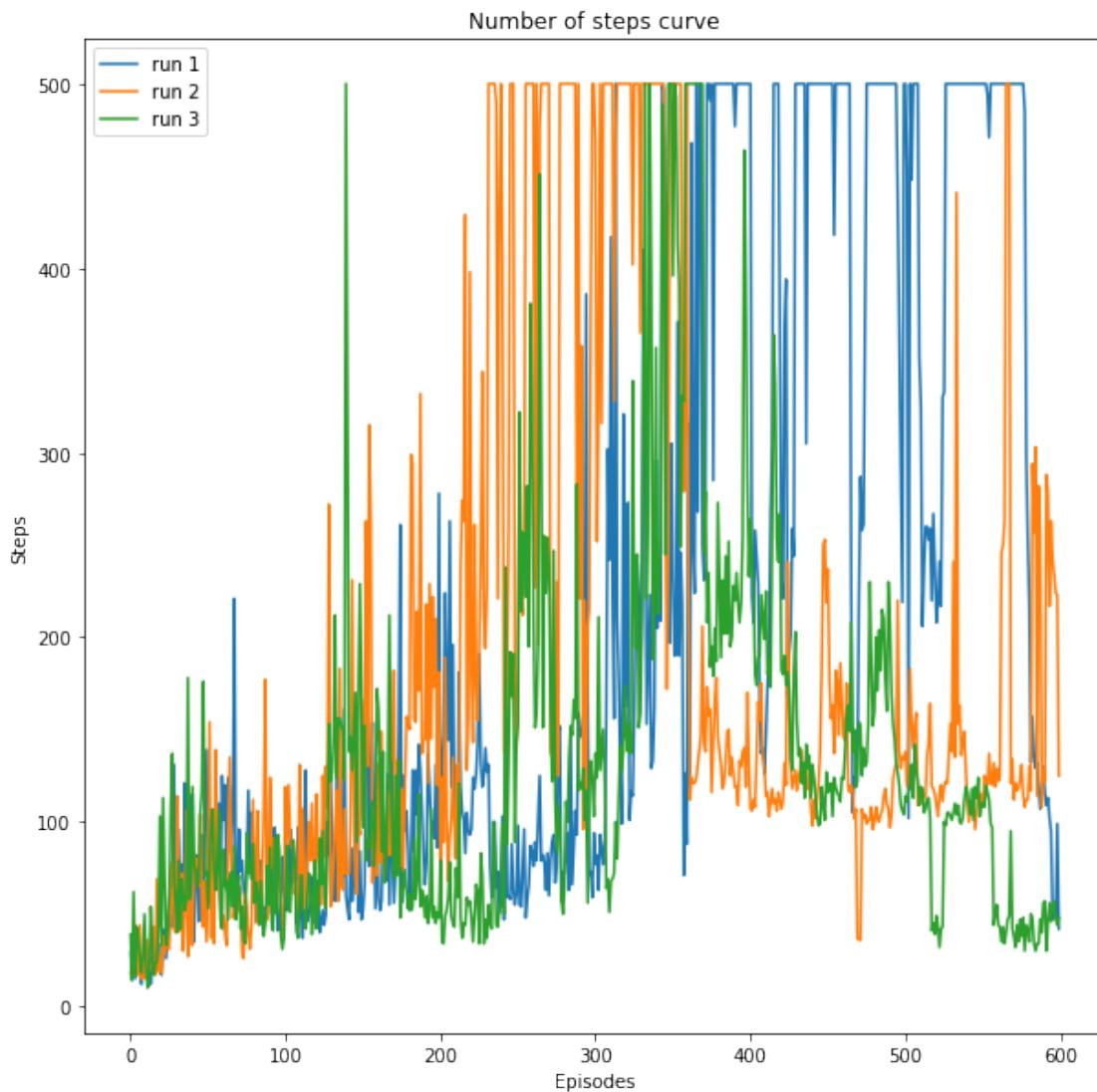
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Episode 600 Reward 67.000000 Average Reward 52.400000
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```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [512, 512]
LR = 2e-4
NUM_EPISODES = 600
AVG_NUM = 50
ENV_NAME = 'CartPole-v1'
SOLVE_CUTOFF = 195.0
STEP = 0

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{hs}-{lr}-{env}-{numep}-{NSTEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

```

/usr/local/lib/python3.9/dist-packages/gym/core.py:317: DeprecationWarning:
WARN: Initializing wrapper in old step API which returns one bool instead
of two. It is recommended to set `new_step_api=True` to use new step API. This
will be the default behaviour in future.

deprecation(
/usr/local/lib/python3.9/dist-
packages/gym/wrappers/step_api_compatibility.py:39: DeprecationWarning:
WARN: Initializing environment in old step API which returns one bool
instead of two. It is recommended to set `new_step_api=True` to use new step
API. This will be the default behaviour in future.

deprecation(
/usr/local/lib/python3.9/dist-packages/gym/core.py:256: DeprecationWarning:
WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
in the future. Please use `env.reset(seed=seed)` instead.

deprecation(
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Episode 160 Reward 118.000000 Average Reward 390.600000

```

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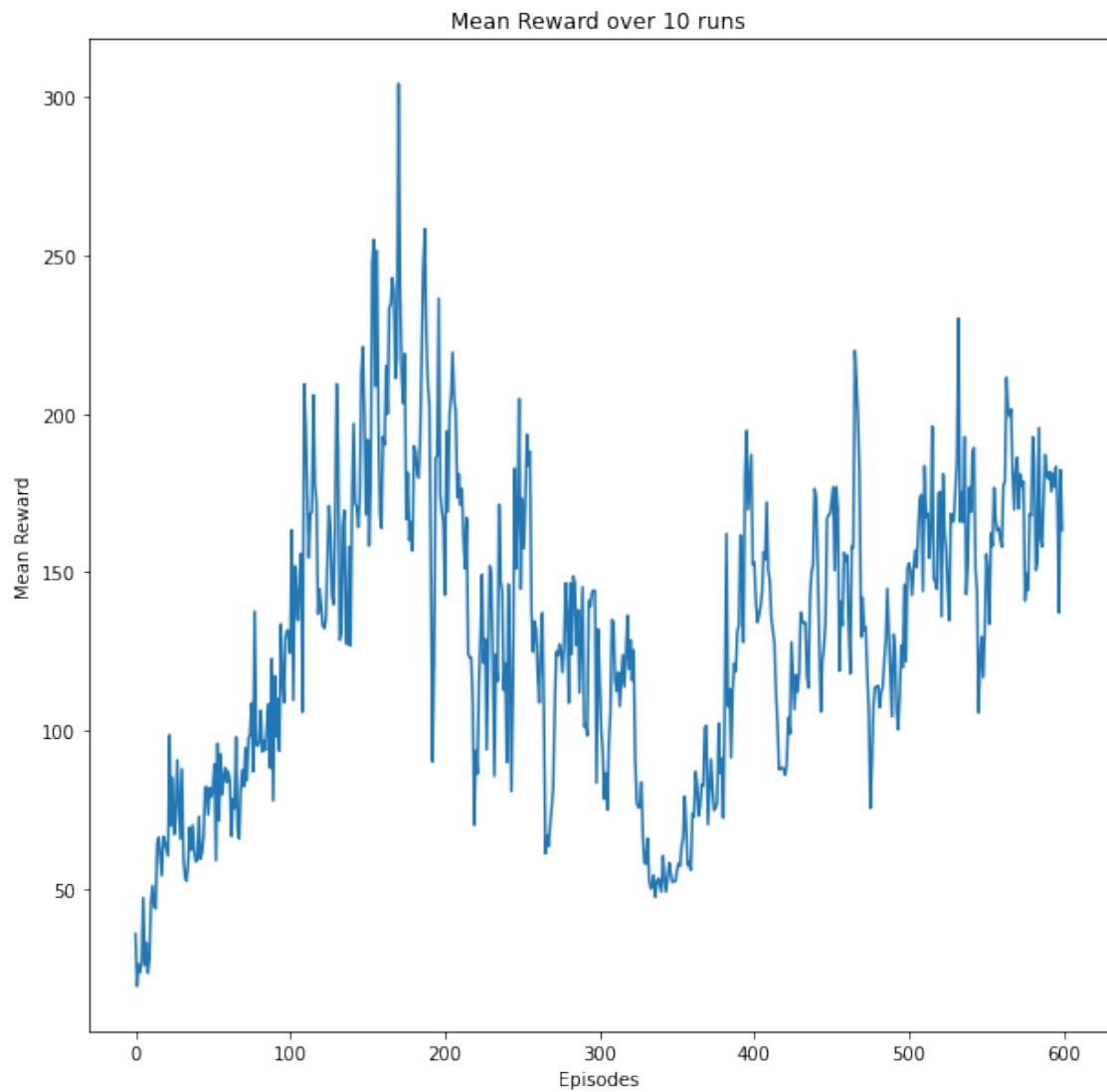
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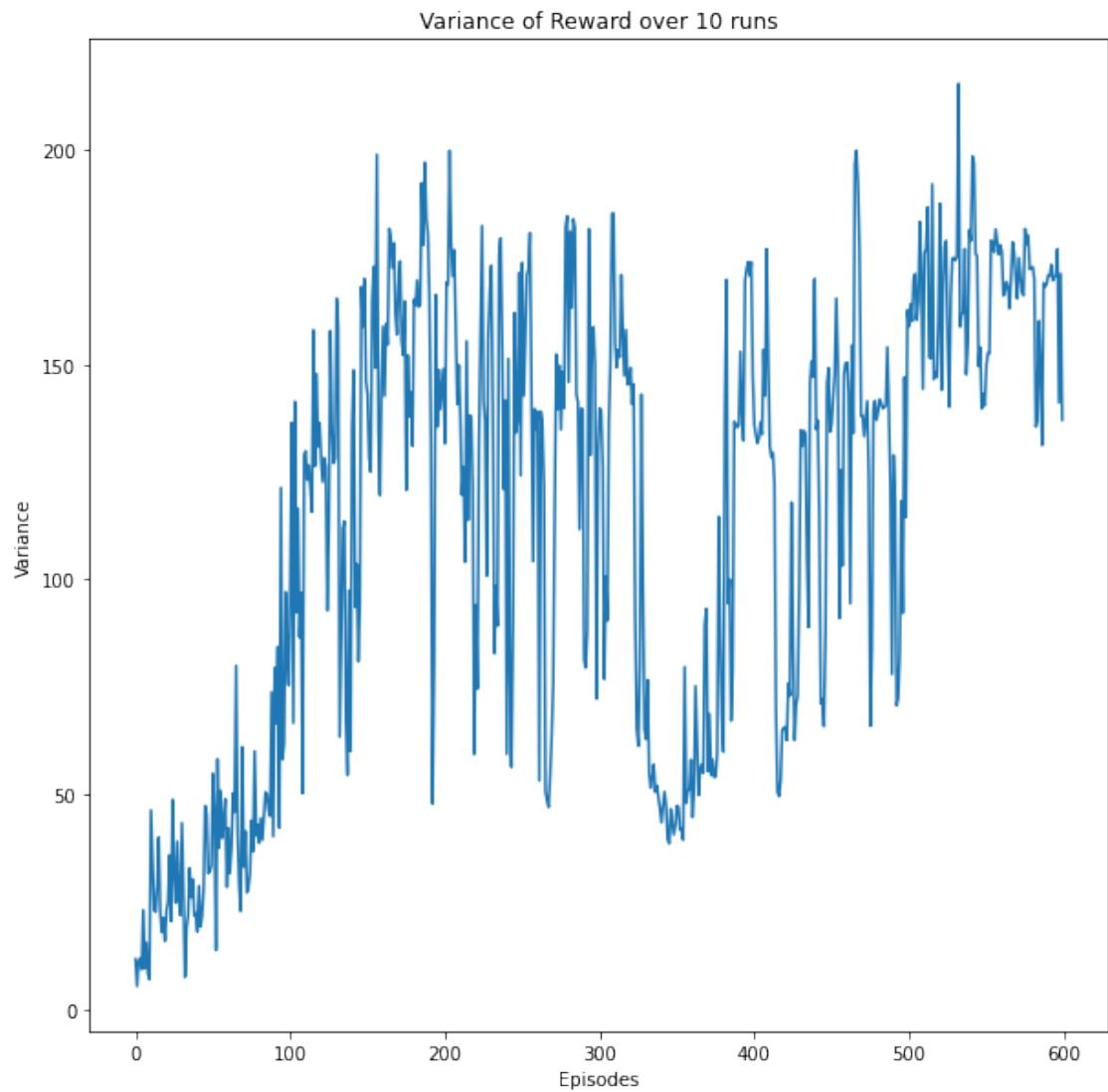
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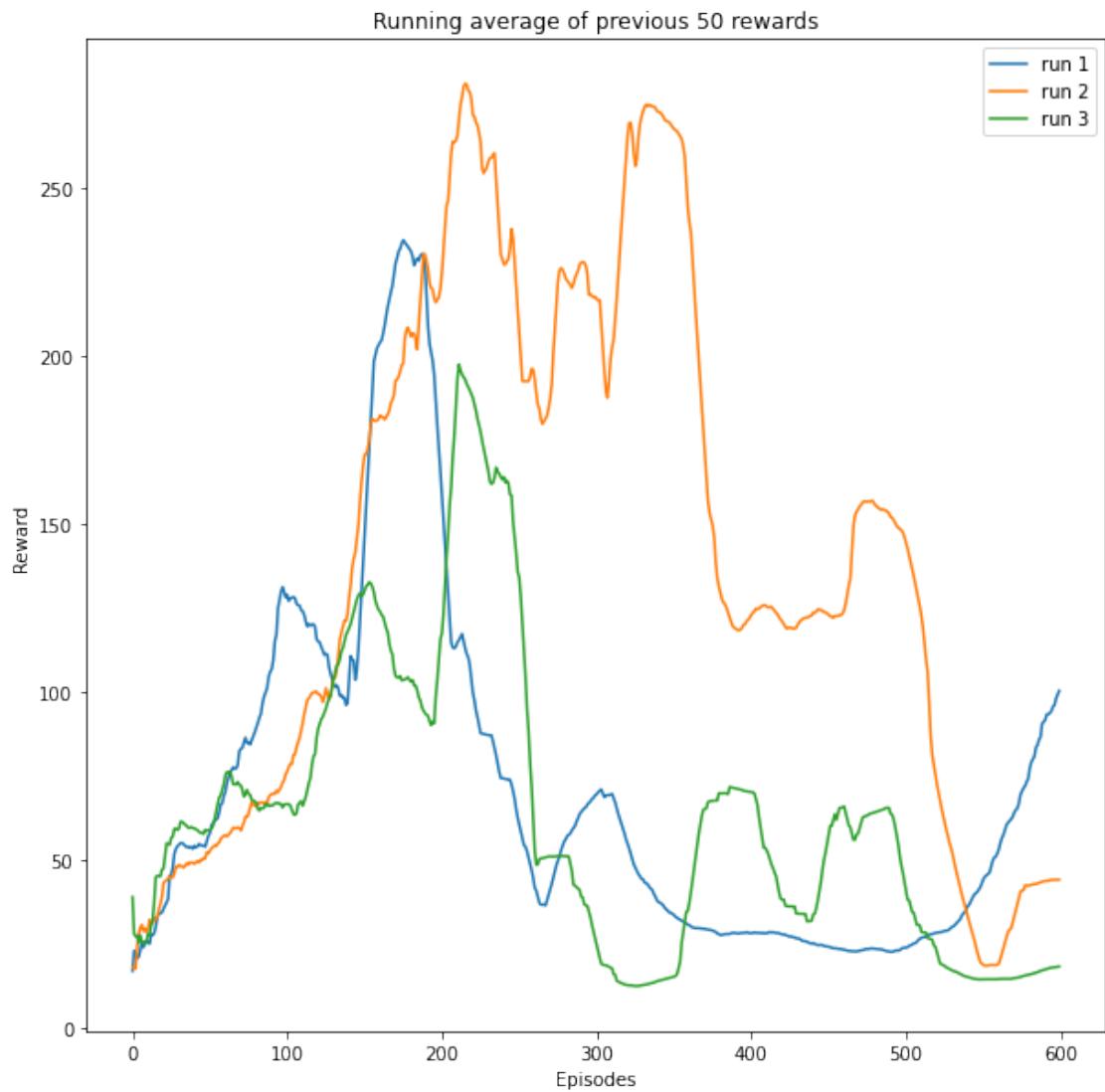
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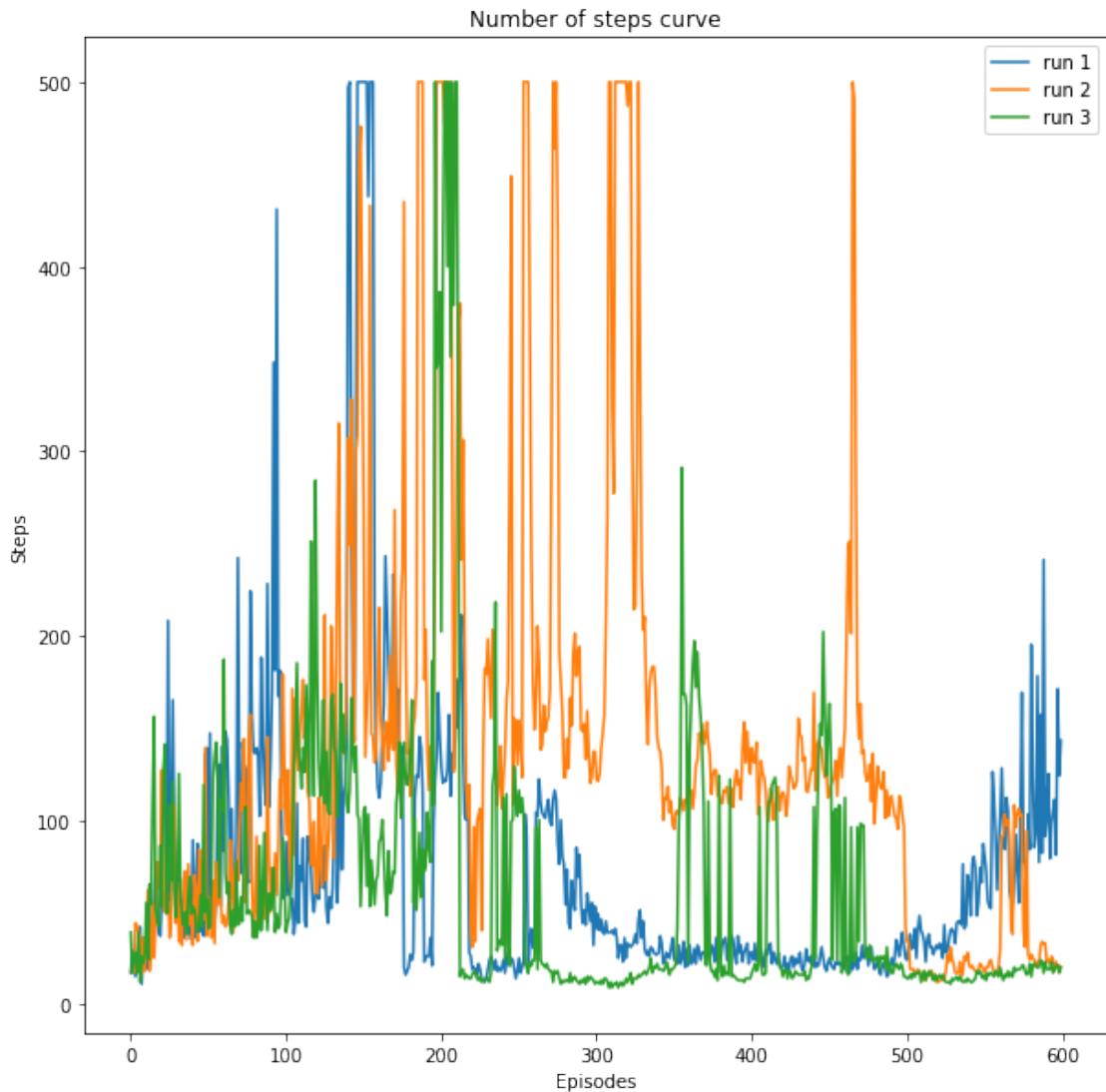
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Episode 600 Reward 198.000000 Average Reward 215.400000
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```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [1024, 512]
LR = 1e-4
NUM_EPISODES = 600
AVG_NUM = 50
ENV_NAME = 'CartPole-v1'
SOLVE_CUTOFF = 195.0
STEP = 0

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{hs}-{lr}-{env}-{numep}-{NSTEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

```

/usr/local/lib/python3.9/dist-packages/gym/core.py:317: DeprecationWarning:
WARN: Initializing wrapper in old step API which returns one bool instead
of two. It is recommended to set `new_step_api=True` to use new step API. This
will be the default behaviour in future.

deprecation(
/usr/local/lib/python3.9/dist-
packages/gym/wrappers/step_api_compatibility.py:39: DeprecationWarning:
WARN: Initializing environment in old step API which returns one bool
instead of two. It is recommended to set `new_step_api=True` to use new step
API. This will be the default behaviour in future.

deprecation(
/usr/local/lib/python3.9/dist-packages/gym/core.py:256: DeprecationWarning:
WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
in the future. Please use `env.reset(seed=seed)` instead.

deprecation(
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Episode 40 Reward 43.000000 Average Reward 57.600000
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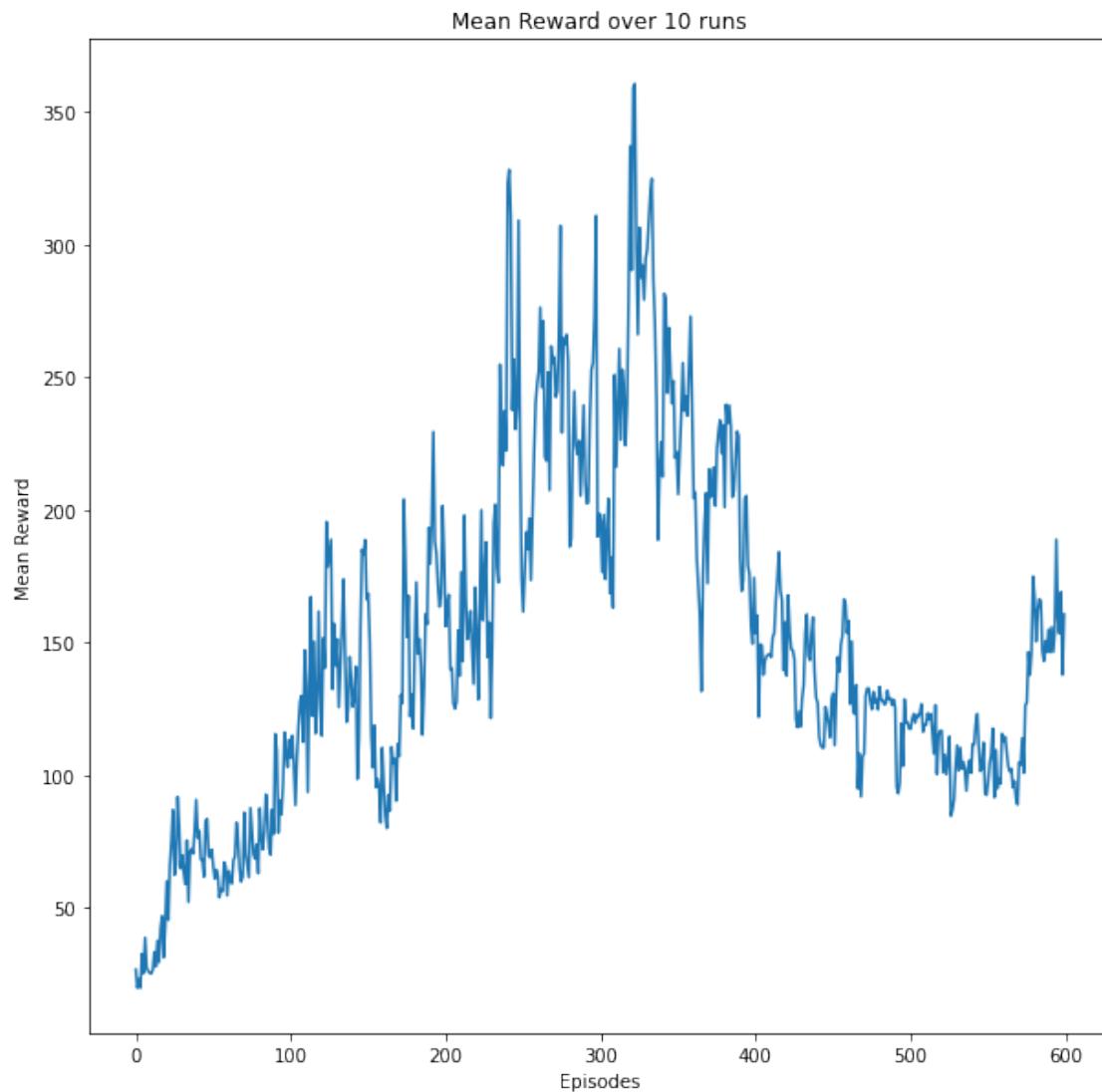
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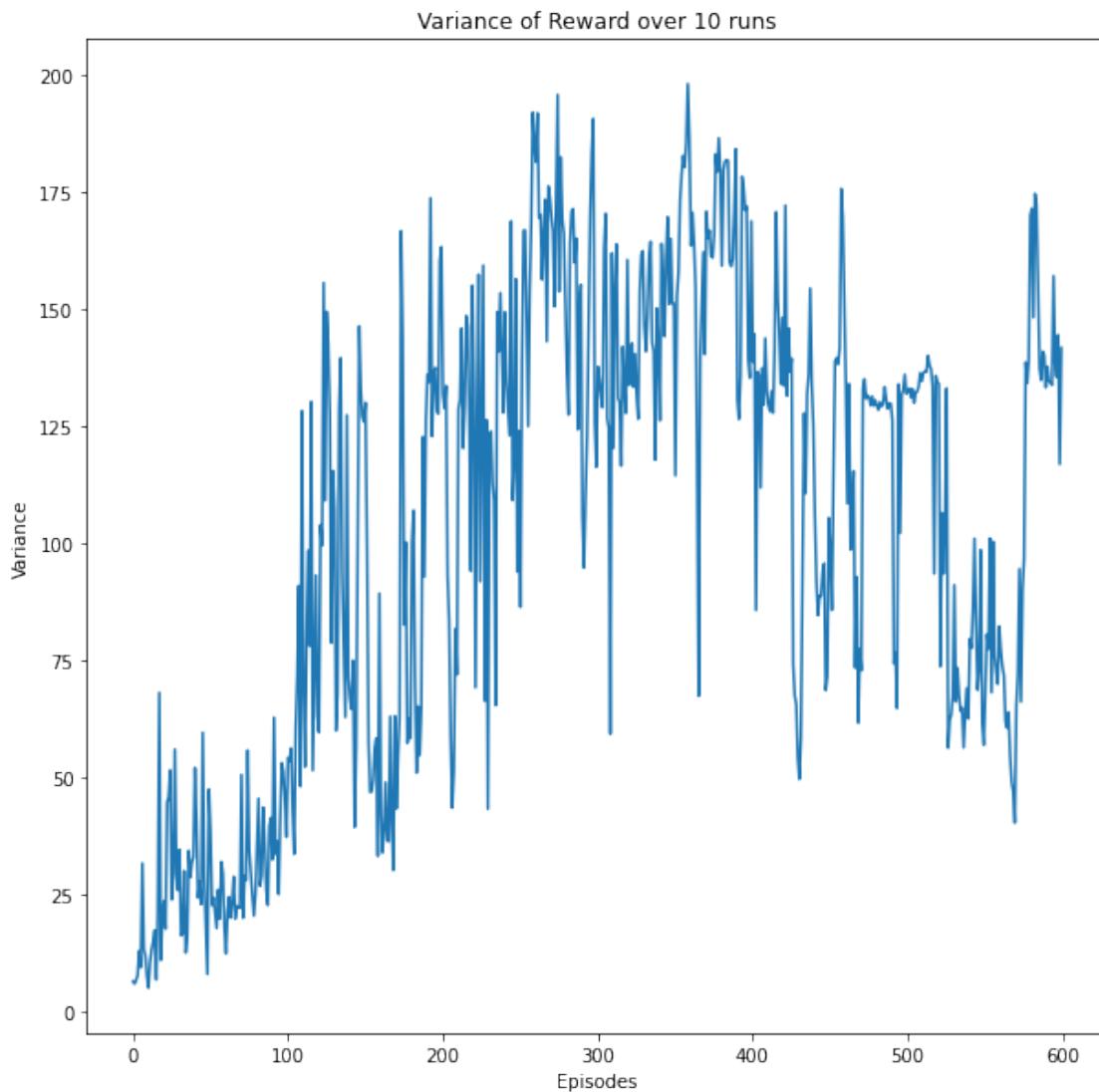
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Episode 70 Reward 51.000000 Average Reward 55.800000
Episode 80 Reward 36.000000 Average Reward 57.100000

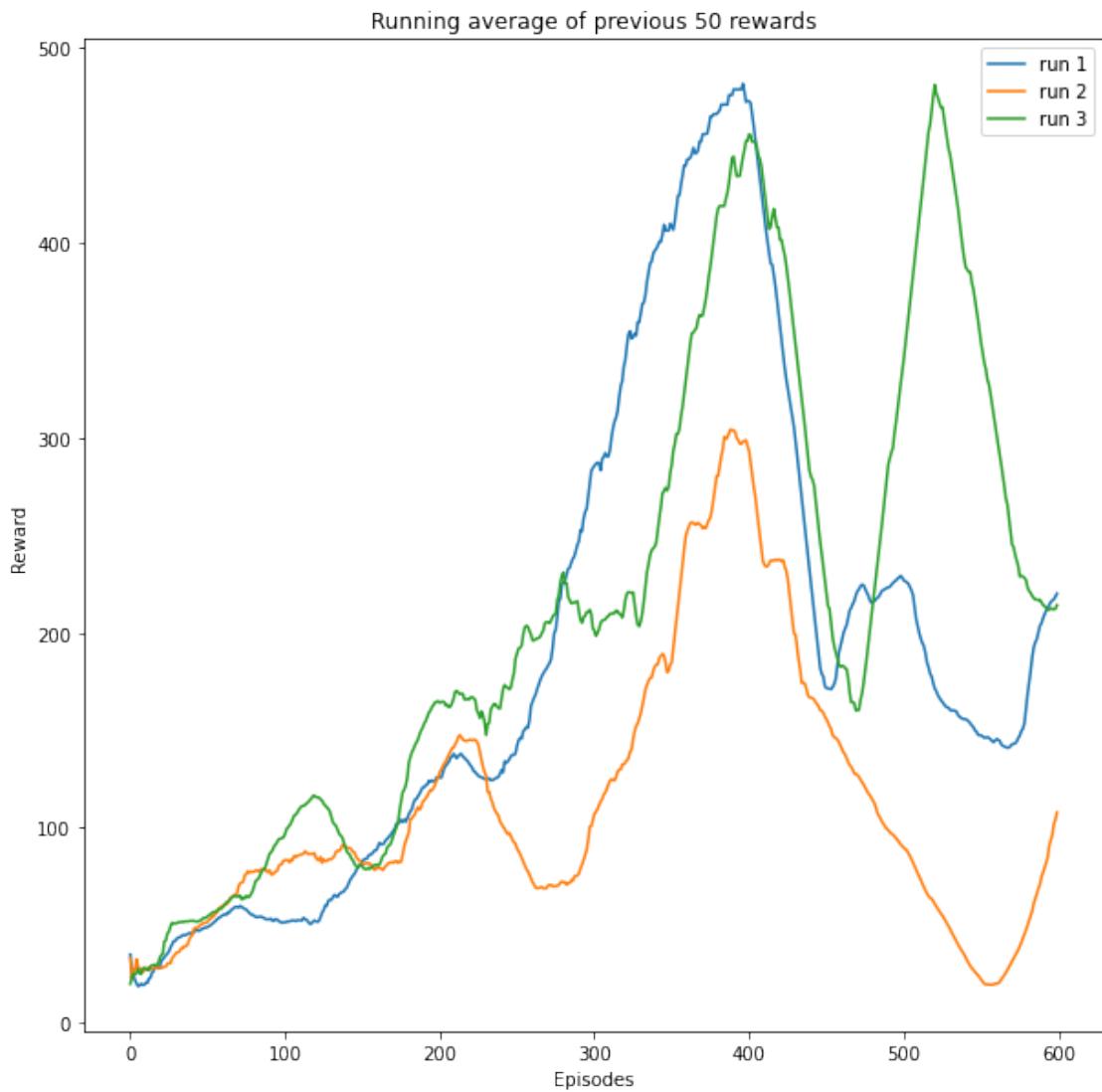
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Episode 480 Reward 34.000000 Average Reward 40.400000
Episode 490 Reward 56.000000 Average Reward 49.200000
Episode 500 Reward 59.000000 Average Reward 42.800000
Episode 510 Reward 37.000000 Average Reward 51.200000
Episode 520 Reward 64.000000 Average Reward 49.300000
Episode 530 Reward 70.000000 Average Reward 63.800000
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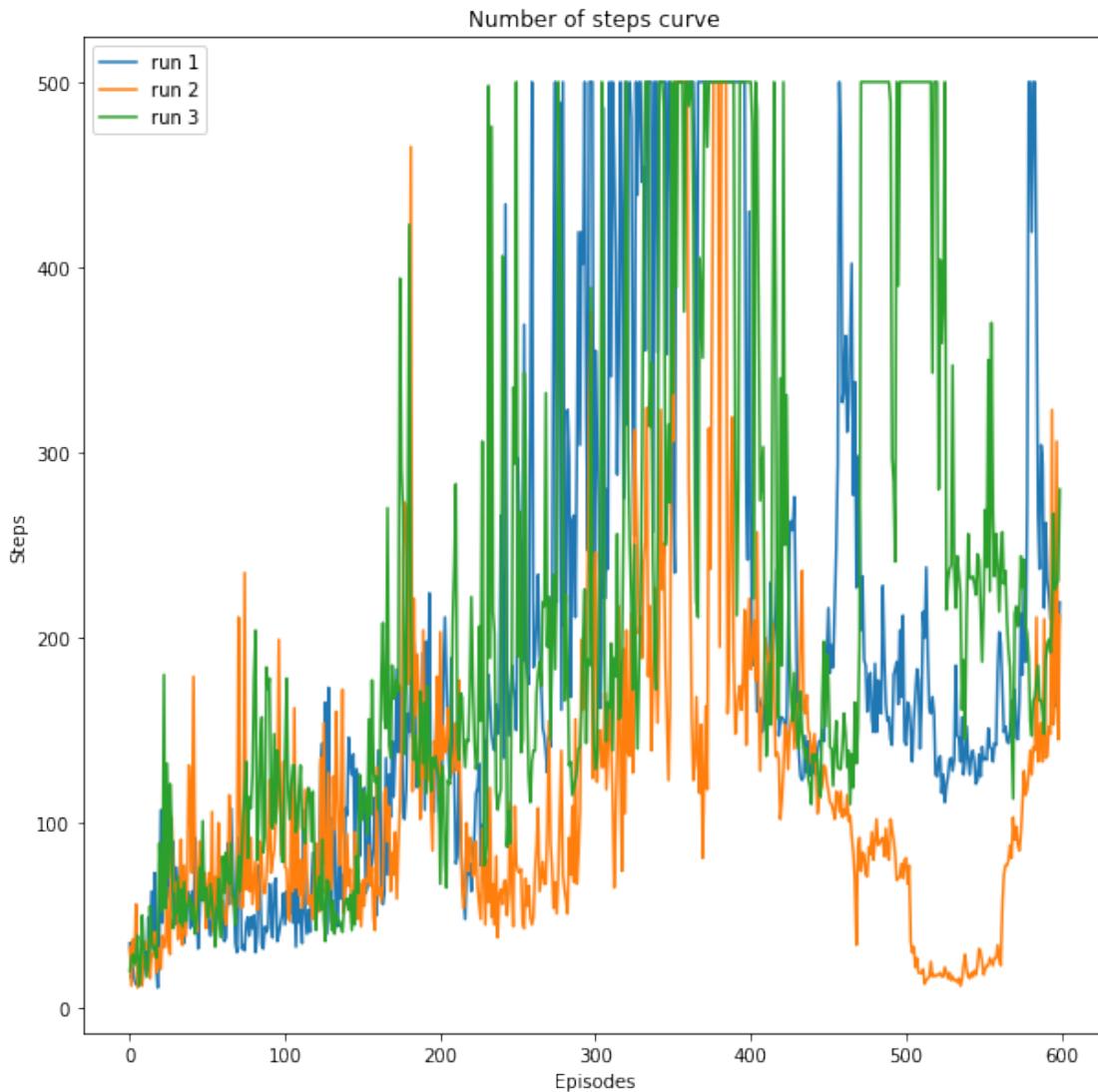
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Episode 70 Reward 82.000000 Average Reward 75.500000
Episode 80 Reward 58.000000 Average Reward 77.700000
Episode 90 Reward 136.000000 Average Reward 90.100000
Episode 100 Reward 89.000000 Average Reward 124.300000
Episode 110 Reward 76.000000 Average Reward 106.000000
Episode 120 Reward 122.000000 Average Reward 79.200000
Episode 130 Reward 94.000000 Average Reward 71.600000
Episode 140 Reward 43.000000 Average Reward 71.000000
Episode 150 Reward 49.000000 Average Reward 55.700000
Episode 160 Reward 47.000000 Average Reward 49.100000
Episode 170 Reward 141.000000 Average Reward 75.000000
Episode 180 Reward 107.000000 Average Reward 126.100000
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Episode 230 Reward 68.000000 Average Reward 80.300000
Episode 240 Reward 199.000000 Average Reward 194.500000
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Episode 270 Reward 236.000000 Average Reward 238.800000
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Episode 290 Reward 331.000000 Average Reward 243.500000
Episode 300 Reward 500.000000 Average Reward 380.800000
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Episode 390 Reward 31.000000 Average Reward 31.000000
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Episode 440 Reward 16.000000 Average Reward 15.300000
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Episode 580 Reward 144.000000 Average Reward 91.200000
Episode 590 Reward 78.000000 Average Reward 90.300000
Episode 600 Reward 132.000000 Average Reward 101.400000
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```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [1024, 1024]
LR = 0.5e-4
NUM_EPISODES = 600
AVG_NUM = 50
ENV_NAME = 'CartPole-v1'
SOLVE_CUTOFF = 195.0
STEP = 0

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{NUM_HIDDEN}_{hs}-{HIDDEN_SIZES}_{lr}-{LR}_{env}-{ENV_NAME}_{numep}-{NUM_EPISODES}_{nstep}-{STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

```

/usr/local/lib/python3.9/dist-packages/gym/core.py:317: DeprecationWarning:
WARN: Initializing wrapper in old step API which returns one bool instead
of two. It is recommended to set `new_step_api=True` to use new step API. This
will be the default behaviour in future.

deprecation(
/usr/local/lib/python3.9/dist-
packages/gym/wrappers/step_api_compatibility.py:39: DeprecationWarning:
WARN: Initializing environment in old step API which returns one bool
instead of two. It is recommended to set `new_step_api=True` to use new step
API. This will be the default behaviour in future.

deprecation(
/usr/local/lib/python3.9/dist-packages/gym/core.py:256: DeprecationWarning:
WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
in the future. Please use `env.reset(seed=seed)` instead.

deprecation(
Episode 10 Reward 25.000000 Average Reward 22.700000
Episode 20 Reward 18.000000 Average Reward 28.900000
Episode 30 Reward 34.000000 Average Reward 39.700000
Episode 40 Reward 113.000000 Average Reward 50.000000
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Episode 70 Reward 37.000000 Average Reward 74.200000
Episode 80 Reward 86.000000 Average Reward 63.800000
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Episode 120 Reward 48.000000 Average Reward 50.500000
Episode 130 Reward 102.000000 Average Reward 84.900000
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Episode 150 Reward 69.000000 Average Reward 83.100000
Episode 160 Reward 146.000000 Average Reward 116.800000

```

Episode 170 Reward 92.000000 Average Reward 120.600000
Episode 180 Reward 92.000000 Average Reward 151.600000
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Episode 210 Reward 64.000000 Average Reward 85.100000
Episode 220 Reward 63.000000 Average Reward 76.300000
Episode 230 Reward 64.000000 Average Reward 91.700000
Episode 240 Reward 74.000000 Average Reward 89.500000
Episode 250 Reward 125.000000 Average Reward 171.800000
Episode 260 Reward 213.000000 Average Reward 224.100000
Episode 270 Reward 500.000000 Average Reward 395.400000
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Episode 300 Reward 129.000000 Average Reward 127.800000
Episode 310 Reward 114.000000 Average Reward 263.900000
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Episode 330 Reward 350.000000 Average Reward 349.500000
Episode 340 Reward 500.000000 Average Reward 416.600000
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Episode 360 Reward 500.000000 Average Reward 500.000000
Episode 370 Reward 170.000000 Average Reward 323.000000
Episode 380 Reward 23.000000 Average Reward 67.600000
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Episode 400 Reward 16.000000 Average Reward 16.600000
Episode 410 Reward 29.000000 Average Reward 19.300000
Episode 420 Reward 20.000000 Average Reward 52.200000
Episode 430 Reward 201.000000 Average Reward 163.700000
Episode 440 Reward 422.000000 Average Reward 283.000000
Episode 450 Reward 500.000000 Average Reward 457.200000
Episode 460 Reward 500.000000 Average Reward 500.000000
Episode 470 Reward 500.000000 Average Reward 500.000000
Episode 480 Reward 500.000000 Average Reward 335.500000
Episode 490 Reward 500.000000 Average Reward 322.400000
Episode 500 Reward 288.000000 Average Reward 450.800000
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Episode 530 Reward 150.000000 Average Reward 185.100000
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Episode 550 Reward 101.000000 Average Reward 116.100000
Episode 560 Reward 107.000000 Average Reward 114.500000
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Episode 410 Reward 203.000000 Average Reward 188.700000
Episode 420 Reward 189.000000 Average Reward 190.100000
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Episode 540 Reward 16.000000 Average Reward 14.400000
Episode 550 Reward 14.000000 Average Reward 13.400000
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Episode 570 Reward 16.000000 Average Reward 12.300000
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Episode 530 Reward 113.000000 Average Reward 186.600000
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Episode 550 Reward 165.000000 Average Reward 155.500000
Episode 560 Reward 163.000000 Average Reward 162.300000
Episode 570 Reward 169.000000 Average Reward 155.200000
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Episode 90 Reward 52.000000 Average Reward 102.800000
Episode 100 Reward 179.000000 Average Reward 72.200000
Episode 110 Reward 91.000000 Average Reward 78.400000
Episode 120 Reward 54.000000 Average Reward 81.500000
Episode 130 Reward 55.000000 Average Reward 96.800000
Episode 140 Reward 155.000000 Average Reward 89.000000
Episode 150 Reward 117.000000 Average Reward 129.700000
Episode 160 Reward 96.000000 Average Reward 107.700000
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Episode 190 Reward 75.000000 Average Reward 107.200000
Episode 200 Reward 58.000000 Average Reward 63.400000
Episode 210 Reward 76.000000 Average Reward 71.600000
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Episode 240 Reward 120.000000 Average Reward 195.900000
Episode 250 Reward 194.000000 Average Reward 176.400000
Episode 260 Reward 114.000000 Average Reward 139.600000
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Episode 390 Reward 25.000000 Average Reward 24.800000
Episode 400 Reward 250.000000 Average Reward 195.600000
Episode 410 Reward 500.000000 Average Reward 452.800000
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Episode 80 Reward 87.000000 Average Reward 89.100000
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Episode 230 Reward 55.000000 Average Reward 80.000000
Episode 240 Reward 90.000000 Average Reward 93.900000
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Episode 260 Reward 128.000000 Average Reward 129.200000
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Episode 280 Reward 151.000000 Average Reward 161.400000
Episode 290 Reward 108.000000 Average Reward 149.100000
Episode 300 Reward 186.000000 Average Reward 142.500000
Episode 310 Reward 89.000000 Average Reward 115.600000
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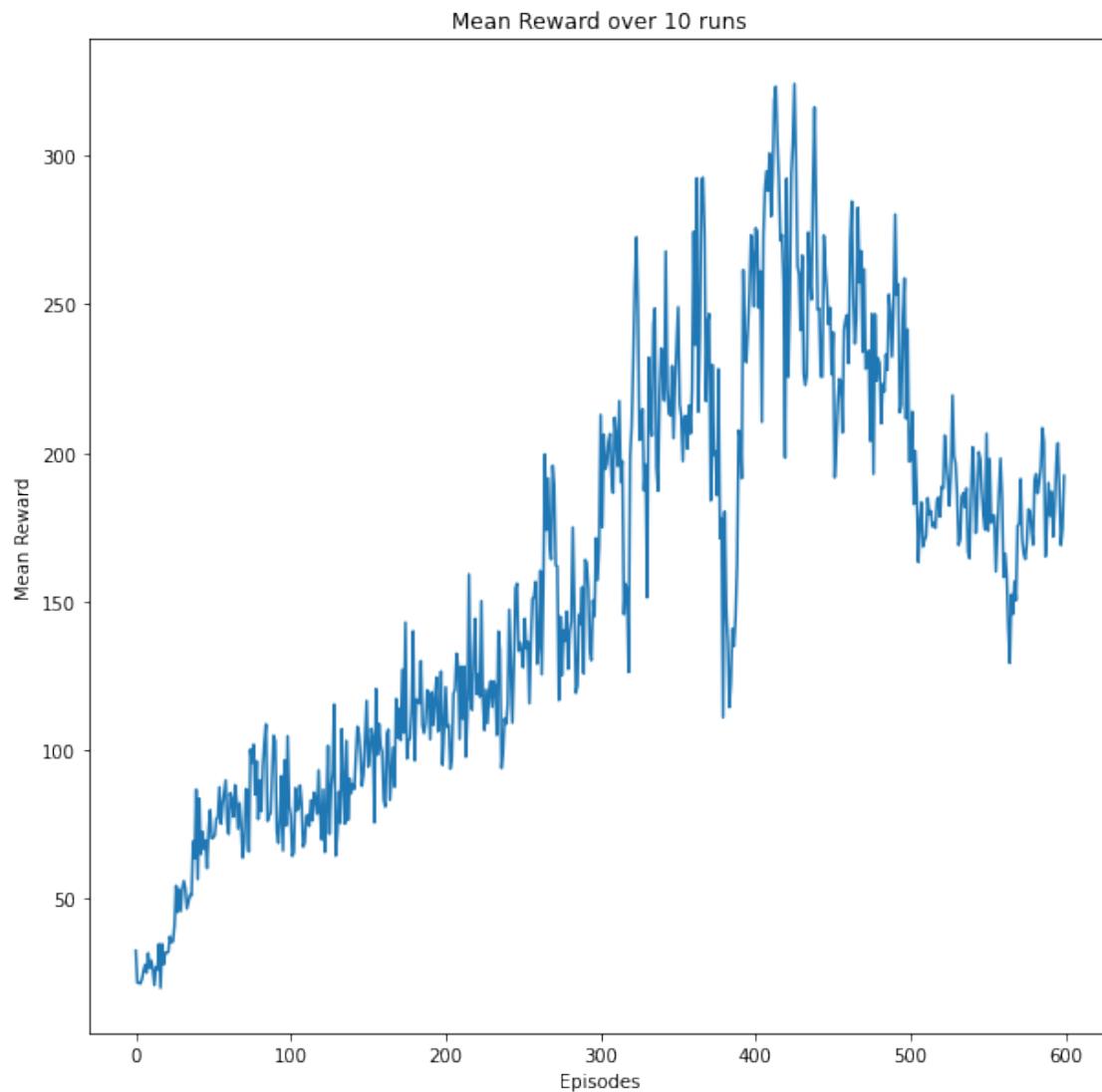
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Episode 70 Reward 55.000000 Average Reward 67.400000
Episode 80 Reward 50.000000 Average Reward 71.200000
Episode 90 Reward 56.000000 Average Reward 79.700000
Episode 100 Reward 69.000000 Average Reward 97.500000
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Episode 130 Reward 66.000000 Average Reward 74.100000
Episode 140 Reward 52.000000 Average Reward 74.100000
Episode 150 Reward 64.000000 Average Reward 60.600000
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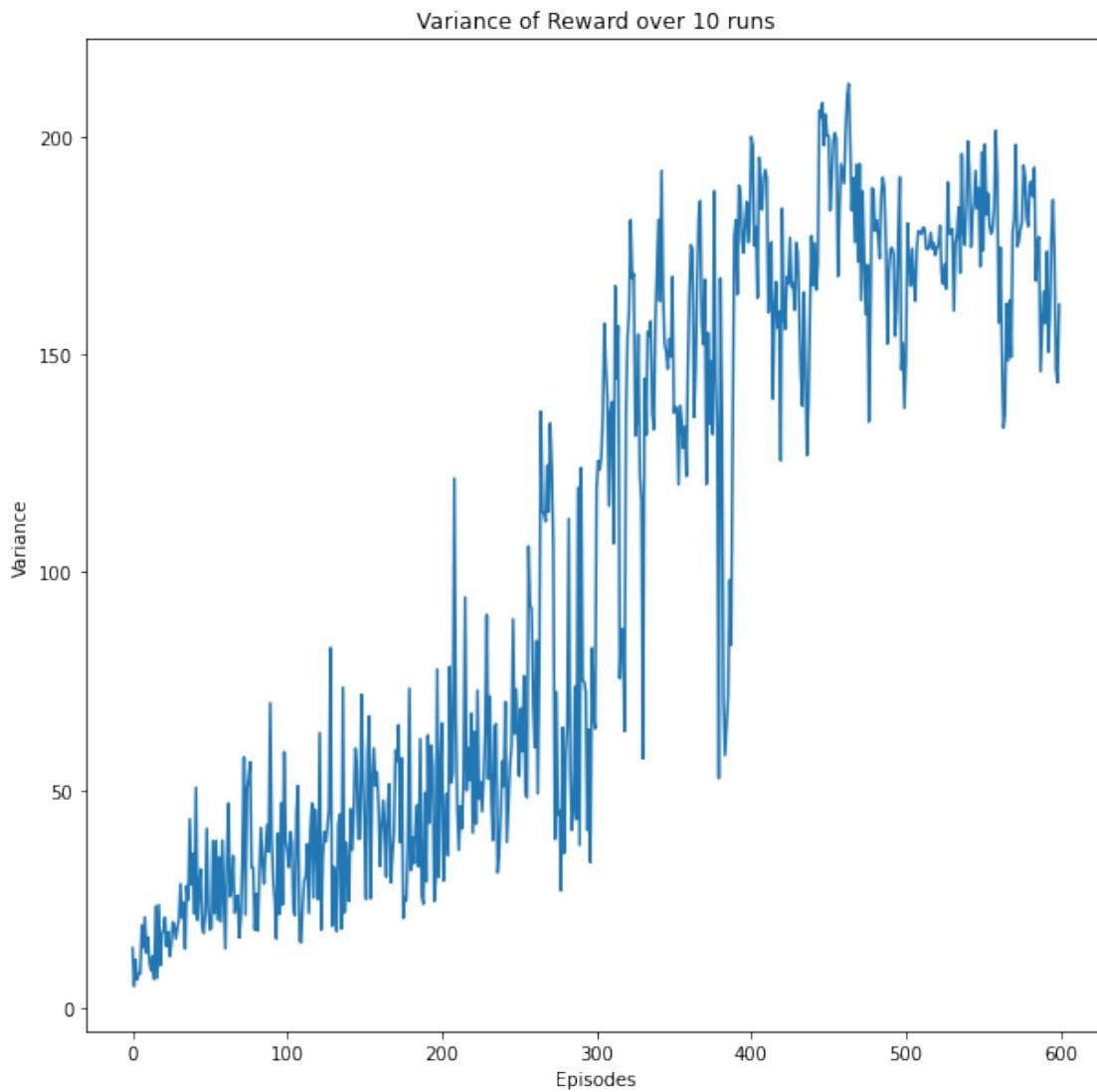
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Episode 550 Reward 97.000000 Average Reward 103.300000
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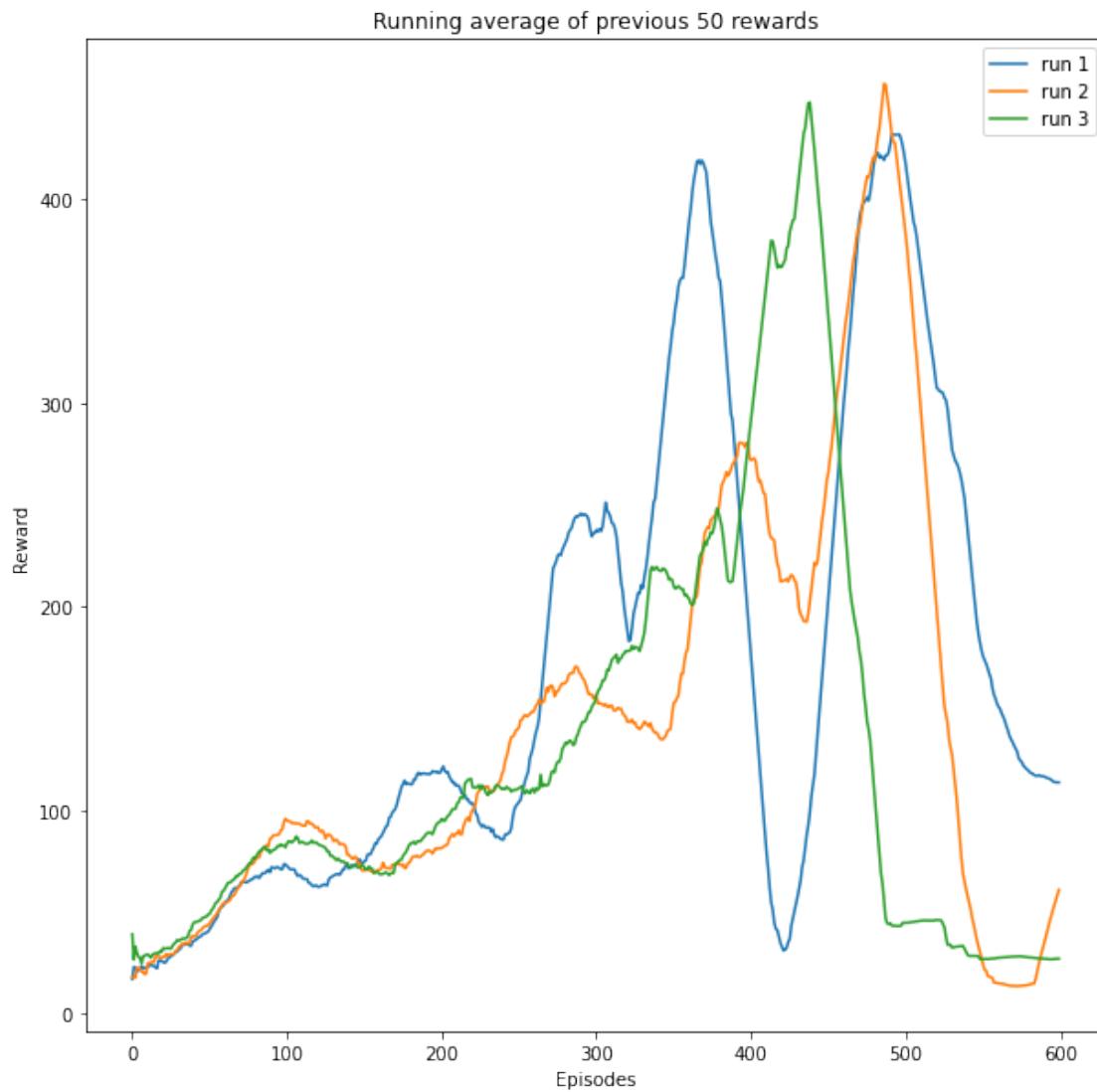
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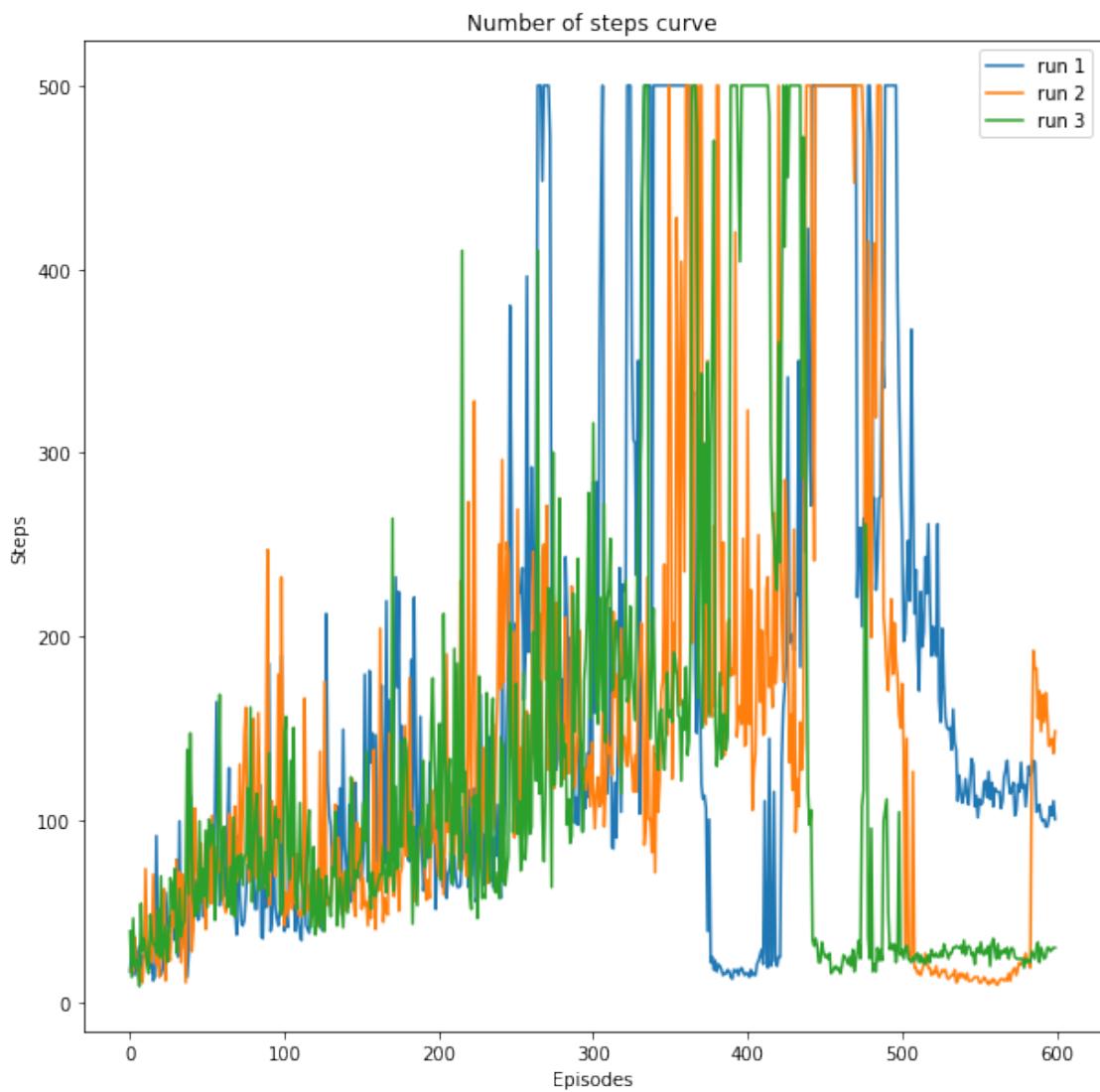
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Episode 600 Reward 500.000000 Average Reward 500.000000
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5StepACmain

March 26, 2023

```
[ ]: import numpy as np
from collections import namedtuple, deque
import datetime
import gym
import glob
import io
import base64
import matplotlib.pyplot as plt
import tensorflow as tf
from PIL import Image
import tensorflow_probability as tfp
import seaborn as sns
import os
```

```
[ ]: from google.colab import drive
drive.mount('/content/drive')
```

Mounted at /content/drive

0.1 One-Step Actor-Critic Algorithm

Actor-Critic methods learn both a policy $\pi(a|s; \theta)$ and a state-value function $v(s; w)$ simultaneously. The policy is referred to as the actor that suggests actions given a state. The estimated value function is referred to as the critic. It evaluates actions taken by the actor based on the given policy. In this exercise, both functions are approximated by feedforward neural networks.

- The policy network is parametrized by θ - it takes a state s as input and outputs the probabilities $\pi(a|s; \theta) \forall a$
- The value network is parametrized by w - it takes a state s as input and outputs a scalar value associated with the state, i.e., $v(s; w)$
- The single step TD error can be defined as follows:

$$\delta_t = R_{t+1} + \gamma v(s_{t+1}; w) - v(s_t; w)$$

- The loss function to be minimized at every step ($L_{tot}^{(t)}$) is a summation of two terms, as follows:

$$L_{tot}^{(t)} = L_{actor}^{(t)} + L_{critic}^{(t)}$$

where,

$$L_{actor}^{(t)} = -\log \pi(a_t|s_t; \theta) \delta_t$$

$$L_{critic}^{(t)} = \delta_t^2$$

- NOTE: Here, weights of the first two hidden layers are shared by the policy and the value network
 - First two hidden layer sizes: [1024, 512]
 - Output size of policy network: 2 (Softmax activation)
 - Output size of value network: 1 (Linear activation)

0.1.1 Actor-Critic Network

```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [1024, 512]

class ActorCriticModel(tf.keras.Model):
    """
    Defining policy and value networks
    """

    def __init__(self, action_size):
        super(ActorCriticModel, self).__init__()

        self.fcls = []
        for i in range(NUM_HIDDEN):
            fc = tf.keras.layers.Dense(HIDDEN_SIZES[i], activation='relu')
            self.fcls.append(fc)

        self.pi_out = tf.keras.layers.Dense(action_size) #Output Layer for policy
        self.v_out = tf.keras.layers.Dense(1) #Output Layer for state-value

    def call(self, state):
        """
        Computes policy distribution and state-value for a given state
        """
        out = state
        for l in self.fcls:
            out = l(out)

        pi = self.pi_out(out)
        v = self.v_out(out)

        return pi, v
```

0.1.2 Agent Class

```
[ ]: ENV = gym.make('CartPole-v1')
LR = 1e-4
STEP = 5
```

```

def env_step(action: np.ndarray):
    """Returns state, reward and done flag given an action."""
    state, reward, done, info = ENV.step(action)
    return (state.astype(np.float32), np.array(reward, np.int32), np.array(done, np.int32))

def tf_env_step(action: tf.Tensor):
    return tf.numpy_function(env_step, [action], [tf.float32, tf.int32, tf.int32])

eps = np.finfo(np.float32).eps.item()
class Agent:
    def __init__(self, action_size):
        self.model = ActorCriticModel(action_size)
        self.loss = tf.keras.losses.Huber(reduction=tf.keras.losses.Reduction.SUM)
        self.optimizer = tf.keras.optimizers.Adam(learning_rate=LR)

    def run_episode(self, initial_state, max_steps=800):
        """Runs a single episode to collect training data."""

        action_probs = tf.TensorArray(dtype=tf.float32, size=0, dynamic_size=True)
        values = tf.TensorArray(dtype=tf.float32, size=0, dynamic_size=True)
        rewards = tf.TensorArray(dtype=tf.int32, size=0, dynamic_size=True)

        initial_state_shape = initial_state.shape
        state = initial_state
        steps = 0
        for t in tf.range(max_steps):
            # Convert state into a batched tensor (batch size = 1)
            state = tf.expand_dims(state, 0)

            # Run the model and to get action probabilities and critic value;
            # and sample next action
            action_logits_t, value = self.model(state)
            action = tf.random.categorical(action_logits_t, 1)[0, 0]
            action_probs_t = tf.nn.softmax(action_logits_t)

            # Store critic values
            values = values.write(t, tf.squeeze(value))

            # Store log probability of the action chosen
            action_probs = action_probs.write(t, action_probs_t[0, action])

            # Apply action to the environment to get next state and reward
            state, reward, done = tf_env_step(action)
            state.set_shape(initial_state_shape)

```

```

        rewards = rewards.write(t, reward)
        steps += 1
        if tf.cast(done, tf.bool):
            break

    action_probs = action_probs.stack()
    values = values.stack()
    rewards = rewards.stack()

    return action_probs, values, rewards, steps

def compute_nstep_returns(self, rewards, values, gamma = 0.99):
    """Compute n step returns at all timesteps."""

    n = tf.shape(rewards)[0]
    returns = tf.TensorArray(dtype=tf.float32, size=n)
    rewards = tf.cast(rewards[:-1], dtype=tf.float32)
    disc_return = tf.constant(0.0)
    disc_ret_shape = disc_return.shape

    # loop to compute the return for every instant
    for i in tf.range(n):
        if i+STEP >= n:
            ret = tf.constant(0.0)
            ret_shape = ret.shape
            for j in tf.range(i,n):
                ret = tf.math.pow(gamma,float(j-i))*rewards[j] + ret
            ret.set_shape(ret_shape)
            disc_return = ret
        else:
            ret = tf.constant(0.0)
            ret_shape = ret.shape
            for j in tf.range(i,i+STEP):
                ret = tf.math.pow(gamma,float(j-i)) * rewards[j] + ret
            ret.set_shape(ret_shape)
            disc_return = ret + tf.math.pow(gamma,float(STEP)) *_
            ↵values[i+STEP]
            disc_return.set_shape(disc_ret_shape)
            returns = returns.write(i, disc_return)

    returns = returns.stack()
    return returns

def compute_loss(self, action_probs, values, returns):
    """Computes the combined Actor-Critic loss."""
    advantage = returns - values

```

```

action_log_probs = tf.math.log(action_probs)
actor_loss = -tf.math.reduce_sum(action_log_probs * advantage)
critic_loss = self.loss(values, returns)
return actor_loss + critic_loss

@tf.function
def train_step(self, initial_state, gamma=0.99, max_steps=800):
    """Runs a model training step."""

    with tf.GradientTape() as tape:
        # Run the model for one episode to collect training data
        action_probs, values, rewards, steps = self.
        ↪run_episode(initial_state,max_steps=max_steps)
        # Calculate the expected returns
        returns = self.compute_nstep_returns(rewards, values, gamma)
        # Convert training data to appropriate TF tensor shapes
        action_probs, values, returns = [tf.expand_dims(x, 1) for x in
        ↪[action_probs, values, returns]]
        # Calculate the loss values to update our network
        loss = self.compute_loss(action_probs, values, returns)
        # Compute the gradients from the loss
        grads = tape.gradient(loss, self.model.trainable_variables)
        # Apply the gradients to the model's parameters
        self.optimizer.apply_gradients(zip(grads, self.model.
        ↪trainable_variables))
        episode_reward = tf.math.reduce_sum(rewards)
    return episode_reward, steps

```

```

/usr/local/lib/python3.9/dist-packages/gym/core.py:317: DeprecationWarning:
WARN: Initializing wrapper in old step API which returns one bool instead
of two. It is recommended to set `new_step_api=True` to use new step API. This
will be the default behaviour in future.

deprecation(
/usr/local/lib/python3.9/dist-
packages/gym/wrappers/step_api_compatibility.py:39: DeprecationWarning:
WARN: Initializing environment in old step API which returns one bool
instead of two. It is recommended to set `new_step_api=True` to use new step
API. This will be the default behaviour in future.

deprecation(

```

0.1.3 Code to train the agent

```
[ ]: NUM_EPISODES = 1800
AVG_NUM = 50
SOLVE_CUTOFF = 195

# do 1 run of the AC-agent in an environment for num_episodes
def run_ac_net(tf_seed=42):
    tf.keras.utils.set_random_seed(tf_seed)
    agent = Agent(action_size=ENV.action_space.n)

    tf.compat.v1.reset_default_graph()

    reward_list = []
    step_list = []
    begin_time = datetime.datetime.now()
    ep_count = NUM_EPISODES

    for ep in range(1, NUM_EPISODES + 1):
        state = ENV.reset()
        ep_rew, steps = agent.train_step(state, gamma=0.99, max_steps=800)
        reward_list.append(ep_rew)
        step_list.append(steps)

        if ep % 10 == 0:
            avg_rew = np.mean(reward_list[-10:])
            print('Episode ', ep, 'Reward %f' % ep_rew, 'Average Reward %f' % avg_rew)

        if ep % 100:
            avg_100 = np.mean(reward_list[-100:])
            if avg_100 > SOLVE_CUTOFF:
                ep_count = min(ep_count, ep) # keep track of number of episodes to solve environment

    time_taken = datetime.datetime.now() - begin_time
    print(time_taken)
    return reward_list, step_list, ep_count
```

```
[ ]: def rolling_average(reward_list, avg_num=AVG_NUM):
    average_reward_list = np.zeros_like(reward_list)
    for i in range(0, len(reward_list)):
        if i < avg_num:
            average_reward_list[i] = np.mean(reward_list[:i+1])
        else:
            average_reward_list[i] = np.mean(reward_list[(i-avg_num+1):(i+1)])
    return average_reward_list
```

```
[ ]: def do_multiple_runs(env_name, num_runs):
    reward_lists, step_lists, comp_list = [], [], []
    ENV.seed(42)

    for r in range(num_runs):
        r, s, c = run_ac_net()
        reward_lists.append(r)
        step_lists.append(list(map(int,s)))
        comp_list.append(c)

    mean_rewards = np.mean(reward_lists, axis=0)
    var_rewards = np.sqrt(np.var(reward_lists, axis=0))

    return mean_rewards, var_rewards, comp_list, reward_lists, step_lists
```

0.2 Plotting Functions and Other Helpers

```
[ ]: PATH = '/content/drive/MyDrive/Colab Notebooks/CS6700/Assignments/Assignment2/
↪ACN/'

def gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, ↪
↪reward_lists, step_lists):

    m_fig, m_ax = plt.subplots(figsize=(10,10))
    v_fig, v_ax = plt.subplots(figsize=(10,10))
    m_ax.set_title(f'Mean Reward over 10 runs')
    m_ax.set_xlabel('Episodes')
    m_ax.set_ylabel('Mean Reward')
    v_ax.set_title(f'Variance of Reward over 10 runs')
    v_ax.set_xlabel('Episodes')
    v_ax.set_ylabel('Variance')

    sns.lineplot(data=mean_rewards, ax=m_ax)
    sns.lineplot(data=var_rewards, ax=v_ax)

    m_fig.savefig(PATH+'/'+fname+'/mean_reward.png')
    v_fig.savefig(PATH+'/'+fname+'/var_reward.png')

    sc_fig, sc_ax = plt.subplots(figsize=(10,10))
    st_fig, st_ax = plt.subplots(figsize=(10,10))
    sc_ax.set_title(f'Running average of previous {AVG_NUM} rewards')
    sc_ax.set_xlabel('Episodes')
    sc_ax.set_ylabel('Reward')
    st_ax.set_title(f'Number of steps curve')
    st_ax.set_xlabel('Episodes')
    st_ax.set_ylabel('Steps')
```

```

run_count = len(reward_lists)
labels = [f'run {i+1}' for i in range(3)]
for idx in range(min(run_count, 3)):

    score_list = rolling_average(reward_lists[idx])
    step_list = step_lists[idx]
    sbn.lineplot(data=score_list, label=labels[idx], ax=sc_ax)
    sbn.lineplot(data=step_list, label=labels[idx], ax=st_ax)

sc_fig.savefig(PATH+'/'+fname+'/sc_fig.png')
st_fig.savefig(PATH+'/'+fname+'/st_fig.png')

with open(PATH+'/'+fname+'/'+'config.txt', 'w') as f:
    for s in data:
        f.write(s + '\n')

```

0.3 Experiments

0.3.1 STEP(N) = 5

CartPole

[]:

```

NUM_HIDDEN = 1
HIDDEN_SIZES = [1024]
LR = 1e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'CartPole-v1'
SOLVE_CUTOFF = 195.0
STEP = 5

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'hl={NUM_HIDDEN}_hs={HIDDEN_SIZES}_lr={LR}_env={ENV_NAME}_numep={NUM_EPISODES}_nstep={STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

Episode 10 Reward 15.000000 Average Reward 28.500000
Episode 20 Reward 15.000000 Average Reward 27.500000
Episode 30 Reward 29.000000 Average Reward 25.100000
Episode 40 Reward 47.000000 Average Reward 18.300000
Episode 50 Reward 53.000000 Average Reward 27.400000
Episode 60 Reward 18.000000 Average Reward 20.400000
Episode 70 Reward 17.000000 Average Reward 19.700000
Episode 80 Reward 20.000000 Average Reward 18.500000
Episode 90 Reward 26.000000 Average Reward 14.800000
Episode 100 Reward 17.000000 Average Reward 24.600000
Episode 110 Reward 28.000000 Average Reward 33.400000
Episode 120 Reward 14.000000 Average Reward 20.900000
Episode 130 Reward 9.000000 Average Reward 21.100000
Episode 140 Reward 22.000000 Average Reward 20.100000
Episode 150 Reward 19.000000 Average Reward 19.800000
Episode 160 Reward 24.000000 Average Reward 18.500000
Episode 170 Reward 23.000000 Average Reward 25.200000
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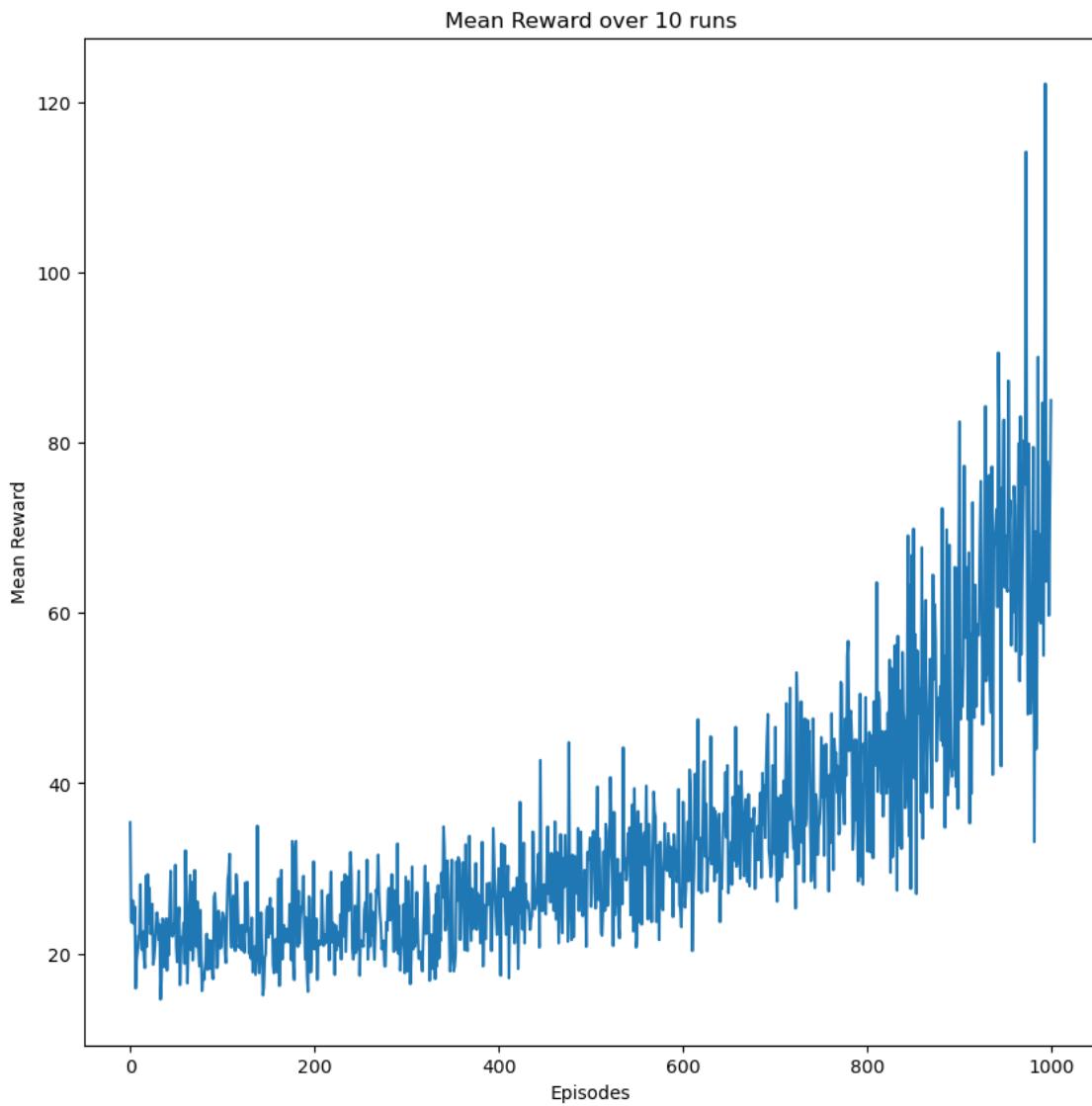
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Episode 550 Reward 16.000000 Average Reward 30.300000
Episode 560 Reward 18.000000 Average Reward 26.800000

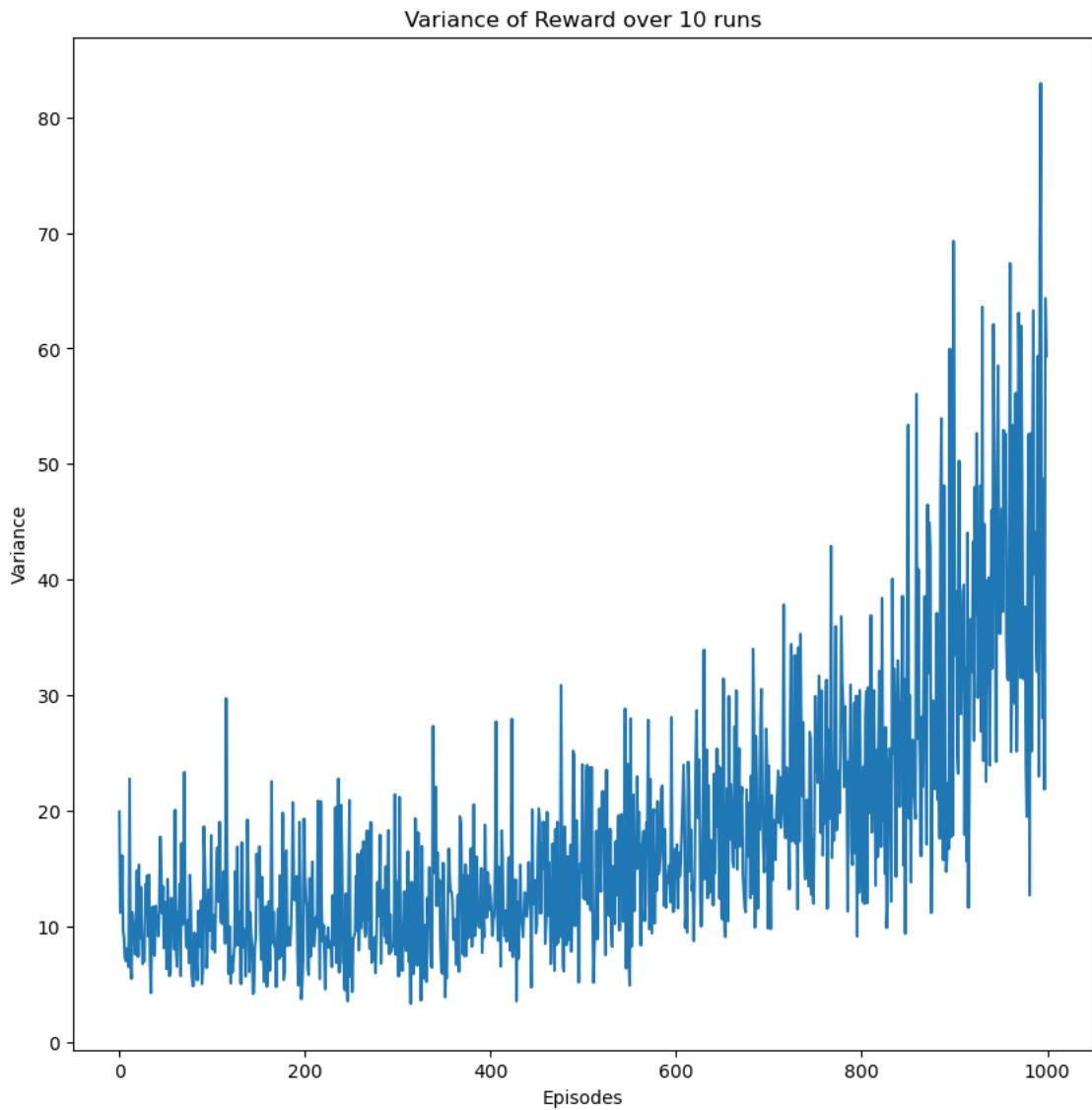
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Episode 590 Reward 18.000000 Average Reward 23.100000
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Episode 610 Reward 16.000000 Average Reward 26.200000
Episode 620 Reward 27.000000 Average Reward 34.600000
Episode 630 Reward 33.000000 Average Reward 26.400000
Episode 640 Reward 52.000000 Average Reward 30.300000
Episode 650 Reward 22.000000 Average Reward 22.800000
Episode 660 Reward 37.000000 Average Reward 29.600000
Episode 670 Reward 31.000000 Average Reward 28.200000
Episode 680 Reward 37.000000 Average Reward 26.000000
Episode 690 Reward 38.000000 Average Reward 30.600000
Episode 700 Reward 29.000000 Average Reward 27.700000
Episode 710 Reward 59.000000 Average Reward 48.000000
Episode 720 Reward 27.000000 Average Reward 19.900000
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Episode 740 Reward 17.000000 Average Reward 33.600000
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Episode 880 Reward 65.000000 Average Reward 51.000000
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Episode 920 Reward 43.000000 Average Reward 41.800000
Episode 930 Reward 55.000000 Average Reward 51.500000
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Episode 50 Reward 19.000000 Average Reward 23.900000
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Episode 90 Reward 22.000000 Average Reward 25.900000
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Episode 170 Reward 29.000000 Average Reward 33.600000
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Episode 280 Reward 38.000000 Average Reward 26.500000
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Episode 330 Reward 32.000000 Average Reward 29.100000
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Episode 510 Reward 29.000000 Average Reward 34.400000

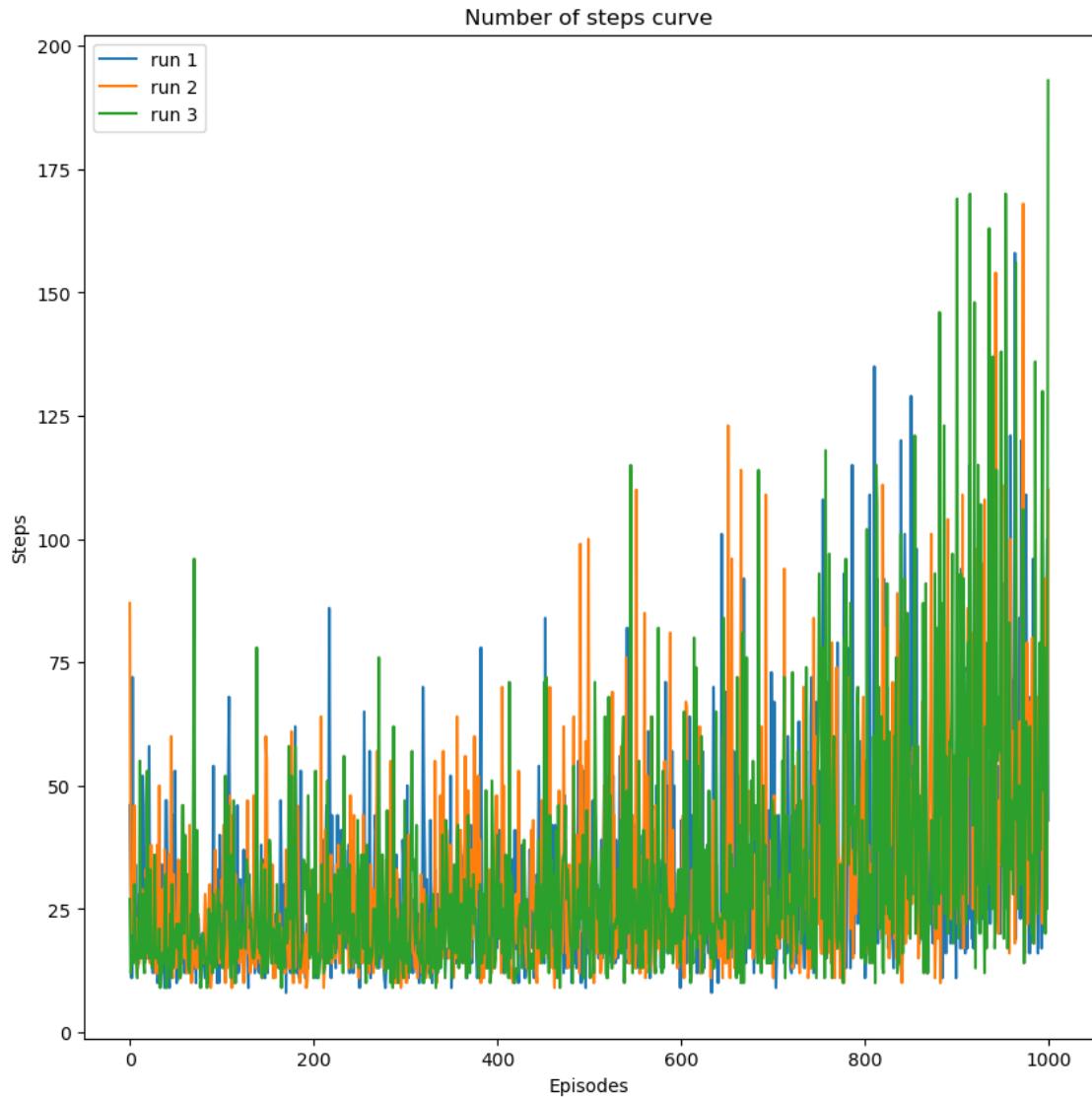
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Episode 580 Reward 44.000000 Average Reward 28.000000
Episode 590 Reward 42.000000 Average Reward 34.200000
Episode 600 Reward 11.000000 Average Reward 42.100000
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Episode 990 Reward 37.000000 Average Reward 59.800000

Episode 1000 Reward 100.000000 Average Reward 78.700000
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```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [512, 512]
LR = 0.5e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'CartPole-v1'
SOLVE_CUTOFF = 195.0
STEP = 5

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{hs}-{lr}-{env}-{numep}-{nstep}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	14.000000	28.500000
20	15.000000	27.500000
30	30.000000	25.200000
40	28.000000	20.000000
50	18.000000	21.700000
60	8.000000	26.600000
70	21.000000	26.000000
80	13.000000	16.800000
90	23.000000	21.300000
100	45.000000	26.600000
110	21.000000	23.800000
120	38.000000	21.900000
130	30.000000	17.800000
140	19.000000	27.300000
150	14.000000	23.700000
160	34.000000	19.500000
170	15.000000	20.400000
180	15.000000	23.100000
190	20.000000	23.500000
200	18.000000	22.400000
210	17.000000	23.700000
220	14.000000	20.300000
230	38.000000	22.600000
240	20.000000	19.900000
250	12.000000	15.700000
260	19.000000	19.200000
270	12.000000	18.800000
280	10.000000	16.400000

Episode 290 Reward 17.000000 Average Reward 18.200000
Episode 300 Reward 13.000000 Average Reward 24.400000
Episode 310 Reward 18.000000 Average Reward 22.300000
Episode 320 Reward 17.000000 Average Reward 24.000000
Episode 330 Reward 11.000000 Average Reward 17.900000
Episode 340 Reward 10.000000 Average Reward 22.000000
Episode 350 Reward 10.000000 Average Reward 17.900000
Episode 360 Reward 21.000000 Average Reward 25.500000
Episode 370 Reward 27.000000 Average Reward 22.300000
Episode 380 Reward 20.000000 Average Reward 22.000000
Episode 390 Reward 27.000000 Average Reward 21.300000
Episode 400 Reward 10.000000 Average Reward 29.100000
Episode 410 Reward 14.000000 Average Reward 26.500000
Episode 420 Reward 17.000000 Average Reward 22.200000
Episode 430 Reward 10.000000 Average Reward 20.800000
Episode 440 Reward 11.000000 Average Reward 29.200000
Episode 450 Reward 25.000000 Average Reward 18.200000
Episode 460 Reward 46.000000 Average Reward 23.200000
Episode 470 Reward 48.000000 Average Reward 30.100000
Episode 480 Reward 31.000000 Average Reward 33.000000
Episode 490 Reward 27.000000 Average Reward 24.800000
Episode 500 Reward 16.000000 Average Reward 30.300000
Episode 510 Reward 43.000000 Average Reward 33.400000
Episode 520 Reward 28.000000 Average Reward 25.000000
Episode 530 Reward 74.000000 Average Reward 30.300000
Episode 540 Reward 15.000000 Average Reward 32.200000
Episode 550 Reward 54.000000 Average Reward 34.900000
Episode 560 Reward 37.000000 Average Reward 26.700000
Episode 570 Reward 19.000000 Average Reward 20.100000
Episode 580 Reward 30.000000 Average Reward 26.100000
Episode 590 Reward 16.000000 Average Reward 28.300000
Episode 600 Reward 27.000000 Average Reward 23.000000
Episode 610 Reward 22.000000 Average Reward 35.600000
Episode 620 Reward 15.000000 Average Reward 37.200000
Episode 630 Reward 24.000000 Average Reward 33.400000
Episode 640 Reward 18.000000 Average Reward 37.600000
Episode 650 Reward 20.000000 Average Reward 34.900000
Episode 660 Reward 51.000000 Average Reward 38.000000
Episode 670 Reward 34.000000 Average Reward 34.800000
Episode 680 Reward 47.000000 Average Reward 43.800000
Episode 690 Reward 25.000000 Average Reward 51.300000
Episode 700 Reward 128.000000 Average Reward 55.700000
Episode 710 Reward 61.000000 Average Reward 60.200000
Episode 720 Reward 92.000000 Average Reward 49.300000
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Episode 760 Reward 63.000000 Average Reward 60.300000

Episode 770 Reward 18.000000 Average Reward 53.400000
 Episode 780 Reward 122.000000 Average Reward 92.400000
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 Episode 850 Reward 30.000000 Average Reward 96.600000
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 Episode 870 Reward 73.000000 Average Reward 155.200000
 Episode 880 Reward 87.000000 Average Reward 154.000000
 Episode 890 Reward 39.000000 Average Reward 123.900000
 Episode 900 Reward 66.000000 Average Reward 122.900000
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 Episode 960 Reward 150.000000 Average Reward 124.000000
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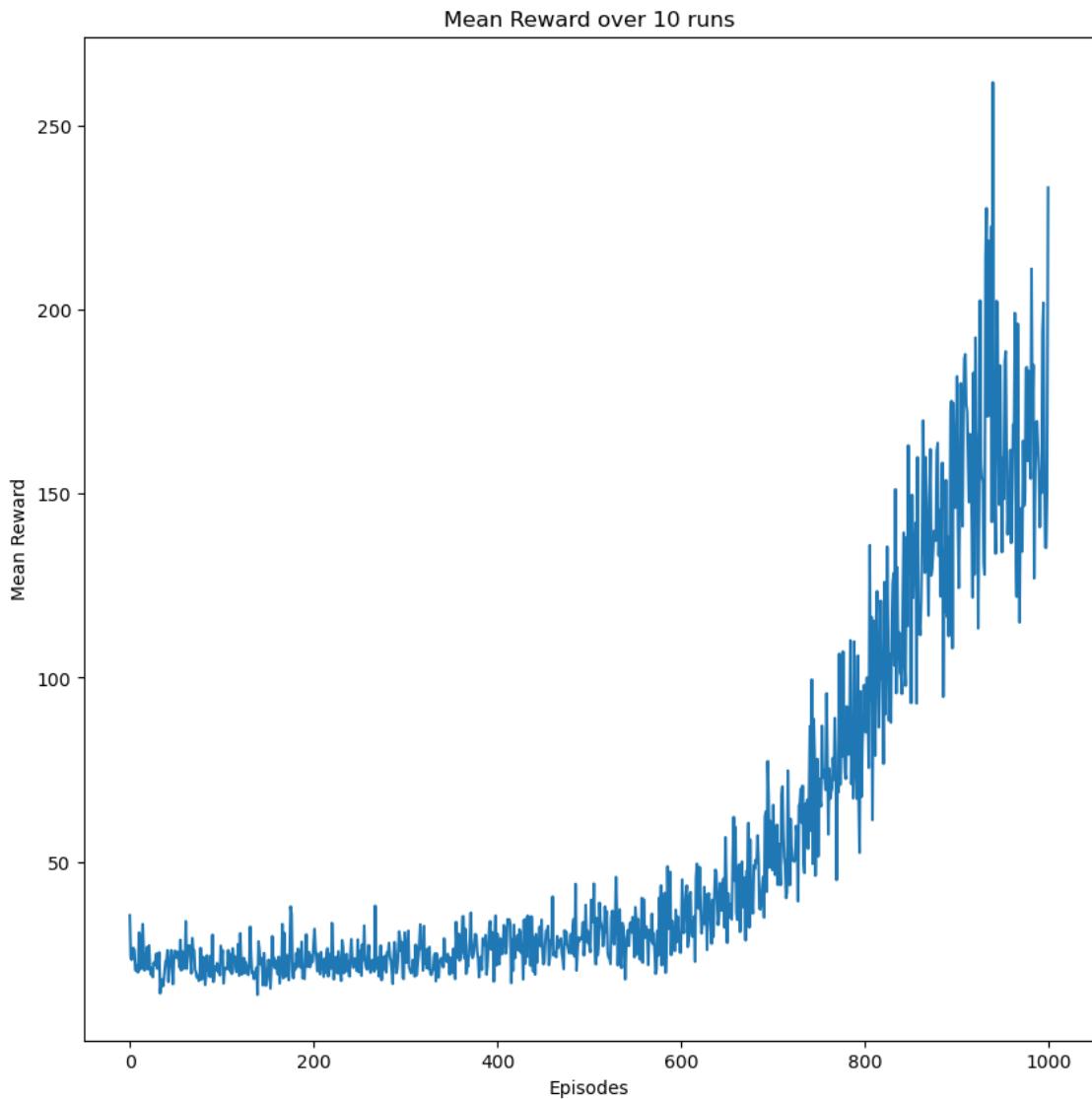
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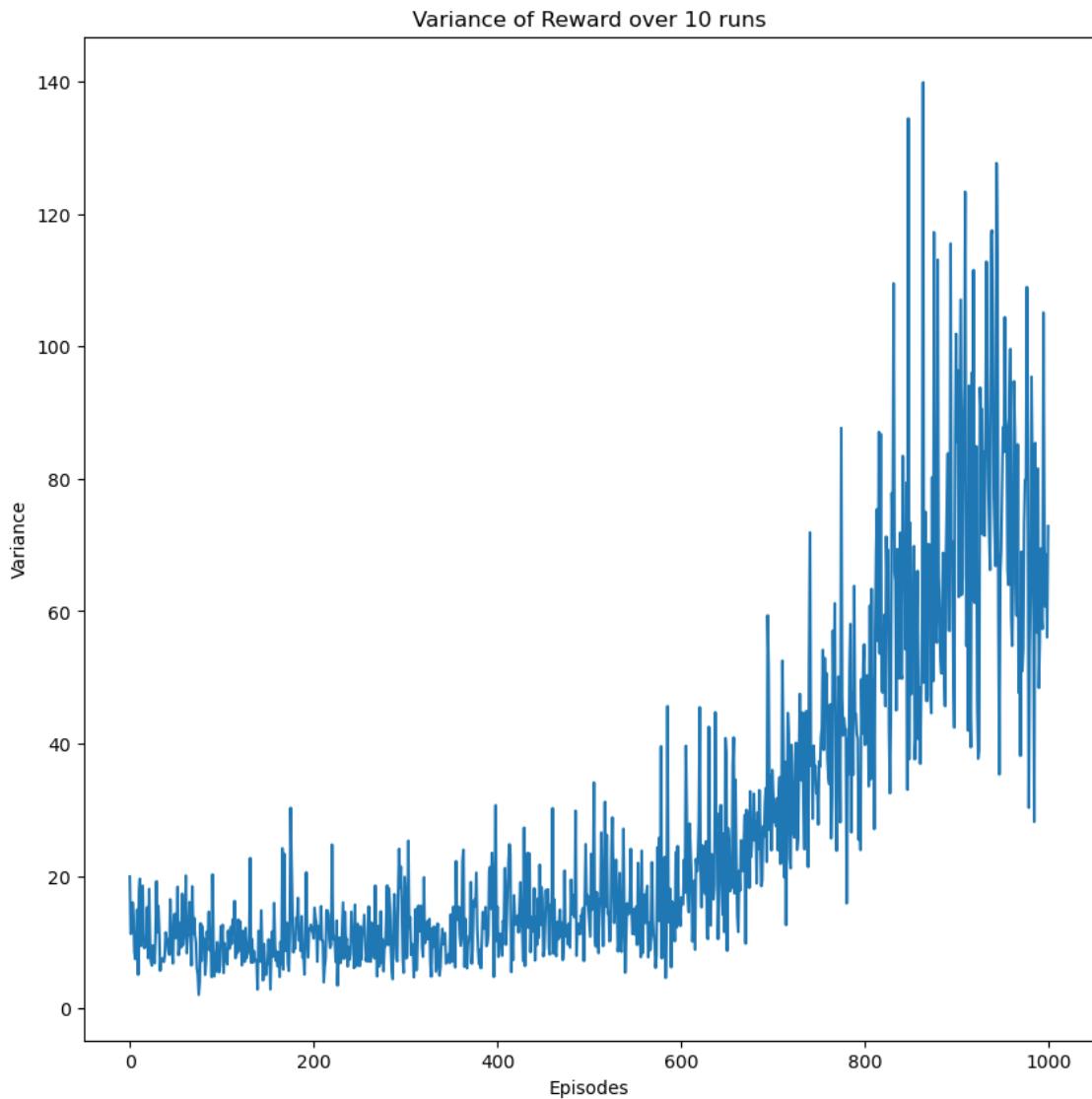
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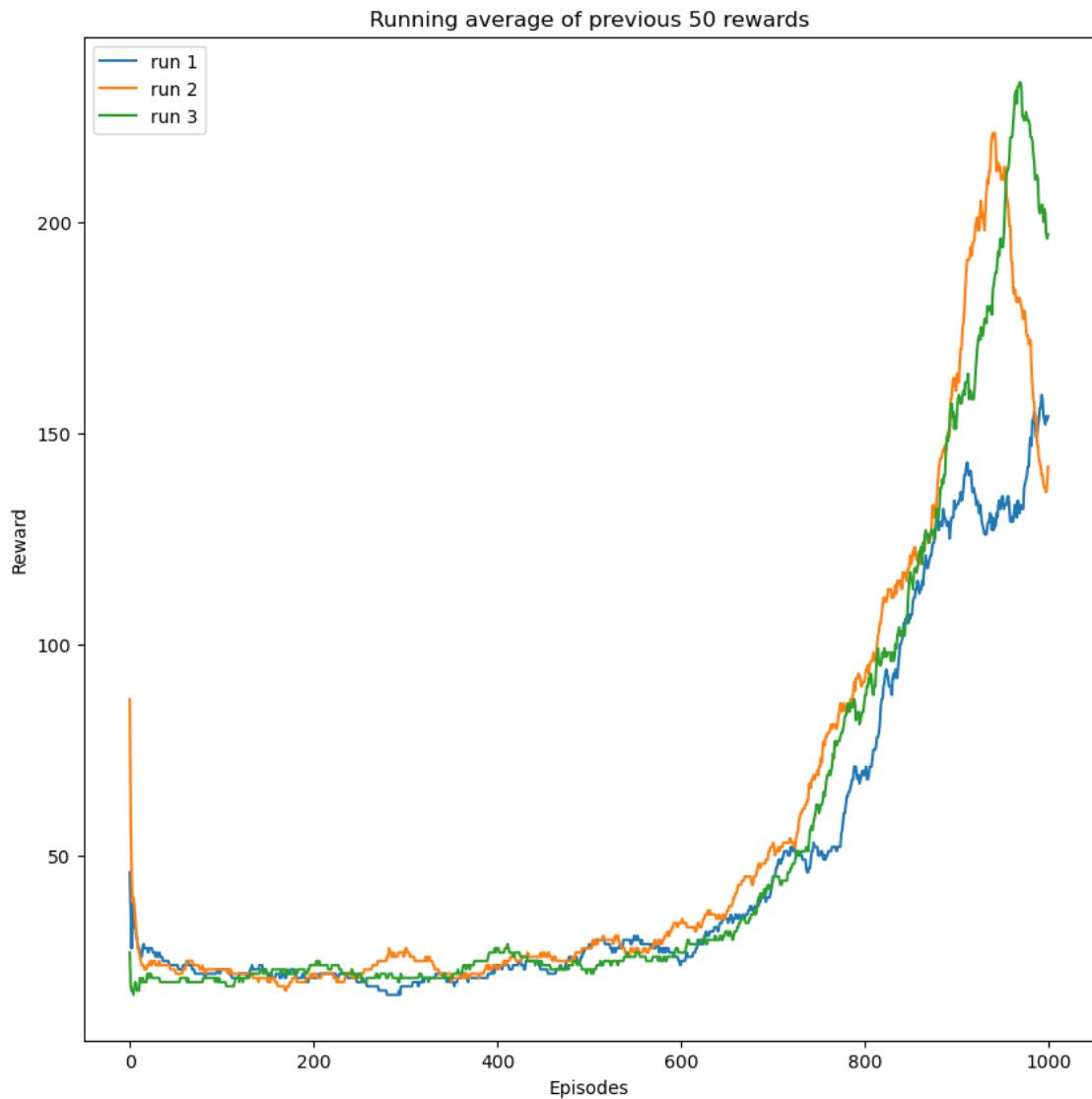
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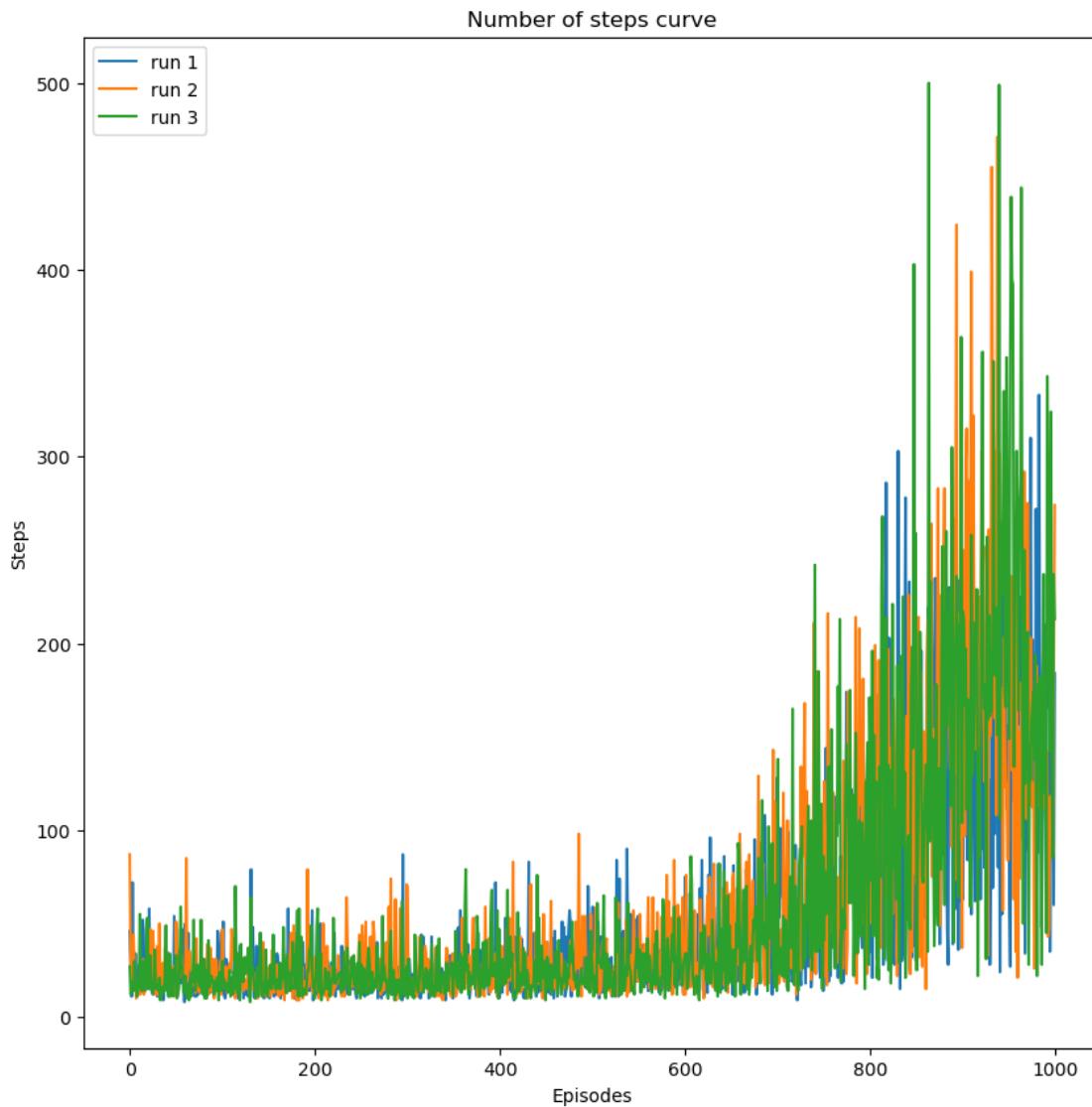
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Episode 1000 Reward 196.000000 Average Reward 152.200000
0:00:47.600807









```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [512, 512]
LR = 1e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'CartPole-v1'
SOLVE_CUTOFF = 195.0
STEP = 5

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{hs}-{lr}-{env}-{numep}-{nstep}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	40.000000	35.400000
20	22.000000	19.700000
30	28.000000	23.900000
40	28.000000	22.200000
50	25.000000	28.700000
60	15.000000	22.600000
70	18.000000	21.400000
80	31.000000	21.500000
90	50.000000	28.700000
100	19.000000	20.100000
110	19.000000	19.800000
120	32.000000	21.300000
130	23.000000	25.800000
140	88.000000	24.000000
150	11.000000	17.600000
160	24.000000	31.700000
170	15.000000	35.600000
180	10.000000	43.800000
190	40.000000	34.700000
200	18.000000	32.700000
210	14.000000	33.600000
220	40.000000	22.400000
230	31.000000	28.800000
240	19.000000	28.900000
250	23.000000	29.100000
260	84.000000	38.000000
270	18.000000	29.000000
280	54.000000	49.900000

Episode 290 Reward 19.000000 Average Reward 34.400000
Episode 300 Reward 97.000000 Average Reward 49.300000
Episode 310 Reward 22.000000 Average Reward 49.900000
Episode 320 Reward 86.000000 Average Reward 61.300000
Episode 330 Reward 38.000000 Average Reward 71.300000
Episode 340 Reward 24.000000 Average Reward 67.100000
Episode 350 Reward 66.000000 Average Reward 81.800000
Episode 360 Reward 98.000000 Average Reward 59.500000
Episode 370 Reward 75.000000 Average Reward 87.100000
Episode 380 Reward 47.000000 Average Reward 66.900000
Episode 390 Reward 17.000000 Average Reward 48.000000
Episode 400 Reward 143.000000 Average Reward 75.400000
Episode 410 Reward 49.000000 Average Reward 56.800000
Episode 420 Reward 131.000000 Average Reward 130.200000
Episode 430 Reward 49.000000 Average Reward 116.800000
Episode 440 Reward 162.000000 Average Reward 128.200000
Episode 450 Reward 88.000000 Average Reward 160.500000
Episode 460 Reward 148.000000 Average Reward 143.600000
Episode 470 Reward 35.000000 Average Reward 121.500000
Episode 480 Reward 184.000000 Average Reward 116.800000
Episode 490 Reward 188.000000 Average Reward 173.100000
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Episode 610 Reward 246.000000 Average Reward 281.000000
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Episode 640 Reward 299.000000 Average Reward 288.500000
Episode 650 Reward 226.000000 Average Reward 231.500000
Episode 660 Reward 123.000000 Average Reward 94.400000
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Episode 680 Reward 225.000000 Average Reward 211.900000
Episode 690 Reward 449.000000 Average Reward 326.700000
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Episode 750 Reward 317.000000 Average Reward 234.300000
Episode 760 Reward 196.000000 Average Reward 230.200000

Episode 770 Reward 129.000000 Average Reward 208.000000
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Episode 350 Reward 52.000000 Average Reward 34.100000
Episode 360 Reward 66.000000 Average Reward 51.500000
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Episode 150 Reward 25.000000 Average Reward 16.100000
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Episode 170 Reward 42.000000 Average Reward 23.200000
Episode 180 Reward 14.000000 Average Reward 31.700000

Episode 190 Reward 16.000000 Average Reward 30.300000
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Episode 250 Reward 14.000000 Average Reward 26.400000
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Episode 300 Reward 42.000000 Average Reward 33.500000
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Episode 960 Reward 260.000000 Average Reward 212.800000
Episode 970 Reward 283.000000 Average Reward 243.500000
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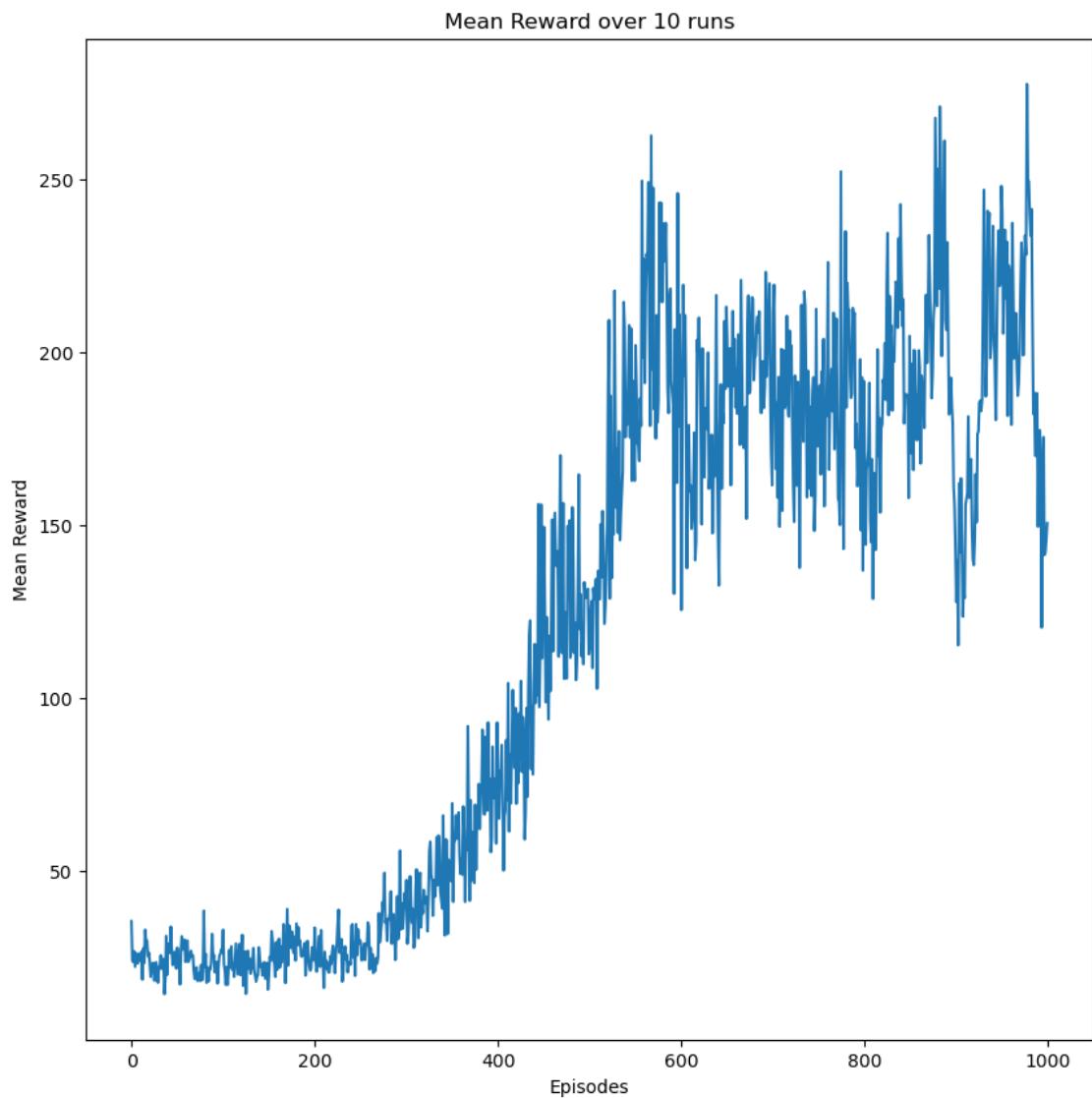
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Episode 780 Reward 131.000000 Average Reward 122.200000
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Episode 800 Reward 172.000000 Average Reward 167.500000
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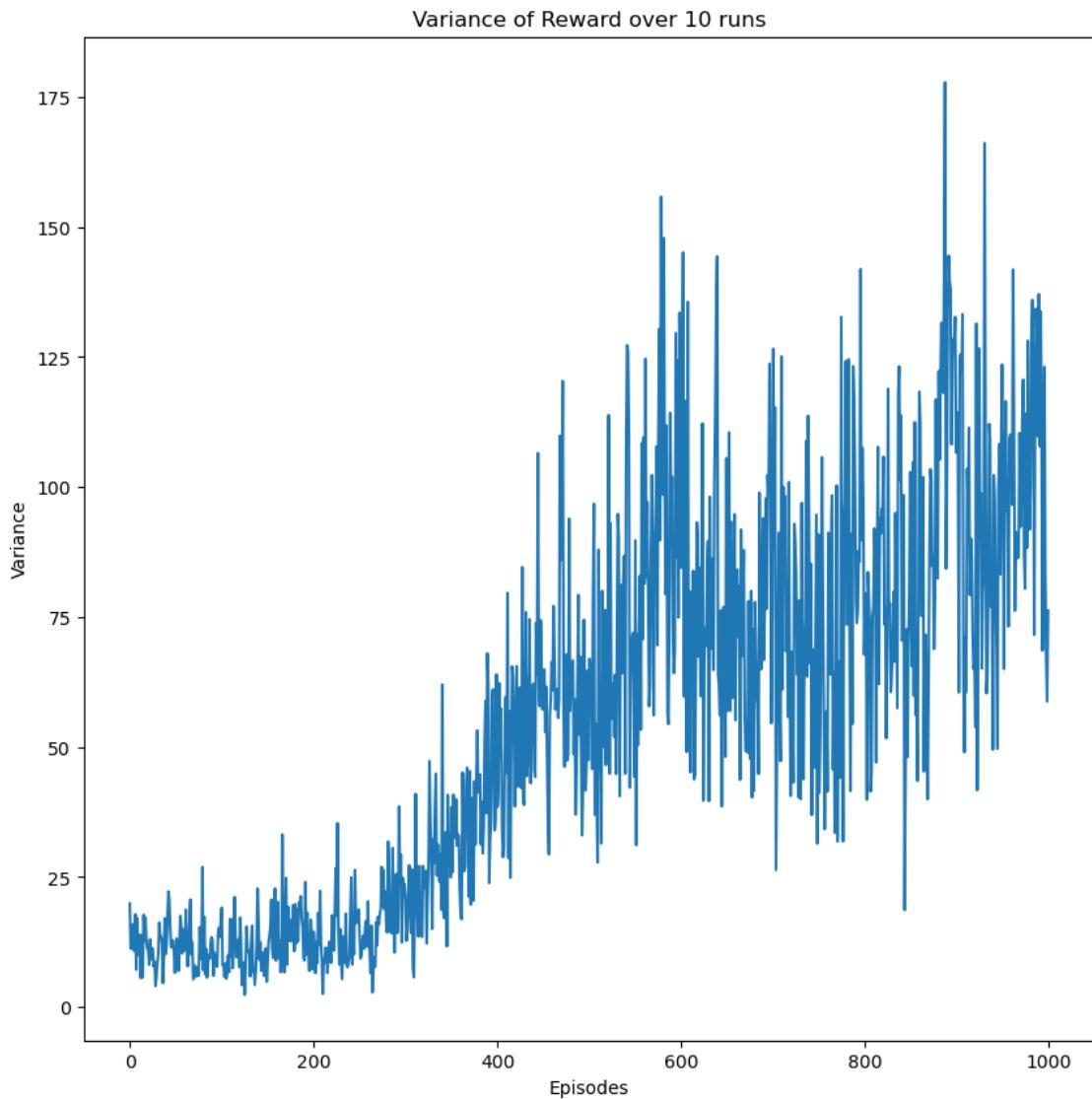
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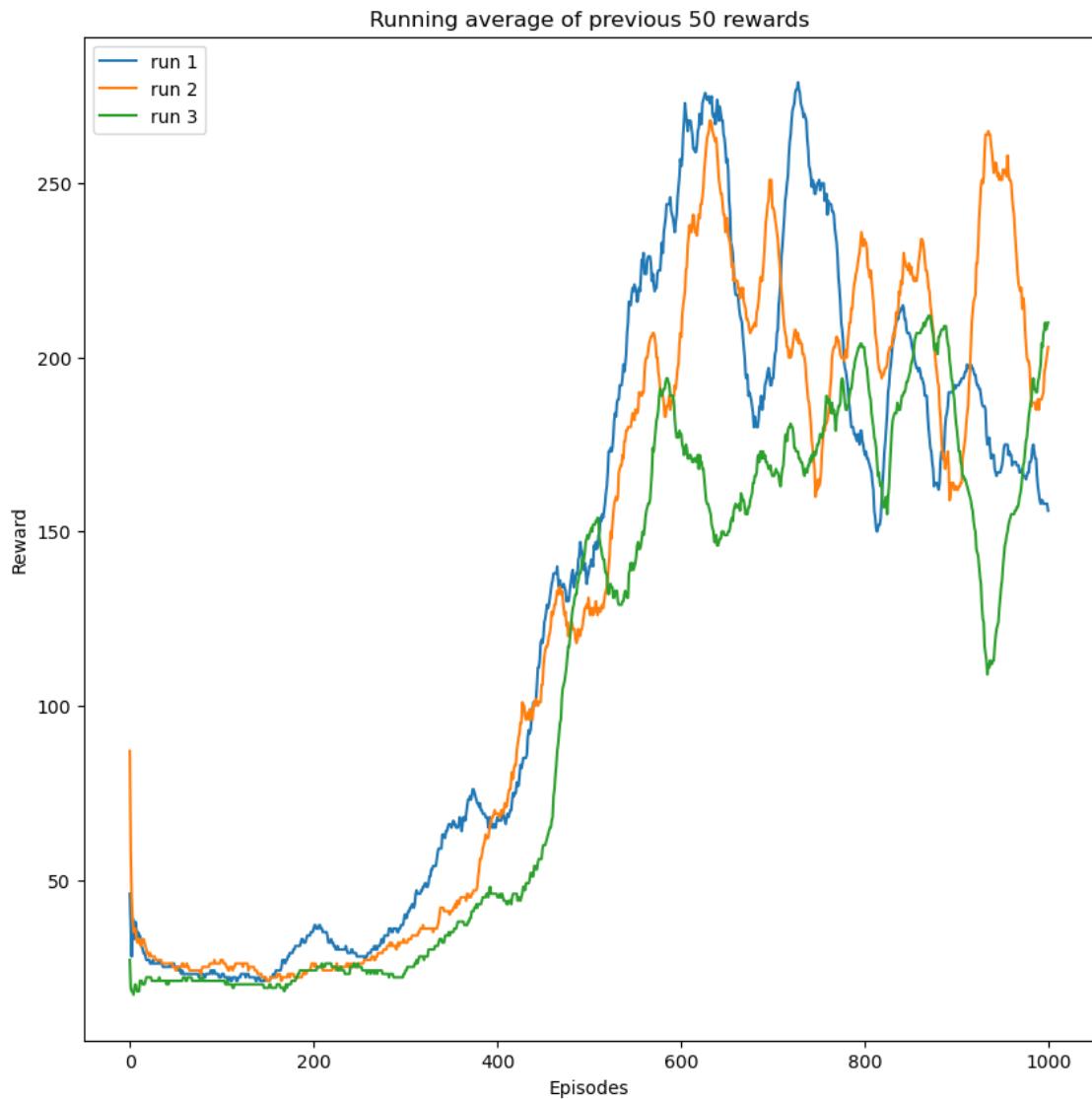
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Episode 90 Reward 10.000000 Average Reward 17.000000
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Episode 190 Reward 23.000000 Average Reward 28.300000
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Episode 260 Reward 15.000000 Average Reward 24.200000
Episode 270 Reward 26.000000 Average Reward 19.100000
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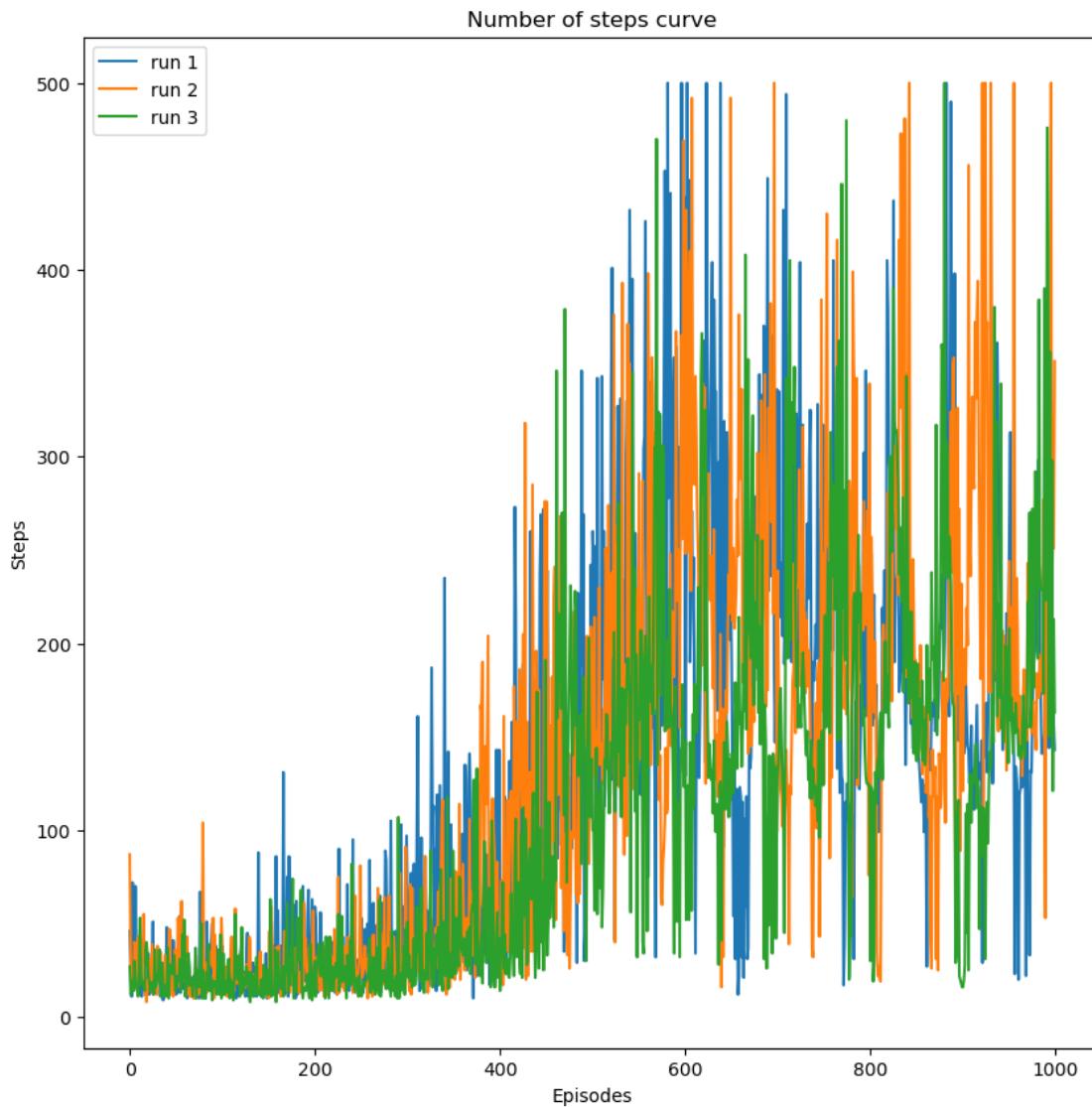
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Episode 360 Reward 64.000000 Average Reward 60.100000
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Episode 430 Reward 22.000000 Average Reward 58.500000
Episode 440 Reward 54.000000 Average Reward 47.300000
Episode 450 Reward 114.000000 Average Reward 68.200000
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Episode 790 Reward 116.000000 Average Reward 125.500000

Episode 800 Reward 123.000000 Average Reward 67.300000
Episode 810 Reward 225.000000 Average Reward 183.600000
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Episode 870 Reward 278.000000 Average Reward 282.900000
Episode 880 Reward 151.000000 Average Reward 168.500000
Episode 890 Reward 118.000000 Average Reward 104.600000
Episode 900 Reward 120.000000 Average Reward 116.400000
Episode 910 Reward 160.000000 Average Reward 164.200000
Episode 920 Reward 140.000000 Average Reward 141.800000
Episode 930 Reward 269.000000 Average Reward 223.400000
Episode 940 Reward 231.000000 Average Reward 281.600000
Episode 950 Reward 125.000000 Average Reward 155.700000
Episode 960 Reward 141.000000 Average Reward 134.300000
Episode 970 Reward 34.000000 Average Reward 81.000000
Episode 980 Reward 215.000000 Average Reward 143.300000
Episode 990 Reward 29.000000 Average Reward 107.900000
Episode 1000 Reward 145.000000 Average Reward 134.000000
0:01:22.398989









```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [512, 512]
LR = 2e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'CartPole-v1'
SOLVE_CUTOFF = 195.0
STEP = 5

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{hs}-{lr}-{env}-{numep}-{nstep}-{STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	60.000000	37.400000
20	19.000000	27.300000
30	12.000000	25.700000
40	42.000000	25.700000
50	26.000000	30.100000
60	21.000000	37.500000
70	61.000000	30.100000
80	34.000000	26.000000
90	34.000000	26.900000
100	24.000000	18.600000
110	46.000000	28.000000
120	19.000000	30.200000
130	21.000000	26.600000
140	40.000000	27.000000
150	30.000000	45.600000
160	12.000000	31.800000
170	35.000000	31.400000
180	17.000000	29.900000
190	22.000000	38.700000
200	25.000000	47.300000
210	51.000000	61.100000
220	18.000000	40.200000
230	45.000000	37.800000
240	42.000000	81.000000
250	163.000000	135.100000
260	79.000000	140.400000
270	44.000000	90.800000
280	396.000000	181.400000

Episode 290 Reward 322.000000 Average Reward 205.800000
Episode 300 Reward 54.000000 Average Reward 165.200000
Episode 310 Reward 148.000000 Average Reward 115.000000
Episode 320 Reward 218.000000 Average Reward 139.800000
Episode 330 Reward 134.000000 Average Reward 199.200000
Episode 340 Reward 33.000000 Average Reward 107.700000
Episode 350 Reward 125.000000 Average Reward 124.200000
Episode 360 Reward 122.000000 Average Reward 199.700000
Episode 370 Reward 140.000000 Average Reward 209.500000
Episode 380 Reward 120.000000 Average Reward 97.300000
Episode 390 Reward 175.000000 Average Reward 98.500000
Episode 400 Reward 382.000000 Average Reward 260.600000
Episode 410 Reward 196.000000 Average Reward 355.000000
Episode 420 Reward 237.000000 Average Reward 242.700000
Episode 430 Reward 271.000000 Average Reward 221.000000
Episode 440 Reward 16.000000 Average Reward 123.500000
Episode 450 Reward 10.000000 Average Reward 10.900000
Episode 460 Reward 10.000000 Average Reward 10.800000
Episode 470 Reward 11.000000 Average Reward 10.700000
Episode 480 Reward 13.000000 Average Reward 14.800000
Episode 490 Reward 12.000000 Average Reward 17.500000
Episode 500 Reward 9.000000 Average Reward 12.300000
Episode 510 Reward 25.000000 Average Reward 19.600000
Episode 520 Reward 169.000000 Average Reward 75.100000
Episode 530 Reward 180.000000 Average Reward 222.500000
Episode 540 Reward 39.000000 Average Reward 93.700000
Episode 550 Reward 202.000000 Average Reward 101.000000
Episode 560 Reward 124.000000 Average Reward 185.900000
Episode 570 Reward 31.000000 Average Reward 100.500000
Episode 580 Reward 205.000000 Average Reward 181.100000
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Episode 610 Reward 221.000000 Average Reward 342.300000
Episode 620 Reward 162.000000 Average Reward 176.900000
Episode 630 Reward 192.000000 Average Reward 188.500000
Episode 640 Reward 169.000000 Average Reward 192.100000
Episode 650 Reward 195.000000 Average Reward 196.200000
Episode 660 Reward 203.000000 Average Reward 182.300000
Episode 670 Reward 262.000000 Average Reward 235.300000
Episode 680 Reward 494.000000 Average Reward 302.200000
Episode 690 Reward 169.000000 Average Reward 302.800000
Episode 700 Reward 130.000000 Average Reward 144.200000
Episode 710 Reward 38.000000 Average Reward 103.100000
Episode 720 Reward 204.000000 Average Reward 156.600000
Episode 730 Reward 489.000000 Average Reward 247.300000
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Episode 750 Reward 500.000000 Average Reward 357.300000
Episode 760 Reward 338.000000 Average Reward 401.500000

Episode 770 Reward 156.000000 Average Reward 183.700000
Episode 780 Reward 132.000000 Average Reward 151.800000
Episode 790 Reward 159.000000 Average Reward 77.900000
Episode 800 Reward 145.000000 Average Reward 154.000000
Episode 810 Reward 128.000000 Average Reward 113.800000
Episode 820 Reward 189.000000 Average Reward 157.900000
Episode 830 Reward 159.000000 Average Reward 162.500000
Episode 840 Reward 165.000000 Average Reward 166.800000
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Episode 860 Reward 500.000000 Average Reward 282.600000
Episode 870 Reward 193.000000 Average Reward 281.600000
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Episode 100 Reward 32.000000 Average Reward 26.200000
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Episode 190 Reward 14.000000 Average Reward 26.800000
Episode 200 Reward 15.000000 Average Reward 23.800000
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Episode 220 Reward 16.000000 Average Reward 37.600000
Episode 230 Reward 40.000000 Average Reward 33.600000

Episode 240 Reward 49.000000 Average Reward 30.600000
Episode 250 Reward 30.000000 Average Reward 38.900000
Episode 260 Reward 36.000000 Average Reward 81.500000
Episode 270 Reward 17.000000 Average Reward 42.100000
Episode 280 Reward 64.000000 Average Reward 55.200000
Episode 290 Reward 60.000000 Average Reward 108.300000
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Episode 310 Reward 204.000000 Average Reward 154.500000
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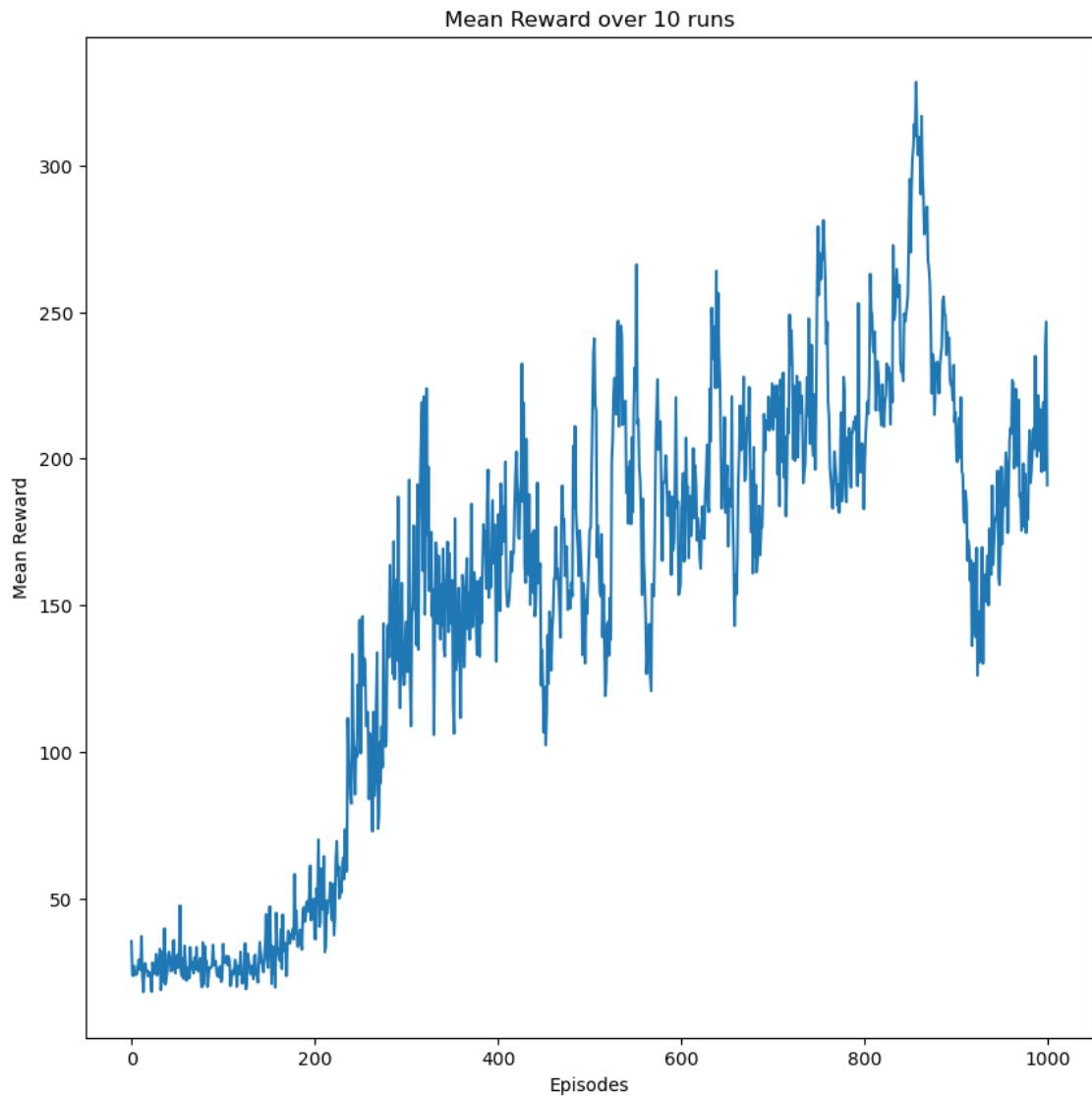
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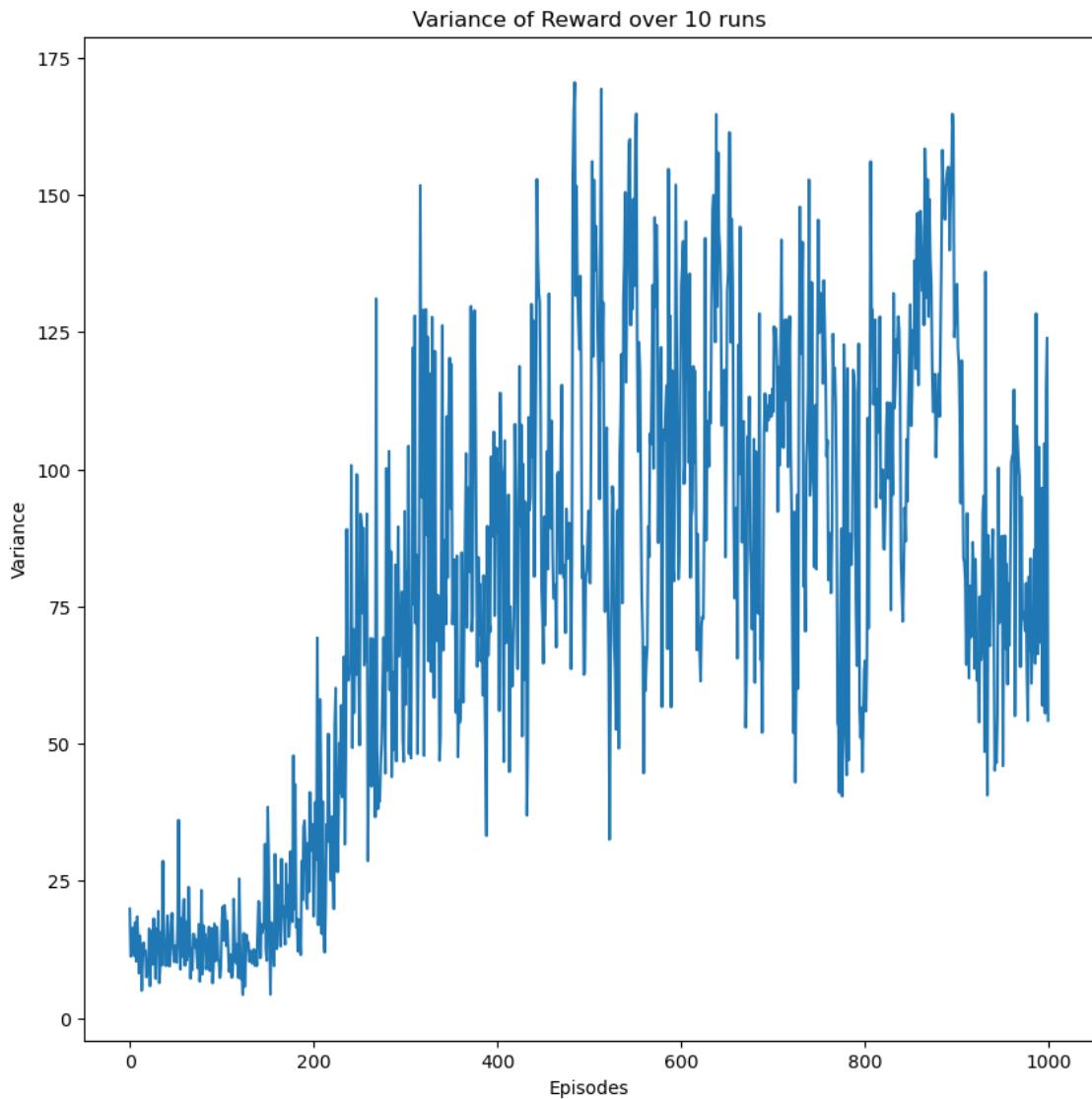
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Episode 630 Reward 119.000000 Average Reward 101.000000
Episode 640 Reward 121.000000 Average Reward 112.700000
Episode 650 Reward 143.000000 Average Reward 141.400000
Episode 660 Reward 169.000000 Average Reward 148.000000
Episode 670 Reward 137.000000 Average Reward 147.100000
Episode 680 Reward 142.000000 Average Reward 145.400000
Episode 690 Reward 147.000000 Average Reward 162.600000
Episode 700 Reward 187.000000 Average Reward 182.800000
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Episode 790 Reward 215.000000 Average Reward 211.200000
Episode 800 Reward 264.000000 Average Reward 272.500000
Episode 810 Reward 249.000000 Average Reward 368.700000
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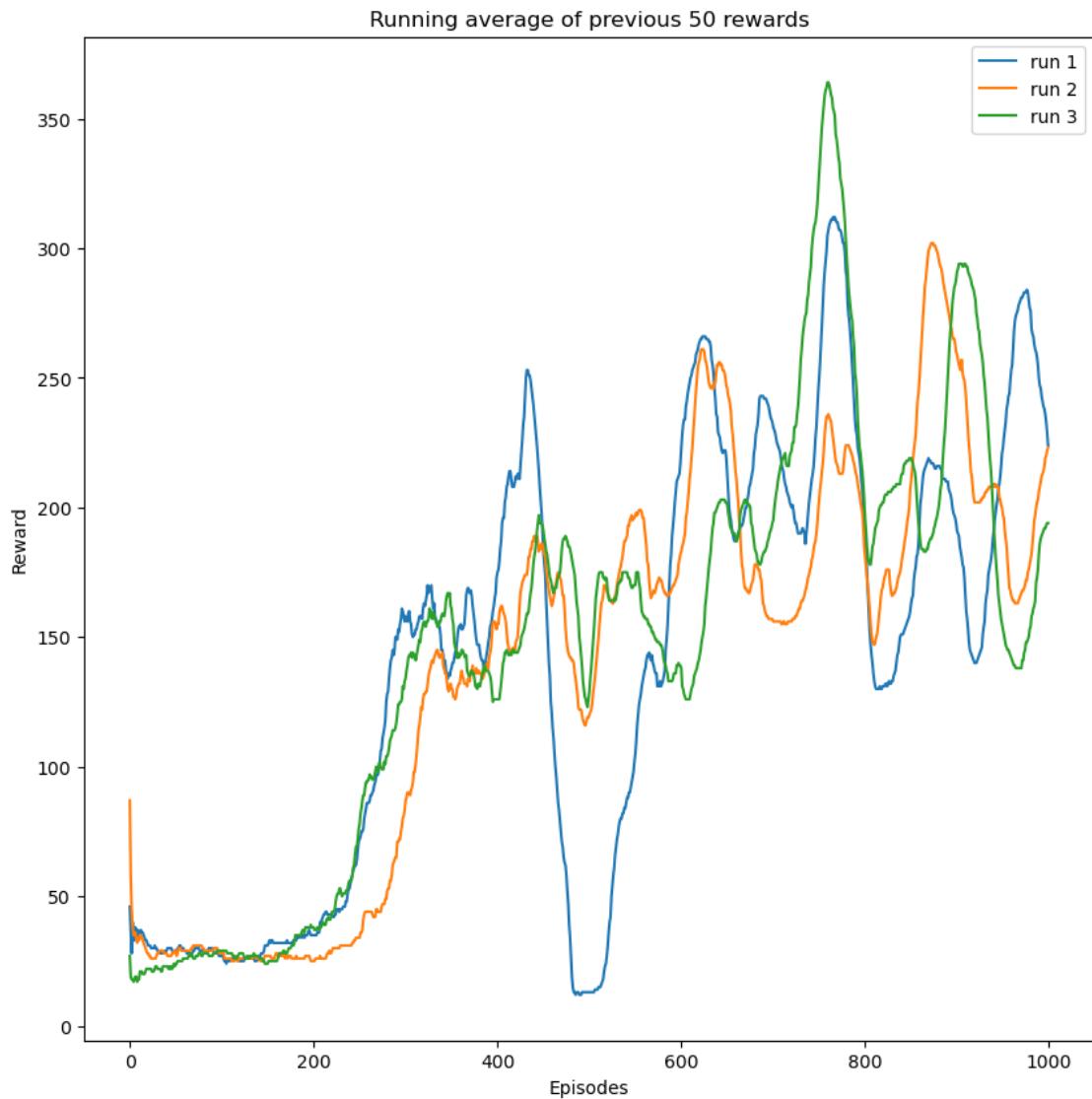
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Episode 80 Reward 26.000000 Average Reward 35.800000
Episode 90 Reward 24.000000 Average Reward 31.400000
Episode 100 Reward 36.000000 Average Reward 27.500000
Episode 110 Reward 12.000000 Average Reward 40.200000
Episode 120 Reward 20.000000 Average Reward 24.700000
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Episode 140 Reward 43.000000 Average Reward 25.600000
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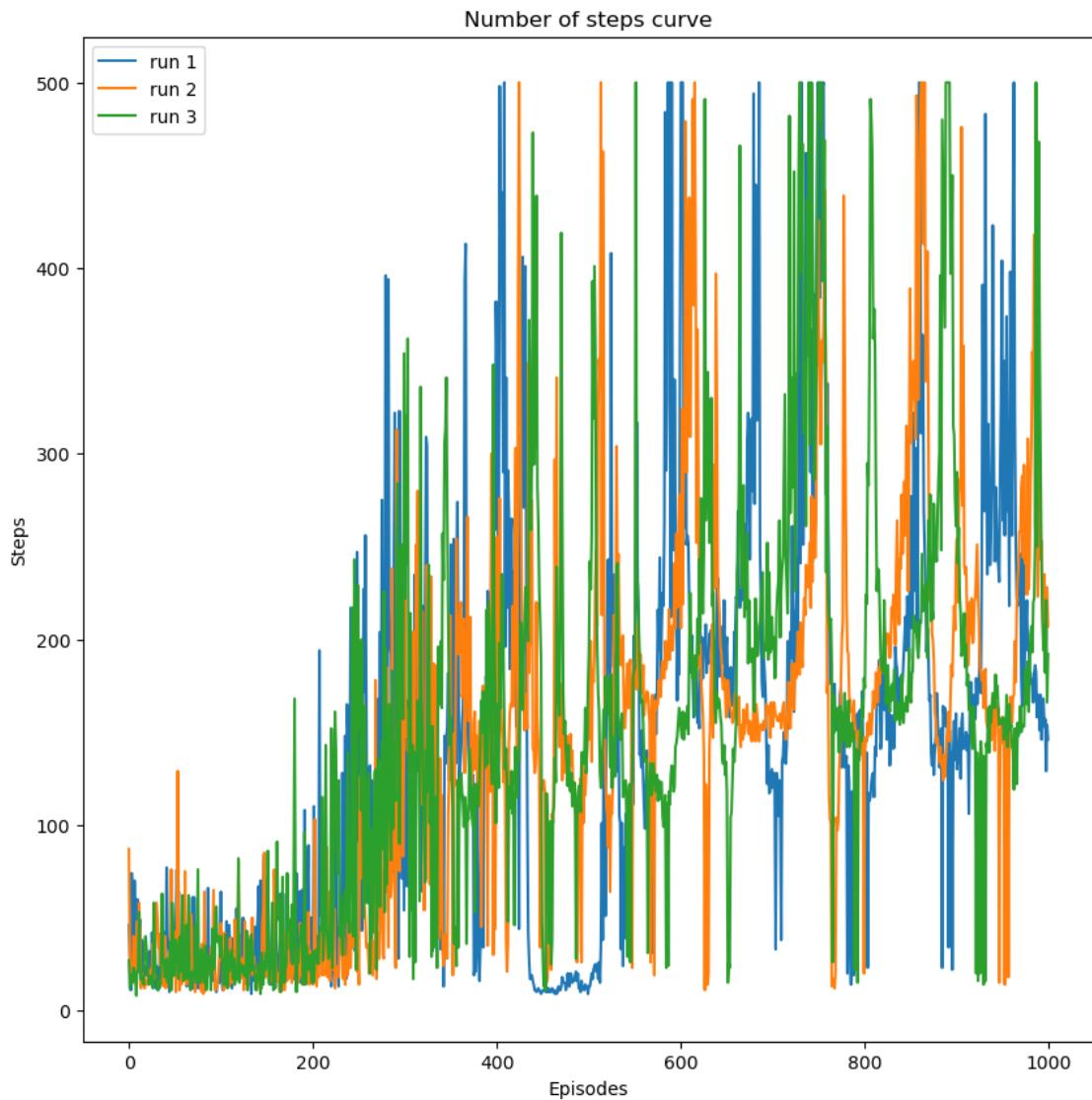
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Episode 630 Reward 164.000000 Average Reward 150.400000
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Episode 690 Reward 356.000000 Average Reward 214.200000
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Episode 920 Reward 177.000000 Average Reward 164.400000
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Episode 1000 Reward 116.000000 Average Reward 113.900000
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```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [1024, 512]
LR = 1e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'CartPole-v1'
SOLVE_CUTOFF = 195.0
STEP = 5

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{hs}-{lr}-{env}-{numep}-{nstep}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	15.000000	28.800000
20	73.000000	33.000000
30	13.000000	24.000000
40	12.000000	22.000000
50	20.000000	28.400000
60	28.000000	37.000000
70	13.000000	24.600000
80	32.000000	26.000000
90	33.000000	31.200000
100	78.000000	38.200000
110	23.000000	22.300000
120	22.000000	30.400000
130	20.000000	23.200000
140	17.000000	23.700000
150	20.000000	25.200000
160	20.000000	22.200000
170	31.000000	26.800000
180	14.000000	22.200000
190	19.000000	29.400000
200	16.000000	39.500000
210	35.000000	29.000000
220	34.000000	29.700000
230	29.000000	36.000000
240	28.000000	25.400000
250	20.000000	47.900000
260	25.000000	32.600000
270	13.000000	27.200000
280	40.000000	29.400000

Episode 290 Reward 23.000000 Average Reward 28.900000
Episode 300 Reward 51.000000 Average Reward 36.000000
Episode 310 Reward 27.000000 Average Reward 42.600000
Episode 320 Reward 177.000000 Average Reward 67.500000
Episode 330 Reward 50.000000 Average Reward 44.000000
Episode 340 Reward 30.000000 Average Reward 55.400000
Episode 350 Reward 40.000000 Average Reward 38.000000
Episode 360 Reward 41.000000 Average Reward 56.300000
Episode 370 Reward 174.000000 Average Reward 89.700000
Episode 380 Reward 68.000000 Average Reward 81.800000
Episode 390 Reward 101.000000 Average Reward 92.100000
Episode 400 Reward 129.000000 Average Reward 96.400000
Episode 410 Reward 262.000000 Average Reward 166.500000
Episode 420 Reward 143.000000 Average Reward 108.600000
Episode 430 Reward 46.000000 Average Reward 79.400000
Episode 440 Reward 79.000000 Average Reward 75.500000
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Episode 520 Reward 200.000000 Average Reward 198.100000
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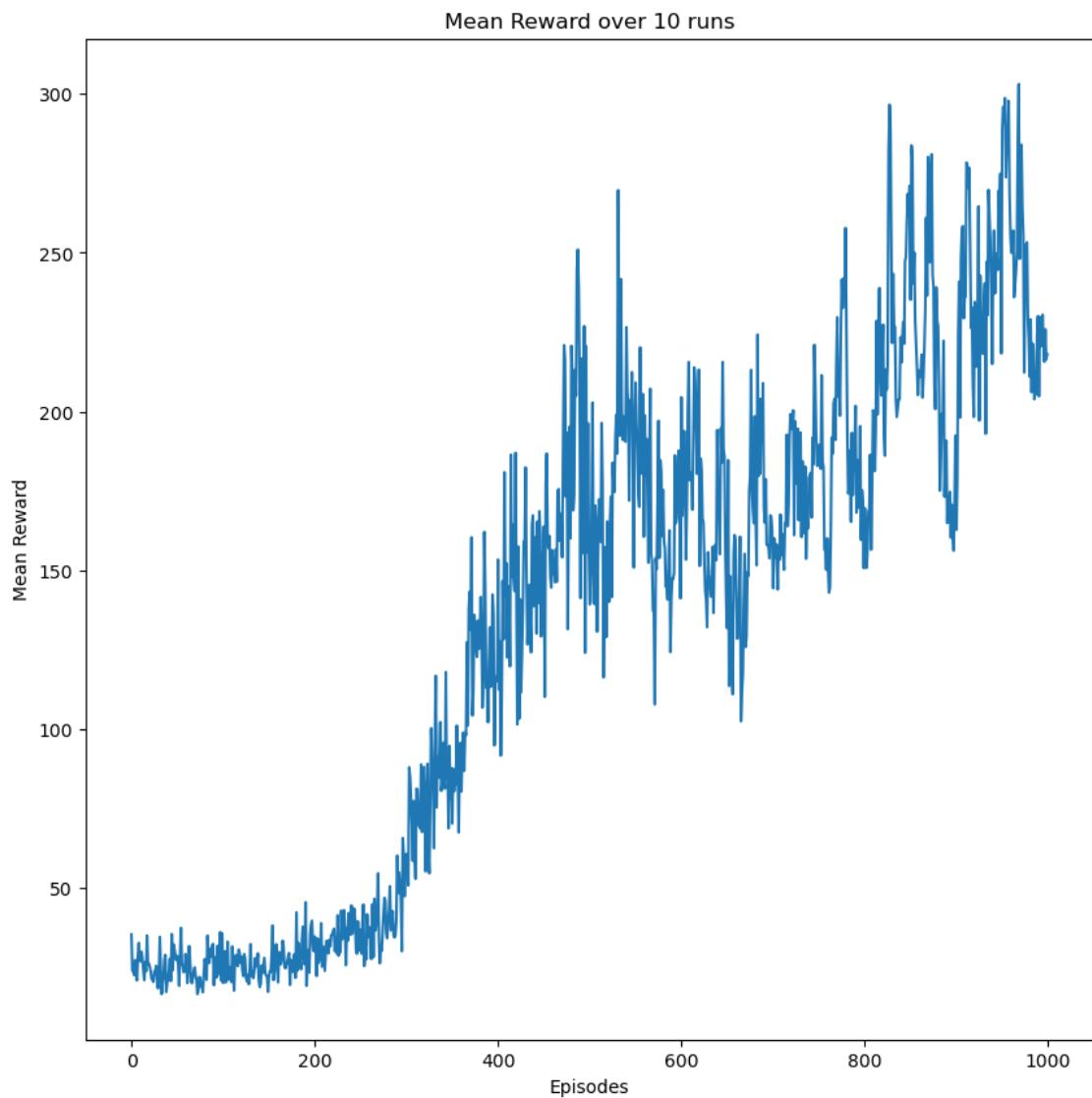
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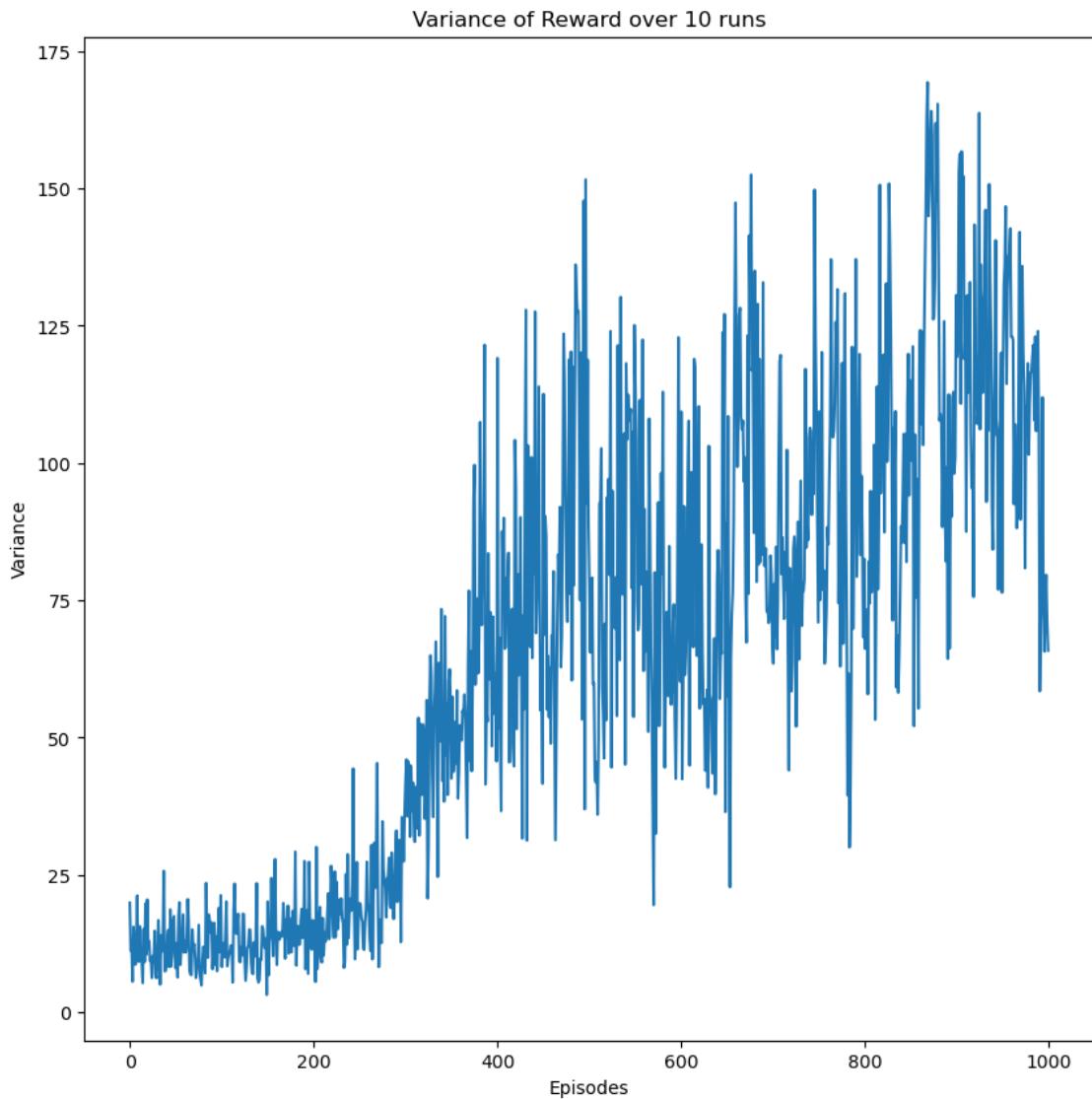
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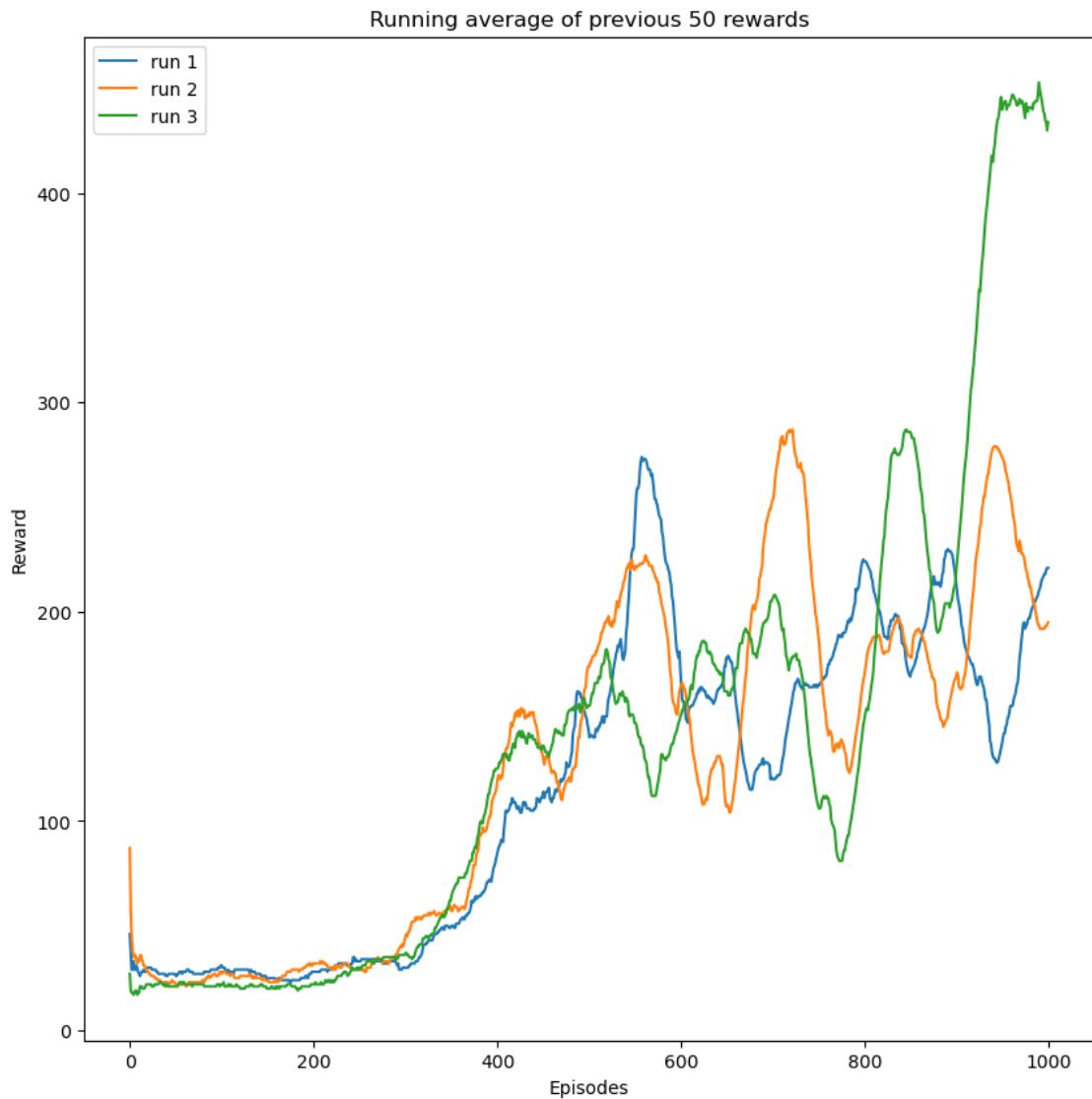
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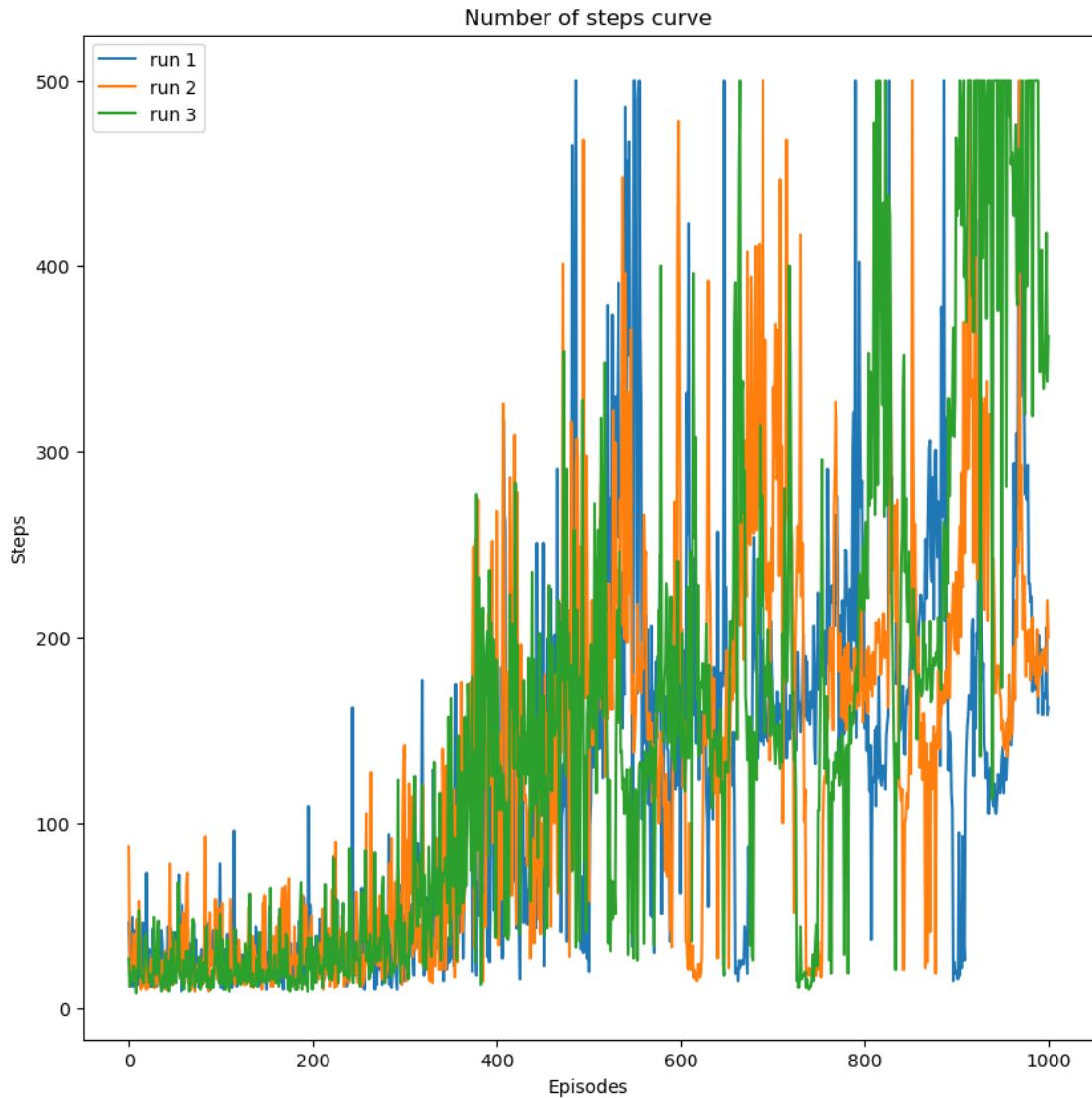
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Episode 780 Reward 349.000000 Average Reward 187.500000
Episode 790 Reward 184.000000 Average Reward 207.700000

Episode 800 Reward 189.000000 Average Reward 216.600000
Episode 810 Reward 130.000000 Average Reward 114.800000
Episode 820 Reward 106.000000 Average Reward 115.000000
Episode 830 Reward 146.000000 Average Reward 129.500000
Episode 840 Reward 176.000000 Average Reward 169.700000
Episode 850 Reward 405.000000 Average Reward 341.900000
Episode 860 Reward 123.000000 Average Reward 198.700000
Episode 870 Reward 112.000000 Average Reward 58.800000
Episode 880 Reward 118.000000 Average Reward 113.900000
Episode 890 Reward 304.000000 Average Reward 226.900000
Episode 900 Reward 192.000000 Average Reward 194.900000
Episode 910 Reward 183.000000 Average Reward 195.300000
Episode 920 Reward 223.000000 Average Reward 217.900000
Episode 930 Reward 350.000000 Average Reward 339.300000
Episode 940 Reward 377.000000 Average Reward 376.800000
Episode 950 Reward 348.000000 Average Reward 360.400000
Episode 960 Reward 178.000000 Average Reward 227.100000
Episode 970 Reward 225.000000 Average Reward 217.700000
Episode 980 Reward 351.000000 Average Reward 305.800000
Episode 990 Reward 251.000000 Average Reward 322.900000
Episode 1000 Reward 264.000000 Average Reward 220.600000
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```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [1024, 1024]
LR = 0.5e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'CartPole-v1'
SOLVE_CUTOFF = 195.0
STEP = 5

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{hs}-{lr}-{env}-{numep}-{nstep}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	33.000000	28.600000
20	12.000000	21.500000
30	12.000000	26.200000
40	22.000000	31.500000
50	14.000000	24.000000
60	13.000000	24.500000
70	16.000000	20.600000
80	17.000000	20.800000
90	31.000000	27.700000
100	12.000000	28.700000
110	26.000000	30.900000
120	26.000000	26.200000
130	31.000000	21.000000
140	16.000000	26.100000
150	21.000000	20.400000
160	23.000000	24.200000
170	14.000000	36.300000
180	10.000000	25.000000
190	12.000000	25.800000
200	17.000000	26.900000
210	45.000000	34.700000
220	15.000000	32.800000
230	32.000000	26.600000
240	19.000000	29.400000
250	18.000000	24.400000
260	23.000000	29.200000
270	18.000000	32.800000
280	38.000000	30.500000

Episode 290 Reward 18.000000 Average Reward 37.000000
Episode 300 Reward 45.000000 Average Reward 39.200000
Episode 310 Reward 25.000000 Average Reward 45.700000
Episode 320 Reward 55.000000 Average Reward 37.500000
Episode 330 Reward 21.000000 Average Reward 49.800000
Episode 340 Reward 42.000000 Average Reward 51.300000
Episode 350 Reward 71.000000 Average Reward 38.500000
Episode 360 Reward 33.000000 Average Reward 43.900000
Episode 370 Reward 70.000000 Average Reward 60.700000
Episode 380 Reward 44.000000 Average Reward 52.200000
Episode 390 Reward 78.000000 Average Reward 56.200000
Episode 400 Reward 34.000000 Average Reward 74.800000
Episode 410 Reward 83.000000 Average Reward 65.600000
Episode 420 Reward 94.000000 Average Reward 75.300000
Episode 430 Reward 92.000000 Average Reward 68.400000
Episode 440 Reward 115.000000 Average Reward 62.100000
Episode 450 Reward 155.000000 Average Reward 129.800000
Episode 460 Reward 22.000000 Average Reward 78.700000
Episode 470 Reward 133.000000 Average Reward 115.800000
Episode 480 Reward 205.000000 Average Reward 83.300000
Episode 490 Reward 61.000000 Average Reward 112.000000
Episode 500 Reward 152.000000 Average Reward 123.100000
Episode 510 Reward 181.000000 Average Reward 104.800000
Episode 520 Reward 69.000000 Average Reward 98.000000
Episode 530 Reward 108.000000 Average Reward 102.900000
Episode 540 Reward 150.000000 Average Reward 132.800000
Episode 550 Reward 42.000000 Average Reward 180.000000
Episode 560 Reward 143.000000 Average Reward 115.900000
Episode 570 Reward 141.000000 Average Reward 116.700000
Episode 580 Reward 352.000000 Average Reward 205.200000
Episode 590 Reward 206.000000 Average Reward 163.600000
Episode 600 Reward 126.000000 Average Reward 168.700000
Episode 610 Reward 235.000000 Average Reward 180.600000
Episode 620 Reward 203.000000 Average Reward 175.000000
Episode 630 Reward 307.000000 Average Reward 197.300000
Episode 640 Reward 87.000000 Average Reward 224.800000
Episode 650 Reward 196.000000 Average Reward 202.300000
Episode 660 Reward 405.000000 Average Reward 282.900000
Episode 670 Reward 241.000000 Average Reward 231.200000
Episode 680 Reward 195.000000 Average Reward 308.100000
Episode 690 Reward 147.000000 Average Reward 280.200000
Episode 700 Reward 182.000000 Average Reward 280.100000
Episode 710 Reward 126.000000 Average Reward 120.700000
Episode 720 Reward 165.000000 Average Reward 162.200000
Episode 730 Reward 439.000000 Average Reward 239.900000
Episode 740 Reward 168.000000 Average Reward 180.100000
Episode 750 Reward 133.000000 Average Reward 97.100000
Episode 760 Reward 211.000000 Average Reward 159.800000

Episode 770 Reward 183.000000 Average Reward 187.900000
Episode 780 Reward 171.000000 Average Reward 152.200000
Episode 790 Reward 116.000000 Average Reward 114.100000
Episode 800 Reward 144.000000 Average Reward 139.900000
Episode 810 Reward 142.000000 Average Reward 155.300000
Episode 820 Reward 143.000000 Average Reward 130.800000
Episode 830 Reward 52.000000 Average Reward 102.100000
Episode 840 Reward 175.000000 Average Reward 136.100000
Episode 850 Reward 219.000000 Average Reward 218.700000
Episode 860 Reward 166.000000 Average Reward 256.800000
Episode 870 Reward 154.000000 Average Reward 181.800000
Episode 880 Reward 173.000000 Average Reward 158.800000
Episode 890 Reward 140.000000 Average Reward 137.700000
Episode 900 Reward 97.000000 Average Reward 126.700000
Episode 910 Reward 131.000000 Average Reward 129.500000
Episode 920 Reward 311.000000 Average Reward 186.300000
Episode 930 Reward 131.000000 Average Reward 158.800000
Episode 940 Reward 119.000000 Average Reward 140.000000
Episode 950 Reward 179.000000 Average Reward 122.000000
Episode 960 Reward 135.000000 Average Reward 156.300000
Episode 970 Reward 203.000000 Average Reward 171.600000
Episode 980 Reward 224.000000 Average Reward 208.400000
Episode 990 Reward 127.000000 Average Reward 111.100000
Episode 1000 Reward 145.000000 Average Reward 176.900000

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Episode 10 Reward 14.000000 Average Reward 30.100000
Episode 20 Reward 19.000000 Average Reward 21.800000
Episode 30 Reward 12.000000 Average Reward 21.400000
Episode 40 Reward 18.000000 Average Reward 25.100000
Episode 50 Reward 20.000000 Average Reward 25.500000
Episode 60 Reward 37.000000 Average Reward 20.300000
Episode 70 Reward 13.000000 Average Reward 28.100000
Episode 80 Reward 10.000000 Average Reward 23.800000
Episode 90 Reward 20.000000 Average Reward 25.100000
Episode 100 Reward 15.000000 Average Reward 32.600000
Episode 110 Reward 14.000000 Average Reward 23.300000
Episode 120 Reward 17.000000 Average Reward 17.600000
Episode 130 Reward 19.000000 Average Reward 24.400000
Episode 140 Reward 24.000000 Average Reward 22.600000
Episode 150 Reward 21.000000 Average Reward 18.300000
Episode 160 Reward 16.000000 Average Reward 22.100000
Episode 170 Reward 39.000000 Average Reward 26.900000
Episode 180 Reward 35.000000 Average Reward 19.300000
Episode 190 Reward 22.000000 Average Reward 26.800000
Episode 200 Reward 19.000000 Average Reward 25.000000
Episode 210 Reward 15.000000 Average Reward 19.200000
Episode 220 Reward 24.000000 Average Reward 20.300000
Episode 230 Reward 69.000000 Average Reward 26.100000

Episode 240 Reward 44.000000 Average Reward 25.300000
Episode 250 Reward 22.000000 Average Reward 24.500000
Episode 260 Reward 25.000000 Average Reward 30.900000
Episode 270 Reward 20.000000 Average Reward 26.900000
Episode 280 Reward 23.000000 Average Reward 21.300000
Episode 290 Reward 13.000000 Average Reward 22.200000
Episode 300 Reward 28.000000 Average Reward 25.300000
Episode 310 Reward 24.000000 Average Reward 28.900000
Episode 320 Reward 53.000000 Average Reward 33.000000
Episode 330 Reward 11.000000 Average Reward 23.200000
Episode 340 Reward 11.000000 Average Reward 28.100000
Episode 350 Reward 61.000000 Average Reward 29.500000
Episode 360 Reward 30.000000 Average Reward 22.900000
Episode 370 Reward 21.000000 Average Reward 32.200000
Episode 380 Reward 40.000000 Average Reward 34.700000
Episode 390 Reward 47.000000 Average Reward 37.900000
Episode 400 Reward 27.000000 Average Reward 38.800000
Episode 410 Reward 36.000000 Average Reward 39.500000
Episode 420 Reward 41.000000 Average Reward 49.100000
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Episode 440 Reward 20.000000 Average Reward 65.700000
Episode 450 Reward 69.000000 Average Reward 58.100000
Episode 460 Reward 39.000000 Average Reward 48.800000
Episode 470 Reward 51.000000 Average Reward 37.700000
Episode 480 Reward 57.000000 Average Reward 53.800000
Episode 490 Reward 104.000000 Average Reward 63.900000
Episode 500 Reward 102.000000 Average Reward 69.500000
Episode 510 Reward 204.000000 Average Reward 71.300000
Episode 520 Reward 102.000000 Average Reward 127.000000
Episode 530 Reward 170.000000 Average Reward 127.900000
Episode 540 Reward 268.000000 Average Reward 134.000000
Episode 550 Reward 158.000000 Average Reward 132.800000
Episode 560 Reward 66.000000 Average Reward 103.400000
Episode 570 Reward 40.000000 Average Reward 114.600000
Episode 580 Reward 29.000000 Average Reward 54.200000
Episode 590 Reward 120.000000 Average Reward 77.500000
Episode 600 Reward 68.000000 Average Reward 174.000000
Episode 610 Reward 61.000000 Average Reward 118.300000
Episode 620 Reward 46.000000 Average Reward 95.100000
Episode 630 Reward 53.000000 Average Reward 52.700000
Episode 640 Reward 141.000000 Average Reward 95.900000
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Episode 660 Reward 139.000000 Average Reward 192.800000
Episode 670 Reward 188.000000 Average Reward 255.800000
Episode 680 Reward 192.000000 Average Reward 249.800000
Episode 690 Reward 161.000000 Average Reward 273.000000
Episode 700 Reward 163.000000 Average Reward 245.900000
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Episode 720 Reward 370.000000 Average Reward 288.400000
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Episode 740 Reward 137.000000 Average Reward 128.000000
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Episode 760 Reward 193.000000 Average Reward 184.800000
Episode 770 Reward 375.000000 Average Reward 241.100000
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Episode 870 Reward 119.000000 Average Reward 184.700000
Episode 880 Reward 220.000000 Average Reward 121.200000
Episode 890 Reward 175.000000 Average Reward 182.800000
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Episode 910 Reward 34.000000 Average Reward 128.600000
Episode 920 Reward 139.000000 Average Reward 158.400000
Episode 930 Reward 251.000000 Average Reward 286.400000
Episode 940 Reward 400.000000 Average Reward 274.400000
Episode 950 Reward 163.000000 Average Reward 274.700000
Episode 960 Reward 155.000000 Average Reward 137.400000
Episode 970 Reward 161.000000 Average Reward 203.900000
Episode 980 Reward 143.000000 Average Reward 182.600000
Episode 990 Reward 151.000000 Average Reward 149.500000
Episode 1000 Reward 170.000000 Average Reward 156.100000

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Episode 10 Reward 11.000000 Average Reward 18.100000
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Episode 60 Reward 16.000000 Average Reward 23.100000
Episode 70 Reward 53.000000 Average Reward 28.500000
Episode 80 Reward 11.000000 Average Reward 16.800000
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Episode 170 Reward 17.000000 Average Reward 17.900000
Episode 180 Reward 17.000000 Average Reward 16.200000

Episode 190 Reward 13.000000 Average Reward 15.900000
Episode 200 Reward 10.000000 Average Reward 26.900000
Episode 210 Reward 25.000000 Average Reward 17.700000
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Episode 280 Reward 15.000000 Average Reward 30.600000
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Episode 300 Reward 52.000000 Average Reward 29.700000
Episode 310 Reward 28.000000 Average Reward 21.000000
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Episode 330 Reward 27.000000 Average Reward 31.200000
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Episode 350 Reward 29.000000 Average Reward 46.800000
Episode 360 Reward 29.000000 Average Reward 37.300000
Episode 370 Reward 52.000000 Average Reward 70.600000
Episode 380 Reward 79.000000 Average Reward 65.100000
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Episode 420 Reward 142.000000 Average Reward 71.100000
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Episode 450 Reward 85.000000 Average Reward 75.400000
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Episode 480 Reward 80.000000 Average Reward 117.700000
Episode 490 Reward 136.000000 Average Reward 78.900000
Episode 500 Reward 35.000000 Average Reward 84.100000
Episode 510 Reward 67.000000 Average Reward 137.100000
Episode 520 Reward 97.000000 Average Reward 85.600000
Episode 530 Reward 93.000000 Average Reward 108.700000
Episode 540 Reward 109.000000 Average Reward 80.700000
Episode 550 Reward 27.000000 Average Reward 62.700000
Episode 560 Reward 112.000000 Average Reward 68.900000
Episode 570 Reward 24.000000 Average Reward 49.600000
Episode 580 Reward 93.000000 Average Reward 71.000000
Episode 590 Reward 191.000000 Average Reward 123.700000
Episode 600 Reward 288.000000 Average Reward 179.900000
Episode 610 Reward 190.000000 Average Reward 172.700000
Episode 620 Reward 39.000000 Average Reward 208.400000
Episode 630 Reward 204.000000 Average Reward 194.000000
Episode 640 Reward 119.000000 Average Reward 181.300000
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Episode 660 Reward 191.000000 Average Reward 204.200000

Episode 670 Reward 126.000000 Average Reward 153.900000
Episode 680 Reward 122.000000 Average Reward 115.000000
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Episode 780 Reward 129.000000 Average Reward 187.600000
Episode 790 Reward 216.000000 Average Reward 245.000000
Episode 800 Reward 197.000000 Average Reward 283.500000
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Episode 840 Reward 275.000000 Average Reward 322.600000
Episode 850 Reward 208.000000 Average Reward 244.000000
Episode 860 Reward 165.000000 Average Reward 170.400000
Episode 870 Reward 152.000000 Average Reward 93.300000
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Episode 900 Reward 135.000000 Average Reward 138.700000
Episode 910 Reward 156.000000 Average Reward 119.700000
Episode 920 Reward 260.000000 Average Reward 247.100000
Episode 930 Reward 240.000000 Average Reward 321.100000
Episode 940 Reward 31.000000 Average Reward 148.900000
Episode 950 Reward 199.000000 Average Reward 126.900000
Episode 960 Reward 168.000000 Average Reward 158.100000
Episode 970 Reward 226.000000 Average Reward 204.800000
Episode 980 Reward 137.000000 Average Reward 238.900000
Episode 990 Reward 123.000000 Average Reward 154.200000
Episode 1000 Reward 208.000000 Average Reward 221.800000

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Episode 10 Reward 36.000000 Average Reward 31.700000
Episode 20 Reward 22.000000 Average Reward 18.400000
Episode 30 Reward 20.000000 Average Reward 28.200000
Episode 40 Reward 17.000000 Average Reward 20.500000
Episode 50 Reward 21.000000 Average Reward 26.400000
Episode 60 Reward 20.000000 Average Reward 28.600000
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Episode 90 Reward 16.000000 Average Reward 24.600000
Episode 100 Reward 17.000000 Average Reward 22.600000
Episode 110 Reward 30.000000 Average Reward 28.200000
Episode 120 Reward 12.000000 Average Reward 22.100000
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Episode 140 Reward 20.000000 Average Reward 25.900000
Episode 150 Reward 16.000000 Average Reward 21.900000
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Episode 190 Reward 19.000000 Average Reward 25.300000
Episode 200 Reward 17.000000 Average Reward 30.400000
Episode 210 Reward 25.000000 Average Reward 33.400000
Episode 220 Reward 42.000000 Average Reward 29.100000
Episode 230 Reward 69.000000 Average Reward 28.500000
Episode 240 Reward 40.000000 Average Reward 29.500000
Episode 250 Reward 33.000000 Average Reward 26.000000
Episode 260 Reward 14.000000 Average Reward 37.800000
Episode 270 Reward 29.000000 Average Reward 40.000000
Episode 280 Reward 34.000000 Average Reward 37.200000
Episode 290 Reward 23.000000 Average Reward 36.500000
Episode 300 Reward 60.000000 Average Reward 38.300000
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Episode 350 Reward 50.000000 Average Reward 45.100000
Episode 360 Reward 47.000000 Average Reward 40.900000
Episode 370 Reward 26.000000 Average Reward 41.600000
Episode 380 Reward 28.000000 Average Reward 62.200000
Episode 390 Reward 33.000000 Average Reward 58.000000
Episode 400 Reward 50.000000 Average Reward 70.900000
Episode 410 Reward 40.000000 Average Reward 46.500000
Episode 420 Reward 64.000000 Average Reward 37.000000
Episode 430 Reward 29.000000 Average Reward 42.000000
Episode 440 Reward 29.000000 Average Reward 59.700000
Episode 450 Reward 67.000000 Average Reward 91.900000
Episode 460 Reward 103.000000 Average Reward 91.400000
Episode 470 Reward 79.000000 Average Reward 101.000000
Episode 480 Reward 149.000000 Average Reward 102.600000
Episode 490 Reward 62.000000 Average Reward 95.800000
Episode 500 Reward 93.000000 Average Reward 109.300000
Episode 510 Reward 44.000000 Average Reward 102.000000
Episode 520 Reward 26.000000 Average Reward 71.100000
Episode 530 Reward 125.000000 Average Reward 81.800000
Episode 540 Reward 125.000000 Average Reward 100.800000
Episode 550 Reward 129.000000 Average Reward 129.000000
Episode 560 Reward 172.000000 Average Reward 161.600000
Episode 570 Reward 274.000000 Average Reward 202.800000
Episode 580 Reward 447.000000 Average Reward 249.900000
Episode 590 Reward 215.000000 Average Reward 188.500000
Episode 600 Reward 210.000000 Average Reward 237.700000
Episode 610 Reward 324.000000 Average Reward 218.700000

Episode 620 Reward 186.000000 Average Reward 197.500000
Episode 630 Reward 144.000000 Average Reward 161.400000
Episode 640 Reward 131.000000 Average Reward 152.200000
Episode 650 Reward 205.000000 Average Reward 150.500000
Episode 660 Reward 158.000000 Average Reward 168.100000
Episode 670 Reward 163.000000 Average Reward 220.000000
Episode 680 Reward 163.000000 Average Reward 264.600000
Episode 690 Reward 127.000000 Average Reward 159.600000
Episode 700 Reward 236.000000 Average Reward 149.100000
Episode 710 Reward 178.000000 Average Reward 216.600000
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Episode 770 Reward 84.000000 Average Reward 169.100000
Episode 780 Reward 324.000000 Average Reward 221.000000
Episode 790 Reward 362.000000 Average Reward 216.800000
Episode 800 Reward 111.000000 Average Reward 236.000000
Episode 810 Reward 212.000000 Average Reward 247.700000
Episode 820 Reward 171.000000 Average Reward 203.000000
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Episode 850 Reward 155.000000 Average Reward 141.900000
Episode 860 Reward 228.000000 Average Reward 155.300000
Episode 870 Reward 148.000000 Average Reward 189.900000
Episode 880 Reward 157.000000 Average Reward 152.100000
Episode 890 Reward 22.000000 Average Reward 118.900000
Episode 900 Reward 380.000000 Average Reward 262.100000
Episode 910 Reward 155.000000 Average Reward 172.800000
Episode 920 Reward 44.000000 Average Reward 186.800000
Episode 930 Reward 103.000000 Average Reward 81.900000
Episode 940 Reward 137.000000 Average Reward 117.000000
Episode 950 Reward 181.000000 Average Reward 188.800000
Episode 960 Reward 225.000000 Average Reward 246.100000
Episode 970 Reward 333.000000 Average Reward 275.700000
Episode 980 Reward 177.000000 Average Reward 294.300000
Episode 990 Reward 196.000000 Average Reward 339.000000
Episode 1000 Reward 186.000000 Average Reward 188.800000

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Episode 10 Reward 15.000000 Average Reward 28.600000
Episode 20 Reward 44.000000 Average Reward 27.900000
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Episode 40 Reward 14.000000 Average Reward 24.600000
Episode 50 Reward 17.000000 Average Reward 25.000000
Episode 60 Reward 34.000000 Average Reward 29.200000
Episode 70 Reward 14.000000 Average Reward 26.300000
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Episode 90 Reward 30.000000 Average Reward 22.800000
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Episode 190 Reward 42.000000 Average Reward 26.200000
Episode 200 Reward 27.000000 Average Reward 21.900000
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Episode 220 Reward 27.000000 Average Reward 32.500000
Episode 230 Reward 37.000000 Average Reward 23.300000
Episode 240 Reward 48.000000 Average Reward 32.700000
Episode 250 Reward 38.000000 Average Reward 28.300000
Episode 260 Reward 12.000000 Average Reward 26.000000
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Episode 320 Reward 41.000000 Average Reward 38.200000
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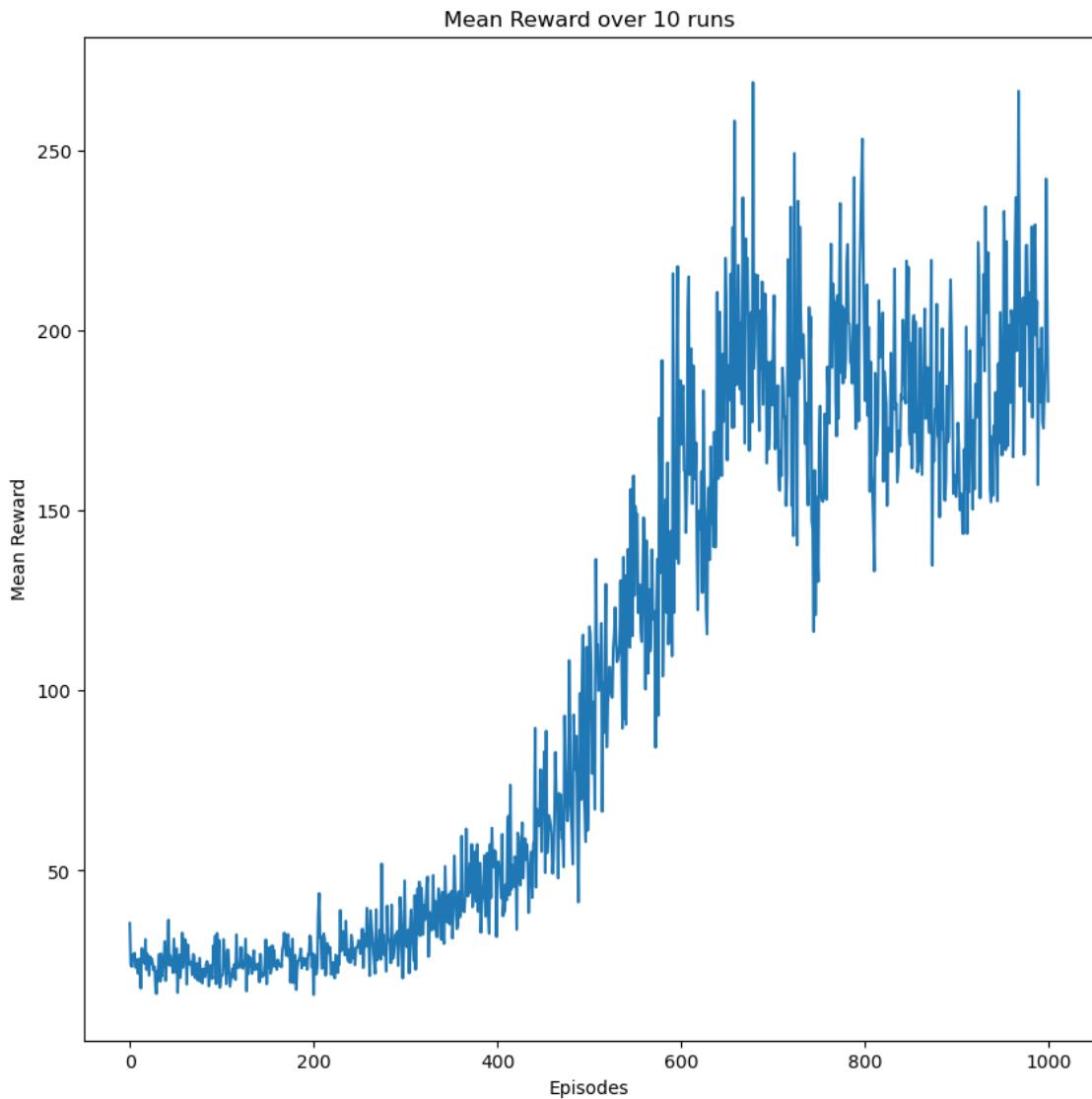
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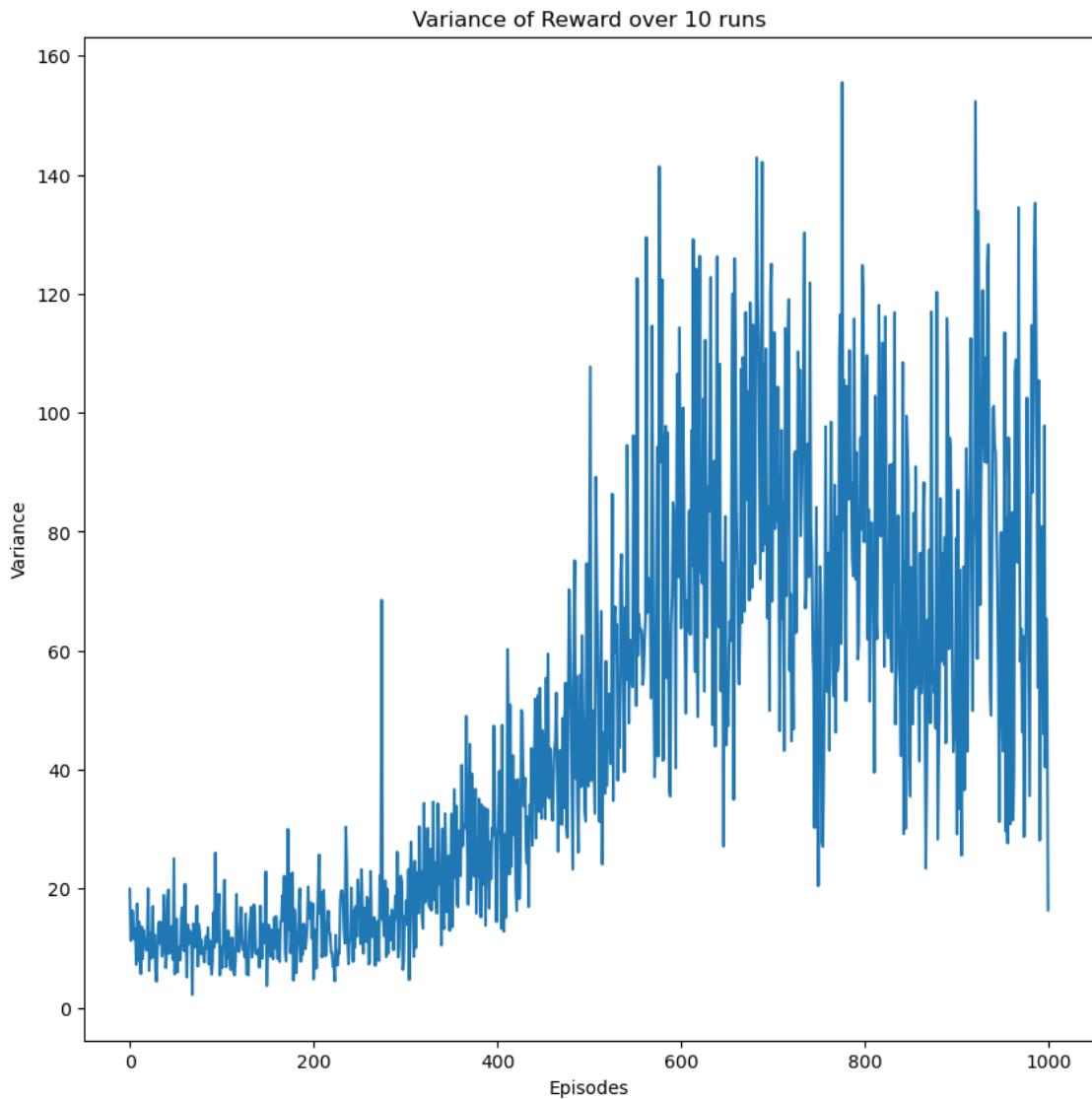
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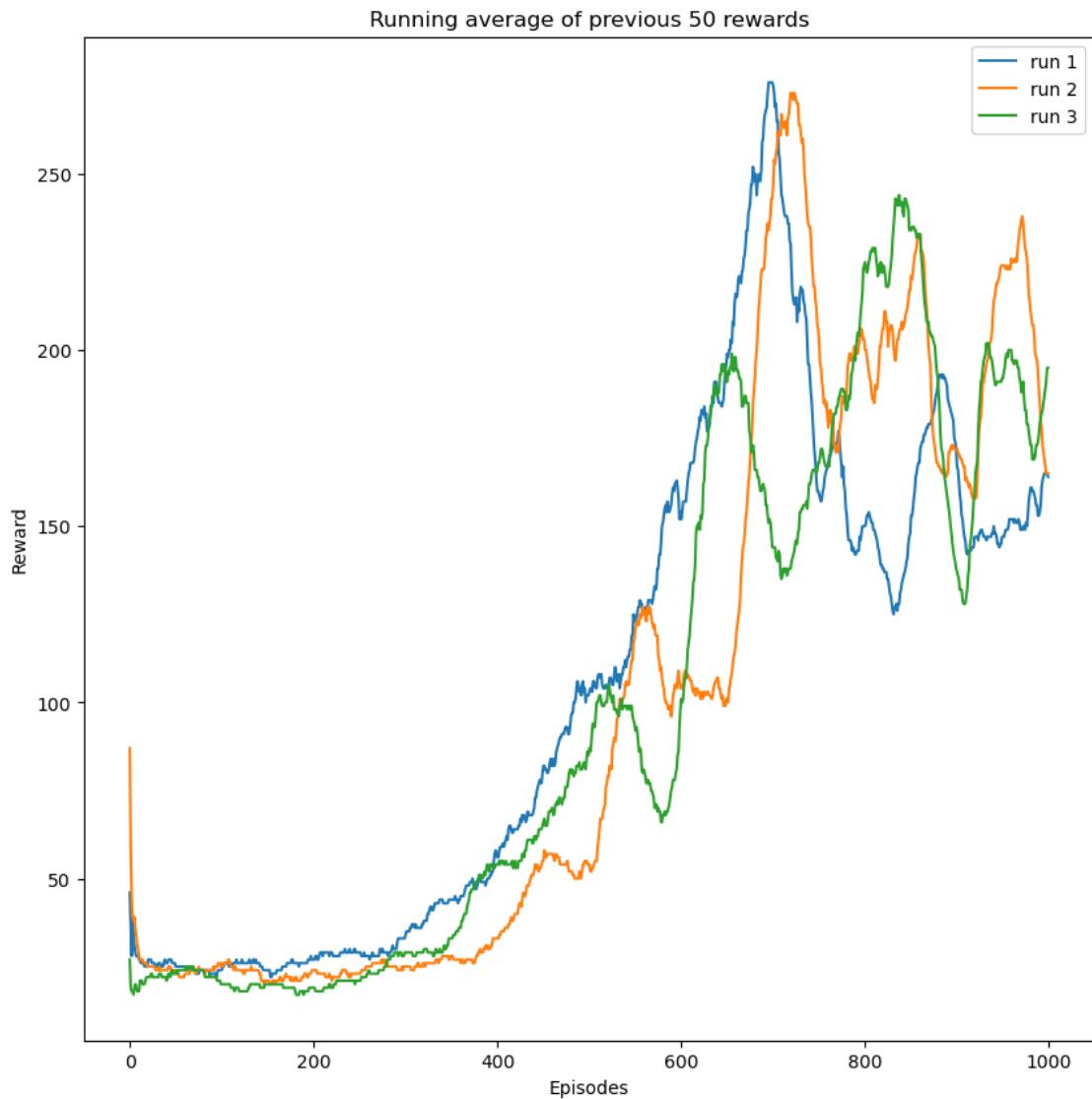
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Episode 50 Reward 26.000000 Average Reward 26.100000
Episode 60 Reward 36.000000 Average Reward 20.800000
Episode 70 Reward 31.000000 Average Reward 26.300000
Episode 80 Reward 18.000000 Average Reward 19.400000
Episode 90 Reward 23.000000 Average Reward 19.700000
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Episode 130 Reward 28.000000 Average Reward 22.100000
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Episode 150 Reward 17.000000 Average Reward 27.700000
Episode 160 Reward 13.000000 Average Reward 20.600000
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Episode 190 Reward 27.000000 Average Reward 32.400000
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Episode 250 Reward 76.000000 Average Reward 37.700000
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Episode 270 Reward 45.000000 Average Reward 29.700000
Episode 280 Reward 12.000000 Average Reward 47.600000
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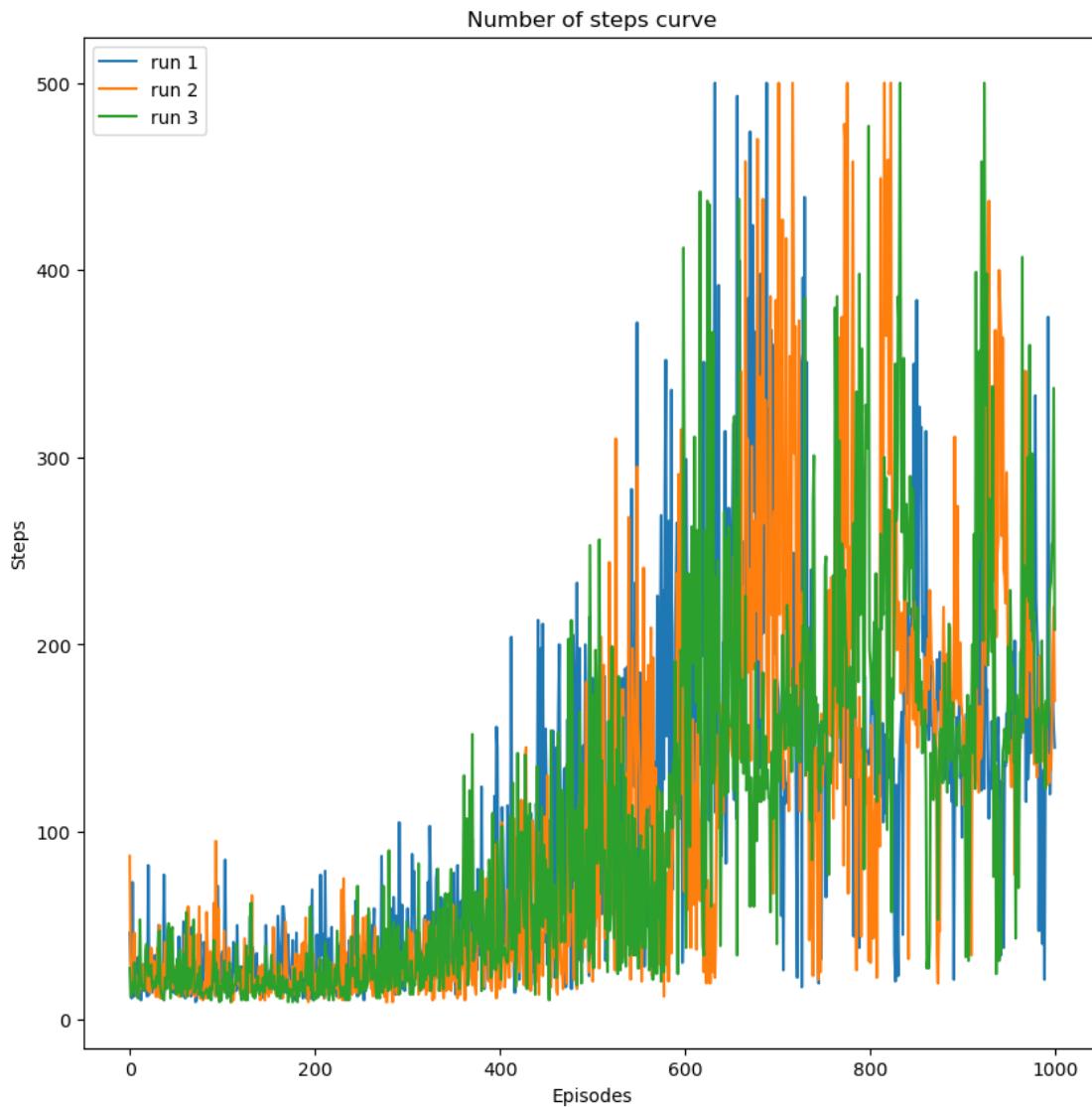
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Episode 360 Reward 27.000000 Average Reward 43.200000
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Episode 380 Reward 19.000000 Average Reward 28.500000
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Episode 490 Reward 146.000000 Average Reward 69.900000
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Episode 540 Reward 66.000000 Average Reward 78.900000
Episode 550 Reward 37.000000 Average Reward 142.100000
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Episode 590 Reward 138.000000 Average Reward 184.500000
Episode 600 Reward 143.000000 Average Reward 212.000000
Episode 610 Reward 224.000000 Average Reward 187.400000
Episode 620 Reward 122.000000 Average Reward 160.900000
Episode 630 Reward 217.000000 Average Reward 170.500000
Episode 640 Reward 320.000000 Average Reward 203.500000
Episode 650 Reward 191.000000 Average Reward 174.100000
Episode 660 Reward 32.000000 Average Reward 147.100000
Episode 670 Reward 83.000000 Average Reward 155.000000
Episode 680 Reward 408.000000 Average Reward 200.600000
Episode 690 Reward 227.000000 Average Reward 245.500000
Episode 700 Reward 280.000000 Average Reward 235.900000
Episode 710 Reward 119.000000 Average Reward 171.200000
Episode 720 Reward 142.000000 Average Reward 126.700000
Episode 730 Reward 128.000000 Average Reward 116.100000
Episode 740 Reward 165.000000 Average Reward 119.600000
Episode 750 Reward 83.000000 Average Reward 124.000000
Episode 760 Reward 139.000000 Average Reward 202.900000
Episode 770 Reward 142.000000 Average Reward 182.000000
Episode 780 Reward 185.000000 Average Reward 181.600000
Episode 790 Reward 257.000000 Average Reward 254.400000

Episode 800 Reward 124.000000 Average Reward 164.200000
Episode 810 Reward 24.000000 Average Reward 128.600000
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Episode 840 Reward 215.000000 Average Reward 185.800000
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Episode 880 Reward 180.000000 Average Reward 190.600000
Episode 890 Reward 217.000000 Average Reward 200.000000
Episode 900 Reward 88.000000 Average Reward 218.100000
Episode 910 Reward 141.000000 Average Reward 220.300000
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Episode 940 Reward 240.000000 Average Reward 300.800000
Episode 950 Reward 224.000000 Average Reward 215.400000
Episode 960 Reward 231.000000 Average Reward 222.000000
Episode 970 Reward 201.000000 Average Reward 261.400000
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0:02:33.509295









```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [1024, 1024]
LR = 1e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'CartPole-v1'
SOLVE_CUTOFF = 195.0
STEP = 5

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{NUM_HIDDEN}_{HIDDEN_SIZES}_{LR}_{ENV_NAME}_{NUM_EPISODES}_{NSTEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

Episode 10 Reward 44.000000 Average Reward 35.800000
 Episode 20 Reward 44.000000 Average Reward 22.800000
 Episode 30 Reward 15.000000 Average Reward 21.300000
 Episode 40 Reward 28.000000 Average Reward 28.500000
 Episode 50 Reward 22.000000 Average Reward 28.700000
 Episode 60 Reward 46.000000 Average Reward 36.000000
 Episode 70 Reward 34.000000 Average Reward 35.700000
 Episode 80 Reward 30.000000 Average Reward 24.400000
 Episode 90 Reward 99.000000 Average Reward 34.500000
 Episode 100 Reward 33.000000 Average Reward 43.800000
 Episode 110 Reward 25.000000 Average Reward 25.100000
 Episode 120 Reward 51.000000 Average Reward 27.000000
 Episode 130 Reward 21.000000 Average Reward 26.400000
 Episode 140 Reward 12.000000 Average Reward 29.700000
 Episode 150 Reward 57.000000 Average Reward 32.900000
 Episode 160 Reward 17.000000 Average Reward 32.800000
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 Episode 180 Reward 35.000000 Average Reward 38.200000
 Episode 190 Reward 52.000000 Average Reward 29.000000
 Episode 200 Reward 47.000000 Average Reward 41.200000
 Episode 210 Reward 26.000000 Average Reward 36.700000
 Episode 220 Reward 143.000000 Average Reward 66.000000
 Episode 230 Reward 39.000000 Average Reward 44.800000
 Episode 240 Reward 42.000000 Average Reward 50.000000
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 Episode 260 Reward 130.000000 Average Reward 80.800000
 Episode 270 Reward 149.000000 Average Reward 97.500000
 Episode 280 Reward 121.000000 Average Reward 119.000000
 Episode 290 Reward 87.000000 Average Reward 90.300000
 Episode 300 Reward 78.000000 Average Reward 139.200000
 Episode 310 Reward 43.000000 Average Reward 90.900000
 Episode 320 Reward 115.000000 Average Reward 76.300000
 Episode 330 Reward 138.000000 Average Reward 157.000000
 Episode 340 Reward 279.000000 Average Reward 158.400000

Episode 350 Reward 270.000000 Average Reward 204.700000
Episode 360 Reward 200.000000 Average Reward 163.400000
Episode 370 Reward 104.000000 Average Reward 132.900000
Episode 380 Reward 23.000000 Average Reward 64.400000
Episode 390 Reward 154.000000 Average Reward 120.200000
Episode 400 Reward 85.000000 Average Reward 110.300000
Episode 410 Reward 132.000000 Average Reward 130.400000
Episode 420 Reward 195.000000 Average Reward 142.400000
Episode 430 Reward 155.000000 Average Reward 115.500000
Episode 440 Reward 264.000000 Average Reward 155.300000
Episode 450 Reward 171.000000 Average Reward 139.200000
Episode 460 Reward 131.000000 Average Reward 158.000000
Episode 470 Reward 93.000000 Average Reward 126.300000
Episode 480 Reward 146.000000 Average Reward 100.600000
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Episode 500 Reward 124.000000 Average Reward 128.200000
Episode 510 Reward 180.000000 Average Reward 117.500000
Episode 520 Reward 202.000000 Average Reward 211.300000
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Episode 620 Reward 153.000000 Average Reward 121.000000
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Episode 660 Reward 500.000000 Average Reward 498.200000
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Episode 720 Reward 134.000000 Average Reward 137.100000
Episode 730 Reward 14.000000 Average Reward 16.300000
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Episode 750 Reward 144.000000 Average Reward 162.900000
Episode 760 Reward 119.000000 Average Reward 141.300000
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Episode 780 Reward 37.000000 Average Reward 90.200000
Episode 790 Reward 111.000000 Average Reward 92.800000
Episode 800 Reward 428.000000 Average Reward 226.400000
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Episode 820 Reward 136.000000 Average Reward 160.100000

Episode 830 Reward 100.000000 Average Reward 125.000000
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Episode 340 Reward 57.000000 Average Reward 56.200000
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Episode 360 Reward 84.000000 Average Reward 130.100000
Episode 370 Reward 122.000000 Average Reward 104.700000
Episode 380 Reward 85.000000 Average Reward 78.200000
Episode 390 Reward 21.000000 Average Reward 126.100000
Episode 400 Reward 241.000000 Average Reward 102.800000
Episode 410 Reward 193.000000 Average Reward 211.700000
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Episode 460 Reward 115.000000 Average Reward 124.100000
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Episode 50 Reward 22.000000 Average Reward 21.100000
Episode 60 Reward 30.000000 Average Reward 23.100000
Episode 70 Reward 30.000000 Average Reward 31.500000
Episode 80 Reward 11.000000 Average Reward 23.500000
Episode 90 Reward 35.000000 Average Reward 24.200000
Episode 100 Reward 24.000000 Average Reward 37.100000
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Episode 150 Reward 11.000000 Average Reward 21.400000
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Episode 360 Reward 230.000000 Average Reward 153.400000
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Episode 380 Reward 131.000000 Average Reward 161.200000
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Episode 460 Reward 125.000000 Average Reward 90.300000
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Episode 490 Reward 137.000000 Average Reward 152.900000
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Episode 560 Reward 168.000000 Average Reward 158.100000
Episode 570 Reward 237.000000 Average Reward 233.700000
Episode 580 Reward 364.000000 Average Reward 347.000000
Episode 590 Reward 16.000000 Average Reward 90.400000
Episode 600 Reward 21.000000 Average Reward 21.600000
Episode 610 Reward 299.000000 Average Reward 145.200000
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Episode 630 Reward 214.000000 Average Reward 212.900000
Episode 640 Reward 182.000000 Average Reward 232.500000
Episode 650 Reward 294.000000 Average Reward 247.000000
Episode 660 Reward 359.000000 Average Reward 287.500000
Episode 670 Reward 199.000000 Average Reward 350.100000
Episode 680 Reward 127.000000 Average Reward 156.000000
Episode 690 Reward 166.000000 Average Reward 122.000000
Episode 700 Reward 22.000000 Average Reward 62.800000
Episode 710 Reward 144.000000 Average Reward 112.600000
Episode 720 Reward 105.000000 Average Reward 128.800000

Episode 730 Reward 117.000000 Average Reward 66.900000
Episode 740 Reward 500.000000 Average Reward 226.800000
Episode 750 Reward 275.000000 Average Reward 280.500000
Episode 760 Reward 300.000000 Average Reward 284.600000
Episode 770 Reward 263.000000 Average Reward 250.800000
Episode 780 Reward 233.000000 Average Reward 249.100000
Episode 790 Reward 191.000000 Average Reward 222.300000
Episode 800 Reward 221.000000 Average Reward 201.200000
Episode 810 Reward 197.000000 Average Reward 195.000000
Episode 820 Reward 268.000000 Average Reward 225.200000
Episode 830 Reward 307.000000 Average Reward 274.800000
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Episode 850 Reward 500.000000 Average Reward 377.500000
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Episode 880 Reward 120.000000 Average Reward 92.200000
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Episode 900 Reward 18.000000 Average Reward 181.000000
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Episode 940 Reward 217.000000 Average Reward 251.600000
Episode 950 Reward 293.000000 Average Reward 239.200000
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Episode 970 Reward 334.000000 Average Reward 386.200000
Episode 980 Reward 472.000000 Average Reward 449.300000
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Episode 110 Reward 42.000000 Average Reward 32.700000
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Episode 290 Reward 278.000000 Average Reward 179.400000
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Episode 320 Reward 364.000000 Average Reward 211.300000
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Episode 340 Reward 30.000000 Average Reward 81.600000
Episode 350 Reward 185.000000 Average Reward 156.600000
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Episode 500 Reward 26.000000 Average Reward 69.300000
Episode 510 Reward 403.000000 Average Reward 166.100000
Episode 520 Reward 169.000000 Average Reward 233.800000
Episode 530 Reward 325.000000 Average Reward 390.800000
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Episode 570 Reward 161.000000 Average Reward 386.300000
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Episode 600 Reward 166.000000 Average Reward 175.900000
Episode 610 Reward 105.000000 Average Reward 123.900000
Episode 620 Reward 131.000000 Average Reward 89.000000
Episode 630 Reward 172.000000 Average Reward 171.800000
Episode 640 Reward 207.000000 Average Reward 229.800000
Episode 650 Reward 441.000000 Average Reward 339.100000
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Episode 670 Reward 500.000000 Average Reward 500.000000

Episode 680 Reward 500.000000 Average Reward 500.000000
Episode 690 Reward 274.000000 Average Reward 358.400000
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Episode 710 Reward 134.000000 Average Reward 31.200000
Episode 720 Reward 238.000000 Average Reward 161.300000
Episode 730 Reward 18.000000 Average Reward 141.000000
Episode 740 Reward 118.000000 Average Reward 62.100000
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Episode 140 Reward 39.000000 Average Reward 27.200000

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Episode 390 Reward 99.000000 Average Reward 143.700000
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Episode 420 Reward 206.000000 Average Reward 190.900000
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Episode 460 Reward 124.000000 Average Reward 104.600000
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Episode 620 Reward 160.000000 Average Reward 168.700000

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Episode 710 Reward 206.000000 Average Reward 359.100000
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Episode 780 Reward 178.000000 Average Reward 208.500000
Episode 790 Reward 140.000000 Average Reward 130.900000
Episode 800 Reward 213.000000 Average Reward 158.200000
Episode 810 Reward 270.000000 Average Reward 248.300000
Episode 820 Reward 204.000000 Average Reward 217.100000
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Episode 890 Reward 141.000000 Average Reward 146.200000
Episode 900 Reward 140.000000 Average Reward 149.500000
Episode 910 Reward 216.000000 Average Reward 184.300000
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Episode 970 Reward 454.000000 Average Reward 321.500000
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Episode 1000 Reward 255.000000 Average Reward 303.400000

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Episode 90 Reward 14.000000 Average Reward 17.400000

Episode 100 Reward 28.000000 Average Reward 19.700000
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Episode 120 Reward 13.000000 Average Reward 24.400000
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Episode 150 Reward 22.000000 Average Reward 25.000000
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Episode 180 Reward 24.000000 Average Reward 32.200000
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Episode 220 Reward 51.000000 Average Reward 29.200000
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Episode 270 Reward 27.000000 Average Reward 54.000000
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Episode 320 Reward 49.000000 Average Reward 64.800000
Episode 330 Reward 32.000000 Average Reward 52.200000
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Episode 370 Reward 30.000000 Average Reward 80.500000
Episode 380 Reward 23.000000 Average Reward 62.700000
Episode 390 Reward 174.000000 Average Reward 159.000000
Episode 400 Reward 93.000000 Average Reward 73.600000
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Episode 430 Reward 217.000000 Average Reward 214.000000
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Episode 530 Reward 299.000000 Average Reward 276.200000
Episode 540 Reward 134.000000 Average Reward 207.500000
Episode 550 Reward 132.000000 Average Reward 142.000000
Episode 560 Reward 143.000000 Average Reward 131.500000
Episode 570 Reward 180.000000 Average Reward 175.300000

Episode 580 Reward 144.000000 Average Reward 253.500000
Episode 590 Reward 18.000000 Average Reward 49.800000
Episode 600 Reward 281.000000 Average Reward 116.500000
Episode 610 Reward 150.000000 Average Reward 317.900000
Episode 620 Reward 246.000000 Average Reward 255.400000
Episode 630 Reward 332.000000 Average Reward 297.200000
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Episode 650 Reward 190.000000 Average Reward 219.400000
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Episode 670 Reward 377.000000 Average Reward 369.100000
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Episode 750 Reward 214.000000 Average Reward 120.900000
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Episode 780 Reward 141.000000 Average Reward 155.000000
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Episode 800 Reward 144.000000 Average Reward 145.800000
Episode 810 Reward 137.000000 Average Reward 131.400000
Episode 820 Reward 158.000000 Average Reward 126.100000
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Episode 840 Reward 201.000000 Average Reward 190.600000
Episode 850 Reward 266.000000 Average Reward 234.000000
Episode 860 Reward 240.000000 Average Reward 303.800000
Episode 870 Reward 201.000000 Average Reward 248.800000
Episode 880 Reward 162.000000 Average Reward 187.800000
Episode 890 Reward 162.000000 Average Reward 184.400000
Episode 900 Reward 210.000000 Average Reward 188.600000
Episode 910 Reward 250.000000 Average Reward 214.200000
Episode 920 Reward 241.000000 Average Reward 244.700000
Episode 930 Reward 470.000000 Average Reward 341.600000
Episode 940 Reward 500.000000 Average Reward 439.100000
Episode 950 Reward 192.000000 Average Reward 265.100000
Episode 960 Reward 20.000000 Average Reward 81.700000
Episode 970 Reward 102.000000 Average Reward 54.900000
Episode 980 Reward 122.000000 Average Reward 46.600000
Episode 990 Reward 134.000000 Average Reward 109.900000
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Episode 40 Reward 22.000000 Average Reward 27.200000

Episode 50 Reward 39.000000 Average Reward 42.900000
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Episode 90 Reward 59.000000 Average Reward 36.200000
Episode 100 Reward 24.000000 Average Reward 43.100000
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Episode 190 Reward 36.000000 Average Reward 26.300000
Episode 200 Reward 18.000000 Average Reward 19.500000
Episode 210 Reward 61.000000 Average Reward 34.300000
Episode 220 Reward 29.000000 Average Reward 37.000000
Episode 230 Reward 34.000000 Average Reward 38.100000
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Episode 280 Reward 20.000000 Average Reward 19.000000
Episode 290 Reward 17.000000 Average Reward 33.700000
Episode 300 Reward 116.000000 Average Reward 58.100000
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Episode 330 Reward 38.000000 Average Reward 75.500000
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Episode 360 Reward 18.000000 Average Reward 42.400000
Episode 370 Reward 54.000000 Average Reward 46.800000
Episode 380 Reward 253.000000 Average Reward 153.100000
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Episode 400 Reward 210.000000 Average Reward 206.600000
Episode 410 Reward 175.000000 Average Reward 260.400000
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Episode 430 Reward 34.000000 Average Reward 124.800000
Episode 440 Reward 19.000000 Average Reward 41.800000
Episode 450 Reward 143.000000 Average Reward 86.600000
Episode 460 Reward 276.000000 Average Reward 251.500000
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Episode 480 Reward 187.000000 Average Reward 313.900000
Episode 490 Reward 25.000000 Average Reward 134.200000
Episode 500 Reward 145.000000 Average Reward 116.000000
Episode 510 Reward 347.000000 Average Reward 204.400000
Episode 520 Reward 421.000000 Average Reward 361.000000

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Episode 570 Reward 121.000000 Average Reward 71.900000
Episode 580 Reward 222.000000 Average Reward 167.700000
Episode 590 Reward 370.000000 Average Reward 215.900000
Episode 600 Reward 179.000000 Average Reward 236.600000
Episode 610 Reward 169.000000 Average Reward 165.100000
Episode 620 Reward 169.000000 Average Reward 197.700000
Episode 630 Reward 142.000000 Average Reward 146.100000
Episode 640 Reward 166.000000 Average Reward 140.500000
Episode 650 Reward 199.000000 Average Reward 176.300000
Episode 660 Reward 149.000000 Average Reward 176.900000
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Episode 680 Reward 187.000000 Average Reward 157.600000
Episode 690 Reward 179.000000 Average Reward 168.400000
Episode 700 Reward 150.000000 Average Reward 167.900000
Episode 710 Reward 207.000000 Average Reward 198.200000
Episode 720 Reward 379.000000 Average Reward 326.900000
Episode 730 Reward 249.000000 Average Reward 263.800000
Episode 740 Reward 195.000000 Average Reward 285.000000
Episode 750 Reward 15.000000 Average Reward 46.000000
Episode 760 Reward 20.000000 Average Reward 14.600000
Episode 770 Reward 98.000000 Average Reward 60.100000
Episode 780 Reward 163.000000 Average Reward 125.500000
Episode 790 Reward 161.000000 Average Reward 171.500000
Episode 800 Reward 245.000000 Average Reward 237.300000
Episode 810 Reward 256.000000 Average Reward 219.300000
Episode 820 Reward 161.000000 Average Reward 193.500000
Episode 830 Reward 166.000000 Average Reward 159.400000
Episode 840 Reward 500.000000 Average Reward 287.500000
Episode 850 Reward 106.000000 Average Reward 159.800000
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Episode 920 Reward 145.000000 Average Reward 163.700000
Episode 930 Reward 157.000000 Average Reward 157.700000
Episode 940 Reward 173.000000 Average Reward 155.100000
Episode 950 Reward 172.000000 Average Reward 157.300000
Episode 960 Reward 215.000000 Average Reward 173.700000
Episode 970 Reward 185.000000 Average Reward 182.100000
Episode 980 Reward 240.000000 Average Reward 205.100000
Episode 990 Reward 208.000000 Average Reward 212.100000
Episode 1000 Reward 231.000000 Average Reward 273.600000

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Episode	Reward	Average Reward
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20	11.000000	25.600000
30	14.000000	23.500000
40	46.000000	26.200000
50	8.000000	26.200000
60	12.000000	28.500000
70	12.000000	29.100000
80	22.000000	18.100000
90	20.000000	17.300000
100	12.000000	15.800000
110	10.000000	23.900000
120	57.000000	26.000000
130	15.000000	21.400000
140	24.000000	20.600000
150	11.000000	19.500000
160	17.000000	21.900000
170	27.000000	29.600000
180	20.000000	26.000000
190	30.000000	25.100000
200	39.000000	26.500000
210	18.000000	33.000000
220	23.000000	22.000000
230	22.000000	27.700000
240	16.000000	21.800000
250	54.000000	28.300000
260	19.000000	47.400000
270	64.000000	43.900000
280	20.000000	22.100000
290	22.000000	34.100000
300	57.000000	59.600000
310	37.000000	93.900000
320	121.000000	84.400000
330	58.000000	113.400000
340	32.000000	99.100000
350	324.000000	167.000000
360	37.000000	119.500000
370	83.000000	60.400000
380	323.000000	137.200000
390	163.000000	194.100000
400	206.000000	201.900000
410	332.000000	254.900000
420	184.000000	208.600000
430	103.000000	117.900000
440	179.000000	137.700000
450	210.000000	233.500000
460	198.000000	228.600000
470	183.000000	209.500000

Episode 480 Reward 140.000000 Average Reward 142.000000
Episode 490 Reward 122.000000 Average Reward 129.700000
Episode 500 Reward 213.000000 Average Reward 161.200000
Episode 510 Reward 113.000000 Average Reward 153.400000
Episode 520 Reward 253.000000 Average Reward 166.200000
Episode 530 Reward 111.000000 Average Reward 227.200000
Episode 540 Reward 178.000000 Average Reward 116.900000
Episode 550 Reward 236.000000 Average Reward 233.100000
Episode 560 Reward 43.000000 Average Reward 37.300000
Episode 570 Reward 138.000000 Average Reward 180.700000
Episode 580 Reward 29.000000 Average Reward 96.600000
Episode 590 Reward 205.000000 Average Reward 155.600000
Episode 600 Reward 368.000000 Average Reward 355.100000
Episode 610 Reward 168.000000 Average Reward 336.600000
Episode 620 Reward 151.000000 Average Reward 142.400000
Episode 630 Reward 148.000000 Average Reward 150.800000
Episode 640 Reward 217.000000 Average Reward 162.000000
Episode 650 Reward 343.000000 Average Reward 226.400000
Episode 660 Reward 115.000000 Average Reward 177.600000
Episode 670 Reward 29.000000 Average Reward 97.200000
Episode 680 Reward 500.000000 Average Reward 342.500000
Episode 690 Reward 279.000000 Average Reward 417.300000
Episode 700 Reward 143.000000 Average Reward 180.700000
Episode 710 Reward 180.000000 Average Reward 118.400000
Episode 720 Reward 395.000000 Average Reward 263.800000
Episode 730 Reward 184.000000 Average Reward 247.000000
Episode 740 Reward 118.000000 Average Reward 161.300000
Episode 750 Reward 18.000000 Average Reward 28.100000
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Episode 770 Reward 134.000000 Average Reward 121.500000
Episode 780 Reward 500.000000 Average Reward 285.600000
Episode 790 Reward 220.000000 Average Reward 351.900000
Episode 800 Reward 312.000000 Average Reward 232.300000
Episode 810 Reward 449.000000 Average Reward 458.200000
Episode 820 Reward 387.000000 Average Reward 280.500000
Episode 830 Reward 318.000000 Average Reward 317.100000
Episode 840 Reward 207.000000 Average Reward 300.800000
Episode 850 Reward 135.000000 Average Reward 155.700000
Episode 860 Reward 37.000000 Average Reward 91.800000
Episode 870 Reward 156.000000 Average Reward 119.700000
Episode 880 Reward 125.000000 Average Reward 132.600000
Episode 890 Reward 117.000000 Average Reward 109.900000
Episode 900 Reward 103.000000 Average Reward 108.300000
Episode 910 Reward 106.000000 Average Reward 81.400000
Episode 920 Reward 114.000000 Average Reward 108.900000
Episode 930 Reward 149.000000 Average Reward 133.100000
Episode 940 Reward 373.000000 Average Reward 239.800000
Episode 950 Reward 155.000000 Average Reward 289.900000

Episode 960 Reward 142.000000 Average Reward 150.100000
Episode 970 Reward 130.000000 Average Reward 143.800000
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Episode 990 Reward 172.000000 Average Reward 155.800000
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Episode 50 Reward 14.000000 Average Reward 20.100000
Episode 60 Reward 23.000000 Average Reward 26.000000
Episode 70 Reward 33.000000 Average Reward 21.300000
Episode 80 Reward 22.000000 Average Reward 28.000000
Episode 90 Reward 14.000000 Average Reward 18.200000
Episode 100 Reward 21.000000 Average Reward 23.500000
Episode 110 Reward 14.000000 Average Reward 21.500000
Episode 120 Reward 19.000000 Average Reward 24.700000
Episode 130 Reward 13.000000 Average Reward 25.800000
Episode 140 Reward 31.000000 Average Reward 24.000000
Episode 150 Reward 17.000000 Average Reward 26.600000
Episode 160 Reward 13.000000 Average Reward 26.300000
Episode 170 Reward 49.000000 Average Reward 33.300000
Episode 180 Reward 30.000000 Average Reward 32.800000
Episode 190 Reward 22.000000 Average Reward 31.100000
Episode 200 Reward 30.000000 Average Reward 31.500000
Episode 210 Reward 10.000000 Average Reward 27.700000
Episode 220 Reward 128.000000 Average Reward 39.800000
Episode 230 Reward 28.000000 Average Reward 23.000000
Episode 240 Reward 26.000000 Average Reward 40.800000
Episode 250 Reward 144.000000 Average Reward 61.600000
Episode 260 Reward 37.000000 Average Reward 37.400000
Episode 270 Reward 19.000000 Average Reward 32.000000
Episode 280 Reward 34.000000 Average Reward 37.700000
Episode 290 Reward 52.000000 Average Reward 95.400000
Episode 300 Reward 24.000000 Average Reward 79.700000
Episode 310 Reward 94.000000 Average Reward 80.800000
Episode 320 Reward 164.000000 Average Reward 132.200000
Episode 330 Reward 124.000000 Average Reward 125.300000
Episode 340 Reward 193.000000 Average Reward 170.400000
Episode 350 Reward 100.000000 Average Reward 121.500000
Episode 360 Reward 118.000000 Average Reward 147.100000
Episode 370 Reward 290.000000 Average Reward 168.100000
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Episode 410 Reward 331.000000 Average Reward 223.200000
Episode 420 Reward 132.000000 Average Reward 148.800000

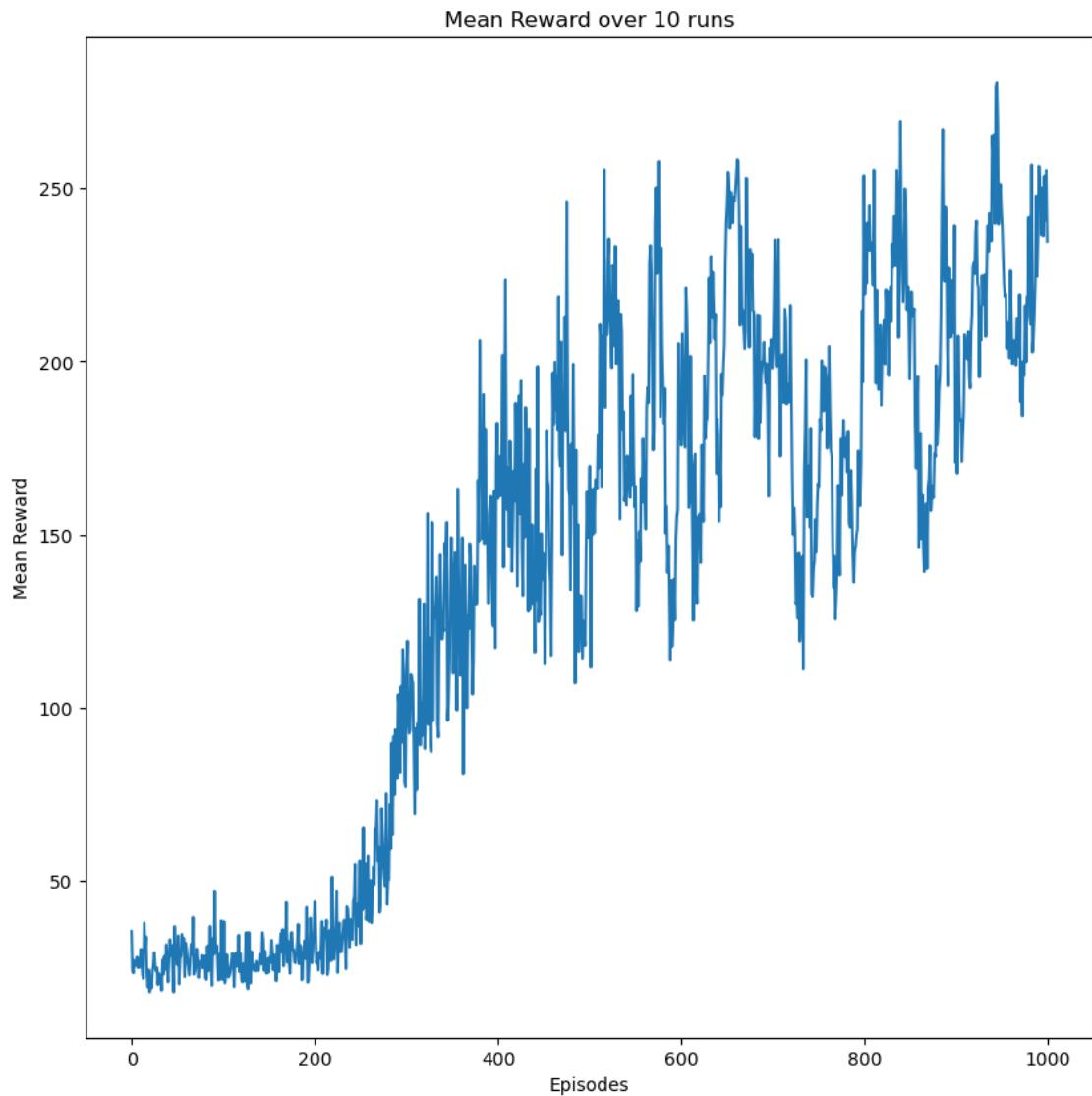
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Episode 700 Reward 159.000000 Average Reward 164.200000
Episode 710 Reward 175.000000 Average Reward 169.400000
Episode 720 Reward 204.000000 Average Reward 184.100000
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Episode 740 Reward 295.000000 Average Reward 380.200000
Episode 750 Reward 392.000000 Average Reward 348.400000
Episode 760 Reward 331.000000 Average Reward 454.100000
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Episode 780 Reward 148.000000 Average Reward 106.000000
Episode 790 Reward 14.000000 Average Reward 40.600000
Episode 800 Reward 12.000000 Average Reward 15.000000
Episode 810 Reward 151.000000 Average Reward 78.000000
Episode 820 Reward 138.000000 Average Reward 207.400000
Episode 830 Reward 147.000000 Average Reward 142.800000
Episode 840 Reward 131.000000 Average Reward 137.900000
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Episode 860 Reward 24.000000 Average Reward 130.800000
Episode 870 Reward 178.000000 Average Reward 162.600000
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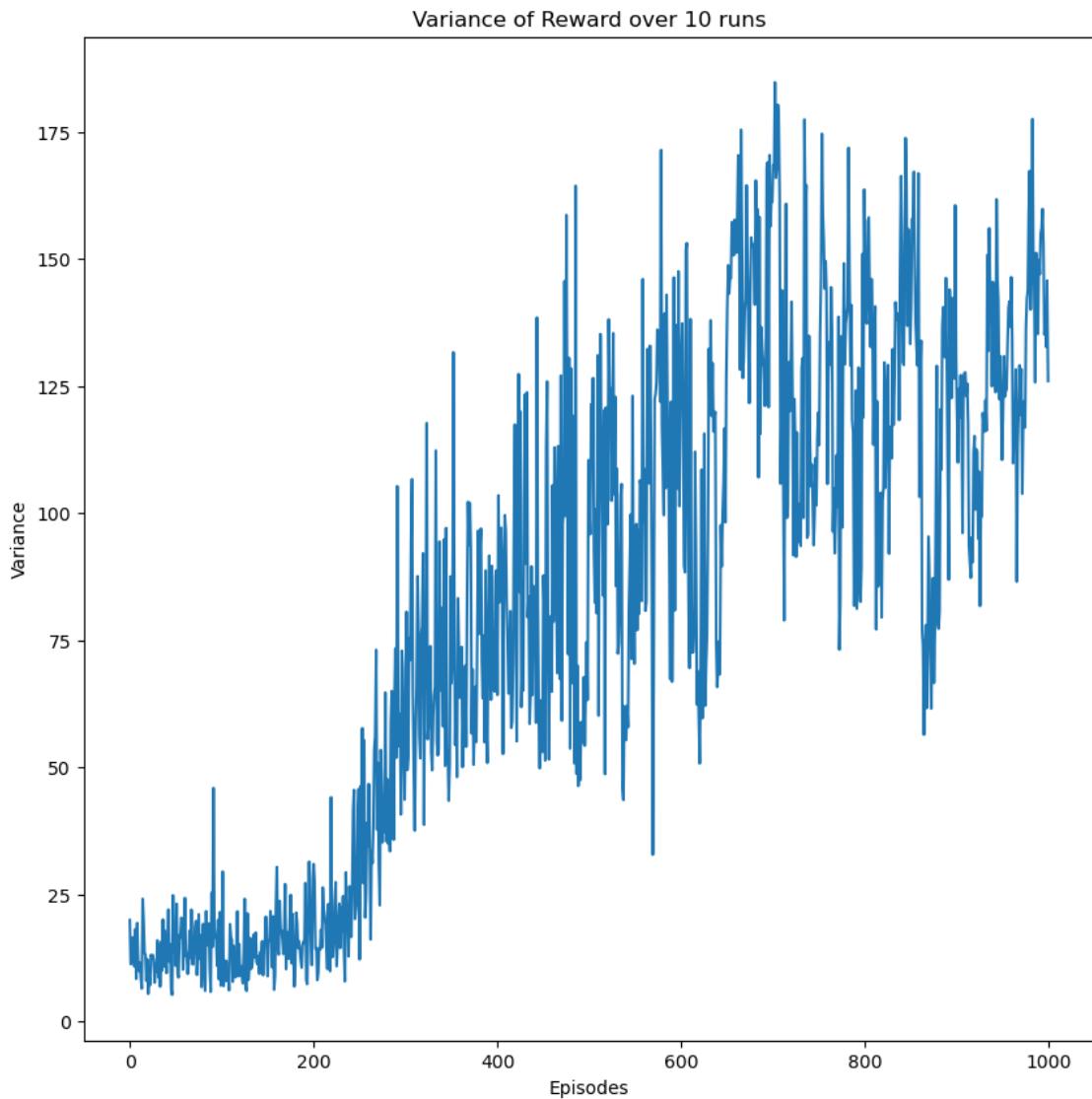
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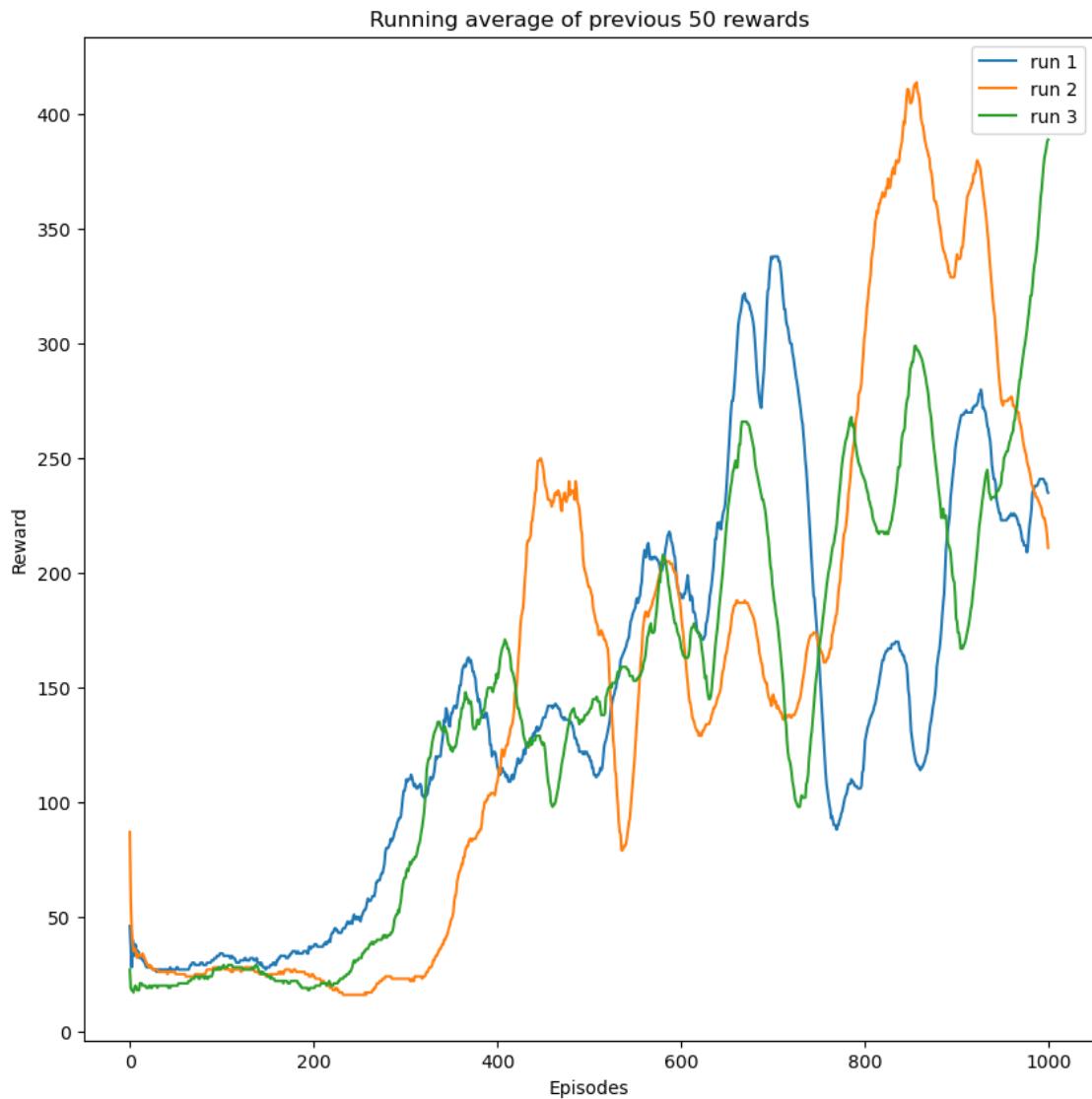
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Episode 230 Reward 19.000000 Average Reward 53.000000
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Episode 250 Reward 12.000000 Average Reward 29.100000
Episode 260 Reward 21.000000 Average Reward 32.400000
Episode 270 Reward 60.000000 Average Reward 48.100000
Episode 280 Reward 29.000000 Average Reward 68.300000
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Episode 300 Reward 148.000000 Average Reward 105.200000
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Episode 330 Reward 97.000000 Average Reward 83.700000
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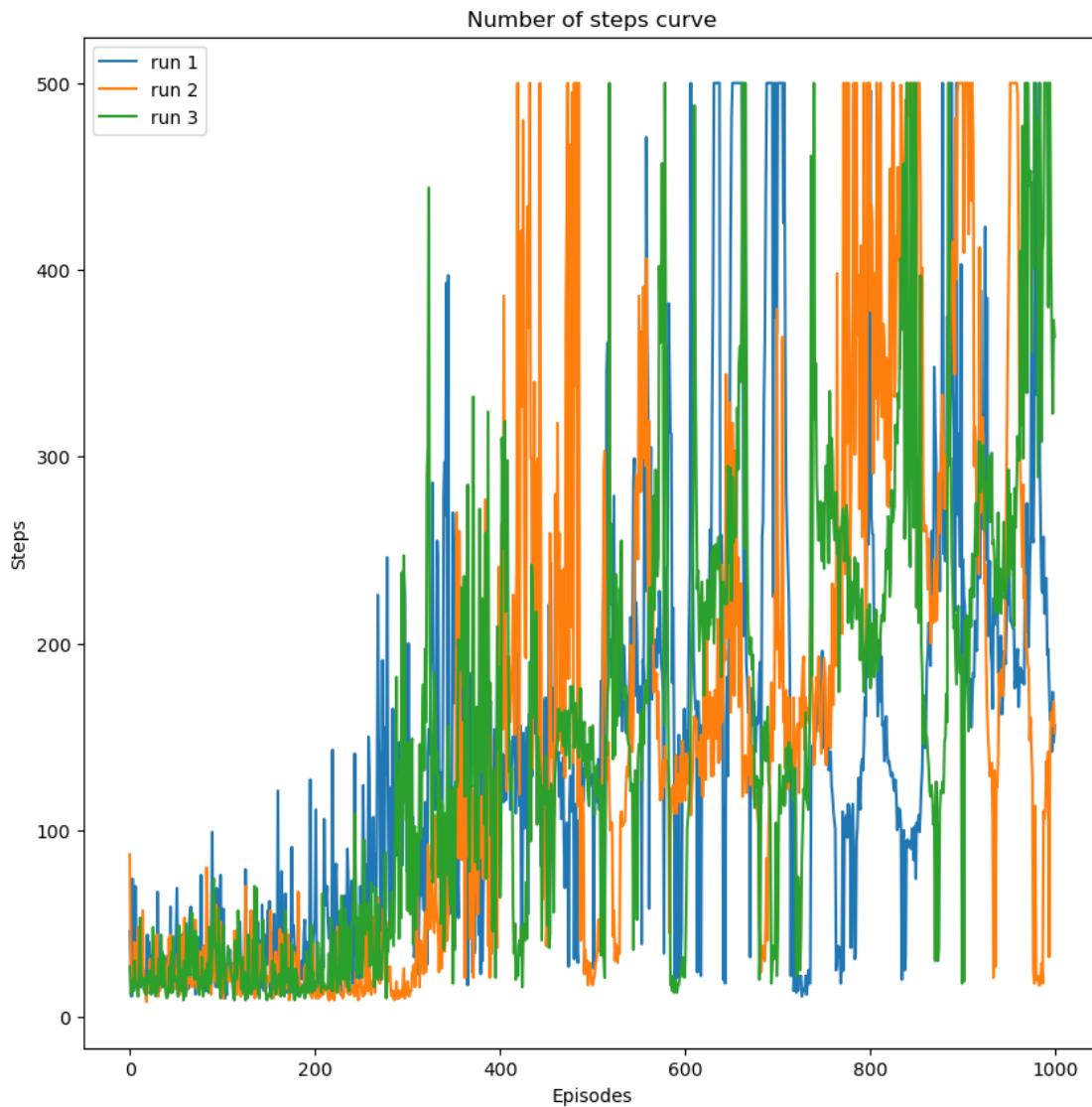
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Episode 970 Reward 8.000000 Average Reward 8.900000
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Episode 990 Reward 10.000000 Average Reward 9.300000
Episode 1000 Reward 10.000000 Average Reward 9.300000
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```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [1024, 1024]
LR = 2e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'CartPole-v1'
SOLVE_CUTOFF = 195.0
STEP = 5

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{hs}-{lr}-{env}-{numep}-{nstep}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	47.000000	43.000000
20	35.000000	29.200000
30	24.000000	24.500000
40	30.000000	28.200000
50	29.000000	44.700000
60	33.000000	32.600000
70	58.000000	37.700000
80	42.000000	47.700000
90	24.000000	40.100000
100	30.000000	44.700000
110	16.000000	42.100000
120	48.000000	37.200000
130	23.000000	41.300000
140	20.000000	22.900000
150	31.000000	24.500000
160	25.000000	36.500000
170	44.000000	38.400000
180	231.000000	92.800000
190	26.000000	117.100000
200	93.000000	57.000000
210	252.000000	110.000000
220	211.000000	165.200000
230	148.000000	244.000000
240	227.000000	127.800000
250	273.000000	387.000000
260	40.000000	198.800000
270	179.000000	246.000000
280	178.000000	89.500000

Episode 290 Reward 174.000000 Average Reward 340.500000
Episode 300 Reward 117.000000 Average Reward 119.200000
Episode 310 Reward 500.000000 Average Reward 235.500000
Episode 320 Reward 154.000000 Average Reward 220.200000
Episode 330 Reward 99.000000 Average Reward 111.800000
Episode 340 Reward 219.000000 Average Reward 159.500000
Episode 350 Reward 280.000000 Average Reward 279.600000
Episode 360 Reward 237.000000 Average Reward 317.200000
Episode 370 Reward 152.000000 Average Reward 215.800000
Episode 380 Reward 137.000000 Average Reward 123.700000
Episode 390 Reward 180.000000 Average Reward 143.200000
Episode 400 Reward 356.000000 Average Reward 269.600000
Episode 410 Reward 12.000000 Average Reward 173.800000
Episode 420 Reward 12.000000 Average Reward 11.700000
Episode 430 Reward 10.000000 Average Reward 9.700000
Episode 440 Reward 10.000000 Average Reward 9.600000
Episode 450 Reward 10.000000 Average Reward 9.600000
Episode 460 Reward 10.000000 Average Reward 9.100000
Episode 470 Reward 10.000000 Average Reward 9.600000
Episode 480 Reward 10.000000 Average Reward 8.800000
Episode 490 Reward 10.000000 Average Reward 9.600000
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Episode 570 Reward 10.000000 Average Reward 9.500000
Episode 580 Reward 10.000000 Average Reward 9.400000
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Episode 610 Reward 9.000000 Average Reward 9.300000
Episode 620 Reward 9.000000 Average Reward 9.100000
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Episode 640 Reward 9.000000 Average Reward 9.500000
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Episode 660 Reward 10.000000 Average Reward 9.400000
Episode 670 Reward 10.000000 Average Reward 9.700000
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Episode 720 Reward 9.000000 Average Reward 9.200000
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Episode 750 Reward 10.000000 Average Reward 9.200000
Episode 760 Reward 9.000000 Average Reward 9.300000

Episode 770 Reward 10.000000 Average Reward 9.600000
Episode 780 Reward 9.000000 Average Reward 9.600000
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Episode 800 Reward 9.000000 Average Reward 9.200000
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Episode 320 Reward 223.000000 Average Reward 244.200000
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Episode 740 Reward 151.000000 Average Reward 161.100000
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Episode 540 Reward 151.000000 Average Reward 168.900000
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Episode 560 Reward 225.000000 Average Reward 185.400000
Episode 570 Reward 241.000000 Average Reward 221.000000
Episode 580 Reward 227.000000 Average Reward 226.200000
Episode 590 Reward 184.000000 Average Reward 213.100000
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Episode 620 Reward 500.000000 Average Reward 343.000000
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Episode 640 Reward 394.000000 Average Reward 261.300000
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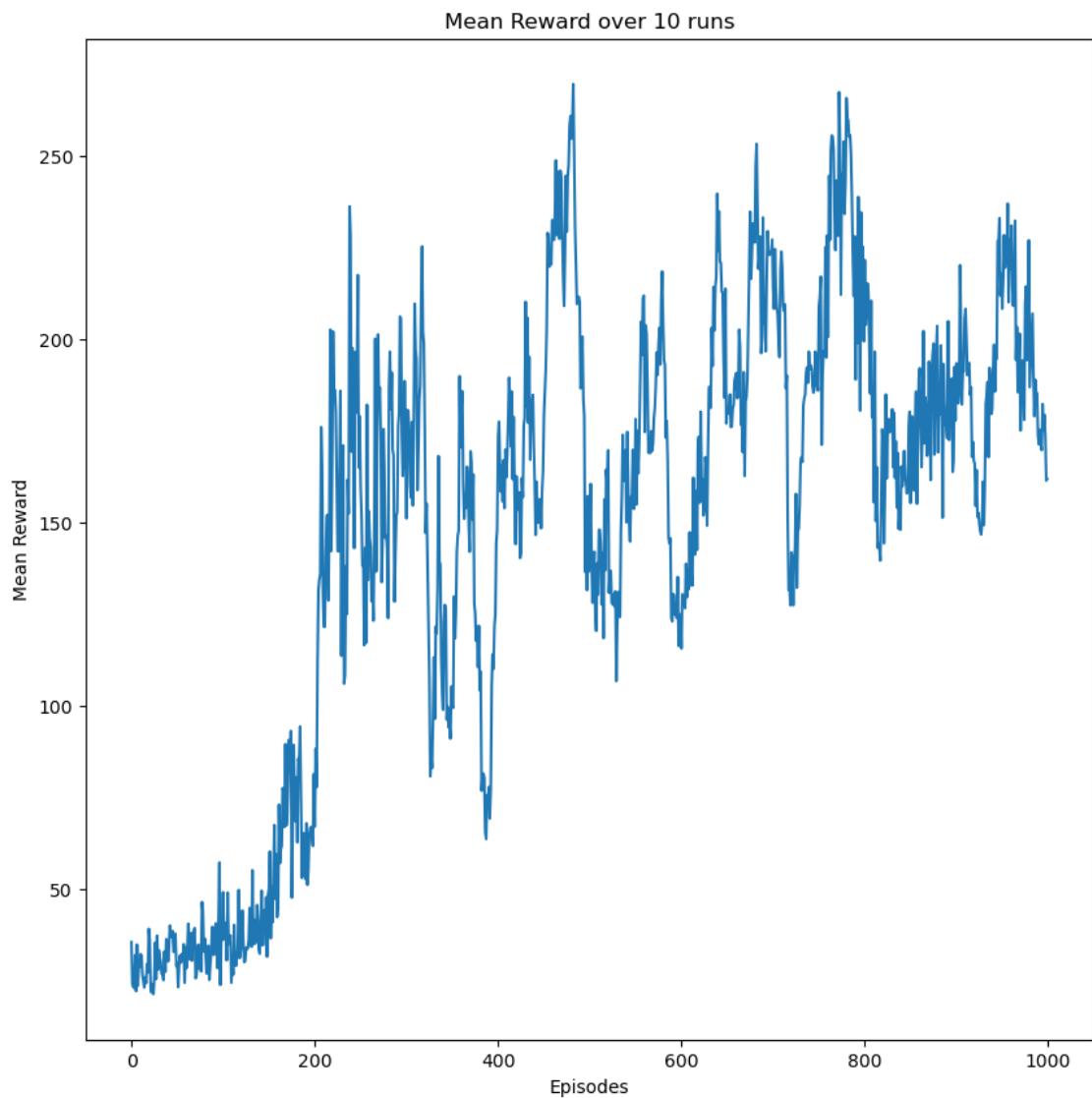
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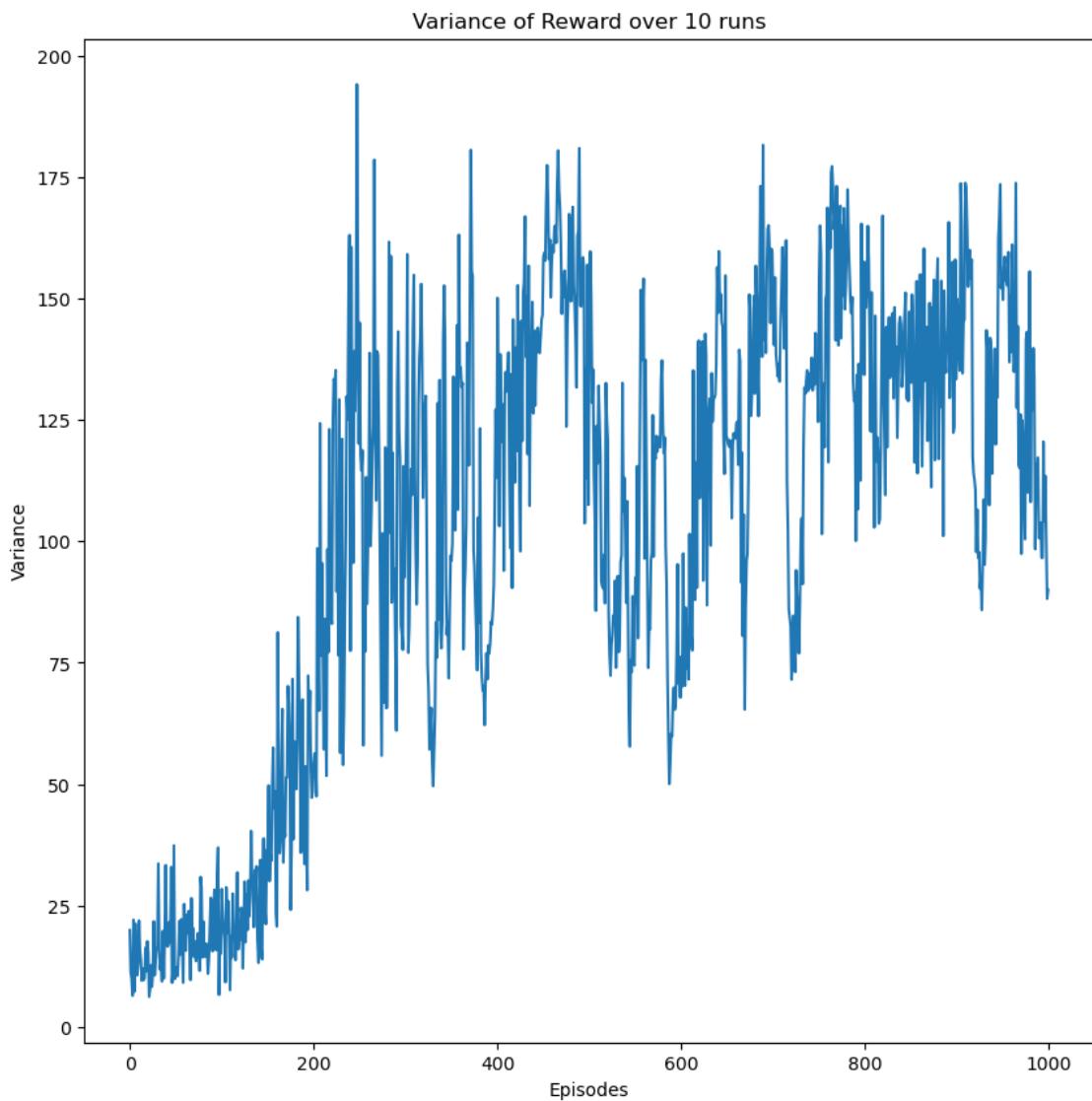
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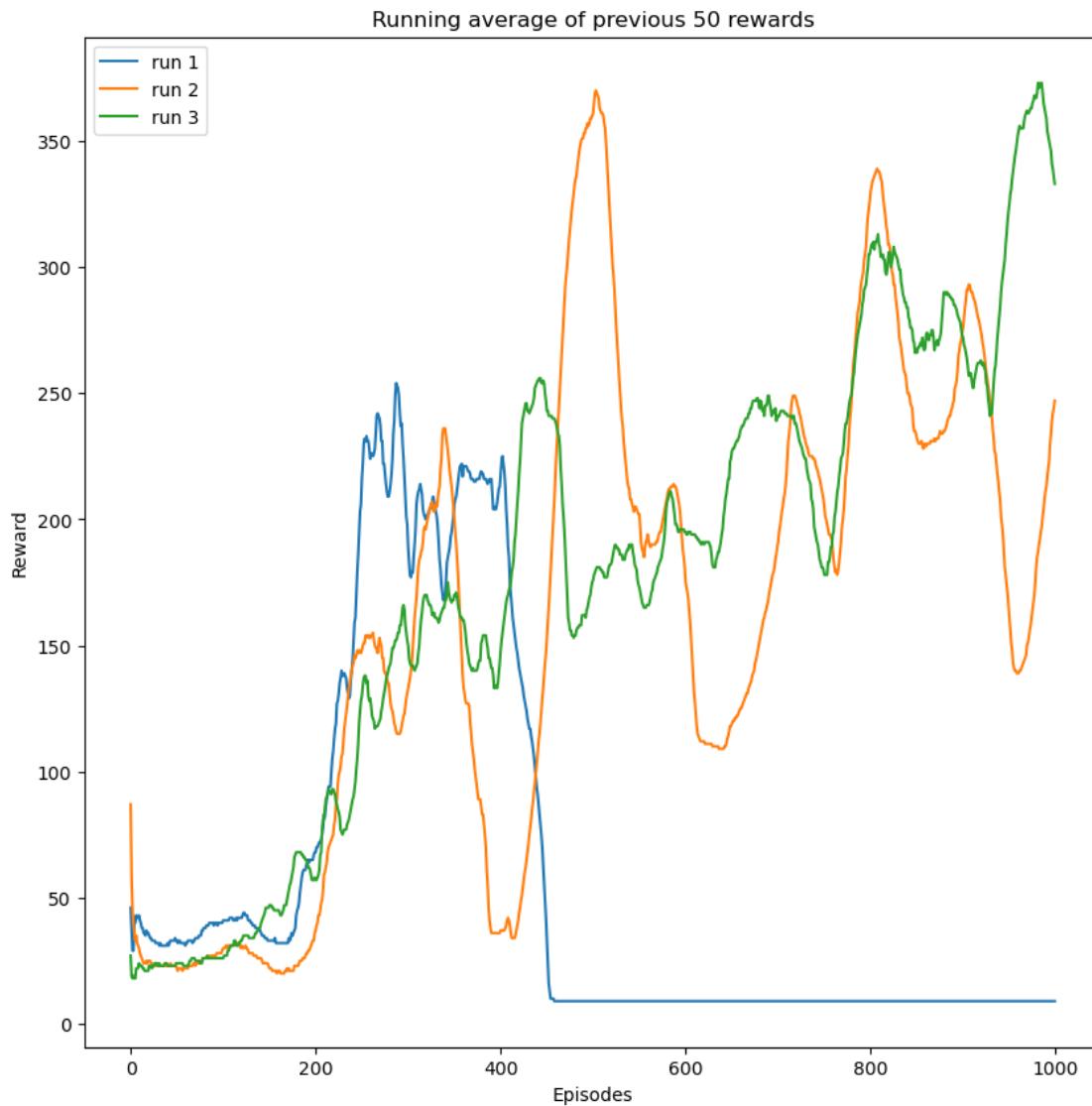
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Episode 230 Reward 144.000000 Average Reward 164.500000
Episode 240 Reward 456.000000 Average Reward 226.600000
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Episode 270 Reward 22.000000 Average Reward 19.400000
Episode 280 Reward 121.000000 Average Reward 65.500000
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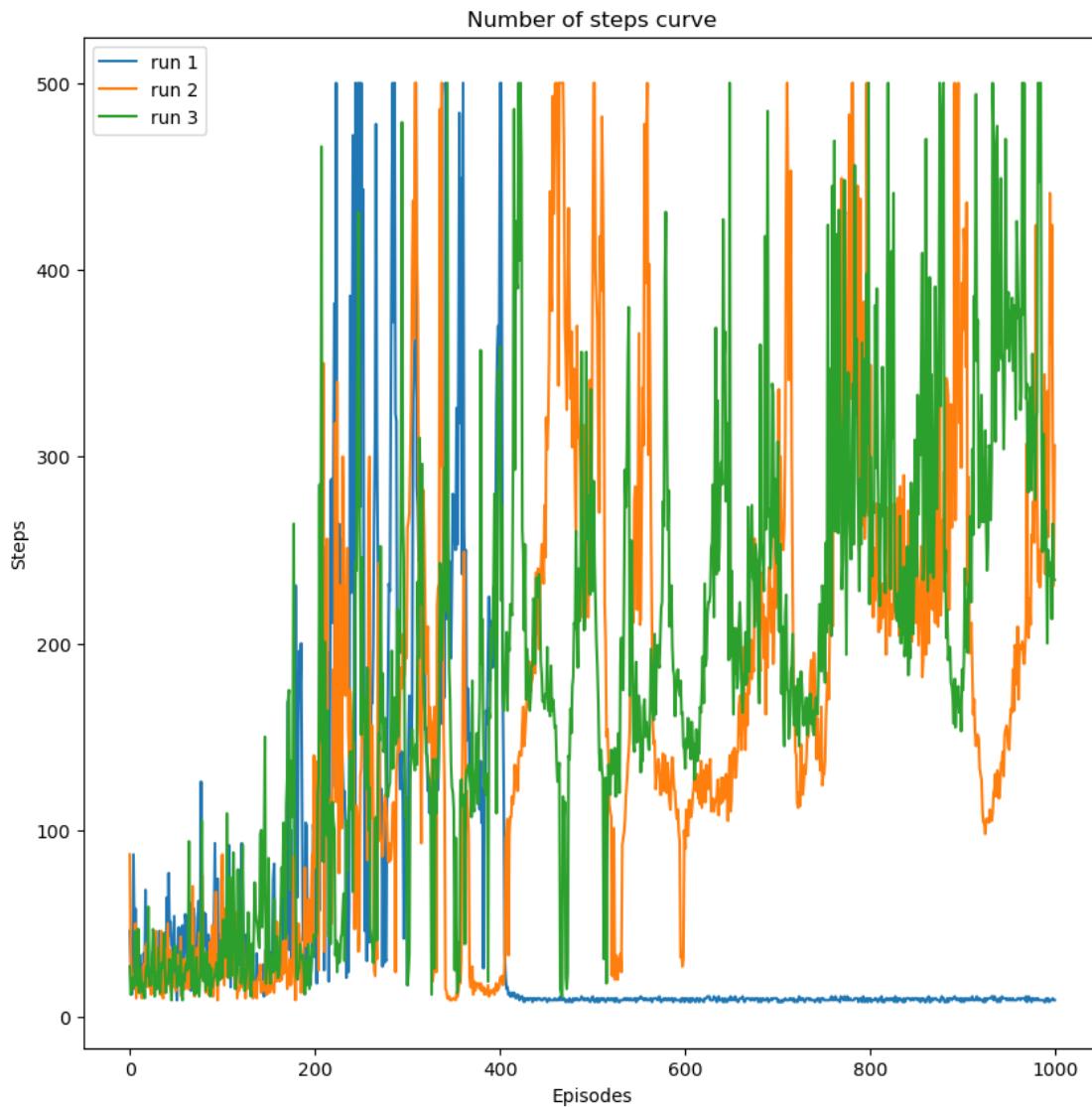
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Episode 400 Reward 188.000000 Average Reward 176.200000
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Episode 1000 Reward 203.000000 Average Reward 253.400000
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```
[ ]: NUM_HIDDEN = 3
HIDDEN_SIZES = [512, 1024, 512]
LR = 1e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'CartPole-v1'
SOLVE_CUTOFF = 195.0
STEP = 5

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{hs}-{lr}-{env}-{numep}-{nstep}-{STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	15.000000	28.800000
20	96.000000	35.300000
30	14.000000	25.900000
40	42.000000	26.100000
50	29.000000	34.300000
60	18.000000	25.100000
70	16.000000	19.900000
80	14.000000	24.800000
90	18.000000	29.400000
100	13.000000	27.400000
110	21.000000	30.600000
120	21.000000	18.000000
130	15.000000	24.200000
140	15.000000	29.100000
150	20.000000	25.400000
160	11.000000	19.500000
170	25.000000	24.200000
180	28.000000	29.100000
190	28.000000	25.000000
200	36.000000	27.400000
210	37.000000	38.100000
220	52.000000	34.400000
230	18.000000	61.400000
240	38.000000	64.100000
250	129.000000	94.900000
260	79.000000	59.400000
270	115.000000	135.400000
280	299.000000	167.100000

Episode 290 Reward 386.000000 Average Reward 319.800000
Episode 300 Reward 180.000000 Average Reward 112.000000
Episode 310 Reward 305.000000 Average Reward 203.200000
Episode 320 Reward 16.000000 Average Reward 88.400000
Episode 330 Reward 19.000000 Average Reward 15.300000
Episode 340 Reward 96.000000 Average Reward 32.600000
Episode 350 Reward 140.000000 Average Reward 100.500000
Episode 360 Reward 479.000000 Average Reward 239.100000
Episode 370 Reward 99.000000 Average Reward 350.000000
Episode 380 Reward 19.000000 Average Reward 15.800000
Episode 390 Reward 47.000000 Average Reward 31.800000
Episode 400 Reward 127.000000 Average Reward 159.500000
Episode 410 Reward 22.000000 Average Reward 63.500000
Episode 420 Reward 23.000000 Average Reward 29.500000
Episode 430 Reward 16.000000 Average Reward 17.100000
Episode 440 Reward 18.000000 Average Reward 18.200000
Episode 450 Reward 23.000000 Average Reward 19.500000
Episode 460 Reward 159.000000 Average Reward 124.400000
Episode 470 Reward 184.000000 Average Reward 178.300000
Episode 480 Reward 195.000000 Average Reward 186.700000
Episode 490 Reward 278.000000 Average Reward 229.100000
Episode 500 Reward 337.000000 Average Reward 319.700000
Episode 510 Reward 269.000000 Average Reward 323.000000
Episode 520 Reward 215.000000 Average Reward 303.200000
Episode 530 Reward 29.000000 Average Reward 130.400000
Episode 540 Reward 103.000000 Average Reward 83.100000
Episode 550 Reward 337.000000 Average Reward 180.400000
Episode 560 Reward 29.000000 Average Reward 84.500000
Episode 570 Reward 301.000000 Average Reward 138.800000
Episode 580 Reward 146.000000 Average Reward 186.600000
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Episode 610 Reward 177.000000 Average Reward 162.200000
Episode 620 Reward 171.000000 Average Reward 178.200000
Episode 630 Reward 182.000000 Average Reward 189.000000
Episode 640 Reward 194.000000 Average Reward 205.500000
Episode 650 Reward 237.000000 Average Reward 221.900000
Episode 660 Reward 272.000000 Average Reward 253.300000
Episode 670 Reward 301.000000 Average Reward 270.500000
Episode 680 Reward 352.000000 Average Reward 332.400000
Episode 690 Reward 500.000000 Average Reward 430.300000
Episode 700 Reward 18.000000 Average Reward 227.100000
Episode 710 Reward 121.000000 Average Reward 106.500000
Episode 720 Reward 191.000000 Average Reward 139.300000
Episode 730 Reward 380.000000 Average Reward 351.600000
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Episode 760 Reward 206.000000 Average Reward 219.000000

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Episode 270 Reward 107.000000 Average Reward 101.100000
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Episode 290 Reward 285.000000 Average Reward 276.300000
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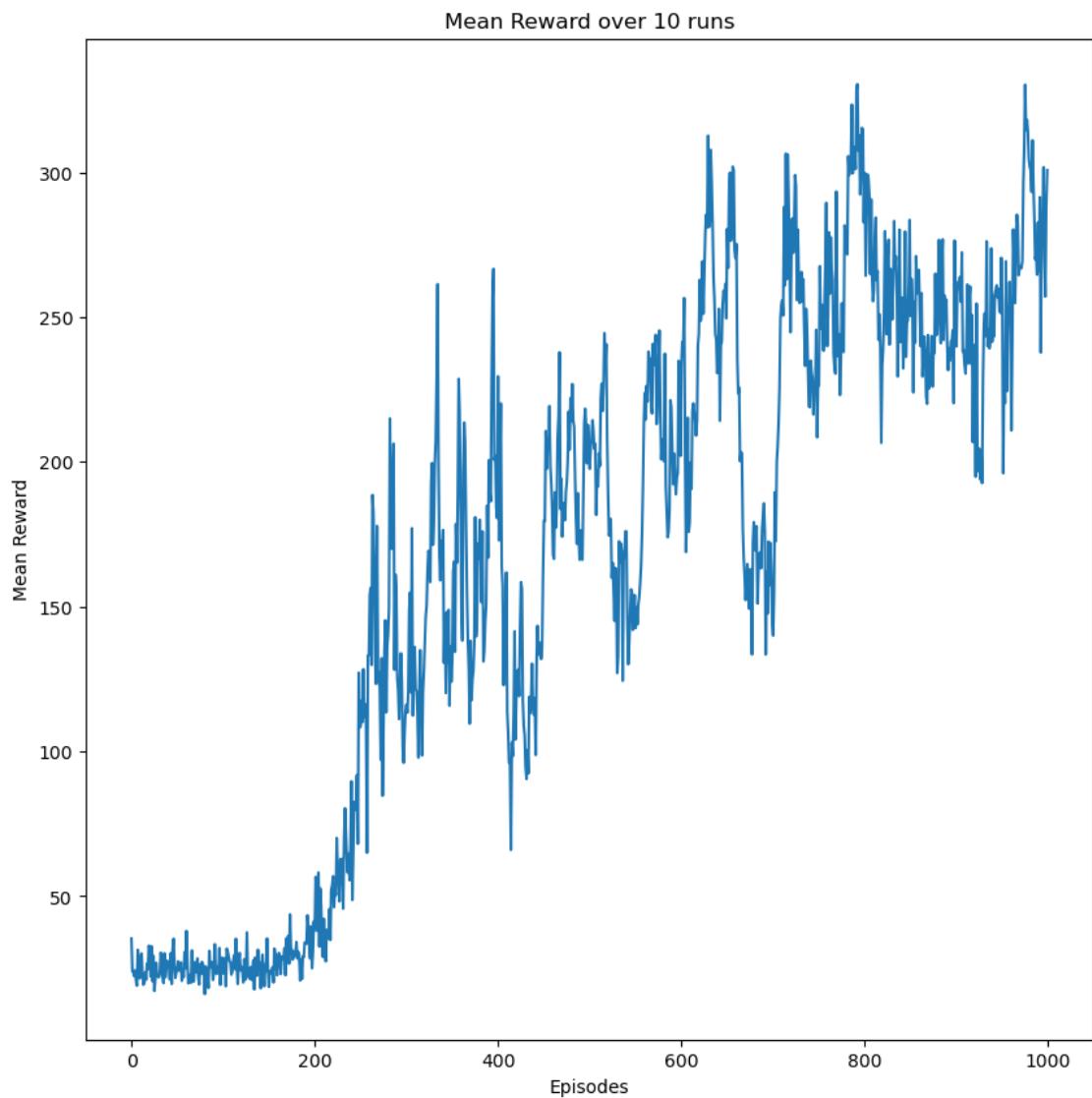
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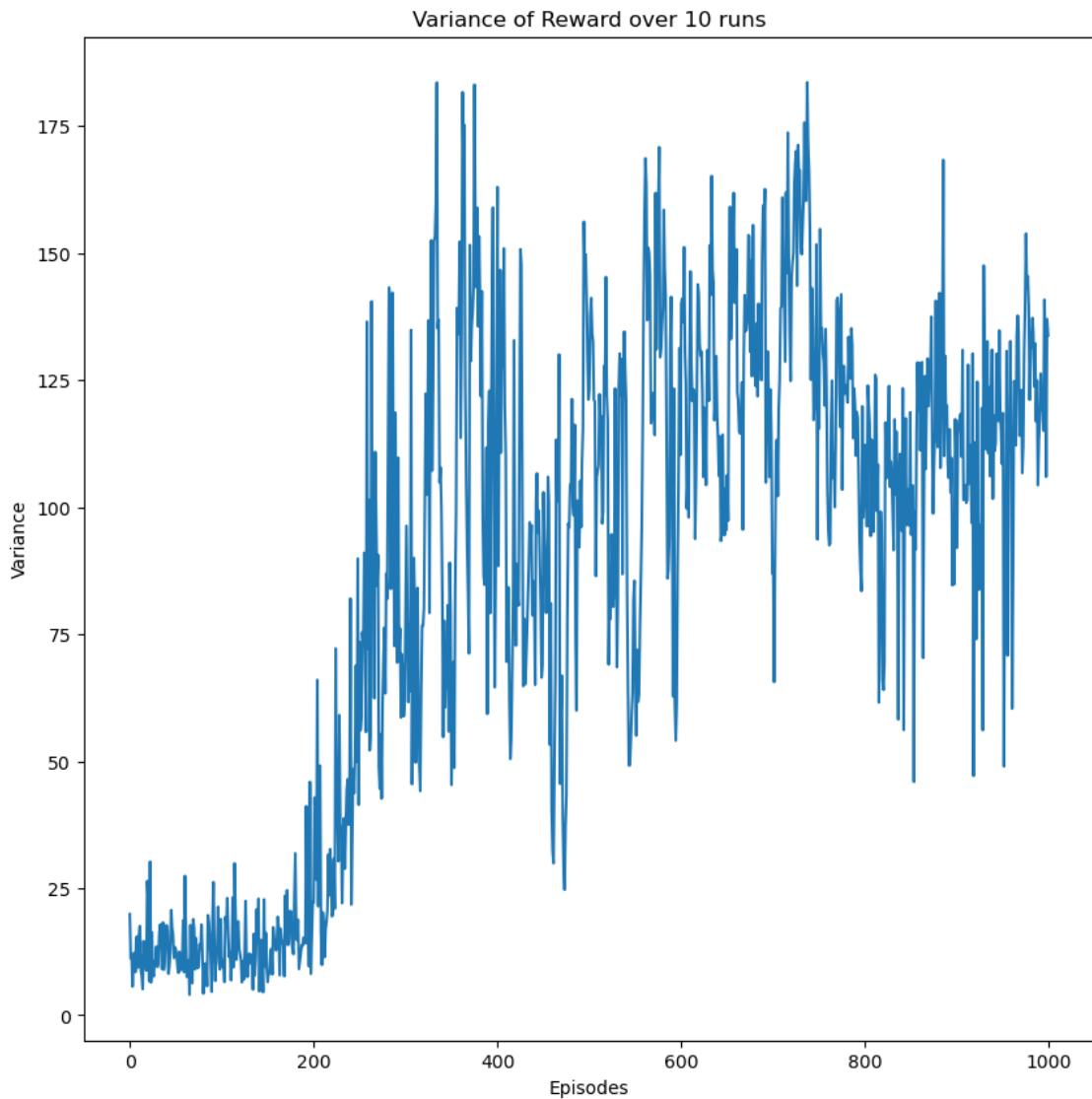
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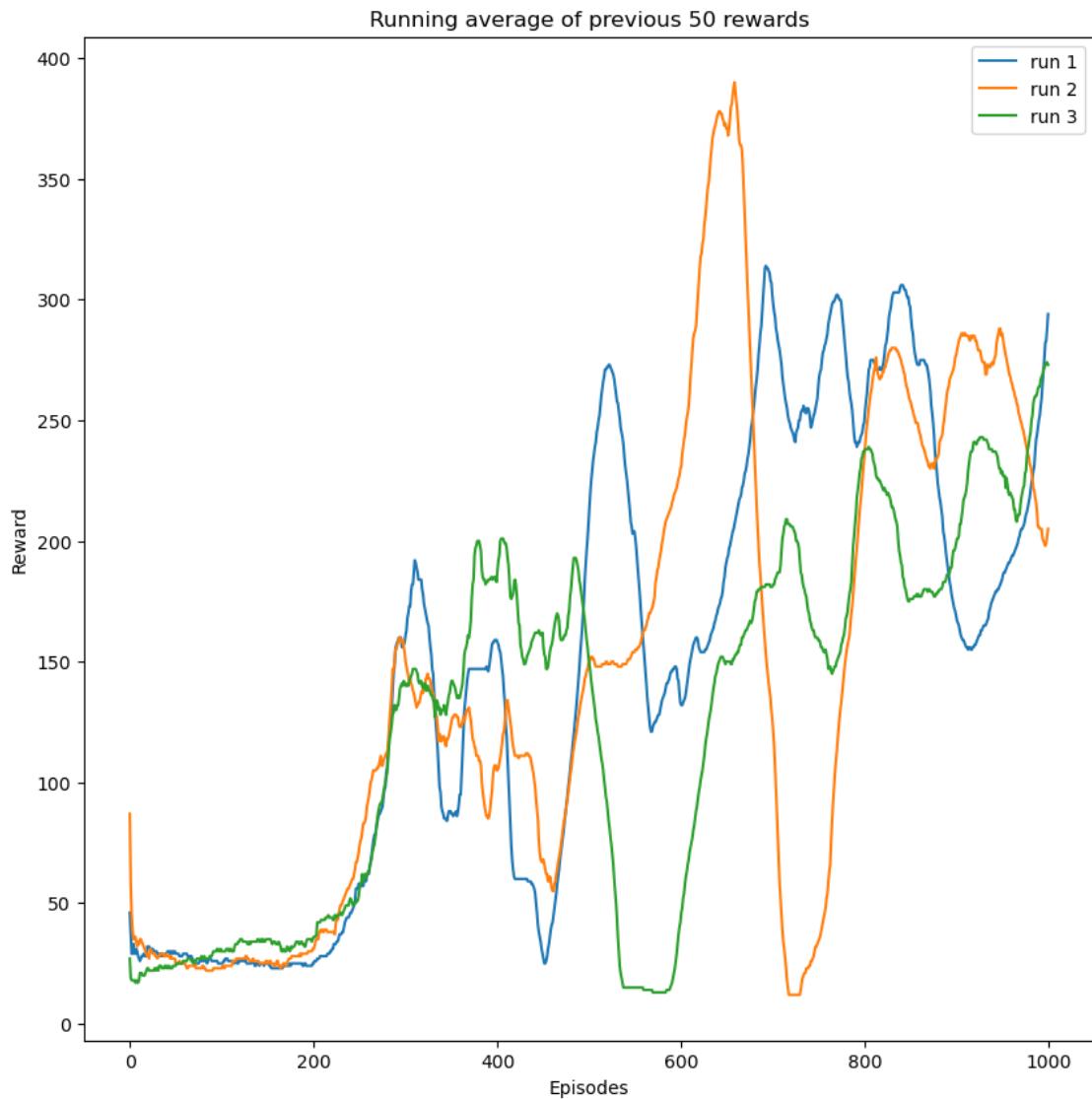
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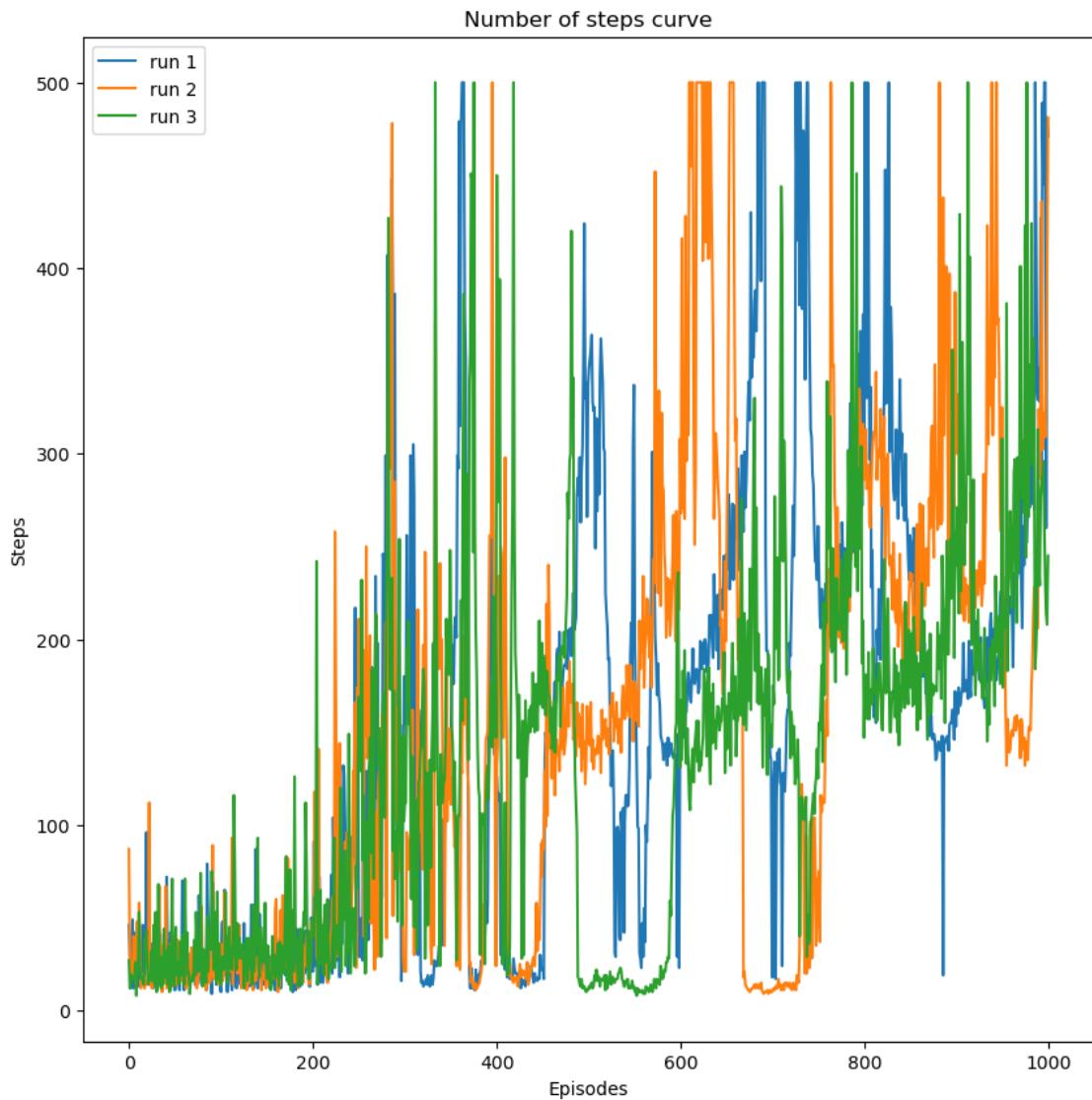
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Acrobot

```
[ ]: NUM_HIDDEN = 1
HIDDEN_SIZES = [1024]
LR = 1e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'Acrobot-v1'
SOLVE_CUTOFF = -100.0
STEP = 5

ENV = gym.make(ENV_NAME)
```

```

mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname =
    f'hl={NUM_HIDDEN}_hs={HIDDEN_SIZES}_lr={LR}_env={ENV_NAME}_numep={NUM_EPISODES}_nstep={STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed) instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	-500.000000	-495.800000
20	-500.000000	-451.900000
30	-283.000000	-335.300000
40	-500.000000	-412.700000
50	-300.000000	-405.500000
60	-500.000000	-436.500000
70	-500.000000	-459.300000
80	-321.000000	-416.100000
90	-500.000000	-448.700000
100	-500.000000	-455.300000
110	-500.000000	-500.000000
120	-393.000000	-460.600000
130	-419.000000	-450.100000
140	-487.000000	-462.300000
150	-500.000000	-487.400000
160	-473.000000	-457.400000
170	-500.000000	-500.000000
180	-500.000000	-481.100000
190	-500.000000	-477.900000
200	-500.000000	-490.200000
210	-500.000000	-485.000000
220	-500.000000	-471.900000
230	-500.000000	-457.800000
240	-500.000000	-425.100000
250	-368.000000	-455.300000

Episode	260	Reward	-500.000000	Average Reward	-417.800000
Episode	270	Reward	-481.000000	Average Reward	-437.900000
Episode	280	Reward	-385.000000	Average Reward	-461.400000
Episode	290	Reward	-492.000000	Average Reward	-449.200000
Episode	300	Reward	-500.000000	Average Reward	-453.400000
Episode	310	Reward	-261.000000	Average Reward	-342.000000
Episode	320	Reward	-311.000000	Average Reward	-415.900000
Episode	330	Reward	-391.000000	Average Reward	-384.500000
Episode	340	Reward	-273.000000	Average Reward	-414.000000
Episode	350	Reward	-430.000000	Average Reward	-406.600000
Episode	360	Reward	-379.000000	Average Reward	-383.200000
Episode	370	Reward	-437.000000	Average Reward	-350.100000
Episode	380	Reward	-430.000000	Average Reward	-315.300000
Episode	390	Reward	-398.000000	Average Reward	-377.600000
Episode	400	Reward	-339.000000	Average Reward	-364.600000
Episode	410	Reward	-269.000000	Average Reward	-283.400000
Episode	420	Reward	-329.000000	Average Reward	-313.000000
Episode	430	Reward	-333.000000	Average Reward	-304.900000
Episode	440	Reward	-388.000000	Average Reward	-314.100000
Episode	450	Reward	-320.000000	Average Reward	-324.400000
Episode	460	Reward	-364.000000	Average Reward	-305.500000
Episode	470	Reward	-205.000000	Average Reward	-288.500000
Episode	480	Reward	-228.000000	Average Reward	-302.900000
Episode	490	Reward	-440.000000	Average Reward	-354.100000
Episode	500	Reward	-350.000000	Average Reward	-244.100000
Episode	510	Reward	-289.000000	Average Reward	-280.300000
Episode	520	Reward	-309.000000	Average Reward	-327.400000
Episode	530	Reward	-272.000000	Average Reward	-261.900000
Episode	540	Reward	-500.000000	Average Reward	-329.400000
Episode	550	Reward	-257.000000	Average Reward	-256.600000
Episode	560	Reward	-170.000000	Average Reward	-290.500000
Episode	570	Reward	-245.000000	Average Reward	-286.400000
Episode	580	Reward	-297.000000	Average Reward	-300.500000
Episode	590	Reward	-408.000000	Average Reward	-363.900000
Episode	600	Reward	-243.000000	Average Reward	-262.500000
Episode	610	Reward	-272.000000	Average Reward	-309.200000
Episode	620	Reward	-214.000000	Average Reward	-296.100000
Episode	630	Reward	-220.000000	Average Reward	-285.000000
Episode	640	Reward	-457.000000	Average Reward	-272.300000
Episode	650	Reward	-278.000000	Average Reward	-247.100000
Episode	660	Reward	-383.000000	Average Reward	-225.500000
Episode	670	Reward	-256.000000	Average Reward	-230.200000
Episode	680	Reward	-281.000000	Average Reward	-240.700000
Episode	690	Reward	-330.000000	Average Reward	-235.700000
Episode	700	Reward	-213.000000	Average Reward	-297.300000
Episode	710	Reward	-366.000000	Average Reward	-329.900000
Episode	720	Reward	-473.000000	Average Reward	-292.600000
Episode	730	Reward	-261.000000	Average Reward	-257.100000

Episode 740 Reward -185.000000 Average Reward -262.200000
Episode 750 Reward -230.000000 Average Reward -249.600000
Episode 760 Reward -170.000000 Average Reward -254.900000
Episode 770 Reward -158.000000 Average Reward -237.200000
Episode 780 Reward -301.000000 Average Reward -253.000000
Episode 790 Reward -201.000000 Average Reward -210.900000
Episode 800 Reward -210.000000 Average Reward -258.500000
Episode 810 Reward -196.000000 Average Reward -208.400000
Episode 820 Reward -219.000000 Average Reward -250.500000
Episode 830 Reward -196.000000 Average Reward -219.800000
Episode 840 Reward -210.000000 Average Reward -253.900000
Episode 850 Reward -175.000000 Average Reward -226.200000
Episode 860 Reward -261.000000 Average Reward -255.400000
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Episode 880 Reward -334.000000 Average Reward -243.000000
Episode 890 Reward -166.000000 Average Reward -236.700000
Episode 900 Reward -355.000000 Average Reward -237.300000
Episode 910 Reward -342.000000 Average Reward -269.600000
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Episode 930 Reward -258.000000 Average Reward -231.600000
Episode 940 Reward -195.000000 Average Reward -208.000000
Episode 950 Reward -207.000000 Average Reward -189.400000
Episode 960 Reward -221.000000 Average Reward -213.000000
Episode 970 Reward -167.000000 Average Reward -193.100000
Episode 980 Reward -168.000000 Average Reward -185.900000
Episode 990 Reward -135.000000 Average Reward -188.000000
Episode 1000 Reward -219.000000 Average Reward -238.200000

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Episode 10 Reward -500.000000 Average Reward -479.200000
Episode 20 Reward -275.000000 Average Reward -454.600000
Episode 30 Reward -500.000000 Average Reward -471.600000
Episode 40 Reward -500.000000 Average Reward -468.600000
Episode 50 Reward -463.000000 Average Reward -478.400000
Episode 60 Reward -409.000000 Average Reward -440.500000
Episode 70 Reward -500.000000 Average Reward -475.000000
Episode 80 Reward -500.000000 Average Reward -453.300000
Episode 90 Reward -463.000000 Average Reward -400.500000
Episode 100 Reward -477.000000 Average Reward -449.900000
Episode 110 Reward -400.000000 Average Reward -429.800000
Episode 120 Reward -500.000000 Average Reward -479.700000
Episode 130 Reward -500.000000 Average Reward -497.800000
Episode 140 Reward -500.000000 Average Reward -493.200000
Episode 150 Reward -500.000000 Average Reward -500.000000
Episode 160 Reward -500.000000 Average Reward -497.700000
Episode 170 Reward -500.000000 Average Reward -494.400000
Episode 180 Reward -500.000000 Average Reward -500.000000
Episode 190 Reward -500.000000 Average Reward -495.400000
Episode 200 Reward -432.000000 Average Reward -465.100000

Episode	210	Reward	-454.000000	Average Reward	-486.000000
Episode	220	Reward	-500.000000	Average Reward	-494.500000
Episode	230	Reward	-268.000000	Average Reward	-440.500000
Episode	240	Reward	-488.000000	Average Reward	-420.600000
Episode	250	Reward	-270.000000	Average Reward	-385.600000
Episode	260	Reward	-500.000000	Average Reward	-411.200000
Episode	270	Reward	-428.000000	Average Reward	-438.000000
Episode	280	Reward	-246.000000	Average Reward	-399.900000
Episode	290	Reward	-490.000000	Average Reward	-383.300000
Episode	300	Reward	-228.000000	Average Reward	-418.800000
Episode	310	Reward	-356.000000	Average Reward	-400.800000
Episode	320	Reward	-417.000000	Average Reward	-427.800000
Episode	330	Reward	-420.000000	Average Reward	-332.000000
Episode	340	Reward	-369.000000	Average Reward	-370.200000
Episode	350	Reward	-273.000000	Average Reward	-341.400000
Episode	360	Reward	-259.000000	Average Reward	-368.900000
Episode	370	Reward	-307.000000	Average Reward	-328.500000
Episode	380	Reward	-269.000000	Average Reward	-321.400000
Episode	390	Reward	-452.000000	Average Reward	-310.900000
Episode	400	Reward	-353.000000	Average Reward	-317.100000
Episode	410	Reward	-259.000000	Average Reward	-317.600000
Episode	420	Reward	-256.000000	Average Reward	-334.500000
Episode	430	Reward	-314.000000	Average Reward	-283.500000
Episode	440	Reward	-327.000000	Average Reward	-283.700000
Episode	450	Reward	-257.000000	Average Reward	-324.600000
Episode	460	Reward	-316.000000	Average Reward	-283.500000
Episode	470	Reward	-268.000000	Average Reward	-261.600000
Episode	480	Reward	-314.000000	Average Reward	-280.100000
Episode	490	Reward	-293.000000	Average Reward	-257.800000
Episode	500	Reward	-241.000000	Average Reward	-275.400000
Episode	510	Reward	-301.000000	Average Reward	-245.500000
Episode	520	Reward	-250.000000	Average Reward	-283.600000
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Episode	540	Reward	-257.000000	Average Reward	-252.400000
Episode	550	Reward	-264.000000	Average Reward	-279.700000
Episode	560	Reward	-244.000000	Average Reward	-239.900000
Episode	570	Reward	-196.000000	Average Reward	-252.000000
Episode	580	Reward	-237.000000	Average Reward	-248.700000
Episode	590	Reward	-182.000000	Average Reward	-234.700000
Episode	600	Reward	-236.000000	Average Reward	-262.100000
Episode	610	Reward	-272.000000	Average Reward	-230.000000
Episode	620	Reward	-181.000000	Average Reward	-243.200000
Episode	630	Reward	-131.000000	Average Reward	-215.800000
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Episode	650	Reward	-203.000000	Average Reward	-214.200000
Episode	660	Reward	-270.000000	Average Reward	-220.000000
Episode	670	Reward	-240.000000	Average Reward	-204.000000
Episode	680	Reward	-143.000000	Average Reward	-203.000000

Episode 690 Reward -273.000000 Average Reward -218.300000
Episode 700 Reward -134.000000 Average Reward -201.200000
Episode 710 Reward -216.000000 Average Reward -188.000000
Episode 720 Reward -196.000000 Average Reward -202.600000
Episode 730 Reward -119.000000 Average Reward -192.500000
Episode 740 Reward -228.000000 Average Reward -221.800000
Episode 750 Reward -232.000000 Average Reward -244.000000
Episode 760 Reward -212.000000 Average Reward -213.800000
Episode 770 Reward -158.000000 Average Reward -200.600000
Episode 780 Reward -210.000000 Average Reward -194.300000
Episode 790 Reward -205.000000 Average Reward -218.000000
Episode 800 Reward -245.000000 Average Reward -188.800000
Episode 810 Reward -112.000000 Average Reward -232.900000
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Episode 850 Reward -172.000000 Average Reward -179.300000
Episode 860 Reward -202.000000 Average Reward -182.900000
Episode 870 Reward -133.000000 Average Reward -166.800000
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Episode 900 Reward -176.000000 Average Reward -197.700000
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Episode 30 Reward -451.000000 Average Reward -485.200000
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Episode 50 Reward -500.000000 Average Reward -444.300000
Episode 60 Reward -500.000000 Average Reward -500.000000
Episode 70 Reward -500.000000 Average Reward -467.600000
Episode 80 Reward -500.000000 Average Reward -447.500000
Episode 90 Reward -356.000000 Average Reward -469.900000
Episode 100 Reward -389.000000 Average Reward -422.500000
Episode 110 Reward -500.000000 Average Reward -449.400000
Episode 120 Reward -500.000000 Average Reward -479.300000
Episode 130 Reward -306.000000 Average Reward -457.300000
Episode 140 Reward -500.000000 Average Reward -476.900000
Episode 150 Reward -500.000000 Average Reward -500.000000

Episode 640 Reward -500.000000 Average Reward -500.000000
Episode 650 Reward -500.000000 Average Reward -500.000000
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Episode 670 Reward -500.000000 Average Reward -500.000000
Episode 680 Reward -500.000000 Average Reward -496.900000
Episode 690 Reward -500.000000 Average Reward -500.000000
Episode 700 Reward -500.000000 Average Reward -481.300000
Episode 710 Reward -500.000000 Average Reward -500.000000
Episode 720 Reward -500.000000 Average Reward -500.000000
Episode 730 Reward -500.000000 Average Reward -500.000000
Episode 740 Reward -500.000000 Average Reward -500.000000
Episode 750 Reward -500.000000 Average Reward -500.000000
Episode 760 Reward -458.000000 Average Reward -495.800000
Episode 770 Reward -500.000000 Average Reward -500.000000
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Episode 810 Reward -485.000000 Average Reward -488.400000
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Episode 100 Reward -500.000000 Average Reward -500.000000

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Episode 120 Reward -448.000000 Average Reward -494.800000
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Episode 150 Reward -500.000000 Average Reward -481.700000
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Episode 260 Reward -500.000000 Average Reward -459.200000
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Episode 390 Reward -500.000000 Average Reward -416.400000
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Episode 410 Reward -500.000000 Average Reward -484.800000
Episode 420 Reward -500.000000 Average Reward -424.400000
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Episode 540 Reward -450.000000 Average Reward -411.800000
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Episode 570 Reward -355.000000 Average Reward -355.200000
Episode 580 Reward -500.000000 Average Reward -448.600000

Episode 590 Reward -275.000000 Average Reward -412.100000
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Episode 650 Reward -500.000000 Average Reward -412.800000
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Episode 670 Reward -235.000000 Average Reward -385.300000
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Episode 950 Reward -281.000000 Average Reward -227.000000
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Episode 100 Reward -366.000000 Average Reward -474.200000
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Episode 190 Reward -352.000000 Average Reward -474.200000
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Episode 260 Reward -500.000000 Average Reward -488.200000
Episode 270 Reward -361.000000 Average Reward -436.600000
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Episode 300 Reward -500.000000 Average Reward -481.100000
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Episode 460 Reward -500.000000 Average Reward -492.500000
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Episode 480 Reward -500.000000 Average Reward -500.000000
Episode 490 Reward -500.000000 Average Reward -500.000000
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Episode 520 Reward -500.000000 Average Reward -500.000000
Episode 530 Reward -500.000000 Average Reward -500.000000

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Episode 80 Reward -500.000000 Average Reward -481.500000
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Episode 120 Reward -329.000000 Average Reward -470.700000
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Episode 140 Reward -500.000000 Average Reward -500.000000
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Episode 170 Reward -500.000000 Average Reward -500.000000
Episode 180 Reward -500.000000 Average Reward -490.600000
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Episode 470 Reward -500.000000 Average Reward -405.800000
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Episode 490 Reward -309.000000 Average Reward -394.800000
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Episode 560 Reward -362.000000 Average Reward -322.800000
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Episode 580 Reward -290.000000 Average Reward -337.800000
Episode 590 Reward -250.000000 Average Reward -372.000000
Episode 600 Reward -264.000000 Average Reward -284.500000
Episode 610 Reward -334.000000 Average Reward -305.500000
Episode 620 Reward -382.000000 Average Reward -389.000000
Episode 630 Reward -334.000000 Average Reward -291.000000
Episode 640 Reward -323.000000 Average Reward -368.400000
Episode 650 Reward -372.000000 Average Reward -365.500000
Episode 660 Reward -464.000000 Average Reward -385.300000
Episode 670 Reward -470.000000 Average Reward -484.600000
Episode 680 Reward -387.000000 Average Reward -448.600000
Episode 690 Reward -500.000000 Average Reward -442.100000
Episode 700 Reward -365.000000 Average Reward -439.800000
Episode 710 Reward -311.000000 Average Reward -359.600000
Episode 720 Reward -495.000000 Average Reward -411.000000
Episode 730 Reward -253.000000 Average Reward -384.900000
Episode 740 Reward -269.000000 Average Reward -408.500000
Episode 750 Reward -362.000000 Average Reward -412.300000
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Episode 770 Reward -287.000000 Average Reward -426.400000
Episode 780 Reward -318.000000 Average Reward -456.100000
Episode 790 Reward -500.000000 Average Reward -442.600000
Episode 800 Reward -286.000000 Average Reward -429.800000
Episode 810 Reward -447.000000 Average Reward -392.500000
Episode 820 Reward -276.000000 Average Reward -359.700000
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Episode 950 Reward -386.000000 Average Reward -310.900000
Episode 960 Reward -217.000000 Average Reward -315.300000

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Episode 330 Reward -500.000000 Average Reward -421.200000
Episode 340 Reward -500.000000 Average Reward -415.400000
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Episode 390 Reward -337.000000 Average Reward -369.800000
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Episode 480 Reward -439.000000 Average Reward -332.900000
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Episode 290 Reward -316.000000 Average Reward -297.300000
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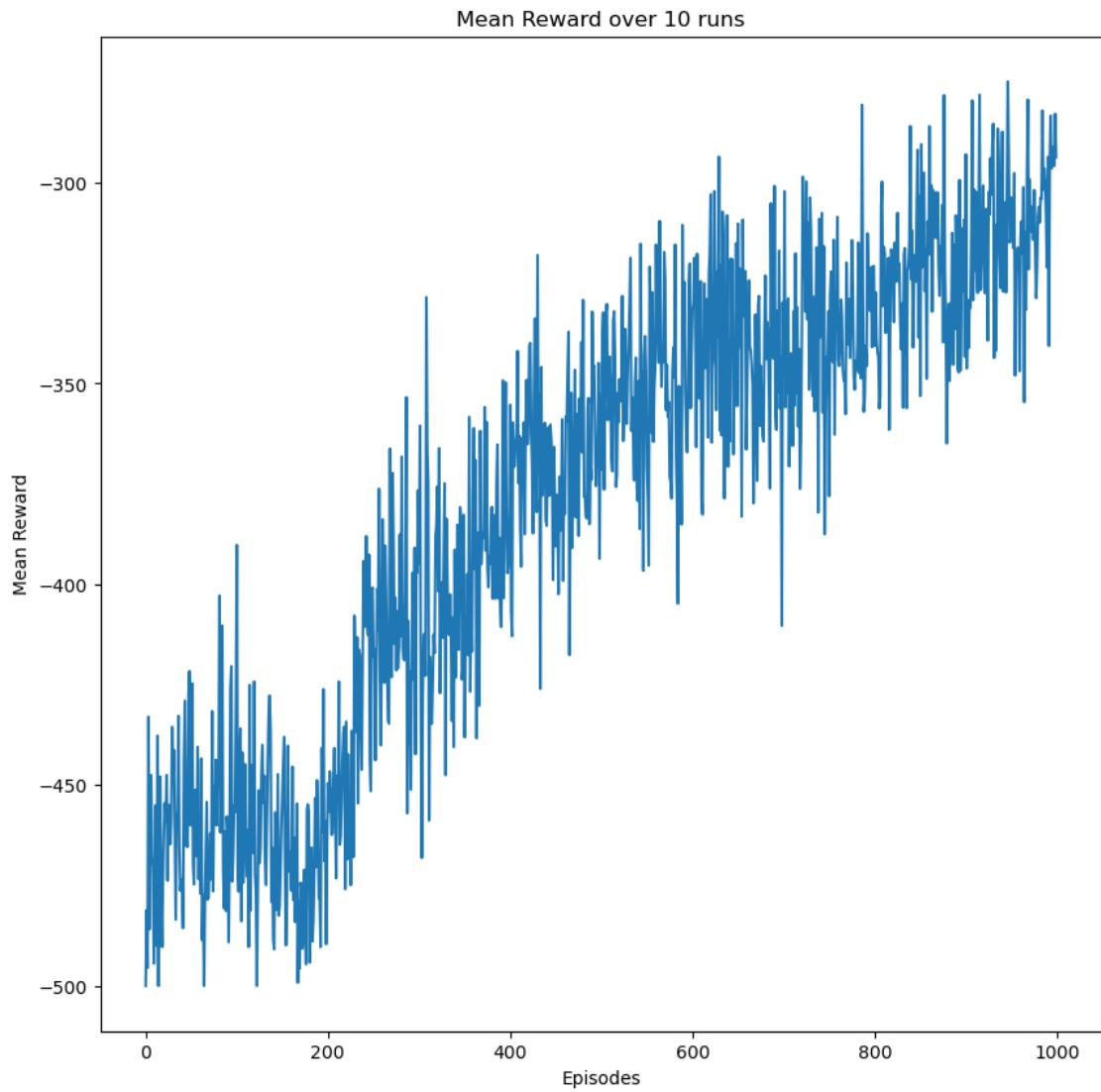
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 Episode 260 Reward -500.000000 Average Reward -481.300000
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 Episode 300 Reward -500.000000 Average Reward -487.900000
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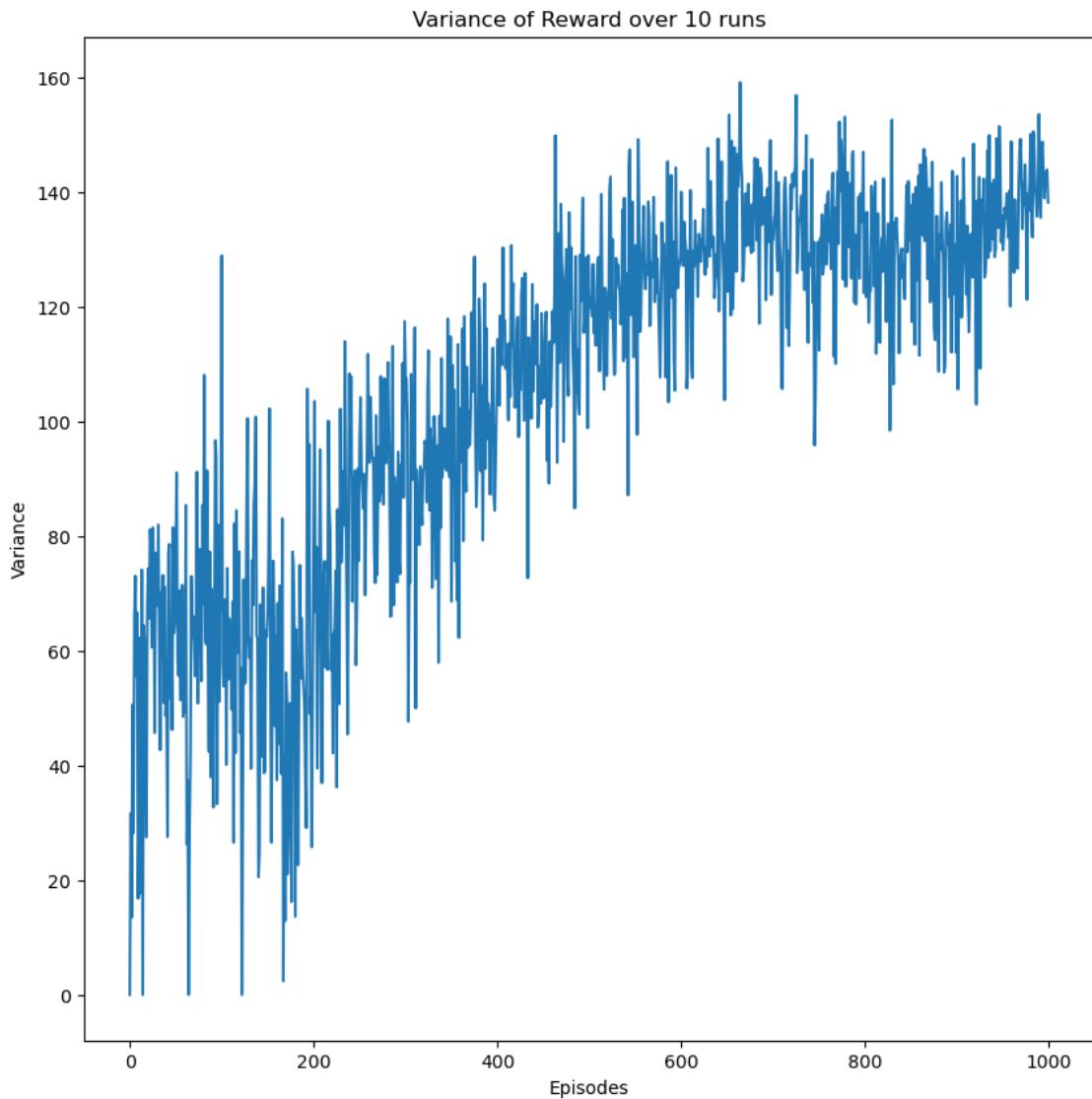
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 Episode 920 Reward -500.000000 Average Reward -500.000000
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 Episode 960 Reward -500.000000 Average Reward -500.000000
 Episode 970 Reward -500.000000 Average Reward -500.000000
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 Episode 50 Reward -500.000000 Average Reward -457.100000
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 Episode 70 Reward -280.000000 Average Reward -450.400000
 Episode 80 Reward -398.000000 Average Reward -459.700000
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 Episode 160 Reward -312.000000 Average Reward -379.000000
 Episode 170 Reward -500.000000 Average Reward -423.100000
 Episode 180 Reward -366.000000 Average Reward -436.100000
 Episode 190 Reward -455.000000 Average Reward -403.700000
 Episode 200 Reward -374.000000 Average Reward -375.300000
 Episode 210 Reward -390.000000 Average Reward -320.700000
 Episode 220 Reward -313.000000 Average Reward -331.400000
 Episode 230 Reward -214.000000 Average Reward -354.900000
 Episode 240 Reward -285.000000 Average Reward -325.400000
 Episode 250 Reward -384.000000 Average Reward -306.500000
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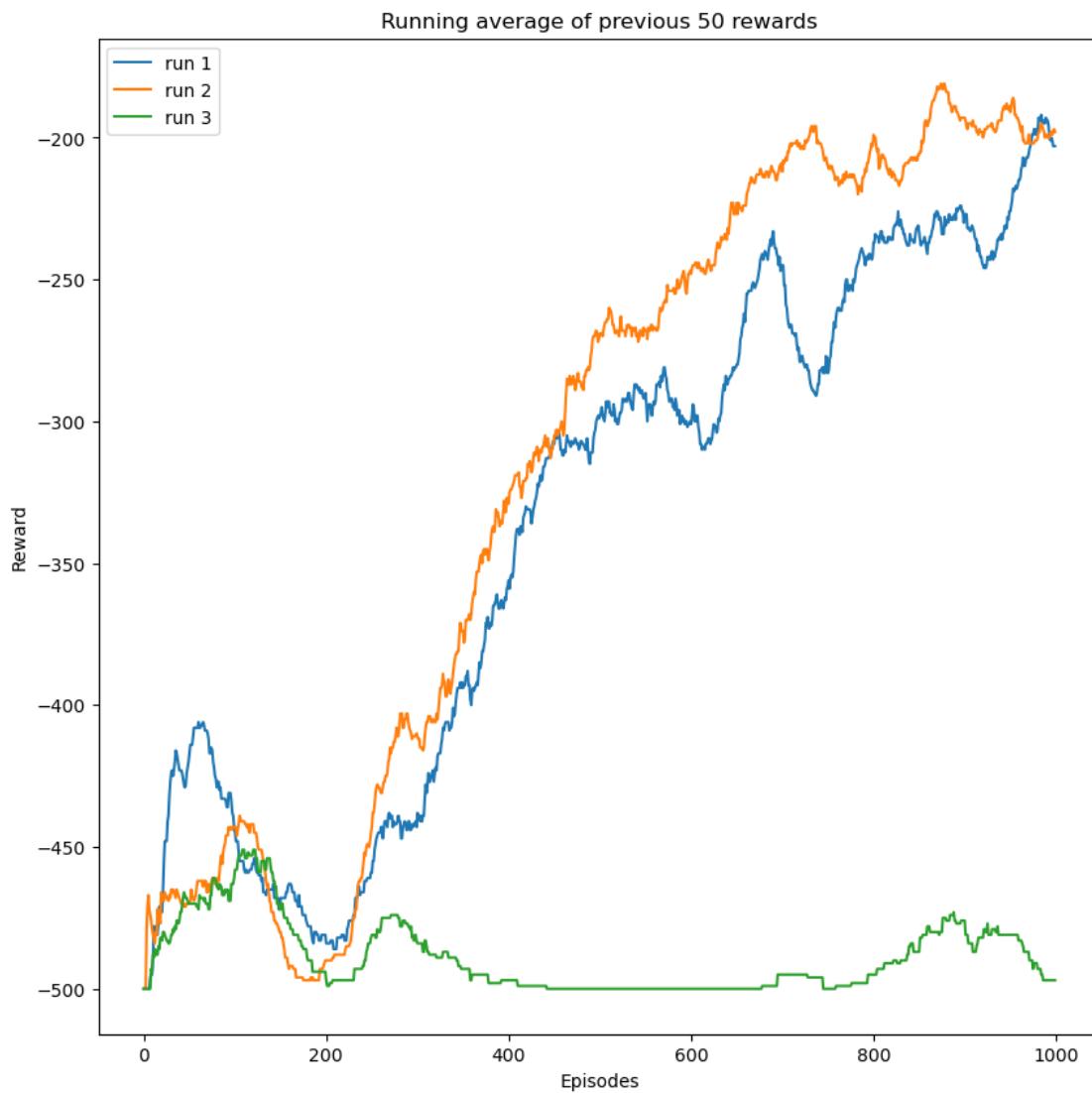
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Episode 330 Reward -372.000000 Average Reward -296.800000
Episode 340 Reward -170.000000 Average Reward -313.400000
Episode 350 Reward -172.000000 Average Reward -278.600000
Episode 360 Reward -369.000000 Average Reward -322.700000
Episode 370 Reward -243.000000 Average Reward -254.700000
Episode 380 Reward -249.000000 Average Reward -293.000000
Episode 390 Reward -225.000000 Average Reward -287.400000
Episode 400 Reward -284.000000 Average Reward -272.600000
Episode 410 Reward -290.000000 Average Reward -234.600000
Episode 420 Reward -189.000000 Average Reward -222.500000
Episode 430 Reward -275.000000 Average Reward -242.700000
Episode 440 Reward -196.000000 Average Reward -263.800000
Episode 450 Reward -273.000000 Average Reward -247.700000
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Episode 480 Reward -197.000000 Average Reward -224.600000
Episode 490 Reward -322.000000 Average Reward -274.200000
Episode 500 Reward -241.000000 Average Reward -236.700000
Episode 510 Reward -188.000000 Average Reward -230.700000
Episode 520 Reward -200.000000 Average Reward -236.500000
Episode 530 Reward -240.000000 Average Reward -215.100000
Episode 540 Reward -230.000000 Average Reward -203.700000
Episode 550 Reward -266.000000 Average Reward -257.000000
Episode 560 Reward -313.000000 Average Reward -241.600000
Episode 570 Reward -211.000000 Average Reward -239.600000
Episode 580 Reward -195.000000 Average Reward -226.000000
Episode 590 Reward -149.000000 Average Reward -207.500000
Episode 600 Reward -224.000000 Average Reward -201.900000
Episode 610 Reward -165.000000 Average Reward -218.800000
Episode 620 Reward -195.000000 Average Reward -233.700000
Episode 630 Reward -177.000000 Average Reward -183.400000
Episode 640 Reward -260.000000 Average Reward -231.500000
Episode 650 Reward -329.000000 Average Reward -248.400000
Episode 660 Reward -157.000000 Average Reward -239.000000
Episode 670 Reward -211.000000 Average Reward -202.200000
Episode 680 Reward -346.000000 Average Reward -257.100000
Episode 690 Reward -253.000000 Average Reward -216.800000
Episode 700 Reward -264.000000 Average Reward -215.200000
Episode 710 Reward -245.000000 Average Reward -221.300000
Episode 720 Reward -209.000000 Average Reward -219.800000
Episode 730 Reward -265.000000 Average Reward -187.700000
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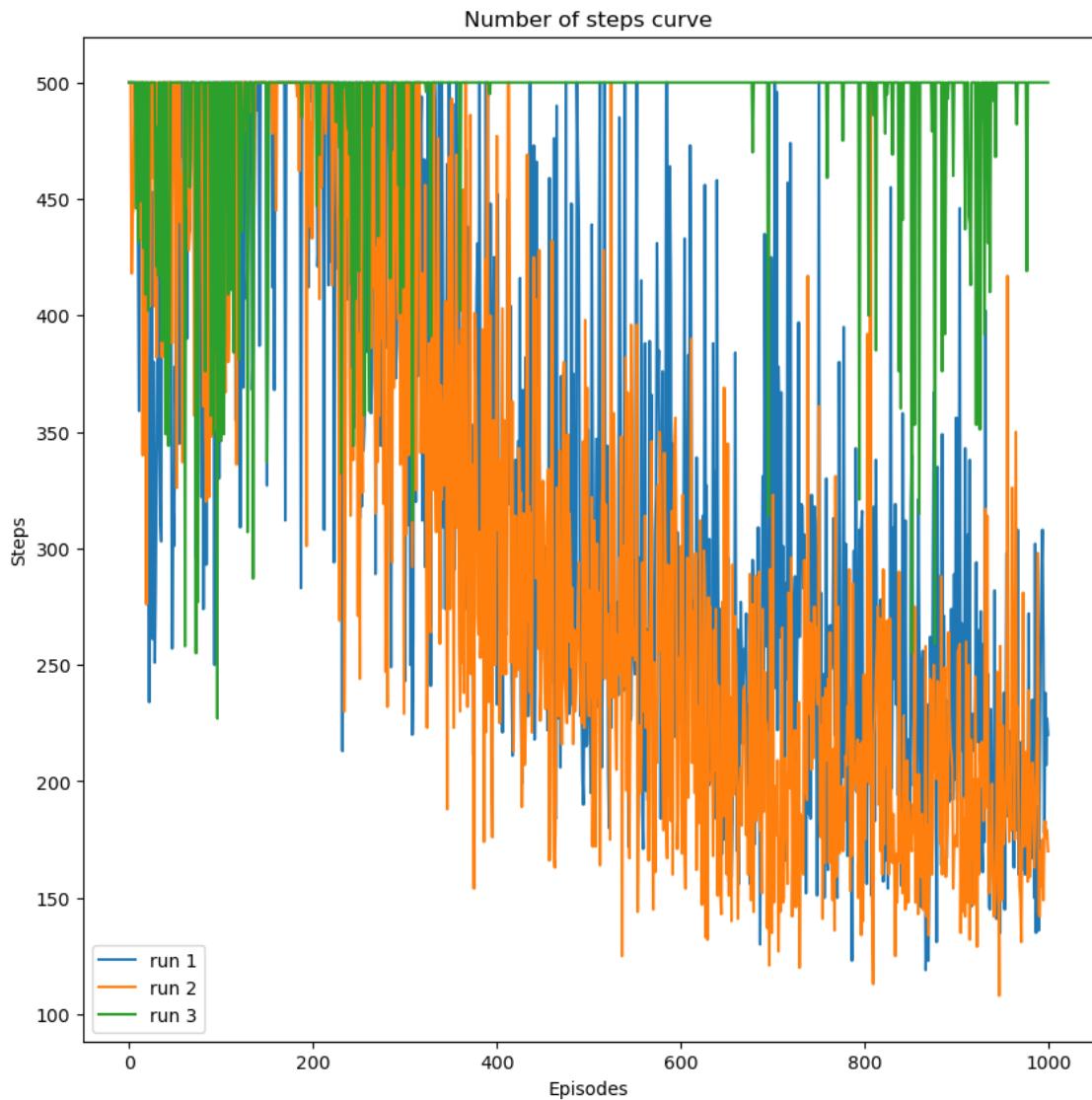
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Episode 900 Reward -240.000000 Average Reward -219.800000
Episode 910 Reward -177.000000 Average Reward -198.100000
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Episode 970 Reward -266.000000 Average Reward -239.800000
Episode 980 Reward -204.000000 Average Reward -197.000000
Episode 990 Reward -162.000000 Average Reward -180.000000
Episode 1000 Reward -173.000000 Average Reward -174.500000

0:03:48.464158









```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [512, 512]
LR = 0.5e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'Acrobot-v1'
SOLVE_CUTOFF = -100.0
STEP = 5

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{hs}-{lr}-{env}-{numep}-{nstep}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	-358.000000	-485.800000
20	-500.000000	-453.700000
30	-500.000000	-457.700000
40	-500.000000	-487.600000
50	-500.000000	-463.600000
60	-347.000000	-484.700000
70	-500.000000	-498.700000
80	-500.000000	-453.300000
90	-321.000000	-463.300000
100	-419.000000	-431.100000
110	-431.000000	-485.900000
120	-500.000000	-467.700000
130	-500.000000	-443.700000
140	-500.000000	-463.700000
150	-441.000000	-460.700000
160	-500.000000	-485.200000
170	-330.000000	-417.700000
180	-500.000000	-440.800000
190	-500.000000	-412.600000
200	-398.000000	-462.300000
210	-335.000000	-425.300000
220	-320.000000	-432.600000
230	-493.000000	-444.800000
240	-255.000000	-358.600000
250	-419.000000	-307.500000
260	-396.000000	-384.600000
270	-421.000000	-371.100000
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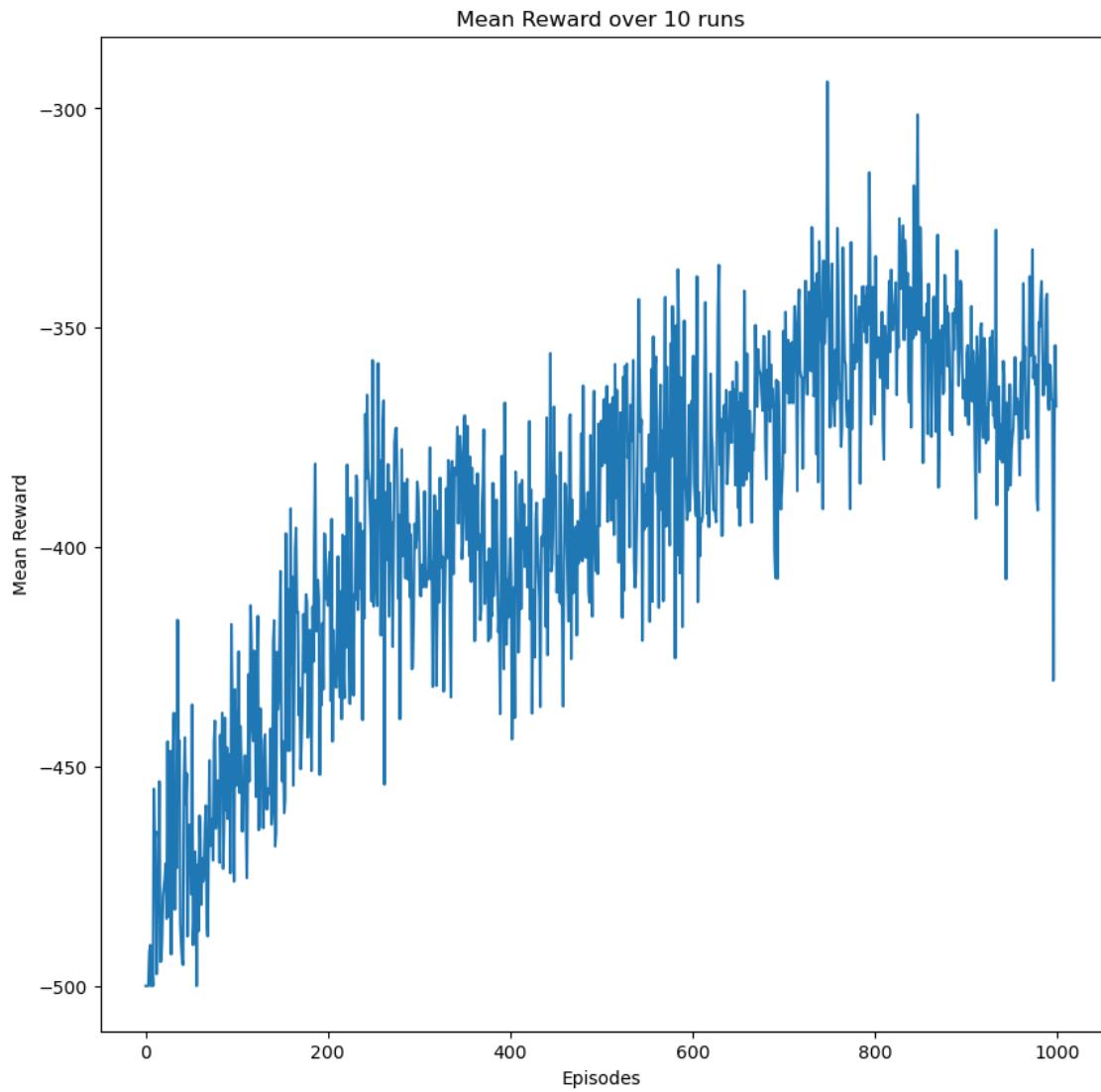
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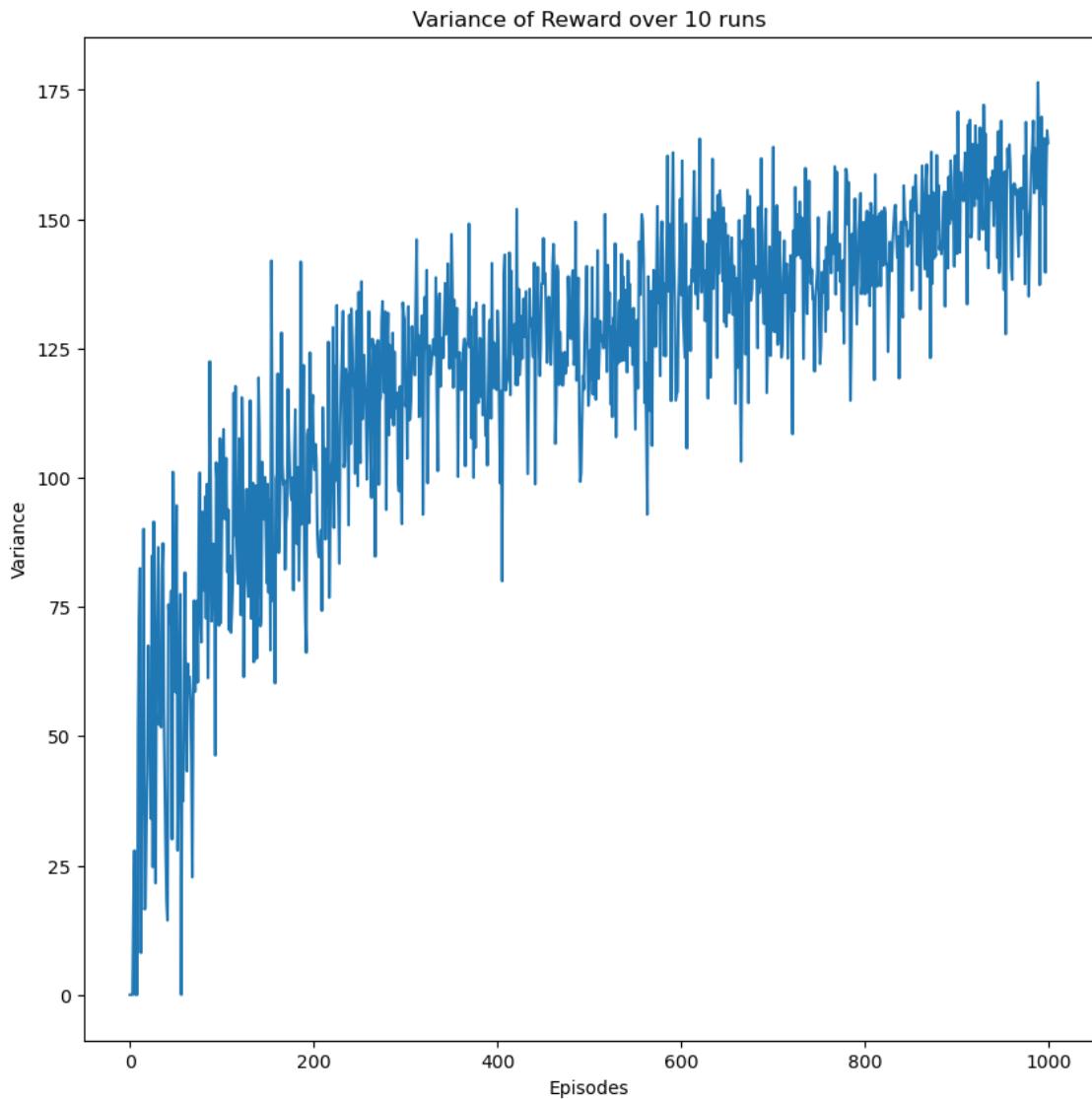
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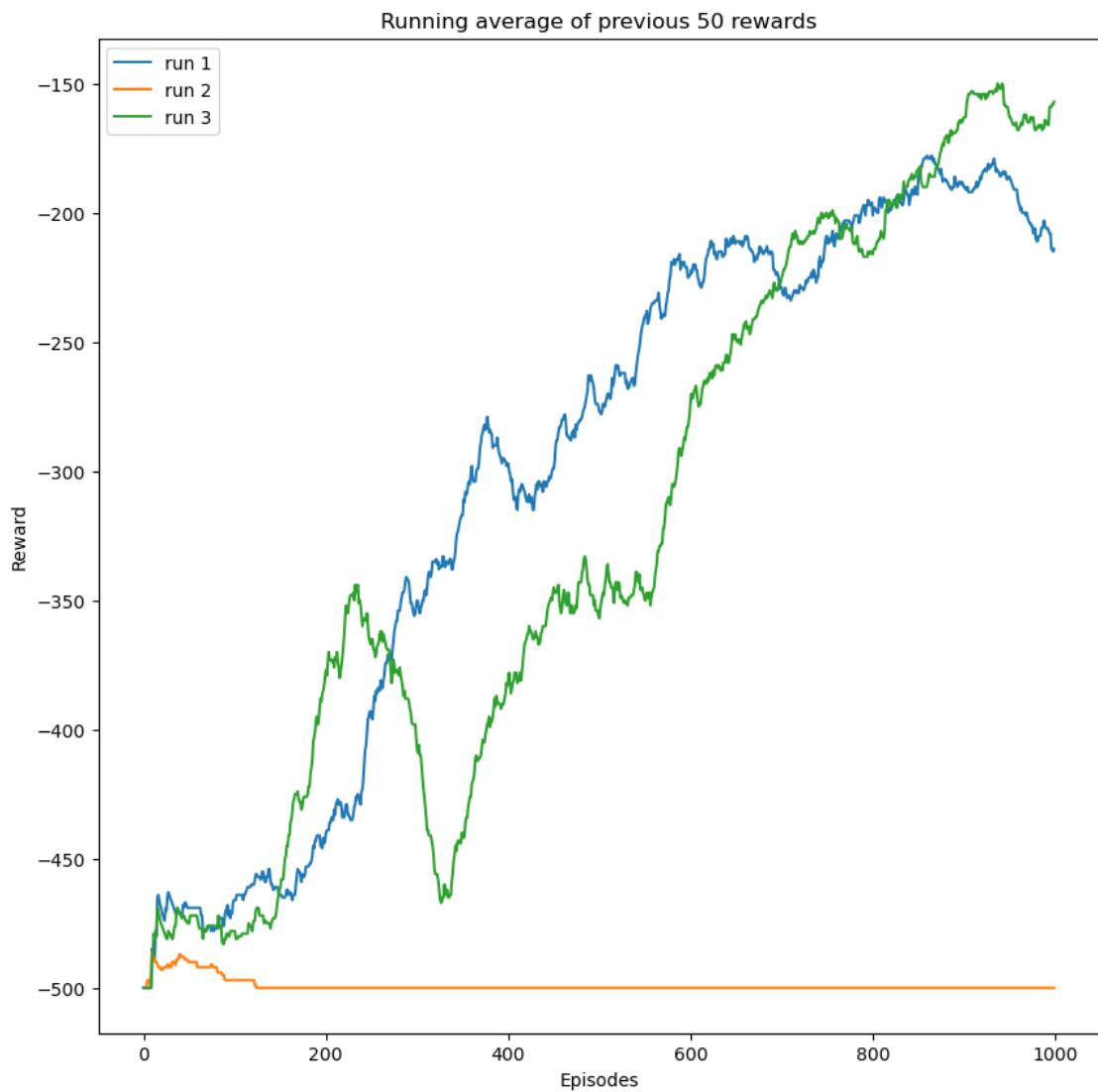
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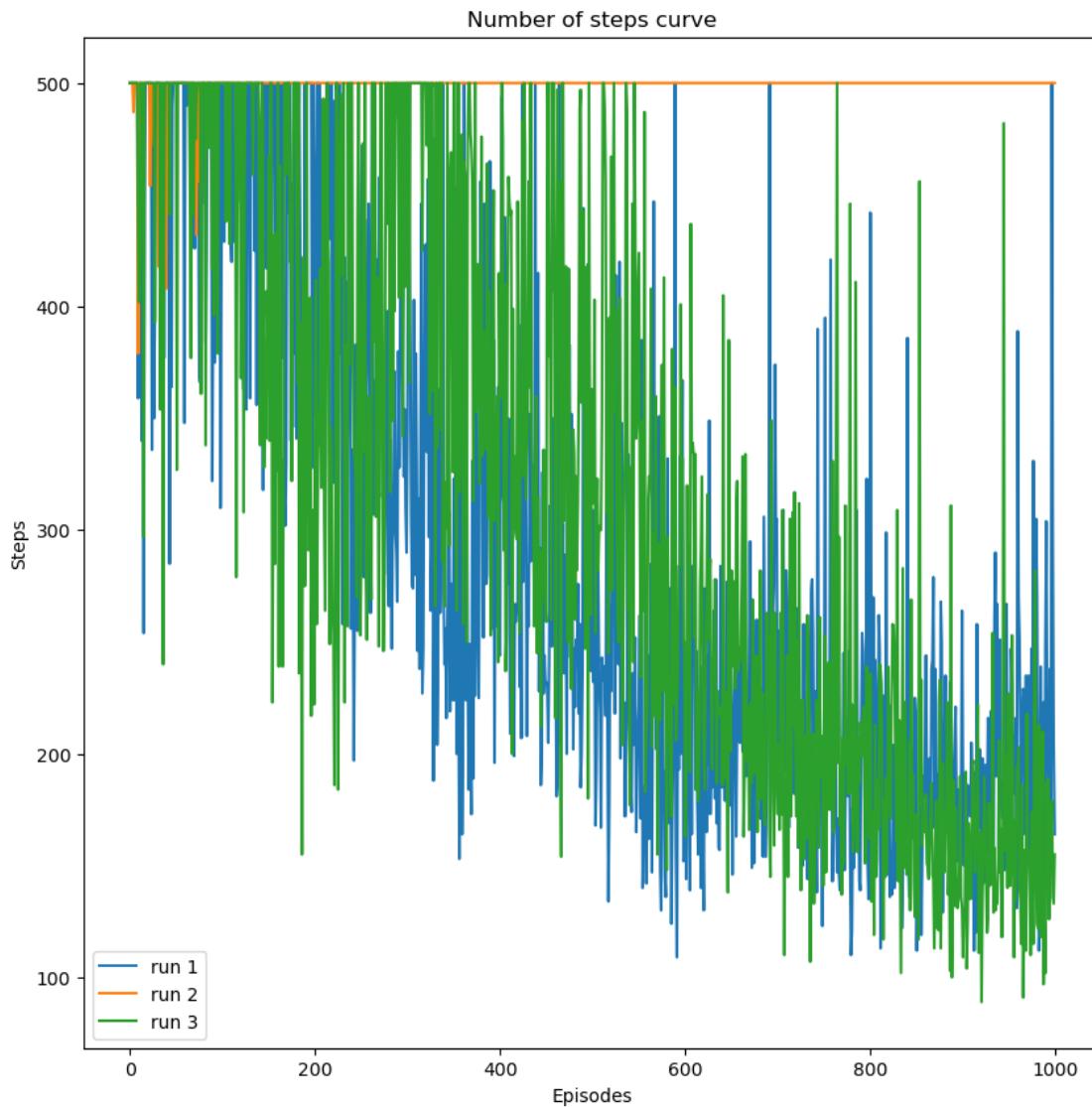
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Episode 660 Reward -388.000000 Average Reward -426.800000
Episode 670 Reward -417.000000 Average Reward -391.000000
Episode 680 Reward -386.000000 Average Reward -344.000000
Episode 690 Reward -334.000000 Average Reward -392.600000
Episode 700 Reward -500.000000 Average Reward -448.100000
Episode 710 Reward -277.000000 Average Reward -364.500000
Episode 720 Reward -427.000000 Average Reward -370.500000
Episode 730 Reward -500.000000 Average Reward -359.200000
Episode 740 Reward -422.000000 Average Reward -403.700000
Episode 750 Reward -403.000000 Average Reward -348.100000
Episode 760 Reward -269.000000 Average Reward -376.300000
Episode 770 Reward -477.000000 Average Reward -396.100000
Episode 780 Reward -500.000000 Average Reward -437.900000
Episode 790 Reward -409.000000 Average Reward -411.300000

Episode 800 Reward -425.000000 Average Reward -357.800000
Episode 810 Reward -500.000000 Average Reward -414.700000
Episode 820 Reward -367.000000 Average Reward -381.300000
Episode 830 Reward -243.000000 Average Reward -331.500000
Episode 840 Reward -369.000000 Average Reward -330.600000
Episode 850 Reward -409.000000 Average Reward -398.200000
Episode 860 Reward -376.000000 Average Reward -438.900000
Episode 870 Reward -355.000000 Average Reward -432.800000
Episode 880 Reward -483.000000 Average Reward -450.800000
Episode 890 Reward -432.000000 Average Reward -421.800000
Episode 900 Reward -500.000000 Average Reward -436.400000
Episode 910 Reward -439.000000 Average Reward -478.700000
Episode 920 Reward -500.000000 Average Reward -434.600000
Episode 930 Reward -437.000000 Average Reward -443.300000
Episode 940 Reward -500.000000 Average Reward -458.900000
Episode 950 Reward -500.000000 Average Reward -481.400000
Episode 960 Reward -500.000000 Average Reward -470.900000
Episode 970 Reward -467.000000 Average Reward -464.400000
Episode 980 Reward -500.000000 Average Reward -463.200000
Episode 990 Reward -430.000000 Average Reward -461.700000
Episode 1000 Reward -500.000000 Average Reward -469.600000
0:08:03.977527









```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [512, 512]
LR = 1e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'Acrobot-v1'
SOLVE_CUTOFF = -100.0
STEP = 5

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{hs}-{lr}-{env}-{numep}-{nstep}-{STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	-500.000000	-479.600000
20	-500.000000	-406.300000
30	-459.000000	-454.100000
40	-500.000000	-440.000000
50	-500.000000	-479.900000
60	-500.000000	-500.000000
70	-500.000000	-493.200000
80	-500.000000	-500.000000
90	-500.000000	-492.800000
100	-500.000000	-487.700000
110	-500.000000	-439.800000
120	-297.000000	-402.600000
130	-448.000000	-380.700000
140	-361.000000	-358.200000
150	-232.000000	-376.900000
160	-347.000000	-281.800000
170	-289.000000	-283.300000
180	-307.000000	-334.800000
190	-268.000000	-295.200000
200	-233.000000	-277.000000
210	-433.000000	-323.900000
220	-325.000000	-307.300000
230	-227.000000	-294.200000
240	-273.000000	-250.500000
250	-311.000000	-344.800000
260	-170.000000	-253.400000
270	-244.000000	-245.200000
280	-222.000000	-234.000000

Episode 290 Reward -184.000000 Average Reward -188.400000
Episode 300 Reward -131.000000 Average Reward -168.700000
Episode 310 Reward -166.000000 Average Reward -196.700000
Episode 320 Reward -202.000000 Average Reward -243.100000
Episode 330 Reward -185.000000 Average Reward -233.900000
Episode 340 Reward -234.000000 Average Reward -214.400000
Episode 350 Reward -155.000000 Average Reward -260.400000
Episode 360 Reward -177.000000 Average Reward -228.600000
Episode 370 Reward -137.000000 Average Reward -181.600000
Episode 380 Reward -138.000000 Average Reward -200.600000
Episode 390 Reward -265.000000 Average Reward -182.900000
Episode 400 Reward -115.000000 Average Reward -176.400000
Episode 410 Reward -149.000000 Average Reward -145.800000
Episode 420 Reward -159.000000 Average Reward -162.800000
Episode 430 Reward -178.000000 Average Reward -152.000000
Episode 440 Reward -132.000000 Average Reward -148.500000
Episode 450 Reward -108.000000 Average Reward -168.500000
Episode 460 Reward -177.000000 Average Reward -187.600000
Episode 470 Reward -126.000000 Average Reward -159.100000
Episode 480 Reward -136.000000 Average Reward -162.400000
Episode 490 Reward -169.000000 Average Reward -147.500000
Episode 500 Reward -130.000000 Average Reward -167.600000
Episode 510 Reward -137.000000 Average Reward -161.000000
Episode 520 Reward -155.000000 Average Reward -145.600000
Episode 530 Reward -176.000000 Average Reward -156.300000
Episode 540 Reward -161.000000 Average Reward -140.700000
Episode 550 Reward -165.000000 Average Reward -162.700000
Episode 560 Reward -167.000000 Average Reward -139.800000
Episode 570 Reward -127.000000 Average Reward -145.000000
Episode 580 Reward -98.000000 Average Reward -127.800000
Episode 590 Reward -143.000000 Average Reward -161.100000
Episode 600 Reward -132.000000 Average Reward -129.800000
Episode 610 Reward -111.000000 Average Reward -118.400000
Episode 620 Reward -166.000000 Average Reward -131.300000
Episode 630 Reward -122.000000 Average Reward -130.100000
Episode 640 Reward -244.000000 Average Reward -137.400000
Episode 650 Reward -148.000000 Average Reward -134.100000
Episode 660 Reward -147.000000 Average Reward -117.900000
Episode 670 Reward -130.000000 Average Reward -132.500000
Episode 680 Reward -116.000000 Average Reward -119.300000
Episode 690 Reward -115.000000 Average Reward -128.200000
Episode 700 Reward -116.000000 Average Reward -121.100000
Episode 710 Reward -135.000000 Average Reward -135.900000
Episode 720 Reward -93.000000 Average Reward -133.500000
Episode 730 Reward -130.000000 Average Reward -128.600000
Episode 740 Reward -127.000000 Average Reward -121.300000
Episode 750 Reward -124.000000 Average Reward -115.500000
Episode 760 Reward -304.000000 Average Reward -147.900000

Episode 770 Reward -157.000000 Average Reward -133.100000
Episode 780 Reward -100.000000 Average Reward -108.900000
Episode 790 Reward -102.000000 Average Reward -116.000000
Episode 800 Reward -75.000000 Average Reward -95.100000
Episode 810 Reward -113.000000 Average Reward -115.300000
Episode 820 Reward -90.000000 Average Reward -130.700000
Episode 830 Reward -94.000000 Average Reward -106.900000
Episode 840 Reward -117.000000 Average Reward -105.800000
Episode 850 Reward -93.000000 Average Reward -97.400000
Episode 860 Reward -101.000000 Average Reward -109.500000
Episode 870 Reward -115.000000 Average Reward -122.100000
Episode 880 Reward -115.000000 Average Reward -121.900000
Episode 890 Reward -114.000000 Average Reward -101.400000
Episode 900 Reward -150.000000 Average Reward -126.500000
Episode 910 Reward -81.000000 Average Reward -116.300000
Episode 920 Reward -173.000000 Average Reward -130.200000
Episode 930 Reward -97.000000 Average Reward -111.600000
Episode 940 Reward -88.000000 Average Reward -107.000000
Episode 950 Reward -88.000000 Average Reward -125.200000
Episode 960 Reward -132.000000 Average Reward -111.300000
Episode 970 Reward -93.000000 Average Reward -110.100000
Episode 980 Reward -89.000000 Average Reward -116.400000
Episode 990 Reward -112.000000 Average Reward -119.900000
Episode 1000 Reward -135.000000 Average Reward -133.000000
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Episode 10 Reward -411.000000 Average Reward -491.100000
Episode 20 Reward -269.000000 Average Reward -440.100000
Episode 30 Reward -334.000000 Average Reward -362.500000
Episode 40 Reward -482.000000 Average Reward -293.200000
Episode 50 Reward -177.000000 Average Reward -294.500000
Episode 60 Reward -378.000000 Average Reward -257.000000
Episode 70 Reward -227.000000 Average Reward -231.200000
Episode 80 Reward -294.000000 Average Reward -325.500000
Episode 90 Reward -251.000000 Average Reward -367.700000
Episode 100 Reward -500.000000 Average Reward -397.300000
Episode 110 Reward -500.000000 Average Reward -468.300000
Episode 120 Reward -500.000000 Average Reward -494.300000
Episode 130 Reward -373.000000 Average Reward -386.100000
Episode 140 Reward -216.000000 Average Reward -252.900000
Episode 150 Reward -251.000000 Average Reward -235.600000
Episode 160 Reward -220.000000 Average Reward -200.200000
Episode 170 Reward -189.000000 Average Reward -249.900000
Episode 180 Reward -136.000000 Average Reward -185.900000
Episode 190 Reward -353.000000 Average Reward -235.900000
Episode 200 Reward -212.000000 Average Reward -209.900000
Episode 210 Reward -219.000000 Average Reward -191.500000
Episode 220 Reward -219.000000 Average Reward -211.000000
Episode 230 Reward -252.000000 Average Reward -212.000000

Episode 240 Reward -195.000000 Average Reward -229.800000
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Episode 260 Reward -219.000000 Average Reward -209.400000
Episode 270 Reward -179.000000 Average Reward -213.700000
Episode 280 Reward -139.000000 Average Reward -193.300000
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Episode 630 Reward -121.000000 Average Reward -167.900000
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Episode 660 Reward -90.000000 Average Reward -110.800000
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Episode 680 Reward -144.000000 Average Reward -154.200000
Episode 690 Reward -118.000000 Average Reward -132.700000
Episode 700 Reward -151.000000 Average Reward -157.300000
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Episode 720 Reward -143.000000 Average Reward -165.500000
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Episode 900 Reward -168.000000 Average Reward -289.900000
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Episode 970 Reward -500.000000 Average Reward -500.000000
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Episode 30 Reward -500.000000 Average Reward -500.000000
Episode 40 Reward -439.000000 Average Reward -412.000000
Episode 50 Reward -470.000000 Average Reward -438.200000
Episode 60 Reward -500.000000 Average Reward -379.400000
Episode 70 Reward -428.000000 Average Reward -478.200000
Episode 80 Reward -500.000000 Average Reward -473.300000
Episode 90 Reward -500.000000 Average Reward -424.500000
Episode 100 Reward -249.000000 Average Reward -401.100000
Episode 110 Reward -407.000000 Average Reward -405.800000
Episode 120 Reward -333.000000 Average Reward -425.800000
Episode 130 Reward -390.000000 Average Reward -426.800000
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Episode 770 Reward -125.000000 Average Reward -162.100000
Episode 780 Reward -161.000000 Average Reward -162.200000
Episode 790 Reward -101.000000 Average Reward -161.500000
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Episode 940 Reward -147.000000 Average Reward -146.300000
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Episode 960 Reward -175.000000 Average Reward -159.800000
Episode 970 Reward -114.000000 Average Reward -144.800000
Episode 980 Reward -164.000000 Average Reward -134.700000
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Episode 1000 Reward -107.000000 Average Reward -145.200000

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Episode 10 Reward -500.000000 Average Reward -487.200000
Episode 20 Reward -500.000000 Average Reward -500.000000
Episode 30 Reward -500.000000 Average Reward -500.000000
Episode 40 Reward -500.000000 Average Reward -500.000000
Episode 50 Reward -500.000000 Average Reward -500.000000
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Episode 90 Reward -500.000000 Average Reward -500.000000
Episode 100 Reward -500.000000 Average Reward -494.500000
Episode 110 Reward -500.000000 Average Reward -500.000000
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Episode 130 Reward -500.000000 Average Reward -500.000000

Episode 140 Reward -500.000000 Average Reward -500.000000
Episode 150 Reward -500.000000 Average Reward -477.000000
Episode 160 Reward -500.000000 Average Reward -486.900000
Episode 170 Reward -500.000000 Average Reward -483.200000
Episode 180 Reward -344.000000 Average Reward -467.200000
Episode 190 Reward -248.000000 Average Reward -372.500000
Episode 200 Reward -348.000000 Average Reward -403.100000
Episode 210 Reward -411.000000 Average Reward -394.900000
Episode 220 Reward -442.000000 Average Reward -415.900000
Episode 230 Reward -363.000000 Average Reward -397.500000
Episode 240 Reward -500.000000 Average Reward -442.000000
Episode 250 Reward -413.000000 Average Reward -358.500000
Episode 260 Reward -500.000000 Average Reward -395.200000
Episode 270 Reward -489.000000 Average Reward -324.400000
Episode 280 Reward -319.000000 Average Reward -313.100000
Episode 290 Reward -403.000000 Average Reward -332.500000
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Episode 310 Reward -202.000000 Average Reward -320.600000
Episode 320 Reward -248.000000 Average Reward -291.400000
Episode 330 Reward -278.000000 Average Reward -337.700000
Episode 340 Reward -378.000000 Average Reward -277.800000
Episode 350 Reward -241.000000 Average Reward -320.200000
Episode 360 Reward -363.000000 Average Reward -298.800000
Episode 370 Reward -250.000000 Average Reward -329.300000
Episode 380 Reward -209.000000 Average Reward -228.900000
Episode 390 Reward -238.000000 Average Reward -263.300000
Episode 400 Reward -188.000000 Average Reward -271.200000
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Episode 460 Reward -358.000000 Average Reward -284.500000
Episode 470 Reward -390.000000 Average Reward -275.100000
Episode 480 Reward -204.000000 Average Reward -261.100000
Episode 490 Reward -190.000000 Average Reward -229.400000
Episode 500 Reward -260.000000 Average Reward -229.300000
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Episode 520 Reward -148.000000 Average Reward -233.900000
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Episode 620 Reward -219.000000 Average Reward -211.300000
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Episode 680 Reward -183.000000 Average Reward -199.100000
Episode 690 Reward -138.000000 Average Reward -164.600000
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Episode 710 Reward -155.000000 Average Reward -172.000000
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Episode 730 Reward -179.000000 Average Reward -197.700000
Episode 740 Reward -129.000000 Average Reward -175.300000
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Episode 820 Reward -115.000000 Average Reward -129.800000
Episode 830 Reward -186.000000 Average Reward -142.600000
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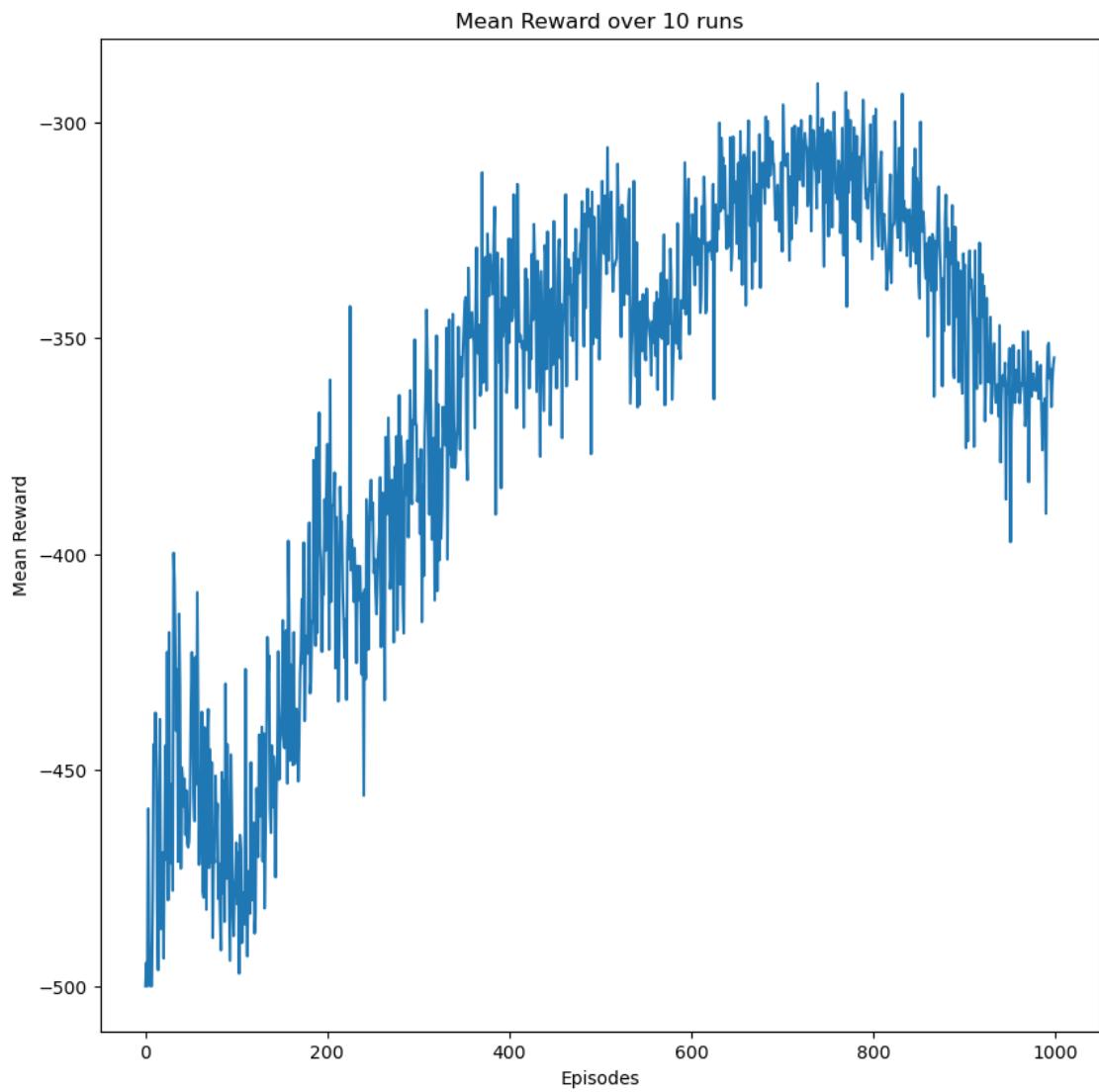
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Episode 630 Reward -182.000000 Average Reward -196.400000
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Episode 650 Reward -193.000000 Average Reward -193.300000
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Episode 740 Reward -157.000000 Average Reward -183.200000
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Episode 810 Reward -192.000000 Average Reward -165.200000
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Episode 830 Reward -138.000000 Average Reward -156.700000
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Episode 860 Reward -159.000000 Average Reward -181.300000
Episode 870 Reward -213.000000 Average Reward -196.100000
Episode 880 Reward -141.000000 Average Reward -168.700000
Episode 890 Reward -188.000000 Average Reward -179.500000
Episode 900 Reward -198.000000 Average Reward -180.600000
Episode 910 Reward -188.000000 Average Reward -213.600000
Episode 920 Reward -159.000000 Average Reward -195.900000
Episode 930 Reward -227.000000 Average Reward -185.100000
Episode 940 Reward -142.000000 Average Reward -182.000000
Episode 950 Reward -145.000000 Average Reward -186.900000
Episode 960 Reward -147.000000 Average Reward -161.900000
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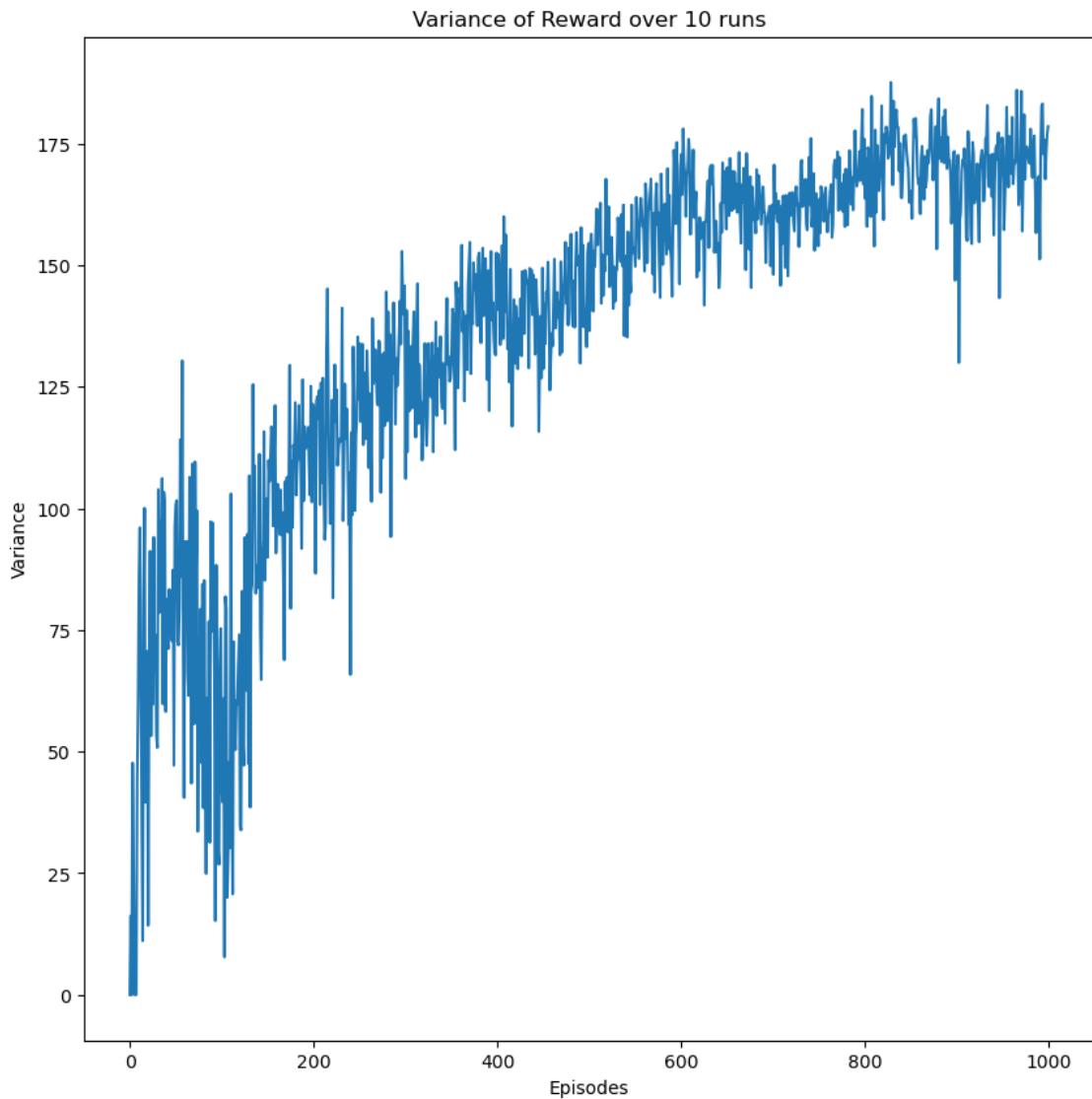
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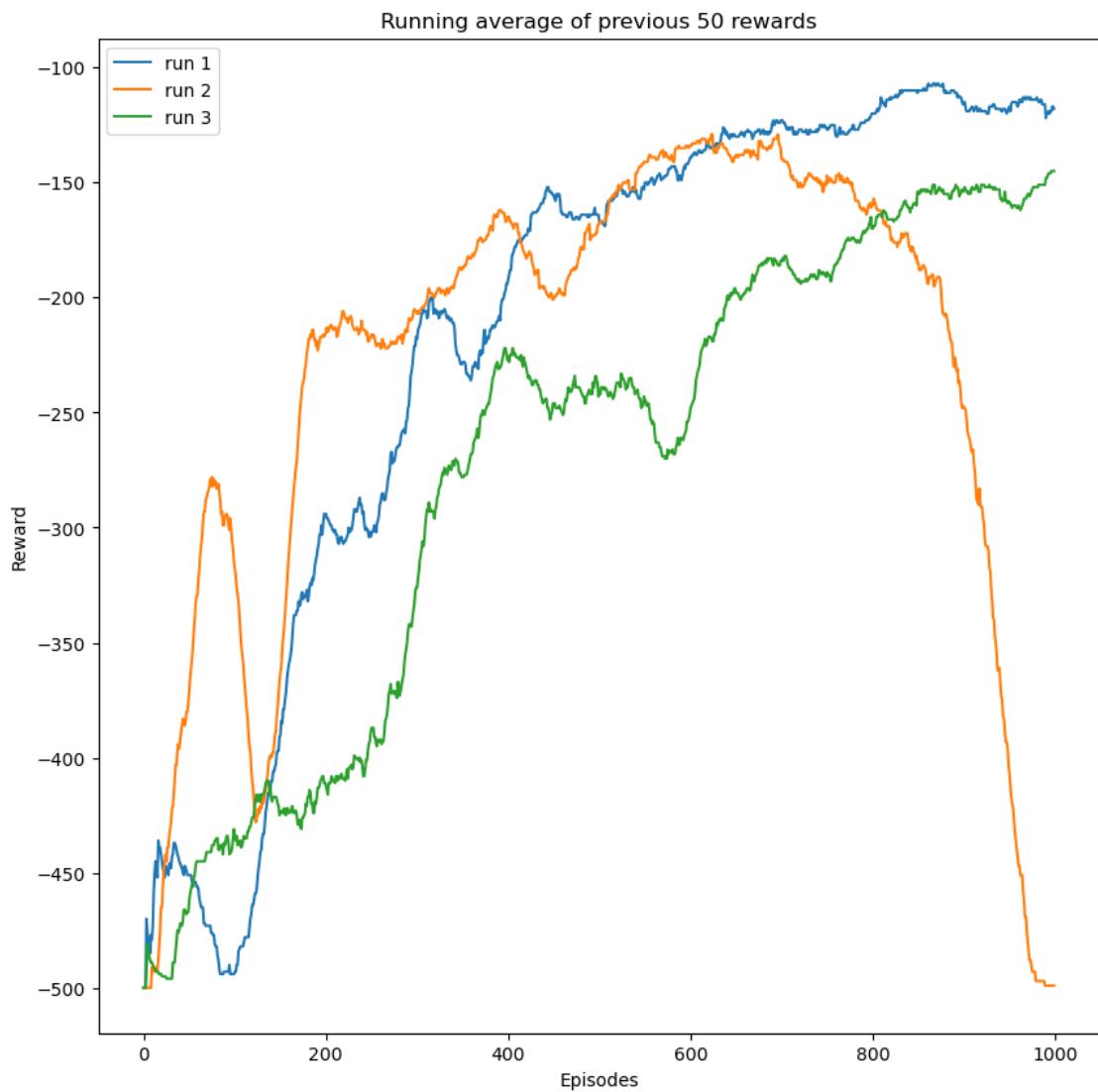
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Episode 60 Reward -472.000000 Average Reward -487.600000
Episode 70 Reward -500.000000 Average Reward -496.800000
Episode 80 Reward -500.000000 Average Reward -500.000000
Episode 90 Reward -500.000000 Average Reward -500.000000
Episode 100 Reward -500.000000 Average Reward -500.000000
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Episode 210 Reward -471.000000 Average Reward -380.800000
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Episode 270 Reward -500.000000 Average Reward -498.900000
Episode 280 Reward -500.000000 Average Reward -491.200000
Episode 290 Reward -500.000000 Average Reward -500.000000
Episode 300 Reward -500.000000 Average Reward -478.200000
Episode 310 Reward -500.000000 Average Reward -500.000000
Episode 320 Reward -340.000000 Average Reward -484.000000
Episode 330 Reward -500.000000 Average Reward -500.000000
Episode 340 Reward -500.000000 Average Reward -500.000000
Episode 350 Reward -500.000000 Average Reward -500.000000
Episode 360 Reward -500.000000 Average Reward -500.000000
Episode 370 Reward -500.000000 Average Reward -500.000000
Episode 380 Reward -500.000000 Average Reward -500.000000
Episode 390 Reward -500.000000 Average Reward -500.000000
Episode 400 Reward -464.000000 Average Reward -496.400000
Episode 410 Reward -500.000000 Average Reward -492.500000
Episode 420 Reward -500.000000 Average Reward -500.000000
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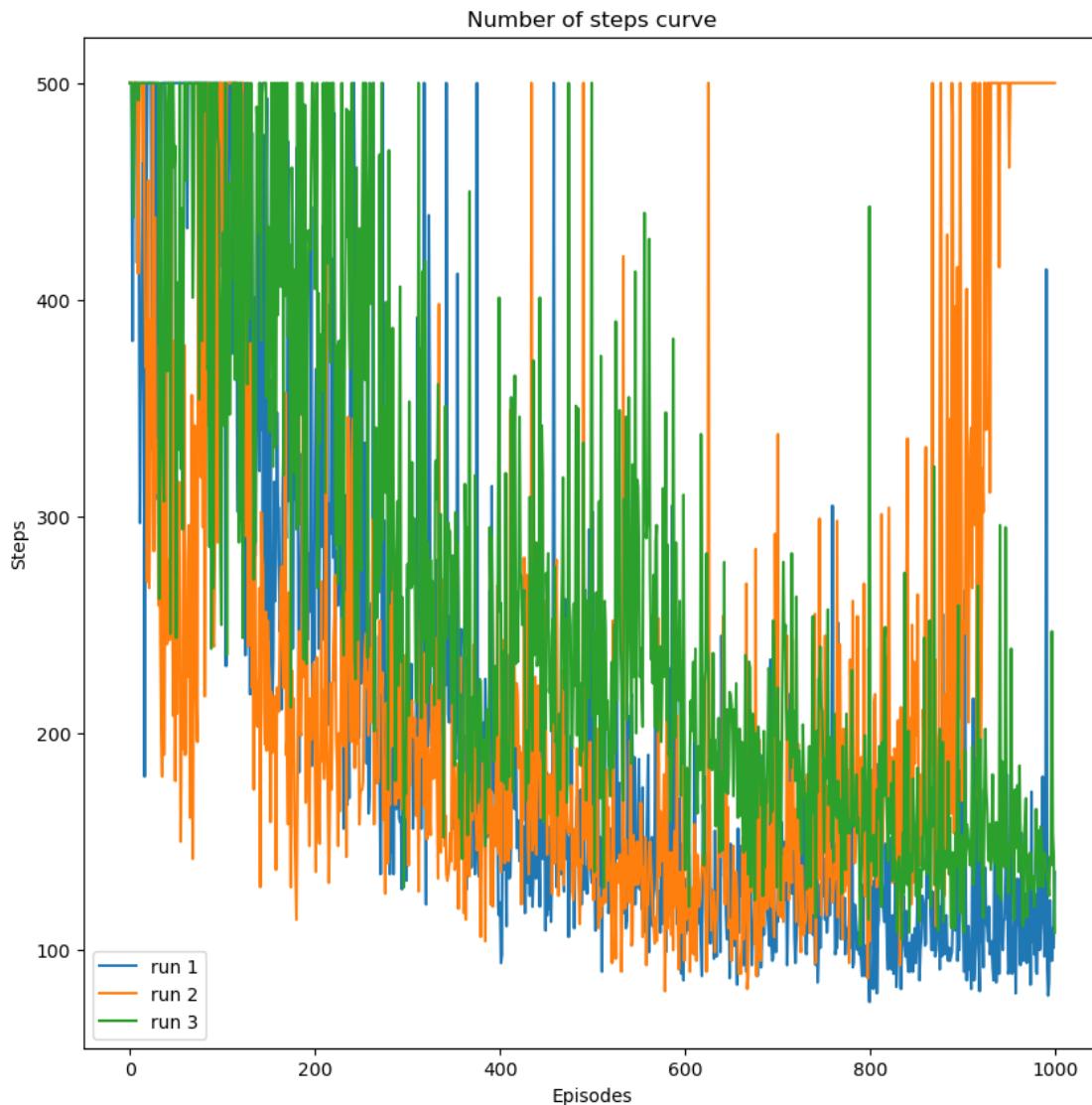
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Episode 50 Reward -424.000000 Average Reward -483.200000
Episode 60 Reward -500.000000 Average Reward -500.000000
Episode 70 Reward -500.000000 Average Reward -500.000000
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Episode 90 Reward -500.000000 Average Reward -500.000000
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Episode 120 Reward -500.000000 Average Reward -500.000000
Episode 130 Reward -500.000000 Average Reward -500.000000
Episode 140 Reward -500.000000 Average Reward -500.000000
Episode 150 Reward -500.000000 Average Reward -500.000000
Episode 160 Reward -500.000000 Average Reward -500.000000
Episode 170 Reward -500.000000 Average Reward -500.000000
Episode 180 Reward -500.000000 Average Reward -500.000000
Episode 190 Reward -500.000000 Average Reward -500.000000
Episode 200 Reward -500.000000 Average Reward -474.700000
Episode 210 Reward -500.000000 Average Reward -490.000000
Episode 220 Reward -500.000000 Average Reward -489.600000
Episode 230 Reward -500.000000 Average Reward -476.700000
Episode 240 Reward -500.000000 Average Reward -493.600000
Episode 250 Reward -500.000000 Average Reward -495.500000
Episode 260 Reward -500.000000 Average Reward -500.000000
Episode 270 Reward -500.000000 Average Reward -500.000000
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Episode 300 Reward -500.000000 Average Reward -498.700000
Episode 310 Reward -487.000000 Average Reward -490.500000
Episode 320 Reward -500.000000 Average Reward -486.900000
Episode 330 Reward -500.000000 Average Reward -483.700000
Episode 340 Reward -500.000000 Average Reward -471.100000
Episode 350 Reward -500.000000 Average Reward -472.700000
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Episode 370 Reward -500.000000 Average Reward -466.900000
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Episode 410 Reward -500.000000 Average Reward -500.000000

Episode 800 Reward -500.000000 Average Reward -500.000000
Episode 810 Reward -500.000000 Average Reward -500.000000
Episode 820 Reward -500.000000 Average Reward -500.000000
Episode 830 Reward -500.000000 Average Reward -500.000000
Episode 840 Reward -500.000000 Average Reward -500.000000
Episode 850 Reward -500.000000 Average Reward -500.000000
Episode 860 Reward -500.000000 Average Reward -500.000000
Episode 870 Reward -500.000000 Average Reward -500.000000
Episode 880 Reward -500.000000 Average Reward -500.000000
Episode 890 Reward -500.000000 Average Reward -500.000000
Episode 900 Reward -500.000000 Average Reward -500.000000
Episode 910 Reward -500.000000 Average Reward -500.000000
Episode 920 Reward -500.000000 Average Reward -500.000000
Episode 930 Reward -500.000000 Average Reward -500.000000
Episode 940 Reward -500.000000 Average Reward -500.000000
Episode 950 Reward -500.000000 Average Reward -500.000000
Episode 960 Reward -500.000000 Average Reward -500.000000
Episode 970 Reward -500.000000 Average Reward -500.000000
Episode 980 Reward -500.000000 Average Reward -500.000000
Episode 990 Reward -500.000000 Average Reward -500.000000
Episode 1000 Reward -500.000000 Average Reward -500.000000
0:08:55.869407









```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [512, 512]
LR = 2e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'Acrobot-v1'
SOLVE_CUTOFF = -100.0
STEP = 5

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{hs}-{lr}-{env}-{numep}-{nstep}-{STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	-281.000000	-437.900000
20	-500.000000	-429.700000
30	-319.000000	-423.500000
40	-243.000000	-294.000000
50	-186.000000	-217.600000
60	-202.000000	-213.800000
70	-149.000000	-186.500000
80	-204.000000	-220.500000
90	-129.000000	-201.900000
100	-238.000000	-228.000000
110	-145.000000	-228.600000
120	-289.000000	-234.400000
130	-183.000000	-229.000000
140	-104.000000	-203.800000
150	-182.000000	-199.700000
160	-158.000000	-210.000000
170	-174.000000	-208.000000
180	-155.000000	-198.500000
190	-127.000000	-161.700000
200	-147.000000	-184.400000
210	-194.000000	-161.800000
220	-117.000000	-136.500000
230	-93.000000	-127.700000
240	-120.000000	-151.200000
250	-131.000000	-128.500000
260	-121.000000	-115.000000
270	-111.000000	-117.200000
280	-100.000000	-116.600000

Episode 290 Reward -88.000000 Average Reward -98.800000
Episode 300 Reward -102.000000 Average Reward -115.700000
Episode 310 Reward -109.000000 Average Reward -109.700000
Episode 320 Reward -154.000000 Average Reward -119.500000
Episode 330 Reward -156.000000 Average Reward -127.100000
Episode 340 Reward -106.000000 Average Reward -111.600000
Episode 350 Reward -152.000000 Average Reward -140.500000
Episode 360 Reward -148.000000 Average Reward -124.000000
Episode 370 Reward -96.000000 Average Reward -108.900000
Episode 380 Reward -98.000000 Average Reward -126.100000
Episode 390 Reward -120.000000 Average Reward -125.700000
Episode 400 Reward -142.000000 Average Reward -138.700000
Episode 410 Reward -97.000000 Average Reward -117.000000
Episode 420 Reward -124.000000 Average Reward -116.000000
Episode 430 Reward -89.000000 Average Reward -121.300000
Episode 440 Reward -105.000000 Average Reward -107.200000
Episode 450 Reward -168.000000 Average Reward -153.900000
Episode 460 Reward -126.000000 Average Reward -111.900000
Episode 470 Reward -96.000000 Average Reward -109.300000
Episode 480 Reward -149.000000 Average Reward -126.300000
Episode 490 Reward -106.000000 Average Reward -147.500000
Episode 500 Reward -108.000000 Average Reward -107.600000
Episode 510 Reward -136.000000 Average Reward -105.300000
Episode 520 Reward -288.000000 Average Reward -134.500000
Episode 530 Reward -102.000000 Average Reward -100.200000
Episode 540 Reward -92.000000 Average Reward -100.900000
Episode 550 Reward -85.000000 Average Reward -90.400000
Episode 560 Reward -87.000000 Average Reward -90.400000
Episode 570 Reward -98.000000 Average Reward -96.500000
Episode 580 Reward -88.000000 Average Reward -100.700000
Episode 590 Reward -80.000000 Average Reward -89.000000
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Episode 670 Reward -86.000000 Average Reward -92.900000
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Episode 690 Reward -111.000000 Average Reward -106.800000
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Episode 190 Reward -158.000000 Average Reward -203.200000
Episode 200 Reward -170.000000 Average Reward -151.900000
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Episode 640 Reward -138.000000 Average Reward -139.300000
Episode 650 Reward -145.000000 Average Reward -155.600000
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Episode 670 Reward -116.000000 Average Reward -136.200000
Episode 680 Reward -192.000000 Average Reward -148.200000
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Episode 70 Reward -212.000000 Average Reward -230.700000
Episode 80 Reward -292.000000 Average Reward -255.000000
Episode 90 Reward -473.000000 Average Reward -315.000000
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Episode	60	Reward	-292.000000	Average Reward	-382.000000
Episode	70	Reward	-252.000000	Average Reward	-298.800000
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Episode 650 Reward -143.000000 Average Reward -144.200000
Episode 660 Reward -164.000000 Average Reward -155.000000
Episode 670 Reward -195.000000 Average Reward -162.000000
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Episode 690 Reward -161.000000 Average Reward -173.700000
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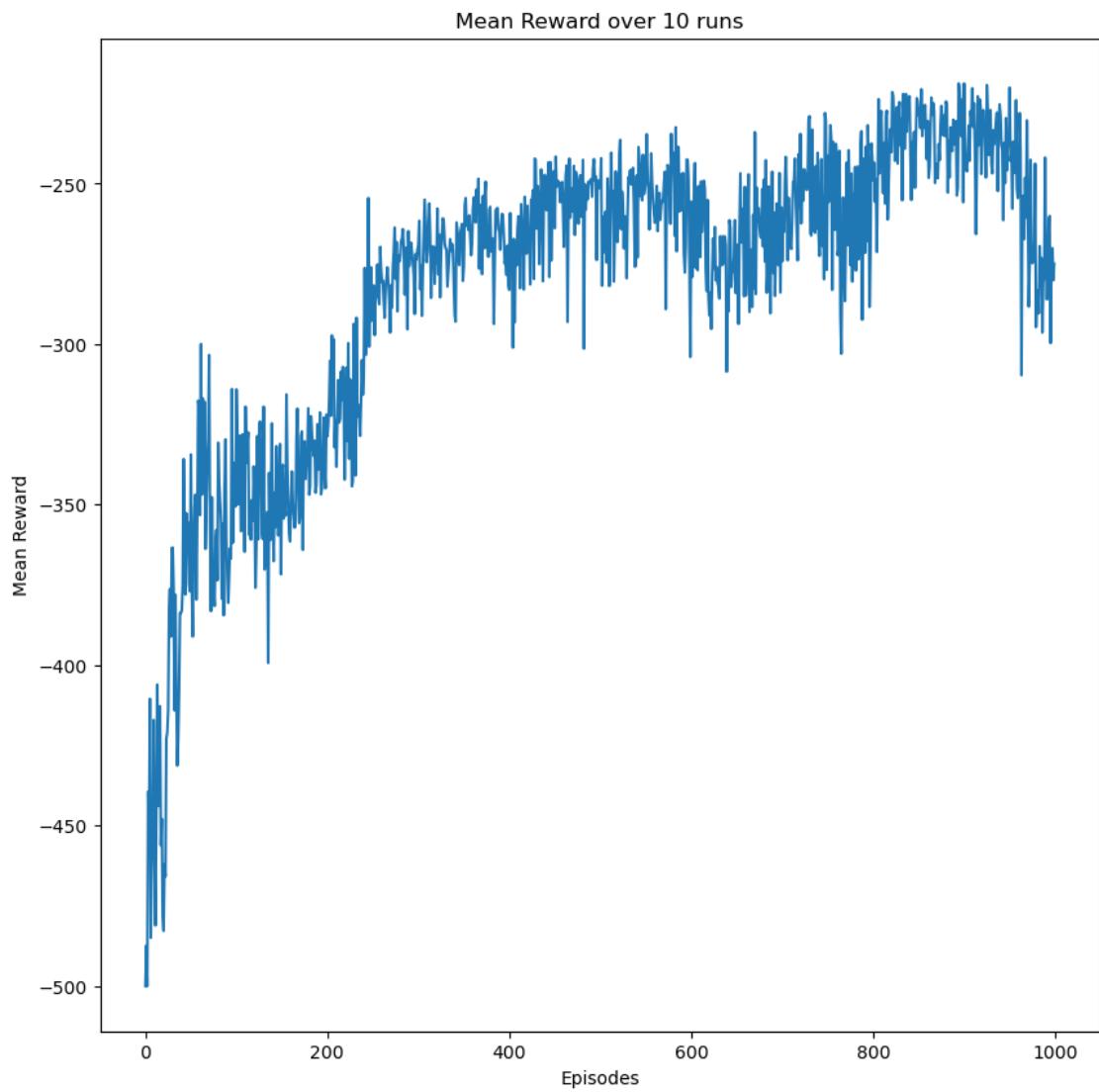
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Episode 730 Reward -107.000000 Average Reward -213.600000
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Episode 760 Reward -166.000000 Average Reward -271.300000
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Episode 780 Reward -349.000000 Average Reward -351.600000
Episode 790 Reward -500.000000 Average Reward -335.000000
Episode 800 Reward -146.000000 Average Reward -288.700000
Episode 810 Reward -82.000000 Average Reward -258.700000
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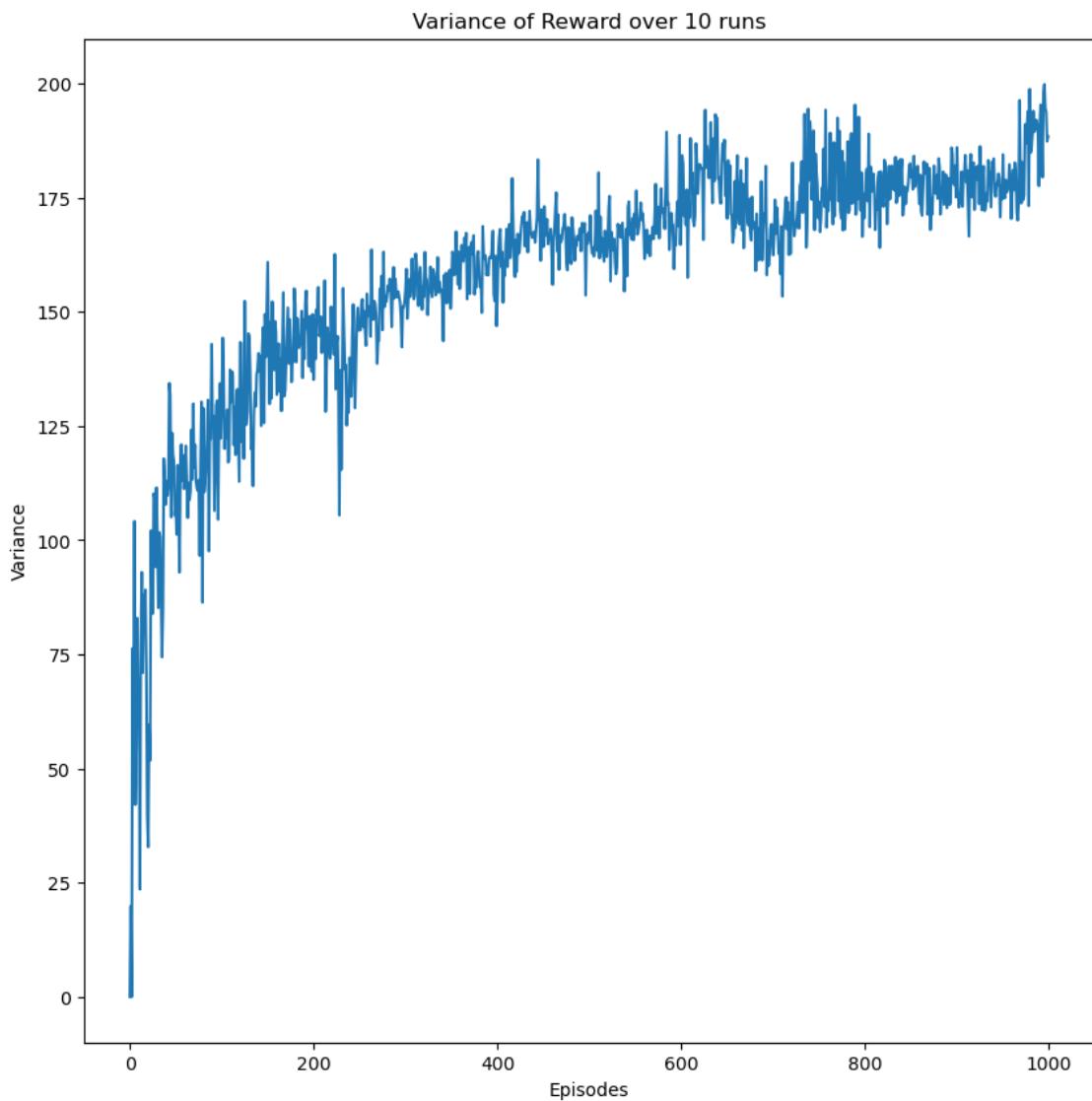
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Episode 890 Reward -150.000000 Average Reward -94.800000
Episode 900 Reward -88.000000 Average Reward -89.900000
Episode 910 Reward -63.000000 Average Reward -94.700000
Episode 920 Reward -86.000000 Average Reward -88.700000
Episode 930 Reward -93.000000 Average Reward -76.500000
Episode 940 Reward -80.000000 Average Reward -98.800000
Episode 950 Reward -71.000000 Average Reward -98.400000
Episode 960 Reward -78.000000 Average Reward -82.000000
Episode 970 Reward -76.000000 Average Reward -90.300000
Episode 980 Reward -87.000000 Average Reward -85.300000
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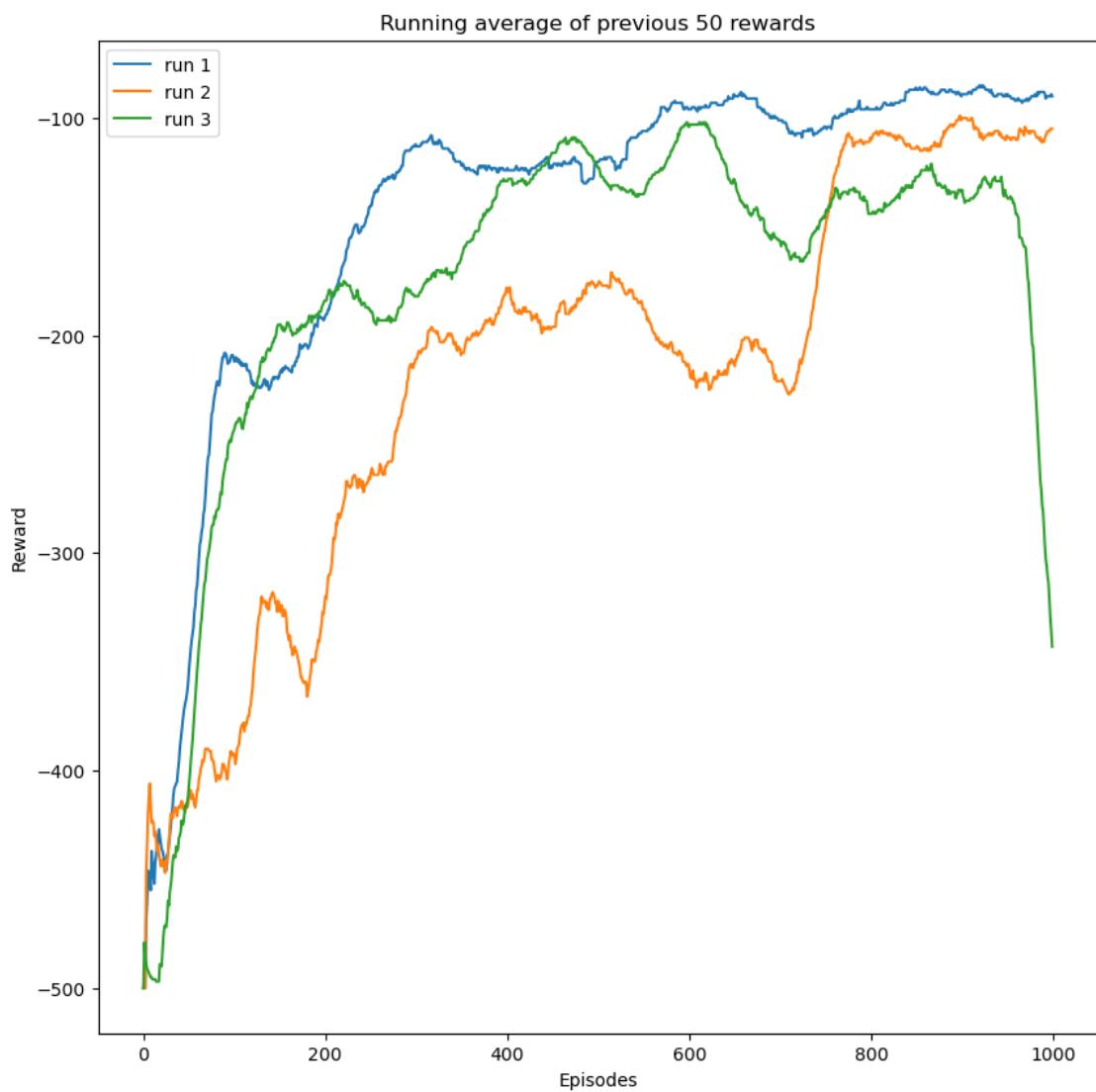
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Episode 50 Reward -381.000000 Average Reward -336.100000
Episode 60 Reward -417.000000 Average Reward -408.500000
Episode 70 Reward -315.000000 Average Reward -392.000000
Episode 80 Reward -318.000000 Average Reward -297.900000
Episode 90 Reward -263.000000 Average Reward -277.100000
Episode 100 Reward -325.000000 Average Reward -253.400000
Episode 110 Reward -144.000000 Average Reward -249.600000
Episode 120 Reward -223.000000 Average Reward -258.300000
Episode 130 Reward -331.000000 Average Reward -300.600000
Episode 140 Reward -170.000000 Average Reward -256.100000
Episode 150 Reward -179.000000 Average Reward -229.600000
Episode 160 Reward -192.000000 Average Reward -178.800000
Episode 170 Reward -164.000000 Average Reward -195.900000
Episode 180 Reward -149.000000 Average Reward -199.700000
Episode 190 Reward -206.000000 Average Reward -170.300000
Episode 200 Reward -163.000000 Average Reward -181.200000
Episode 210 Reward -170.000000 Average Reward -161.200000
Episode 220 Reward -177.000000 Average Reward -175.900000
Episode 230 Reward -166.000000 Average Reward -207.500000
Episode 240 Reward -186.000000 Average Reward -180.400000
Episode 250 Reward -196.000000 Average Reward -186.600000
Episode 260 Reward -180.000000 Average Reward -177.200000
Episode 270 Reward -256.000000 Average Reward -193.800000
Episode 280 Reward -184.000000 Average Reward -187.100000
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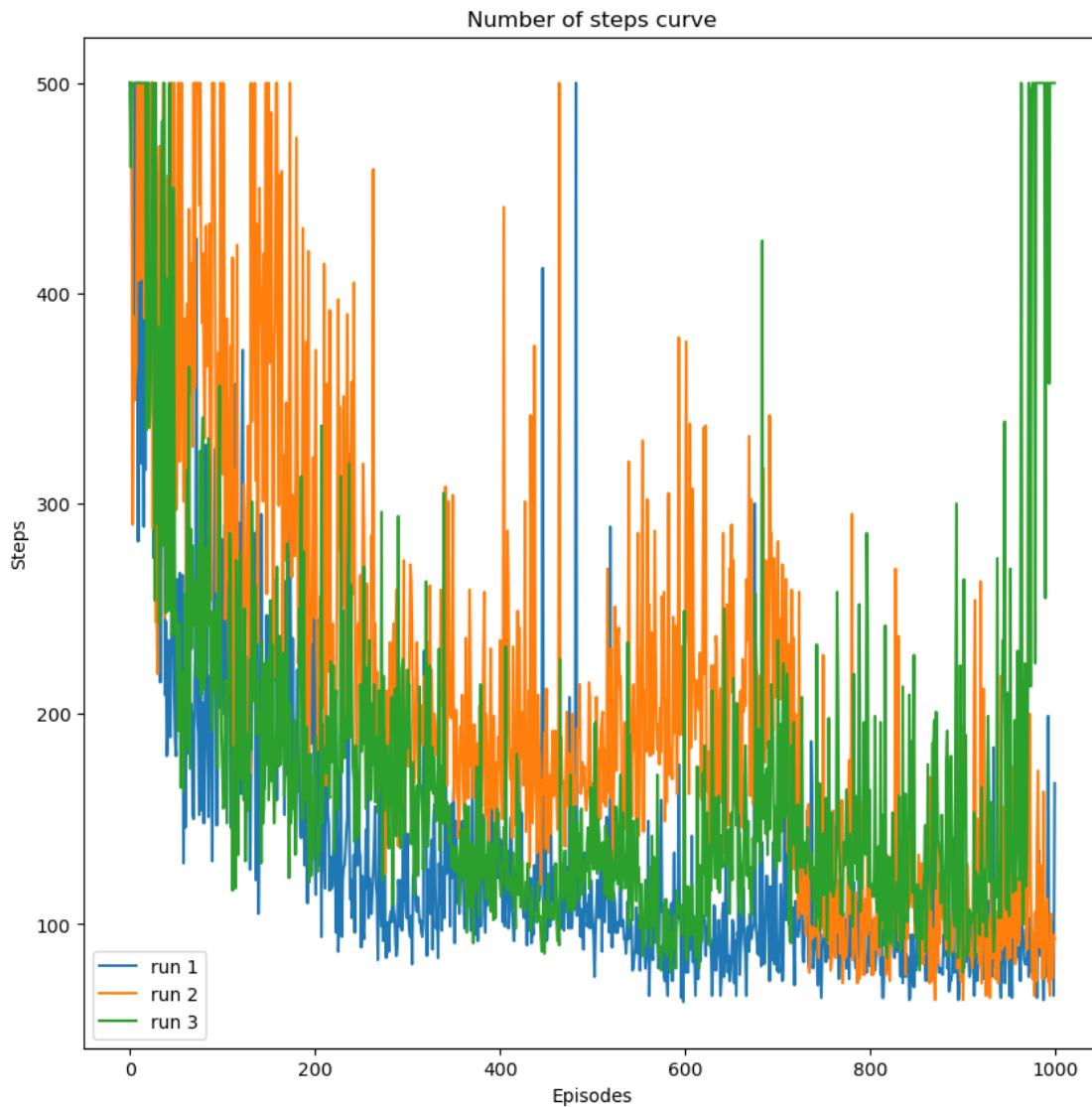
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Episode 360 Reward -163.000000 Average Reward -155.200000
Episode 370 Reward -129.000000 Average Reward -137.800000
Episode 380 Reward -124.000000 Average Reward -138.900000
Episode 390 Reward -124.000000 Average Reward -137.200000
Episode 400 Reward -226.000000 Average Reward -124.500000
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Episode 420 Reward -102.000000 Average Reward -108.400000
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Episode 490 Reward -136.000000 Average Reward -133.200000
Episode 500 Reward -124.000000 Average Reward -133.800000
Episode 510 Reward -117.000000 Average Reward -149.800000
Episode 520 Reward -133.000000 Average Reward -148.900000
Episode 530 Reward -211.000000 Average Reward -153.600000
Episode 540 Reward -161.000000 Average Reward -157.300000
Episode 550 Reward -128.000000 Average Reward -143.300000
Episode 560 Reward -176.000000 Average Reward -155.700000
Episode 570 Reward -181.000000 Average Reward -152.600000
Episode 580 Reward -140.000000 Average Reward -156.800000
Episode 590 Reward -145.000000 Average Reward -144.400000
Episode 600 Reward -151.000000 Average Reward -164.200000
Episode 610 Reward -119.000000 Average Reward -130.100000
Episode 620 Reward -110.000000 Average Reward -111.200000
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Episode 640 Reward -109.000000 Average Reward -99.200000
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Episode 660 Reward -133.000000 Average Reward -116.800000
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Episode 680 Reward -108.000000 Average Reward -96.300000
Episode 690 Reward -112.000000 Average Reward -115.200000
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Episode 800 Reward -153.000000 Average Reward -142.900000
Episode 810 Reward -130.000000 Average Reward -147.700000
Episode 820 Reward -131.000000 Average Reward -158.800000
Episode 830 Reward -150.000000 Average Reward -155.300000
Episode 840 Reward -158.000000 Average Reward -166.100000
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Episode 870 Reward -172.000000 Average Reward -175.000000
Episode 880 Reward -175.000000 Average Reward -179.100000
Episode 890 Reward -154.000000 Average Reward -182.700000
Episode 900 Reward -340.000000 Average Reward -200.400000
Episode 910 Reward -154.000000 Average Reward -194.500000
Episode 920 Reward -167.000000 Average Reward -200.900000
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Episode 940 Reward -145.000000 Average Reward -200.900000
Episode 950 Reward -186.000000 Average Reward -198.100000
Episode 960 Reward -224.000000 Average Reward -231.400000
Episode 970 Reward -211.000000 Average Reward -296.000000
Episode 980 Reward -464.000000 Average Reward -259.600000
Episode 990 Reward -206.000000 Average Reward -296.300000
Episode 1000 Reward -224.000000 Average Reward -287.900000
0:03:26.987248









```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [1024, 512]
LR = 1e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'Acrobot-v1'
SOLVE_CUTOFF = -100.0
STEP = 5

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{NUM_HIDDEN}_{HIDDEN_SIZES}_{LR}_{ENV_NAME}_{NUM_EPISODES}_{NSTEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

Episode	Reward	Average Reward
10	-492.000000	-487.500000
20	-402.000000	-371.900000
30	-330.000000	-387.800000
40	-500.000000	-434.200000
50	-500.000000	-491.700000
60	-500.000000	-500.000000
70	-500.000000	-500.000000
80	-500.000000	-500.000000
90	-319.000000	-467.600000
100	-483.000000	-454.100000
110	-380.000000	-361.100000
120	-374.000000	-347.000000
130	-418.000000	-434.200000
140	-500.000000	-430.300000
150	-425.000000	-466.200000
160	-500.000000	-458.500000
170	-499.000000	-468.800000
180	-500.000000	-486.200000
190	-463.000000	-480.500000
200	-370.000000	-409.000000
210	-320.000000	-364.400000
220	-333.000000	-311.600000
230	-306.000000	-322.600000
240	-203.000000	-275.900000
250	-251.000000	-259.100000
260	-250.000000	-240.400000
270	-163.000000	-217.700000
280	-244.000000	-235.600000
290	-232.000000	-227.100000
300	-256.000000	-249.200000
310	-195.000000	-229.600000
320	-258.000000	-234.600000
330	-179.000000	-188.100000
340	-164.000000	-214.400000

Episode 350 Reward -143.000000 Average Reward -202.400000
Episode 360 Reward -231.000000 Average Reward -228.400000
Episode 370 Reward -191.000000 Average Reward -195.800000
Episode 380 Reward -150.000000 Average Reward -221.300000
Episode 390 Reward -261.000000 Average Reward -227.200000
Episode 400 Reward -235.000000 Average Reward -218.300000
Episode 410 Reward -148.000000 Average Reward -189.900000
Episode 420 Reward -175.000000 Average Reward -197.700000
Episode 430 Reward -220.000000 Average Reward -203.000000
Episode 440 Reward -174.000000 Average Reward -181.900000
Episode 450 Reward -180.000000 Average Reward -185.700000
Episode 460 Reward -178.000000 Average Reward -185.800000
Episode 470 Reward -162.000000 Average Reward -177.400000
Episode 480 Reward -150.000000 Average Reward -196.800000
Episode 490 Reward -193.000000 Average Reward -166.700000
Episode 500 Reward -257.000000 Average Reward -180.000000
Episode 510 Reward -217.000000 Average Reward -174.300000
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Episode 580 Reward -190.000000 Average Reward -166.700000
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Episode 600 Reward -169.000000 Average Reward -148.800000
Episode 610 Reward -239.000000 Average Reward -170.000000
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Episode 640 Reward -196.000000 Average Reward -158.600000
Episode 650 Reward -114.000000 Average Reward -133.000000
Episode 660 Reward -122.000000 Average Reward -123.900000
Episode 670 Reward -123.000000 Average Reward -122.600000
Episode 680 Reward -141.000000 Average Reward -134.200000
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Episode 870 Reward -103.000000 Average Reward -129.100000
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Episode 970 Reward -154.000000 Average Reward -124.900000
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Episode 60 Reward -251.000000 Average Reward -320.700000
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Episode 80 Reward -445.000000 Average Reward -325.700000
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Episode 100 Reward -480.000000 Average Reward -425.600000
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Episode 120 Reward -500.000000 Average Reward -462.600000
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Episode	150	Reward	-500.000000	Average Reward	-500.000000
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Episode	180	Reward	-500.000000	Average Reward	-500.000000
Episode	190	Reward	-500.000000	Average Reward	-500.000000
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Episode	230	Reward	-500.000000	Average Reward	-500.000000
Episode	240	Reward	-500.000000	Average Reward	-500.000000
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Episode	260	Reward	-500.000000	Average Reward	-484.300000
Episode	270	Reward	-396.000000	Average Reward	-411.800000
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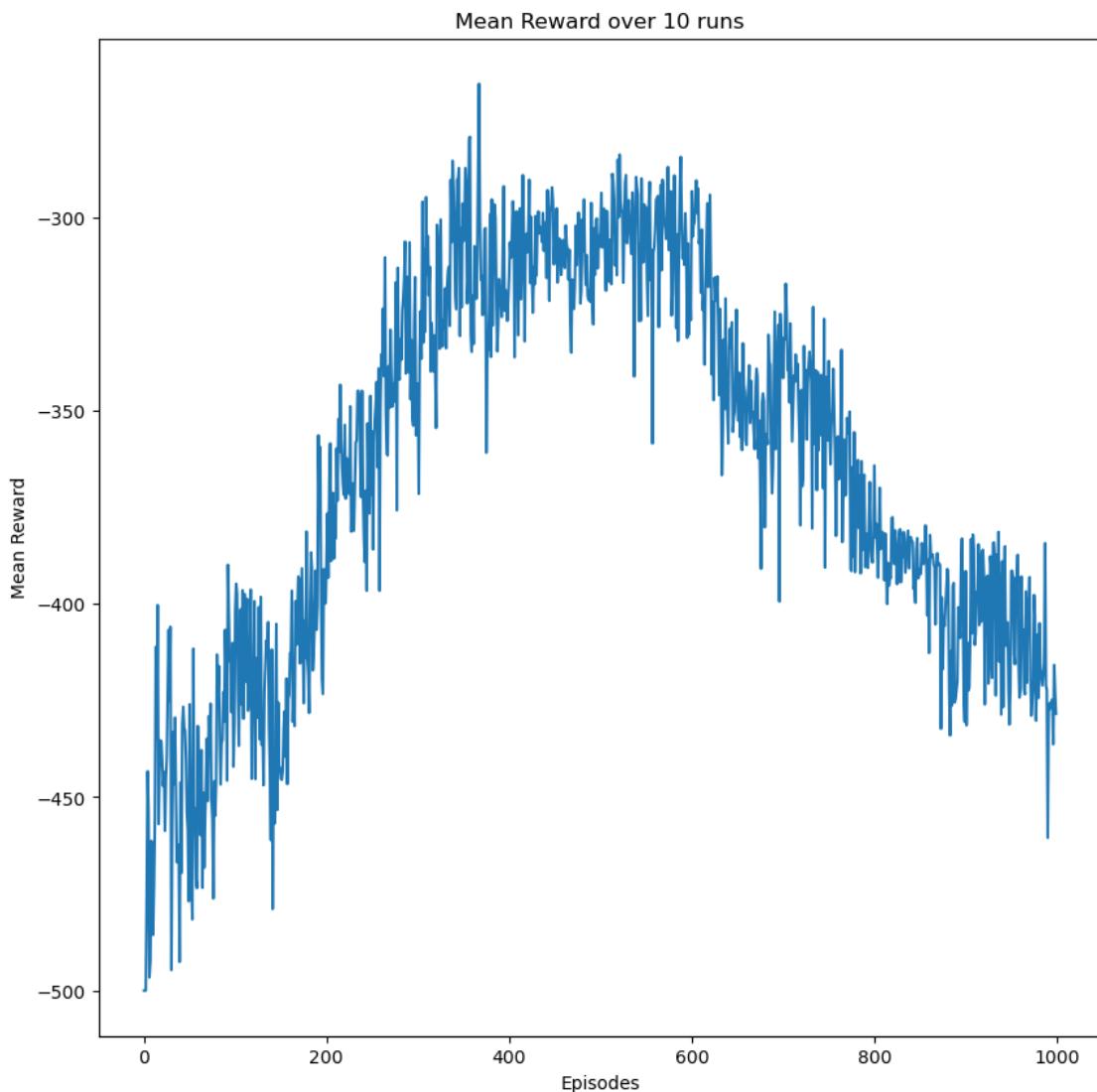
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Episode 100 Reward -193.000000 Average Reward -199.900000
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Episode 120 Reward -273.000000 Average Reward -262.500000
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Episode 210 Reward -329.000000 Average Reward -243.100000
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Episode 310 Reward -133.000000 Average Reward -174.600000
Episode 320 Reward -152.000000 Average Reward -183.000000
Episode 330 Reward -139.000000 Average Reward -154.100000
Episode 340 Reward -116.000000 Average Reward -138.200000
Episode 350 Reward -120.000000 Average Reward -137.500000
Episode 360 Reward -207.000000 Average Reward -134.800000
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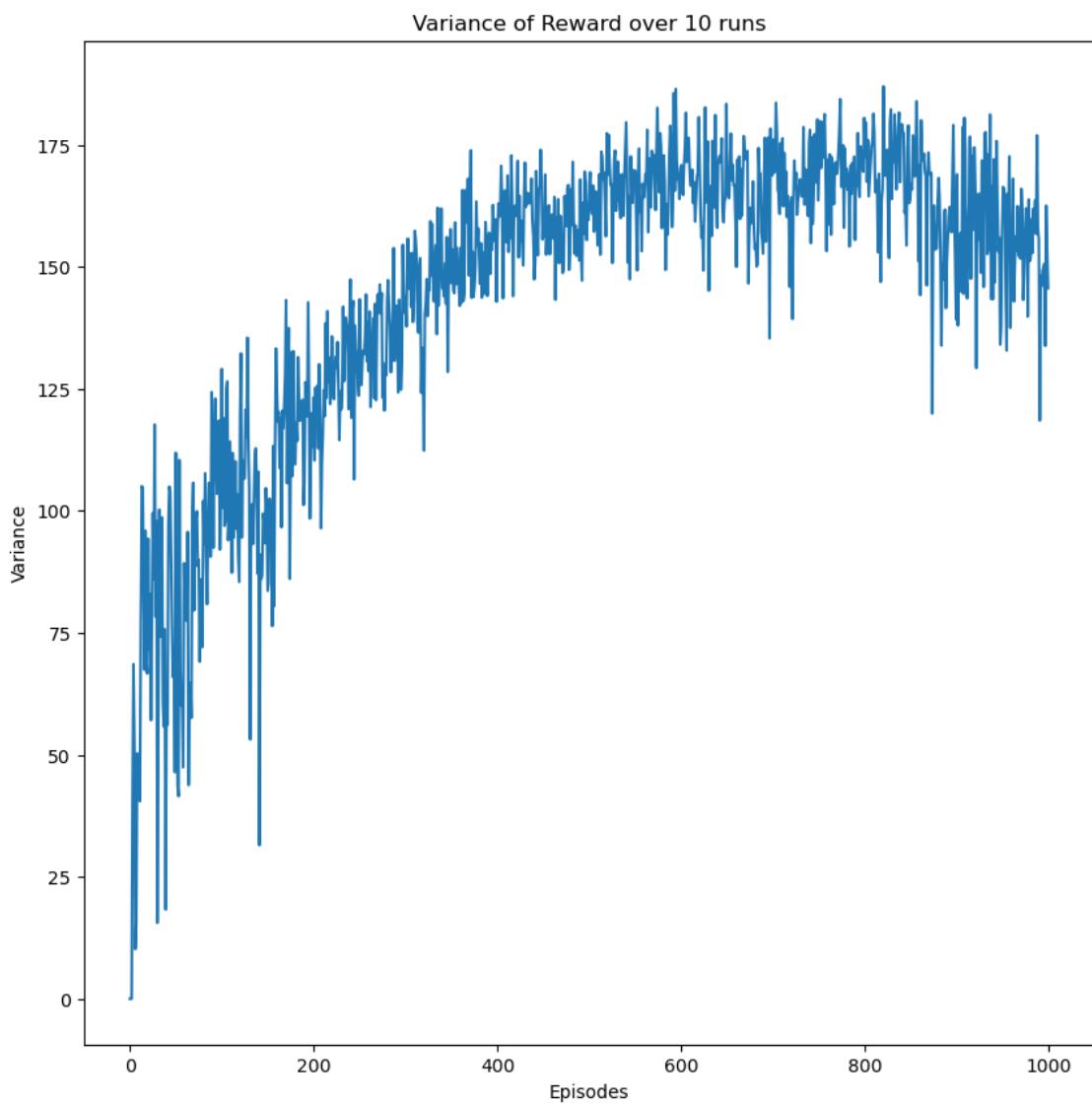
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Episode 490 Reward -114.000000 Average Reward -146.500000
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Episode 580 Reward -223.000000 Average Reward -115.600000
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Episode 640 Reward -149.000000 Average Reward -123.800000
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Episode 660 Reward -178.000000 Average Reward -139.900000
Episode 670 Reward -126.000000 Average Reward -135.400000
Episode 680 Reward -222.000000 Average Reward -148.200000
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Episode 710 Reward -154.000000 Average Reward -144.700000
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Episode 730 Reward -141.000000 Average Reward -151.600000
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Episode 760 Reward -109.000000 Average Reward -156.300000
Episode 770 Reward -108.000000 Average Reward -131.400000
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Episode 790 Reward -151.000000 Average Reward -129.100000
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Episode 810 Reward -81.000000 Average Reward -121.300000
Episode 820 Reward -153.000000 Average Reward -142.600000
Episode 830 Reward -146.000000 Average Reward -138.000000
Episode 840 Reward -99.000000 Average Reward -125.600000
Episode 850 Reward -147.000000 Average Reward -144.700000
Episode 860 Reward -161.000000 Average Reward -149.800000
Episode 870 Reward -104.000000 Average Reward -167.100000
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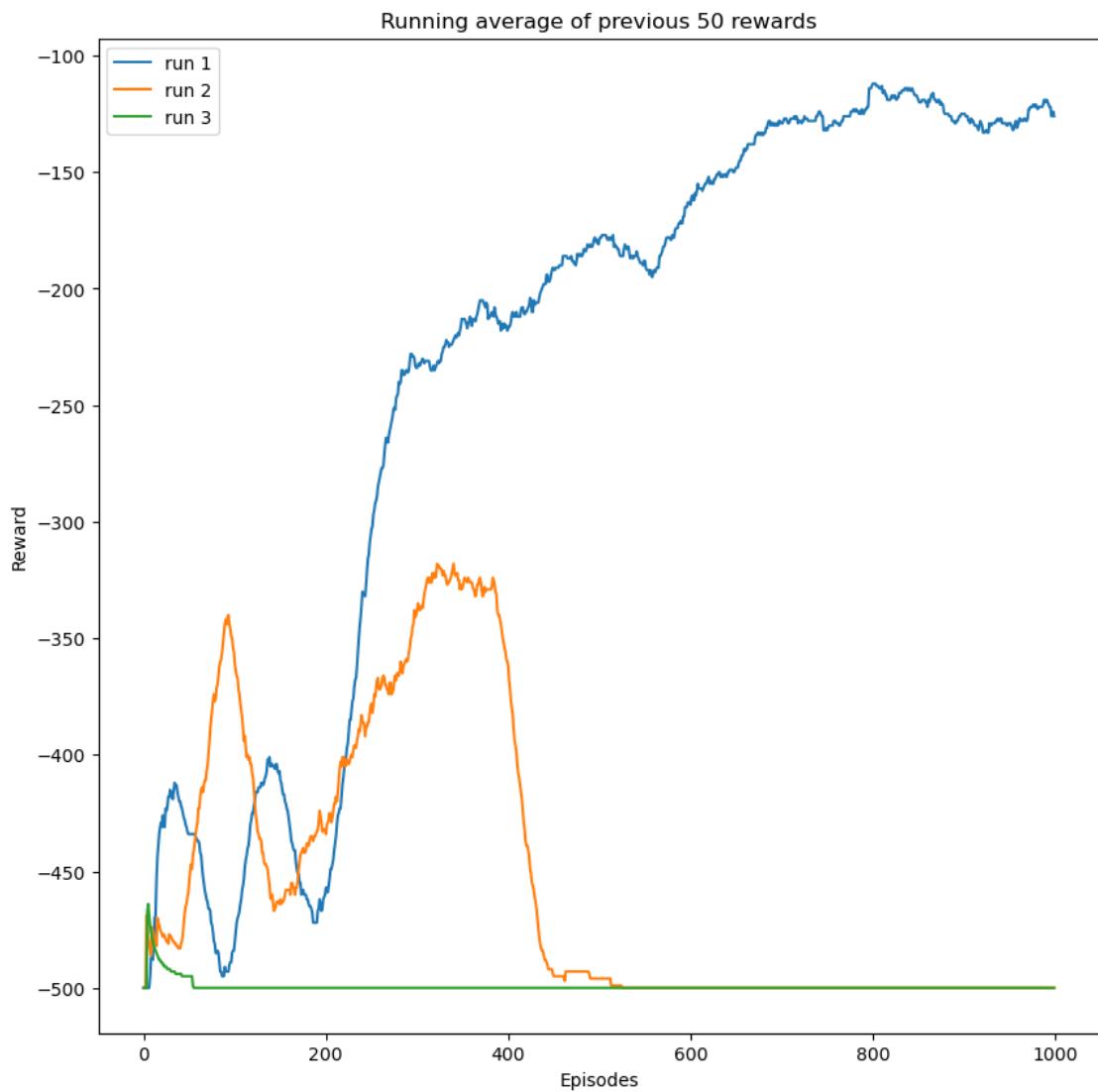
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Episode 130 Reward -297.000000 Average Reward -279.100000
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Episode 170 Reward -235.000000 Average Reward -370.900000
Episode 180 Reward -223.000000 Average Reward -303.800000
Episode 190 Reward -297.000000 Average Reward -233.400000
Episode 200 Reward -299.000000 Average Reward -276.100000
Episode 210 Reward -190.000000 Average Reward -233.600000
Episode 220 Reward -169.000000 Average Reward -184.900000
Episode 230 Reward -170.000000 Average Reward -180.100000
Episode 240 Reward -178.000000 Average Reward -178.700000
Episode 250 Reward -129.000000 Average Reward -191.000000
Episode 260 Reward -153.000000 Average Reward -168.800000
Episode 270 Reward -169.000000 Average Reward -209.100000
Episode 280 Reward -174.000000 Average Reward -179.200000
Episode 290 Reward -147.000000 Average Reward -154.000000
Episode 300 Reward -146.000000 Average Reward -167.900000
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Episode 330 Reward -136.000000 Average Reward -163.800000
Episode 340 Reward -137.000000 Average Reward -158.500000
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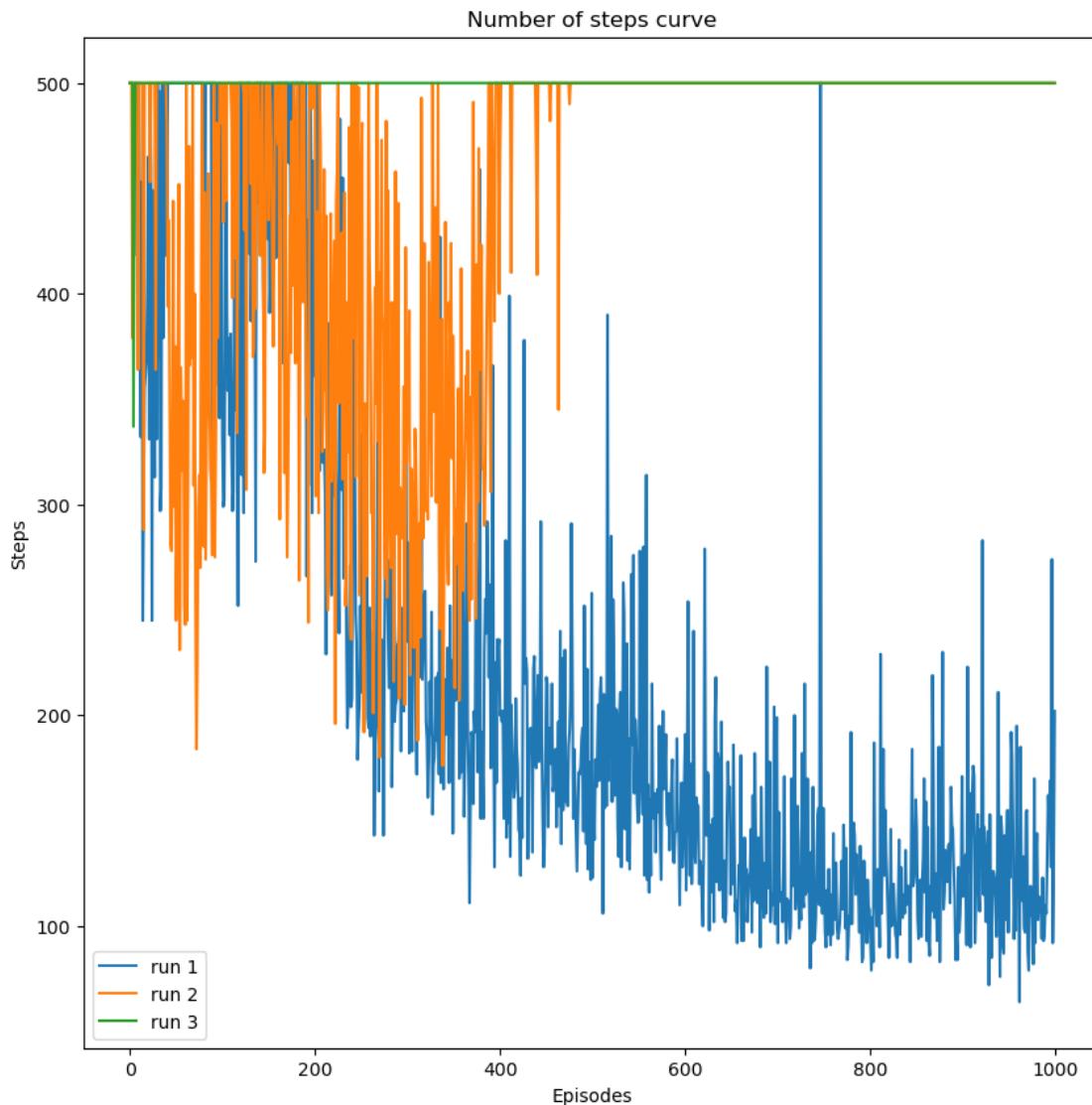
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Episode 420 Reward -202.000000 Average Reward -166.800000
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Episode 440 Reward -145.000000 Average Reward -166.100000
Episode 450 Reward -205.000000 Average Reward -170.500000
Episode 460 Reward -244.000000 Average Reward -226.100000
Episode 470 Reward -346.000000 Average Reward -301.500000
Episode 480 Reward -288.000000 Average Reward -227.900000
Episode 490 Reward -291.000000 Average Reward -253.000000
Episode 500 Reward -166.000000 Average Reward -241.700000
Episode 510 Reward -210.000000 Average Reward -205.400000
Episode 520 Reward -133.000000 Average Reward -186.200000
Episode 530 Reward -173.000000 Average Reward -148.700000
Episode 540 Reward -140.000000 Average Reward -160.000000
Episode 550 Reward -145.000000 Average Reward -156.800000
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Episode 580 Reward -154.000000 Average Reward -136.500000
Episode 590 Reward -108.000000 Average Reward -139.900000
Episode 600 Reward -151.000000 Average Reward -142.500000
Episode 610 Reward -133.000000 Average Reward -148.600000
Episode 620 Reward -179.000000 Average Reward -195.400000
Episode 630 Reward -298.000000 Average Reward -222.300000
Episode 640 Reward -340.000000 Average Reward -282.600000
Episode 650 Reward -291.000000 Average Reward -298.800000
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Episode 730 Reward -120.000000 Average Reward -201.500000
Episode 740 Reward -252.000000 Average Reward -245.600000
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Episode 760 Reward -282.000000 Average Reward -222.900000
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Episode 820 Reward -389.000000 Average Reward -470.100000
Episode 830 Reward -500.000000 Average Reward -483.200000
Episode 840 Reward -500.000000 Average Reward -500.000000
Episode 850 Reward -500.000000 Average Reward -500.000000

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Episode 860 Reward -500.000000 Average Reward -500.000000
Episode 870 Reward -500.000000 Average Reward -500.000000
Episode 880 Reward -500.000000 Average Reward -500.000000
Episode 890 Reward -500.000000 Average Reward -500.000000
Episode 900 Reward -500.000000 Average Reward -500.000000
Episode 910 Reward -500.000000 Average Reward -500.000000
Episode 920 Reward -500.000000 Average Reward -500.000000
Episode 930 Reward -500.000000 Average Reward -500.000000
Episode 940 Reward -500.000000 Average Reward -500.000000
Episode 950 Reward -500.000000 Average Reward -500.000000
Episode 960 Reward -500.000000 Average Reward -500.000000
Episode 970 Reward -500.000000 Average Reward -500.000000
Episode 980 Reward -500.000000 Average Reward -500.000000
Episode 990 Reward -500.000000 Average Reward -500.000000
Episode 1000 Reward -500.000000 Average Reward -500.000000
0:05:52.904385
```









```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [1024, 1024]
LR = 0.5e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'Acrobot-v1'
SOLVE_CUTOFF = -100.0
STEP = 5

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{hs}-{lr}-{env}-{numep}-{nstep}-{STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	-500.000000	-491.900000
20	-180.000000	-298.800000
30	-191.000000	-263.300000
40	-260.000000	-257.600000
50	-244.000000	-229.200000
60	-145.000000	-187.800000
70	-188.000000	-197.800000
80	-351.000000	-196.200000
90	-231.000000	-190.600000
100	-167.000000	-221.000000
110	-196.000000	-230.000000
120	-247.000000	-229.100000
130	-159.000000	-230.200000
140	-167.000000	-195.600000
150	-285.000000	-198.800000
160	-156.000000	-183.200000
170	-143.000000	-169.600000
180	-187.000000	-169.000000
190	-134.000000	-174.800000
200	-231.000000	-175.800000
210	-299.000000	-206.900000
220	-155.000000	-209.500000
230	-193.000000	-179.900000
240	-111.000000	-175.400000
250	-343.000000	-211.600000
260	-289.000000	-185.700000
270	-190.000000	-187.700000
280	-210.000000	-189.400000

Episode 290 Reward -209.000000 Average Reward -240.400000
Episode 300 Reward -213.000000 Average Reward -163.300000
Episode 310 Reward -109.000000 Average Reward -155.300000
Episode 320 Reward -121.000000 Average Reward -160.900000
Episode 330 Reward -114.000000 Average Reward -147.000000
Episode 340 Reward -137.000000 Average Reward -143.300000
Episode 350 Reward -149.000000 Average Reward -137.800000
Episode 360 Reward -154.000000 Average Reward -147.000000
Episode 370 Reward -117.000000 Average Reward -137.100000
Episode 380 Reward -107.000000 Average Reward -149.800000
Episode 390 Reward -131.000000 Average Reward -183.200000
Episode 400 Reward -119.000000 Average Reward -143.300000
Episode 410 Reward -153.000000 Average Reward -154.900000
Episode 420 Reward -179.000000 Average Reward -148.800000
Episode 430 Reward -138.000000 Average Reward -141.100000
Episode 440 Reward -104.000000 Average Reward -150.900000
Episode 450 Reward -111.000000 Average Reward -143.600000
Episode 460 Reward -103.000000 Average Reward -133.900000
Episode 470 Reward -156.000000 Average Reward -142.700000
Episode 480 Reward -189.000000 Average Reward -153.300000
Episode 490 Reward -124.000000 Average Reward -126.300000
Episode 500 Reward -126.000000 Average Reward -144.400000
Episode 510 Reward -196.000000 Average Reward -157.100000
Episode 520 Reward -108.000000 Average Reward -120.500000
Episode 530 Reward -123.000000 Average Reward -125.200000
Episode 540 Reward -140.000000 Average Reward -137.200000
Episode 550 Reward -125.000000 Average Reward -119.600000
Episode 560 Reward -89.000000 Average Reward -113.500000
Episode 570 Reward -112.000000 Average Reward -126.000000
Episode 580 Reward -131.000000 Average Reward -125.100000
Episode 590 Reward -118.000000 Average Reward -134.400000
Episode 600 Reward -105.000000 Average Reward -138.800000
Episode 610 Reward -122.000000 Average Reward -154.200000
Episode 620 Reward -107.000000 Average Reward -139.100000
Episode 630 Reward -126.000000 Average Reward -112.900000
Episode 640 Reward -120.000000 Average Reward -140.100000
Episode 650 Reward -125.000000 Average Reward -122.800000
Episode 660 Reward -107.000000 Average Reward -126.400000
Episode 670 Reward -104.000000 Average Reward -106.500000
Episode 680 Reward -98.000000 Average Reward -132.000000
Episode 690 Reward -111.000000 Average Reward -159.500000
Episode 700 Reward -139.000000 Average Reward -129.600000
Episode 710 Reward -140.000000 Average Reward -135.400000
Episode 720 Reward -226.000000 Average Reward -142.600000
Episode 730 Reward -93.000000 Average Reward -122.200000
Episode 740 Reward -138.000000 Average Reward -135.700000
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Episode 760 Reward -129.000000 Average Reward -139.200000

Episode 770 Reward -101.000000 Average Reward -131.700000
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Episode 950 Reward -140.000000 Average Reward -109.100000
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Episode 970 Reward -87.000000 Average Reward -126.500000
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Episode 990 Reward -126.000000 Average Reward -109.200000
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Episode 50 Reward -500.000000 Average Reward -489.400000
Episode 60 Reward -500.000000 Average Reward -500.000000
Episode 70 Reward -500.000000 Average Reward -500.000000
Episode 80 Reward -500.000000 Average Reward -500.000000
Episode 90 Reward -500.000000 Average Reward -500.000000
Episode 100 Reward -500.000000 Average Reward -500.000000
Episode 110 Reward -477.000000 Average Reward -443.100000
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Episode 130 Reward -500.000000 Average Reward -500.000000
Episode 140 Reward -500.000000 Average Reward -500.000000
Episode 150 Reward -500.000000 Average Reward -500.000000
Episode 160 Reward -500.000000 Average Reward -500.000000
Episode 170 Reward -500.000000 Average Reward -500.000000
Episode 180 Reward -500.000000 Average Reward -493.400000
Episode 190 Reward -500.000000 Average Reward -495.200000
Episode 200 Reward -500.000000 Average Reward -500.000000
Episode 210 Reward -500.000000 Average Reward -500.000000
Episode 220 Reward -500.000000 Average Reward -500.000000
Episode 230 Reward -500.000000 Average Reward -500.000000

Episode 720 Reward -500.000000 Average Reward -500.000000
Episode 730 Reward -500.000000 Average Reward -500.000000
Episode 740 Reward -500.000000 Average Reward -500.000000
Episode 750 Reward -500.000000 Average Reward -500.000000
Episode 760 Reward -500.000000 Average Reward -500.000000
Episode 770 Reward -500.000000 Average Reward -500.000000
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Episode 970 Reward -500.000000 Average Reward -500.000000
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Episode 60 Reward -490.000000 Average Reward -383.400000
Episode 70 Reward -383.000000 Average Reward -337.700000
Episode 80 Reward -324.000000 Average Reward -331.400000
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Episode 180 Reward -469.000000 Average Reward -379.600000

Episode 190 Reward -240.000000 Average Reward -271.200000
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Episode 220 Reward -224.000000 Average Reward -253.000000
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Episode 380 Reward -227.000000 Average Reward -192.700000
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Episode 400 Reward -204.000000 Average Reward -210.000000
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Episode 430 Reward -155.000000 Average Reward -183.300000
Episode 440 Reward -116.000000 Average Reward -192.300000
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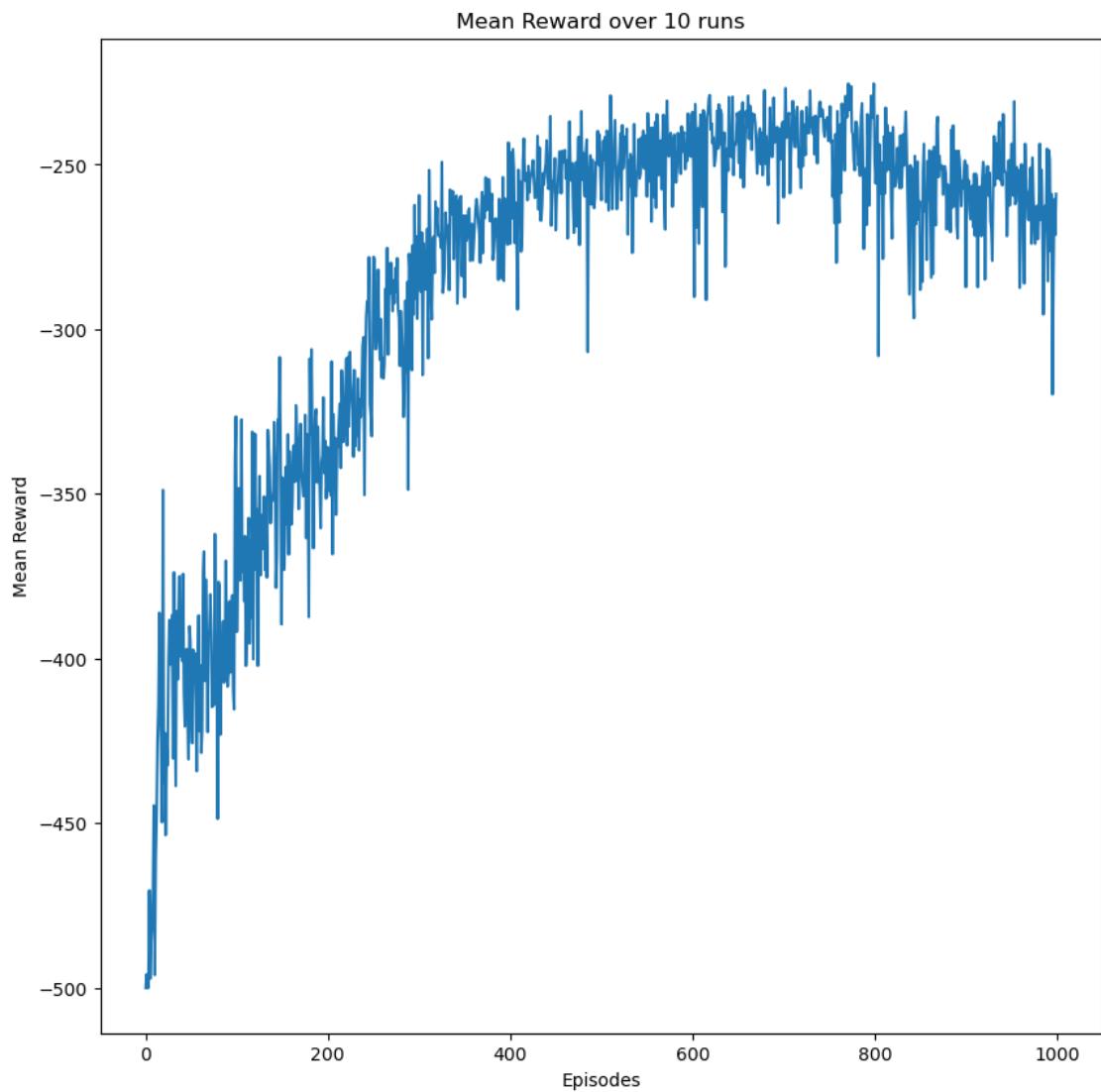
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Episode 500 Reward -214.000000 Average Reward -143.400000
Episode 510 Reward -154.000000 Average Reward -141.500000
Episode 520 Reward -172.000000 Average Reward -159.000000
Episode 530 Reward -166.000000 Average Reward -151.700000
Episode 540 Reward -128.000000 Average Reward -160.600000
Episode 550 Reward -139.000000 Average Reward -148.500000
Episode 560 Reward -146.000000 Average Reward -151.400000
Episode 570 Reward -186.000000 Average Reward -156.500000
Episode 580 Reward -173.000000 Average Reward -144.100000
Episode 590 Reward -107.000000 Average Reward -137.600000
Episode 600 Reward -133.000000 Average Reward -131.800000
Episode 610 Reward -93.000000 Average Reward -133.600000
Episode 620 Reward -133.000000 Average Reward -142.900000
Episode 630 Reward -131.000000 Average Reward -138.900000
Episode 640 Reward -104.000000 Average Reward -144.000000
Episode 650 Reward -113.000000 Average Reward -124.400000
Episode 660 Reward -112.000000 Average Reward -127.300000
Episode 670 Reward -93.000000 Average Reward -121.500000
Episode 680 Reward -101.000000 Average Reward -137.100000
Episode 690 Reward -127.000000 Average Reward -132.300000
Episode 700 Reward -118.000000 Average Reward -183.500000
Episode 710 Reward -169.000000 Average Reward -159.600000
Episode 720 Reward -321.000000 Average Reward -173.500000
Episode 730 Reward -149.000000 Average Reward -137.100000
Episode 740 Reward -126.000000 Average Reward -135.400000
Episode 750 Reward -209.000000 Average Reward -145.600000
Episode 760 Reward -141.000000 Average Reward -179.900000
Episode 770 Reward -219.000000 Average Reward -152.200000
Episode 780 Reward -112.000000 Average Reward -125.300000
Episode 790 Reward -147.000000 Average Reward -185.500000
Episode 800 Reward -140.000000 Average Reward -129.400000
Episode 810 Reward -162.000000 Average Reward -180.500000
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Episode 830 Reward -187.000000 Average Reward -164.600000
Episode 840 Reward -121.000000 Average Reward -137.100000

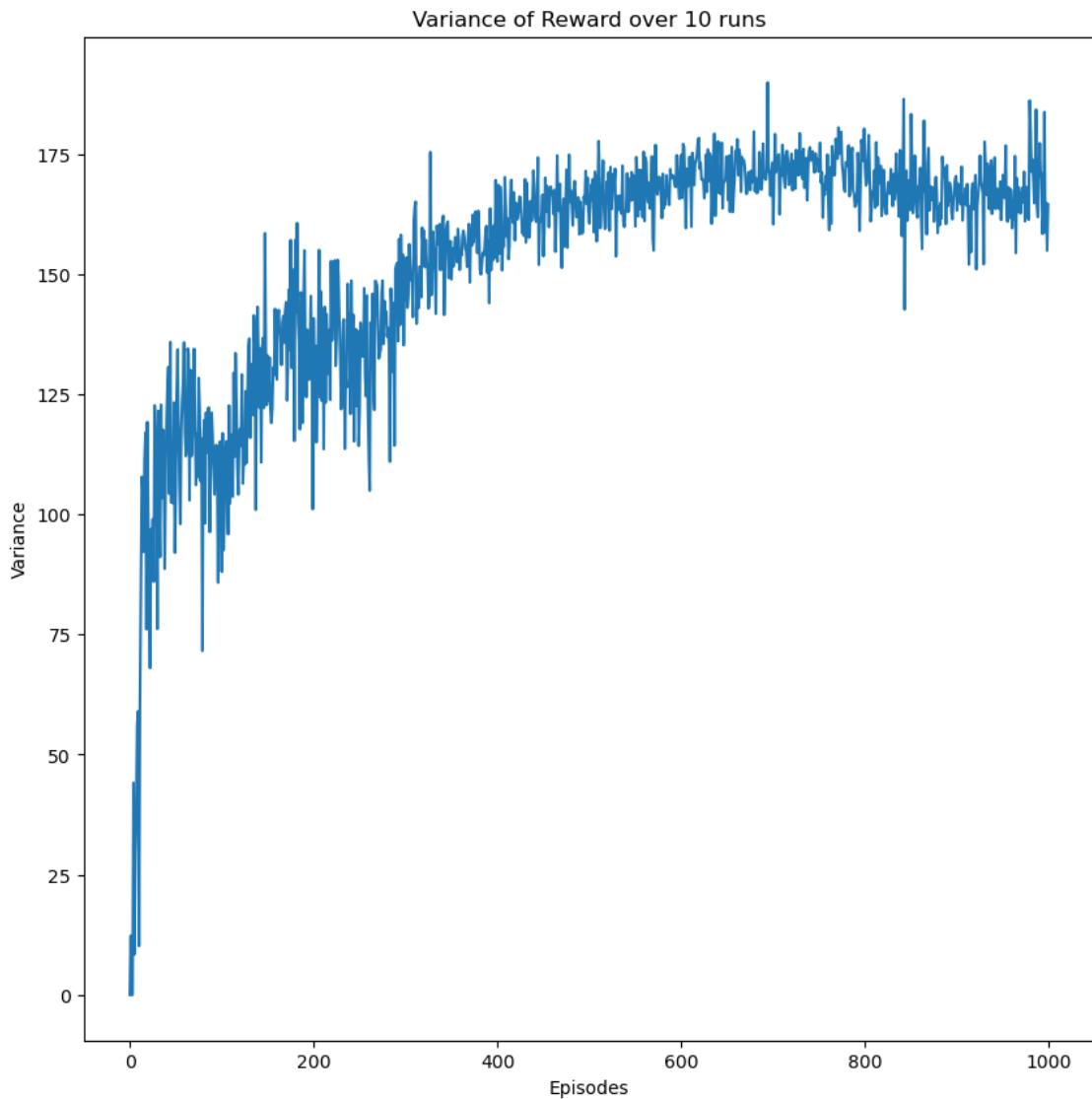
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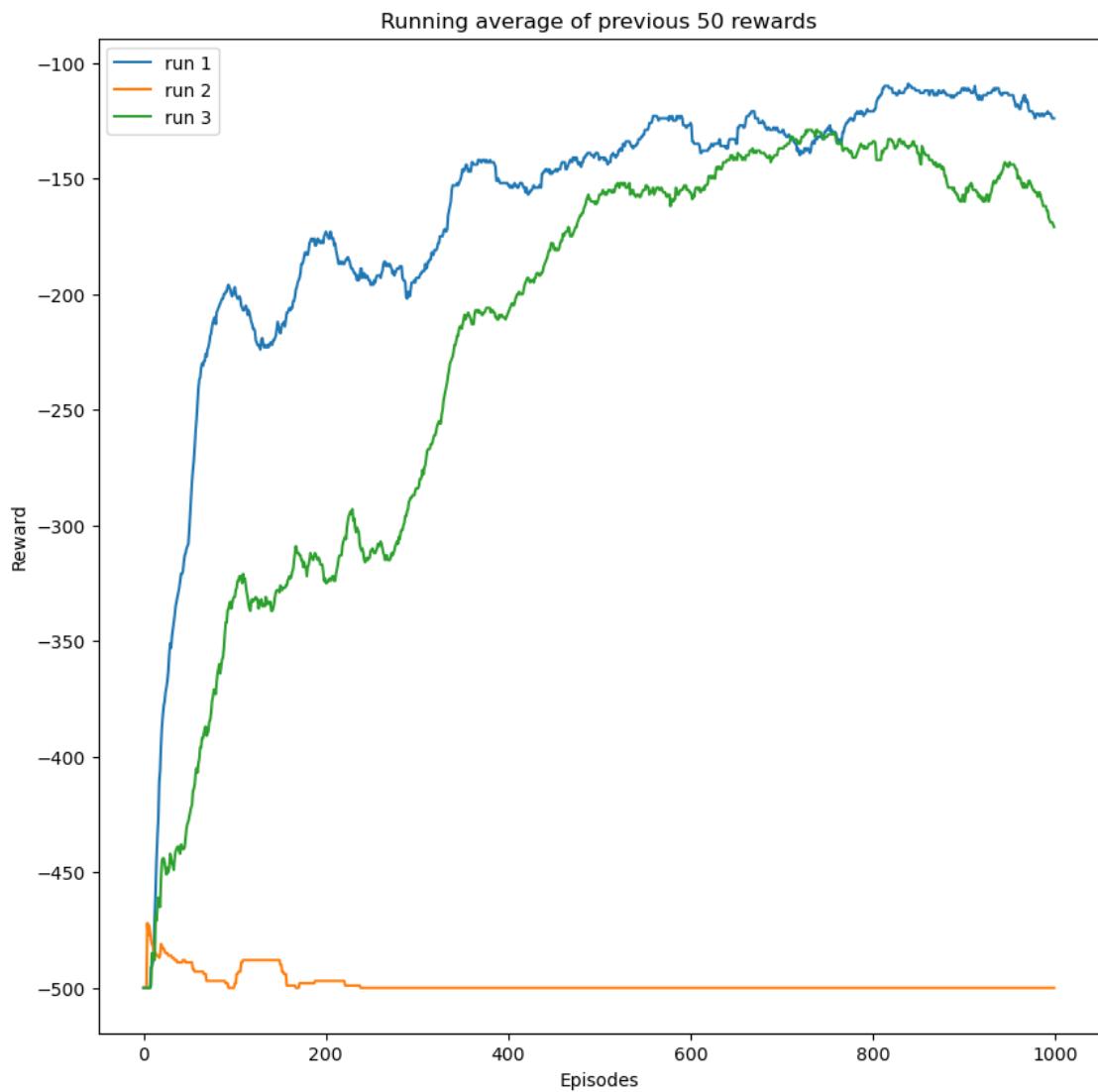
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 Episode 40 Reward -251.000000 Average Reward -277.100000
 Episode 50 Reward -290.000000 Average Reward -271.200000
 Episode 60 Reward -159.000000 Average Reward -241.200000
 Episode 70 Reward -177.000000 Average Reward -221.800000
 Episode 80 Reward -348.000000 Average Reward -247.500000
 Episode 90 Reward -255.000000 Average Reward -293.800000
 Episode 100 Reward -179.000000 Average Reward -310.800000
 Episode 110 Reward -360.000000 Average Reward -295.100000
 Episode 120 Reward -166.000000 Average Reward -217.700000
 Episode 130 Reward -159.000000 Average Reward -233.600000
 Episode 140 Reward -203.000000 Average Reward -198.400000
 Episode 150 Reward -500.000000 Average Reward -255.500000
 Episode 160 Reward -275.000000 Average Reward -290.900000
 Episode 170 Reward -222.000000 Average Reward -229.200000
 Episode 180 Reward -252.000000 Average Reward -248.500000
 Episode 190 Reward -279.000000 Average Reward -228.300000
 Episode 200 Reward -253.000000 Average Reward -236.500000
 Episode 210 Reward -280.000000 Average Reward -225.200000
 Episode 220 Reward -279.000000 Average Reward -276.700000
 Episode 230 Reward -178.000000 Average Reward -178.900000
 Episode 240 Reward -223.000000 Average Reward -223.700000
 Episode 250 Reward -179.000000 Average Reward -235.900000
 Episode 260 Reward -193.000000 Average Reward -182.300000
 Episode 270 Reward -203.000000 Average Reward -211.200000
 Episode 280 Reward -154.000000 Average Reward -157.800000
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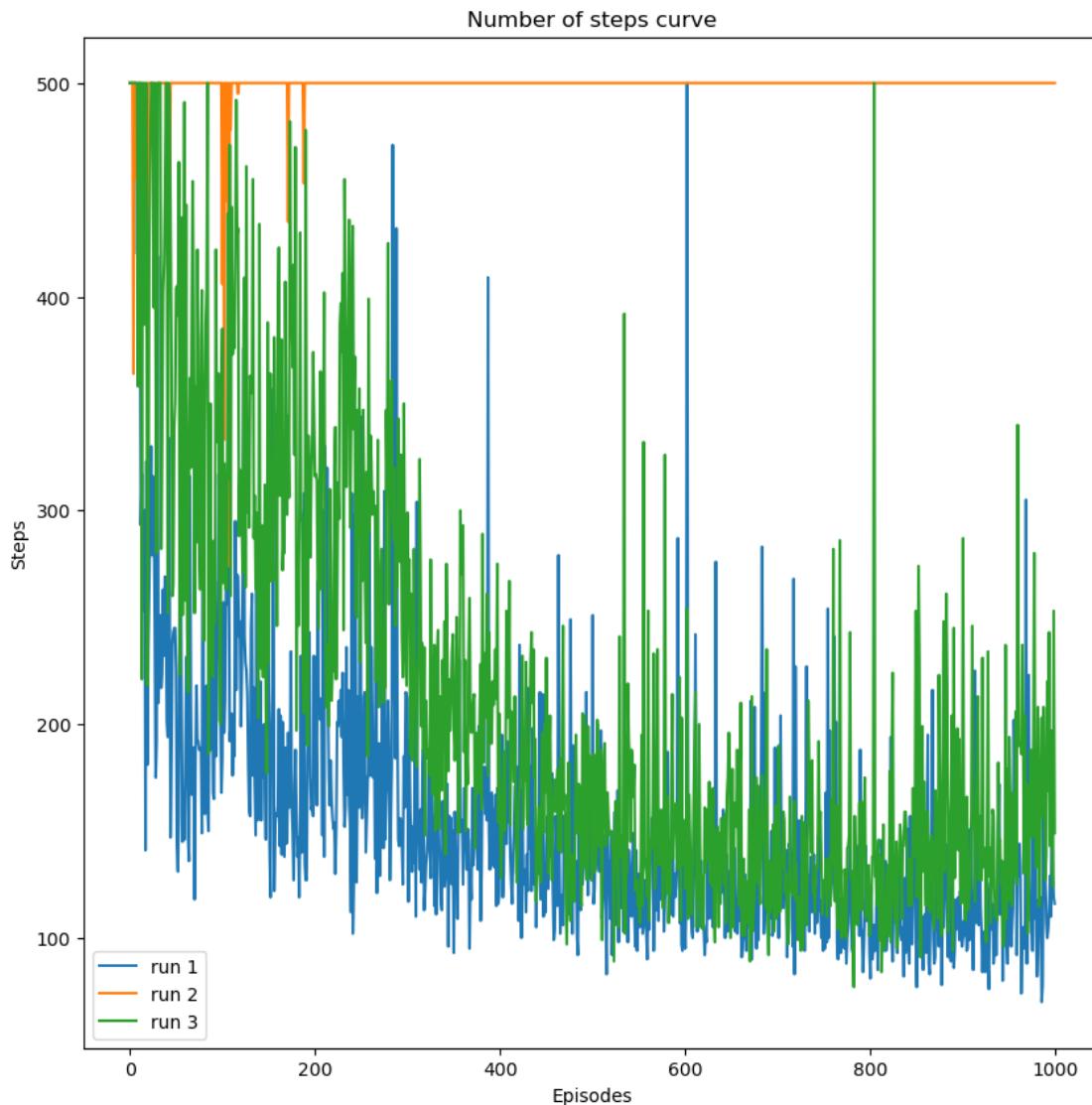
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Episode 360 Reward -140.000000 Average Reward -191.800000
Episode 370 Reward -108.000000 Average Reward -179.400000
Episode 380 Reward -159.000000 Average Reward -150.900000
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Episode 510 Reward -114.000000 Average Reward -151.300000
Episode 520 Reward -259.000000 Average Reward -159.000000
Episode 530 Reward -223.000000 Average Reward -163.900000
Episode 540 Reward -173.000000 Average Reward -159.200000
Episode 550 Reward -122.000000 Average Reward -135.500000
Episode 560 Reward -106.000000 Average Reward -128.500000
Episode 570 Reward -201.000000 Average Reward -139.100000
Episode 580 Reward -151.000000 Average Reward -133.500000
Episode 590 Reward -119.000000 Average Reward -139.800000
Episode 600 Reward -91.000000 Average Reward -119.000000
Episode 610 Reward -114.000000 Average Reward -166.900000
Episode 620 Reward -119.000000 Average Reward -122.200000
Episode 630 Reward -91.000000 Average Reward -142.000000
Episode 640 Reward -105.000000 Average Reward -125.700000
Episode 650 Reward -158.000000 Average Reward -144.300000
Episode 660 Reward -105.000000 Average Reward -148.600000
Episode 670 Reward -128.000000 Average Reward -136.500000
Episode 680 Reward -108.000000 Average Reward -138.700000
Episode 690 Reward -129.000000 Average Reward -144.400000
Episode 700 Reward -174.000000 Average Reward -135.100000
Episode 710 Reward -126.000000 Average Reward -122.400000
Episode 720 Reward -88.000000 Average Reward -116.500000
Episode 730 Reward -88.000000 Average Reward -122.900000
Episode 740 Reward -105.000000 Average Reward -115.500000
Episode 750 Reward -169.000000 Average Reward -123.300000
Episode 760 Reward -82.000000 Average Reward -135.500000
Episode 770 Reward -93.000000 Average Reward -127.800000
Episode 780 Reward -173.000000 Average Reward -134.800000
Episode 790 Reward -144.000000 Average Reward -140.800000

Episode 800 Reward -108.000000 Average Reward -145.300000
Episode 810 Reward -417.000000 Average Reward -225.900000
Episode 820 Reward -333.000000 Average Reward -199.200000
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Episode 840 Reward -314.000000 Average Reward -228.500000
Episode 850 Reward -178.000000 Average Reward -264.000000
Episode 860 Reward -310.000000 Average Reward -313.000000
Episode 870 Reward -216.000000 Average Reward -237.600000
Episode 880 Reward -202.000000 Average Reward -191.000000
Episode 890 Reward -164.000000 Average Reward -190.900000
Episode 900 Reward -181.000000 Average Reward -202.400000
Episode 910 Reward -265.000000 Average Reward -265.900000
Episode 920 Reward -161.000000 Average Reward -226.000000
Episode 930 Reward -301.000000 Average Reward -271.300000
Episode 940 Reward -211.000000 Average Reward -207.900000
Episode 950 Reward -220.000000 Average Reward -222.100000
Episode 960 Reward -162.000000 Average Reward -187.700000
Episode 970 Reward -278.000000 Average Reward -197.400000
Episode 980 Reward -500.000000 Average Reward -246.800000
Episode 990 Reward -196.000000 Average Reward -240.900000
Episode 1000 Reward -274.000000 Average Reward -256.000000
0:05:27.088748









```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [1024, 1024]
LR = 1e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'Acrobot-v1'
SOLVE_CUTOFF = -100.0
STEP = 5

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{hs}-{lr}-{env}-{numep}-{nstep}-{STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	-334.000000	-390.600000
20	-245.000000	-300.200000
30	-422.000000	-330.100000
40	-227.000000	-274.400000
50	-405.000000	-302.300000
60	-500.000000	-437.300000
70	-265.000000	-422.400000
80	-500.000000	-420.200000
90	-500.000000	-500.000000
100	-500.000000	-500.000000
110	-500.000000	-500.000000
120	-500.000000	-500.000000
130	-500.000000	-500.000000
140	-500.000000	-500.000000
150	-500.000000	-500.000000
160	-500.000000	-500.000000
170	-500.000000	-500.000000
180	-500.000000	-500.000000
190	-500.000000	-500.000000
200	-500.000000	-500.000000
210	-500.000000	-500.000000
220	-500.000000	-500.000000
230	-500.000000	-500.000000
240	-500.000000	-500.000000
250	-500.000000	-500.000000
260	-500.000000	-500.000000
270	-500.000000	-500.000000
280	-500.000000	-500.000000

Episode 770 Reward -500.000000 Average Reward -500.000000
Episode 780 Reward -500.000000 Average Reward -500.000000
Episode 790 Reward -500.000000 Average Reward -500.000000
Episode 800 Reward -500.000000 Average Reward -500.000000
Episode 810 Reward -500.000000 Average Reward -500.000000
Episode 820 Reward -500.000000 Average Reward -500.000000
Episode 830 Reward -500.000000 Average Reward -500.000000
Episode 840 Reward -500.000000 Average Reward -500.000000
Episode 850 Reward -500.000000 Average Reward -500.000000
Episode 860 Reward -500.000000 Average Reward -500.000000
Episode 870 Reward -500.000000 Average Reward -500.000000
Episode 880 Reward -500.000000 Average Reward -500.000000
Episode 890 Reward -500.000000 Average Reward -500.000000
Episode 900 Reward -500.000000 Average Reward -500.000000
Episode 910 Reward -500.000000 Average Reward -500.000000
Episode 920 Reward -500.000000 Average Reward -500.000000
Episode 930 Reward -500.000000 Average Reward -500.000000
Episode 940 Reward -500.000000 Average Reward -500.000000
Episode 950 Reward -500.000000 Average Reward -500.000000
Episode 960 Reward -500.000000 Average Reward -500.000000
Episode 970 Reward -500.000000 Average Reward -500.000000
Episode 980 Reward -500.000000 Average Reward -500.000000
Episode 990 Reward -500.000000 Average Reward -500.000000
Episode 1000 Reward -500.000000 Average Reward -500.000000

0:12:30.731343

Episode 10 Reward -500.000000 Average Reward -461.900000
Episode 20 Reward -500.000000 Average Reward -474.500000
Episode 30 Reward -500.000000 Average Reward -463.900000
Episode 40 Reward -282.000000 Average Reward -388.400000
Episode 50 Reward -348.000000 Average Reward -329.300000
Episode 60 Reward -333.000000 Average Reward -351.200000
Episode 70 Reward -500.000000 Average Reward -432.400000
Episode 80 Reward -500.000000 Average Reward -491.500000
Episode 90 Reward -428.000000 Average Reward -436.100000
Episode 100 Reward -500.000000 Average Reward -439.500000
Episode 110 Reward -500.000000 Average Reward -494.400000
Episode 120 Reward -500.000000 Average Reward -490.600000
Episode 130 Reward -500.000000 Average Reward -500.000000
Episode 140 Reward -500.000000 Average Reward -500.000000
Episode 150 Reward -500.000000 Average Reward -500.000000
Episode 160 Reward -500.000000 Average Reward -500.000000
Episode 170 Reward -500.000000 Average Reward -500.000000
Episode 180 Reward -500.000000 Average Reward -500.000000
Episode 190 Reward -500.000000 Average Reward -500.000000
Episode 200 Reward -500.000000 Average Reward -500.000000
Episode 210 Reward -500.000000 Average Reward -500.000000
Episode 220 Reward -500.000000 Average Reward -500.000000
Episode 230 Reward -500.000000 Average Reward -500.000000

Episode 40 Reward -221.000000 Average Reward -268.700000
Episode 50 Reward -286.000000 Average Reward -332.900000
Episode 60 Reward -410.000000 Average Reward -425.100000
Episode 70 Reward -431.000000 Average Reward -474.900000
Episode 80 Reward -372.000000 Average Reward -420.400000
Episode 90 Reward -500.000000 Average Reward -452.400000
Episode 100 Reward -428.000000 Average Reward -429.900000
Episode 110 Reward -219.000000 Average Reward -373.600000
Episode 120 Reward -500.000000 Average Reward -344.800000
Episode 130 Reward -216.000000 Average Reward -290.100000
Episode 140 Reward -394.000000 Average Reward -296.800000
Episode 150 Reward -202.000000 Average Reward -216.000000
Episode 160 Reward -186.000000 Average Reward -223.600000
Episode 170 Reward -200.000000 Average Reward -239.800000
Episode 180 Reward -196.000000 Average Reward -213.700000
Episode 190 Reward -202.000000 Average Reward -231.700000
Episode 200 Reward -165.000000 Average Reward -239.700000
Episode 210 Reward -157.000000 Average Reward -214.300000
Episode 220 Reward -211.000000 Average Reward -231.300000
Episode 230 Reward -274.000000 Average Reward -196.400000
Episode 240 Reward -172.000000 Average Reward -191.600000
Episode 250 Reward -124.000000 Average Reward -156.700000
Episode 260 Reward -107.000000 Average Reward -131.500000
Episode 270 Reward -138.000000 Average Reward -139.600000
Episode 280 Reward -95.000000 Average Reward -138.900000
Episode 290 Reward -112.000000 Average Reward -138.900000
Episode 300 Reward -140.000000 Average Reward -148.100000
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Episode 320 Reward -122.000000 Average Reward -129.600000
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Episode 400 Reward -99.000000 Average Reward -121.000000
Episode 410 Reward -97.000000 Average Reward -100.300000
Episode 420 Reward -86.000000 Average Reward -107.400000
Episode 430 Reward -93.000000 Average Reward -108.300000
Episode 440 Reward -129.000000 Average Reward -127.100000
Episode 450 Reward -88.000000 Average Reward -110.300000
Episode 460 Reward -234.000000 Average Reward -158.400000
Episode 470 Reward -133.000000 Average Reward -128.200000
Episode 480 Reward -146.000000 Average Reward -124.300000
Episode 490 Reward -118.000000 Average Reward -116.800000
Episode 500 Reward -178.000000 Average Reward -127.800000
Episode 510 Reward -178.000000 Average Reward -132.600000

Episode 520 Reward -186.000000 Average Reward -135.800000
Episode 530 Reward -102.000000 Average Reward -135.100000
Episode 540 Reward -95.000000 Average Reward -111.100000
Episode 550 Reward -239.000000 Average Reward -127.000000
Episode 560 Reward -114.000000 Average Reward -104.600000
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Episode 810 Reward -105.000000 Average Reward -117.300000
Episode 820 Reward -117.000000 Average Reward -105.600000
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Episode 840 Reward -129.000000 Average Reward -102.600000
Episode 850 Reward -102.000000 Average Reward -124.200000
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Episode 870 Reward -107.000000 Average Reward -88.200000
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Episode 50 Reward -245.000000 Average Reward -203.800000
Episode 60 Reward -125.000000 Average Reward -206.200000
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Episode 80 Reward -187.000000 Average Reward -193.800000
Episode 90 Reward -310.000000 Average Reward -280.700000
Episode 100 Reward -199.000000 Average Reward -286.500000
Episode 110 Reward -232.000000 Average Reward -318.800000
Episode 120 Reward -252.000000 Average Reward -240.200000
Episode 130 Reward -279.000000 Average Reward -257.900000
Episode 140 Reward -212.000000 Average Reward -248.100000
Episode 150 Reward -256.000000 Average Reward -214.100000
Episode 160 Reward -169.000000 Average Reward -222.500000
Episode 170 Reward -187.000000 Average Reward -240.900000
Episode 180 Reward -264.000000 Average Reward -240.400000
Episode 190 Reward -263.000000 Average Reward -259.200000
Episode 200 Reward -238.000000 Average Reward -217.100000
Episode 210 Reward -237.000000 Average Reward -212.300000
Episode 220 Reward -235.000000 Average Reward -212.000000
Episode 230 Reward -178.000000 Average Reward -218.000000
Episode 240 Reward -166.000000 Average Reward -201.500000
Episode 250 Reward -182.000000 Average Reward -180.200000
Episode 260 Reward -294.000000 Average Reward -220.700000
Episode 270 Reward -226.000000 Average Reward -228.500000
Episode 280 Reward -244.000000 Average Reward -211.500000
Episode 290 Reward -217.000000 Average Reward -216.900000
Episode 300 Reward -222.000000 Average Reward -194.400000
Episode 310 Reward -225.000000 Average Reward -222.000000
Episode 320 Reward -181.000000 Average Reward -215.800000
Episode 330 Reward -268.000000 Average Reward -222.200000
Episode 340 Reward -199.000000 Average Reward -220.000000
Episode 350 Reward -175.000000 Average Reward -236.000000
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Episode 380 Reward -201.000000 Average Reward -198.500000
Episode 390 Reward -187.000000 Average Reward -233.300000
Episode 400 Reward -258.000000 Average Reward -255.400000
Episode 410 Reward -272.000000 Average Reward -268.600000
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Episode 430 Reward -151.000000 Average Reward -181.900000
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Episode 470 Reward -233.000000 Average Reward -186.500000
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Episode 500 Reward -208.000000 Average Reward -180.700000
Episode 510 Reward -201.000000 Average Reward -191.600000
Episode 520 Reward -165.000000 Average Reward -187.400000
Episode 530 Reward -283.000000 Average Reward -203.100000
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Episode 580 Reward -164.000000 Average Reward -184.500000
Episode 590 Reward -191.000000 Average Reward -183.200000
Episode 600 Reward -208.000000 Average Reward -228.200000
Episode 610 Reward -179.000000 Average Reward -240.200000
Episode 620 Reward -179.000000 Average Reward -192.600000
Episode 630 Reward -224.000000 Average Reward -194.000000
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Episode 650 Reward -151.000000 Average Reward -189.400000
Episode 660 Reward -226.000000 Average Reward -197.100000
Episode 670 Reward -190.000000 Average Reward -196.000000
Episode 680 Reward -167.000000 Average Reward -194.200000
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Episode 720 Reward -138.000000 Average Reward -188.200000
Episode 730 Reward -169.000000 Average Reward -171.500000
Episode 740 Reward -167.000000 Average Reward -176.500000
Episode 750 Reward -161.000000 Average Reward -170.900000
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Episode 770 Reward -188.000000 Average Reward -167.400000
Episode 780 Reward -120.000000 Average Reward -150.900000
Episode 790 Reward -134.000000 Average Reward -140.300000
Episode 800 Reward -93.000000 Average Reward -106.300000
Episode 810 Reward -104.000000 Average Reward -131.600000
Episode 820 Reward -108.000000 Average Reward -110.500000
Episode 830 Reward -112.000000 Average Reward -101.900000
Episode 840 Reward -102.000000 Average Reward -100.400000
Episode 850 Reward -101.000000 Average Reward -99.000000
Episode 860 Reward -106.000000 Average Reward -100.000000
Episode 870 Reward -90.000000 Average Reward -99.300000
Episode 880 Reward -119.000000 Average Reward -102.600000
Episode 890 Reward -106.000000 Average Reward -105.900000
Episode 900 Reward -96.000000 Average Reward -97.800000
Episode 910 Reward -106.000000 Average Reward -96.900000
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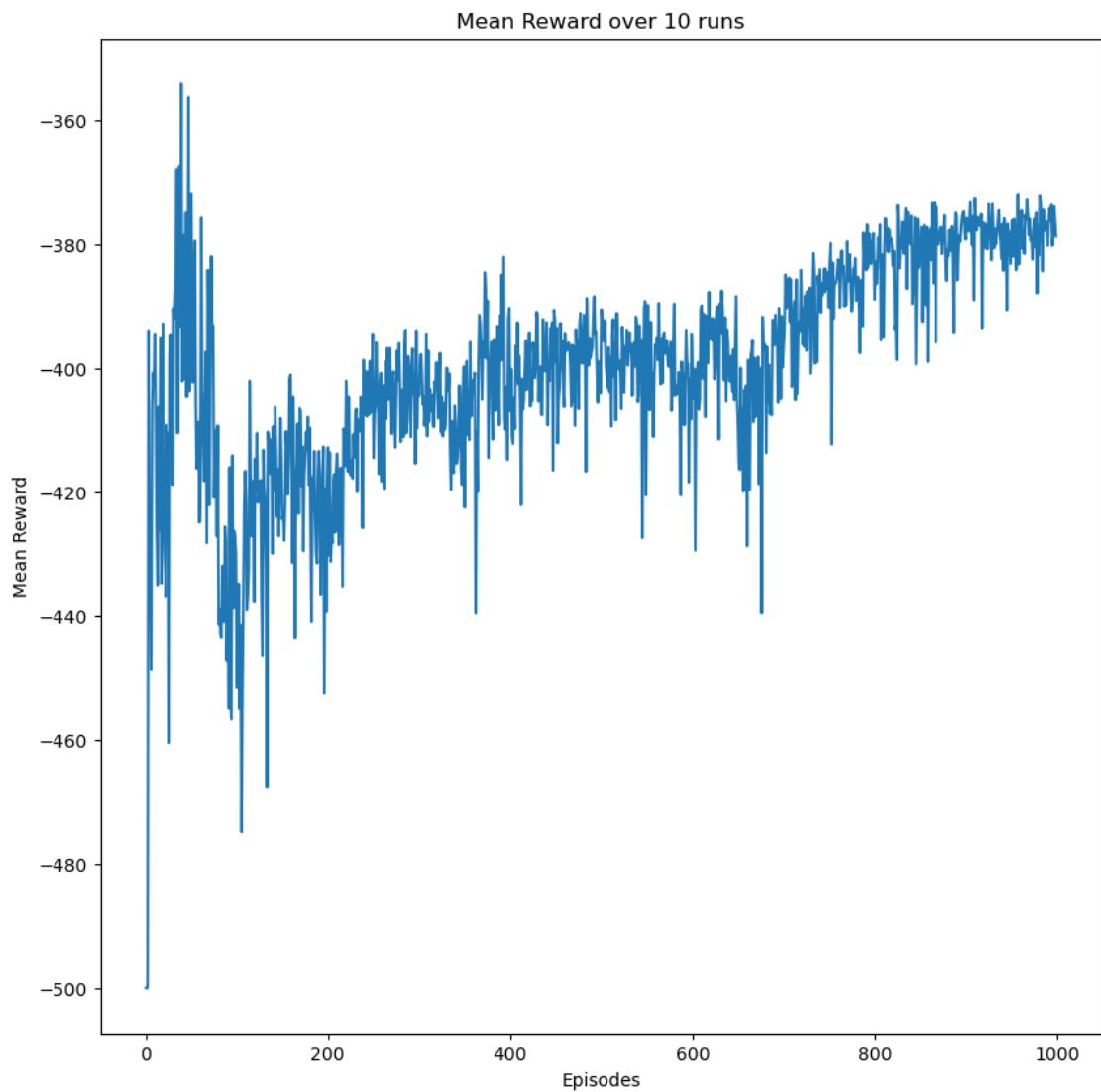
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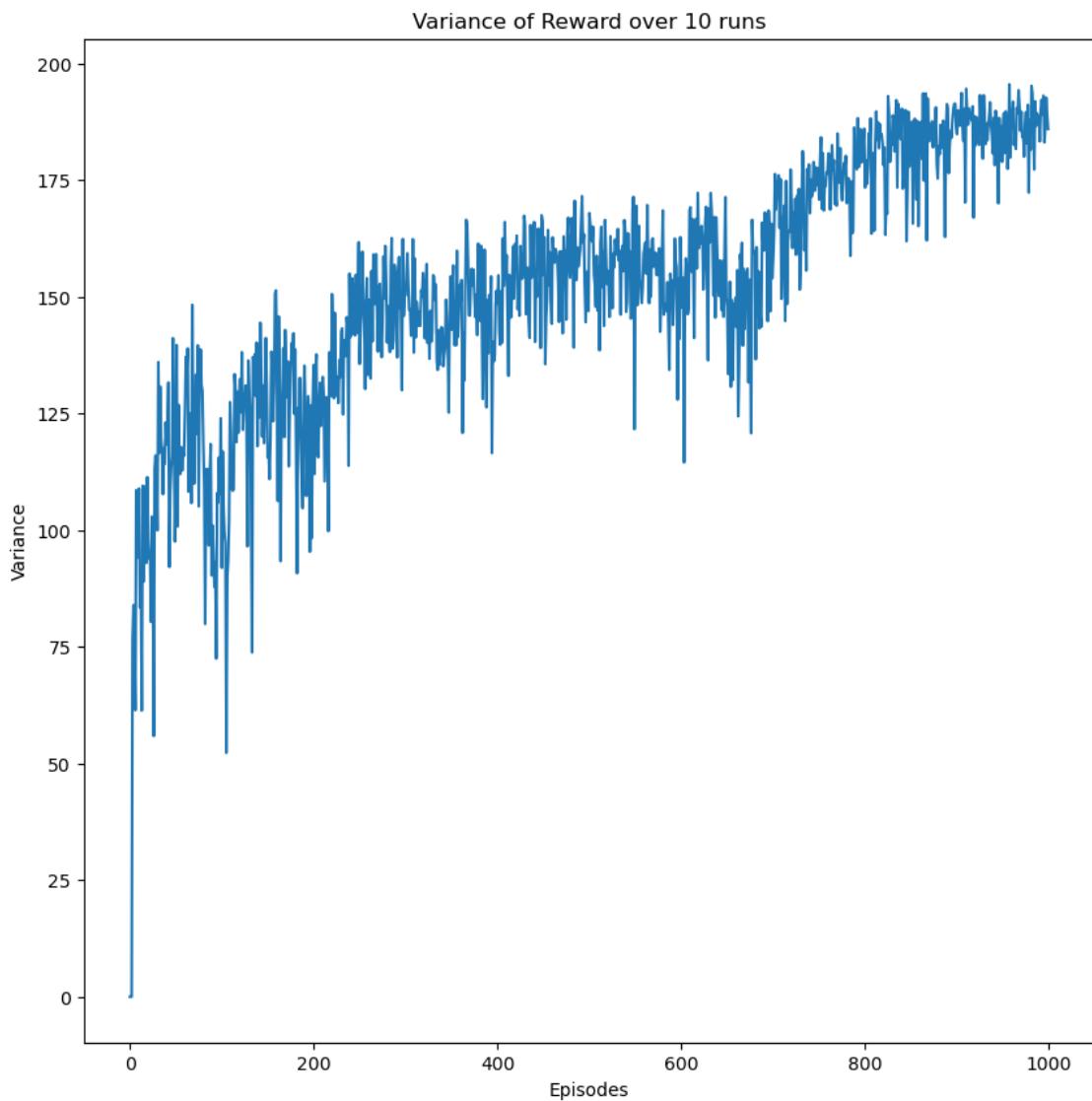
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Episode 960 Reward -500.000000 Average Reward -500.000000
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Episode 40 Reward -257.000000 Average Reward -399.300000
Episode 50 Reward -341.000000 Average Reward -382.300000
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Episode 90 Reward -239.000000 Average Reward -209.300000
Episode 100 Reward -173.000000 Average Reward -231.400000
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Episode 120 Reward -126.000000 Average Reward -179.300000
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Episode 140 Reward -193.000000 Average Reward -188.600000
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Episode 170 Reward -178.000000 Average Reward -200.900000
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Episode 220 Reward -212.000000 Average Reward -245.900000
Episode 230 Reward -192.000000 Average Reward -207.000000
Episode 240 Reward -148.000000 Average Reward -205.700000
Episode 250 Reward -139.000000 Average Reward -195.200000
Episode 260 Reward -282.000000 Average Reward -220.000000
Episode 270 Reward -178.000000 Average Reward -179.700000
Episode 280 Reward -183.000000 Average Reward -185.300000
Episode 290 Reward -170.000000 Average Reward -185.900000
Episode 300 Reward -161.000000 Average Reward -197.600000
Episode 310 Reward -243.000000 Average Reward -192.500000
Episode 320 Reward -187.000000 Average Reward -193.900000
Episode 330 Reward -199.000000 Average Reward -199.400000
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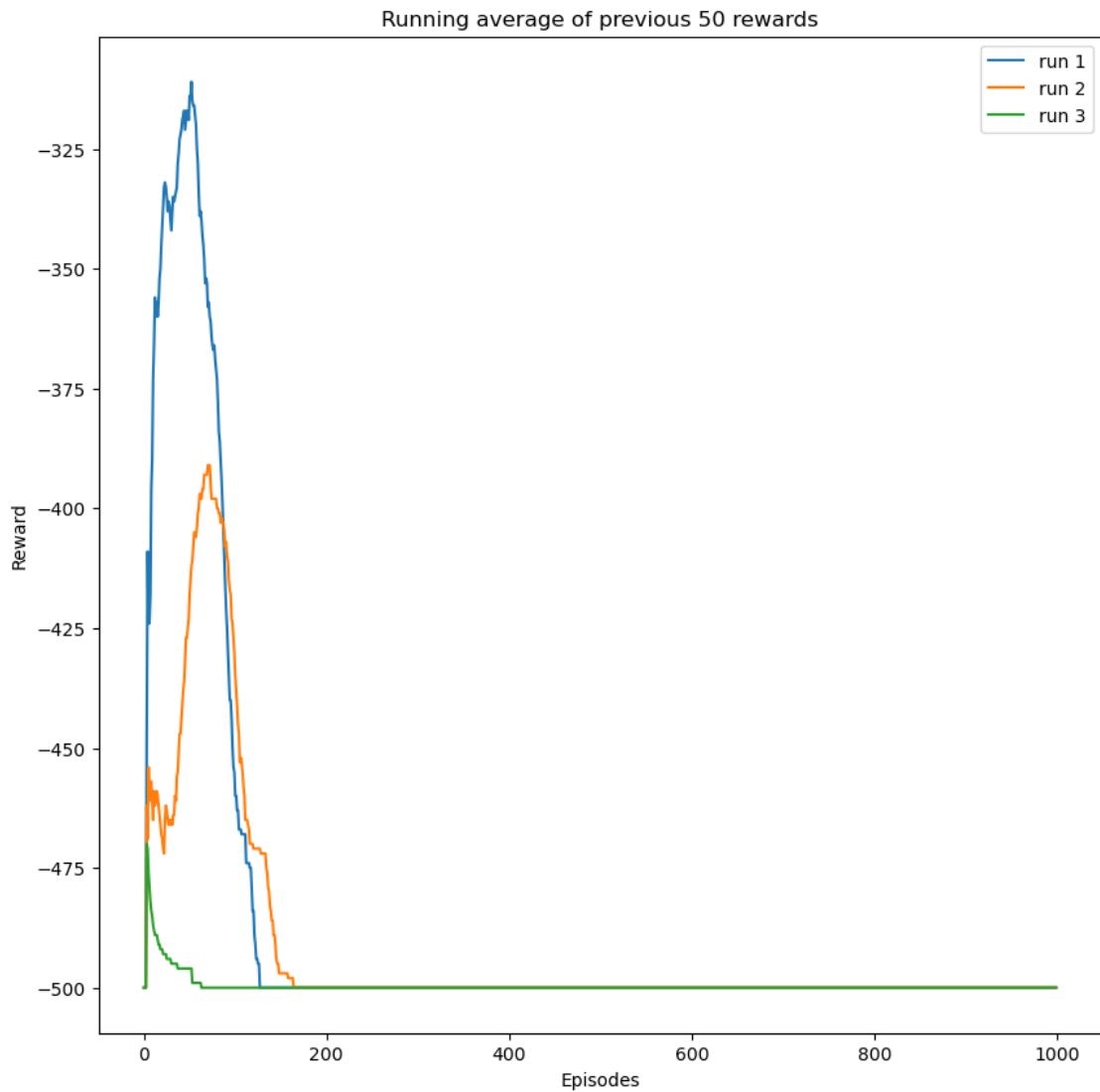
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Episode 410 Reward -158.000000 Average Reward -179.100000
Episode 420 Reward -148.000000 Average Reward -192.400000
Episode 430 Reward -166.000000 Average Reward -202.600000
Episode 440 Reward -154.000000 Average Reward -182.000000
Episode 450 Reward -143.000000 Average Reward -186.200000
Episode 460 Reward -162.000000 Average Reward -174.000000
Episode 470 Reward -189.000000 Average Reward -169.900000
Episode 480 Reward -173.000000 Average Reward -182.900000
Episode 490 Reward -145.000000 Average Reward -172.900000
Episode 500 Reward -155.000000 Average Reward -165.100000
Episode 510 Reward -160.000000 Average Reward -143.200000
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Episode 530 Reward -110.000000 Average Reward -150.900000
Episode 540 Reward -161.000000 Average Reward -153.300000
Episode 550 Reward -249.000000 Average Reward -184.300000
Episode 560 Reward -176.000000 Average Reward -202.600000
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Episode 580 Reward -130.000000 Average Reward -152.800000
Episode 590 Reward -173.000000 Average Reward -176.200000
Episode 600 Reward -119.000000 Average Reward -145.100000
Episode 610 Reward -149.000000 Average Reward -145.000000
Episode 620 Reward -134.000000 Average Reward -137.500000
Episode 630 Reward -158.000000 Average Reward -132.900000
Episode 640 Reward -134.000000 Average Reward -128.300000
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Episode 660 Reward -131.000000 Average Reward -131.500000
Episode 670 Reward -136.000000 Average Reward -148.500000
Episode 680 Reward -110.000000 Average Reward -144.900000
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Episode 700 Reward -124.000000 Average Reward -147.200000
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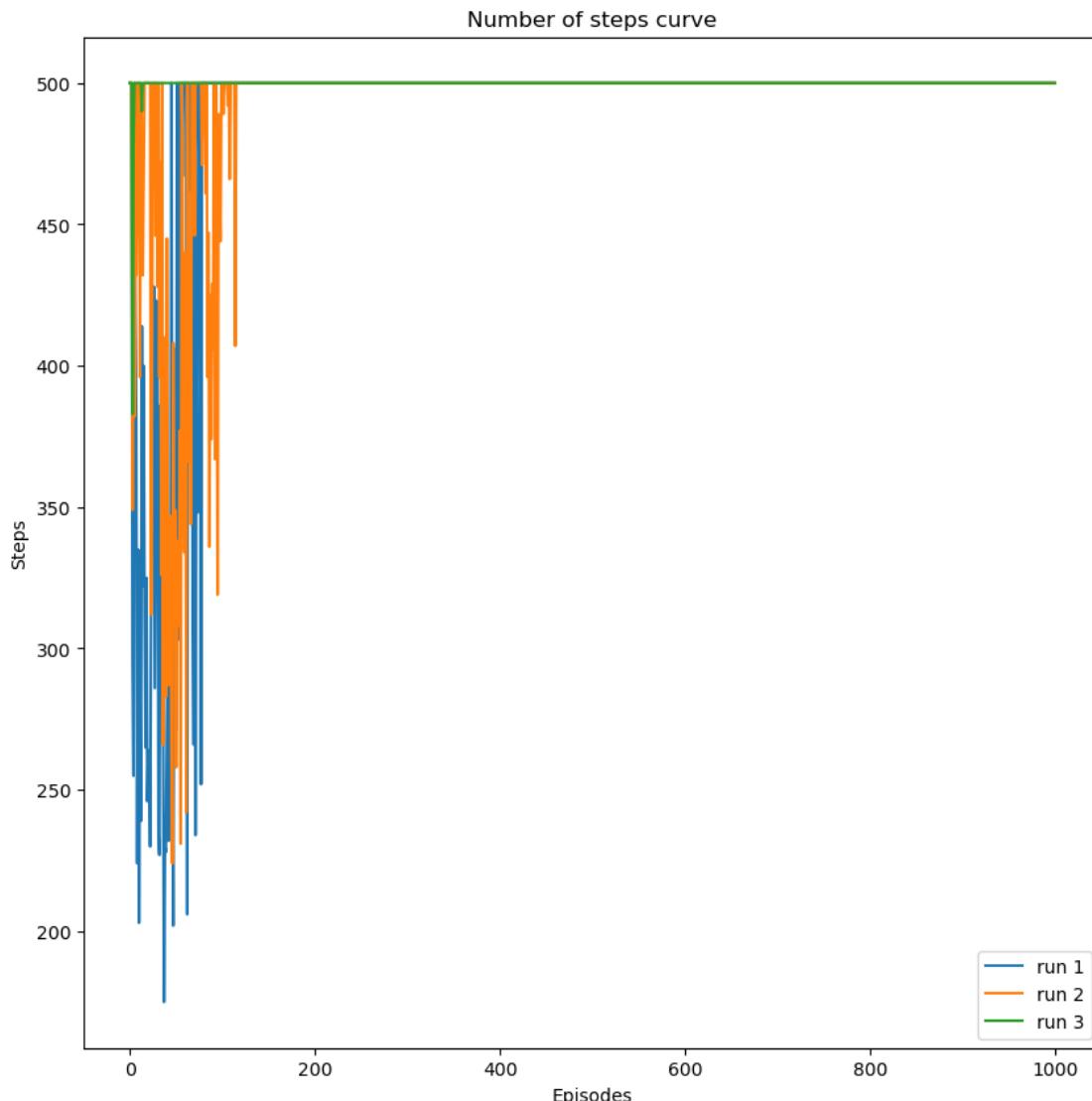
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Episode 900 Reward -97.000000 Average Reward -94.900000
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Episode 920 Reward -96.000000 Average Reward -108.000000
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Episode 960 Reward -86.000000 Average Reward -96.200000
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Episode 170 Reward -500.000000 Average Reward -500.000000
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Episode 210 Reward -500.000000 Average Reward -500.000000
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Episode 940 Reward -500.000000 Average Reward -500.000000
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Episode 960 Reward -500.000000 Average Reward -500.000000
Episode 970 Reward -500.000000 Average Reward -500.000000
Episode 980 Reward -500.000000 Average Reward -500.000000
Episode 990 Reward -500.000000 Average Reward -500.000000
Episode 1000 Reward -500.000000 Average Reward -500.000000
0:13:15.293255









```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [1024, 1024]
LR = 2e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'Acrobot-v1'
SOLVE_CUTOFF = -100.0
STEP = 5

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{hs}-{lr}-{env}-{numep}-{nstep}-{STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	-193.000000	-281.100000
20	-193.000000	-169.200000
30	-258.000000	-184.200000
40	-111.000000	-162.800000
50	-131.000000	-157.000000
60	-146.000000	-138.700000
70	-131.000000	-138.000000
80	-106.000000	-140.900000
90	-105.000000	-128.700000
100	-108.000000	-147.500000
110	-143.000000	-156.800000
120	-127.000000	-144.900000
130	-117.000000	-151.800000
140	-134.000000	-136.000000
150	-193.000000	-159.700000
160	-177.000000	-186.100000
170	-406.000000	-252.600000
180	-155.000000	-213.400000
190	-211.000000	-242.600000
200	-151.000000	-228.100000
210	-144.000000	-197.600000
220	-351.000000	-219.900000
230	-260.000000	-222.400000
240	-281.000000	-258.900000
250	-500.000000	-434.300000
260	-445.000000	-494.500000
270	-500.000000	-476.200000
280	-431.000000	-493.100000

Episode	10	Reward	-500.000000	Average	Reward	-404.500000
Episode	20	Reward	-500.000000	Average	Reward	-495.700000
Episode	30	Reward	-500.000000	Average	Reward	-500.000000
Episode	40	Reward	-500.000000	Average	Reward	-493.800000
Episode	50	Reward	-500.000000	Average	Reward	-500.000000
Episode	60	Reward	-500.000000	Average	Reward	-500.000000
Episode	70	Reward	-500.000000	Average	Reward	-500.000000
Episode	80	Reward	-500.000000	Average	Reward	-500.000000

Episode 40 Reward -131.000000 Average Reward -226.200000
Episode 50 Reward -249.000000 Average Reward -189.500000
Episode 60 Reward -290.000000 Average Reward -210.000000
Episode 70 Reward -308.000000 Average Reward -191.900000
Episode 80 Reward -192.000000 Average Reward -250.900000
Episode 90 Reward -361.000000 Average Reward -241.400000
Episode 100 Reward -233.000000 Average Reward -243.000000
Episode 110 Reward -177.000000 Average Reward -200.800000
Episode 120 Reward -168.000000 Average Reward -224.800000
Episode 130 Reward -156.000000 Average Reward -200.800000
Episode 140 Reward -194.000000 Average Reward -209.100000
Episode 150 Reward -211.000000 Average Reward -165.100000
Episode 160 Reward -158.000000 Average Reward -212.200000
Episode 170 Reward -139.000000 Average Reward -171.900000
Episode 180 Reward -113.000000 Average Reward -161.200000
Episode 190 Reward -123.000000 Average Reward -141.900000
Episode 200 Reward -100.000000 Average Reward -135.000000
Episode 210 Reward -155.000000 Average Reward -149.800000
Episode 220 Reward -124.000000 Average Reward -145.700000
Episode 230 Reward -145.000000 Average Reward -179.000000
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Episode 250 Reward -117.000000 Average Reward -140.800000
Episode 260 Reward -113.000000 Average Reward -137.300000
Episode 270 Reward -141.000000 Average Reward -152.600000
Episode 280 Reward -163.000000 Average Reward -142.100000
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Episode 350 Reward -107.000000 Average Reward -107.300000
Episode 360 Reward -134.000000 Average Reward -113.300000
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Episode 570 Reward -258.000000 Average Reward -104.100000
Episode 580 Reward -64.000000 Average Reward -109.800000
Episode 590 Reward -72.000000 Average Reward -83.700000
Episode 600 Reward -71.000000 Average Reward -98.000000
Episode 610 Reward -86.000000 Average Reward -85.500000
Episode 620 Reward -94.000000 Average Reward -105.600000
Episode 630 Reward -76.000000 Average Reward -85.000000
Episode 640 Reward -107.000000 Average Reward -91.800000
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Episode 690 Reward -118.000000 Average Reward -95.600000
Episode 700 Reward -88.000000 Average Reward -100.000000
Episode 710 Reward -100.000000 Average Reward -110.000000
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Episode 730 Reward -77.000000 Average Reward -182.100000
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Episode 770 Reward -115.000000 Average Reward -216.800000
Episode 780 Reward -79.000000 Average Reward -175.000000
Episode 790 Reward -134.000000 Average Reward -97.000000
Episode 800 Reward -151.000000 Average Reward -94.500000
Episode 810 Reward -92.000000 Average Reward -95.200000
Episode 820 Reward -95.000000 Average Reward -80.600000
Episode 830 Reward -84.000000 Average Reward -99.800000
Episode 840 Reward -71.000000 Average Reward -84.900000
Episode 850 Reward -73.000000 Average Reward -80.800000
Episode 860 Reward -95.000000 Average Reward -96.400000
Episode 870 Reward -80.000000 Average Reward -88.700000
Episode 880 Reward -107.000000 Average Reward -87.100000
Episode 890 Reward -66.000000 Average Reward -115.000000
Episode 900 Reward -73.000000 Average Reward -84.800000
Episode 910 Reward -88.000000 Average Reward -78.800000
Episode 920 Reward -65.000000 Average Reward -78.400000
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Episode 940 Reward -89.000000 Average Reward -84.200000
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Episode 960 Reward -64.000000 Average Reward -90.000000
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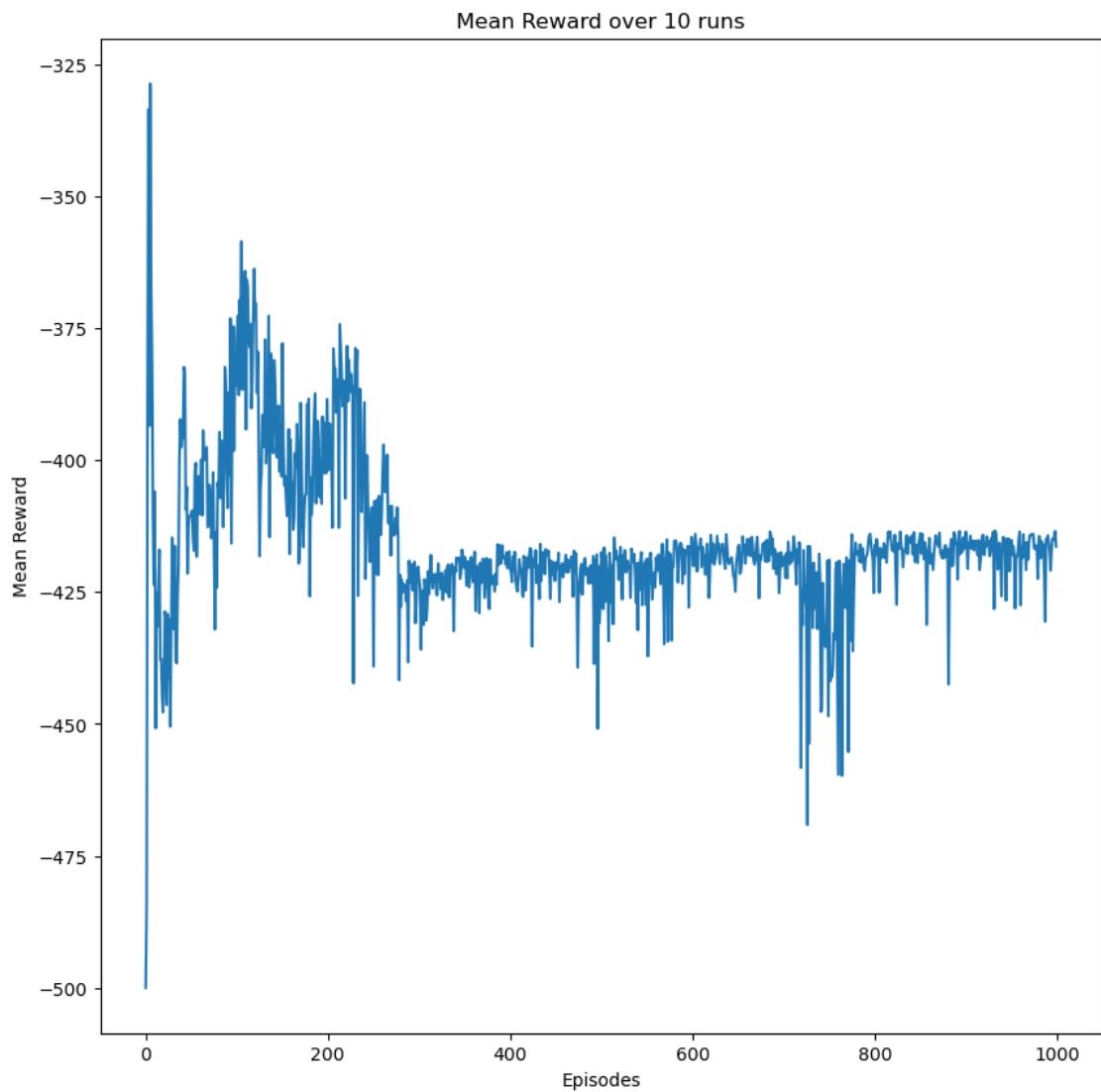
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Episode 240 Reward -100.000000 Average Reward -111.000000
Episode 250 Reward -80.000000 Average Reward -95.800000
Episode 260 Reward -113.000000 Average Reward -116.500000
Episode 270 Reward -95.000000 Average Reward -93.900000
Episode 280 Reward -124.000000 Average Reward -133.800000
Episode 290 Reward -93.000000 Average Reward -103.800000
Episode 300 Reward -94.000000 Average Reward -96.800000
Episode 310 Reward -157.000000 Average Reward -111.500000
Episode 320 Reward -119.000000 Average Reward -90.700000
Episode 330 Reward -81.000000 Average Reward -100.800000
Episode 340 Reward -108.000000 Average Reward -91.400000
Episode 350 Reward -97.000000 Average Reward -88.100000
Episode 360 Reward -97.000000 Average Reward -92.800000
Episode 370 Reward -131.000000 Average Reward -91.600000
Episode 380 Reward -81.000000 Average Reward -96.900000
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Episode 400 Reward -81.000000 Average Reward -91.000000
Episode 410 Reward -99.000000 Average Reward -93.000000

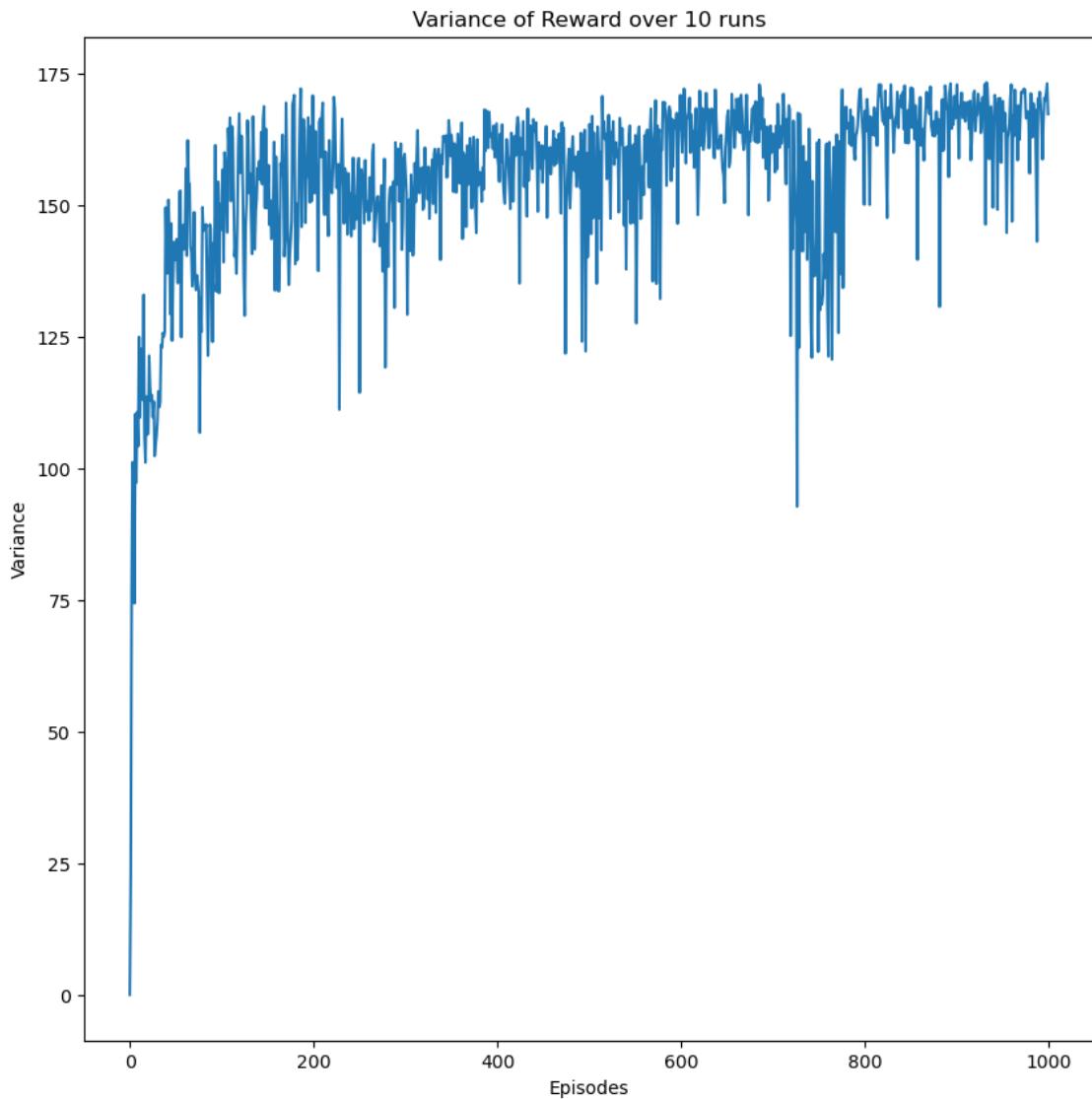
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Episode 480 Reward -105.000000 Average Reward -111.400000
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Episode 660 Reward -76.000000 Average Reward -82.200000
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Episode 700 Reward -106.000000 Average Reward -95.500000
Episode 710 Reward -92.000000 Average Reward -79.600000
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Episode 740 Reward -90.000000 Average Reward -83.200000
Episode 750 Reward -96.000000 Average Reward -89.700000
Episode 760 Reward -94.000000 Average Reward -80.300000
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Episode 810 Reward -91.000000 Average Reward -85.300000
Episode 820 Reward -76.000000 Average Reward -79.100000
Episode 830 Reward -79.000000 Average Reward -76.400000
Episode 840 Reward -75.000000 Average Reward -80.900000
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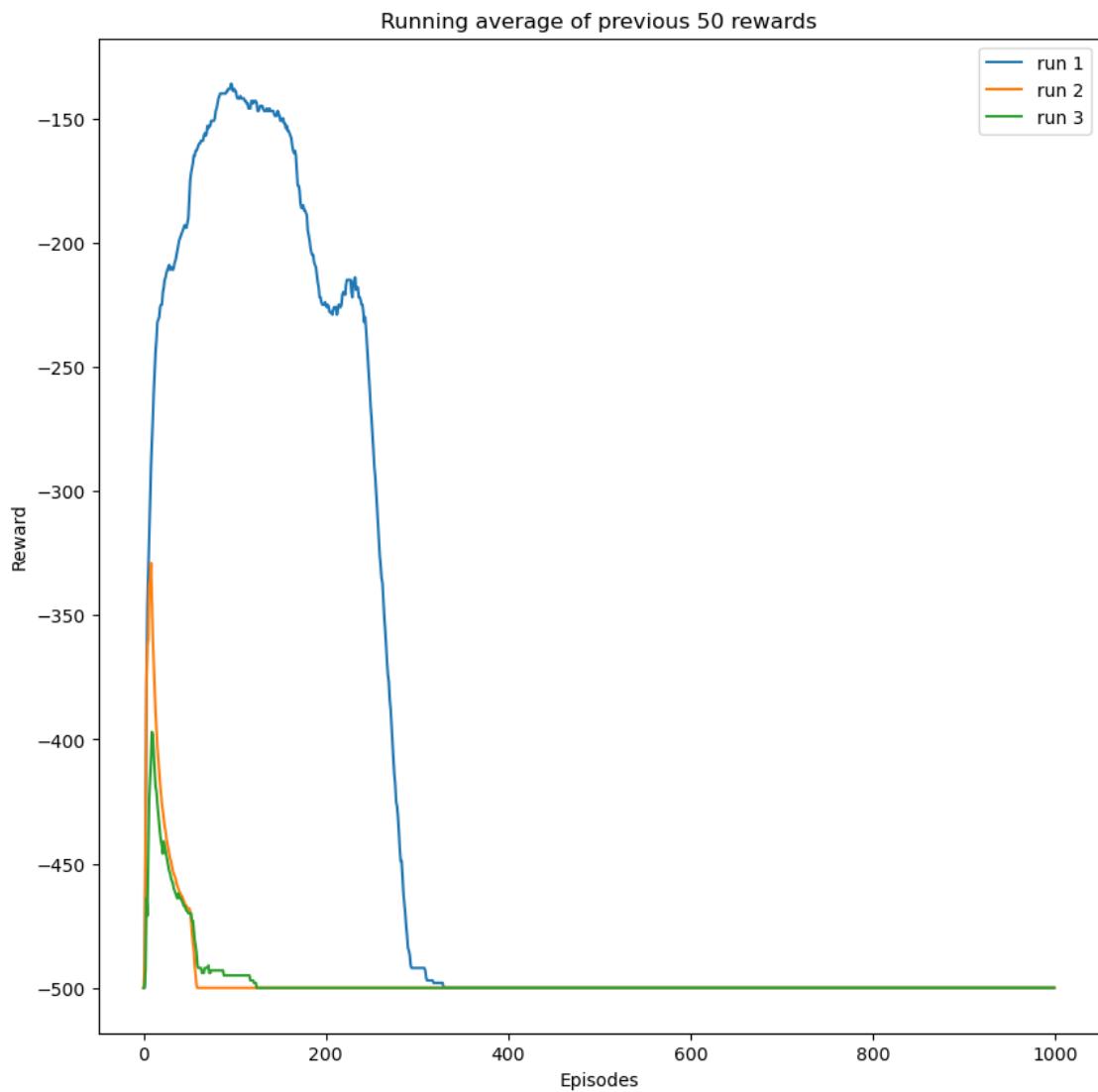
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Episode 190 Reward -500.000000 Average Reward -500.000000
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Episode 250 Reward -500.000000 Average Reward -500.000000
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Episode 280 Reward -500.000000 Average Reward -500.000000
Episode 290 Reward -500.000000 Average Reward -500.000000
Episode 300 Reward -500.000000 Average Reward -500.000000
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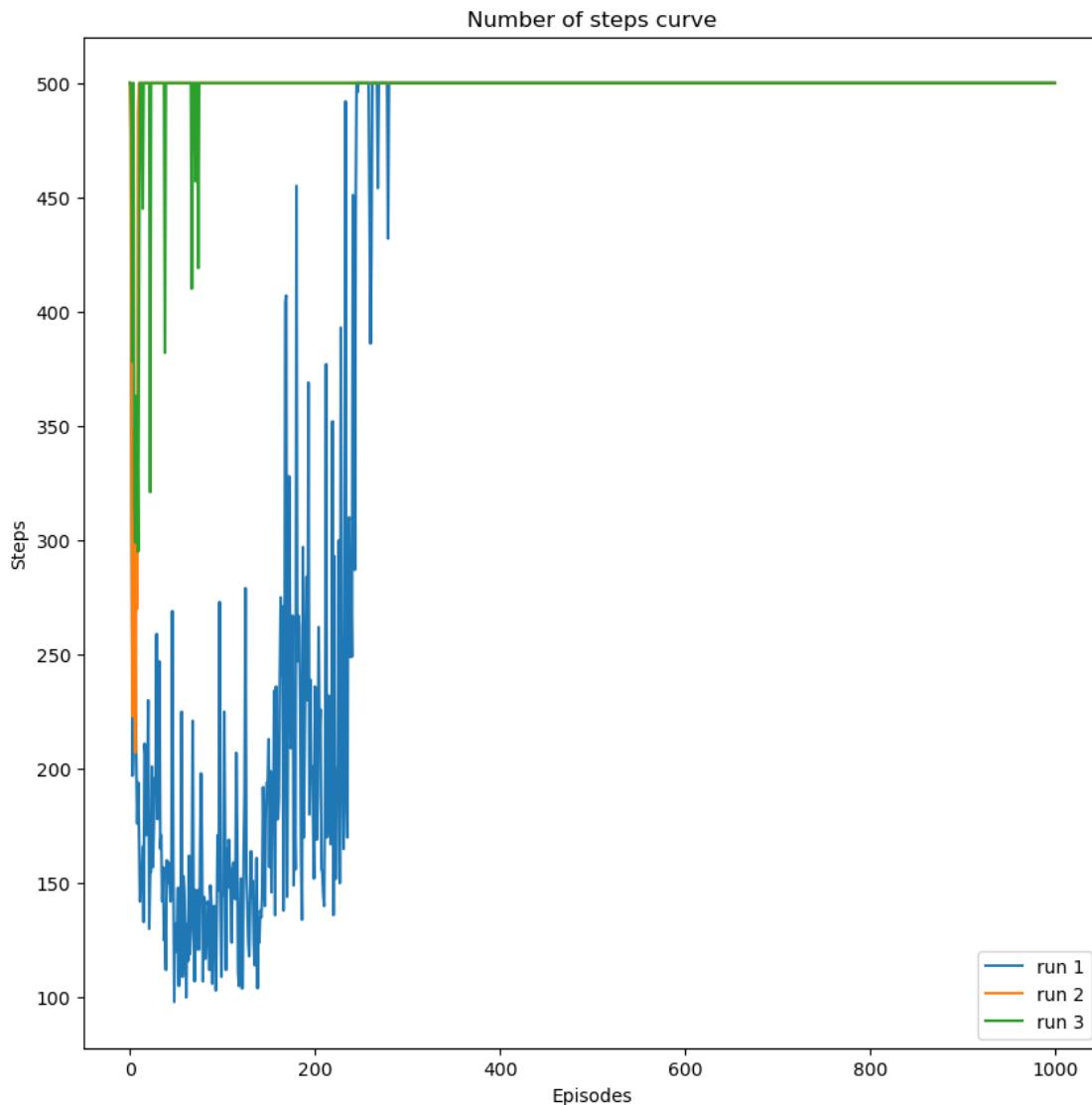
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Episode 890 Reward -500.000000 Average Reward -500.000000
Episode 900 Reward -500.000000 Average Reward -500.000000
Episode 910 Reward -500.000000 Average Reward -500.000000
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Episode 930 Reward -500.000000 Average Reward -500.000000
Episode 940 Reward -500.000000 Average Reward -500.000000
Episode 950 Reward -500.000000 Average Reward -500.000000
Episode 960 Reward -500.000000 Average Reward -500.000000
Episode 970 Reward -500.000000 Average Reward -500.000000
Episode 980 Reward -500.000000 Average Reward -500.000000
Episode 990 Reward -500.000000 Average Reward -500.000000
Episode 1000 Reward -500.000000 Average Reward -500.000000
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Episode 20 Reward -285.000000 Average Reward -272.400000
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Episode 40 Reward -315.000000 Average Reward -388.300000
Episode 50 Reward -225.000000 Average Reward -281.000000
Episode 60 Reward -166.000000 Average Reward -246.300000
Episode 70 Reward -186.000000 Average Reward -219.300000
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Episode 90 Reward -214.000000 Average Reward -239.300000
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Episode 800 Reward -500.000000 Average Reward -500.000000
Episode 810 Reward -500.000000 Average Reward -500.000000
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Episode 830 Reward -500.000000 Average Reward -500.000000
Episode 840 Reward -500.000000 Average Reward -500.000000
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Episode 880 Reward -500.000000 Average Reward -500.000000
Episode 890 Reward -500.000000 Average Reward -500.000000
Episode 900 Reward -500.000000 Average Reward -500.000000
Episode 910 Reward -500.000000 Average Reward -500.000000
Episode 920 Reward -500.000000 Average Reward -500.000000
Episode 930 Reward -500.000000 Average Reward -500.000000
Episode 940 Reward -500.000000 Average Reward -500.000000
Episode 950 Reward -500.000000 Average Reward -500.000000
Episode 960 Reward -500.000000 Average Reward -500.000000
Episode 970 Reward -500.000000 Average Reward -500.000000
Episode 980 Reward -500.000000 Average Reward -500.000000
Episode 990 Reward -500.000000 Average Reward -500.000000
Episode 1000 Reward -500.000000 Average Reward -500.000000
0:12:55.364341









```
[ ]: NUM_HIDDEN = 3
HIDDEN_SIZES = [512, 1024, 512]
LR = 1e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'Acrobot-v1'
SOLVE_CUTOFF = -100.0
STEP = 5

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{hs}-{lr}-{env}-{numep}-{nstep}-{STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	-500.000000	-475.900000
20	-500.000000	-480.100000
30	-355.000000	-452.700000
40	-471.000000	-368.100000
50	-390.000000	-391.500000
60	-500.000000	-414.300000
70	-500.000000	-487.500000
80	-500.000000	-488.800000
90	-410.000000	-466.500000
100	-500.000000	-495.400000
110	-500.000000	-500.000000
120	-500.000000	-500.000000
130	-500.000000	-500.000000
140	-500.000000	-500.000000
150	-500.000000	-500.000000
160	-500.000000	-500.000000
170	-500.000000	-500.000000
180	-500.000000	-500.000000
190	-500.000000	-500.000000
200	-500.000000	-500.000000
210	-500.000000	-500.000000
220	-500.000000	-500.000000
230	-500.000000	-500.000000
240	-500.000000	-500.000000
250	-500.000000	-500.000000
260	-500.000000	-500.000000
270	-500.000000	-500.000000
280	-500.000000	-500.000000

Episode 770 Reward -500.000000 Average Reward -500.000000
 Episode 780 Reward -500.000000 Average Reward -500.000000
 Episode 790 Reward -500.000000 Average Reward -500.000000
 Episode 800 Reward -500.000000 Average Reward -500.000000
 Episode 810 Reward -500.000000 Average Reward -500.000000
 Episode 820 Reward -500.000000 Average Reward -500.000000
 Episode 830 Reward -500.000000 Average Reward -500.000000
 Episode 840 Reward -500.000000 Average Reward -500.000000
 Episode 850 Reward -500.000000 Average Reward -500.000000
 Episode 860 Reward -500.000000 Average Reward -500.000000
 Episode 870 Reward -500.000000 Average Reward -500.000000
 Episode 880 Reward -500.000000 Average Reward -500.000000
 Episode 890 Reward -500.000000 Average Reward -500.000000
 Episode 900 Reward -500.000000 Average Reward -500.000000
 Episode 910 Reward -500.000000 Average Reward -500.000000
 Episode 920 Reward -500.000000 Average Reward -500.000000
 Episode 930 Reward -500.000000 Average Reward -500.000000
 Episode 940 Reward -500.000000 Average Reward -500.000000
 Episode 950 Reward -500.000000 Average Reward -500.000000
 Episode 960 Reward -500.000000 Average Reward -500.000000
 Episode 970 Reward -500.000000 Average Reward -500.000000
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 Episode 990 Reward -500.000000 Average Reward -500.000000
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 Episode 20 Reward -500.000000 Average Reward -500.000000
 Episode 30 Reward -500.000000 Average Reward -500.000000
 Episode 40 Reward -500.000000 Average Reward -500.000000
 Episode 50 Reward -500.000000 Average Reward -500.000000
 Episode 60 Reward -500.000000 Average Reward -500.000000
 Episode 70 Reward -500.000000 Average Reward -500.000000
 Episode 80 Reward -500.000000 Average Reward -500.000000
 Episode 90 Reward -500.000000 Average Reward -500.000000
 Episode 100 Reward -500.000000 Average Reward -500.000000
 Episode 110 Reward -500.000000 Average Reward -500.000000
 Episode 120 Reward -500.000000 Average Reward -494.900000
 Episode 130 Reward -500.000000 Average Reward -500.000000
 Episode 140 Reward -500.000000 Average Reward -482.900000
 Episode 150 Reward -500.000000 Average Reward -500.000000
 Episode 160 Reward -500.000000 Average Reward -480.800000
 Episode 170 Reward -496.000000 Average Reward -491.300000
 Episode 180 Reward -500.000000 Average Reward -435.300000
 Episode 190 Reward -362.000000 Average Reward -342.600000
 Episode 200 Reward -216.000000 Average Reward -315.400000
 Episode 210 Reward -190.000000 Average Reward -236.600000
 Episode 220 Reward -278.000000 Average Reward -242.800000
 Episode 230 Reward -216.000000 Average Reward -274.200000

Episode 240 Reward -258.000000 Average Reward -252.900000
Episode 250 Reward -393.000000 Average Reward -255.000000
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Episode 490 Reward -295.000000 Average Reward -218.800000
Episode 500 Reward -128.000000 Average Reward -145.100000
Episode 510 Reward -165.000000 Average Reward -147.300000
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Episode 560 Reward -259.000000 Average Reward -177.600000
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Episode 580 Reward -156.000000 Average Reward -161.000000
Episode 590 Reward -120.000000 Average Reward -164.400000
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Episode 650 Reward -345.000000 Average Reward -183.200000
Episode 660 Reward -155.000000 Average Reward -153.700000
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Episode 690 Reward -159.000000 Average Reward -155.500000
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Episode 710 Reward -138.000000 Average Reward -143.200000

Episode 720 Reward -161.000000 Average Reward -152.800000
 Episode 730 Reward -146.000000 Average Reward -158.200000
 Episode 740 Reward -136.000000 Average Reward -143.800000
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 Episode 70 Reward -500.000000 Average Reward -500.000000
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 Episode 90 Reward -500.000000 Average Reward -500.000000
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Episode 290 Reward -203.000000 Average Reward -227.200000
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Episode 670 Reward -160.000000 Average Reward -144.100000
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Episode 810 Reward -500.000000 Average Reward -500.000000
Episode 820 Reward -500.000000 Average Reward -500.000000
Episode 830 Reward -500.000000 Average Reward -500.000000
Episode 840 Reward -500.000000 Average Reward -500.000000
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Episode 90 Reward -343.000000 Average Reward -356.600000
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Episode 170 Reward -261.000000 Average Reward -213.600000
Episode 180 Reward -308.000000 Average Reward -327.500000
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Episode 400 Reward -135.000000 Average Reward -142.500000
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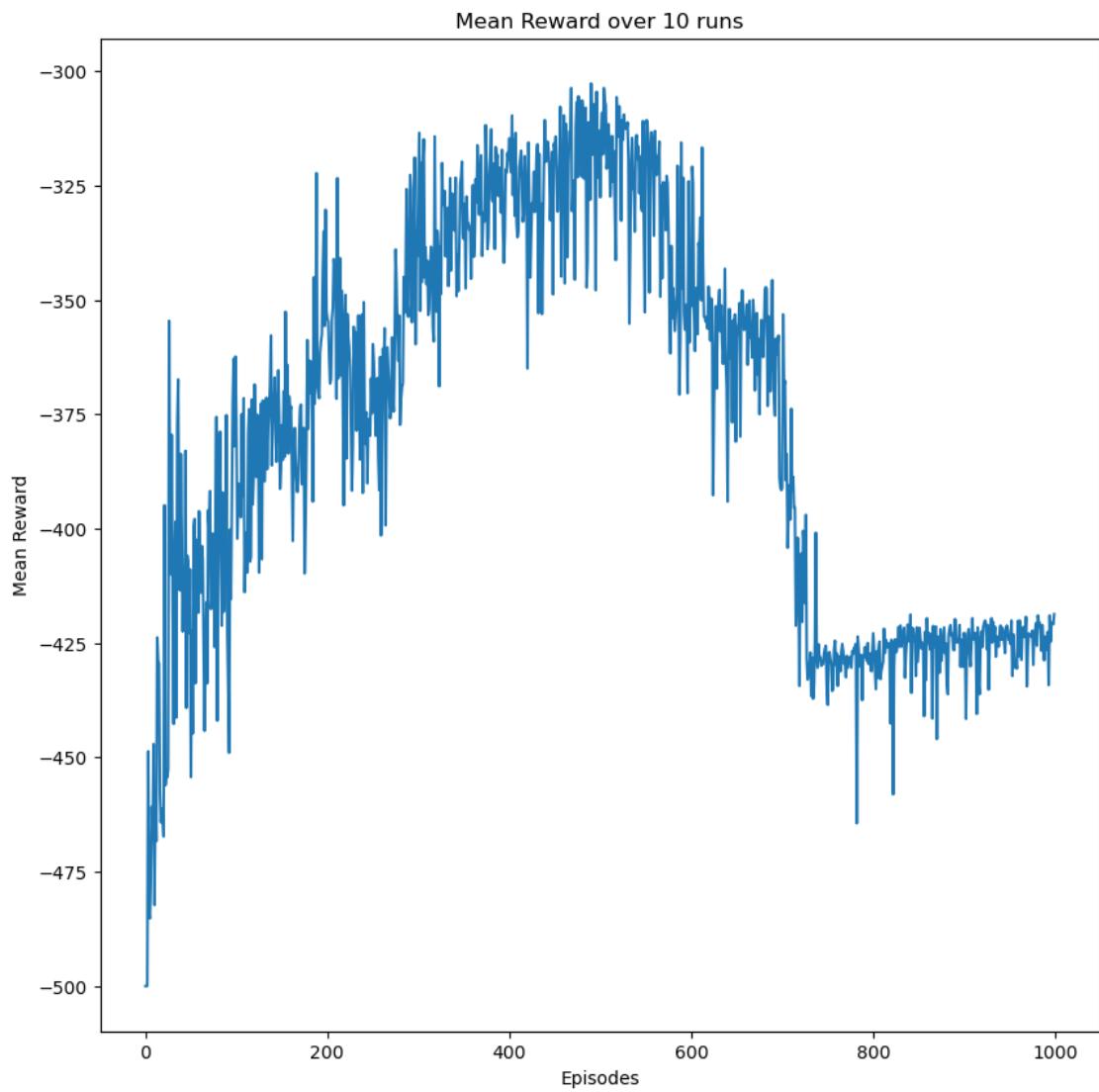
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Episode 810 Reward -500.000000 Average Reward -500.000000
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Episode 840 Reward -500.000000 Average Reward -500.000000
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Episode 860 Reward -500.000000 Average Reward -500.000000
Episode 870 Reward -500.000000 Average Reward -500.000000
Episode 880 Reward -500.000000 Average Reward -500.000000
Episode 890 Reward -500.000000 Average Reward -500.000000
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Episode 910 Reward -500.000000 Average Reward -500.000000
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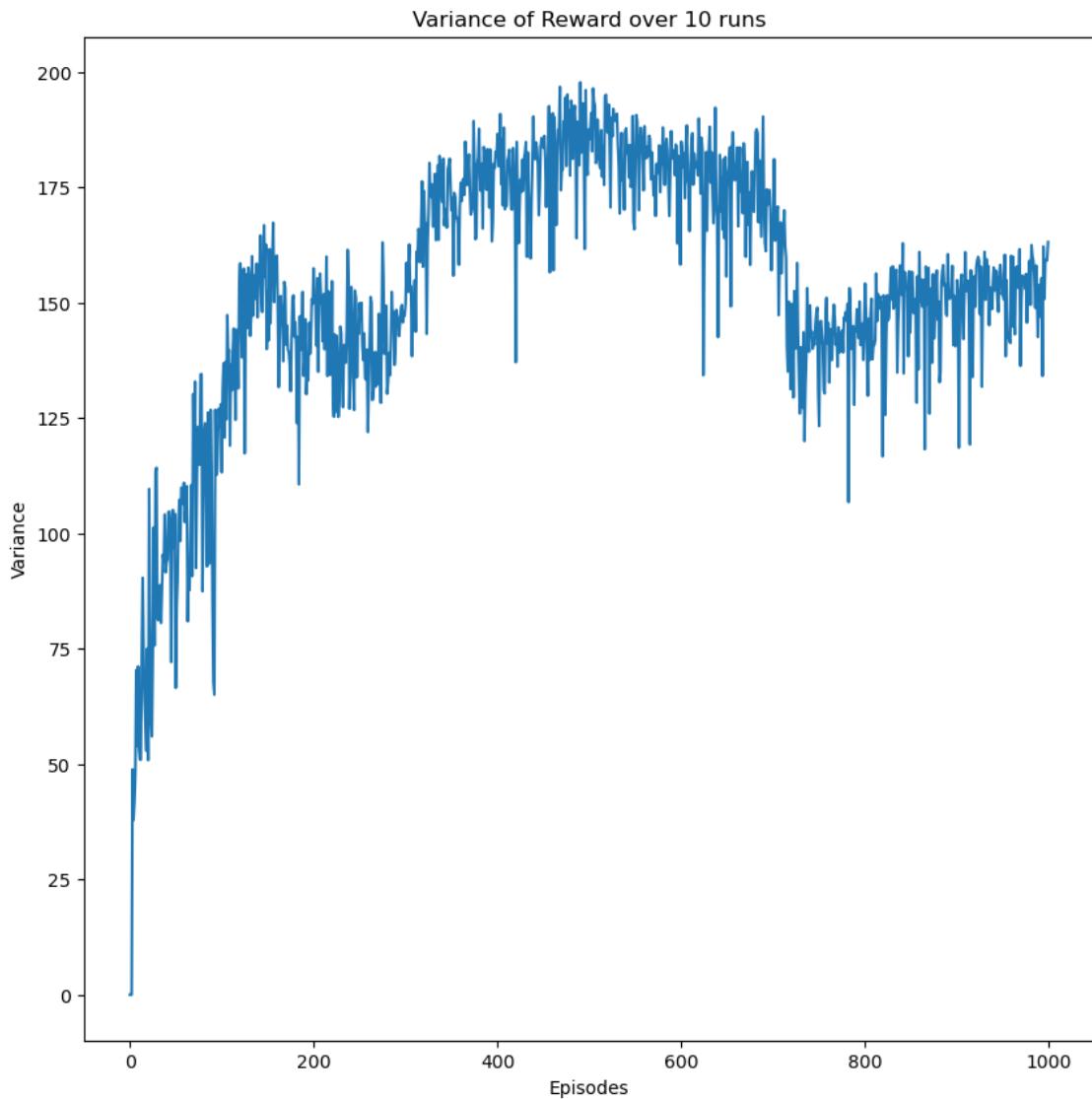
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Episode 220 Reward -500.000000 Average Reward -500.000000
Episode 230 Reward -500.000000 Average Reward -500.000000
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Episode 310 Reward -500.000000 Average Reward -500.000000
Episode 320 Reward -500.000000 Average Reward -500.000000
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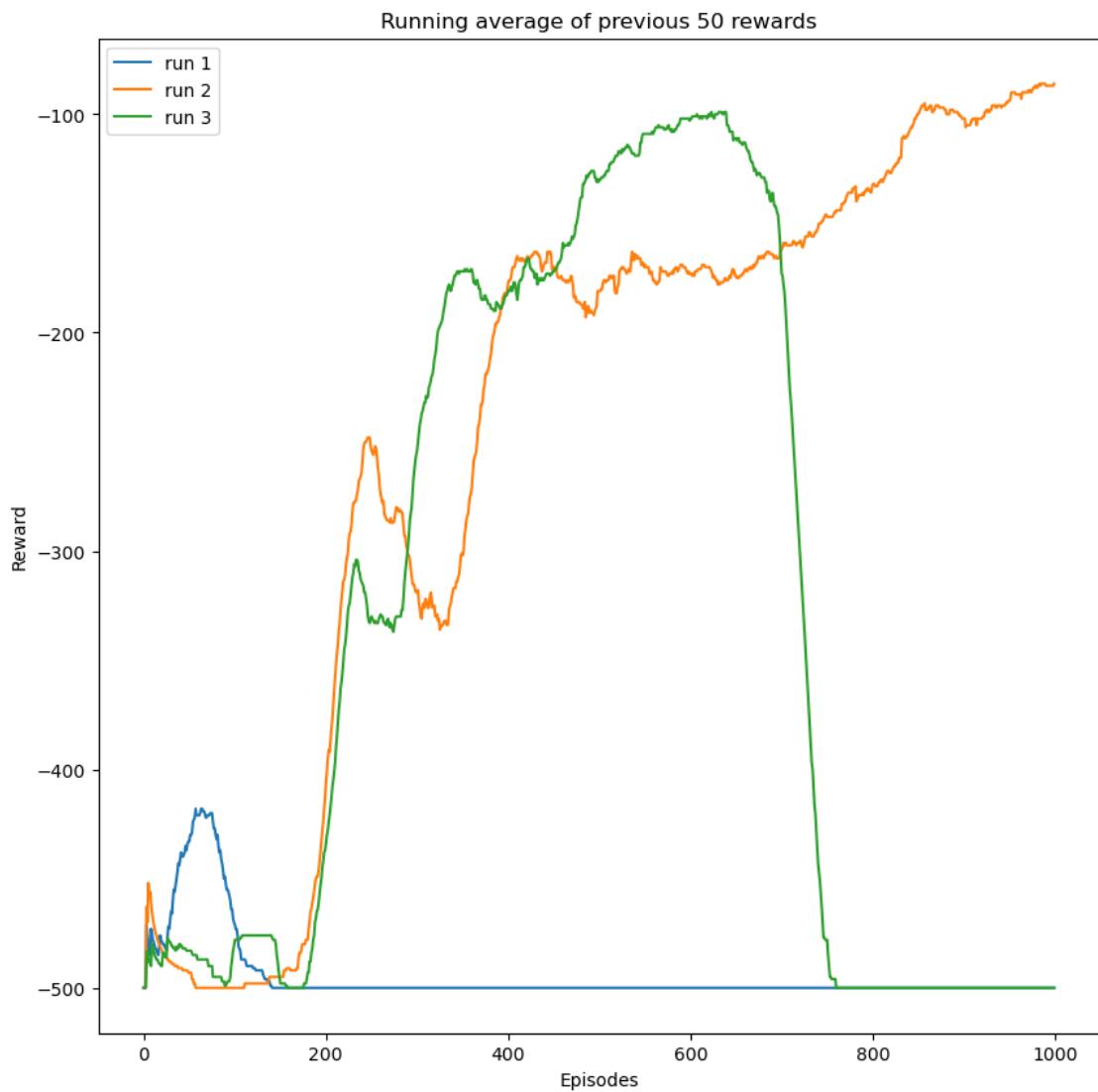
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 Episode 990 Reward -500.000000 Average Reward -500.000000
 Episode 1000 Reward -500.000000 Average Reward -500.000000
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 Episode 60 Reward -189.000000 Average Reward -292.700000
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 Episode 100 Reward -351.000000 Average Reward -314.700000
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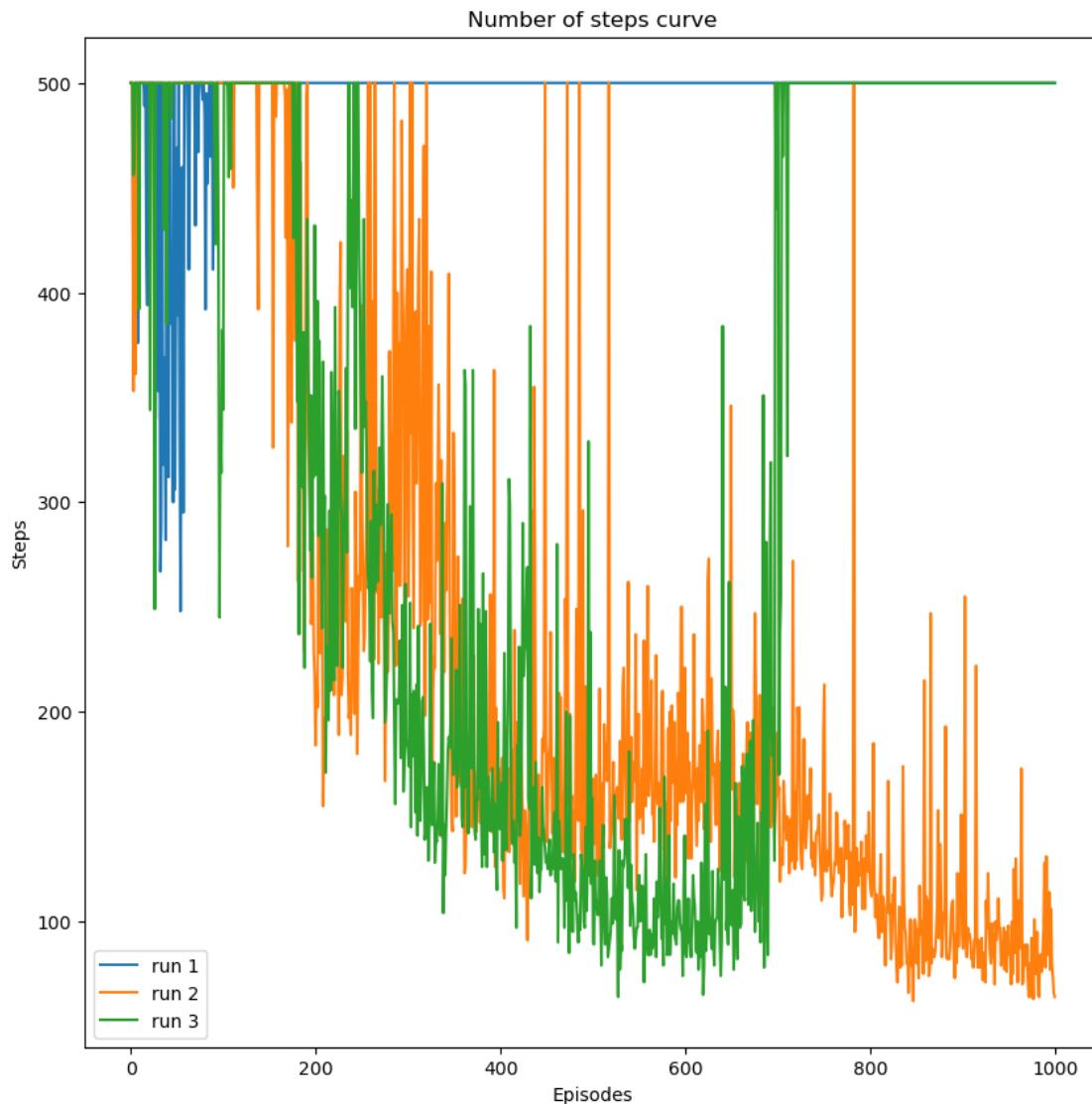
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Episode 600 Reward -192.000000 Average Reward -155.800000
Episode 610 Reward -209.000000 Average Reward -183.400000
Episode 620 Reward -131.000000 Average Reward -146.500000
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Episode 780 Reward -128.000000 Average Reward -158.500000
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Episode 800 Reward -151.000000 Average Reward -151.800000
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Episode 920 Reward -147.000000 Average Reward -177.200000
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Episode 1000 Reward -124.000000 Average Reward -145.300000
0:05:09.289218









MountainCar

```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [1024, 512]
LR = 1e-4
NUM_EPISODES = 600
AVG_NUM = 50
ENV_NAME = 'MountainCar-v0'
SOLVE_CUTOFF = -125
STEP = 5

ENV = gym.make(ENV_NAME)
```

```

mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname =
    f'hl={NUM_HIDDEN}_hs={HIDDEN_SIZES}_lr={LR}_env={ENV_NAME}_numep={NUM_EPISODES}_nstep={STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed) instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

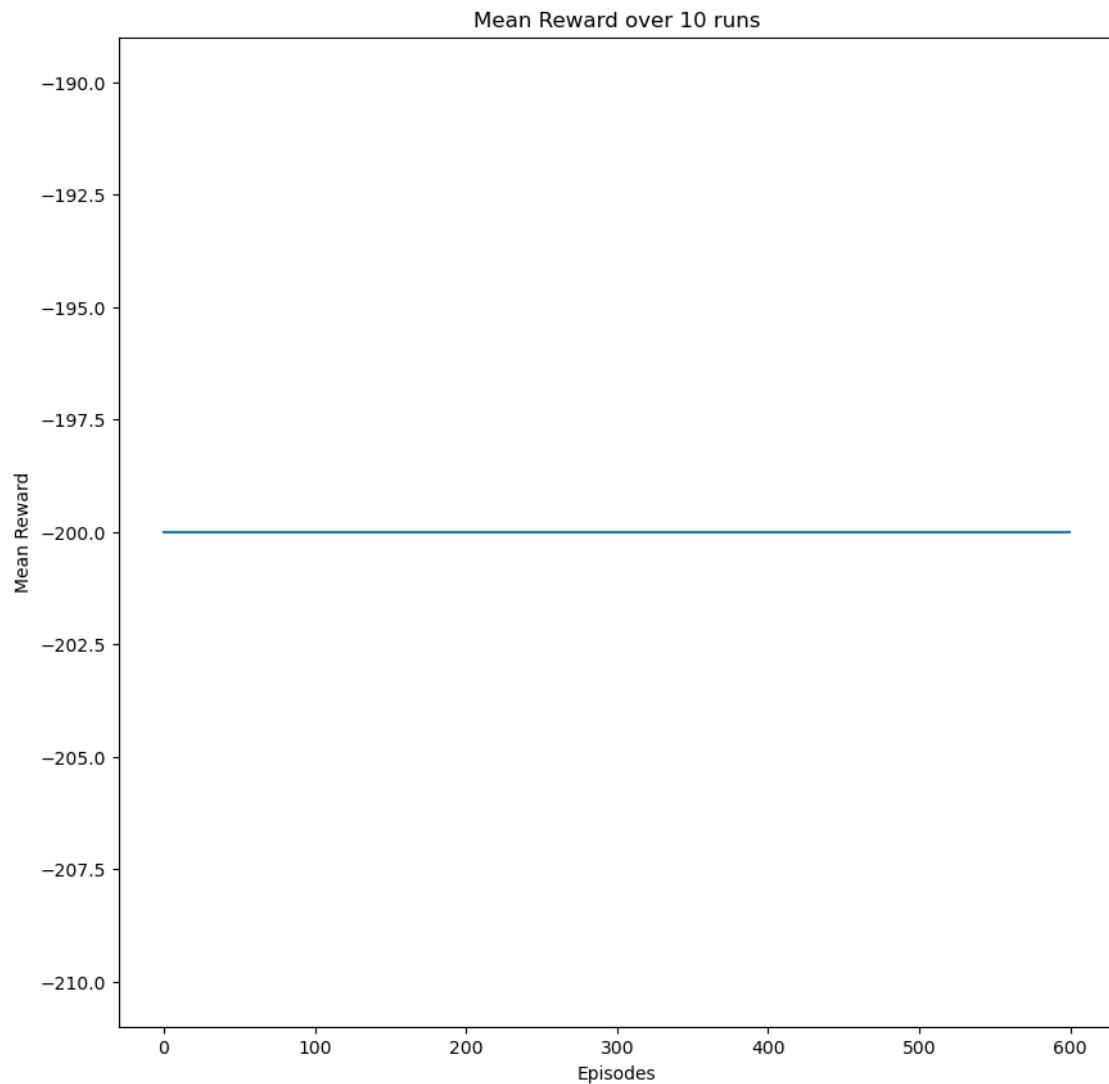
Episode 10 Reward -200.000000 Average Reward -200.000000
 Episode 20 Reward -200.000000 Average Reward -200.000000
 Episode 30 Reward -200.000000 Average Reward -200.000000
 Episode 40 Reward -200.000000 Average Reward -200.000000
 Episode 50 Reward -200.000000 Average Reward -200.000000
 Episode 60 Reward -200.000000 Average Reward -200.000000
 Episode 70 Reward -200.000000 Average Reward -200.000000
 Episode 80 Reward -200.000000 Average Reward -200.000000
 Episode 90 Reward -200.000000 Average Reward -200.000000
 Episode 100 Reward -200.000000 Average Reward -200.000000
 Episode 110 Reward -200.000000 Average Reward -200.000000
 Episode 120 Reward -200.000000 Average Reward -200.000000
 Episode 130 Reward -200.000000 Average Reward -200.000000
 Episode 140 Reward -200.000000 Average Reward -200.000000
 Episode 150 Reward -200.000000 Average Reward -200.000000
 Episode 160 Reward -200.000000 Average Reward -200.000000
 Episode 170 Reward -200.000000 Average Reward -200.000000
 Episode 180 Reward -200.000000 Average Reward -200.000000
 Episode 190 Reward -200.000000 Average Reward -200.000000
 Episode 200 Reward -200.000000 Average Reward -200.000000
 Episode 210 Reward -200.000000 Average Reward -200.000000
 Episode 220 Reward -200.000000 Average Reward -200.000000
 Episode 230 Reward -200.000000 Average Reward -200.000000
 Episode 240 Reward -200.000000 Average Reward -200.000000
 Episode 250 Reward -200.000000 Average Reward -200.000000

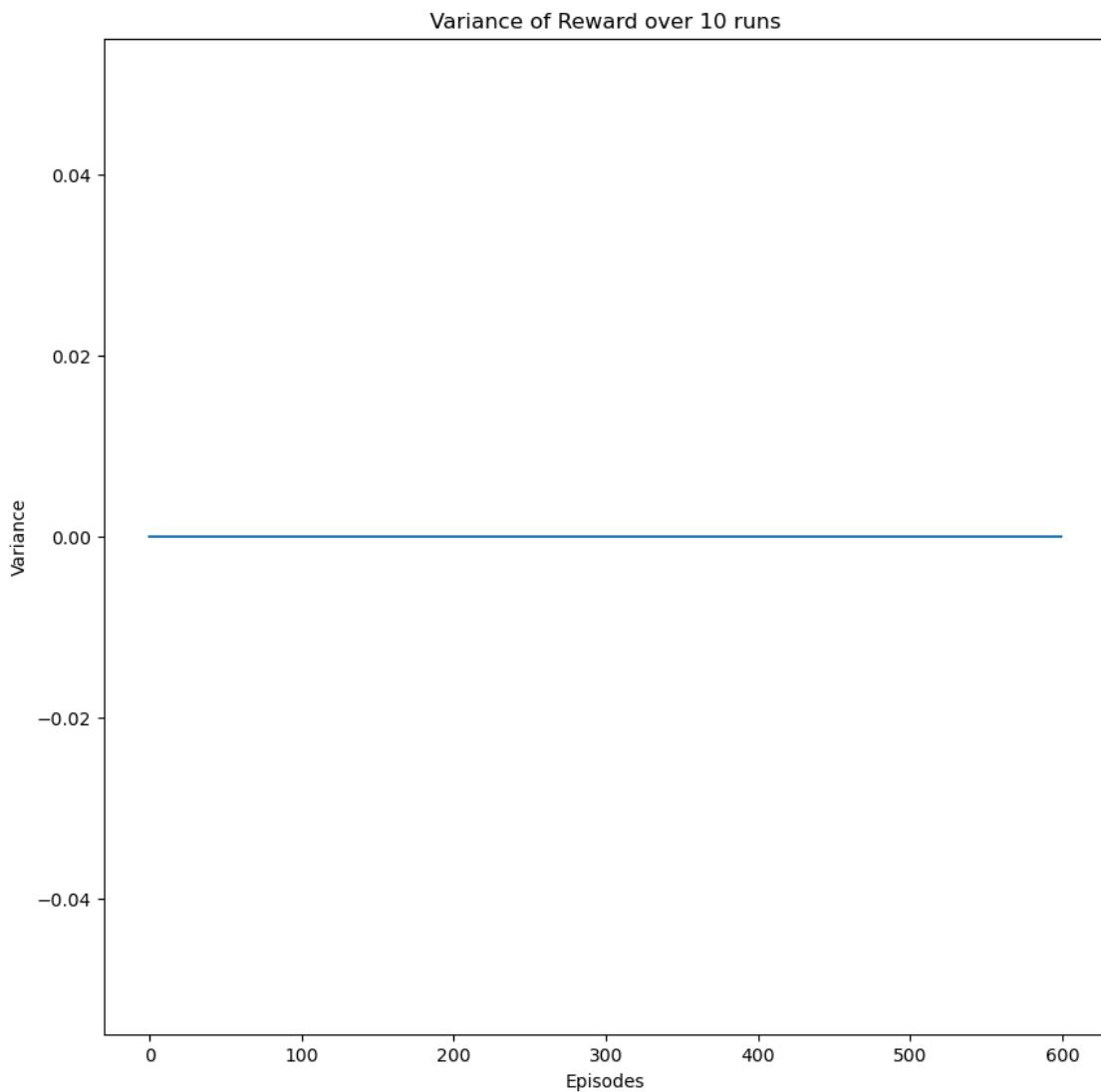
0:02:15.912738

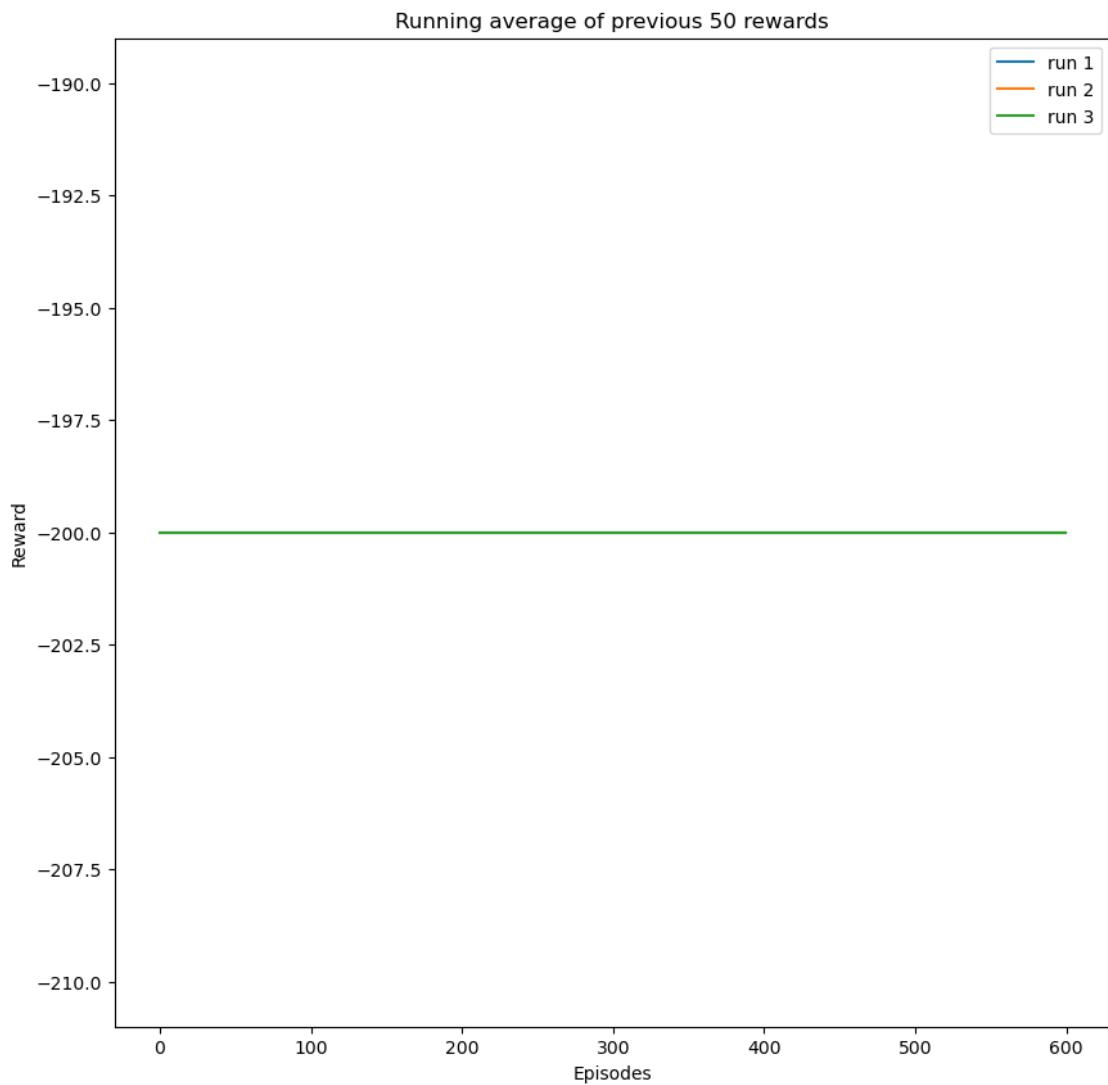
Episode 10 Rev

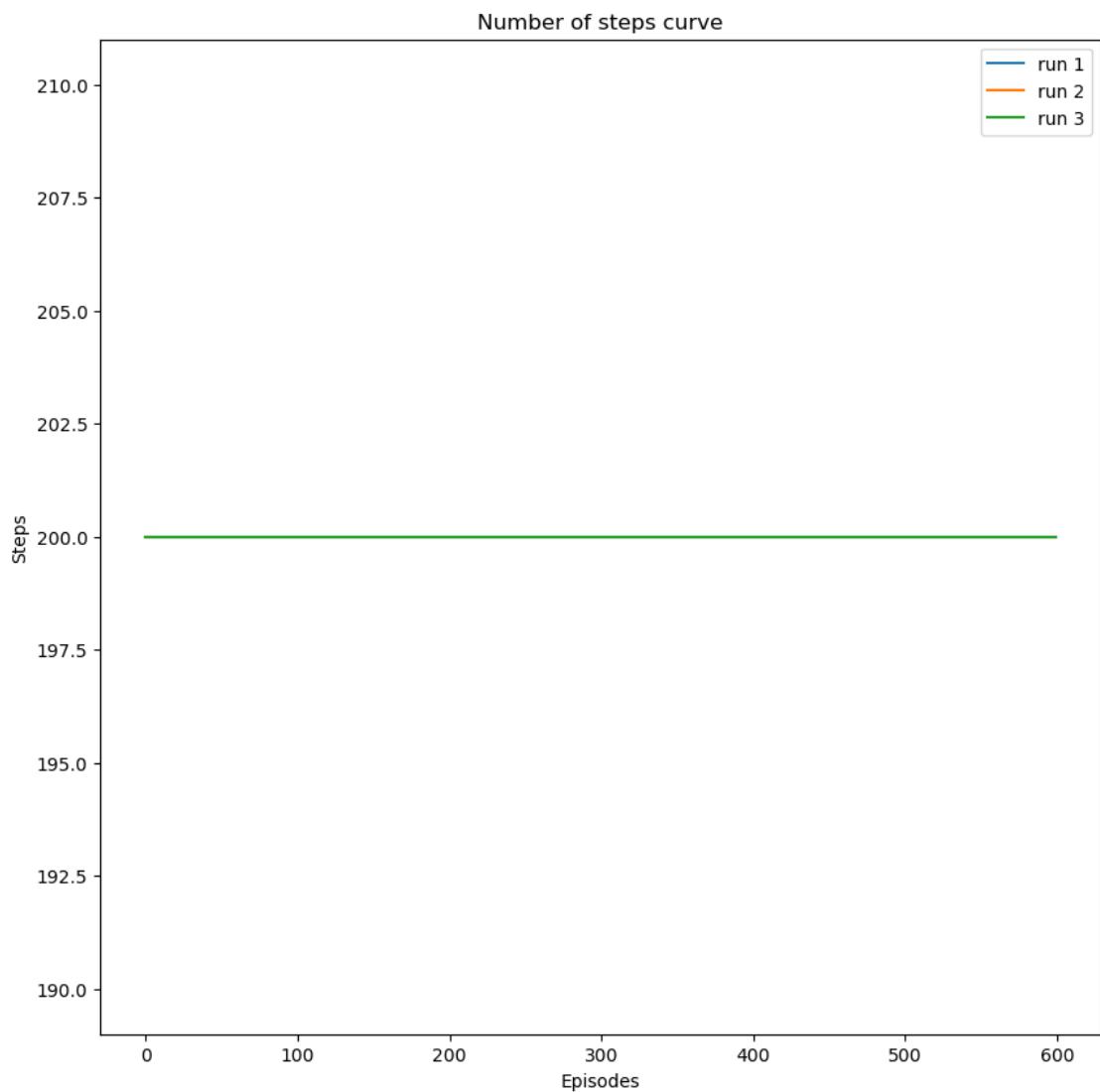
Episode 10 Reward -200.000000 Average Reward -200.000000
Episode 20 Reward -200.000000 Average Reward -200.000000
Episode 30 Reward -200.000000 Average Reward -200.000000
Episode 40 Reward -200.000000 Average Reward -200.000000
Episode 50 Reward -200.000000 Average Reward -200.000000
Episode 60 Reward -200.000000 Average Reward -200.000000
Episode 70 Reward -200.000000 Average Reward -200.000000
Episode 80 Reward -200.000000 Average Reward -200.000000

Episode 530 Reward -200.000000 Average Reward -200.000000
Episode 540 Reward -200.000000 Average Reward -200.000000
Episode 550 Reward -200.000000 Average Reward -200.000000
Episode 560 Reward -200.000000 Average Reward -200.000000
Episode 570 Reward -200.000000 Average Reward -200.000000
Episode 580 Reward -200.000000 Average Reward -200.000000
Episode 590 Reward -200.000000 Average Reward -200.000000
Episode 600 Reward -200.000000 Average Reward -200.000000
0:02:13.422668









10StepACmain

March 26, 2023

```
[ ]: import numpy as np
from collections import namedtuple, deque
import datetime
import gym
import glob
import io
import base64
import matplotlib.pyplot as plt
import tensorflow as tf
from PIL import Image
import tensorflow_probability as tfp
import seaborn as sns
import os
```

```
[ ]: from google.colab import drive
drive.mount('/content/drive')
```

Mounted at /content/drive

0.1 One-Step Actor-Critic Algorithm

Actor-Critic methods learn both a policy $\pi(a|s; \theta)$ and a state-value function $v(s; w)$ simultaneously. The policy is referred to as the actor that suggests actions given a state. The estimated value function is referred to as the critic. It evaluates actions taken by the actor based on the given policy. In this exercise, both functions are approximated by feedforward neural networks.

- The policy network is parametrized by θ - it takes a state s as input and outputs the probabilities $\pi(a|s; \theta) \forall a$
- The value network is parametrized by w - it takes a state s as input and outputs a scalar value associated with the state, i.e., $v(s; w)$
- The single step TD error can be defined as follows:

$$\delta_t = R_{t+1} + \gamma v(s_{t+1}; w) - v(s_t; w)$$

- The loss function to be minimized at every step ($L_{tot}^{(t)}$) is a summation of two terms, as follows:

$$L_{tot}^{(t)} = L_{actor}^{(t)} + L_{critic}^{(t)}$$

where,

$$L_{actor}^{(t)} = -\log \pi(a_t|s_t; \theta) \delta_t$$

$$L_{critic}^{(t)} = \delta_t^2$$

- NOTE: Here, weights of the first two hidden layers are shared by the policy and the value network
 - First two hidden layer sizes: [1024, 512]
 - Output size of policy network: 2 (Softmax activation)
 - Output size of value network: 1 (Linear activation)

0.1.1 Actor-Critic Network

```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [1024, 512]

class ActorCriticModel(tf.keras.Model):
    """
    Defining policy and value networks
    """

    def __init__(self, action_size):
        super(ActorCriticModel, self).__init__()

        self.fcls = []
        for i in range(NUM_HIDDEN):
            fc = tf.keras.layers.Dense(HIDDEN_SIZES[i], activation='relu')
            self.fcls.append(fc)

        self.pi_out = tf.keras.layers.Dense(action_size) #Output Layer for policy
        self.v_out = tf.keras.layers.Dense(1) #Output Layer for state-value

    def call(self, state):
        """
        Computes policy distribution and state-value for a given state
        """
        out = state
        for l in self.fcls:
            out = l(out)

        pi = self.pi_out(out)
        v = self.v_out(out)

        return pi, v
```

0.1.2 Agent Class

```
[ ]: ENV = gym.make('CartPole-v1')
LR = 1e-4
STEP = 5
```

```

def env_step(action: np.ndarray):
    """Returns state, reward and done flag given an action."""
    state, reward, done, info = ENV.step(action)
    return (state.astype(np.float32), np.array(reward, np.int32), np.array(done, np.int32))

def tf_env_step(action: tf.Tensor):
    return tf.numpy_function(env_step, [action], [tf.float32, tf.int32, tf.int32])

eps = np.finfo(np.float32).eps.item()
class Agent:
    def __init__(self, action_size):
        self.model = ActorCriticModel(action_size)
        self.loss = tf.keras.losses.Huber(reduction=tf.keras.losses.Reduction.SUM)
        self.optimizer = tf.keras.optimizers.Adam(learning_rate=LR)

    def run_episode(self, initial_state, max_steps=800):
        """Runs a single episode to collect training data."""

        action_probs = tf.TensorArray(dtype=tf.float32, size=0, dynamic_size=True)
        values = tf.TensorArray(dtype=tf.float32, size=0, dynamic_size=True)
        rewards = tf.TensorArray(dtype=tf.int32, size=0, dynamic_size=True)

        initial_state_shape = initial_state.shape
        state = initial_state
        steps = 0
        for t in tf.range(max_steps):
            # Convert state into a batched tensor (batch size = 1)
            state = tf.expand_dims(state, 0)

            # Run the model and to get action probabilities and critic value; and sample next action
            action_logits_t, value = self.model(state)
            action = tf.random.categorical(action_logits_t, 1)[0, 0]
            action_probs_t = tf.nn.softmax(action_logits_t)

            # Store critic values
            values = values.write(t, tf.squeeze(value))

            # Store log probability of the action chosen
            action_probs = action_probs.write(t, action_probs_t[0, action])

            # Apply action to the environment to get next state and reward
            state, reward, done = tf_env_step(action)
            state.set_shape(initial_state_shape)

```

```

        rewards = rewards.write(t, reward)
        steps += 1
        if tf.cast(done, tf.bool):
            break

    action_probs = action_probs.stack()
    values = values.stack()
    rewards = rewards.stack()

    return action_probs, values, rewards, steps

def compute_nstep_returns(self, rewards, values, gamma = 0.99):
    """Compute n step returns at all timesteps."""

    n = tf.shape(rewards)[0]
    returns = tf.TensorArray(dtype=tf.float32, size=n)
    rewards = tf.cast(rewards[:-1], dtype=tf.float32)
    disc_return = tf.constant(0.0)
    disc_ret_shape = disc_return.shape

    # loop to compute the return for every instant
    for i in tf.range(n):
        if i+STEP >= n:
            ret = tf.constant(0.0)
            ret_shape = ret.shape
            for j in tf.range(i,n):
                ret = tf.math.pow(gamma,float(j-i))*rewards[j] + ret
            ret.set_shape(ret_shape)
            disc_return = ret
        else:
            ret = tf.constant(0.0)
            ret_shape = ret.shape
            for j in tf.range(i,i+STEP):
                ret = tf.math.pow(gamma,float(j-i)) * rewards[j] + ret
            ret.set_shape(ret_shape)
            disc_return = ret + tf.math.pow(gamma,float(STEP)) *_
            ↵values[i+STEP]
            disc_return.set_shape(disc_ret_shape)
            returns = returns.write(i, disc_return)

    returns = returns.stack()
    return returns

def compute_loss(self, action_probs, values, returns):
    """Computes the combined Actor-Critic loss."""
    advantage = returns - values

```

```

action_log_probs = tf.math.log(action_probs)
actor_loss = -tf.math.reduce_sum(action_log_probs * advantage)
critic_loss = self.loss(values, returns)
return actor_loss + critic_loss

@tf.function
def train_step(self, initial_state, gamma=0.99, max_steps=800):
    """Runs a model training step."""

    with tf.GradientTape() as tape:
        # Run the model for one episode to collect training data
        action_probs, values, rewards, steps = self.
        ↪run_episode(initial_state,max_steps=max_steps)
        # Calculate the expected returns
        returns = self.compute_nstep_returns(rewards, values, gamma)
        # Convert training data to appropriate TF tensor shapes
        action_probs, values, returns = [tf.expand_dims(x, 1) for x in
        ↪[action_probs, values, returns]]
        # Calculate the loss values to update our network
        loss = self.compute_loss(action_probs, values, returns)
        # Compute the gradients from the loss
        grads = tape.gradient(loss, self.model.trainable_variables)
        # Apply the gradients to the model's parameters
        self.optimizer.apply_gradients(zip(grads, self.model.
        ↪trainable_variables))
        episode_reward = tf.math.reduce_sum(rewards)
    return episode_reward, steps

```

```

/usr/local/lib/python3.9/dist-packages/gym/core.py:317: DeprecationWarning:
WARN: Initializing wrapper in old step API which returns one bool instead
of two. It is recommended to set `new_step_api=True` to use new step API. This
will be the default behaviour in future.

deprecation(
/usr/local/lib/python3.9/dist-
packages/gym/wrappers/step_api_compatibility.py:39: DeprecationWarning:
WARN: Initializing environment in old step API which returns one bool
instead of two. It is recommended to set `new_step_api=True` to use new step
API. This will be the default behaviour in future.

deprecation(

```

0.1.3 Code to train the agent

```
[ ]: NUM_EPISODES = 1800
AVG_NUM = 50
SOLVE_CUTOFF = 195

# do 1 run of the AC-agent in an environment for num_episodes
def run_ac_net(tf_seed=42):
    tf.keras.utils.set_random_seed(tf_seed)
    agent = Agent(action_size=ENV.action_space.n)

    tf.compat.v1.reset_default_graph()

    reward_list = []
    step_list = []
    begin_time = datetime.datetime.now()
    ep_count = NUM_EPISODES

    for ep in range(1, NUM_EPISODES + 1):
        state = ENV.reset()
        ep_rew, steps = agent.train_step(state, gamma=0.99, max_steps=800)
        reward_list.append(ep_rew)
        step_list.append(steps)

        if ep % 10 == 0:
            avg_rew = np.mean(reward_list[-10:])
            print('Episode ', ep, 'Reward %f' % ep_rew, 'Average Reward %f' % avg_rew)

        if ep % 100:
            avg_100 = np.mean(reward_list[-100:])
            if avg_100 > SOLVE_CUTOFF:
                ep_count = min(ep_count, ep) # keep track of number of episodes to solve environment

    time_taken = datetime.datetime.now() - begin_time
    print(time_taken)
    return reward_list, step_list, ep_count
```

```
[ ]: def rolling_average(reward_list, avg_num=AVG_NUM):
    average_reward_list = np.zeros_like(reward_list)
    for i in range(0, len(reward_list)):
        if i < avg_num:
            average_reward_list[i] = np.mean(reward_list[:i+1])
        else:
            average_reward_list[i] = np.mean(reward_list[(i-avg_num+1):(i+1)])
    return average_reward_list
```

```
[ ]: def do_multiple_runs(env_name, num_runs):
    reward_lists, step_lists, comp_list = [], [], []
    ENV.seed(42)

    for r in range(num_runs):
        r, s, c = run_ac_net()
        reward_lists.append(r)
        step_lists.append(list(map(int,s)))
        comp_list.append(c)

    mean_rewards = np.mean(reward_lists, axis=0)
    var_rewards = np.sqrt(np.var(reward_lists, axis=0))

    return mean_rewards, var_rewards, comp_list, reward_lists, step_lists
```

0.2 Plotting Functions and Other Helpers

```
[ ]: PATH = '/content/drive/MyDrive/Colab Notebooks/CS6700/Assignments/Assignment2/
↪ACN/'

def gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, ↪
↪reward_lists, step_lists):

    m_fig, m_ax = plt.subplots(figsize=(10,10))
    v_fig, v_ax = plt.subplots(figsize=(10,10))
    m_ax.set_title(f'Mean Reward over 10 runs')
    m_ax.set_xlabel('Episodes')
    m_ax.set_ylabel('Mean Reward')
    v_ax.set_title(f'Variance of Reward over 10 runs')
    v_ax.set_xlabel('Episodes')
    v_ax.set_ylabel('Variance')

    sns.lineplot(data=mean_rewards, ax=m_ax)
    sns.lineplot(data=var_rewards, ax=v_ax)

    m_fig.savefig(PATH+'/'+fname+'/mean_reward.png')
    v_fig.savefig(PATH+'/'+fname+'/var_reward.png')

    sc_fig, sc_ax = plt.subplots(figsize=(10,10))
    st_fig, st_ax = plt.subplots(figsize=(10,10))
    sc_ax.set_title(f'Running average of previous {AVG_NUM} rewards')
    sc_ax.set_xlabel('Episodes')
    sc_ax.set_ylabel('Reward')
    st_ax.set_title(f'Number of steps curve')
    st_ax.set_xlabel('Episodes')
    st_ax.set_ylabel('Steps')
```

```

run_count = len(reward_lists)
labels = [f'run {i+1}' for i in range(3)]
for idx in range(min(run_count, 3)):

    score_list = rolling_average(reward_lists[idx])
    step_list = step_lists[idx]
    sbn.lineplot(data=score_list, label=labels[idx], ax=sc_ax)
    sbn.lineplot(data=step_list, label=labels[idx], ax=st_ax)

sc_fig.savefig(PATH+'/'+fname+'/sc_fig.png')
st_fig.savefig(PATH+'/'+fname+'/st_fig.png')

with open(PATH+'/'+fname+'/'+'config.txt', 'w') as f:
    for s in data:
        f.write(s + '\n')

```

0.3 Experiments

0.3.1 STEP(N) = 10

CartPole

[]:

```

NUM_HIDDEN = 1
HIDDEN_SIZES = [1024]
LR = 1e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'CartPole-v1'
SOLVE_CUTOFF = 195.0
STEP = 10

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'hl={NUM_HIDDEN}_hs={HIDDEN_SIZES}_lr={LR}_env={ENV_NAME}_numep={NUM_EPISODES}_nstep={STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

```
/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:  
WARN: Function `env.seed(seed)` is marked as deprecated and will be removed  
in the future. Please use `env.reset(seed=seed) instead.  
"Function `env.seed(seed)` is marked as deprecated and will be removed in the  
future. "
```

```
Episode 10 Reward 11.000000 Average Reward 28.200000  
Episode 20 Reward 15.000000 Average Reward 27.800000  
Episode 30 Reward 29.000000 Average Reward 25.100000  
Episode 40 Reward 13.000000 Average Reward 26.400000  
Episode 50 Reward 24.000000 Average Reward 23.100000  
Episode 60 Reward 11.000000 Average Reward 18.700000  
Episode 70 Reward 13.000000 Average Reward 23.200000  
Episode 80 Reward 18.000000 Average Reward 21.400000  
Episode 90 Reward 22.000000 Average Reward 21.200000  
Episode 100 Reward 10.000000 Average Reward 23.500000  
Episode 110 Reward 14.000000 Average Reward 20.900000  
Episode 120 Reward 31.000000 Average Reward 36.500000  
Episode 130 Reward 33.000000 Average Reward 23.700000  
Episode 140 Reward 25.000000 Average Reward 20.100000  
Episode 150 Reward 23.000000 Average Reward 18.700000  
Episode 160 Reward 19.000000 Average Reward 21.800000  
Episode 170 Reward 69.000000 Average Reward 35.600000  
Episode 180 Reward 25.000000 Average Reward 24.200000  
Episode 190 Reward 8.000000 Average Reward 23.500000  
Episode 200 Reward 18.000000 Average Reward 21.800000  
Episode 210 Reward 27.000000 Average Reward 26.900000  
Episode 220 Reward 56.000000 Average Reward 35.200000  
Episode 230 Reward 59.000000 Average Reward 24.800000  
Episode 240 Reward 21.000000 Average Reward 23.300000  
Episode 250 Reward 38.000000 Average Reward 31.900000  
Episode 260 Reward 27.000000 Average Reward 27.200000  
Episode 270 Reward 41.000000 Average Reward 41.400000  
Episode 280 Reward 25.000000 Average Reward 27.800000  
Episode 290 Reward 17.000000 Average Reward 32.700000  
Episode 300 Reward 24.000000 Average Reward 35.700000  
Episode 310 Reward 14.000000 Average Reward 31.700000  
Episode 320 Reward 26.000000 Average Reward 33.200000  
Episode 330 Reward 32.000000 Average Reward 28.100000  
Episode 340 Reward 28.000000 Average Reward 37.100000  
Episode 350 Reward 56.000000 Average Reward 37.100000  
Episode 360 Reward 41.000000 Average Reward 26.100000  
Episode 370 Reward 32.000000 Average Reward 35.900000  
Episode 380 Reward 20.000000 Average Reward 30.500000  
Episode 390 Reward 12.000000 Average Reward 31.300000  
Episode 400 Reward 31.000000 Average Reward 34.900000  
Episode 410 Reward 32.000000 Average Reward 33.600000
```

Episode 420 Reward 40.000000 Average Reward 33.000000
Episode 430 Reward 29.000000 Average Reward 29.300000
Episode 440 Reward 59.000000 Average Reward 41.500000
Episode 450 Reward 35.000000 Average Reward 38.200000
Episode 460 Reward 24.000000 Average Reward 46.900000
Episode 470 Reward 72.000000 Average Reward 34.000000
Episode 480 Reward 15.000000 Average Reward 36.000000
Episode 490 Reward 28.000000 Average Reward 47.700000
Episode 500 Reward 32.000000 Average Reward 45.500000
Episode 510 Reward 51.000000 Average Reward 33.000000
Episode 520 Reward 24.000000 Average Reward 46.700000
Episode 530 Reward 18.000000 Average Reward 50.700000
Episode 540 Reward 26.000000 Average Reward 39.300000
Episode 550 Reward 67.000000 Average Reward 48.500000
Episode 560 Reward 56.000000 Average Reward 52.100000
Episode 570 Reward 65.000000 Average Reward 46.000000
Episode 580 Reward 42.000000 Average Reward 50.100000
Episode 590 Reward 28.000000 Average Reward 38.200000
Episode 600 Reward 101.000000 Average Reward 45.200000
Episode 610 Reward 76.000000 Average Reward 47.700000
Episode 620 Reward 44.000000 Average Reward 57.600000
Episode 630 Reward 40.000000 Average Reward 63.700000
Episode 640 Reward 24.000000 Average Reward 43.600000
Episode 650 Reward 23.000000 Average Reward 45.600000
Episode 660 Reward 23.000000 Average Reward 45.600000
Episode 670 Reward 100.000000 Average Reward 58.300000
Episode 680 Reward 62.000000 Average Reward 56.500000
Episode 690 Reward 37.000000 Average Reward 47.300000
Episode 700 Reward 77.000000 Average Reward 42.200000
Episode 710 Reward 43.000000 Average Reward 58.400000
Episode 720 Reward 71.000000 Average Reward 50.700000
Episode 730 Reward 104.000000 Average Reward 66.100000
Episode 740 Reward 98.000000 Average Reward 66.300000
Episode 750 Reward 55.000000 Average Reward 40.500000
Episode 760 Reward 61.000000 Average Reward 53.200000
Episode 770 Reward 36.000000 Average Reward 67.000000
Episode 780 Reward 75.000000 Average Reward 88.900000
Episode 790 Reward 27.000000 Average Reward 58.300000
Episode 800 Reward 167.000000 Average Reward 94.700000
Episode 810 Reward 31.000000 Average Reward 109.800000
Episode 820 Reward 59.000000 Average Reward 73.100000
Episode 830 Reward 106.000000 Average Reward 88.100000
Episode 840 Reward 61.000000 Average Reward 74.200000
Episode 850 Reward 42.000000 Average Reward 64.100000
Episode 860 Reward 83.000000 Average Reward 119.800000
Episode 870 Reward 33.000000 Average Reward 80.200000
Episode 880 Reward 124.000000 Average Reward 116.100000
Episode 890 Reward 20.000000 Average Reward 87.600000

Episode 900 Reward 161.000000 Average Reward 107.500000
Episode 910 Reward 65.000000 Average Reward 119.700000
Episode 920 Reward 269.000000 Average Reward 124.300000
Episode 930 Reward 37.000000 Average Reward 138.500000
Episode 940 Reward 99.000000 Average Reward 193.700000
Episode 950 Reward 30.000000 Average Reward 119.000000
Episode 960 Reward 118.000000 Average Reward 120.800000
Episode 970 Reward 117.000000 Average Reward 115.700000
Episode 980 Reward 120.000000 Average Reward 108.400000
Episode 990 Reward 29.000000 Average Reward 100.800000
Episode 1000 Reward 296.000000 Average Reward 114.100000
0:00:48.642123
Episode 10 Reward 14.000000 Average Reward 28.600000
Episode 20 Reward 51.000000 Average Reward 21.000000
Episode 30 Reward 12.000000 Average Reward 23.700000
Episode 40 Reward 15.000000 Average Reward 24.400000
Episode 50 Reward 11.000000 Average Reward 18.900000
Episode 60 Reward 38.000000 Average Reward 21.600000
Episode 70 Reward 37.000000 Average Reward 25.900000
Episode 80 Reward 17.000000 Average Reward 17.300000
Episode 90 Reward 23.000000 Average Reward 22.300000
Episode 100 Reward 20.000000 Average Reward 21.400000
Episode 110 Reward 21.000000 Average Reward 26.200000
Episode 120 Reward 14.000000 Average Reward 22.400000
Episode 130 Reward 15.000000 Average Reward 22.300000
Episode 140 Reward 33.000000 Average Reward 23.700000
Episode 150 Reward 23.000000 Average Reward 24.000000
Episode 160 Reward 17.000000 Average Reward 20.500000
Episode 170 Reward 13.000000 Average Reward 17.700000
Episode 180 Reward 32.000000 Average Reward 30.100000
Episode 190 Reward 28.000000 Average Reward 20.700000
Episode 200 Reward 21.000000 Average Reward 26.300000
Episode 210 Reward 15.000000 Average Reward 29.900000
Episode 220 Reward 11.000000 Average Reward 25.700000
Episode 230 Reward 52.000000 Average Reward 29.900000
Episode 240 Reward 10.000000 Average Reward 27.600000
Episode 250 Reward 20.000000 Average Reward 32.800000
Episode 260 Reward 66.000000 Average Reward 31.100000
Episode 270 Reward 15.000000 Average Reward 29.200000
Episode 280 Reward 38.000000 Average Reward 35.700000
Episode 290 Reward 22.000000 Average Reward 27.800000
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Episode 950 Reward 145.000000 Average Reward 106.100000
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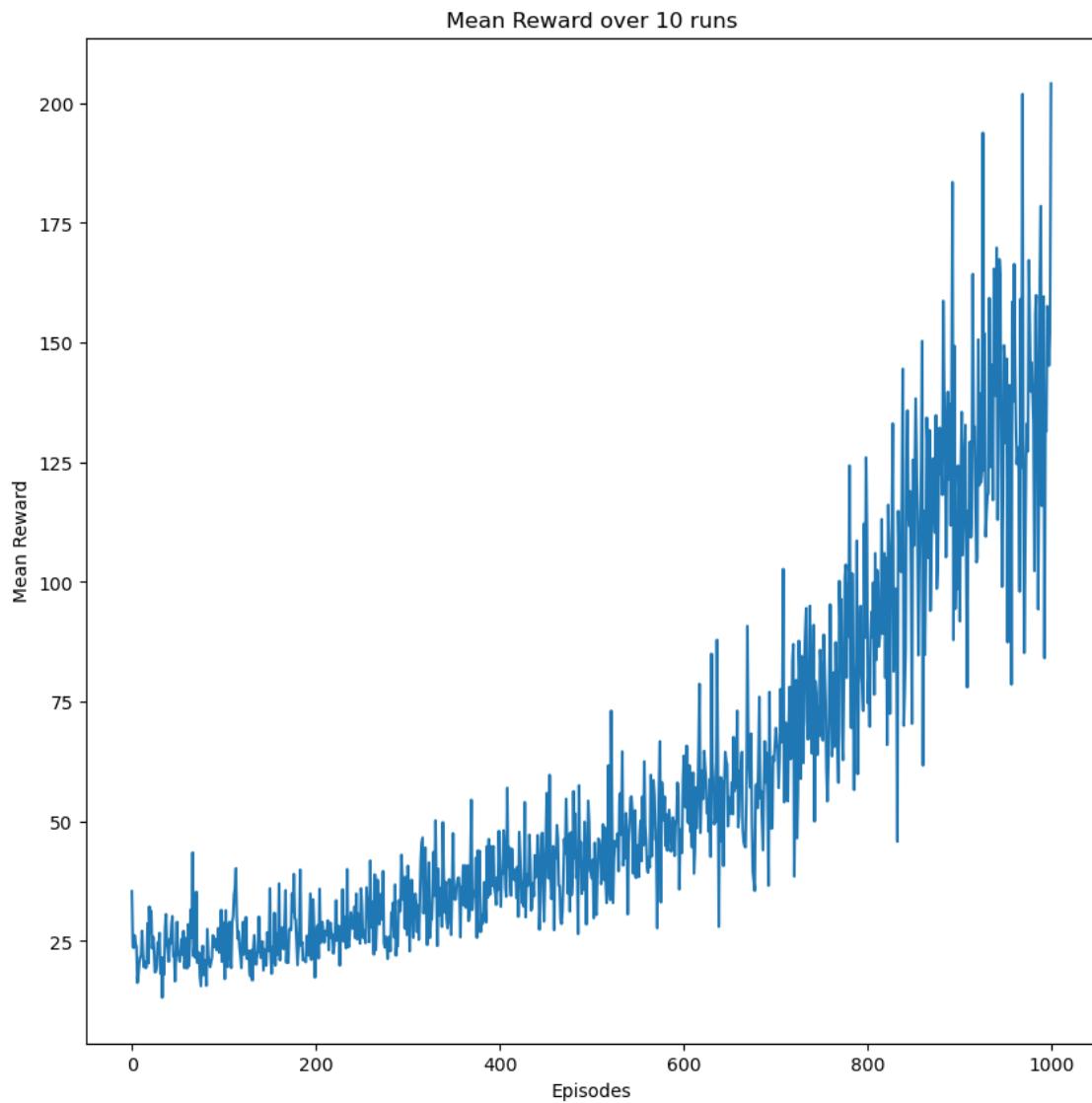
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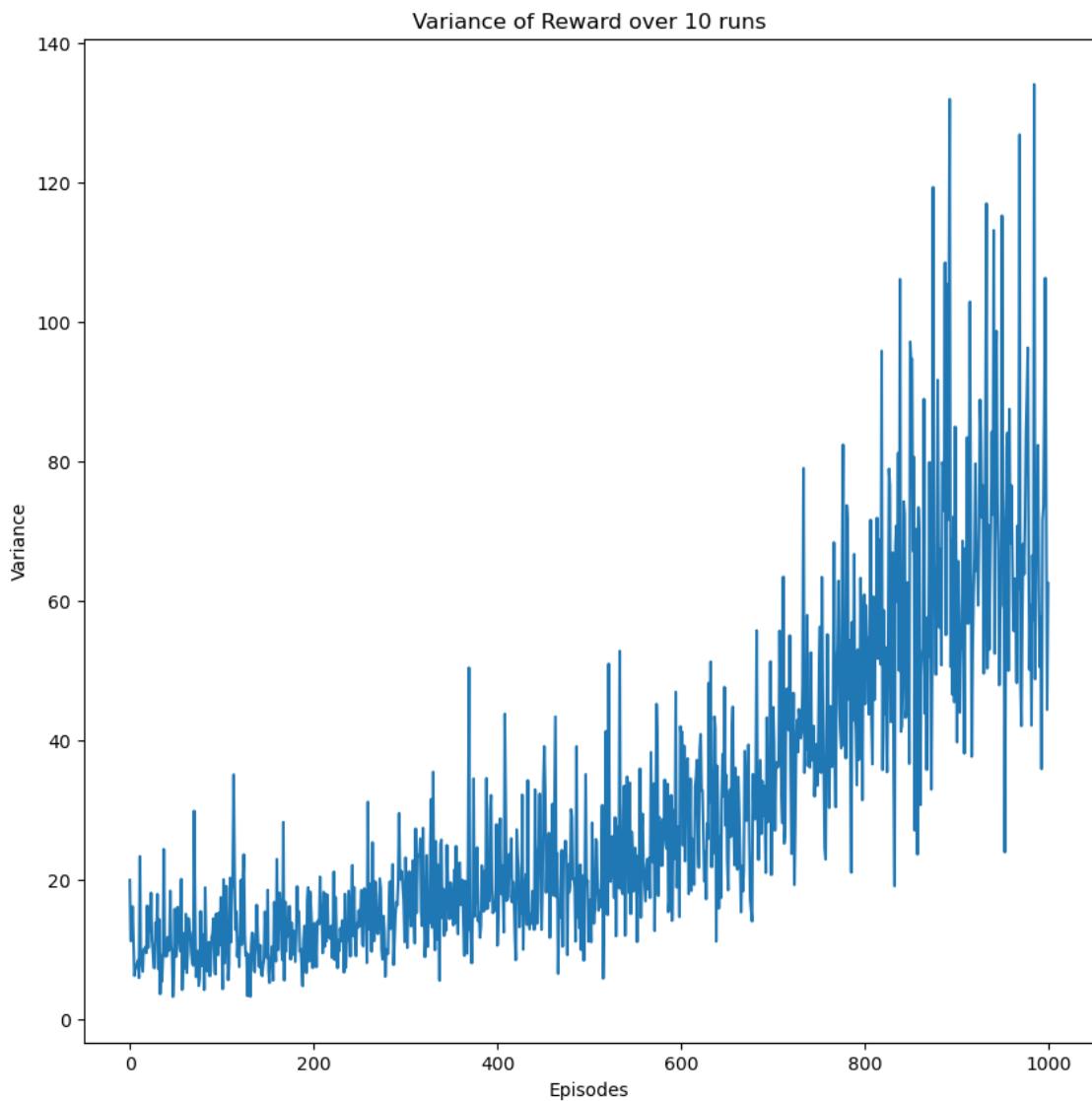
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Episode 790 Reward 22.000000 Average Reward 101.200000
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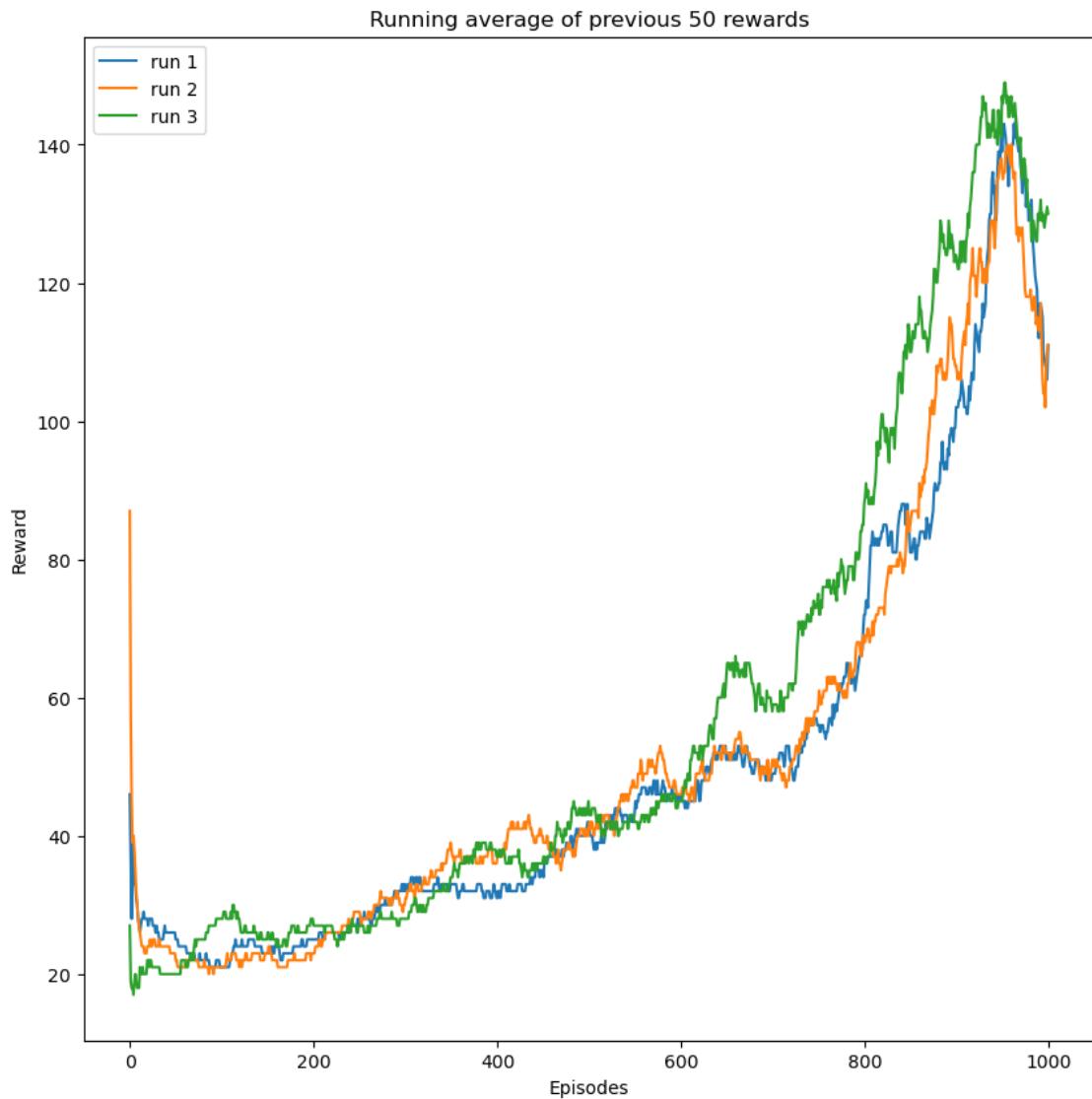
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Episode 100 Reward 41.000000 Average Reward 25.700000
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Episode 270 Reward 49.000000 Average Reward 25.600000
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Episode 290 Reward 59.000000 Average Reward 23.700000
Episode 300 Reward 41.000000 Average Reward 34.100000
Episode 310 Reward 50.000000 Average Reward 37.000000
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Episode 330 Reward 43.000000 Average Reward 31.400000
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Episode 350 Reward 47.000000 Average Reward 37.500000
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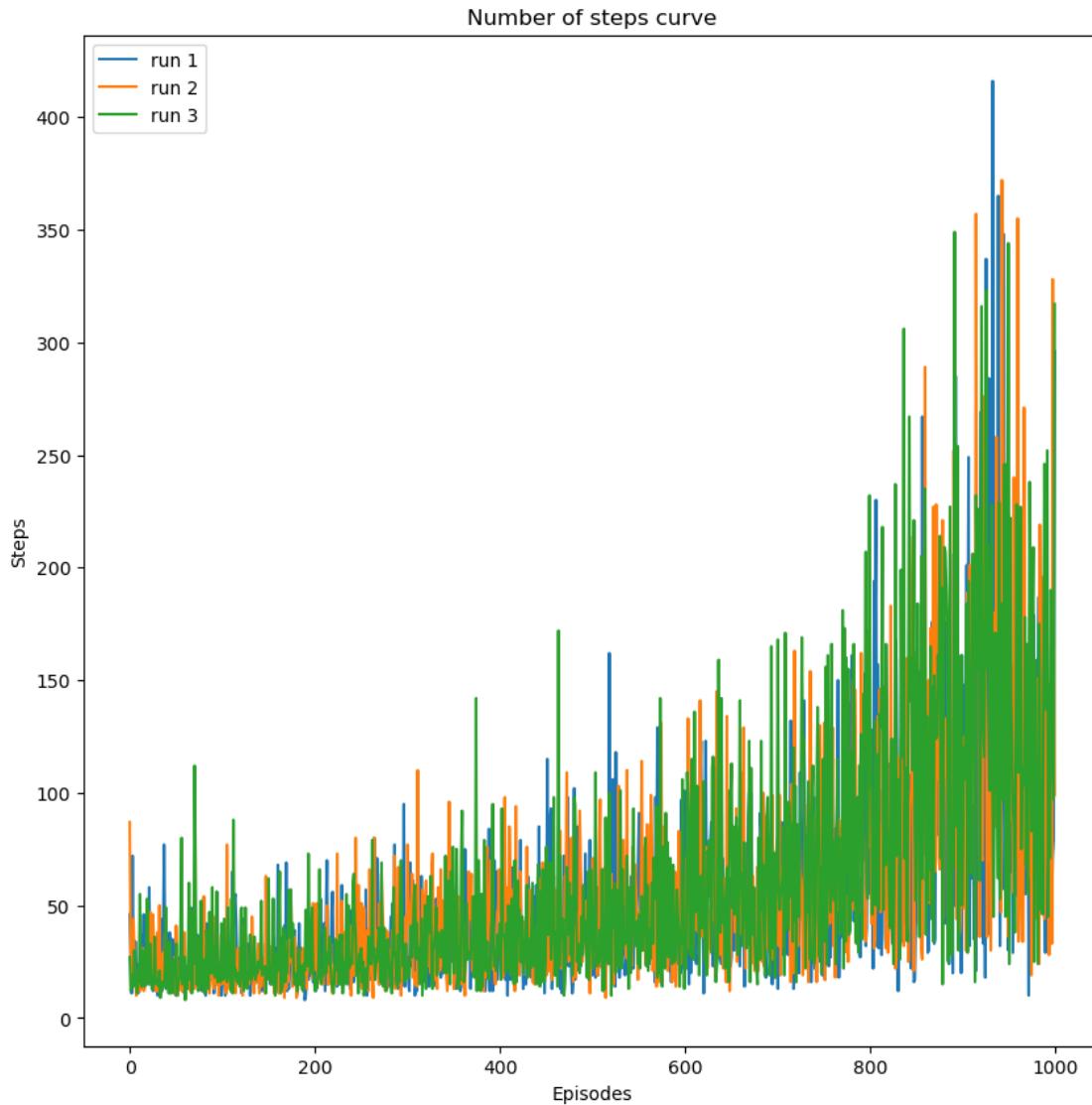
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Episode 910 Reward 267.000000 Average Reward 136.000000
Episode 920 Reward 33.000000 Average Reward 112.400000

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Episode 930 Reward 104.000000 Average Reward 134.000000
Episode 940 Reward 240.000000 Average Reward 136.400000
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Episode 960 Reward 83.000000 Average Reward 113.700000
Episode 970 Reward 107.000000 Average Reward 167.900000
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Episode 990 Reward 80.000000 Average Reward 177.800000
Episode 1000 Reward 167.000000 Average Reward 159.000000
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```









```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [512, 512]
LR = 0.5e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'CartPole-v1'
SOLVE_CUTOFF = 195.0
STEP = 10

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{hs}-{lr}-{env}-{numep}-{nstep}-{STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	11.000000	28.800000
20	15.000000	27.200000
30	30.000000	27.300000
40	27.000000	34.300000
50	17.000000	25.100000
60	14.000000	30.900000
70	21.000000	26.000000
80	50.000000	28.600000
90	16.000000	24.300000
100	33.000000	30.500000
110	30.000000	29.800000
120	31.000000	22.900000
130	34.000000	23.400000
140	10.000000	25.600000
150	22.000000	19.900000
160	56.000000	26.200000
170	11.000000	33.900000
180	15.000000	22.300000
190	17.000000	30.300000
200	20.000000	29.200000
210	22.000000	33.800000
220	16.000000	24.100000
230	65.000000	40.000000
240	35.000000	24.400000
250	35.000000	26.900000
260	25.000000	28.200000
270	14.000000	32.300000
280	13.000000	40.100000

Episode 290 Reward 16.000000 Average Reward 28.600000
Episode 300 Reward 30.000000 Average Reward 43.200000
Episode 310 Reward 21.000000 Average Reward 30.500000
Episode 320 Reward 27.000000 Average Reward 35.300000
Episode 330 Reward 23.000000 Average Reward 45.100000
Episode 340 Reward 24.000000 Average Reward 34.400000
Episode 350 Reward 23.000000 Average Reward 35.400000
Episode 360 Reward 19.000000 Average Reward 29.800000
Episode 370 Reward 22.000000 Average Reward 44.200000
Episode 380 Reward 47.000000 Average Reward 42.200000
Episode 390 Reward 30.000000 Average Reward 45.300000
Episode 400 Reward 54.000000 Average Reward 60.100000
Episode 410 Reward 18.000000 Average Reward 62.100000
Episode 420 Reward 33.000000 Average Reward 40.000000
Episode 430 Reward 59.000000 Average Reward 52.500000
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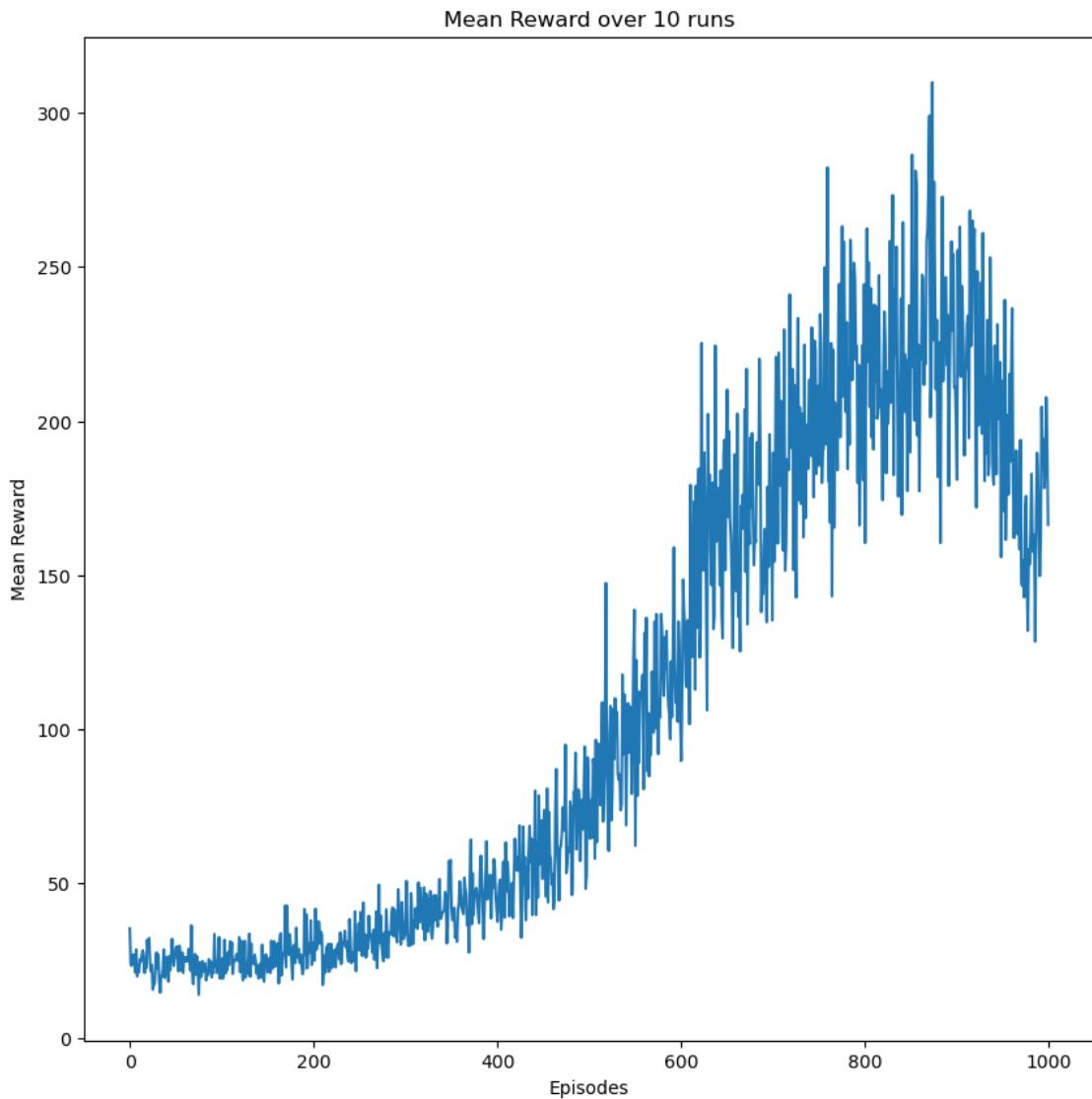
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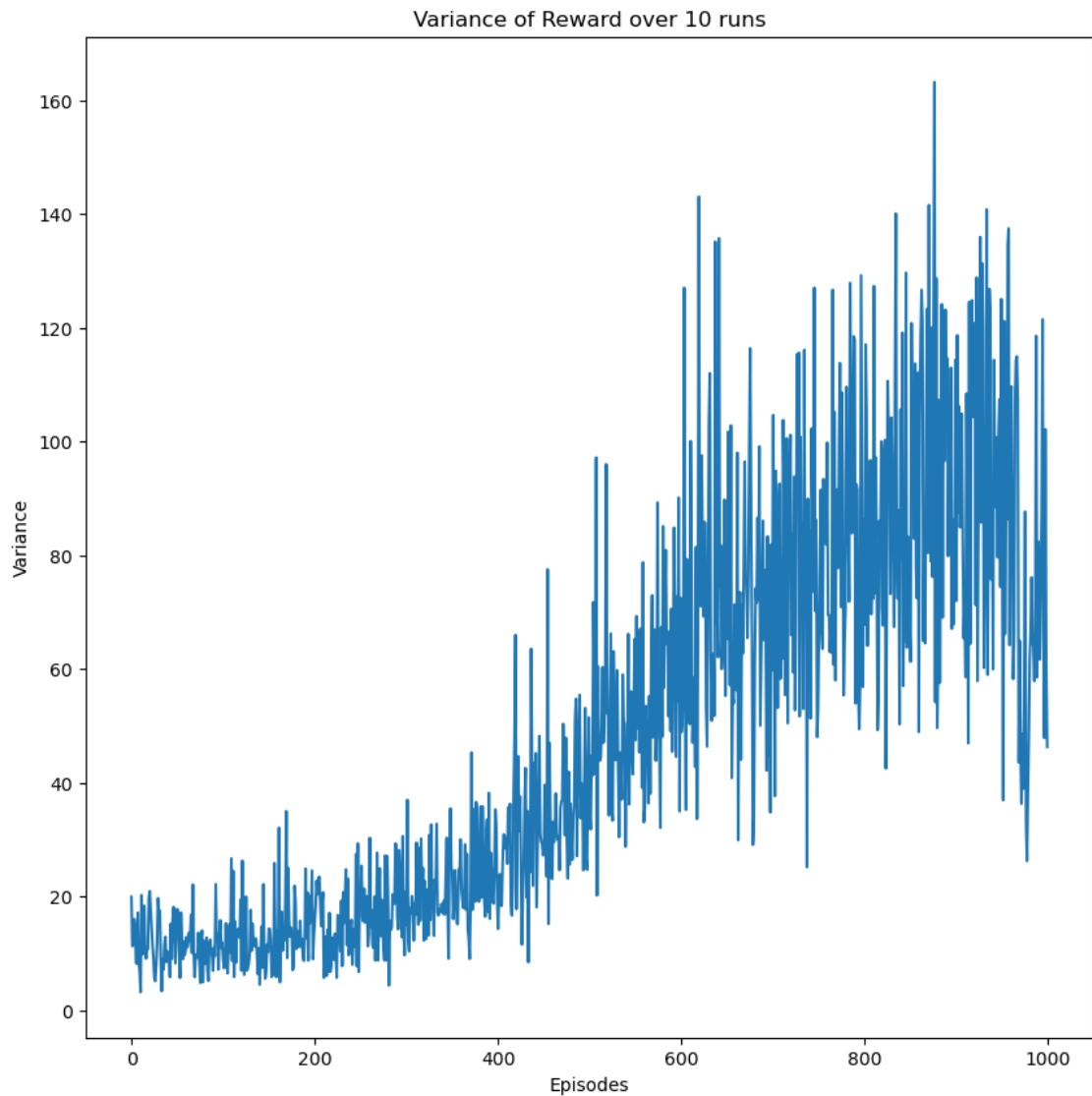
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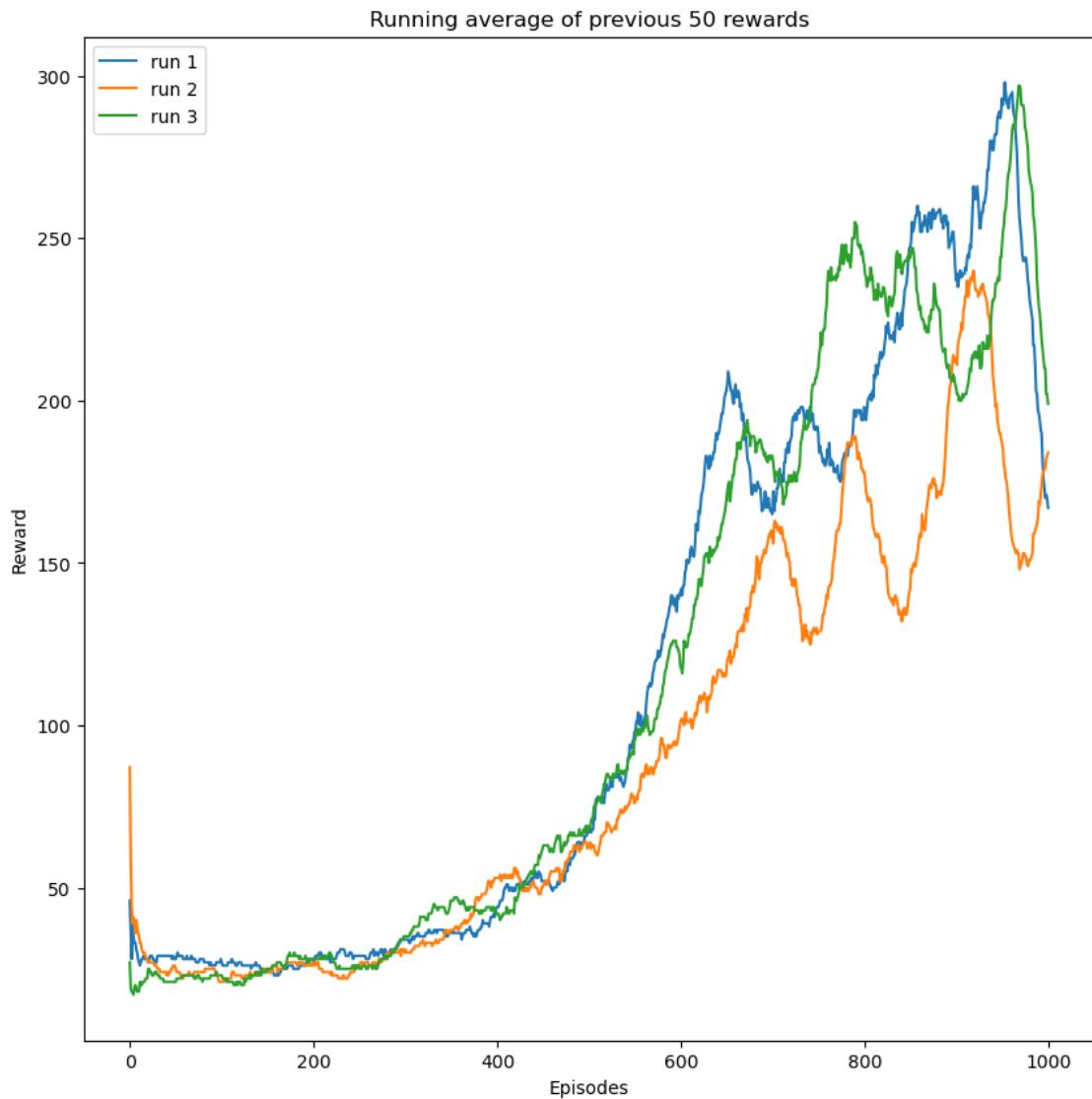
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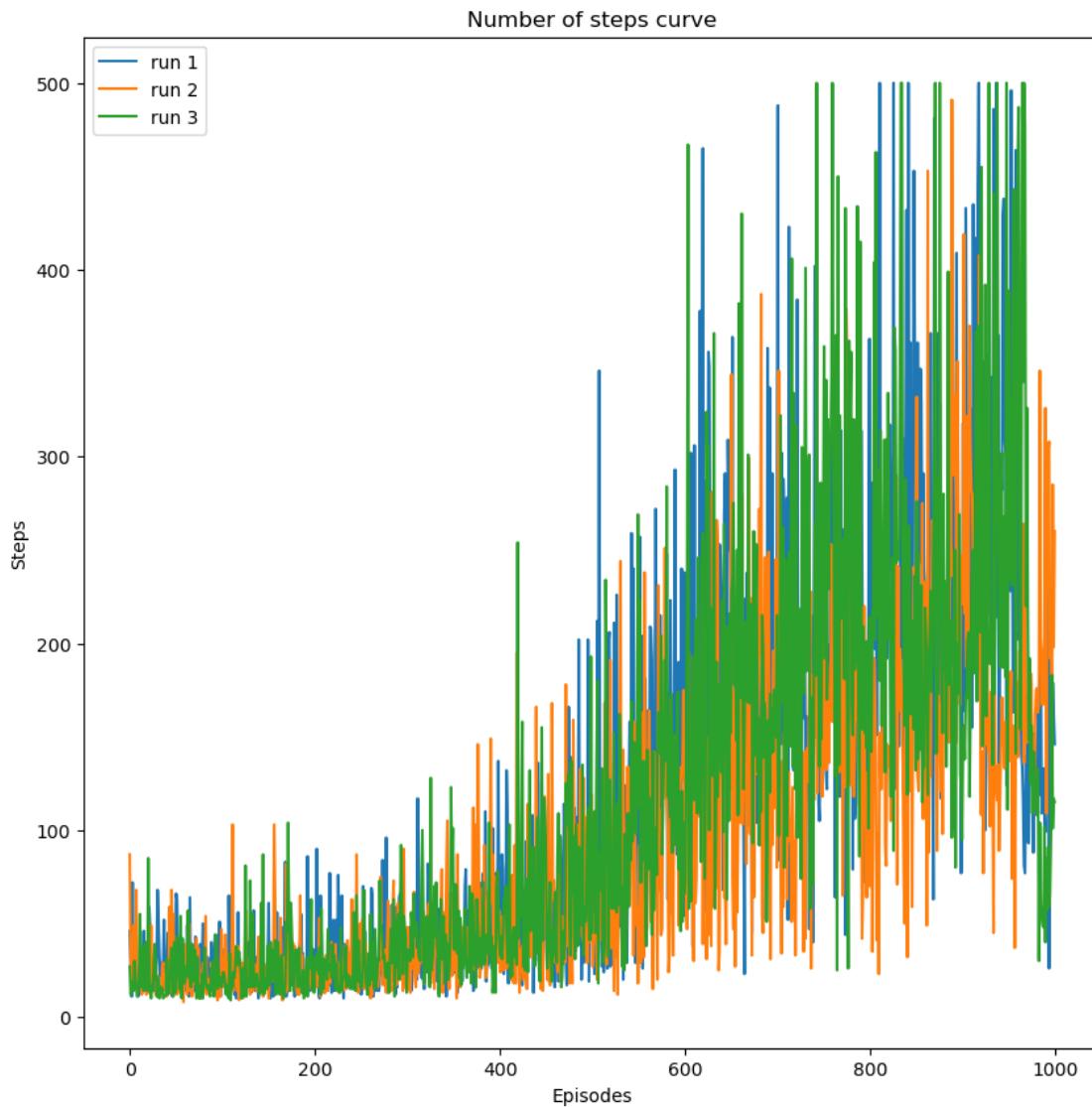
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Episode 790 Reward 101.000000 Average Reward 186.800000

Episode 800 Reward 280.000000 Average Reward 241.000000
Episode 810 Reward 255.000000 Average Reward 248.400000
Episode 820 Reward 178.000000 Average Reward 256.500000
Episode 830 Reward 306.000000 Average Reward 290.000000
Episode 840 Reward 173.000000 Average Reward 218.000000
Episode 850 Reward 216.000000 Average Reward 214.000000
Episode 860 Reward 183.000000 Average Reward 266.900000
Episode 870 Reward 246.000000 Average Reward 289.700000
Episode 880 Reward 219.000000 Average Reward 282.800000
Episode 890 Reward 251.000000 Average Reward 308.100000
Episode 900 Reward 500.000000 Average Reward 292.700000
Episode 910 Reward 133.000000 Average Reward 229.200000
Episode 920 Reward 316.000000 Average Reward 231.400000
Episode 930 Reward 136.000000 Average Reward 215.600000
Episode 940 Reward 371.000000 Average Reward 197.400000
Episode 950 Reward 117.000000 Average Reward 176.200000
Episode 960 Reward 147.000000 Average Reward 138.200000
Episode 970 Reward 205.000000 Average Reward 156.700000
Episode 980 Reward 258.000000 Average Reward 171.500000
Episode 990 Reward 122.000000 Average Reward 201.300000
Episode 1000 Reward 126.000000 Average Reward 227.700000
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```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [512, 512]
LR = 1e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'CartPole-v1'
SOLVE_CUTOFF = 195.0
STEP = 10

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{hs}-{lr}-{env}-{numep}-{nstep}-{STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	44.000000	35.800000
20	10.000000	22.200000
30	46.000000	26.900000
40	42.000000	31.200000
50	26.000000	30.100000
60	14.000000	27.400000
70	25.000000	27.000000
80	43.000000	35.400000
90	25.000000	30.500000
100	25.000000	22.800000
110	26.000000	25.000000
120	19.000000	27.200000
130	21.000000	28.600000
140	53.000000	32.300000
150	21.000000	31.300000
160	25.000000	37.600000
170	13.000000	31.700000
180	75.000000	51.200000
190	25.000000	36.000000
200	46.000000	38.000000
210	34.000000	43.900000
220	40.000000	49.800000
230	76.000000	68.800000
240	32.000000	65.000000
250	134.000000	93.600000
260	127.000000	142.100000
270	247.000000	147.000000
280	203.000000	143.800000

Episode 290 Reward 211.000000 Average Reward 172.800000
Episode 300 Reward 182.000000 Average Reward 109.500000
Episode 310 Reward 172.000000 Average Reward 147.600000
Episode 320 Reward 288.000000 Average Reward 175.600000
Episode 330 Reward 236.000000 Average Reward 171.000000
Episode 340 Reward 202.000000 Average Reward 157.900000
Episode 350 Reward 68.000000 Average Reward 115.600000
Episode 360 Reward 98.000000 Average Reward 84.800000
Episode 370 Reward 219.000000 Average Reward 146.400000
Episode 380 Reward 195.000000 Average Reward 286.500000
Episode 390 Reward 350.000000 Average Reward 201.400000
Episode 400 Reward 280.000000 Average Reward 237.100000
Episode 410 Reward 203.000000 Average Reward 142.100000
Episode 420 Reward 107.000000 Average Reward 107.400000
Episode 430 Reward 313.000000 Average Reward 175.800000
Episode 440 Reward 138.000000 Average Reward 179.600000
Episode 450 Reward 138.000000 Average Reward 136.200000
Episode 460 Reward 213.000000 Average Reward 213.100000
Episode 470 Reward 468.000000 Average Reward 320.700000
Episode 480 Reward 209.000000 Average Reward 322.300000
Episode 490 Reward 128.000000 Average Reward 262.100000
Episode 500 Reward 101.000000 Average Reward 174.500000
Episode 510 Reward 110.000000 Average Reward 159.500000
Episode 520 Reward 93.000000 Average Reward 138.000000
Episode 530 Reward 90.000000 Average Reward 164.600000
Episode 540 Reward 160.000000 Average Reward 253.600000
Episode 550 Reward 75.000000 Average Reward 138.300000
Episode 560 Reward 82.000000 Average Reward 67.400000
Episode 570 Reward 168.000000 Average Reward 115.000000
Episode 580 Reward 162.000000 Average Reward 199.800000
Episode 590 Reward 250.000000 Average Reward 192.100000
Episode 600 Reward 237.000000 Average Reward 231.900000
Episode 610 Reward 124.000000 Average Reward 143.600000
Episode 620 Reward 132.000000 Average Reward 129.400000
Episode 630 Reward 130.000000 Average Reward 106.500000
Episode 640 Reward 147.000000 Average Reward 115.900000
Episode 650 Reward 23.000000 Average Reward 121.100000
Episode 660 Reward 109.000000 Average Reward 107.500000
Episode 670 Reward 107.000000 Average Reward 117.000000
Episode 680 Reward 154.000000 Average Reward 121.400000
Episode 690 Reward 106.000000 Average Reward 139.900000
Episode 700 Reward 127.000000 Average Reward 125.100000
Episode 710 Reward 49.000000 Average Reward 115.200000
Episode 720 Reward 141.000000 Average Reward 120.000000
Episode 730 Reward 131.000000 Average Reward 114.100000
Episode 740 Reward 124.000000 Average Reward 126.300000
Episode 750 Reward 107.000000 Average Reward 131.800000
Episode 760 Reward 118.000000 Average Reward 136.300000

Episode 770 Reward 137.000000 Average Reward 138.000000
Episode 780 Reward 150.000000 Average Reward 131.400000
Episode 790 Reward 360.000000 Average Reward 169.300000
Episode 800 Reward 156.000000 Average Reward 301.600000
Episode 810 Reward 36.000000 Average Reward 99.600000
Episode 820 Reward 167.000000 Average Reward 119.400000
Episode 830 Reward 321.000000 Average Reward 251.900000
Episode 840 Reward 349.000000 Average Reward 347.700000
Episode 850 Reward 155.000000 Average Reward 282.100000
Episode 860 Reward 169.000000 Average Reward 227.000000
Episode 870 Reward 135.000000 Average Reward 150.200000
Episode 880 Reward 115.000000 Average Reward 99.900000
Episode 890 Reward 165.000000 Average Reward 117.000000
Episode 900 Reward 199.000000 Average Reward 252.500000
Episode 910 Reward 122.000000 Average Reward 190.100000
Episode 920 Reward 119.000000 Average Reward 120.800000
Episode 930 Reward 98.000000 Average Reward 100.100000
Episode 940 Reward 131.000000 Average Reward 123.300000
Episode 950 Reward 289.000000 Average Reward 183.600000
Episode 960 Reward 256.000000 Average Reward 314.900000
Episode 970 Reward 419.000000 Average Reward 416.700000
Episode 980 Reward 500.000000 Average Reward 383.900000
Episode 990 Reward 263.000000 Average Reward 243.700000
Episode 1000 Reward 309.000000 Average Reward 265.400000
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Episode 10 Reward 43.000000 Average Reward 33.600000
Episode 20 Reward 27.000000 Average Reward 26.900000
Episode 30 Reward 23.000000 Average Reward 17.900000
Episode 40 Reward 13.000000 Average Reward 29.300000
Episode 50 Reward 43.000000 Average Reward 39.200000
Episode 60 Reward 21.000000 Average Reward 24.000000
Episode 70 Reward 13.000000 Average Reward 21.600000
Episode 80 Reward 29.000000 Average Reward 25.800000
Episode 90 Reward 22.000000 Average Reward 33.200000
Episode 100 Reward 22.000000 Average Reward 53.500000
Episode 110 Reward 62.000000 Average Reward 37.300000
Episode 120 Reward 59.000000 Average Reward 32.700000
Episode 130 Reward 70.000000 Average Reward 32.800000
Episode 140 Reward 32.000000 Average Reward 36.300000
Episode 150 Reward 24.000000 Average Reward 42.100000
Episode 160 Reward 42.000000 Average Reward 52.700000
Episode 170 Reward 22.000000 Average Reward 52.100000
Episode 180 Reward 63.000000 Average Reward 64.300000
Episode 190 Reward 141.000000 Average Reward 51.100000
Episode 200 Reward 35.000000 Average Reward 54.700000
Episode 210 Reward 164.000000 Average Reward 80.300000
Episode 220 Reward 67.000000 Average Reward 58.000000
Episode 230 Reward 44.000000 Average Reward 78.000000

Episode 240 Reward 47.000000 Average Reward 106.100000
Episode 250 Reward 107.000000 Average Reward 110.400000
Episode 260 Reward 108.000000 Average Reward 116.800000
Episode 270 Reward 148.000000 Average Reward 120.300000
Episode 280 Reward 65.000000 Average Reward 121.900000
Episode 290 Reward 99.000000 Average Reward 100.100000
Episode 300 Reward 20.000000 Average Reward 137.900000
Episode 310 Reward 160.000000 Average Reward 142.500000
Episode 320 Reward 248.000000 Average Reward 189.000000
Episode 330 Reward 198.000000 Average Reward 200.000000
Episode 340 Reward 250.000000 Average Reward 169.900000
Episode 350 Reward 98.000000 Average Reward 149.200000
Episode 360 Reward 230.000000 Average Reward 175.200000
Episode 370 Reward 181.000000 Average Reward 175.200000
Episode 380 Reward 249.000000 Average Reward 239.100000
Episode 390 Reward 173.000000 Average Reward 195.500000
Episode 400 Reward 158.000000 Average Reward 209.200000
Episode 410 Reward 372.000000 Average Reward 201.600000
Episode 420 Reward 252.000000 Average Reward 252.100000
Episode 430 Reward 253.000000 Average Reward 256.700000
Episode 440 Reward 144.000000 Average Reward 167.000000
Episode 450 Reward 112.000000 Average Reward 131.900000
Episode 460 Reward 297.000000 Average Reward 146.300000
Episode 470 Reward 467.000000 Average Reward 256.400000
Episode 480 Reward 145.000000 Average Reward 264.800000
Episode 490 Reward 49.000000 Average Reward 106.900000
Episode 500 Reward 101.000000 Average Reward 85.400000
Episode 510 Reward 171.000000 Average Reward 125.600000
Episode 520 Reward 351.000000 Average Reward 251.300000
Episode 530 Reward 230.000000 Average Reward 325.100000
Episode 540 Reward 500.000000 Average Reward 368.000000
Episode 550 Reward 154.000000 Average Reward 230.800000
Episode 560 Reward 225.000000 Average Reward 178.600000
Episode 570 Reward 198.000000 Average Reward 168.900000
Episode 580 Reward 126.000000 Average Reward 142.000000
Episode 590 Reward 160.000000 Average Reward 156.500000
Episode 600 Reward 500.000000 Average Reward 307.000000
Episode 610 Reward 171.000000 Average Reward 329.700000
Episode 620 Reward 500.000000 Average Reward 257.700000
Episode 630 Reward 127.000000 Average Reward 324.000000
Episode 640 Reward 123.000000 Average Reward 251.200000
Episode 650 Reward 381.000000 Average Reward 280.200000
Episode 660 Reward 500.000000 Average Reward 445.000000
Episode 670 Reward 193.000000 Average Reward 385.900000
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Episode 710 Reward 213.000000 Average Reward 179.900000

Episode 720 Reward 265.000000 Average Reward 242.200000
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Episode 740 Reward 424.000000 Average Reward 372.200000
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Episode 770 Reward 124.000000 Average Reward 58.200000
Episode 780 Reward 184.000000 Average Reward 139.700000
Episode 790 Reward 125.000000 Average Reward 112.800000
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Episode 860 Reward 137.000000 Average Reward 79.000000
Episode 870 Reward 158.000000 Average Reward 149.700000
Episode 880 Reward 161.000000 Average Reward 162.100000
Episode 890 Reward 126.000000 Average Reward 163.400000
Episode 900 Reward 143.000000 Average Reward 156.800000
Episode 910 Reward 120.000000 Average Reward 134.600000
Episode 920 Reward 151.000000 Average Reward 177.300000
Episode 930 Reward 159.000000 Average Reward 277.100000
Episode 940 Reward 206.000000 Average Reward 212.800000
Episode 950 Reward 249.000000 Average Reward 218.100000
Episode 960 Reward 231.000000 Average Reward 224.600000
Episode 970 Reward 150.000000 Average Reward 202.500000
Episode 980 Reward 161.000000 Average Reward 169.500000
Episode 990 Reward 239.000000 Average Reward 243.800000
Episode 1000 Reward 420.000000 Average Reward 369.500000

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Episode 10 Reward 11.000000 Average Reward 18.100000
Episode 20 Reward 34.000000 Average Reward 27.300000
Episode 30 Reward 18.000000 Average Reward 19.300000
Episode 40 Reward 32.000000 Average Reward 24.000000
Episode 50 Reward 15.000000 Average Reward 20.100000
Episode 60 Reward 21.000000 Average Reward 24.900000
Episode 70 Reward 34.000000 Average Reward 26.500000
Episode 80 Reward 47.000000 Average Reward 25.800000
Episode 90 Reward 41.000000 Average Reward 20.300000
Episode 100 Reward 59.000000 Average Reward 26.700000
Episode 110 Reward 19.000000 Average Reward 25.400000
Episode 120 Reward 14.000000 Average Reward 35.100000
Episode 130 Reward 14.000000 Average Reward 28.100000
Episode 140 Reward 27.000000 Average Reward 27.000000
Episode 150 Reward 21.000000 Average Reward 26.200000
Episode 160 Reward 44.000000 Average Reward 41.000000
Episode 170 Reward 65.000000 Average Reward 37.800000
Episode 180 Reward 50.000000 Average Reward 36.800000

Episode 190 Reward 26.000000 Average Reward 48.700000
Episode 200 Reward 28.000000 Average Reward 40.700000
Episode 210 Reward 59.000000 Average Reward 49.000000
Episode 220 Reward 34.000000 Average Reward 39.200000
Episode 230 Reward 84.000000 Average Reward 41.700000
Episode 240 Reward 93.000000 Average Reward 76.100000
Episode 250 Reward 55.000000 Average Reward 72.300000
Episode 260 Reward 63.000000 Average Reward 73.000000
Episode 270 Reward 22.000000 Average Reward 95.000000
Episode 280 Reward 102.000000 Average Reward 89.000000
Episode 290 Reward 65.000000 Average Reward 101.400000
Episode 300 Reward 125.000000 Average Reward 111.400000
Episode 310 Reward 167.000000 Average Reward 112.200000
Episode 320 Reward 93.000000 Average Reward 103.200000
Episode 330 Reward 51.000000 Average Reward 57.900000
Episode 340 Reward 81.000000 Average Reward 133.300000
Episode 350 Reward 102.000000 Average Reward 118.000000
Episode 360 Reward 192.000000 Average Reward 149.100000
Episode 370 Reward 135.000000 Average Reward 194.600000
Episode 380 Reward 127.000000 Average Reward 162.800000
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Episode 500 Reward 112.000000 Average Reward 100.200000
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Episode 520 Reward 162.000000 Average Reward 104.900000
Episode 530 Reward 195.000000 Average Reward 162.800000
Episode 540 Reward 500.000000 Average Reward 306.100000
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Episode 630 Reward 151.000000 Average Reward 169.600000
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Episode 650 Reward 164.000000 Average Reward 270.200000
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Episode 670 Reward 174.000000 Average Reward 124.700000
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Episode 870 Reward 117.000000 Average Reward 118.300000
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Episode 900 Reward 198.000000 Average Reward 209.700000
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Episode 920 Reward 204.000000 Average Reward 231.000000
Episode 930 Reward 248.000000 Average Reward 208.400000
Episode 940 Reward 198.000000 Average Reward 201.100000
Episode 950 Reward 187.000000 Average Reward 232.900000
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Episode 980 Reward 200.000000 Average Reward 189.400000
Episode 990 Reward 201.000000 Average Reward 249.100000
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Episode 60 Reward 17.000000 Average Reward 30.800000
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Episode 120 Reward 17.000000 Average Reward 22.200000
Episode 130 Reward 15.000000 Average Reward 22.300000

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Episode 150 Reward 14.000000 Average Reward 24.500000
Episode 160 Reward 42.000000 Average Reward 37.200000
Episode 170 Reward 11.000000 Average Reward 30.700000
Episode 180 Reward 23.000000 Average Reward 25.400000
Episode 190 Reward 23.000000 Average Reward 40.400000
Episode 200 Reward 67.000000 Average Reward 43.000000
Episode 210 Reward 29.000000 Average Reward 25.300000
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Episode 240 Reward 55.000000 Average Reward 63.400000
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Episode 260 Reward 88.000000 Average Reward 52.200000
Episode 270 Reward 82.000000 Average Reward 65.600000
Episode 280 Reward 87.000000 Average Reward 72.000000
Episode 290 Reward 160.000000 Average Reward 71.700000
Episode 300 Reward 135.000000 Average Reward 98.000000
Episode 310 Reward 63.000000 Average Reward 142.700000
Episode 320 Reward 166.000000 Average Reward 139.100000
Episode 330 Reward 122.000000 Average Reward 126.400000
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Episode 360 Reward 104.000000 Average Reward 100.300000
Episode 370 Reward 181.000000 Average Reward 139.500000
Episode 380 Reward 223.000000 Average Reward 161.200000
Episode 390 Reward 267.000000 Average Reward 228.000000
Episode 400 Reward 74.000000 Average Reward 94.600000
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Episode 420 Reward 194.000000 Average Reward 145.400000
Episode 430 Reward 206.000000 Average Reward 217.700000
Episode 440 Reward 279.000000 Average Reward 340.100000
Episode 450 Reward 252.000000 Average Reward 261.300000
Episode 460 Reward 244.000000 Average Reward 235.300000
Episode 470 Reward 500.000000 Average Reward 335.300000
Episode 480 Reward 131.000000 Average Reward 231.100000
Episode 490 Reward 113.000000 Average Reward 135.500000
Episode 500 Reward 68.000000 Average Reward 64.800000
Episode 510 Reward 117.000000 Average Reward 83.000000
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Episode 530 Reward 117.000000 Average Reward 131.800000
Episode 540 Reward 146.000000 Average Reward 135.100000
Episode 550 Reward 340.000000 Average Reward 193.700000
Episode 560 Reward 237.000000 Average Reward 282.100000
Episode 570 Reward 167.000000 Average Reward 289.000000
Episode 580 Reward 210.000000 Average Reward 221.900000
Episode 590 Reward 116.000000 Average Reward 154.700000
Episode 600 Reward 103.000000 Average Reward 130.400000
Episode 610 Reward 128.000000 Average Reward 126.900000

Episode 620 Reward 119.000000 Average Reward 120.600000
Episode 630 Reward 151.000000 Average Reward 145.300000
Episode 640 Reward 180.000000 Average Reward 209.200000
Episode 650 Reward 120.000000 Average Reward 126.400000
Episode 660 Reward 208.000000 Average Reward 198.100000
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Episode 760 Reward 133.000000 Average Reward 123.000000
Episode 770 Reward 114.000000 Average Reward 132.400000
Episode 780 Reward 107.000000 Average Reward 127.800000
Episode 790 Reward 156.000000 Average Reward 128.200000
Episode 800 Reward 151.000000 Average Reward 142.000000
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Episode 820 Reward 226.000000 Average Reward 175.100000
Episode 830 Reward 207.000000 Average Reward 247.200000
Episode 840 Reward 198.000000 Average Reward 223.700000
Episode 850 Reward 239.000000 Average Reward 221.400000
Episode 860 Reward 256.000000 Average Reward 237.900000
Episode 870 Reward 183.000000 Average Reward 243.600000
Episode 880 Reward 307.000000 Average Reward 295.200000
Episode 890 Reward 154.000000 Average Reward 264.000000
Episode 900 Reward 27.000000 Average Reward 135.800000
Episode 910 Reward 105.000000 Average Reward 129.000000
Episode 920 Reward 139.000000 Average Reward 151.900000
Episode 930 Reward 177.000000 Average Reward 144.500000
Episode 940 Reward 241.000000 Average Reward 208.000000
Episode 950 Reward 127.000000 Average Reward 270.800000
Episode 960 Reward 188.000000 Average Reward 357.200000
Episode 970 Reward 169.000000 Average Reward 151.000000
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Episode 990 Reward 232.000000 Average Reward 271.000000
Episode 1000 Reward 202.000000 Average Reward 170.400000

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Episode 10 Reward 15.000000 Average Reward 28.600000
Episode 20 Reward 28.000000 Average Reward 27.100000
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Episode 50 Reward 20.000000 Average Reward 31.600000
Episode 60 Reward 14.000000 Average Reward 37.800000
Episode 70 Reward 13.000000 Average Reward 20.700000
Episode 80 Reward 15.000000 Average Reward 24.800000

Episode 90 Reward 25.000000 Average Reward 31.200000
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Episode 150 Reward 56.000000 Average Reward 46.900000
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Episode 200 Reward 47.000000 Average Reward 47.400000
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Episode 220 Reward 87.000000 Average Reward 45.600000
Episode 230 Reward 70.000000 Average Reward 83.600000
Episode 240 Reward 22.000000 Average Reward 40.200000
Episode 250 Reward 57.000000 Average Reward 65.900000
Episode 260 Reward 50.000000 Average Reward 103.800000
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Episode 370 Reward 277.000000 Average Reward 139.100000
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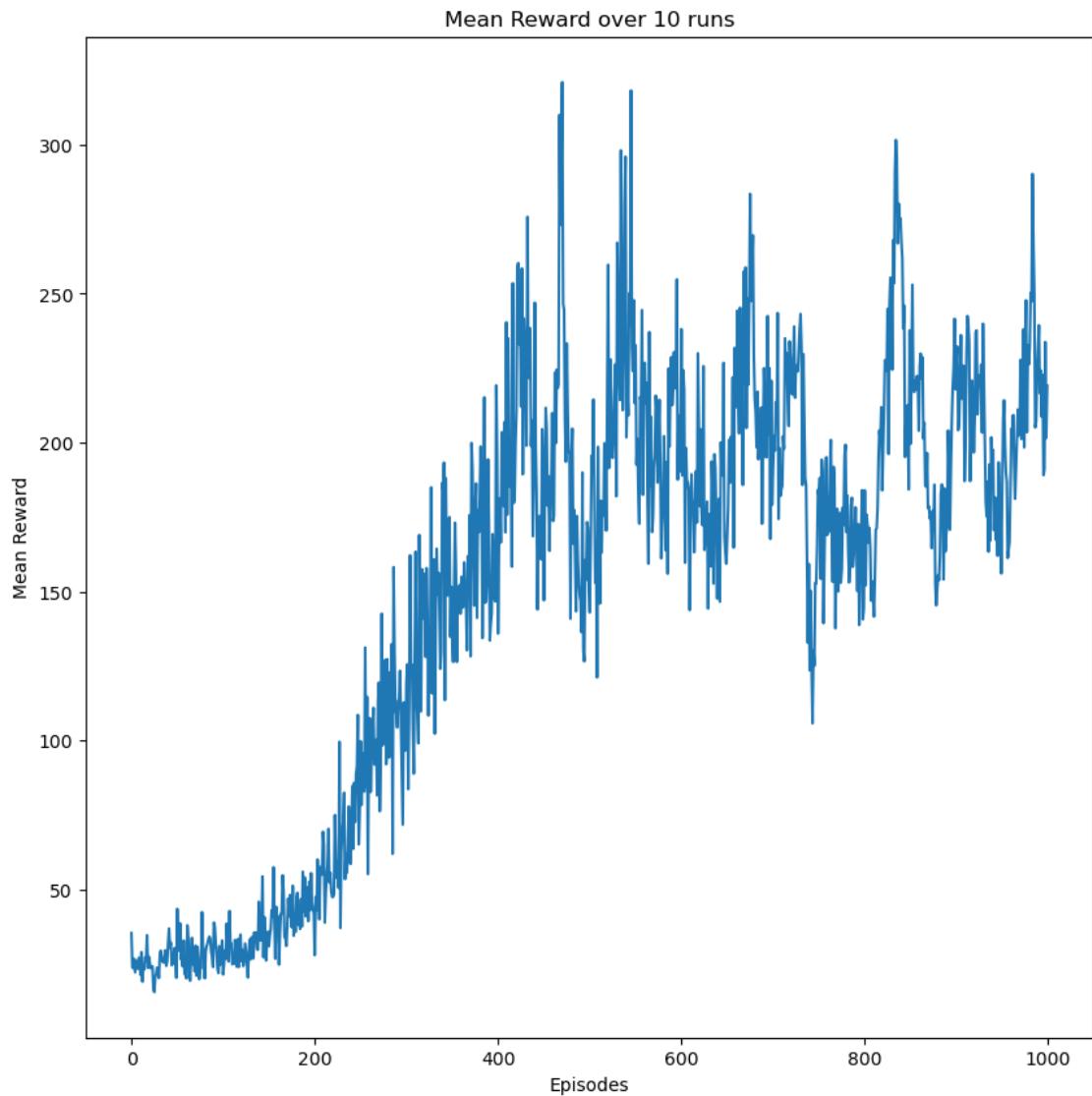
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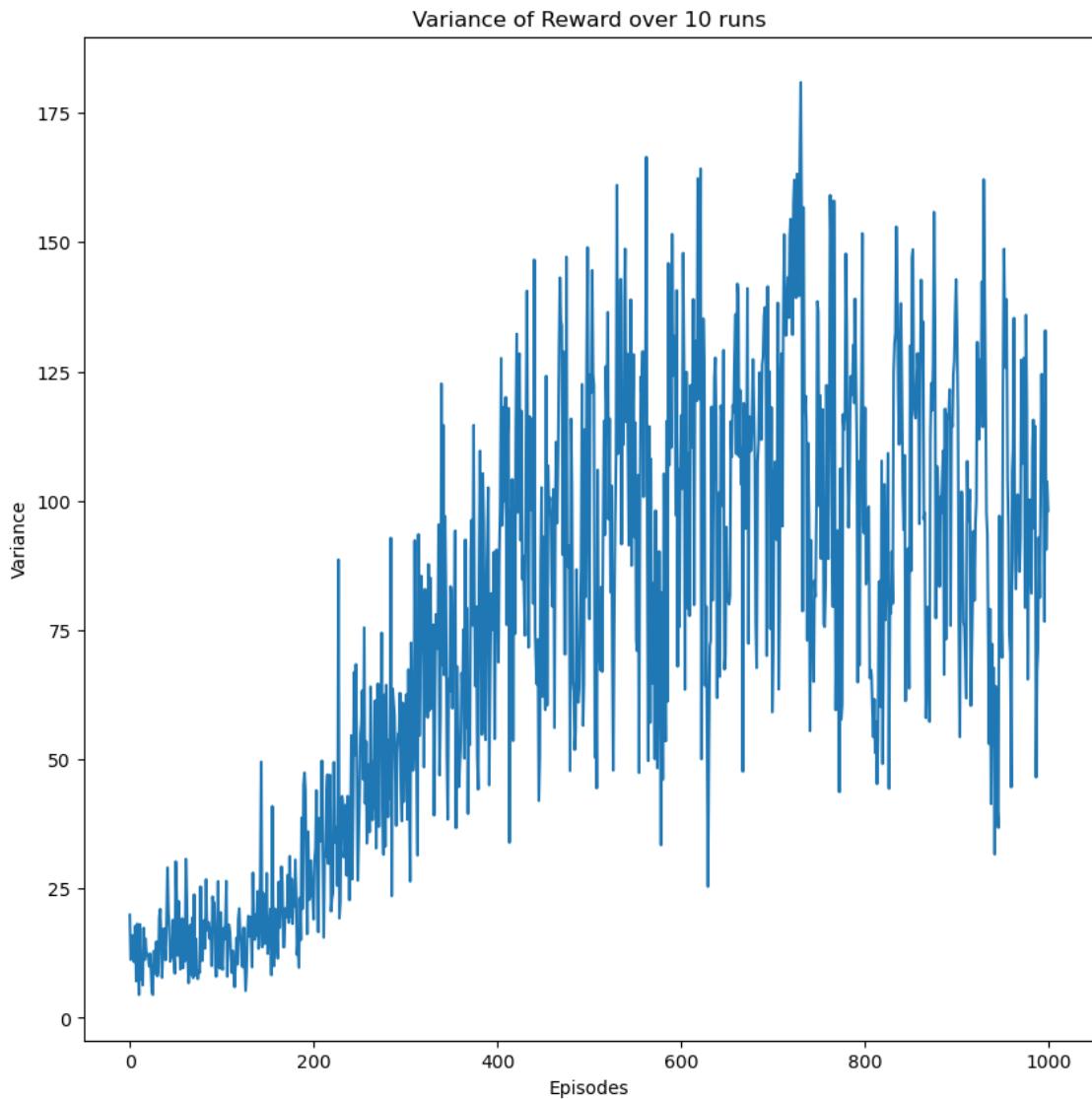
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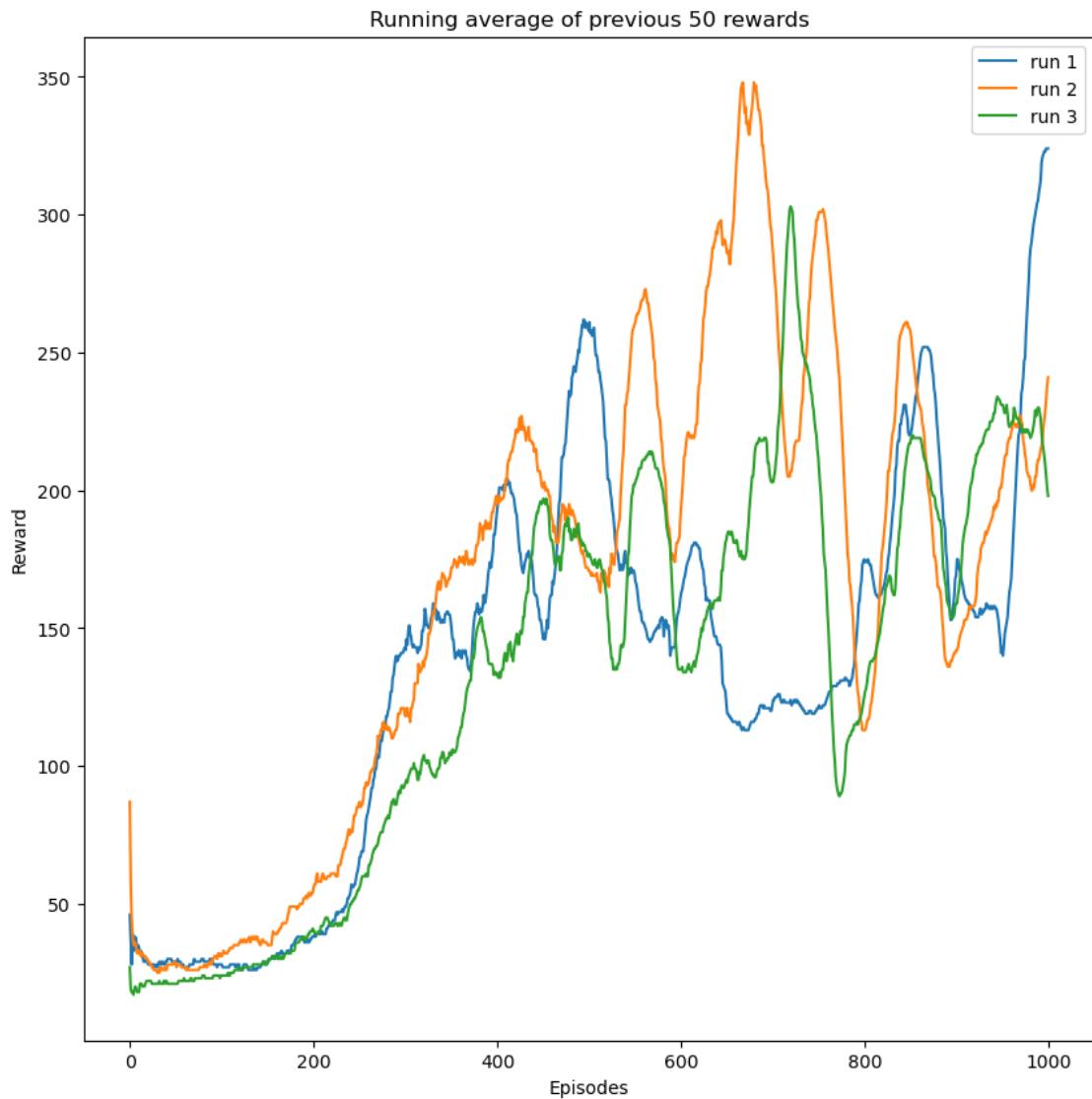
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Episode 980 Reward 282.000000 Average Reward 430.300000
Episode 990 Reward 127.000000 Average Reward 190.600000
Episode 1000 Reward 195.000000 Average Reward 159.100000
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Episode 30 Reward 10.000000 Average Reward 25.600000
Episode 40 Reward 15.000000 Average Reward 27.700000
Episode 50 Reward 22.000000 Average Reward 23.600000
Episode 60 Reward 19.000000 Average Reward 35.100000
Episode 70 Reward 34.000000 Average Reward 30.100000
Episode 80 Reward 27.000000 Average Reward 27.400000
Episode 90 Reward 11.000000 Average Reward 35.200000
Episode 100 Reward 82.000000 Average Reward 32.900000
Episode 110 Reward 12.000000 Average Reward 37.400000
Episode 120 Reward 19.000000 Average Reward 24.100000
Episode 130 Reward 50.000000 Average Reward 21.900000
Episode 140 Reward 112.000000 Average Reward 47.000000
Episode 150 Reward 110.000000 Average Reward 43.500000
Episode 160 Reward 18.000000 Average Reward 29.800000
Episode 170 Reward 15.000000 Average Reward 43.500000
Episode 180 Reward 24.000000 Average Reward 44.900000
Episode 190 Reward 25.000000 Average Reward 36.700000
Episode 200 Reward 21.000000 Average Reward 51.200000
Episode 210 Reward 76.000000 Average Reward 58.100000
Episode 220 Reward 61.000000 Average Reward 61.400000
Episode 230 Reward 70.000000 Average Reward 69.200000
Episode 240 Reward 86.000000 Average Reward 47.200000
Episode 250 Reward 73.000000 Average Reward 63.900000
Episode 260 Reward 153.000000 Average Reward 54.700000
Episode 270 Reward 139.000000 Average Reward 87.500000
Episode 280 Reward 212.000000 Average Reward 100.200000
Episode 290 Reward 129.000000 Average Reward 96.500000
Episode 300 Reward 30.000000 Average Reward 87.000000
Episode 310 Reward 21.000000 Average Reward 79.000000

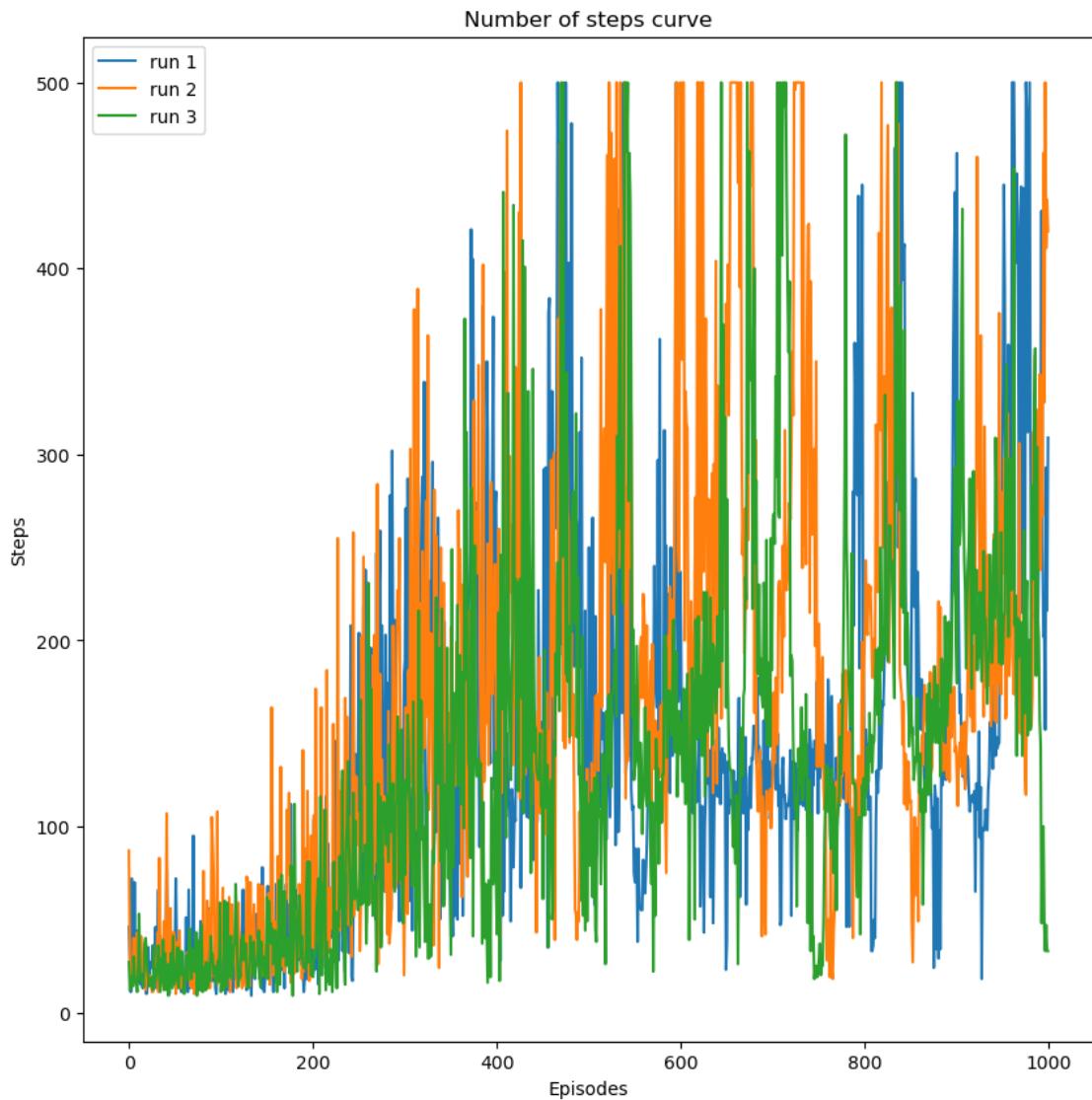
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Episode 420 Reward 93.000000 Average Reward 143.600000
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Episode 440 Reward 240.000000 Average Reward 234.700000
Episode 450 Reward 206.000000 Average Reward 250.000000
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Episode 490 Reward 174.000000 Average Reward 125.300000
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Episode 590 Reward 291.000000 Average Reward 171.100000
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Episode 640 Reward 122.000000 Average Reward 137.200000
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Episode 660 Reward 445.000000 Average Reward 231.500000
Episode 670 Reward 392.000000 Average Reward 317.600000
Episode 680 Reward 172.000000 Average Reward 280.700000
Episode 690 Reward 68.000000 Average Reward 111.600000
Episode 700 Reward 170.000000 Average Reward 160.500000
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Episode 730 Reward 157.000000 Average Reward 323.000000
Episode 740 Reward 145.000000 Average Reward 180.200000
Episode 750 Reward 108.000000 Average Reward 64.200000
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Episode 780 Reward 103.000000 Average Reward 154.600000
Episode 790 Reward 113.000000 Average Reward 93.600000

Episode 800 Reward 79.000000 Average Reward 87.700000
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Episode 870 Reward 110.000000 Average Reward 113.400000
Episode 880 Reward 51.000000 Average Reward 76.300000
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Episode 910 Reward 241.000000 Average Reward 268.100000
Episode 920 Reward 325.000000 Average Reward 292.600000
Episode 930 Reward 500.000000 Average Reward 295.300000
Episode 940 Reward 215.000000 Average Reward 199.100000
Episode 950 Reward 110.000000 Average Reward 147.700000
Episode 960 Reward 118.000000 Average Reward 120.900000
Episode 970 Reward 132.000000 Average Reward 117.900000
Episode 980 Reward 181.000000 Average Reward 192.600000
Episode 990 Reward 152.000000 Average Reward 237.700000
Episode 1000 Reward 202.000000 Average Reward 182.300000
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```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [512, 512]
LR = 2e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'CartPole-v1'
SOLVE_CUTOFF = 195.0
STEP = 10

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{hs}-{lr}-{env}-{numep}-{nstep}-{STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	60.000000	37.400000
20	44.000000	34.900000
30	39.000000	34.100000
40	67.000000	52.000000
50	32.000000	32.600000
60	78.000000	49.400000
70	60.000000	47.500000
80	50.000000	38.800000
90	29.000000	41.700000
100	105.000000	70.700000
110	65.000000	58.700000
120	29.000000	74.700000
130	69.000000	64.100000
140	59.000000	56.900000
150	115.000000	102.800000
160	100.000000	150.300000
170	70.000000	126.800000
180	155.000000	166.600000
190	122.000000	105.800000
200	133.000000	171.000000
210	135.000000	122.200000
220	229.000000	115.400000
230	129.000000	113.500000
240	104.000000	130.400000
250	25.000000	131.500000
260	299.000000	270.000000
270	236.000000	203.500000
280	127.000000	152.000000

Episode 290 Reward 155.000000 Average Reward 135.400000
Episode 300 Reward 158.000000 Average Reward 150.100000
Episode 310 Reward 210.000000 Average Reward 203.600000
Episode 320 Reward 270.000000 Average Reward 260.300000
Episode 330 Reward 432.000000 Average Reward 374.800000
Episode 340 Reward 128.000000 Average Reward 286.900000
Episode 350 Reward 39.000000 Average Reward 80.300000
Episode 360 Reward 210.000000 Average Reward 136.700000
Episode 370 Reward 316.000000 Average Reward 300.500000
Episode 380 Reward 244.000000 Average Reward 371.900000
Episode 390 Reward 55.000000 Average Reward 221.500000
Episode 400 Reward 231.000000 Average Reward 139.900000
Episode 410 Reward 236.000000 Average Reward 188.700000
Episode 420 Reward 500.000000 Average Reward 324.300000
Episode 430 Reward 162.000000 Average Reward 276.100000
Episode 440 Reward 25.000000 Average Reward 90.500000
Episode 450 Reward 29.000000 Average Reward 67.600000
Episode 460 Reward 164.000000 Average Reward 86.800000
Episode 470 Reward 217.000000 Average Reward 248.200000
Episode 480 Reward 106.000000 Average Reward 143.000000
Episode 490 Reward 31.000000 Average Reward 33.000000
Episode 500 Reward 102.000000 Average Reward 65.600000
Episode 510 Reward 172.000000 Average Reward 108.300000
Episode 520 Reward 63.000000 Average Reward 180.400000
Episode 530 Reward 161.000000 Average Reward 84.600000
Episode 540 Reward 184.000000 Average Reward 196.200000
Episode 550 Reward 165.000000 Average Reward 181.800000
Episode 560 Reward 434.000000 Average Reward 320.200000
Episode 570 Reward 267.000000 Average Reward 277.000000
Episode 580 Reward 303.000000 Average Reward 248.500000
Episode 590 Reward 500.000000 Average Reward 380.000000
Episode 600 Reward 309.000000 Average Reward 362.400000
Episode 610 Reward 349.000000 Average Reward 304.500000
Episode 620 Reward 225.000000 Average Reward 335.700000
Episode 630 Reward 117.000000 Average Reward 150.900000
Episode 640 Reward 102.000000 Average Reward 116.800000
Episode 650 Reward 143.000000 Average Reward 131.000000
Episode 660 Reward 197.000000 Average Reward 159.200000
Episode 670 Reward 326.000000 Average Reward 243.200000
Episode 680 Reward 350.000000 Average Reward 395.900000
Episode 690 Reward 453.000000 Average Reward 346.000000
Episode 700 Reward 179.000000 Average Reward 348.900000
Episode 710 Reward 136.000000 Average Reward 144.400000
Episode 720 Reward 140.000000 Average Reward 127.500000
Episode 730 Reward 117.000000 Average Reward 115.100000
Episode 740 Reward 125.000000 Average Reward 126.100000
Episode 750 Reward 106.000000 Average Reward 66.700000
Episode 760 Reward 185.000000 Average Reward 153.000000

Episode 770 Reward 180.000000 Average Reward 182.700000
Episode 780 Reward 206.000000 Average Reward 167.500000
Episode 790 Reward 161.000000 Average Reward 167.200000
Episode 800 Reward 166.000000 Average Reward 158.900000
Episode 810 Reward 218.000000 Average Reward 193.600000
Episode 820 Reward 304.000000 Average Reward 274.900000
Episode 830 Reward 259.000000 Average Reward 259.600000
Episode 840 Reward 284.000000 Average Reward 251.900000
Episode 850 Reward 402.000000 Average Reward 366.800000
Episode 860 Reward 302.000000 Average Reward 354.500000
Episode 870 Reward 191.000000 Average Reward 230.800000
Episode 880 Reward 202.000000 Average Reward 227.700000
Episode 890 Reward 215.000000 Average Reward 227.900000
Episode 900 Reward 234.000000 Average Reward 236.700000
Episode 910 Reward 396.000000 Average Reward 357.600000
Episode 920 Reward 500.000000 Average Reward 500.000000
Episode 930 Reward 500.000000 Average Reward 472.100000
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Episode 950 Reward 212.000000 Average Reward 236.900000
Episode 960 Reward 248.000000 Average Reward 233.800000
Episode 970 Reward 212.000000 Average Reward 224.700000
Episode 980 Reward 209.000000 Average Reward 204.600000
Episode 990 Reward 176.000000 Average Reward 192.500000
Episode 1000 Reward 203.000000 Average Reward 190.200000

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Episode 60 Reward 39.000000 Average Reward 37.600000
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Episode 90 Reward 75.000000 Average Reward 64.500000
Episode 100 Reward 138.000000 Average Reward 58.700000
Episode 110 Reward 79.000000 Average Reward 63.000000
Episode 120 Reward 31.000000 Average Reward 68.400000
Episode 130 Reward 172.000000 Average Reward 75.300000
Episode 140 Reward 233.000000 Average Reward 94.600000
Episode 150 Reward 143.000000 Average Reward 151.800000
Episode 160 Reward 51.000000 Average Reward 149.700000
Episode 170 Reward 160.000000 Average Reward 267.700000
Episode 180 Reward 270.000000 Average Reward 228.400000
Episode 190 Reward 176.000000 Average Reward 232.000000
Episode 200 Reward 115.000000 Average Reward 200.500000
Episode 210 Reward 290.000000 Average Reward 205.700000
Episode 220 Reward 283.000000 Average Reward 215.200000
Episode 230 Reward 239.000000 Average Reward 267.400000

Episode 240 Reward 353.000000 Average Reward 346.400000
Episode 250 Reward 184.000000 Average Reward 285.900000
Episode 260 Reward 114.000000 Average Reward 189.800000
Episode 270 Reward 149.000000 Average Reward 147.800000
Episode 280 Reward 91.000000 Average Reward 128.600000
Episode 290 Reward 245.000000 Average Reward 163.400000
Episode 300 Reward 247.000000 Average Reward 237.000000
Episode 310 Reward 154.000000 Average Reward 263.800000
Episode 320 Reward 147.000000 Average Reward 138.300000
Episode 330 Reward 196.000000 Average Reward 107.900000
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Episode 350 Reward 237.000000 Average Reward 237.800000
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Episode 380 Reward 171.000000 Average Reward 111.600000
Episode 390 Reward 320.000000 Average Reward 315.400000
Episode 400 Reward 500.000000 Average Reward 251.500000
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Episode 450 Reward 413.000000 Average Reward 345.900000
Episode 460 Reward 215.000000 Average Reward 211.100000
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Episode 580 Reward 188.000000 Average Reward 153.500000
Episode 590 Reward 163.000000 Average Reward 156.100000
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Episode 660 Reward 210.000000 Average Reward 191.500000
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Episode 820 Reward 217.000000 Average Reward 191.300000
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Episode 910 Reward 184.000000 Average Reward 200.900000
Episode 920 Reward 193.000000 Average Reward 217.600000
Episode 930 Reward 227.000000 Average Reward 257.400000
Episode 940 Reward 430.000000 Average Reward 332.000000
Episode 950 Reward 421.000000 Average Reward 428.600000
Episode 960 Reward 256.000000 Average Reward 318.900000
Episode 970 Reward 306.000000 Average Reward 382.500000
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Episode 120 Reward 53.000000 Average Reward 46.100000
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Episode 190 Reward 163.000000 Average Reward 128.700000
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Episode 220 Reward 216.000000 Average Reward 295.300000
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Episode 260 Reward 126.000000 Average Reward 202.300000
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Episode 310 Reward 118.000000 Average Reward 126.500000
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Episode 360 Reward 500.000000 Average Reward 269.800000
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Episode 570 Reward 108.000000 Average Reward 115.100000
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Episode 680 Reward 10.000000 Average Reward 8.800000
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Episode 720 Reward 10.000000 Average Reward 9.600000
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Episode 750 Reward 9.000000 Average Reward 9.200000
Episode 760 Reward 9.000000 Average Reward 8.900000
Episode 770 Reward 11.000000 Average Reward 9.100000
Episode 780 Reward 10.000000 Average Reward 9.500000
Episode 790 Reward 10.000000 Average Reward 9.900000
Episode 800 Reward 11.000000 Average Reward 9.700000
Episode 810 Reward 9.000000 Average Reward 9.600000
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Episode 830 Reward 10.000000 Average Reward 9.500000
Episode 840 Reward 11.000000 Average Reward 10.200000
Episode 850 Reward 10.000000 Average Reward 9.900000
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Episode 890 Reward 12.000000 Average Reward 10.100000
Episode 900 Reward 9.000000 Average Reward 9.600000
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Episode 920 Reward 10.000000 Average Reward 10.100000
Episode 930 Reward 9.000000 Average Reward 9.400000
Episode 940 Reward 11.000000 Average Reward 9.900000
Episode 950 Reward 11.000000 Average Reward 10.500000
Episode 960 Reward 10.000000 Average Reward 9.700000
Episode 970 Reward 10.000000 Average Reward 10.800000
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Episode 1000 Reward 12.000000 Average Reward 11.900000
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Episode 70 Reward 31.000000 Average Reward 29.400000
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Episode 90 Reward 59.000000 Average Reward 42.000000
Episode 100 Reward 34.000000 Average Reward 36.900000
Episode 110 Reward 35.000000 Average Reward 51.600000
Episode 120 Reward 41.000000 Average Reward 46.600000
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Episode 140 Reward 229.000000 Average Reward 96.900000
Episode 150 Reward 234.000000 Average Reward 92.300000
Episode 160 Reward 154.000000 Average Reward 137.500000
Episode 170 Reward 97.000000 Average Reward 95.900000
Episode 180 Reward 253.000000 Average Reward 183.100000
Episode 190 Reward 94.000000 Average Reward 139.600000
Episode 200 Reward 90.000000 Average Reward 154.000000
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Episode 220 Reward 309.000000 Average Reward 241.700000
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Episode 300 Reward 178.000000 Average Reward 130.200000
Episode 310 Reward 129.000000 Average Reward 272.900000
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Episode 370 Reward 133.000000 Average Reward 141.100000
Episode 380 Reward 149.000000 Average Reward 121.400000
Episode 390 Reward 164.000000 Average Reward 139.700000
Episode 400 Reward 150.000000 Average Reward 169.400000
Episode 410 Reward 144.000000 Average Reward 305.300000
Episode 420 Reward 137.000000 Average Reward 200.100000
Episode 430 Reward 22.000000 Average Reward 60.800000
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Episode 450 Reward 267.000000 Average Reward 373.100000
Episode 460 Reward 252.000000 Average Reward 368.700000
Episode 470 Reward 99.000000 Average Reward 232.100000
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Episode 260 Reward 287.000000 Average Reward 150.900000
Episode 270 Reward 368.000000 Average Reward 254.400000
Episode 280 Reward 361.000000 Average Reward 253.900000
Episode 290 Reward 131.000000 Average Reward 163.500000
Episode 300 Reward 162.000000 Average Reward 128.100000
Episode 310 Reward 250.000000 Average Reward 158.300000
Episode 320 Reward 500.000000 Average Reward 288.700000
Episode 330 Reward 114.000000 Average Reward 341.000000
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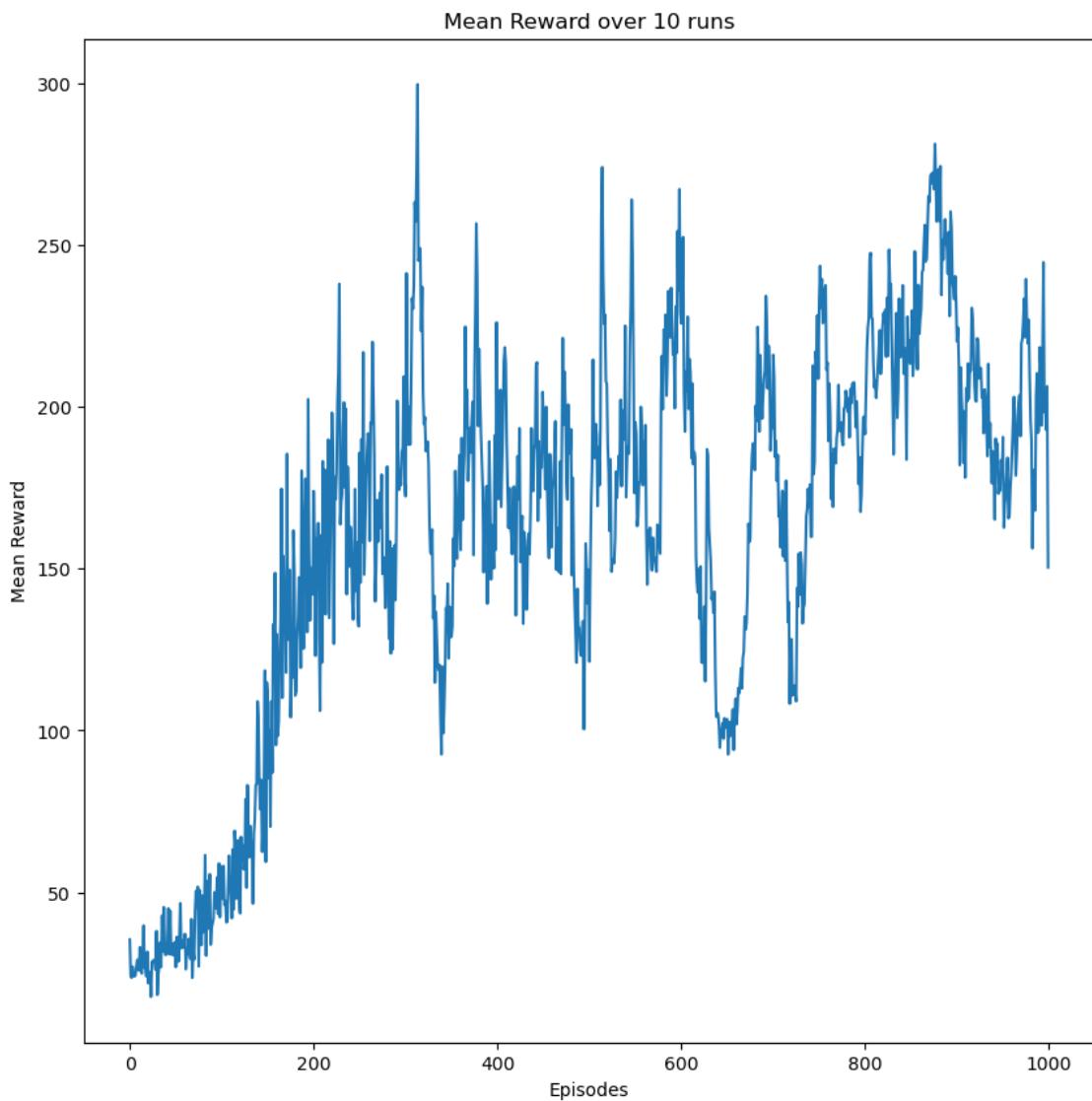
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Episode 740 Reward 128.000000 Average Reward 122.000000
Episode 750 Reward 216.000000 Average Reward 151.300000
Episode 760 Reward 207.000000 Average Reward 230.400000
Episode 770 Reward 181.000000 Average Reward 177.700000
Episode 780 Reward 122.000000 Average Reward 149.200000
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Episode 810 Reward 163.000000 Average Reward 173.100000
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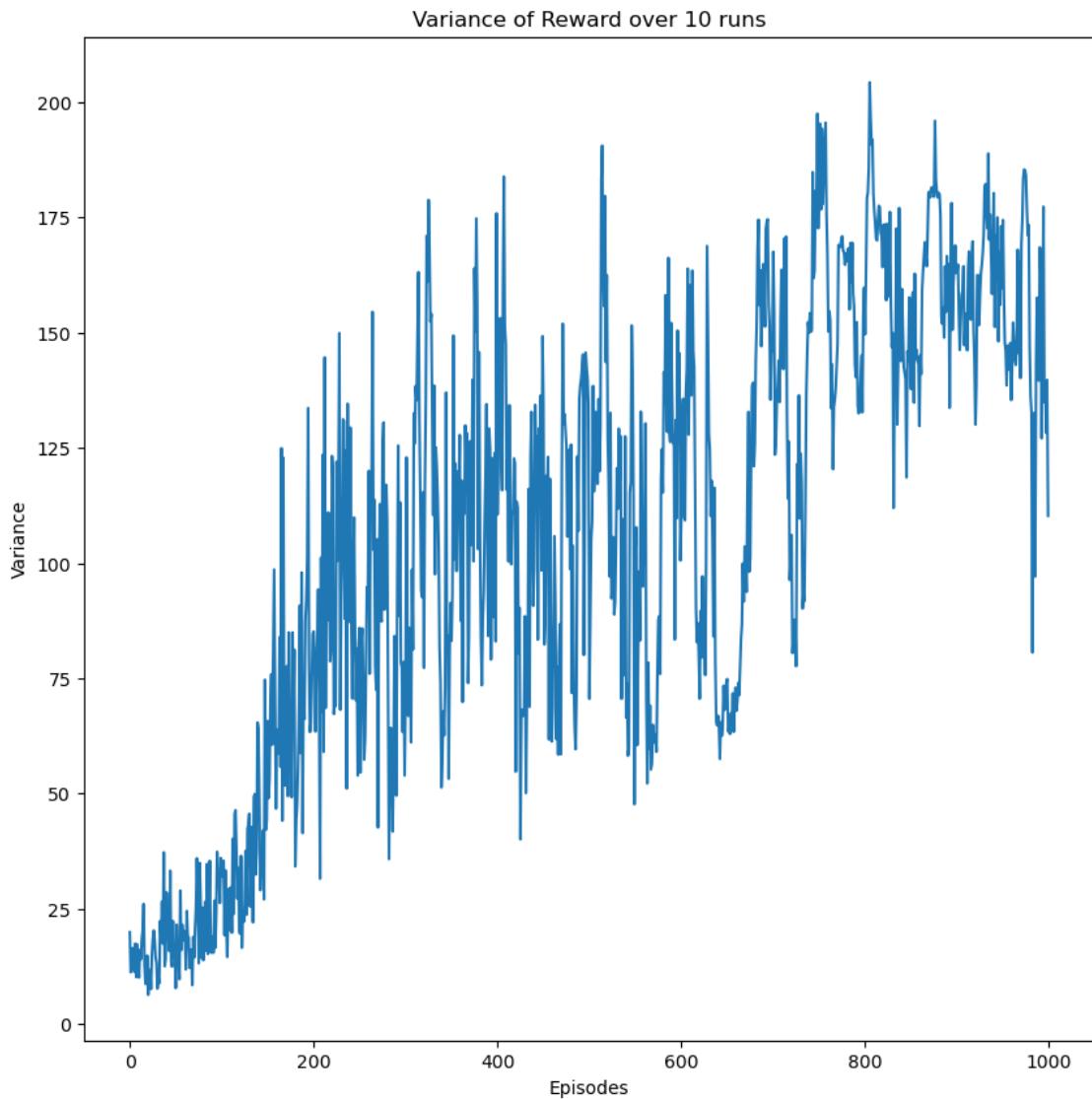
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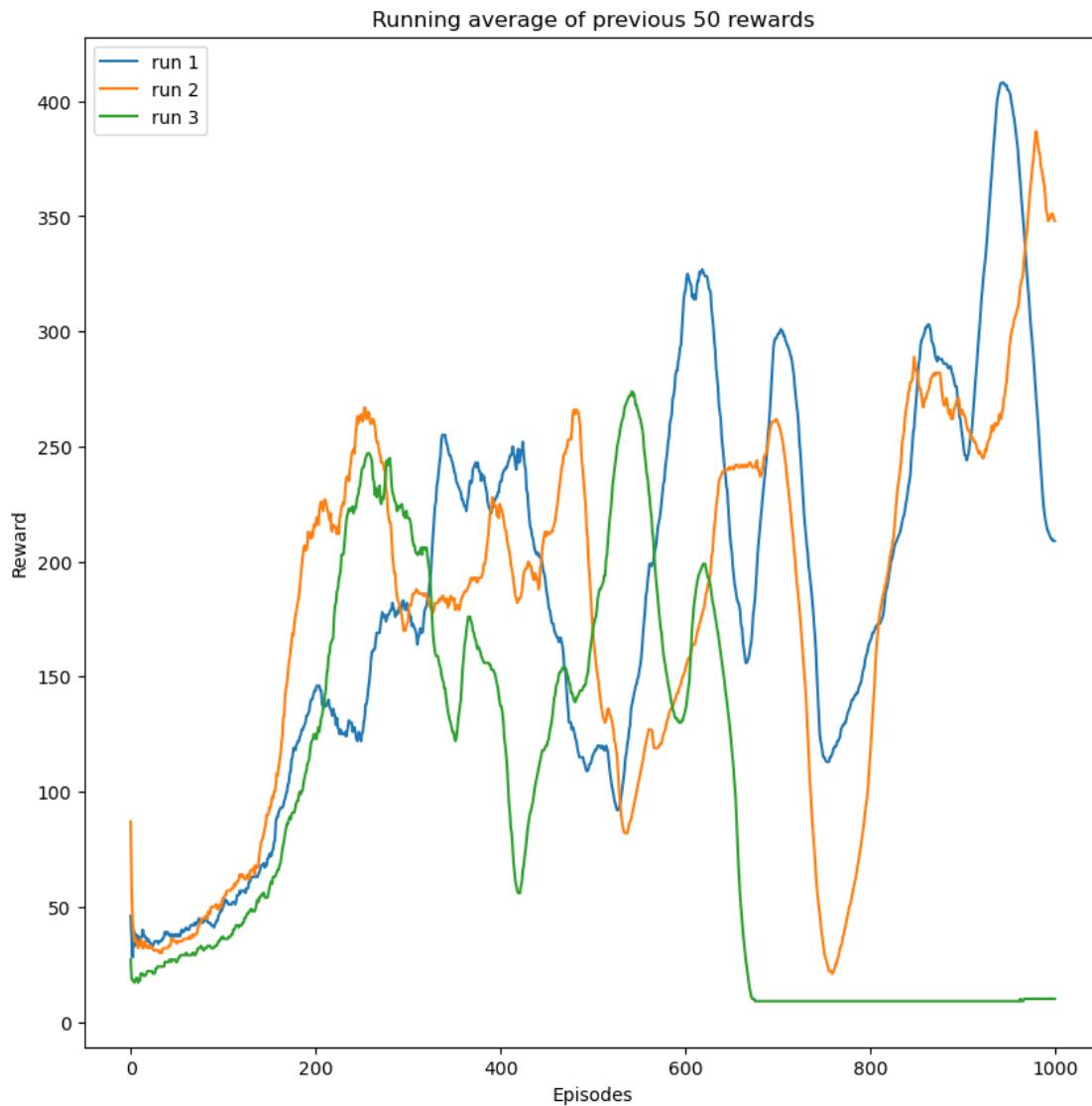
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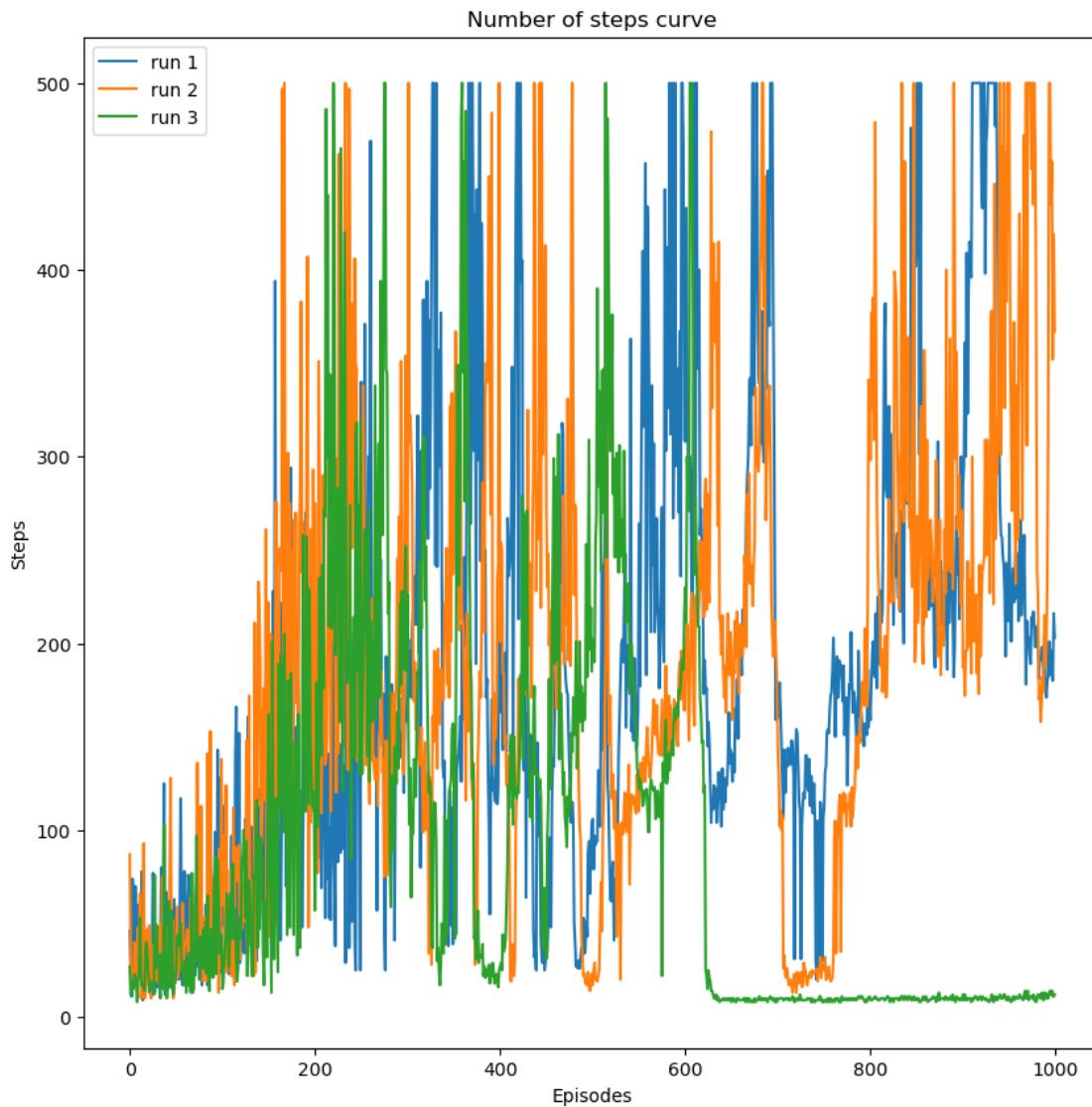
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Episode 410 Reward 122.000000 Average Reward 108.200000
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Episode 1000 Reward 10.000000 Average Reward 9.300000
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```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [1024, 512]
LR = 1e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'CartPole-v1'
SOLVE_CUTOFF = 195.0
STEP = 10

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{hs}-{lr}-{env}-{numep}-{nstep}-{STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	15.000000	28.800000
20	96.000000	35.300000
30	26.000000	31.100000
40	50.000000	37.200000
50	26.000000	37.300000
60	32.000000	22.600000
70	30.000000	38.300000
80	18.000000	27.400000
90	36.000000	39.100000
100	26.000000	38.800000
110	82.000000	55.400000
120	66.000000	67.300000
130	46.000000	31.800000
140	64.000000	71.400000
150	43.000000	49.200000
160	23.000000	48.600000
170	108.000000	43.200000
180	49.000000	61.800000
190	118.000000	82.200000
200	128.000000	117.100000
210	157.000000	119.700000
220	312.000000	176.600000
230	48.000000	128.000000
240	95.000000	108.200000
250	20.000000	69.600000
260	49.000000	49.400000
270	24.000000	99.400000
280	148.000000	123.200000

Episode 290 Reward 65.000000 Average Reward 71.300000
Episode 300 Reward 159.000000 Average Reward 77.000000
Episode 310 Reward 241.000000 Average Reward 129.500000
Episode 320 Reward 258.000000 Average Reward 159.400000
Episode 330 Reward 95.000000 Average Reward 159.400000
Episode 340 Reward 96.000000 Average Reward 136.500000
Episode 350 Reward 453.000000 Average Reward 243.900000
Episode 360 Reward 199.000000 Average Reward 292.700000
Episode 370 Reward 245.000000 Average Reward 293.900000
Episode 380 Reward 241.000000 Average Reward 308.000000
Episode 390 Reward 500.000000 Average Reward 387.500000
Episode 400 Reward 162.000000 Average Reward 258.800000
Episode 410 Reward 136.000000 Average Reward 147.400000
Episode 420 Reward 118.000000 Average Reward 111.100000
Episode 430 Reward 226.000000 Average Reward 156.100000
Episode 440 Reward 239.000000 Average Reward 212.300000
Episode 450 Reward 226.000000 Average Reward 256.400000
Episode 460 Reward 110.000000 Average Reward 173.300000
Episode 470 Reward 59.000000 Average Reward 101.100000
Episode 480 Reward 124.000000 Average Reward 89.500000
Episode 490 Reward 145.000000 Average Reward 155.000000
Episode 500 Reward 217.000000 Average Reward 273.900000
Episode 510 Reward 262.000000 Average Reward 339.900000
Episode 520 Reward 269.000000 Average Reward 260.600000
Episode 530 Reward 439.000000 Average Reward 373.000000
Episode 540 Reward 500.000000 Average Reward 338.400000
Episode 550 Reward 143.000000 Average Reward 381.900000
Episode 560 Reward 216.000000 Average Reward 179.900000
Episode 570 Reward 134.000000 Average Reward 124.800000
Episode 580 Reward 152.000000 Average Reward 152.100000
Episode 590 Reward 119.000000 Average Reward 146.500000
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Episode 610 Reward 177.000000 Average Reward 255.600000
Episode 620 Reward 101.000000 Average Reward 241.100000
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Episode 650 Reward 129.000000 Average Reward 175.900000
Episode 660 Reward 111.000000 Average Reward 134.200000
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Episode 680 Reward 178.000000 Average Reward 156.200000
Episode 690 Reward 148.000000 Average Reward 170.800000
Episode 700 Reward 177.000000 Average Reward 168.500000
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Episode 720 Reward 161.000000 Average Reward 191.500000
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Episode 820 Reward 347.000000 Average Reward 335.500000
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Episode 660 Reward 67.000000 Average Reward 36.900000

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Episode 680 Reward 109.000000 Average Reward 109.500000
Episode 690 Reward 135.000000 Average Reward 69.300000
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Episode 710 Reward 258.000000 Average Reward 312.600000
Episode 720 Reward 203.000000 Average Reward 209.000000
Episode 730 Reward 208.000000 Average Reward 197.800000
Episode 740 Reward 217.000000 Average Reward 222.000000
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Episode 390 Reward 500.000000 Average Reward 263.300000
Episode 400 Reward 151.000000 Average Reward 238.400000
Episode 410 Reward 41.000000 Average Reward 149.800000

Episode 420 Reward 140.000000 Average Reward 123.300000
Episode 430 Reward 165.000000 Average Reward 131.200000
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Episode 480 Reward 500.000000 Average Reward 441.700000
Episode 490 Reward 134.000000 Average Reward 182.100000
Episode 500 Reward 124.000000 Average Reward 110.400000
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Episode 520 Reward 500.000000 Average Reward 418.000000
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Episode 610 Reward 174.000000 Average Reward 164.100000
Episode 620 Reward 224.000000 Average Reward 302.900000
Episode 630 Reward 127.000000 Average Reward 164.400000
Episode 640 Reward 105.000000 Average Reward 144.500000
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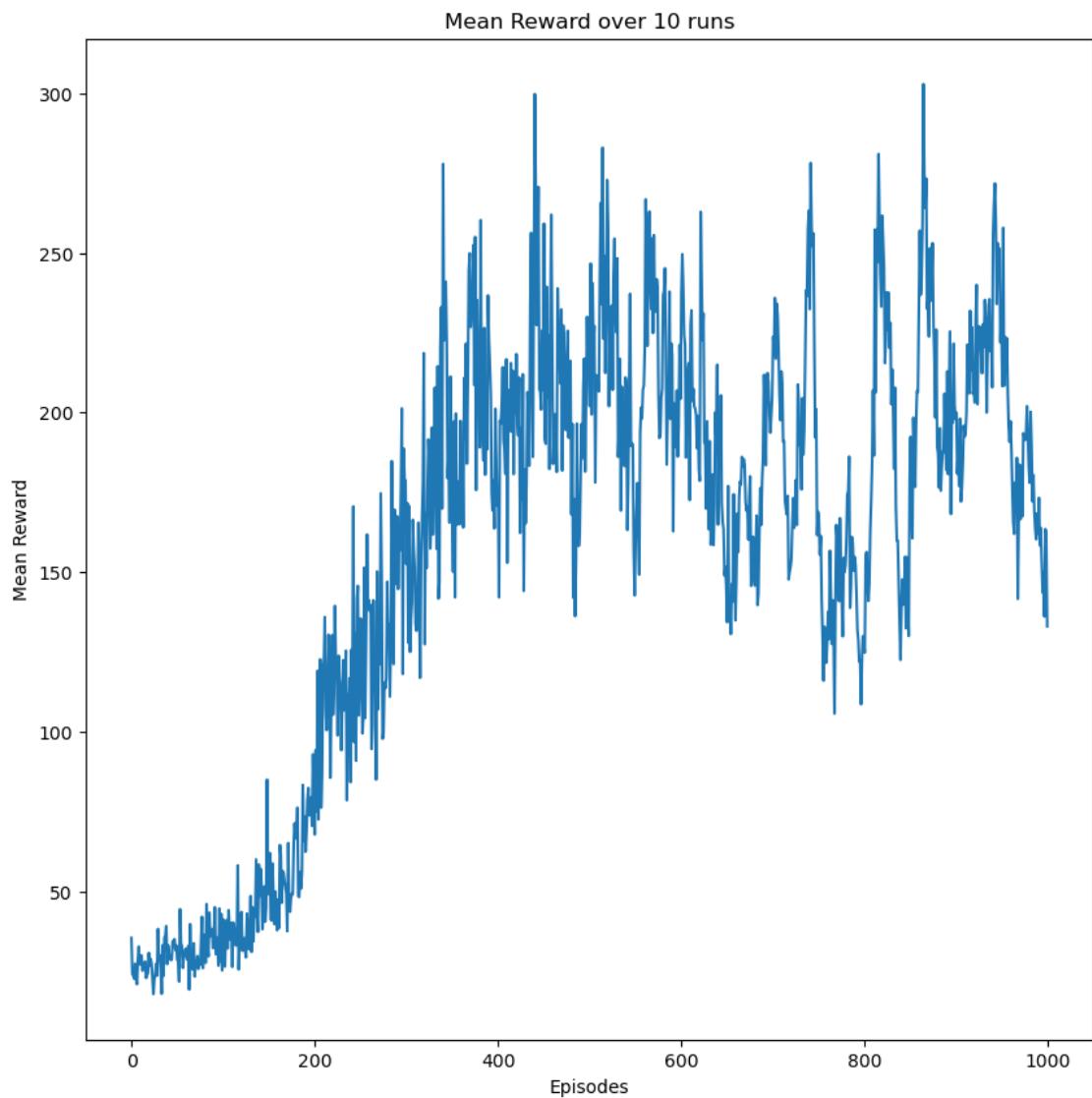
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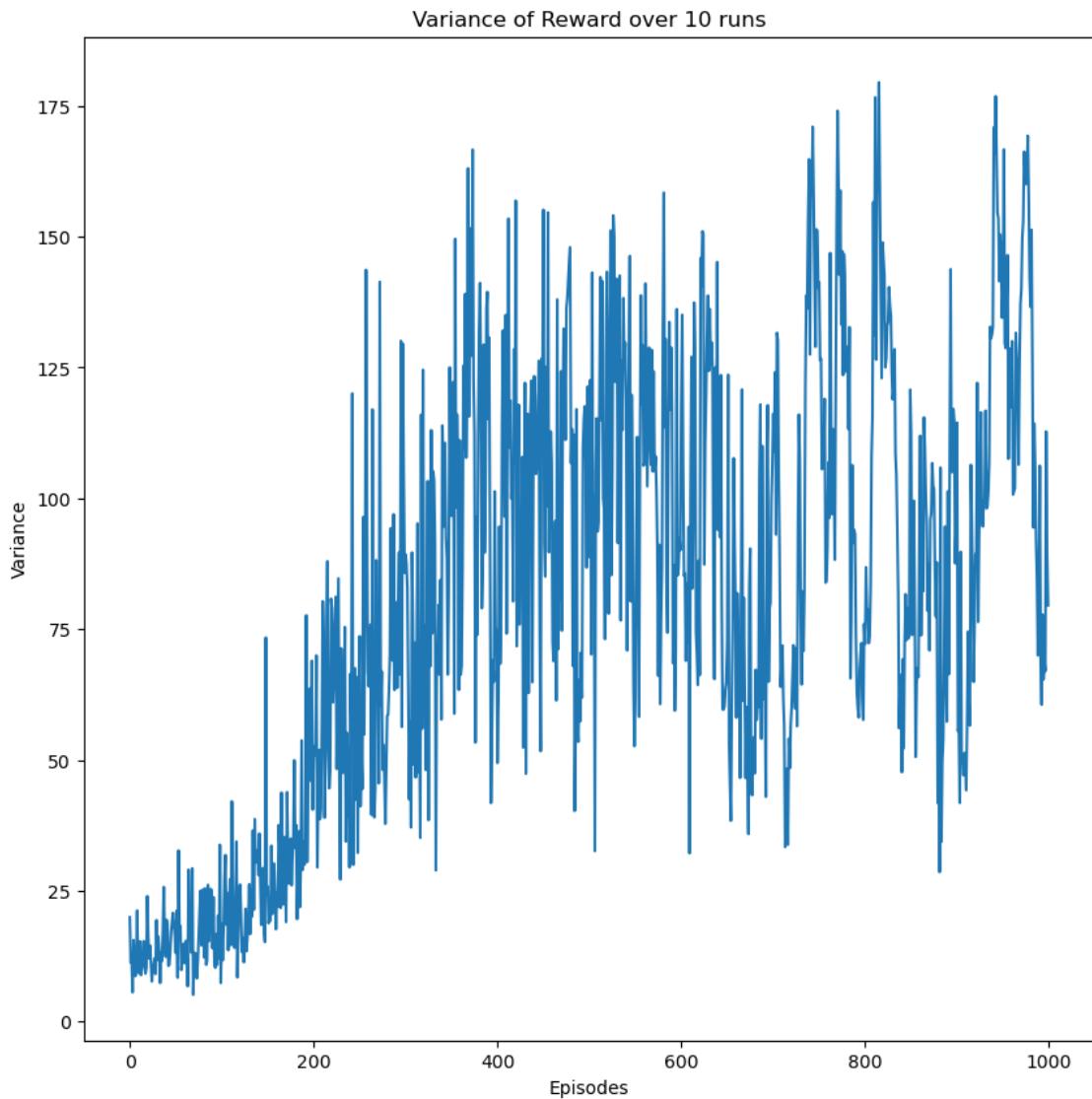
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Episode 630 Reward 135.000000 Average Reward 83.000000
Episode 640 Reward 383.000000 Average Reward 203.800000
Episode 650 Reward 215.000000 Average Reward 264.800000
Episode 660 Reward 32.000000 Average Reward 197.200000
Episode 670 Reward 167.000000 Average Reward 149.100000
Episode 680 Reward 237.000000 Average Reward 206.200000
Episode 690 Reward 273.000000 Average Reward 227.800000
Episode 700 Reward 243.000000 Average Reward 242.500000
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Episode 720 Reward 254.000000 Average Reward 249.400000
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Episode 770 Reward 124.000000 Average Reward 187.000000
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Episode 790 Reward 141.000000 Average Reward 138.000000
Episode 800 Reward 197.000000 Average Reward 172.000000
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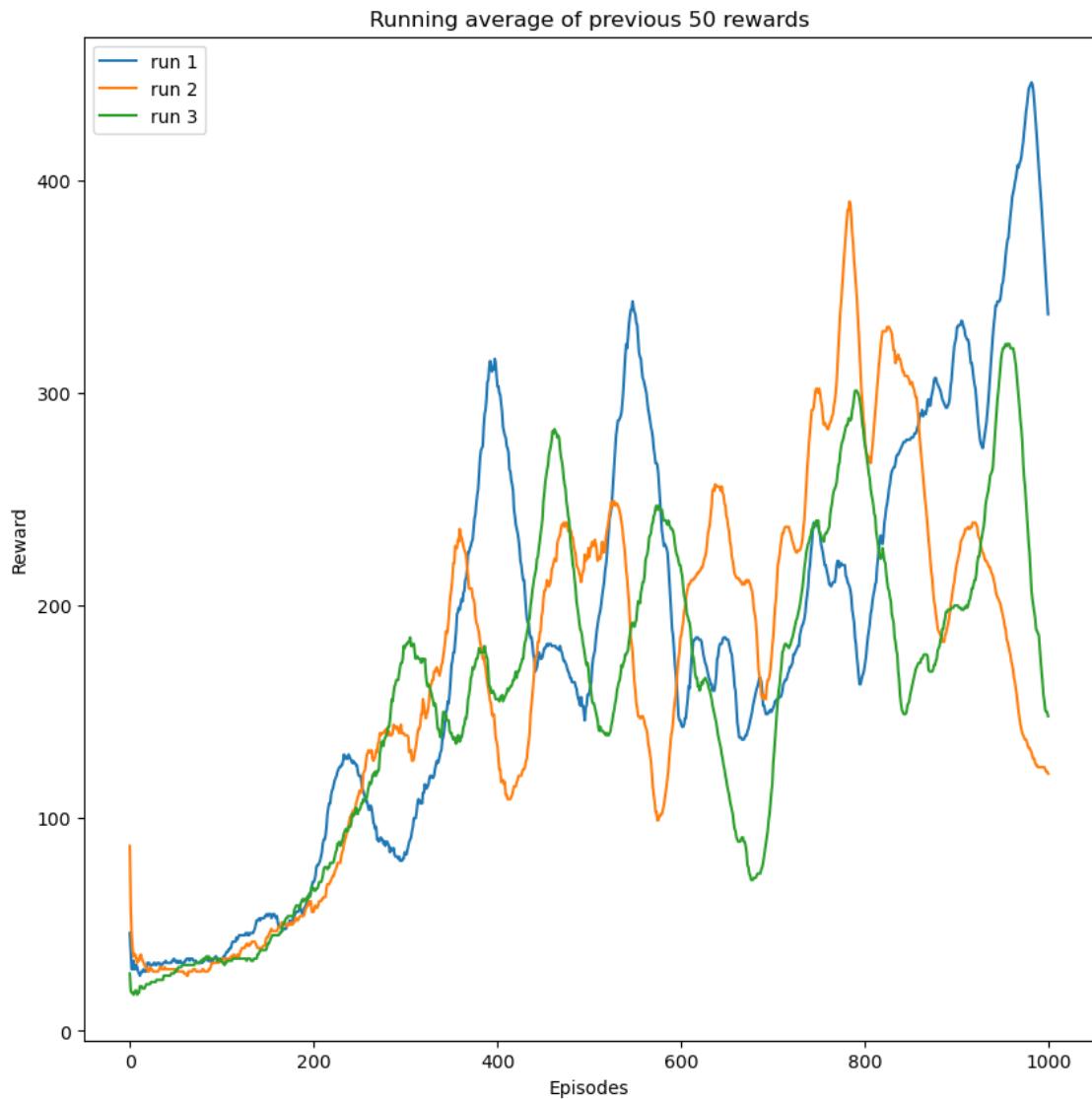
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Episode 90 Reward 25.000000 Average Reward 30.100000
Episode 100 Reward 33.000000 Average Reward 30.100000
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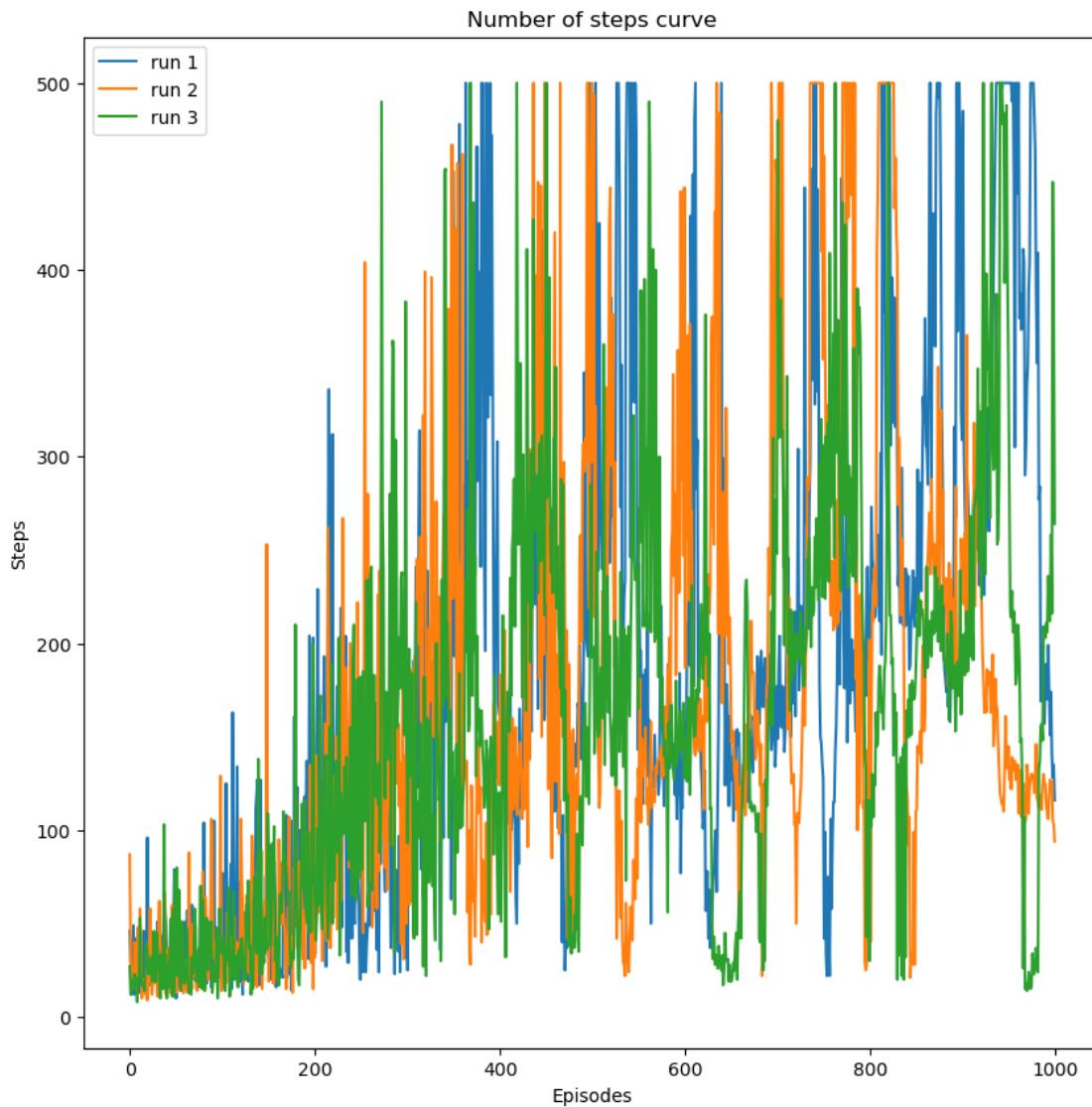
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Episode 390 Reward 152.000000 Average Reward 164.000000
Episode 400 Reward 124.000000 Average Reward 100.300000
Episode 410 Reward 203.000000 Average Reward 148.600000
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Episode 540 Reward 113.000000 Average Reward 121.300000
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Episode 560 Reward 229.000000 Average Reward 178.100000
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Episode 950 Reward 242.000000 Average Reward 353.100000
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Episode 970 Reward 110.000000 Average Reward 96.300000
Episode 980 Reward 155.000000 Average Reward 120.900000
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Episode 1000 Reward 99.000000 Average Reward 91.100000
0:03:24.314286









```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [1024, 1024]
LR = 0.5e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'CartPole-v1'
SOLVE_CUTOFF = 195.0
STEP = 10

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{hs}-{lr}-{env}-{numep}-{nstep}-{STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	33.000000	28.600000
20	12.000000	21.500000
30	12.000000	25.800000
40	28.000000	35.000000
50	17.000000	40.700000
60	54.000000	35.300000
70	26.000000	27.800000
80	70.000000	30.800000
90	12.000000	32.800000
100	75.000000	34.800000
110	43.000000	28.800000
120	39.000000	32.700000
130	163.000000	61.100000
140	36.000000	36.400000
150	51.000000	30.800000
160	46.000000	53.600000
170	21.000000	28.400000
180	43.000000	37.800000
190	17.000000	43.000000
200	16.000000	56.300000
210	115.000000	67.400000
220	60.000000	51.100000
230	48.000000	61.200000
240	34.000000	47.700000
250	83.000000	75.500000
260	32.000000	61.800000
270	158.000000	105.300000
280	215.000000	116.100000

Episode 290 Reward 66.000000 Average Reward 124.300000
Episode 300 Reward 411.000000 Average Reward 124.700000
Episode 310 Reward 72.000000 Average Reward 67.600000
Episode 320 Reward 147.000000 Average Reward 105.100000
Episode 330 Reward 89.000000 Average Reward 95.100000
Episode 340 Reward 97.000000 Average Reward 103.700000
Episode 350 Reward 189.000000 Average Reward 129.700000
Episode 360 Reward 71.000000 Average Reward 183.800000
Episode 370 Reward 190.000000 Average Reward 132.500000
Episode 380 Reward 121.000000 Average Reward 126.800000
Episode 390 Reward 163.000000 Average Reward 137.500000
Episode 400 Reward 60.000000 Average Reward 115.300000
Episode 410 Reward 167.000000 Average Reward 206.500000
Episode 420 Reward 273.000000 Average Reward 255.100000
Episode 430 Reward 285.000000 Average Reward 213.400000
Episode 440 Reward 500.000000 Average Reward 253.300000
Episode 450 Reward 186.000000 Average Reward 295.900000
Episode 460 Reward 238.000000 Average Reward 209.800000
Episode 470 Reward 121.000000 Average Reward 164.700000
Episode 480 Reward 151.000000 Average Reward 176.000000
Episode 490 Reward 207.000000 Average Reward 171.700000
Episode 500 Reward 149.000000 Average Reward 185.600000
Episode 510 Reward 132.000000 Average Reward 239.900000
Episode 520 Reward 84.000000 Average Reward 266.100000
Episode 530 Reward 500.000000 Average Reward 293.400000
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Episode 580 Reward 181.000000 Average Reward 164.400000
Episode 590 Reward 454.000000 Average Reward 280.900000
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Episode 610 Reward 249.000000 Average Reward 327.800000
Episode 620 Reward 404.000000 Average Reward 306.500000
Episode 630 Reward 117.000000 Average Reward 167.800000
Episode 640 Reward 142.000000 Average Reward 126.500000
Episode 650 Reward 107.000000 Average Reward 140.800000
Episode 660 Reward 303.000000 Average Reward 227.700000
Episode 670 Reward 500.000000 Average Reward 370.900000
Episode 680 Reward 155.000000 Average Reward 352.000000
Episode 690 Reward 185.000000 Average Reward 224.500000
Episode 700 Reward 101.000000 Average Reward 143.900000
Episode 710 Reward 124.000000 Average Reward 98.500000
Episode 720 Reward 141.000000 Average Reward 138.500000
Episode 730 Reward 148.000000 Average Reward 162.200000
Episode 740 Reward 150.000000 Average Reward 164.000000
Episode 750 Reward 150.000000 Average Reward 124.100000
Episode 760 Reward 40.000000 Average Reward 87.100000

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Episode 780 Reward 165.000000 Average Reward 201.900000
Episode 790 Reward 260.000000 Average Reward 285.300000
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Episode 150 Reward 11.000000 Average Reward 34.400000
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Episode 190 Reward 28.000000 Average Reward 35.100000
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Episode 230 Reward 32.000000 Average Reward 48.500000

Episode 240 Reward 53.000000 Average Reward 57.400000
Episode 250 Reward 73.000000 Average Reward 56.800000
Episode 260 Reward 33.000000 Average Reward 57.900000
Episode 270 Reward 99.000000 Average Reward 60.200000
Episode 280 Reward 53.000000 Average Reward 63.200000
Episode 290 Reward 46.000000 Average Reward 59.500000
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Episode 360 Reward 36.000000 Average Reward 72.600000
Episode 370 Reward 70.000000 Average Reward 72.000000
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Episode 760 Reward 209.000000 Average Reward 141.900000
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Episode 350 Reward 106.000000 Average Reward 148.400000
Episode 360 Reward 154.000000 Average Reward 179.700000
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Episode 450 Reward 233.000000 Average Reward 249.400000
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Episode 500 Reward 308.000000 Average Reward 299.000000
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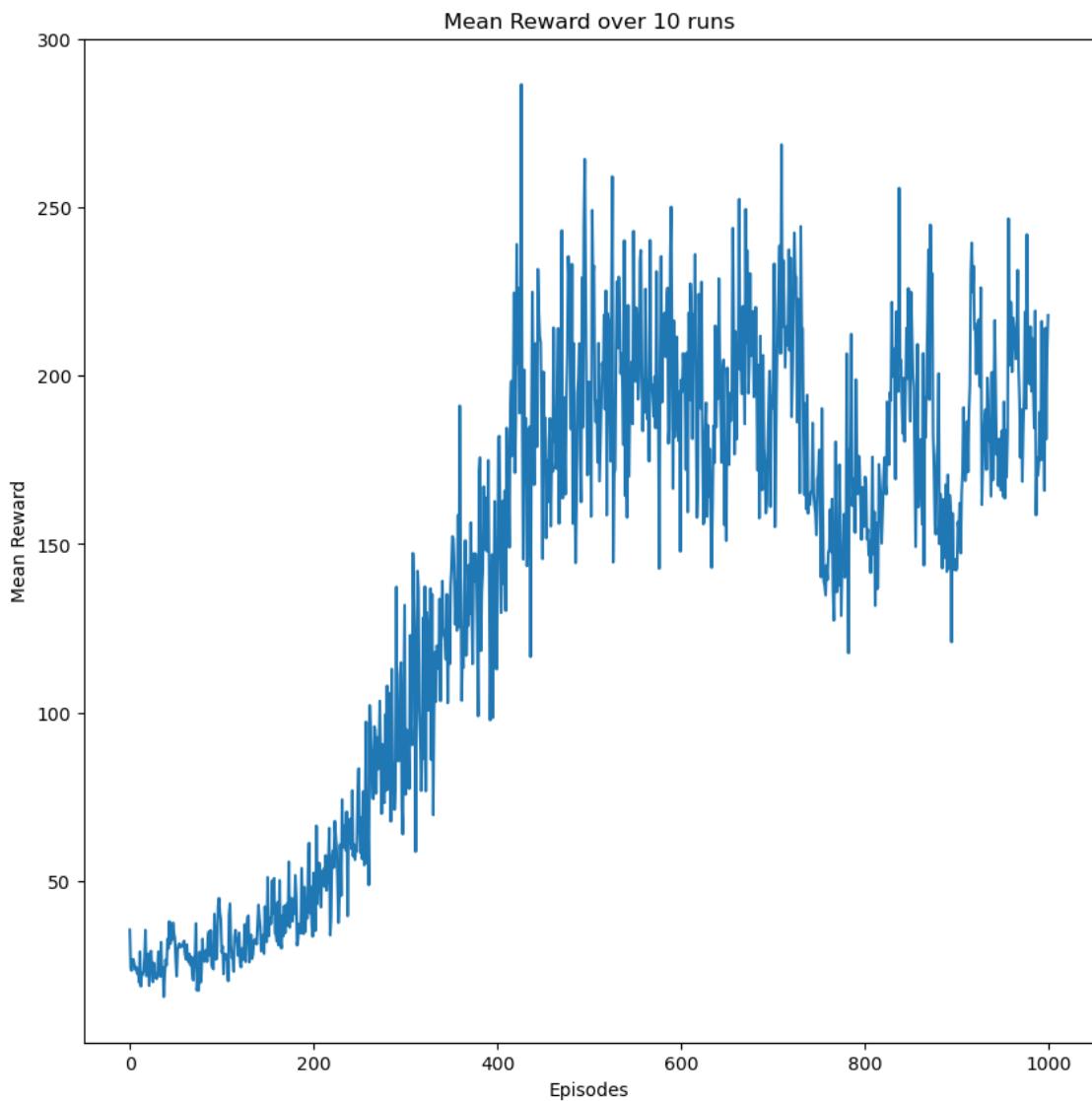
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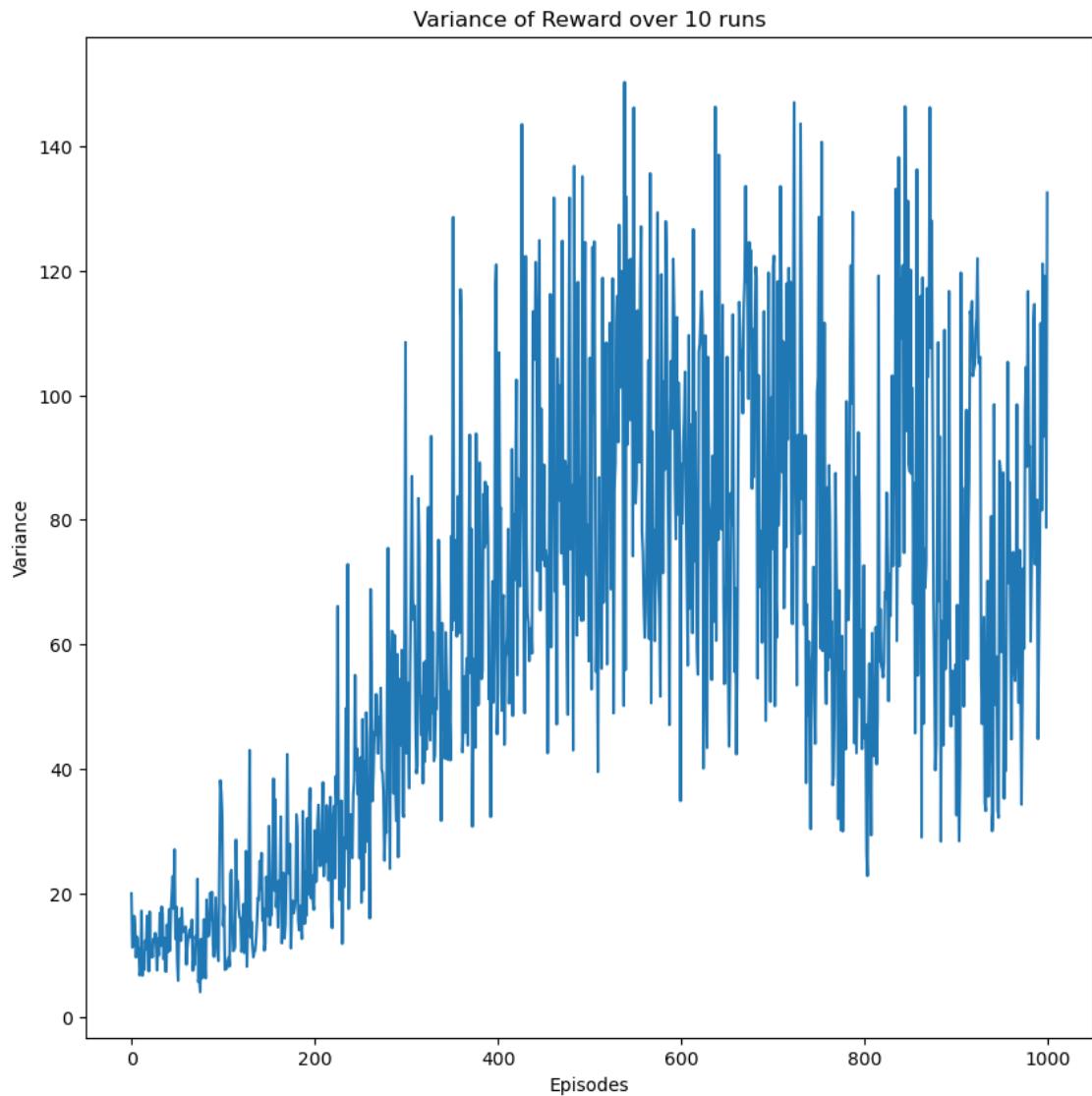
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Episode 620 Reward 211.000000 Average Reward 167.600000
Episode 630 Reward 198.000000 Average Reward 141.400000
Episode 640 Reward 115.000000 Average Reward 122.000000
Episode 650 Reward 174.000000 Average Reward 160.000000
Episode 660 Reward 341.000000 Average Reward 253.200000
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Episode 690 Reward 95.000000 Average Reward 247.200000
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Episode 770 Reward 106.000000 Average Reward 140.000000
Episode 780 Reward 135.000000 Average Reward 121.800000
Episode 790 Reward 165.000000 Average Reward 112.200000
Episode 800 Reward 154.000000 Average Reward 157.500000
Episode 810 Reward 165.000000 Average Reward 147.600000
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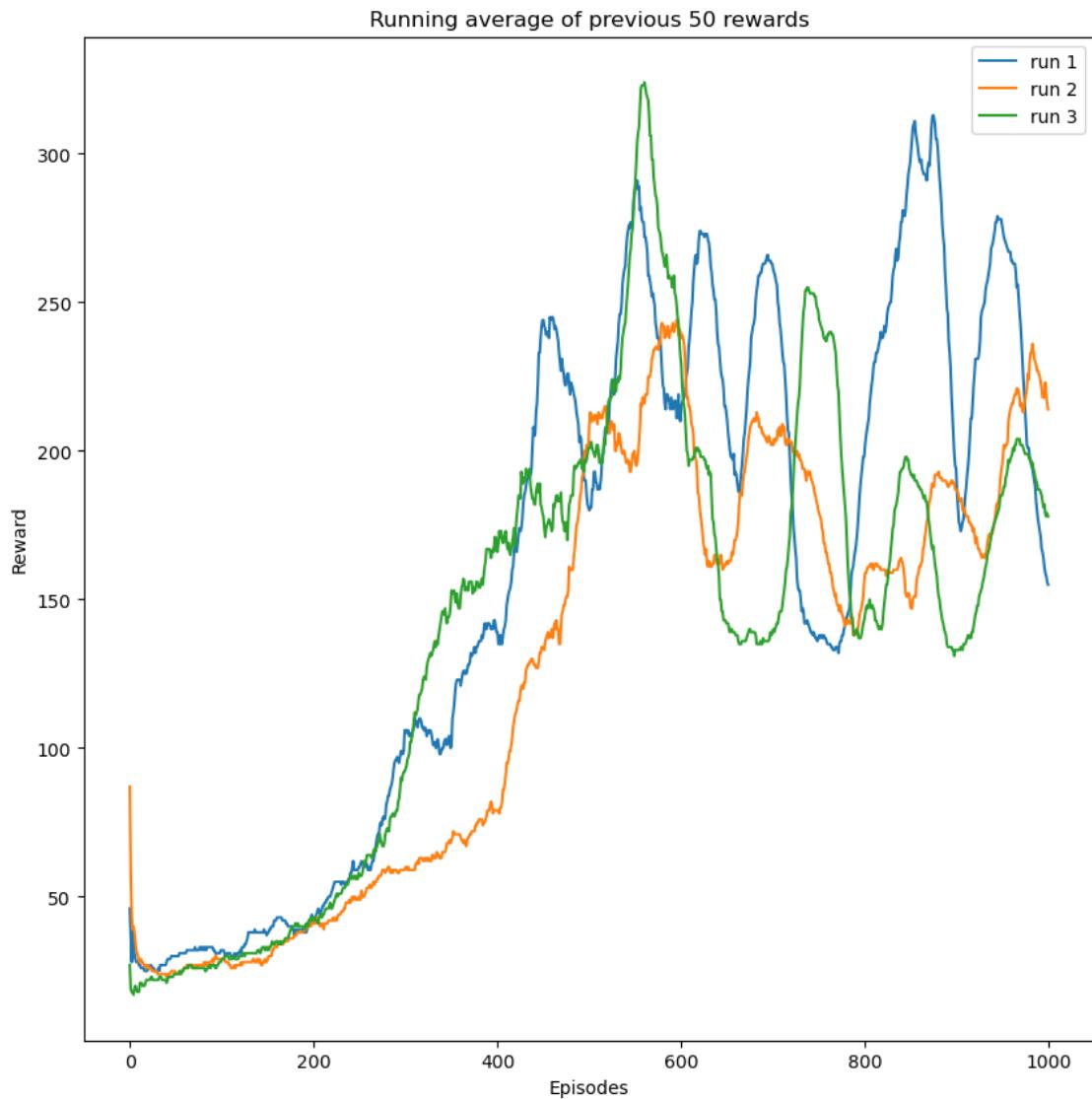
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Episode 130 Reward 17.000000 Average Reward 26.900000
Episode 140 Reward 24.000000 Average Reward 37.500000
Episode 150 Reward 34.000000 Average Reward 34.000000
Episode 160 Reward 13.000000 Average Reward 30.600000
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Episode 190 Reward 37.000000 Average Reward 45.100000
Episode 200 Reward 37.000000 Average Reward 43.800000
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Episode 220 Reward 28.000000 Average Reward 44.600000
Episode 230 Reward 60.000000 Average Reward 64.300000
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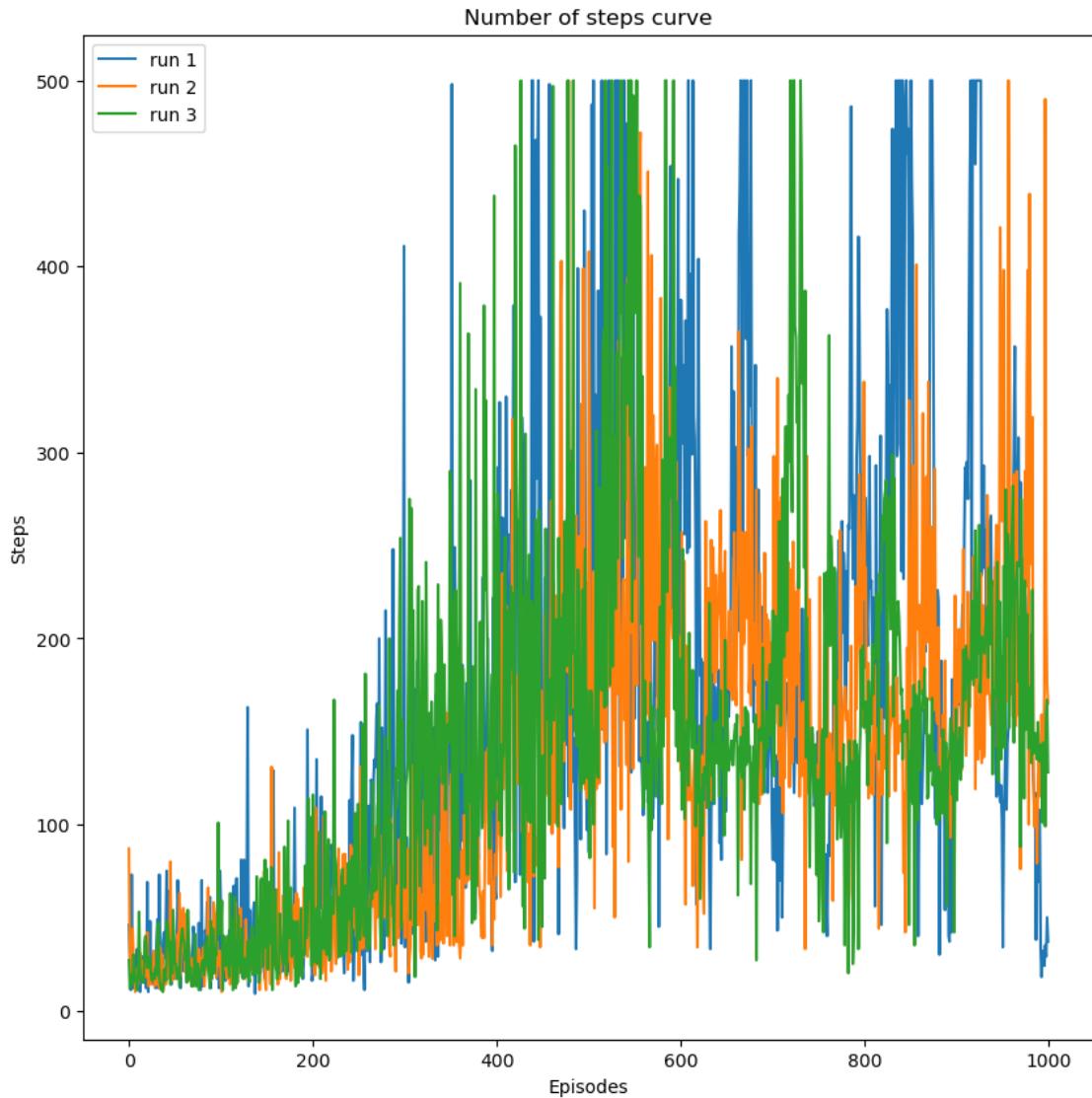
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Episode 920 Reward 186.000000 Average Reward 207.200000
Episode 930 Reward 210.000000 Average Reward 204.300000
Episode 940 Reward 240.000000 Average Reward 261.500000
Episode 950 Reward 118.000000 Average Reward 192.300000
Episode 960 Reward 382.000000 Average Reward 231.500000
Episode 970 Reward 163.000000 Average Reward 197.100000
Episode 980 Reward 128.000000 Average Reward 132.000000
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Episode 1000 Reward 180.000000 Average Reward 155.300000
0:05:19.862463









```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [1024, 1024]
LR = 1e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'CartPole-v1'
SOLVE_CUTOFF = 195.0
STEP = 10

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{NUM_HIDDEN}_{HIDDEN_SIZES}_{LR}_{ENV_NAME}_{NUM_EPISODES}_{NSTEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	51.000000	36.500000
20	42.000000	32.800000
30	51.000000	30.900000
40	16.000000	30.200000
50	23.000000	36.600000
60	48.000000	33.500000
70	108.000000	44.400000
80	43.000000	39.000000
90	40.000000	43.800000
100	32.000000	46.000000
110	104.000000	64.900000
120	122.000000	103.800000
130	76.000000	68.700000
140	38.000000	51.900000
150	73.000000	71.300000
160	264.000000	144.000000
170	181.000000	161.900000
180	221.000000	189.900000
190	56.000000	158.500000
200	35.000000	109.800000
210	49.000000	69.000000
220	141.000000	85.200000
230	149.000000	134.600000
240	177.000000	157.500000
250	260.000000	156.900000
260	249.000000	204.200000
270	175.000000	159.000000
280	185.000000	193.800000

Episode 290 Reward 115.000000 Average Reward 141.600000
Episode 300 Reward 124.000000 Average Reward 101.400000
Episode 310 Reward 139.000000 Average Reward 129.200000
Episode 320 Reward 234.000000 Average Reward 181.600000
Episode 330 Reward 330.000000 Average Reward 255.300000
Episode 340 Reward 382.000000 Average Reward 328.600000
Episode 350 Reward 308.000000 Average Reward 302.800000
Episode 360 Reward 132.000000 Average Reward 257.700000
Episode 370 Reward 138.000000 Average Reward 132.500000
Episode 380 Reward 125.000000 Average Reward 110.500000
Episode 390 Reward 134.000000 Average Reward 108.400000
Episode 400 Reward 140.000000 Average Reward 129.500000
Episode 410 Reward 131.000000 Average Reward 152.900000
Episode 420 Reward 195.000000 Average Reward 163.100000
Episode 430 Reward 338.000000 Average Reward 250.100000
Episode 440 Reward 222.000000 Average Reward 318.000000
Episode 450 Reward 176.000000 Average Reward 281.500000
Episode 460 Reward 119.000000 Average Reward 107.200000
Episode 470 Reward 194.000000 Average Reward 131.100000
Episode 480 Reward 239.000000 Average Reward 235.900000
Episode 490 Reward 236.000000 Average Reward 263.400000
Episode 500 Reward 500.000000 Average Reward 341.700000
Episode 510 Reward 328.000000 Average Reward 448.900000
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Episode 530 Reward 36.000000 Average Reward 127.700000
Episode 540 Reward 500.000000 Average Reward 336.000000
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Episode 560 Reward 171.000000 Average Reward 205.800000
Episode 570 Reward 20.000000 Average Reward 55.800000
Episode 580 Reward 28.000000 Average Reward 25.700000
Episode 590 Reward 106.000000 Average Reward 109.900000
Episode 600 Reward 115.000000 Average Reward 81.700000
Episode 610 Reward 142.000000 Average Reward 129.000000
Episode 620 Reward 219.000000 Average Reward 176.600000
Episode 630 Reward 233.000000 Average Reward 317.000000
Episode 640 Reward 145.000000 Average Reward 179.300000
Episode 650 Reward 43.000000 Average Reward 97.400000
Episode 660 Reward 120.000000 Average Reward 106.400000
Episode 670 Reward 133.000000 Average Reward 101.500000
Episode 680 Reward 158.000000 Average Reward 144.200000
Episode 690 Reward 300.000000 Average Reward 218.700000
Episode 700 Reward 440.000000 Average Reward 405.100000
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Episode 720 Reward 178.000000 Average Reward 217.400000
Episode 730 Reward 197.000000 Average Reward 180.300000
Episode 740 Reward 500.000000 Average Reward 335.700000
Episode 750 Reward 443.000000 Average Reward 429.800000
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Episode 780 Reward 500.000000 Average Reward 500.000000
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Episode 870 Reward 207.000000 Average Reward 212.000000
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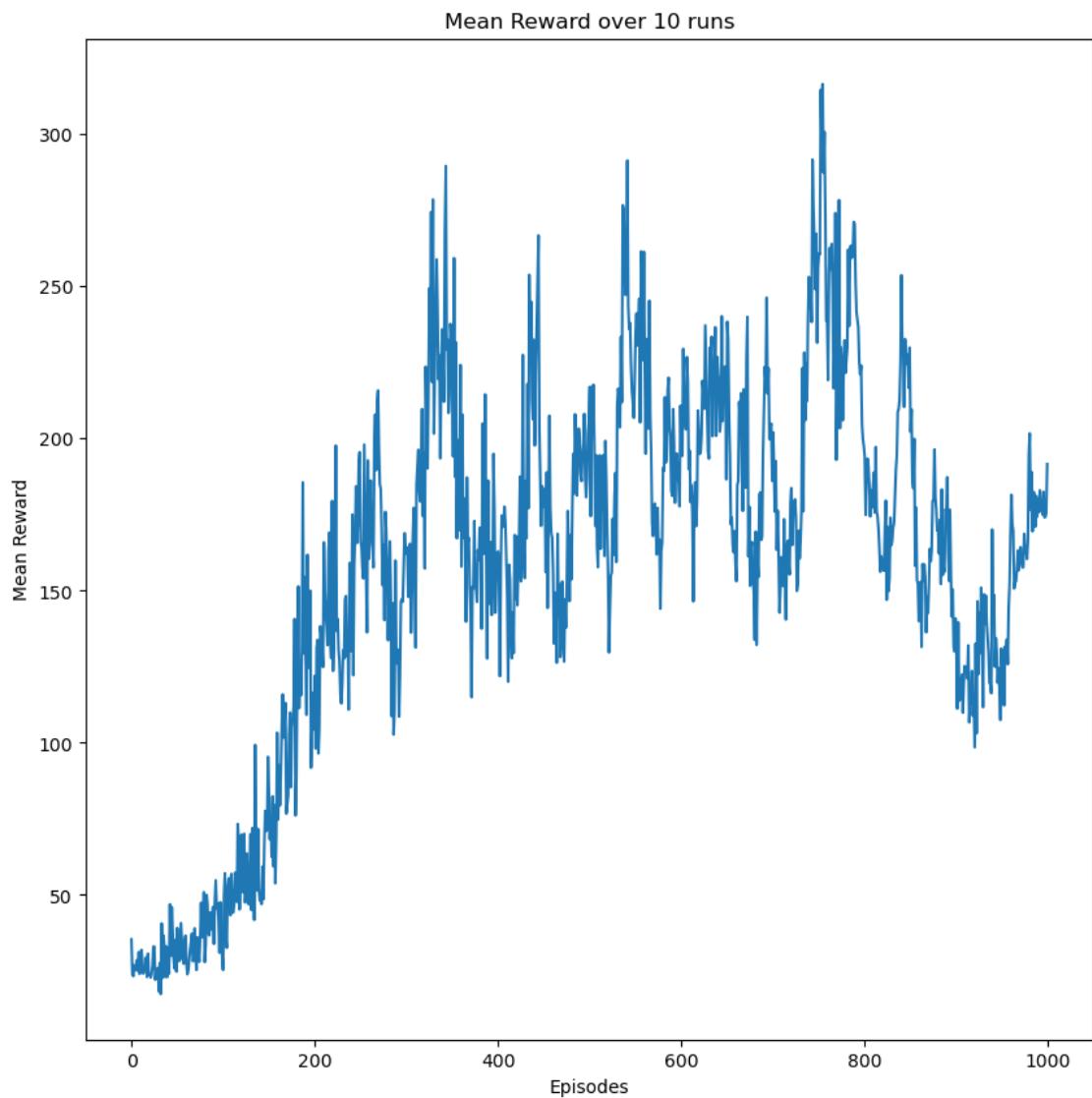
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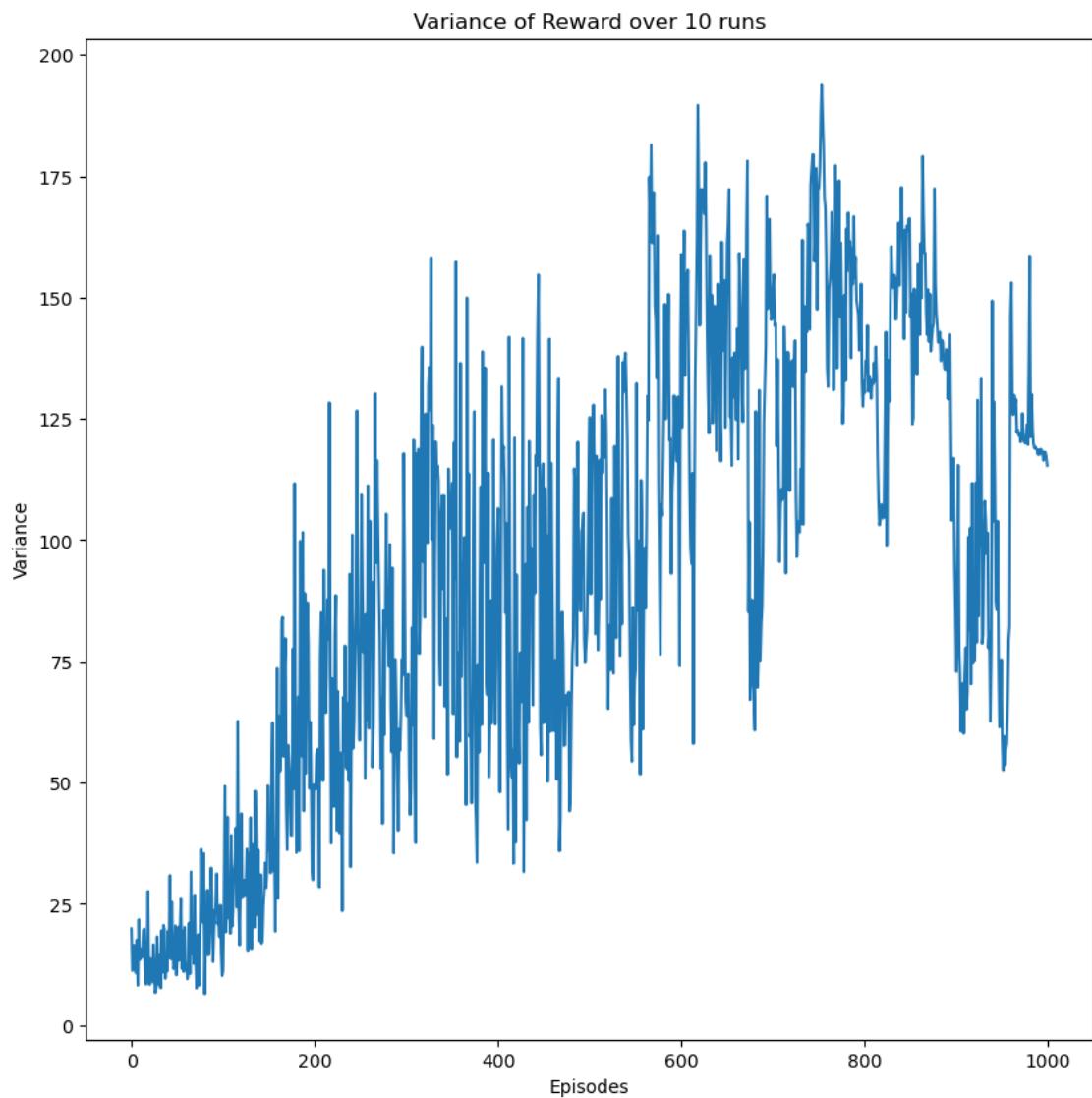
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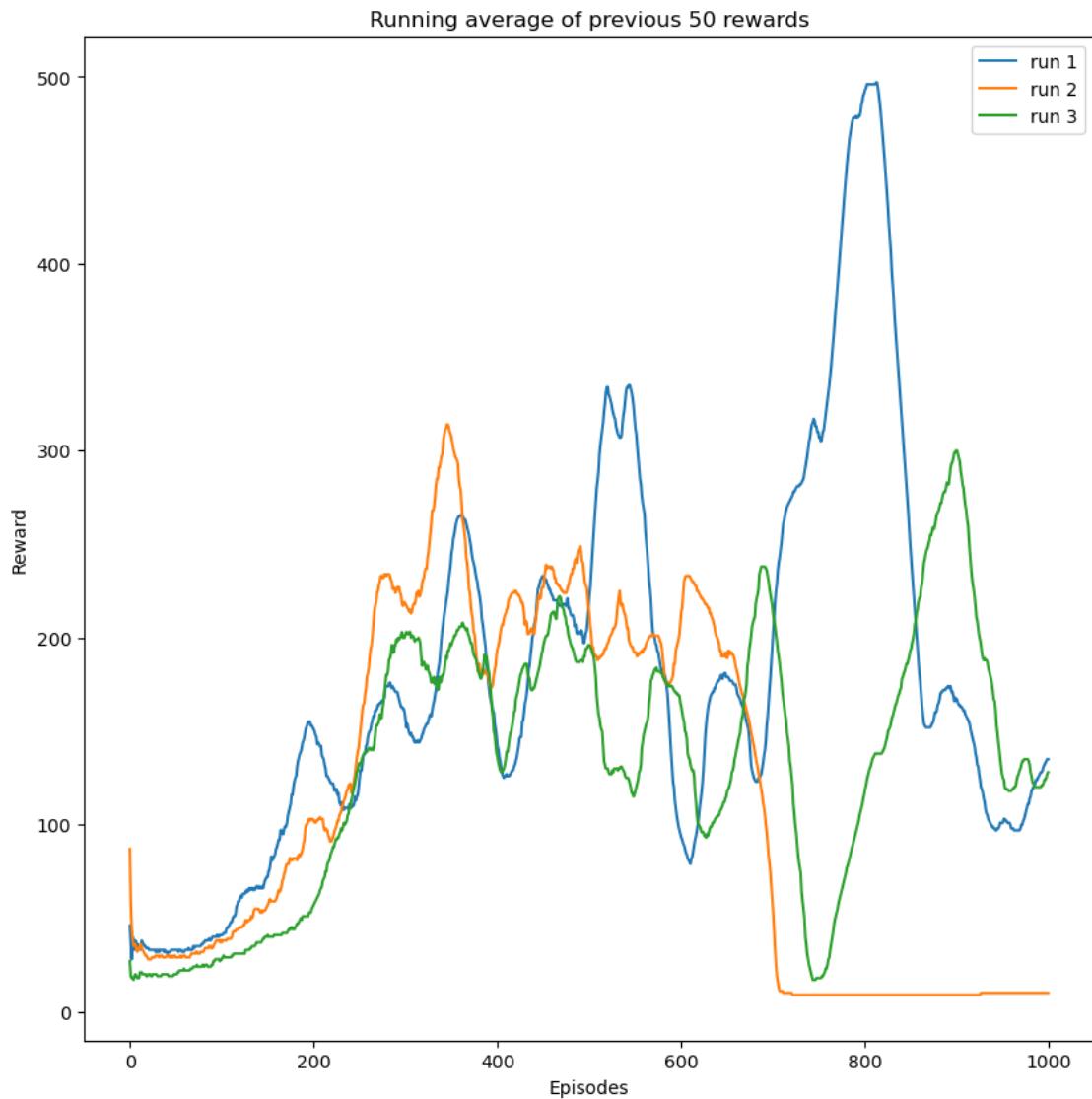
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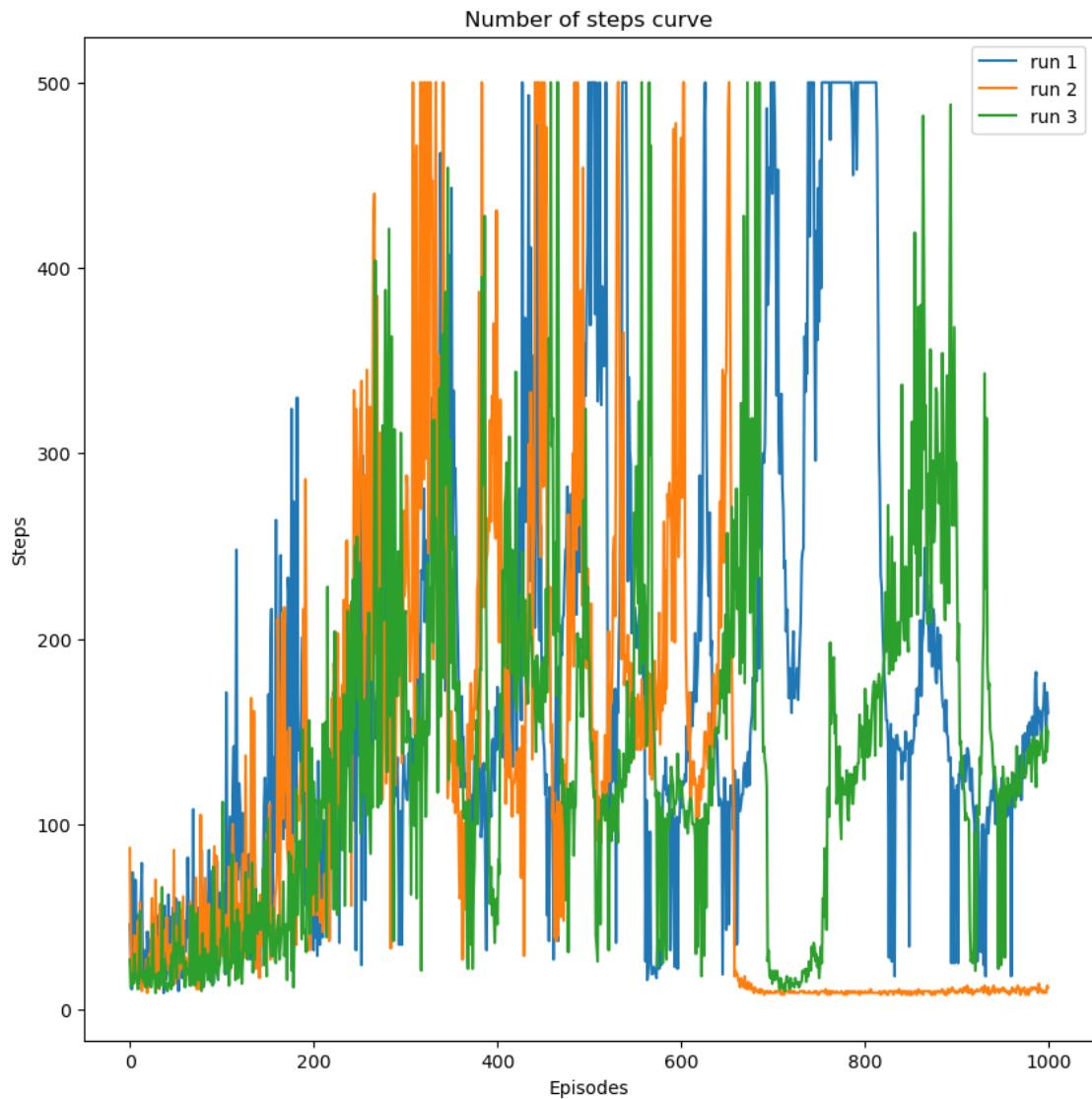
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```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [1024, 1024]
LR = 2e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'CartPole-v1'
SOLVE_CUTOFF = 195.0
STEP = 10

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{hs}-{lr}-{env}-{numep}-{nstep}-{STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	47.000000	43.000000
20	26.000000	29.800000
30	26.000000	36.900000
40	132.000000	50.100000
50	47.000000	46.200000
60	54.000000	54.400000
70	47.000000	37.700000
80	42.000000	55.400000
90	122.000000	66.300000
100	146.000000	96.700000
110	145.000000	105.300000
120	138.000000	107.700000
130	98.000000	176.600000
140	225.000000	211.500000
150	256.000000	246.500000
160	37.000000	93.900000
170	59.000000	51.500000
180	120.000000	91.600000
190	228.000000	259.400000
200	314.000000	259.300000
210	52.000000	238.400000
220	31.000000	28.300000
230	32.000000	38.900000
240	263.000000	147.800000
250	117.000000	176.000000
260	186.000000	199.600000
270	293.000000	218.300000
280	123.000000	192.500000

Episode 290 Reward 128.000000 Average Reward 143.500000
Episode 300 Reward 111.000000 Average Reward 118.700000
Episode 310 Reward 129.000000 Average Reward 122.100000
Episode 320 Reward 186.000000 Average Reward 143.000000
Episode 330 Reward 211.000000 Average Reward 201.000000
Episode 340 Reward 389.000000 Average Reward 380.700000
Episode 350 Reward 148.000000 Average Reward 319.300000
Episode 360 Reward 19.000000 Average Reward 32.100000
Episode 370 Reward 10.000000 Average Reward 12.200000
Episode 380 Reward 10.000000 Average Reward 9.500000
Episode 390 Reward 9.000000 Average Reward 9.600000
Episode 400 Reward 9.000000 Average Reward 9.500000
Episode 410 Reward 10.000000 Average Reward 9.000000
Episode 420 Reward 8.000000 Average Reward 9.300000
Episode 430 Reward 9.000000 Average Reward 9.200000
Episode 440 Reward 8.000000 Average Reward 9.100000
Episode 450 Reward 9.000000 Average Reward 9.300000
Episode 460 Reward 9.000000 Average Reward 9.400000
Episode 470 Reward 9.000000 Average Reward 9.300000
Episode 480 Reward 9.000000 Average Reward 10.000000
Episode 490 Reward 9.000000 Average Reward 9.200000
Episode 500 Reward 9.000000 Average Reward 9.500000
Episode 510 Reward 11.000000 Average Reward 10.200000
Episode 520 Reward 10.000000 Average Reward 9.600000
Episode 530 Reward 10.000000 Average Reward 9.600000
Episode 540 Reward 11.000000 Average Reward 9.600000
Episode 550 Reward 10.000000 Average Reward 9.500000
Episode 560 Reward 11.000000 Average Reward 9.400000
Episode 570 Reward 8.000000 Average Reward 9.500000
Episode 580 Reward 11.000000 Average Reward 9.900000
Episode 590 Reward 10.000000 Average Reward 9.600000
Episode 600 Reward 10.000000 Average Reward 10.000000
Episode 610 Reward 10.000000 Average Reward 9.800000
Episode 620 Reward 10.000000 Average Reward 9.900000
Episode 630 Reward 11.000000 Average Reward 9.400000
Episode 640 Reward 10.000000 Average Reward 9.800000
Episode 650 Reward 8.000000 Average Reward 10.000000
Episode 660 Reward 9.000000 Average Reward 9.900000
Episode 670 Reward 10.000000 Average Reward 9.600000
Episode 680 Reward 13.000000 Average Reward 10.100000
Episode 690 Reward 9.000000 Average Reward 9.800000
Episode 700 Reward 10.000000 Average Reward 10.100000
Episode 710 Reward 11.000000 Average Reward 10.400000
Episode 720 Reward 10.000000 Average Reward 9.900000
Episode 730 Reward 12.000000 Average Reward 9.900000
Episode 740 Reward 10.000000 Average Reward 10.100000
Episode 750 Reward 8.000000 Average Reward 10.100000
Episode 760 Reward 10.000000 Average Reward 9.900000

Episode 770 Reward 9.000000 Average Reward 10.100000
Episode 780 Reward 13.000000 Average Reward 10.900000
Episode 790 Reward 8.000000 Average Reward 10.100000
Episode 800 Reward 10.000000 Average Reward 10.500000
Episode 810 Reward 10.000000 Average Reward 10.500000
Episode 820 Reward 11.000000 Average Reward 10.900000
Episode 830 Reward 11.000000 Average Reward 11.100000
Episode 840 Reward 10.000000 Average Reward 10.900000
Episode 850 Reward 9.000000 Average Reward 10.400000
Episode 860 Reward 16.000000 Average Reward 11.900000
Episode 870 Reward 9.000000 Average Reward 11.100000
Episode 880 Reward 10.000000 Average Reward 11.600000
Episode 890 Reward 12.000000 Average Reward 11.900000
Episode 900 Reward 9.000000 Average Reward 11.300000
Episode 910 Reward 15.000000 Average Reward 13.900000
Episode 920 Reward 14.000000 Average Reward 13.000000
Episode 930 Reward 12.000000 Average Reward 13.800000
Episode 940 Reward 13.000000 Average Reward 14.600000
Episode 950 Reward 18.000000 Average Reward 16.800000
Episode 960 Reward 16.000000 Average Reward 18.500000
Episode 970 Reward 31.000000 Average Reward 21.400000
Episode 980 Reward 30.000000 Average Reward 25.500000
Episode 990 Reward 37.000000 Average Reward 34.400000
Episode 1000 Reward 113.000000 Average Reward 73.800000
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Episode 50 Reward 19.000000 Average Reward 35.800000
Episode 60 Reward 32.000000 Average Reward 41.200000
Episode 70 Reward 30.000000 Average Reward 75.500000
Episode 80 Reward 59.000000 Average Reward 60.800000
Episode 90 Reward 164.000000 Average Reward 110.700000
Episode 100 Reward 62.000000 Average Reward 109.400000
Episode 110 Reward 55.000000 Average Reward 91.600000
Episode 120 Reward 76.000000 Average Reward 125.400000
Episode 130 Reward 111.000000 Average Reward 147.000000
Episode 140 Reward 136.000000 Average Reward 132.200000
Episode 150 Reward 401.000000 Average Reward 192.300000
Episode 160 Reward 231.000000 Average Reward 209.100000
Episode 170 Reward 216.000000 Average Reward 192.100000
Episode 180 Reward 220.000000 Average Reward 208.700000
Episode 190 Reward 157.000000 Average Reward 254.700000
Episode 200 Reward 47.000000 Average Reward 58.000000
Episode 210 Reward 23.000000 Average Reward 27.500000
Episode 220 Reward 75.000000 Average Reward 43.000000
Episode 230 Reward 186.000000 Average Reward 110.600000

Episode 240 Reward 168.000000 Average Reward 229.200000
Episode 250 Reward 251.000000 Average Reward 227.800000
Episode 260 Reward 37.000000 Average Reward 155.600000
Episode 270 Reward 158.000000 Average Reward 146.700000
Episode 280 Reward 165.000000 Average Reward 164.800000
Episode 290 Reward 148.000000 Average Reward 121.800000
Episode 300 Reward 101.000000 Average Reward 133.000000
Episode 310 Reward 195.000000 Average Reward 125.400000
Episode 320 Reward 32.000000 Average Reward 172.900000
Episode 330 Reward 232.000000 Average Reward 88.100000
Episode 340 Reward 31.000000 Average Reward 104.900000
Episode 350 Reward 123.000000 Average Reward 104.700000
Episode 360 Reward 102.000000 Average Reward 115.700000
Episode 370 Reward 122.000000 Average Reward 116.200000
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Episode 400 Reward 231.000000 Average Reward 218.400000
Episode 410 Reward 250.000000 Average Reward 317.100000
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Episode 430 Reward 153.000000 Average Reward 148.200000
Episode 440 Reward 190.000000 Average Reward 144.600000
Episode 450 Reward 203.000000 Average Reward 185.300000
Episode 460 Reward 276.000000 Average Reward 239.200000
Episode 470 Reward 417.000000 Average Reward 327.800000
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Episode 490 Reward 500.000000 Average Reward 500.000000
Episode 500 Reward 500.000000 Average Reward 500.000000
Episode 510 Reward 500.000000 Average Reward 500.000000
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Episode 890 Reward 10.000000 Average Reward 9.300000
Episode 900 Reward 9.000000 Average Reward 9.000000
Episode 910 Reward 10.000000 Average Reward 9.600000
Episode 920 Reward 11.000000 Average Reward 9.500000
Episode 930 Reward 10.000000 Average Reward 9.000000
Episode 940 Reward 9.000000 Average Reward 9.300000
Episode 950 Reward 9.000000 Average Reward 9.600000
Episode 960 Reward 10.000000 Average Reward 9.900000
Episode 970 Reward 11.000000 Average Reward 9.100000
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Episode 990 Reward 9.000000 Average Reward 9.700000
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Episode 60 Reward 148.000000 Average Reward 53.200000
Episode 70 Reward 17.000000 Average Reward 53.200000
Episode 80 Reward 35.000000 Average Reward 64.600000
Episode 90 Reward 66.000000 Average Reward 87.000000
Episode 100 Reward 45.000000 Average Reward 110.200000
Episode 110 Reward 57.000000 Average Reward 63.900000
Episode 120 Reward 46.000000 Average Reward 62.300000
Episode 130 Reward 108.000000 Average Reward 193.100000
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Episode 150 Reward 56.000000 Average Reward 45.100000
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Episode 170 Reward 347.000000 Average Reward 276.100000
Episode 180 Reward 141.000000 Average Reward 319.600000

Episode 190 Reward 244.000000 Average Reward 311.700000
Episode 200 Reward 263.000000 Average Reward 300.700000
Episode 210 Reward 58.000000 Average Reward 181.100000
Episode 220 Reward 119.000000 Average Reward 114.500000
Episode 230 Reward 122.000000 Average Reward 119.100000
Episode 240 Reward 114.000000 Average Reward 103.600000
Episode 250 Reward 163.000000 Average Reward 138.600000
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Episode 290 Reward 104.000000 Average Reward 102.400000
Episode 300 Reward 500.000000 Average Reward 235.800000
Episode 310 Reward 323.000000 Average Reward 326.900000
Episode 320 Reward 492.000000 Average Reward 434.100000
Episode 330 Reward 26.000000 Average Reward 168.300000
Episode 340 Reward 274.000000 Average Reward 143.200000
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Episode 370 Reward 500.000000 Average Reward 499.700000
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Episode 420 Reward 108.000000 Average Reward 108.900000
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Episode 440 Reward 121.000000 Average Reward 136.800000
Episode 450 Reward 121.000000 Average Reward 165.900000
Episode 460 Reward 101.000000 Average Reward 114.800000
Episode 470 Reward 109.000000 Average Reward 102.500000
Episode 480 Reward 128.000000 Average Reward 106.400000
Episode 490 Reward 500.000000 Average Reward 300.200000
Episode 500 Reward 500.000000 Average Reward 500.000000
Episode 510 Reward 148.000000 Average Reward 371.600000
Episode 520 Reward 55.000000 Average Reward 71.600000
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Episode 540 Reward 500.000000 Average Reward 500.000000
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Episode 590 Reward 117.000000 Average Reward 97.600000
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Episode 620 Reward 57.000000 Average Reward 43.100000
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Episode 640 Reward 152.000000 Average Reward 133.600000
Episode 650 Reward 138.000000 Average Reward 142.600000
Episode 660 Reward 192.000000 Average Reward 158.500000

Episode 670 Reward 191.000000 Average Reward 199.100000
Episode 680 Reward 215.000000 Average Reward 255.400000
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Episode 720 Reward 69.000000 Average Reward 34.200000
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Episode 740 Reward 251.000000 Average Reward 256.800000
Episode 750 Reward 187.000000 Average Reward 224.300000
Episode 760 Reward 129.000000 Average Reward 133.200000
Episode 770 Reward 254.000000 Average Reward 161.000000
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Episode 820 Reward 193.000000 Average Reward 206.100000
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Episode 850 Reward 245.000000 Average Reward 306.300000
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Episode 870 Reward 108.000000 Average Reward 100.800000
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Episode 900 Reward 191.000000 Average Reward 231.500000
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Episode 930 Reward 224.000000 Average Reward 223.200000
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Episode 950 Reward 190.000000 Average Reward 194.300000
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Episode 50 Reward 55.000000 Average Reward 48.600000
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Episode 250 Reward 221.000000 Average Reward 102.300000
Episode 260 Reward 89.000000 Average Reward 199.900000
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Episode 290 Reward 145.000000 Average Reward 300.200000
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Episode 360 Reward 86.000000 Average Reward 66.700000
Episode 370 Reward 102.000000 Average Reward 188.500000
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Episode 390 Reward 22.000000 Average Reward 20.900000
Episode 400 Reward 138.000000 Average Reward 80.600000
Episode 410 Reward 138.000000 Average Reward 138.600000
Episode 420 Reward 156.000000 Average Reward 147.400000
Episode 430 Reward 131.000000 Average Reward 150.300000
Episode 440 Reward 126.000000 Average Reward 123.000000
Episode 450 Reward 125.000000 Average Reward 116.100000
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Episode 480 Reward 117.000000 Average Reward 111.000000
Episode 490 Reward 113.000000 Average Reward 109.500000
Episode 500 Reward 136.000000 Average Reward 117.700000
Episode 510 Reward 111.000000 Average Reward 109.700000
Episode 520 Reward 111.000000 Average Reward 114.600000
Episode 530 Reward 119.000000 Average Reward 120.300000
Episode 540 Reward 115.000000 Average Reward 121.800000
Episode 550 Reward 118.000000 Average Reward 125.100000
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Episode 590 Reward 197.000000 Average Reward 167.100000
Episode 600 Reward 192.000000 Average Reward 176.100000
Episode 610 Reward 256.000000 Average Reward 246.300000

Episode 620 Reward 23.000000 Average Reward 170.800000
Episode 630 Reward 116.000000 Average Reward 57.700000
Episode 640 Reward 24.000000 Average Reward 124.200000
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Episode 660 Reward 172.000000 Average Reward 150.800000
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Episode 680 Reward 254.000000 Average Reward 209.100000
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Episode 710 Reward 441.000000 Average Reward 372.500000
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Episode 750 Reward 10.000000 Average Reward 13.100000
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Episode 820 Reward 23.000000 Average Reward 19.100000
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Episode 840 Reward 27.000000 Average Reward 23.400000
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Episode 860 Reward 39.000000 Average Reward 32.700000
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Episode 930 Reward 128.000000 Average Reward 127.300000
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Episode 960 Reward 141.000000 Average Reward 133.900000
Episode 970 Reward 150.000000 Average Reward 140.800000
Episode 980 Reward 147.000000 Average Reward 147.800000
Episode 990 Reward 144.000000 Average Reward 152.200000
Episode 1000 Reward 189.000000 Average Reward 166.500000

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Episode 60 Reward 43.000000 Average Reward 41.000000
Episode 70 Reward 130.000000 Average Reward 73.100000
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Episode 90 Reward 110.000000 Average Reward 67.600000
Episode 100 Reward 144.000000 Average Reward 109.000000
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Episode 230 Reward 94.000000 Average Reward 87.500000
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Episode 260 Reward 176.000000 Average Reward 151.900000
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Episode 280 Reward 125.000000 Average Reward 146.200000
Episode 290 Reward 35.000000 Average Reward 45.500000
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Episode 330 Reward 437.000000 Average Reward 401.100000
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Episode 350 Reward 391.000000 Average Reward 360.800000
Episode 360 Reward 468.000000 Average Reward 368.100000
Episode 370 Reward 175.000000 Average Reward 369.800000
Episode 380 Reward 145.000000 Average Reward 153.400000
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Episode 400 Reward 500.000000 Average Reward 368.300000
Episode 410 Reward 9.000000 Average Reward 77.600000
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Episode 490 Reward 9.000000 Average Reward 10.100000
Episode 500 Reward 10.000000 Average Reward 10.900000
Episode 510 Reward 10.000000 Average Reward 11.800000
Episode 520 Reward 14.000000 Average Reward 12.400000
Episode 530 Reward 16.000000 Average Reward 14.300000
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Episode 570 Reward 20.000000 Average Reward 18.000000
Episode 580 Reward 19.000000 Average Reward 18.300000
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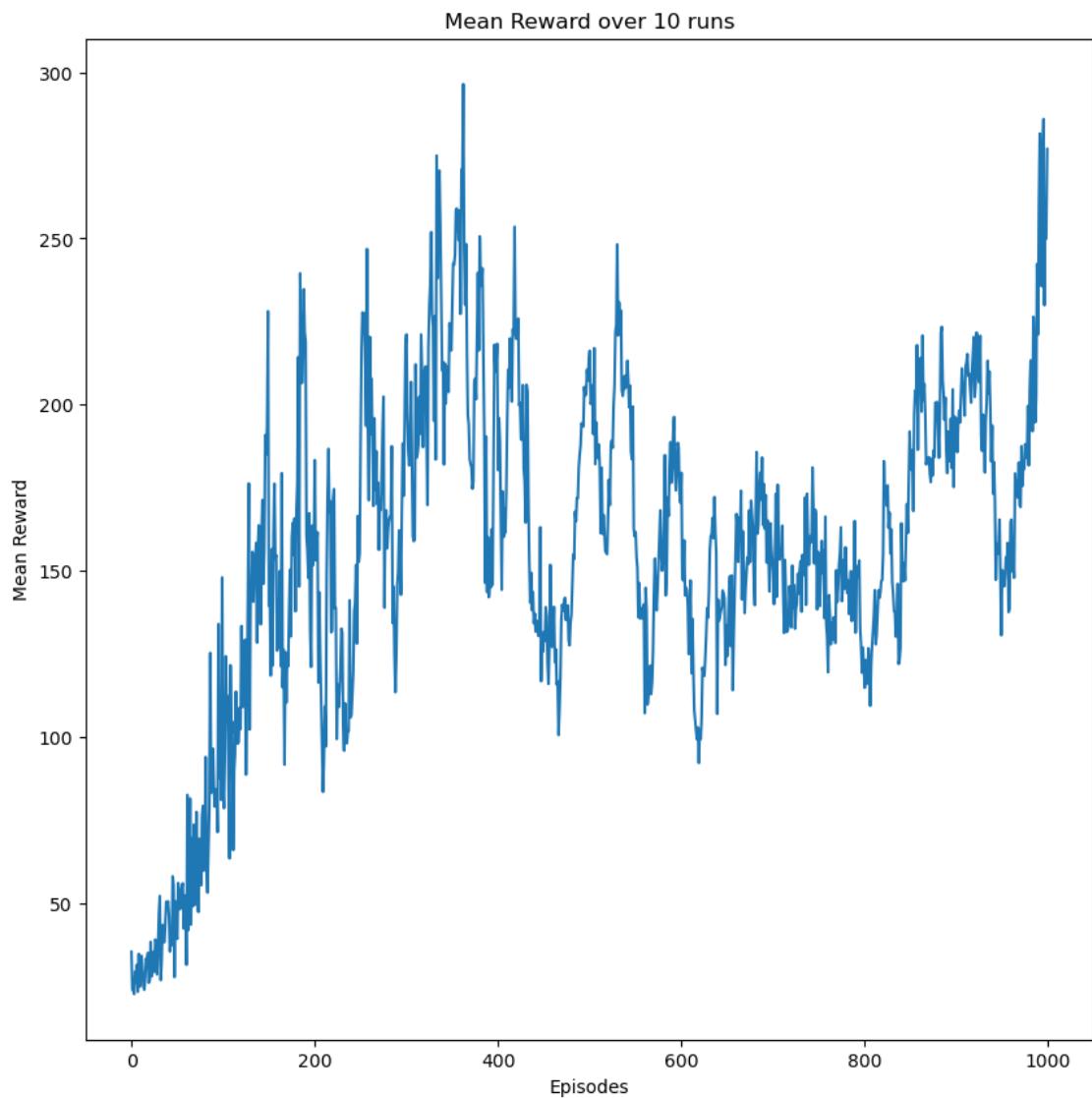
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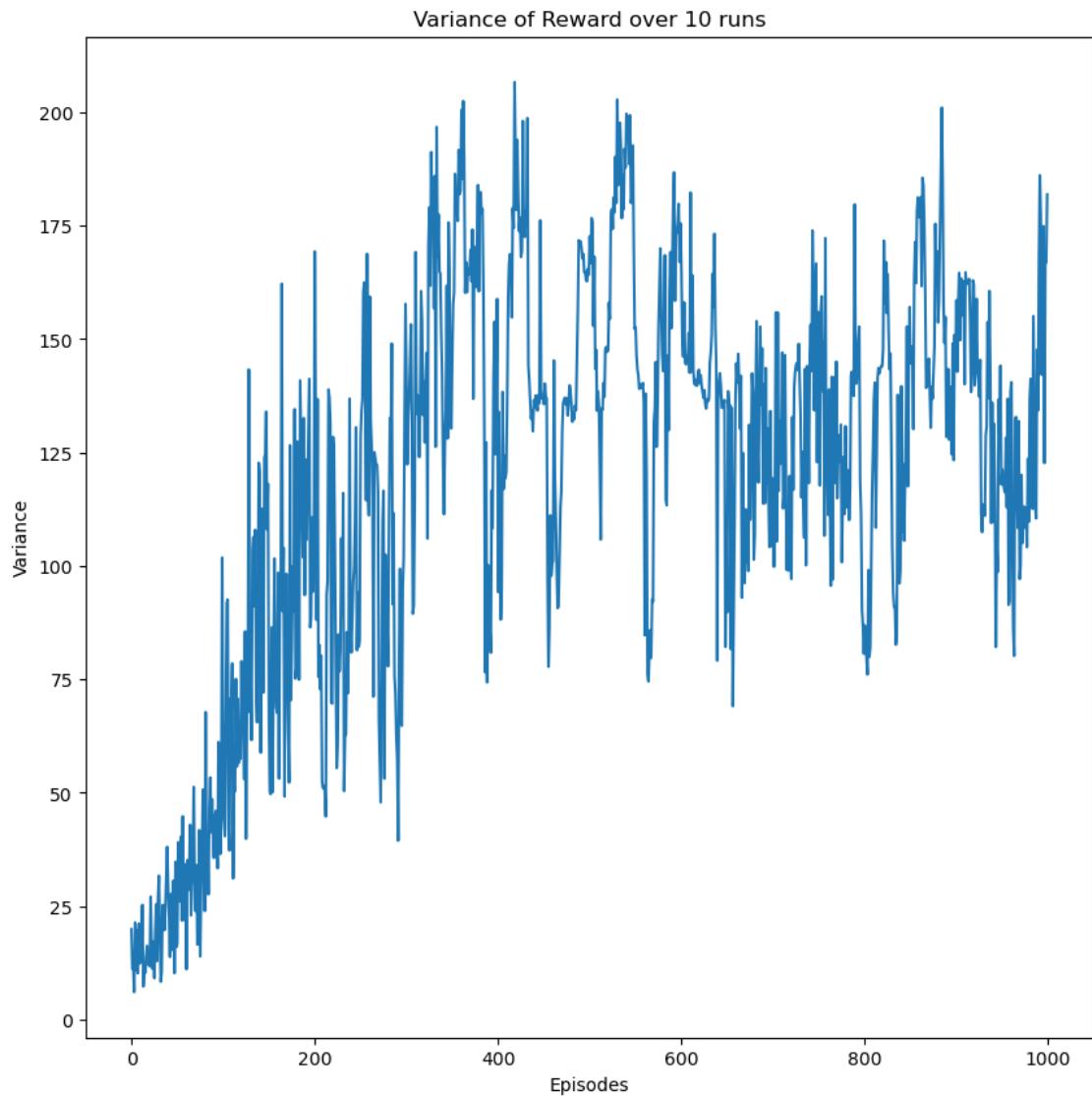
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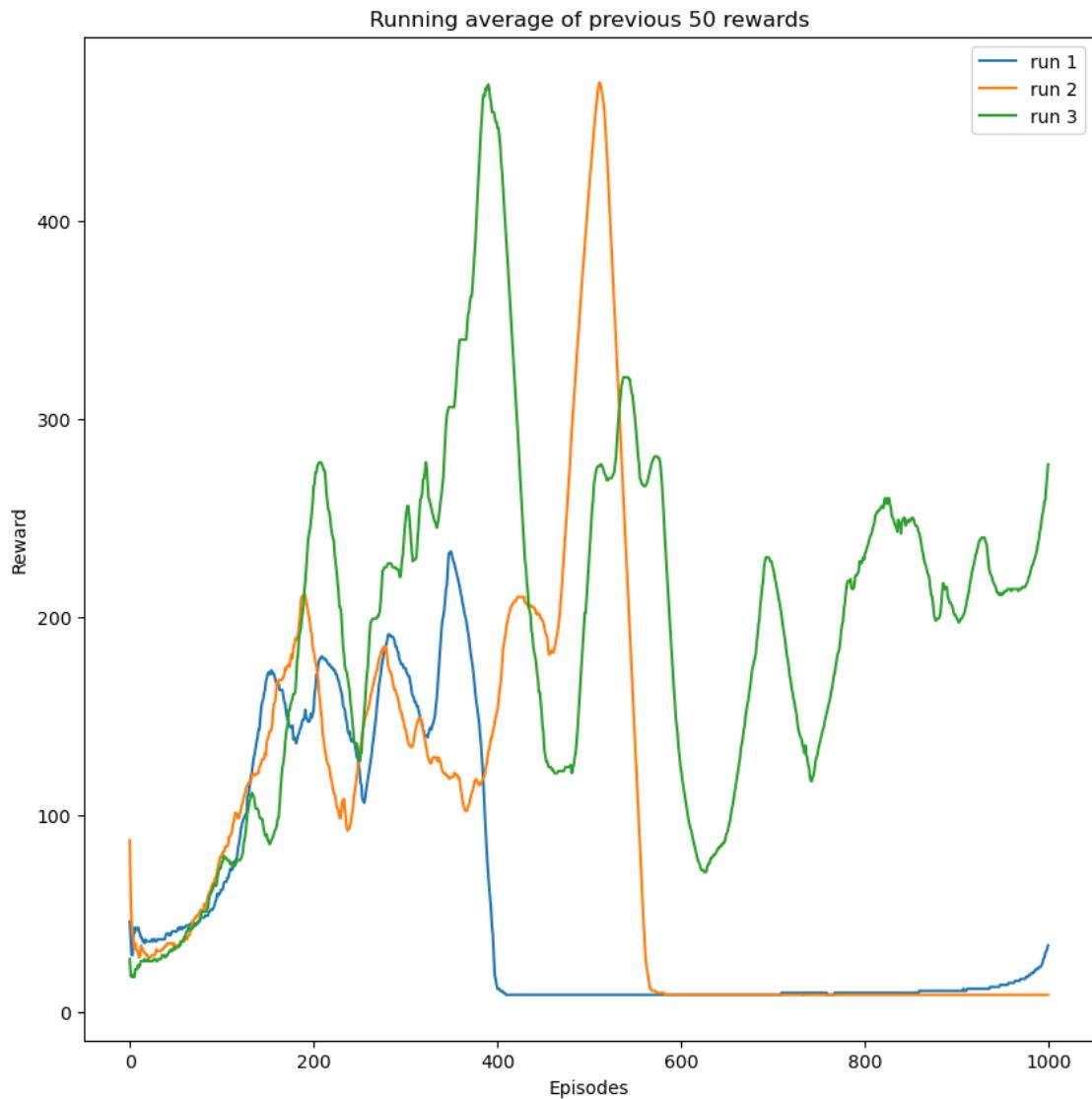
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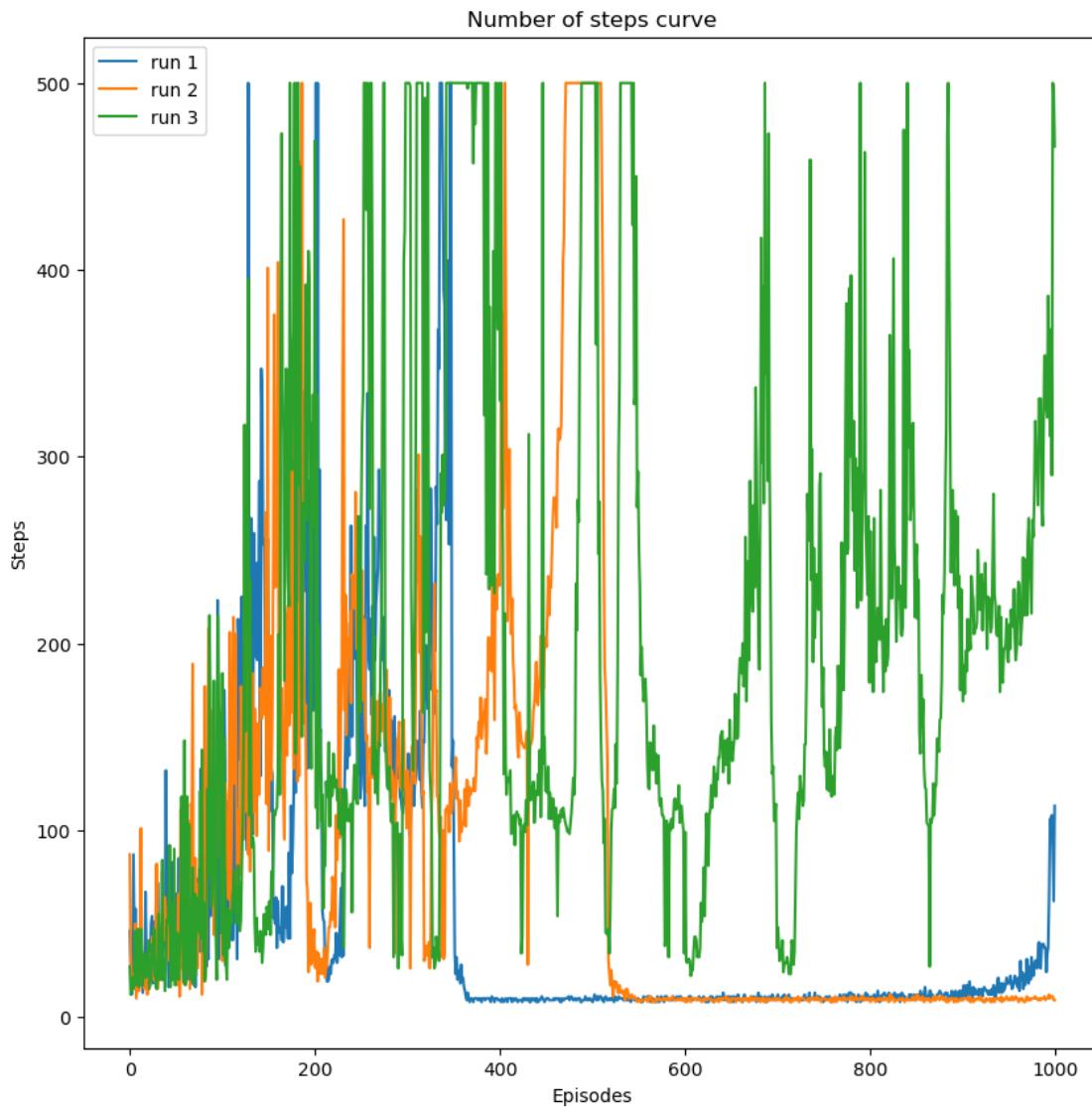
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Episode 380 Reward 500.000000 Average Reward 208.300000
Episode 390 Reward 130.000000 Average Reward 363.300000
Episode 400 Reward 249.000000 Average Reward 130.600000
Episode 410 Reward 369.000000 Average Reward 284.200000
Episode 420 Reward 500.000000 Average Reward 465.700000
Episode 430 Reward 500.000000 Average Reward 500.000000
Episode 440 Reward 500.000000 Average Reward 500.000000
Episode 450 Reward 500.000000 Average Reward 500.000000
Episode 460 Reward 114.000000 Average Reward 328.600000
Episode 470 Reward 185.000000 Average Reward 61.500000
Episode 480 Reward 108.000000 Average Reward 146.700000
Episode 490 Reward 198.000000 Average Reward 160.500000
Episode 500 Reward 148.000000 Average Reward 196.600000
Episode 510 Reward 107.000000 Average Reward 72.000000
Episode 520 Reward 300.000000 Average Reward 171.900000
Episode 530 Reward 398.000000 Average Reward 439.900000
Episode 540 Reward 399.000000 Average Reward 348.500000
Episode 550 Reward 314.000000 Average Reward 474.600000
Episode 560 Reward 199.000000 Average Reward 239.400000
Episode 570 Reward 287.000000 Average Reward 255.100000
Episode 580 Reward 500.000000 Average Reward 441.500000
Episode 590 Reward 341.000000 Average Reward 414.300000
Episode 600 Reward 485.000000 Average Reward 437.800000
Episode 610 Reward 151.000000 Average Reward 234.900000
Episode 620 Reward 22.000000 Average Reward 20.700000
Episode 630 Reward 209.000000 Average Reward 121.000000
Episode 640 Reward 227.000000 Average Reward 348.800000
Episode 650 Reward 138.000000 Average Reward 179.000000
Episode 660 Reward 114.000000 Average Reward 112.900000
Episode 670 Reward 112.000000 Average Reward 104.500000
Episode 680 Reward 119.000000 Average Reward 112.800000
Episode 690 Reward 128.000000 Average Reward 117.300000
Episode 700 Reward 119.000000 Average Reward 115.800000
Episode 710 Reward 139.000000 Average Reward 132.300000
Episode 720 Reward 133.000000 Average Reward 144.200000
Episode 730 Reward 124.000000 Average Reward 137.800000
Episode 740 Reward 130.000000 Average Reward 128.500000
Episode 750 Reward 132.000000 Average Reward 129.000000
Episode 760 Reward 129.000000 Average Reward 131.300000
Episode 770 Reward 146.000000 Average Reward 135.500000
Episode 780 Reward 149.000000 Average Reward 149.300000
Episode 790 Reward 176.000000 Average Reward 161.000000

Episode 800 Reward 198.000000 Average Reward 178.500000
Episode 810 Reward 180.000000 Average Reward 178.100000
Episode 820 Reward 176.000000 Average Reward 182.500000
Episode 830 Reward 218.000000 Average Reward 195.800000
Episode 840 Reward 194.000000 Average Reward 205.300000
Episode 850 Reward 286.000000 Average Reward 232.800000
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Episode 870 Reward 334.000000 Average Reward 298.700000
Episode 880 Reward 456.000000 Average Reward 386.300000
Episode 890 Reward 377.000000 Average Reward 482.800000
Episode 900 Reward 500.000000 Average Reward 426.900000
Episode 910 Reward 500.000000 Average Reward 475.900000
Episode 920 Reward 500.000000 Average Reward 500.000000
Episode 930 Reward 283.000000 Average Reward 432.400000
Episode 940 Reward 175.000000 Average Reward 208.500000
Episode 950 Reward 16.000000 Average Reward 105.500000
Episode 960 Reward 164.000000 Average Reward 139.400000
Episode 970 Reward 153.000000 Average Reward 170.100000
Episode 980 Reward 150.000000 Average Reward 164.300000
Episode 990 Reward 227.000000 Average Reward 194.600000
Episode 1000 Reward 128.000000 Average Reward 178.000000
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```
[ ]: NUM_HIDDEN = 3
HIDDEN_SIZES = [512, 1024, 512]
LR = 1e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'CartPole-v1'
SOLVE_CUTOFF = 195.0
STEP = 10

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{hs}-{lr}-{env}-{numep}-{nstep}-{STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	15.000000	28.800000
20	96.000000	35.300000
30	20.000000	23.900000
40	14.000000	31.600000
50	17.000000	23.100000
60	36.000000	38.900000
70	40.000000	34.900000
80	36.000000	43.600000
90	32.000000	55.000000
100	58.000000	44.400000
110	46.000000	61.800000
120	53.000000	77.500000
130	40.000000	89.700000
140	62.000000	78.000000
150	152.000000	166.400000
160	76.000000	80.200000
170	196.000000	101.100000
180	452.000000	199.000000
190	134.000000	140.700000
200	192.000000	168.900000
210	323.000000	200.100000
220	209.000000	222.200000
230	198.000000	155.200000
240	342.000000	287.300000
250	146.000000	168.500000
260	40.000000	107.200000
270	77.000000	58.200000
280	138.000000	130.100000

Episode 290 Reward 190.000000 Average Reward 216.300000
Episode 300 Reward 190.000000 Average Reward 260.200000
Episode 310 Reward 127.000000 Average Reward 212.400000
Episode 320 Reward 144.000000 Average Reward 126.300000
Episode 330 Reward 127.000000 Average Reward 119.800000
Episode 340 Reward 120.000000 Average Reward 103.100000
Episode 350 Reward 116.000000 Average Reward 108.000000
Episode 360 Reward 127.000000 Average Reward 117.800000
Episode 370 Reward 167.000000 Average Reward 119.800000
Episode 380 Reward 106.000000 Average Reward 129.300000
Episode 390 Reward 139.000000 Average Reward 103.800000
Episode 400 Reward 175.000000 Average Reward 164.500000
Episode 410 Reward 104.000000 Average Reward 125.000000
Episode 420 Reward 147.000000 Average Reward 125.900000
Episode 430 Reward 156.000000 Average Reward 142.400000
Episode 440 Reward 147.000000 Average Reward 145.700000
Episode 450 Reward 158.000000 Average Reward 141.300000
Episode 460 Reward 176.000000 Average Reward 155.500000
Episode 470 Reward 147.000000 Average Reward 188.700000
Episode 480 Reward 190.000000 Average Reward 157.200000
Episode 490 Reward 29.000000 Average Reward 222.900000
Episode 500 Reward 9.000000 Average Reward 16.200000
Episode 510 Reward 9.000000 Average Reward 9.800000
Episode 520 Reward 10.000000 Average Reward 9.500000
Episode 530 Reward 10.000000 Average Reward 9.300000
Episode 540 Reward 11.000000 Average Reward 9.600000
Episode 550 Reward 10.000000 Average Reward 9.800000
Episode 560 Reward 11.000000 Average Reward 10.400000
Episode 570 Reward 12.000000 Average Reward 12.400000
Episode 580 Reward 11.000000 Average Reward 13.400000
Episode 590 Reward 9.000000 Average Reward 12.900000
Episode 600 Reward 17.000000 Average Reward 13.500000
Episode 610 Reward 15.000000 Average Reward 14.300000
Episode 620 Reward 18.000000 Average Reward 16.200000
Episode 630 Reward 14.000000 Average Reward 15.100000
Episode 640 Reward 20.000000 Average Reward 17.800000
Episode 650 Reward 15.000000 Average Reward 20.400000
Episode 660 Reward 18.000000 Average Reward 18.700000
Episode 670 Reward 18.000000 Average Reward 18.900000
Episode 680 Reward 24.000000 Average Reward 19.900000
Episode 690 Reward 19.000000 Average Reward 21.900000
Episode 700 Reward 20.000000 Average Reward 21.600000
Episode 710 Reward 24.000000 Average Reward 25.100000
Episode 720 Reward 24.000000 Average Reward 23.200000
Episode 730 Reward 30.000000 Average Reward 22.900000
Episode 740 Reward 23.000000 Average Reward 24.400000
Episode 750 Reward 22.000000 Average Reward 27.100000
Episode 760 Reward 33.000000 Average Reward 30.400000

Episode 770 Reward 37.000000 Average Reward 35.900000
Episode 780 Reward 52.000000 Average Reward 46.200000
Episode 790 Reward 32.000000 Average Reward 48.800000
Episode 800 Reward 184.000000 Average Reward 134.300000
Episode 810 Reward 378.000000 Average Reward 241.600000
Episode 820 Reward 500.000000 Average Reward 484.200000
Episode 830 Reward 16.000000 Average Reward 186.000000
Episode 840 Reward 10.000000 Average Reward 10.900000
Episode 850 Reward 10.000000 Average Reward 10.900000
Episode 860 Reward 23.000000 Average Reward 17.000000
Episode 870 Reward 22.000000 Average Reward 23.500000
Episode 880 Reward 47.000000 Average Reward 34.800000
Episode 890 Reward 136.000000 Average Reward 124.800000
Episode 900 Reward 140.000000 Average Reward 149.000000
Episode 910 Reward 224.000000 Average Reward 213.500000
Episode 920 Reward 131.000000 Average Reward 141.100000
Episode 930 Reward 291.000000 Average Reward 248.300000
Episode 940 Reward 307.000000 Average Reward 247.900000
Episode 950 Reward 192.000000 Average Reward 242.300000
Episode 960 Reward 258.000000 Average Reward 229.700000
Episode 970 Reward 187.000000 Average Reward 265.800000
Episode 980 Reward 257.000000 Average Reward 252.100000
Episode 990 Reward 200.000000 Average Reward 210.900000
Episode 1000 Reward 182.000000 Average Reward 232.500000

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Episode 10 Reward 48.000000 Average Reward 34.100000
Episode 20 Reward 9.000000 Average Reward 23.900000
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Episode 50 Reward 25.000000 Average Reward 32.900000
Episode 60 Reward 131.000000 Average Reward 46.300000
Episode 70 Reward 74.000000 Average Reward 36.500000
Episode 80 Reward 83.000000 Average Reward 49.000000
Episode 90 Reward 43.000000 Average Reward 68.000000
Episode 100 Reward 30.000000 Average Reward 49.200000
Episode 110 Reward 15.000000 Average Reward 63.500000
Episode 120 Reward 102.000000 Average Reward 75.900000
Episode 130 Reward 128.000000 Average Reward 86.300000
Episode 140 Reward 203.000000 Average Reward 138.500000
Episode 150 Reward 177.000000 Average Reward 124.000000
Episode 160 Reward 165.000000 Average Reward 125.900000
Episode 170 Reward 244.000000 Average Reward 137.200000
Episode 180 Reward 130.000000 Average Reward 209.500000
Episode 190 Reward 150.000000 Average Reward 149.200000
Episode 200 Reward 149.000000 Average Reward 152.700000
Episode 210 Reward 103.000000 Average Reward 126.600000
Episode 220 Reward 60.000000 Average Reward 104.600000
Episode 230 Reward 108.000000 Average Reward 87.600000

Episode 240 Reward 131.000000 Average Reward 96.400000
Episode 250 Reward 35.000000 Average Reward 98.400000
Episode 260 Reward 39.000000 Average Reward 168.800000
Episode 270 Reward 20.000000 Average Reward 22.800000
Episode 280 Reward 22.000000 Average Reward 17.300000
Episode 290 Reward 43.000000 Average Reward 32.800000
Episode 300 Reward 50.000000 Average Reward 41.300000
Episode 310 Reward 51.000000 Average Reward 48.200000
Episode 320 Reward 38.000000 Average Reward 57.000000
Episode 330 Reward 89.000000 Average Reward 121.800000
Episode 340 Reward 266.000000 Average Reward 261.800000
Episode 350 Reward 57.000000 Average Reward 111.200000
Episode 360 Reward 51.000000 Average Reward 57.100000
Episode 370 Reward 132.000000 Average Reward 105.800000
Episode 380 Reward 157.000000 Average Reward 163.300000
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Episode 440 Reward 196.000000 Average Reward 190.000000
Episode 450 Reward 119.000000 Average Reward 91.500000
Episode 460 Reward 214.000000 Average Reward 218.400000
Episode 470 Reward 104.000000 Average Reward 113.500000
Episode 480 Reward 140.000000 Average Reward 113.400000
Episode 490 Reward 133.000000 Average Reward 142.000000
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Episode 510 Reward 136.000000 Average Reward 129.200000
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Episode 580 Reward 30.000000 Average Reward 140.200000
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Episode 610 Reward 74.000000 Average Reward 39.100000
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Episode 630 Reward 117.000000 Average Reward 139.400000
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Episode 870 Reward 439.000000 Average Reward 331.900000
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Episode 910 Reward 410.000000 Average Reward 306.000000
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Episode 960 Reward 225.000000 Average Reward 358.500000
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Episode 990 Reward 500.000000 Average Reward 314.100000
Episode 1000 Reward 500.000000 Average Reward 459.500000

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Episode 10 Reward 21.000000 Average Reward 18.100000
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Episode 70 Reward 23.000000 Average Reward 30.100000
Episode 80 Reward 30.000000 Average Reward 42.500000
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Episode 100 Reward 23.000000 Average Reward 40.200000
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Episode 160 Reward 184.000000 Average Reward 56.600000
Episode 170 Reward 78.000000 Average Reward 92.300000
Episode 180 Reward 107.000000 Average Reward 96.100000

Episode 190 Reward 42.000000 Average Reward 130.300000
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Episode 530 Reward 405.000000 Average Reward 362.100000
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Episode 610 Reward 500.000000 Average Reward 392.600000
Episode 620 Reward 336.000000 Average Reward 401.100000
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Episode 790 Reward 225.000000 Average Reward 218.100000
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Episode 810 Reward 351.000000 Average Reward 341.600000
Episode 820 Reward 401.000000 Average Reward 408.500000
Episode 830 Reward 446.000000 Average Reward 335.100000
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Episode 850 Reward 316.000000 Average Reward 292.900000
Episode 860 Reward 458.000000 Average Reward 347.600000
Episode 870 Reward 340.000000 Average Reward 316.800000
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Episode 930 Reward 500.000000 Average Reward 441.600000
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Episode 10 Reward 21.000000 Average Reward 28.300000
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Episode 140 Reward 24.000000 Average Reward 60.200000
Episode 150 Reward 122.000000 Average Reward 87.200000
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Episode 250 Reward 256.000000 Average Reward 209.600000
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Episode 410 Reward 159.000000 Average Reward 102.200000
Episode 420 Reward 281.000000 Average Reward 322.500000
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Episode 440 Reward 286.000000 Average Reward 422.200000
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Episode 490 Reward 111.000000 Average Reward 129.500000
Episode 500 Reward 100.000000 Average Reward 107.100000
Episode 510 Reward 105.000000 Average Reward 82.100000
Episode 520 Reward 137.000000 Average Reward 124.500000
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Episode 540 Reward 278.000000 Average Reward 225.000000
Episode 550 Reward 320.000000 Average Reward 401.500000
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Episode 720 Reward 329.000000 Average Reward 342.100000
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Episode 740 Reward 349.000000 Average Reward 365.600000
Episode 750 Reward 500.000000 Average Reward 431.100000
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Episode 780 Reward 184.000000 Average Reward 187.300000
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Episode 820 Reward 168.000000 Average Reward 189.100000
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Episode 840 Reward 255.000000 Average Reward 254.000000
Episode 850 Reward 275.000000 Average Reward 312.900000
Episode 860 Reward 199.000000 Average Reward 383.000000
Episode 870 Reward 500.000000 Average Reward 414.900000
Episode 880 Reward 376.000000 Average Reward 403.300000
Episode 890 Reward 500.000000 Average Reward 338.200000
Episode 900 Reward 187.000000 Average Reward 350.600000
Episode 910 Reward 124.000000 Average Reward 87.700000
Episode 920 Reward 180.000000 Average Reward 155.900000
Episode 930 Reward 165.000000 Average Reward 172.600000
Episode 940 Reward 167.000000 Average Reward 163.200000
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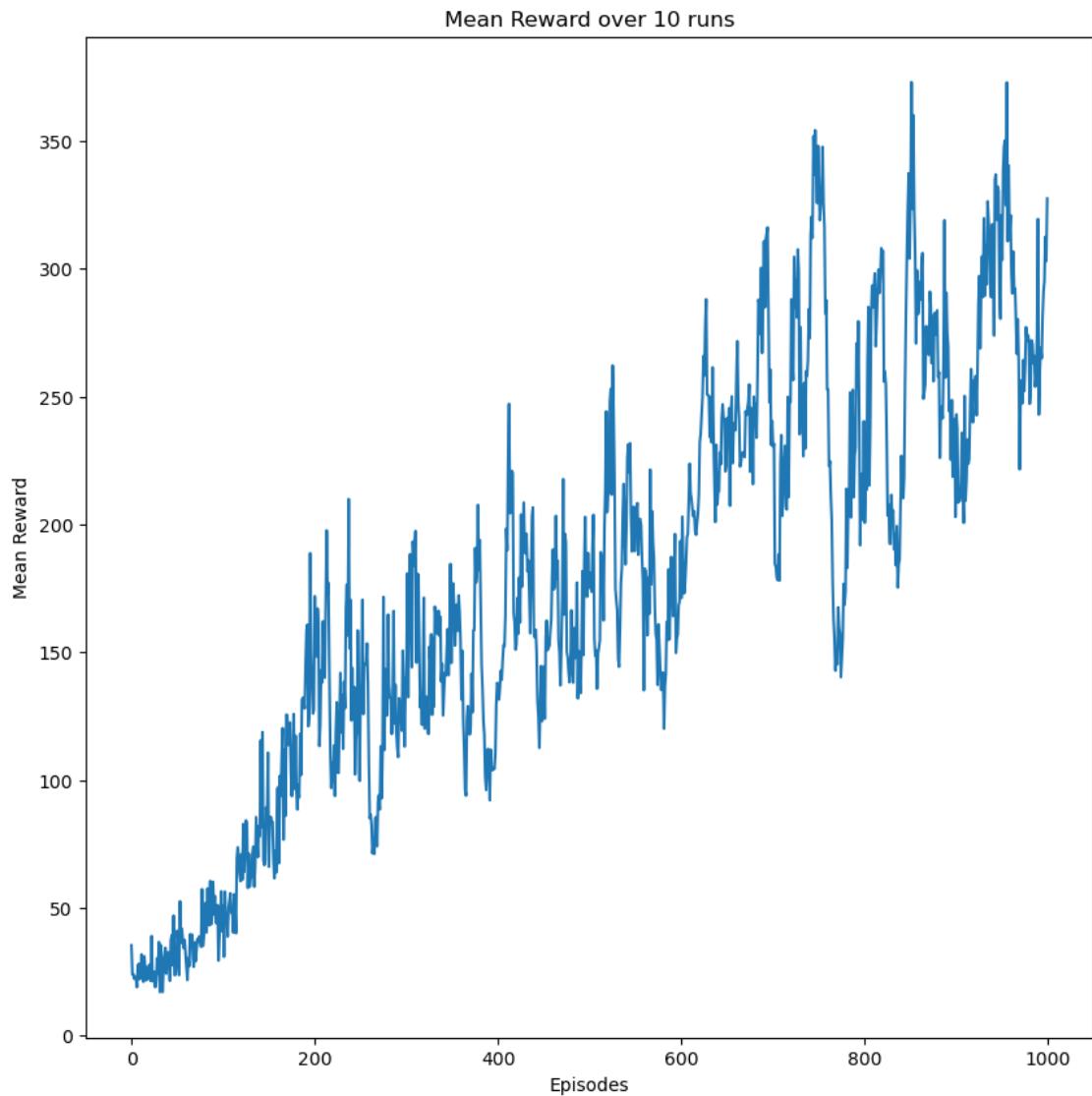
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Episode 660 Reward 449.000000 Average Reward 435.300000
Episode 670 Reward 167.000000 Average Reward 335.300000
Episode 680 Reward 102.000000 Average Reward 118.500000
Episode 690 Reward 105.000000 Average Reward 86.400000
Episode 700 Reward 148.000000 Average Reward 136.700000
Episode 710 Reward 163.000000 Average Reward 182.100000
Episode 720 Reward 500.000000 Average Reward 280.500000
Episode 730 Reward 391.000000 Average Reward 417.300000
Episode 740 Reward 392.000000 Average Reward 299.100000
Episode 750 Reward 500.000000 Average Reward 453.800000
Episode 760 Reward 394.000000 Average Reward 437.700000
Episode 770 Reward 173.000000 Average Reward 335.600000
Episode 780 Reward 280.000000 Average Reward 187.000000
Episode 790 Reward 272.000000 Average Reward 369.000000
Episode 800 Reward 352.000000 Average Reward 245.700000
Episode 810 Reward 301.000000 Average Reward 317.100000
Episode 820 Reward 264.000000 Average Reward 265.200000
Episode 830 Reward 500.000000 Average Reward 368.200000
Episode 840 Reward 336.000000 Average Reward 387.000000

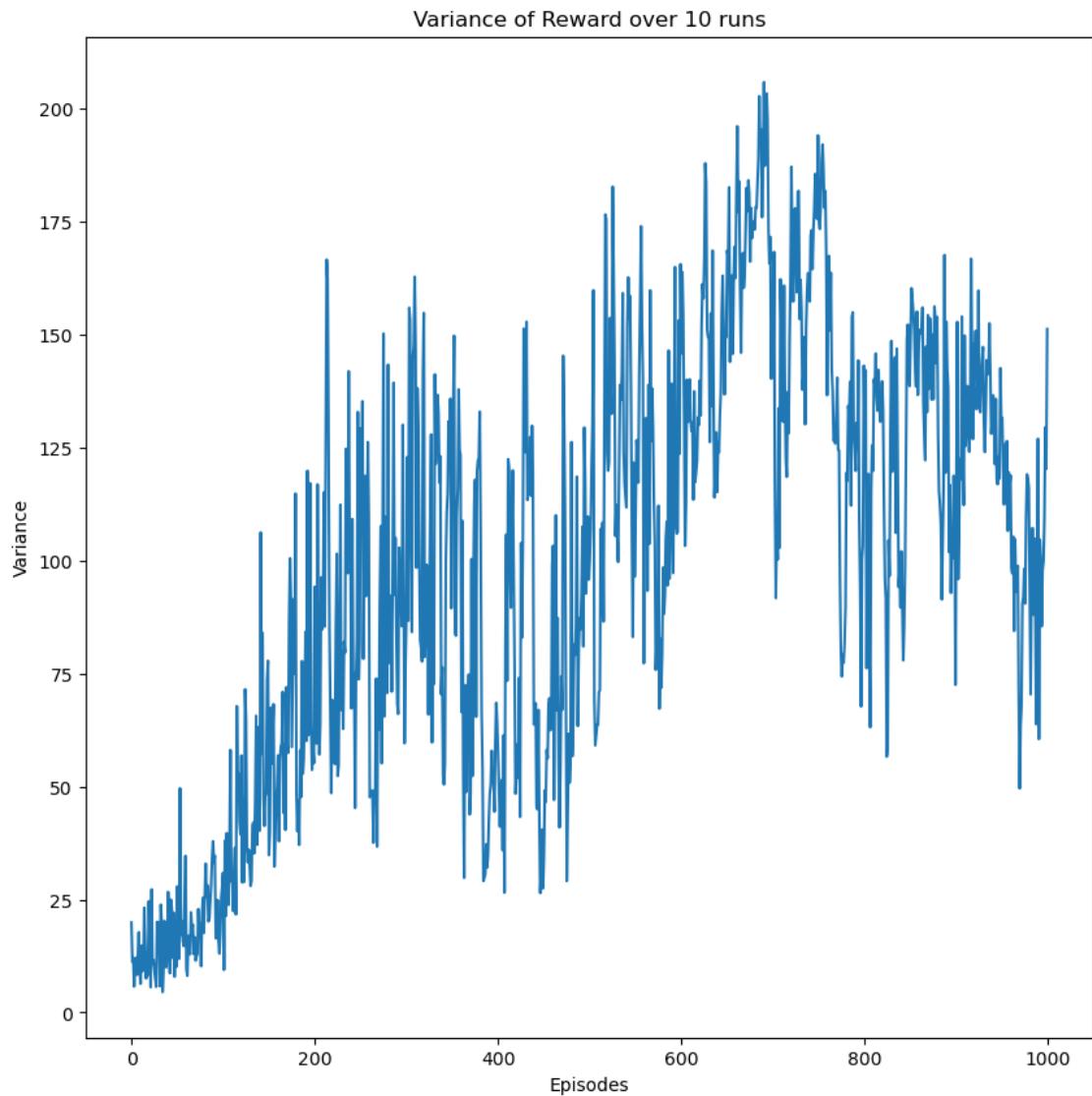
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Episode 960 Reward 500.000000 Average Reward 399.800000
Episode 970 Reward 191.000000 Average Reward 393.100000
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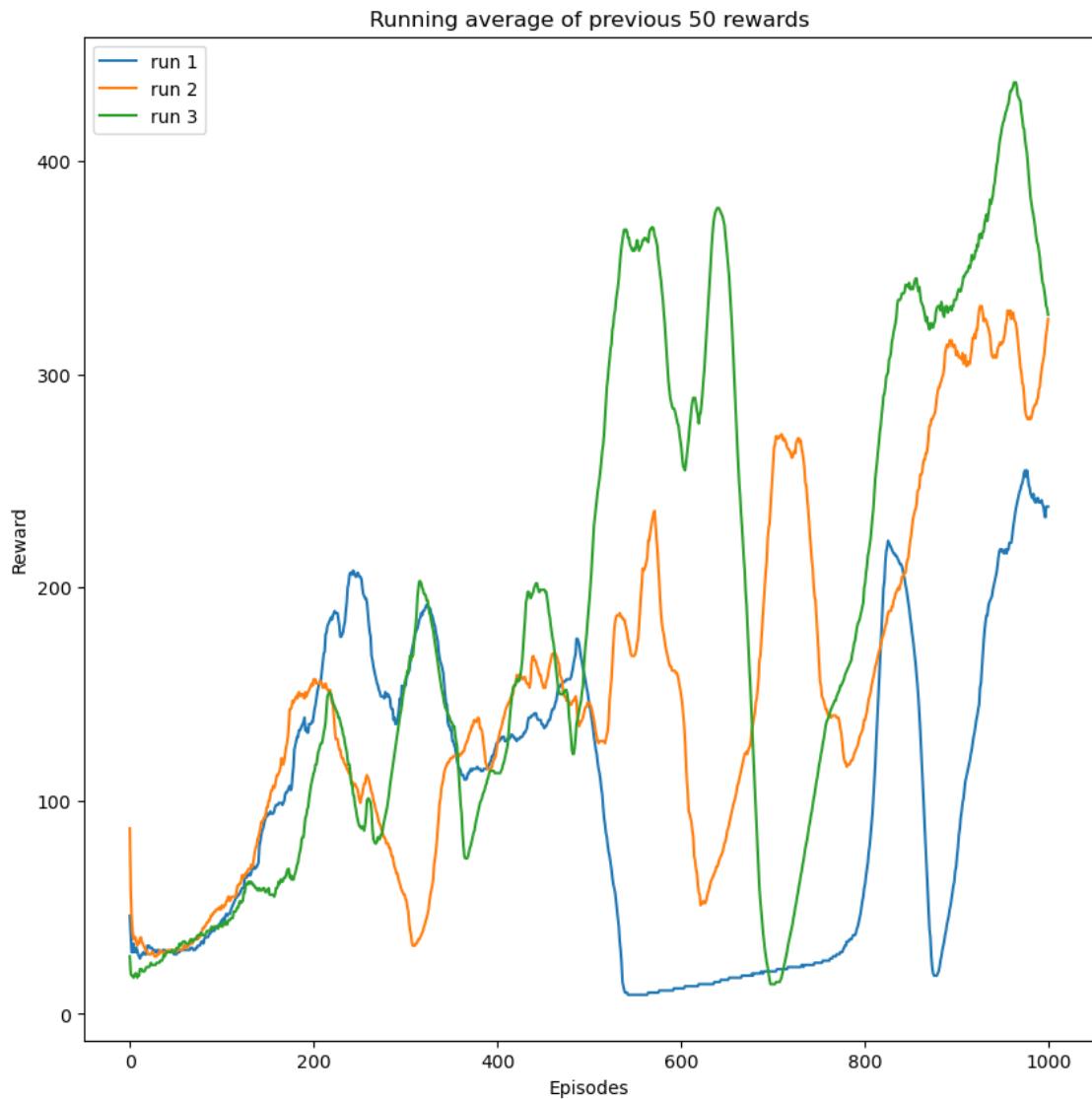
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Episode 50 Reward 32.000000 Average Reward 25.700000
Episode 60 Reward 10.000000 Average Reward 46.700000
Episode 70 Reward 46.000000 Average Reward 37.700000
Episode 80 Reward 46.000000 Average Reward 31.300000
Episode 90 Reward 22.000000 Average Reward 45.000000
Episode 100 Reward 28.000000 Average Reward 43.400000
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Episode 210 Reward 235.000000 Average Reward 218.100000
Episode 220 Reward 118.000000 Average Reward 154.700000
Episode 230 Reward 151.000000 Average Reward 155.700000
Episode 240 Reward 178.000000 Average Reward 222.800000
Episode 250 Reward 40.000000 Average Reward 53.200000
Episode 260 Reward 29.000000 Average Reward 29.200000
Episode 270 Reward 32.000000 Average Reward 31.600000
Episode 280 Reward 31.000000 Average Reward 38.400000
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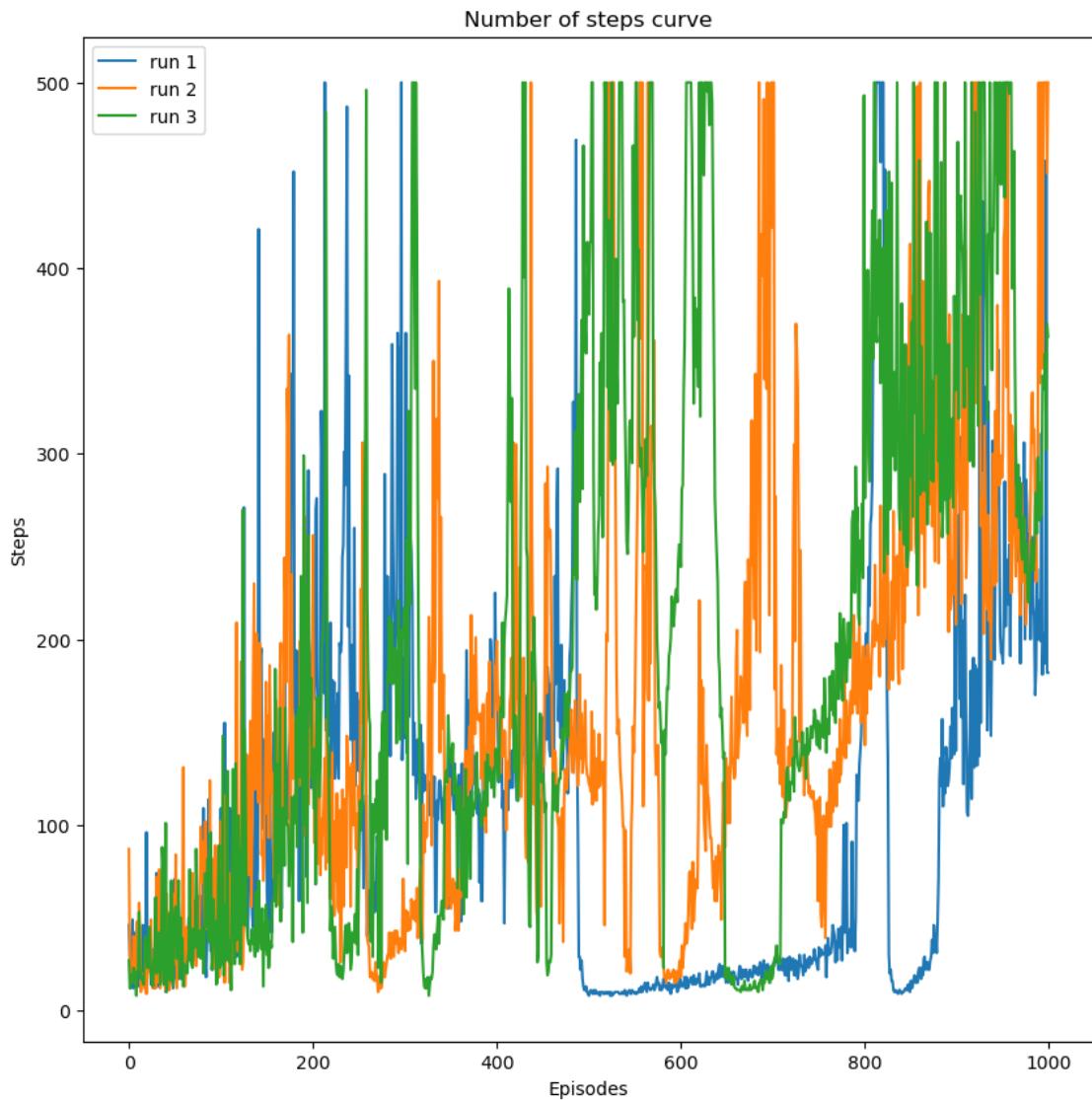
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Episode 370 Reward 48.000000 Average Reward 50.700000
Episode 380 Reward 262.000000 Average Reward 169.500000
Episode 390 Reward 105.000000 Average Reward 196.000000
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Episode 580 Reward 254.000000 Average Reward 272.800000
Episode 590 Reward 412.000000 Average Reward 243.400000
Episode 600 Reward 500.000000 Average Reward 387.900000
Episode 610 Reward 200.000000 Average Reward 323.400000
Episode 620 Reward 305.000000 Average Reward 244.100000
Episode 630 Reward 290.000000 Average Reward 383.500000
Episode 640 Reward 319.000000 Average Reward 271.400000
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Episode 710 Reward 500.000000 Average Reward 367.700000
Episode 720 Reward 500.000000 Average Reward 498.600000
Episode 730 Reward 416.000000 Average Reward 450.000000
Episode 740 Reward 500.000000 Average Reward 419.100000
Episode 750 Reward 500.000000 Average Reward 500.000000
Episode 760 Reward 500.000000 Average Reward 500.000000
Episode 770 Reward 23.000000 Average Reward 238.800000
Episode 780 Reward 293.000000 Average Reward 223.400000
Episode 790 Reward 500.000000 Average Reward 421.000000

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Episode 830 Reward 26.000000 Average Reward 245.100000
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Episode 910 Reward 205.000000 Average Reward 190.900000
Episode 920 Reward 236.000000 Average Reward 224.800000
Episode 930 Reward 381.000000 Average Reward 314.800000
Episode 940 Reward 500.000000 Average Reward 487.000000
Episode 950 Reward 500.000000 Average Reward 500.000000
Episode 960 Reward 335.000000 Average Reward 409.900000
Episode 970 Reward 256.000000 Average Reward 282.200000
Episode 980 Reward 270.000000 Average Reward 278.100000
Episode 990 Reward 325.000000 Average Reward 274.500000
Episode 1000 Reward 500.000000 Average Reward 410.000000
0:07:05.049200









Acrobot

```
[ ]: NUM_HIDDEN = 1
HIDDEN_SIZES = [1024]
LR = 1e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'Acrobot-v1'
SOLVE_CUTOFF = -100.0
STEP = 10

ENV = gym.make(ENV_NAME)
```

```

mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname =
    f'hl={NUM_HIDDEN}_hs={HIDDEN_SIZES}_lr={LR}_env={ENV_NAME}_numep={NUM_EPISODES}_nstep={STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed) instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	-500.000000	-480.600000
20	-419.000000	-464.500000
30	-309.000000	-429.600000
40	-362.000000	-429.600000
50	-450.000000	-436.200000
60	-332.000000	-443.300000
70	-500.000000	-483.900000
80	-500.000000	-440.500000
90	-430.000000	-436.800000
100	-500.000000	-417.900000
110	-500.000000	-443.600000
120	-304.000000	-360.900000
130	-500.000000	-441.500000
140	-500.000000	-444.800000
150	-500.000000	-473.800000
160	-500.000000	-477.600000
170	-449.000000	-464.100000
180	-500.000000	-478.700000
190	-500.000000	-500.000000
200	-304.000000	-437.300000
210	-500.000000	-461.100000
220	-390.000000	-465.100000
230	-500.000000	-496.700000
240	-500.000000	-469.700000
250	-500.000000	-481.200000

Episode 740 Reward -500.000000 Average Reward -500.000000
Episode 750 Reward -500.000000 Average Reward -486.100000
Episode 760 Reward -482.000000 Average Reward -498.200000
Episode 770 Reward -500.000000 Average Reward -500.000000
Episode 780 Reward -500.000000 Average Reward -500.000000
Episode 790 Reward -500.000000 Average Reward -500.000000
Episode 800 Reward -500.000000 Average Reward -500.000000
Episode 810 Reward -500.000000 Average Reward -500.000000
Episode 820 Reward -500.000000 Average Reward -483.700000
Episode 830 Reward -500.000000 Average Reward -489.600000
Episode 840 Reward -500.000000 Average Reward -500.000000
Episode 850 Reward -500.000000 Average Reward -484.400000
Episode 860 Reward -500.000000 Average Reward -478.100000
Episode 870 Reward -500.000000 Average Reward -500.000000
Episode 880 Reward -500.000000 Average Reward -495.900000
Episode 890 Reward -500.000000 Average Reward -500.000000
Episode 900 Reward -500.000000 Average Reward -500.000000
Episode 910 Reward -500.000000 Average Reward -490.100000
Episode 920 Reward -500.000000 Average Reward -494.800000
Episode 930 Reward -500.000000 Average Reward -489.000000
Episode 940 Reward -500.000000 Average Reward -481.600000
Episode 950 Reward -500.000000 Average Reward -436.600000
Episode 960 Reward -500.000000 Average Reward -486.600000
Episode 970 Reward -500.000000 Average Reward -484.300000
Episode 980 Reward -500.000000 Average Reward -466.300000
Episode 990 Reward -465.000000 Average Reward -454.900000
Episode 1000 Reward -500.000000 Average Reward -411.100000

0:08:18.177746

Episode 10 Reward -500.000000 Average Reward -480.400000
Episode 20 Reward -301.000000 Average Reward -470.300000
Episode 30 Reward -500.000000 Average Reward -454.700000
Episode 40 Reward -500.000000 Average Reward -475.300000
Episode 50 Reward -500.000000 Average Reward -463.600000
Episode 60 Reward -500.000000 Average Reward -491.600000
Episode 70 Reward -500.000000 Average Reward -500.000000
Episode 80 Reward -482.000000 Average Reward -478.800000
Episode 90 Reward -478.000000 Average Reward -472.200000
Episode 100 Reward -500.000000 Average Reward -493.800000
Episode 110 Reward -500.000000 Average Reward -500.000000
Episode 120 Reward -500.000000 Average Reward -500.000000
Episode 130 Reward -500.000000 Average Reward -500.000000
Episode 140 Reward -500.000000 Average Reward -500.000000
Episode 150 Reward -500.000000 Average Reward -500.000000
Episode 160 Reward -500.000000 Average Reward -500.000000
Episode 170 Reward -500.000000 Average Reward -494.800000
Episode 180 Reward -500.000000 Average Reward -500.000000
Episode 190 Reward -500.000000 Average Reward -500.000000
Episode 200 Reward -500.000000 Average Reward -500.000000

Episode 210 Reward -500.000000 Average Reward -500.000000
Episode 220 Reward -500.000000 Average Reward -500.000000
Episode 230 Reward -500.000000 Average Reward -500.000000
Episode 240 Reward -500.000000 Average Reward -489.300000
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Episode 260 Reward -500.000000 Average Reward -500.000000
Episode 270 Reward -364.000000 Average Reward -479.300000
Episode 280 Reward -426.000000 Average Reward -461.800000
Episode 290 Reward -243.000000 Average Reward -445.100000
Episode 300 Reward -500.000000 Average Reward -428.600000
Episode 310 Reward -500.000000 Average Reward -429.300000
Episode 320 Reward -485.000000 Average Reward -431.800000
Episode 330 Reward -500.000000 Average Reward -389.500000
Episode 340 Reward -428.000000 Average Reward -354.400000
Episode 350 Reward -424.000000 Average Reward -335.700000
Episode 360 Reward -305.000000 Average Reward -383.400000
Episode 370 Reward -500.000000 Average Reward -396.700000
Episode 380 Reward -372.000000 Average Reward -392.300000
Episode 390 Reward -500.000000 Average Reward -414.000000
Episode 400 Reward -500.000000 Average Reward -432.500000
Episode 410 Reward -500.000000 Average Reward -390.800000
Episode 420 Reward -417.000000 Average Reward -452.100000
Episode 430 Reward -500.000000 Average Reward -460.700000
Episode 440 Reward -480.000000 Average Reward -484.800000
Episode 450 Reward -500.000000 Average Reward -473.100000
Episode 460 Reward -500.000000 Average Reward -496.600000
Episode 470 Reward -403.000000 Average Reward -452.400000
Episode 480 Reward -500.000000 Average Reward -468.600000
Episode 490 Reward -379.000000 Average Reward -454.400000
Episode 500 Reward -452.000000 Average Reward -489.100000
Episode 510 Reward -500.000000 Average Reward -489.700000
Episode 520 Reward -495.000000 Average Reward -470.400000
Episode 530 Reward -500.000000 Average Reward -489.600000
Episode 540 Reward -334.000000 Average Reward -483.400000
Episode 550 Reward -500.000000 Average Reward -481.000000
Episode 560 Reward -500.000000 Average Reward -482.200000
Episode 570 Reward -500.000000 Average Reward -494.900000
Episode 580 Reward -322.000000 Average Reward -475.400000
Episode 590 Reward -500.000000 Average Reward -472.100000
Episode 600 Reward -500.000000 Average Reward -475.600000
Episode 610 Reward -499.000000 Average Reward -499.900000
Episode 620 Reward -500.000000 Average Reward -500.000000
Episode 630 Reward -500.000000 Average Reward -488.800000
Episode 640 Reward -500.000000 Average Reward -499.600000
Episode 650 Reward -500.000000 Average Reward -500.000000
Episode 660 Reward -500.000000 Average Reward -474.800000
Episode 670 Reward -500.000000 Average Reward -461.000000
Episode 680 Reward -435.000000 Average Reward -476.400000

Episode 690 Reward -500.000000 Average Reward -416.000000
Episode 700 Reward -500.000000 Average Reward -445.000000
Episode 710 Reward -250.000000 Average Reward -456.800000
Episode 720 Reward -378.000000 Average Reward -450.200000
Episode 730 Reward -441.000000 Average Reward -470.000000
Episode 740 Reward -488.000000 Average Reward -466.200000
Episode 750 Reward -417.000000 Average Reward -473.200000
Episode 760 Reward -500.000000 Average Reward -496.100000
Episode 770 Reward -488.000000 Average Reward -467.400000
Episode 780 Reward -390.000000 Average Reward -461.800000
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Episode 800 Reward -500.000000 Average Reward -456.100000
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Episode 970 Reward -424.000000 Average Reward -339.400000
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Episode 50 Reward -500.000000 Average Reward -499.100000
Episode 60 Reward -500.000000 Average Reward -494.500000
Episode 70 Reward -500.000000 Average Reward -500.000000
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Episode 120 Reward -500.000000 Average Reward -458.100000
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Episode 520 Reward -500.000000 Average Reward -495.200000
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Episode 540 Reward -500.000000 Average Reward -500.000000
Episode 550 Reward -500.000000 Average Reward -484.600000
Episode 560 Reward -500.000000 Average Reward -500.000000
Episode 570 Reward -500.000000 Average Reward -496.700000
Episode 580 Reward -500.000000 Average Reward -500.000000
Episode 590 Reward -500.000000 Average Reward -500.000000
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Episode 830 Reward -500.000000 Average Reward -500.000000
Episode 840 Reward -465.000000 Average Reward -496.500000
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Episode 890 Reward -345.000000 Average Reward -484.500000
Episode 900 Reward -500.000000 Average Reward -500.000000
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Episode 930 Reward -500.000000 Average Reward -488.300000
Episode 940 Reward -500.000000 Average Reward -487.000000
Episode 950 Reward -500.000000 Average Reward -500.000000
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Episode 990 Reward -500.000000 Average Reward -500.000000
Episode 1000 Reward -500.000000 Average Reward -500.000000
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Episode 100 Reward -500.000000 Average Reward -491.600000

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Episode 120 Reward -500.000000 Average Reward -483.200000
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Episode 210 Reward -500.000000 Average Reward -456.700000
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Episode 230 Reward -500.000000 Average Reward -500.000000
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Episode 990 Reward -376.000000 Average Reward -384.800000
Episode 1000 Reward -272.000000 Average Reward -391.700000

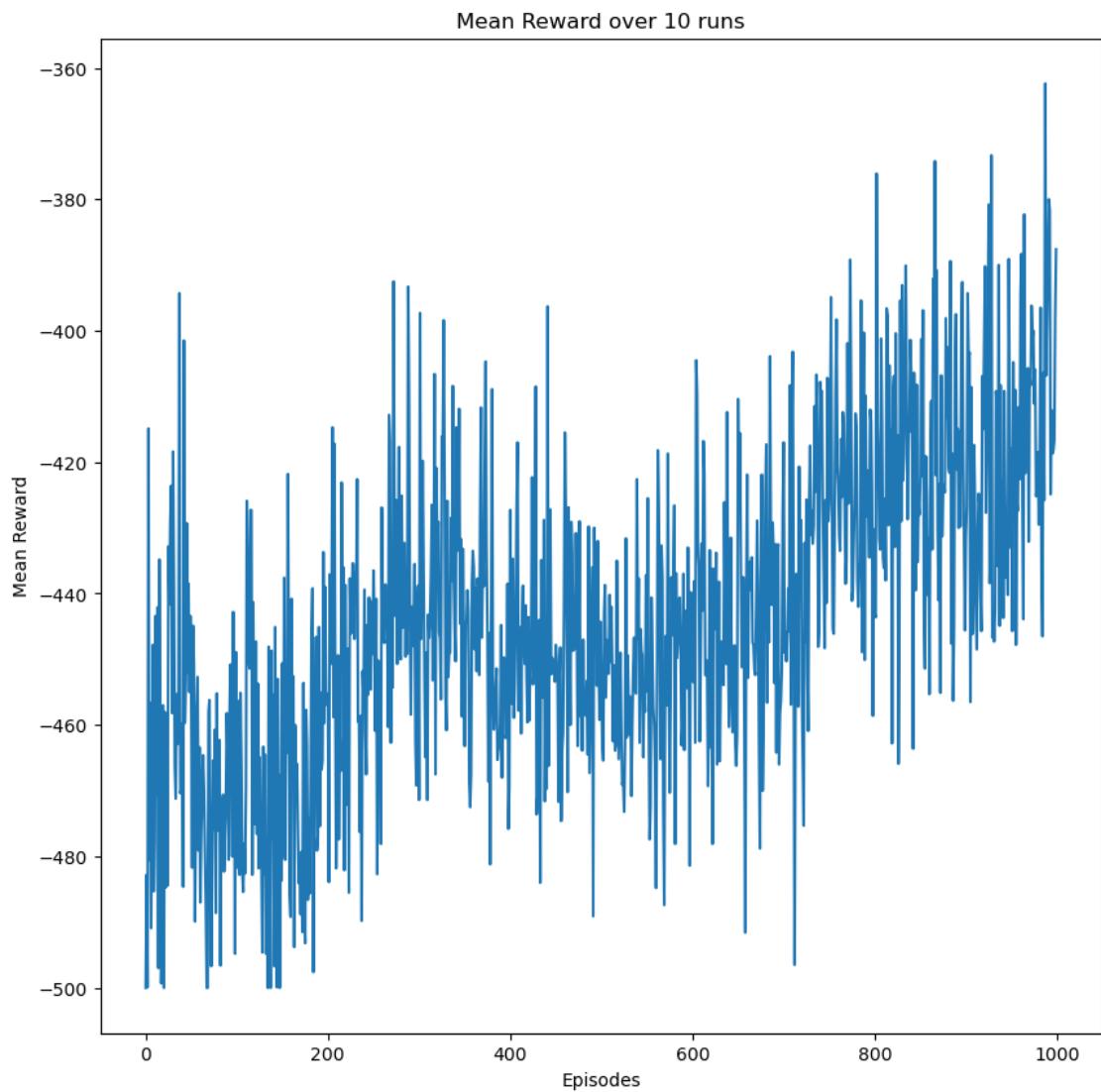
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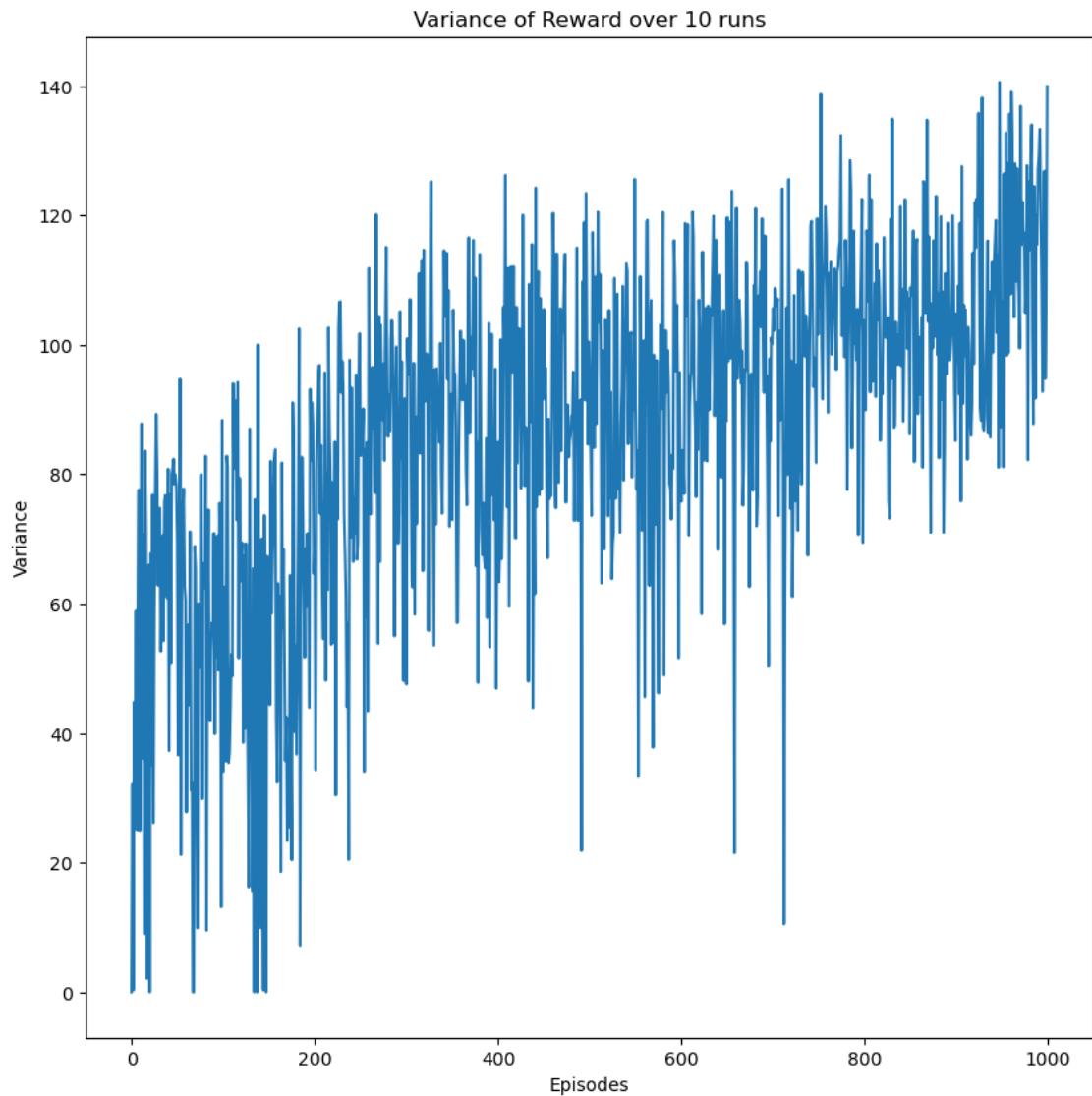
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Episode 60 Reward -367.000000 Average Reward -465.200000
Episode 70 Reward -500.000000 Average Reward -480.000000
Episode 80 Reward -500.000000 Average Reward -482.900000
Episode 90 Reward -323.000000 Average Reward -437.000000
Episode 100 Reward -429.000000 Average Reward -462.800000
Episode 110 Reward -500.000000 Average Reward -430.000000
Episode 120 Reward -405.000000 Average Reward -408.000000
Episode 130 Reward -500.000000 Average Reward -448.200000
Episode 140 Reward -500.000000 Average Reward -454.500000
Episode 150 Reward -500.000000 Average Reward -457.100000
Episode 160 Reward -500.000000 Average Reward -437.800000
Episode 170 Reward -500.000000 Average Reward -474.500000
Episode 180 Reward -500.000000 Average Reward -496.400000
Episode 190 Reward -500.000000 Average Reward -500.000000
Episode 200 Reward -478.000000 Average Reward -455.000000
Episode 210 Reward -500.000000 Average Reward -494.400000
Episode 220 Reward -500.000000 Average Reward -496.800000
Episode 230 Reward -408.000000 Average Reward -456.700000
Episode 240 Reward -496.000000 Average Reward -457.500000
Episode 250 Reward -500.000000 Average Reward -481.800000
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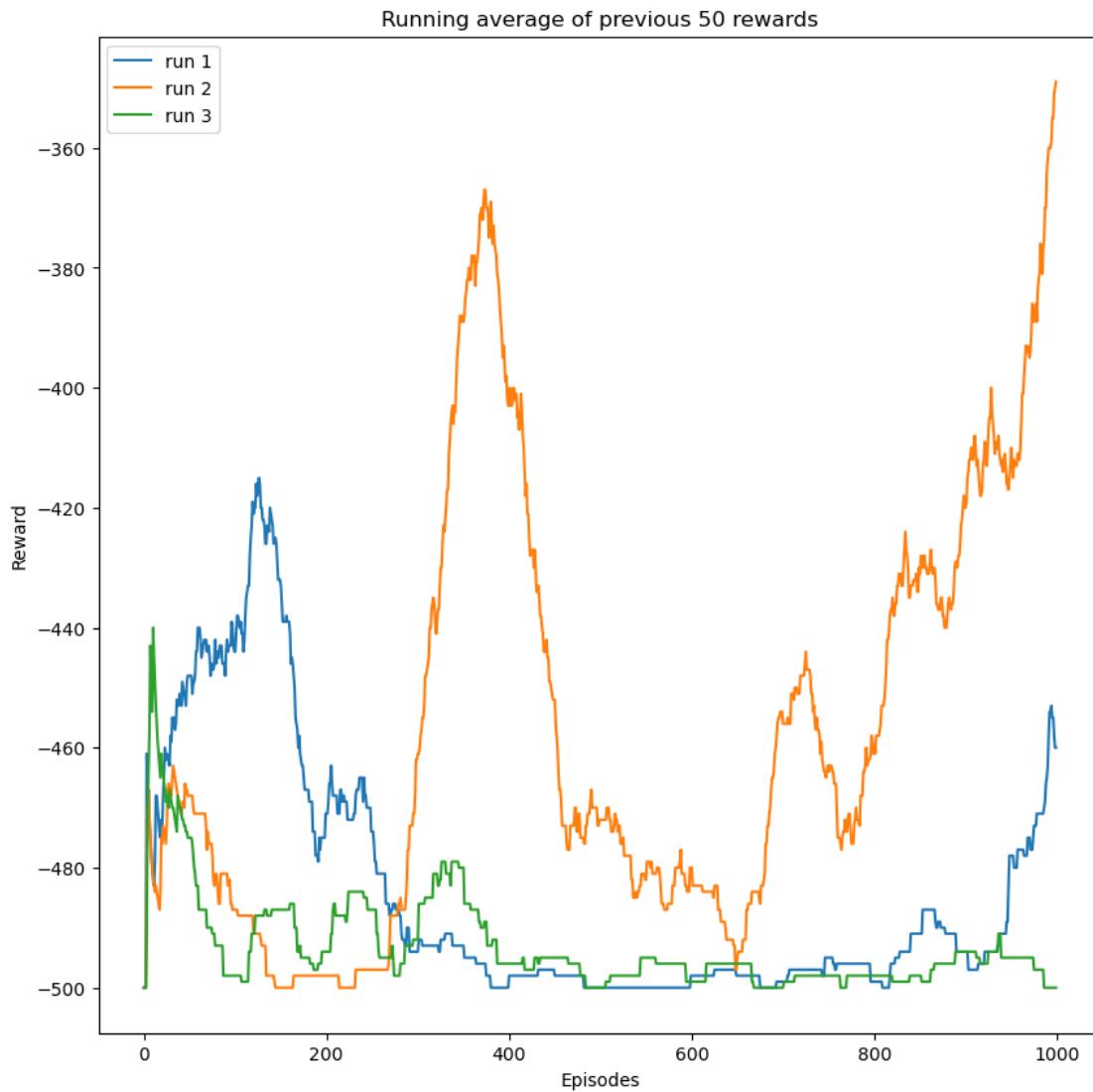
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Episode 440 Reward -461.000000 Average Reward -478.900000
Episode 450 Reward -500.000000 Average Reward -455.700000
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Episode 470 Reward -500.000000 Average Reward -458.400000
Episode 480 Reward -500.000000 Average Reward -482.100000
Episode 490 Reward -500.000000 Average Reward -493.900000
Episode 500 Reward -500.000000 Average Reward -474.100000
Episode 510 Reward -500.000000 Average Reward -500.000000
Episode 520 Reward -500.000000 Average Reward -500.000000
Episode 530 Reward -500.000000 Average Reward -484.700000
Episode 540 Reward -500.000000 Average Reward -495.200000
Episode 550 Reward -500.000000 Average Reward -479.800000
Episode 560 Reward -500.000000 Average Reward -457.500000
Episode 570 Reward -500.000000 Average Reward -482.500000
Episode 580 Reward -500.000000 Average Reward -473.400000
Episode 590 Reward -500.000000 Average Reward -469.200000
Episode 600 Reward -257.000000 Average Reward -433.800000
Episode 610 Reward -417.000000 Average Reward -412.800000
Episode 620 Reward -296.000000 Average Reward -444.300000
Episode 630 Reward -500.000000 Average Reward -473.500000
Episode 640 Reward -500.000000 Average Reward -484.400000
Episode 650 Reward -500.000000 Average Reward -474.700000
Episode 660 Reward -372.000000 Average Reward -487.200000
Episode 670 Reward -500.000000 Average Reward -468.800000
Episode 680 Reward -500.000000 Average Reward -484.300000
Episode 690 Reward -378.000000 Average Reward -448.800000
Episode 700 Reward -277.000000 Average Reward -446.700000
Episode 710 Reward -298.000000 Average Reward -426.000000
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Episode 730 Reward -369.000000 Average Reward -402.200000
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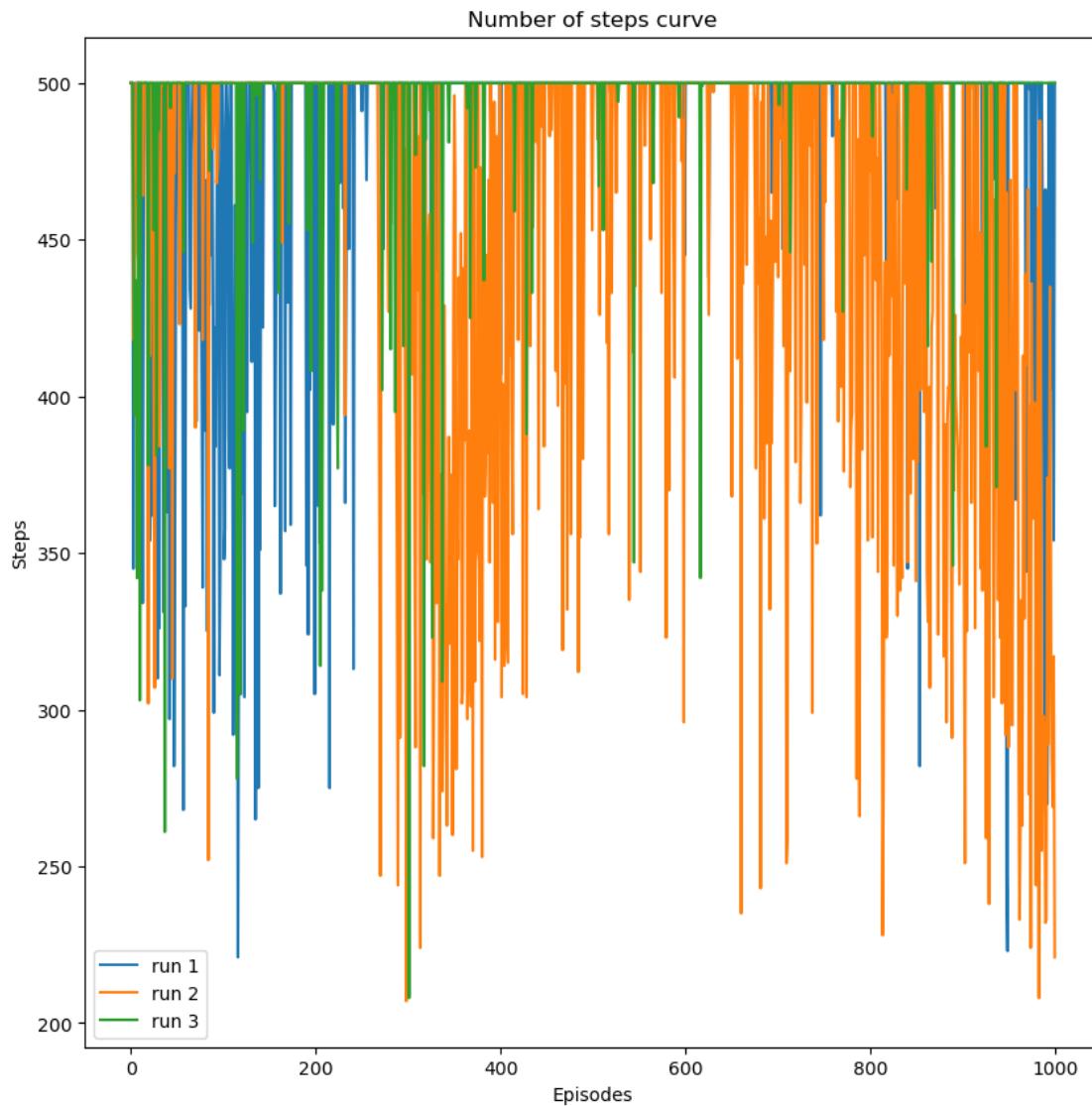
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Episode 810 Reward -461.000000 Average Reward -444.100000
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Episode 830 Reward -387.000000 Average Reward -420.600000
Episode 840 Reward -500.000000 Average Reward -388.700000
Episode 850 Reward -343.000000 Average Reward -400.400000
Episode 860 Reward -420.000000 Average Reward -404.700000
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Episode 890 Reward -302.000000 Average Reward -394.100000
Episode 900 Reward -415.000000 Average Reward -395.500000
Episode 910 Reward -437.000000 Average Reward -452.600000
Episode 920 Reward -398.000000 Average Reward -455.300000
Episode 930 Reward -500.000000 Average Reward -430.400000
Episode 940 Reward -500.000000 Average Reward -462.500000
Episode 950 Reward -500.000000 Average Reward -500.000000
Episode 960 Reward -500.000000 Average Reward -500.000000
Episode 970 Reward -500.000000 Average Reward -472.900000
Episode 980 Reward -500.000000 Average Reward -453.100000
Episode 990 Reward -500.000000 Average Reward -492.500000
Episode 1000 Reward -500.000000 Average Reward -471.100000

0:08:06.750831









```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [512, 512]
LR = 0.5e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'Acrobot-v1'
SOLVE_CUTOFF = -100.0
STEP = 10

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{hs}-{lr}-{env}-{numep}-{nstep}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	-377.000000	-487.700000
20	-500.000000	-485.800000
30	-500.000000	-481.900000
40	-500.000000	-477.600000
50	-500.000000	-442.000000
60	-500.000000	-413.100000
70	-500.000000	-430.100000
80	-500.000000	-444.200000
90	-500.000000	-437.500000
100	-363.000000	-443.500000
110	-295.000000	-389.300000
120	-258.000000	-385.700000
130	-355.000000	-402.000000
140	-500.000000	-444.400000
150	-500.000000	-473.700000
160	-500.000000	-486.200000
170	-316.000000	-444.600000
180	-500.000000	-479.500000
190	-260.000000	-438.700000
200	-500.000000	-458.800000
210	-500.000000	-456.100000
220	-500.000000	-474.400000
230	-500.000000	-500.000000
240	-500.000000	-500.000000
250	-500.000000	-469.100000
260	-500.000000	-477.400000
270	-500.000000	-484.500000
280	-500.000000	-490.400000

Episode 770 Reward -500.000000 Average Reward -500.000000
 Episode 780 Reward -500.000000 Average Reward -500.000000
 Episode 790 Reward -500.000000 Average Reward -500.000000
 Episode 800 Reward -500.000000 Average Reward -500.000000
 Episode 810 Reward -500.000000 Average Reward -500.000000
 Episode 820 Reward -500.000000 Average Reward -500.000000
 Episode 830 Reward -500.000000 Average Reward -500.000000
 Episode 840 Reward -500.000000 Average Reward -500.000000
 Episode 850 Reward -500.000000 Average Reward -500.000000
 Episode 860 Reward -500.000000 Average Reward -500.000000
 Episode 870 Reward -500.000000 Average Reward -500.000000
 Episode 880 Reward -500.000000 Average Reward -500.000000
 Episode 890 Reward -500.000000 Average Reward -500.000000
 Episode 900 Reward -500.000000 Average Reward -500.000000
 Episode 910 Reward -500.000000 Average Reward -500.000000
 Episode 920 Reward -500.000000 Average Reward -500.000000
 Episode 930 Reward -500.000000 Average Reward -500.000000
 Episode 940 Reward -500.000000 Average Reward -500.000000
 Episode 950 Reward -500.000000 Average Reward -500.000000
 Episode 960 Reward -500.000000 Average Reward -500.000000
 Episode 970 Reward -500.000000 Average Reward -500.000000
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 Episode 990 Reward -500.000000 Average Reward -500.000000
 Episode 1000 Reward -500.000000 Average Reward -500.000000
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 Episode 20 Reward -288.000000 Average Reward -439.800000
 Episode 30 Reward -500.000000 Average Reward -449.200000
 Episode 40 Reward -476.000000 Average Reward -474.100000
 Episode 50 Reward -500.000000 Average Reward -449.400000
 Episode 60 Reward -500.000000 Average Reward -457.700000
 Episode 70 Reward -500.000000 Average Reward -456.300000
 Episode 80 Reward -276.000000 Average Reward -390.700000
 Episode 90 Reward -404.000000 Average Reward -396.400000
 Episode 100 Reward -448.000000 Average Reward -388.200000
 Episode 110 Reward -355.000000 Average Reward -319.900000
 Episode 120 Reward -351.000000 Average Reward -373.000000
 Episode 130 Reward -314.000000 Average Reward -357.100000
 Episode 140 Reward -500.000000 Average Reward -399.800000
 Episode 150 Reward -500.000000 Average Reward -429.300000
 Episode 160 Reward -239.000000 Average Reward -403.600000
 Episode 170 Reward -403.000000 Average Reward -377.100000
 Episode 180 Reward -500.000000 Average Reward -434.400000
 Episode 190 Reward -347.000000 Average Reward -428.200000
 Episode 200 Reward -389.000000 Average Reward -419.100000
 Episode 210 Reward -258.000000 Average Reward -348.400000
 Episode 220 Reward -229.000000 Average Reward -286.300000
 Episode 230 Reward -301.000000 Average Reward -315.300000

Episode	240	Reward	-263.000000	Average Reward	-290.200000
Episode	250	Reward	-280.000000	Average Reward	-295.500000
Episode	260	Reward	-230.000000	Average Reward	-290.300000
Episode	270	Reward	-326.000000	Average Reward	-284.900000
Episode	280	Reward	-257.000000	Average Reward	-281.500000
Episode	290	Reward	-223.000000	Average Reward	-281.500000
Episode	300	Reward	-385.000000	Average Reward	-316.800000
Episode	310	Reward	-211.000000	Average Reward	-299.100000
Episode	320	Reward	-320.000000	Average Reward	-283.400000
Episode	330	Reward	-307.000000	Average Reward	-276.700000
Episode	340	Reward	-208.000000	Average Reward	-254.200000
Episode	350	Reward	-221.000000	Average Reward	-237.200000
Episode	360	Reward	-216.000000	Average Reward	-249.800000
Episode	370	Reward	-289.000000	Average Reward	-225.800000
Episode	380	Reward	-186.000000	Average Reward	-244.400000
Episode	390	Reward	-224.000000	Average Reward	-289.500000
Episode	400	Reward	-232.000000	Average Reward	-215.500000
Episode	410	Reward	-209.000000	Average Reward	-251.500000
Episode	420	Reward	-150.000000	Average Reward	-216.500000
Episode	430	Reward	-215.000000	Average Reward	-234.100000
Episode	440	Reward	-223.000000	Average Reward	-244.400000
Episode	450	Reward	-257.000000	Average Reward	-228.000000
Episode	460	Reward	-229.000000	Average Reward	-208.100000
Episode	470	Reward	-228.000000	Average Reward	-227.000000
Episode	480	Reward	-310.000000	Average Reward	-265.800000
Episode	490	Reward	-220.000000	Average Reward	-230.500000
Episode	500	Reward	-170.000000	Average Reward	-212.800000
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Episode	520	Reward	-183.000000	Average Reward	-215.300000
Episode	530	Reward	-212.000000	Average Reward	-194.100000
Episode	540	Reward	-229.000000	Average Reward	-271.200000
Episode	550	Reward	-142.000000	Average Reward	-252.000000
Episode	560	Reward	-209.000000	Average Reward	-267.800000
Episode	570	Reward	-268.000000	Average Reward	-253.200000
Episode	580	Reward	-211.000000	Average Reward	-239.500000
Episode	590	Reward	-185.000000	Average Reward	-233.600000
Episode	600	Reward	-217.000000	Average Reward	-213.700000
Episode	610	Reward	-315.000000	Average Reward	-235.200000
Episode	620	Reward	-215.000000	Average Reward	-241.000000
Episode	630	Reward	-219.000000	Average Reward	-237.000000
Episode	640	Reward	-180.000000	Average Reward	-238.900000
Episode	650	Reward	-210.000000	Average Reward	-214.900000
Episode	660	Reward	-170.000000	Average Reward	-192.300000
Episode	670	Reward	-189.000000	Average Reward	-198.800000
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Episode	700	Reward	-324.000000	Average Reward	-231.100000
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Episode 670 Reward -500.000000 Average Reward -500.000000
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Episode 730 Reward -500.000000 Average Reward -500.000000
Episode 740 Reward -500.000000 Average Reward -500.000000
Episode 750 Reward -500.000000 Average Reward -500.000000
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Episode 780 Reward -500.000000 Average Reward -491.300000
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Episode 130 Reward -442.000000 Average Reward -440.600000

Episode	140	Reward	-398.000000	Average Reward	-390.200000
Episode	150	Reward	-500.000000	Average Reward	-443.600000
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Episode	170	Reward	-337.000000	Average Reward	-437.000000
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Episode	300	Reward	-264.000000	Average Reward	-260.700000
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Episode	410	Reward	-201.000000	Average Reward	-201.100000
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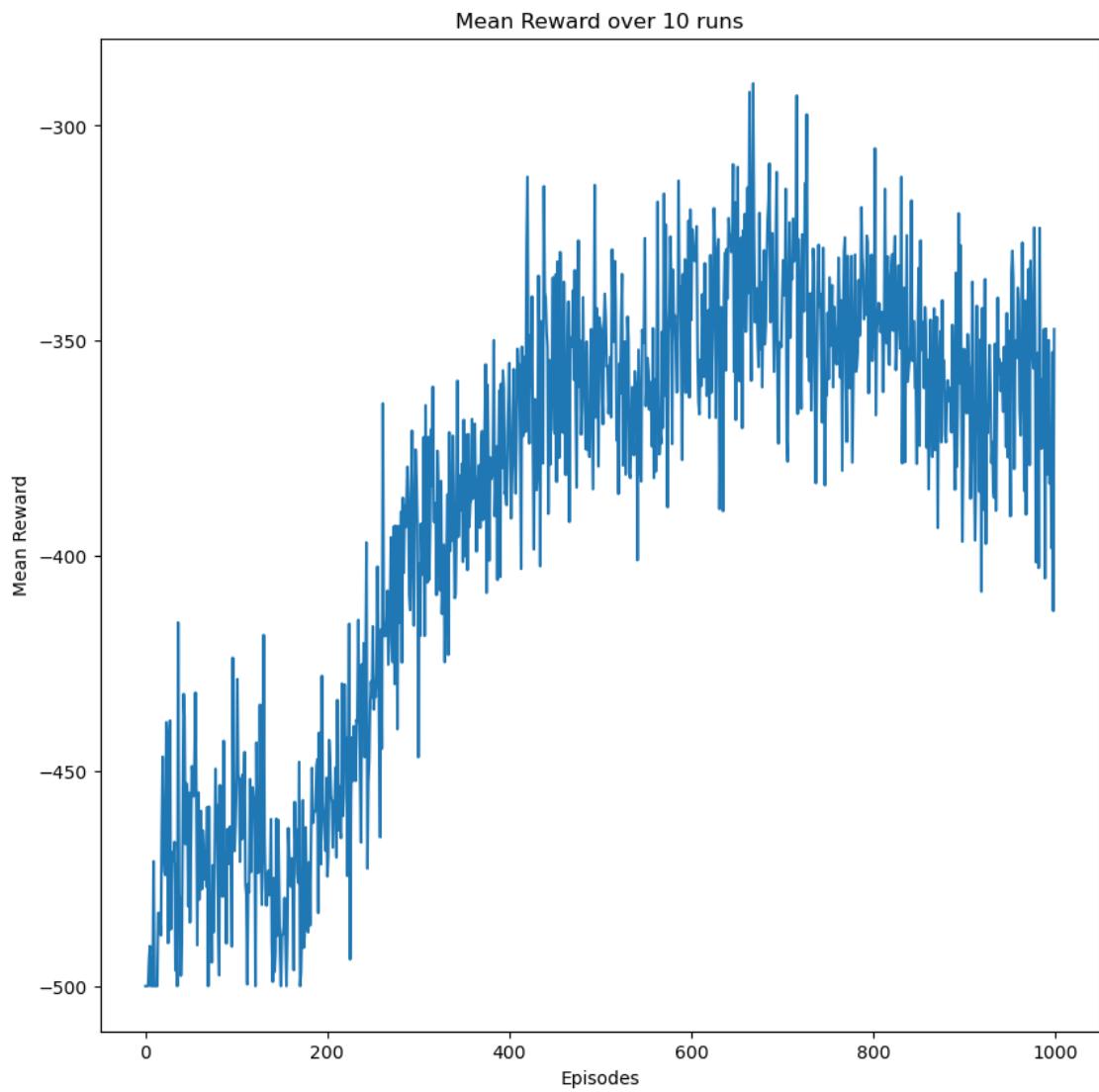
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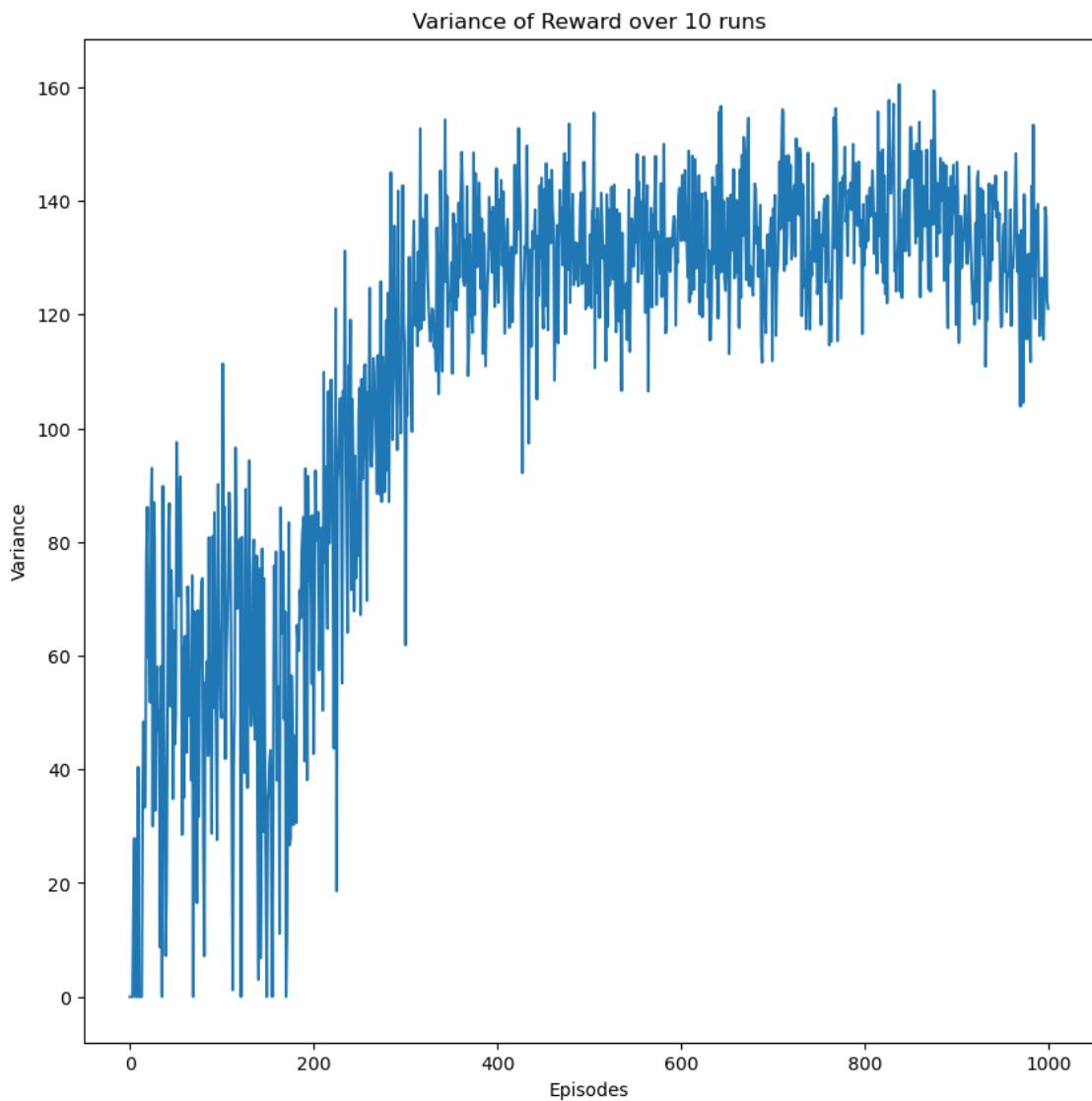
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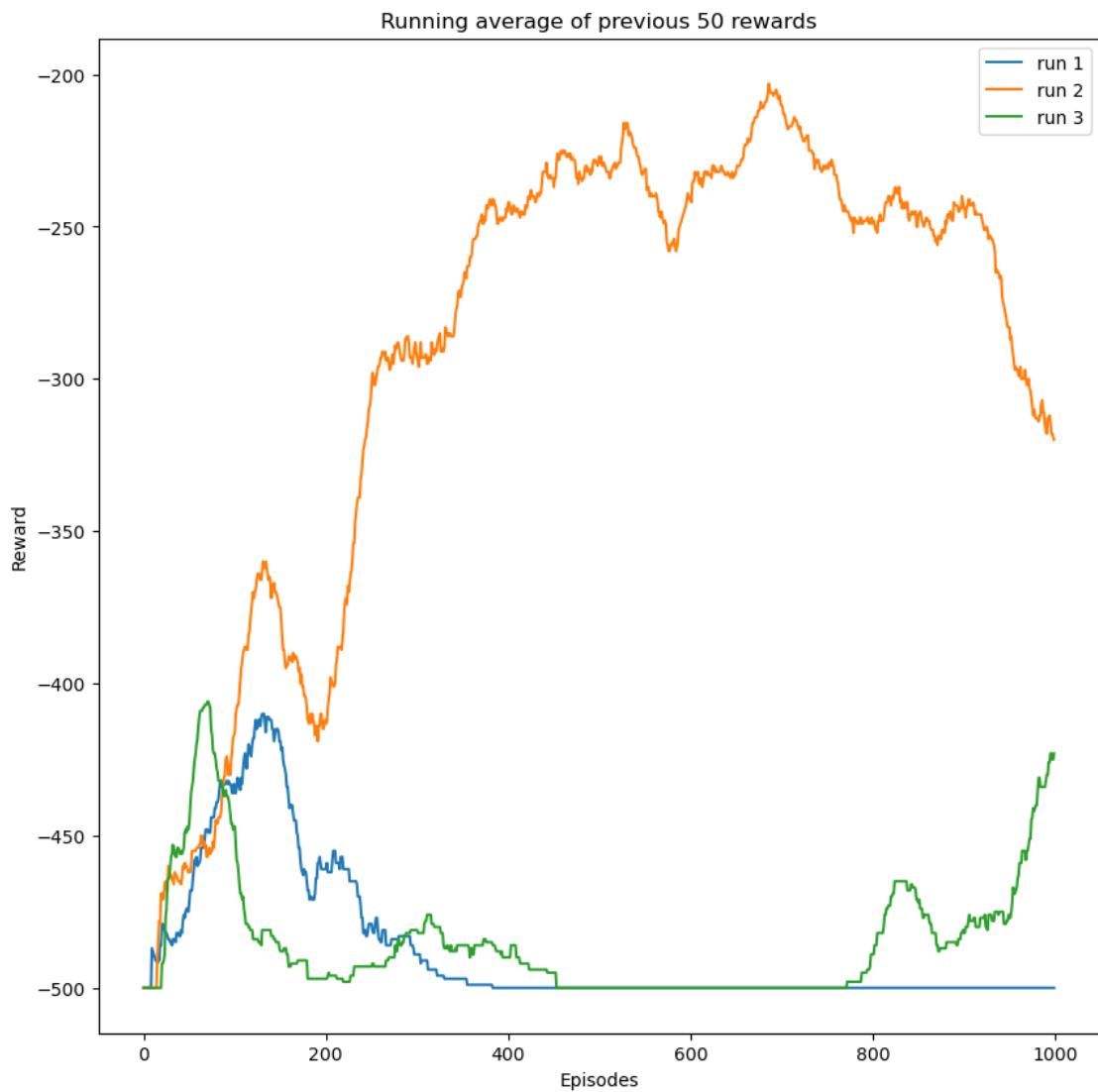
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Episode 390 Reward -364.000000 Average Reward -356.700000
Episode 400 Reward -372.000000 Average Reward -350.900000
Episode 410 Reward -292.000000 Average Reward -365.000000
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Episode 480 Reward -443.000000 Average Reward -374.100000
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Episode 520 Reward -456.000000 Average Reward -406.700000
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Episode 560 Reward -280.000000 Average Reward -309.300000
Episode 570 Reward -377.000000 Average Reward -343.900000
Episode 580 Reward -435.000000 Average Reward -329.600000
Episode 590 Reward -394.000000 Average Reward -347.400000
Episode 600 Reward -283.000000 Average Reward -386.900000
Episode 610 Reward -374.000000 Average Reward -320.600000
Episode 620 Reward -355.000000 Average Reward -340.200000
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Episode 650 Reward -420.000000 Average Reward -271.700000
Episode 660 Reward -287.000000 Average Reward -275.700000
Episode 670 Reward -234.000000 Average Reward -311.700000
Episode 680 Reward -429.000000 Average Reward -332.000000
Episode 690 Reward -216.000000 Average Reward -277.400000
Episode 700 Reward -214.000000 Average Reward -306.700000
Episode 710 Reward -482.000000 Average Reward -362.000000
Episode 720 Reward -285.000000 Average Reward -358.400000
Episode 730 Reward -380.000000 Average Reward -341.100000
Episode 740 Reward -336.000000 Average Reward -345.900000
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Episode 760 Reward -473.000000 Average Reward -335.000000
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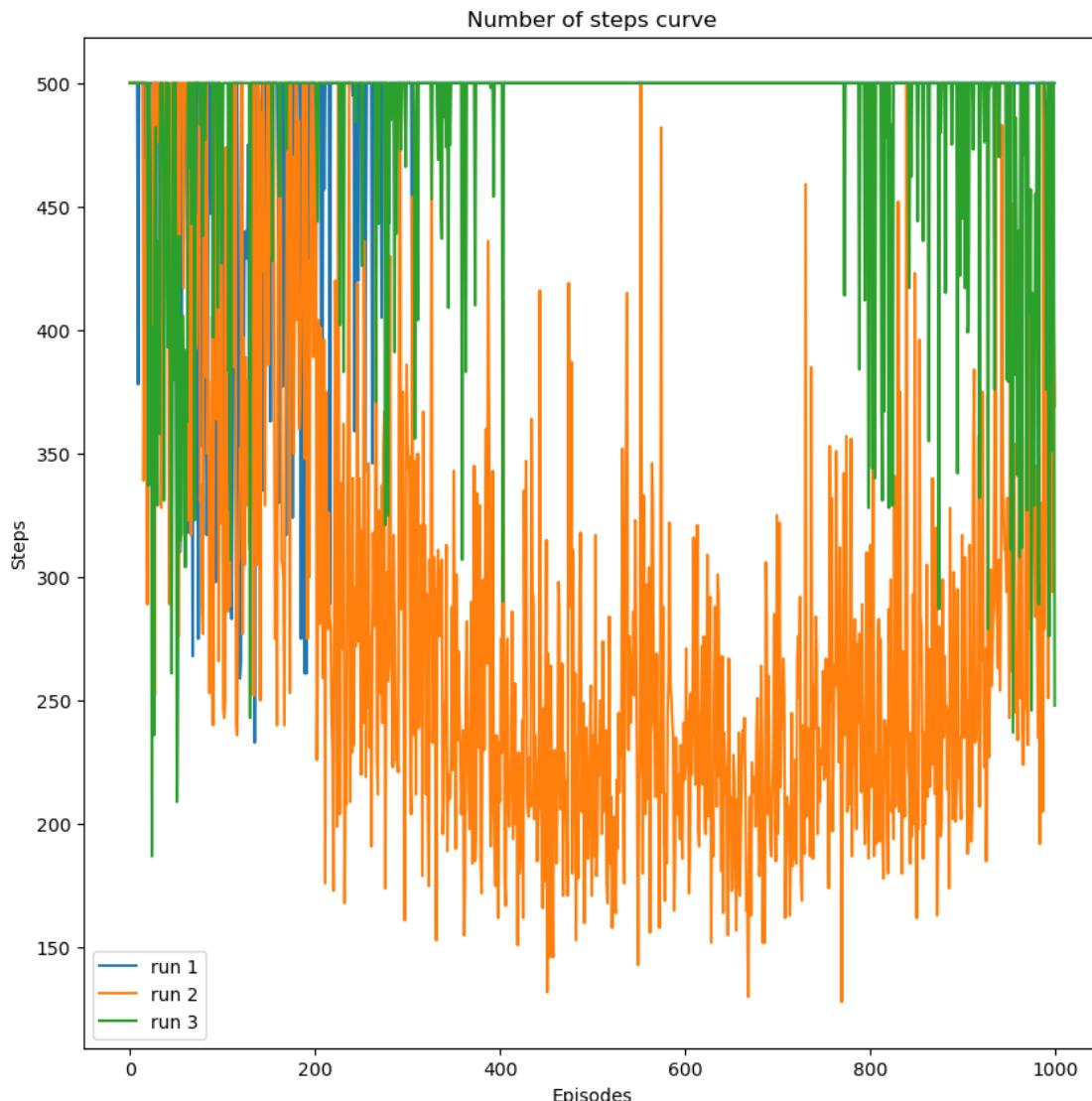
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Episode 840 Reward -262.000000 Average Reward -266.200000
Episode 850 Reward -190.000000 Average Reward -243.300000
Episode 860 Reward -500.000000 Average Reward -330.300000
Episode 870 Reward -334.000000 Average Reward -316.100000
Episode 880 Reward -351.000000 Average Reward -277.000000
Episode 890 Reward -246.000000 Average Reward -278.500000
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Episode 920 Reward -460.000000 Average Reward -394.600000
Episode 930 Reward -267.000000 Average Reward -364.100000
Episode 940 Reward -469.000000 Average Reward -319.300000
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Episode 1000 Reward -372.000000 Average Reward -345.400000

0:08:33.242575









```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [512, 512]
LR = 1e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'Acrobot-v1'
SOLVE_CUTOFF = -100.0
STEP = 5

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{hs}-{lr}-{env}-{numep}-{nstep}-{STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	-500.000000	-479.600000
20	-500.000000	-406.300000
30	-459.000000	-454.100000
40	-500.000000	-440.000000
50	-500.000000	-479.900000
60	-500.000000	-500.000000
70	-500.000000	-493.200000
80	-500.000000	-500.000000
90	-500.000000	-492.800000
100	-500.000000	-487.700000
110	-500.000000	-439.800000
120	-297.000000	-402.600000
130	-448.000000	-380.700000
140	-361.000000	-358.200000
150	-232.000000	-376.900000
160	-347.000000	-281.800000
170	-289.000000	-283.300000
180	-307.000000	-334.800000
190	-268.000000	-295.200000
200	-233.000000	-277.000000
210	-433.000000	-323.900000
220	-325.000000	-307.300000
230	-227.000000	-294.200000
240	-273.000000	-250.500000
250	-311.000000	-344.800000
260	-170.000000	-253.400000
270	-244.000000	-245.200000
280	-222.000000	-234.000000

Episode 290 Reward -184.000000 Average Reward -188.400000
Episode 300 Reward -131.000000 Average Reward -168.700000
Episode 310 Reward -166.000000 Average Reward -196.700000
Episode 320 Reward -202.000000 Average Reward -243.100000
Episode 330 Reward -185.000000 Average Reward -233.900000
Episode 340 Reward -234.000000 Average Reward -214.400000
Episode 350 Reward -155.000000 Average Reward -260.400000
Episode 360 Reward -177.000000 Average Reward -228.600000
Episode 370 Reward -137.000000 Average Reward -181.600000
Episode 380 Reward -138.000000 Average Reward -200.600000
Episode 390 Reward -265.000000 Average Reward -182.900000
Episode 400 Reward -115.000000 Average Reward -176.400000
Episode 410 Reward -149.000000 Average Reward -145.800000
Episode 420 Reward -159.000000 Average Reward -162.800000
Episode 430 Reward -178.000000 Average Reward -152.000000
Episode 440 Reward -132.000000 Average Reward -148.500000
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Episode 520 Reward -155.000000 Average Reward -145.600000
Episode 530 Reward -176.000000 Average Reward -156.300000
Episode 540 Reward -161.000000 Average Reward -140.700000
Episode 550 Reward -165.000000 Average Reward -162.700000
Episode 560 Reward -167.000000 Average Reward -139.800000
Episode 570 Reward -127.000000 Average Reward -145.000000
Episode 580 Reward -98.000000 Average Reward -127.800000
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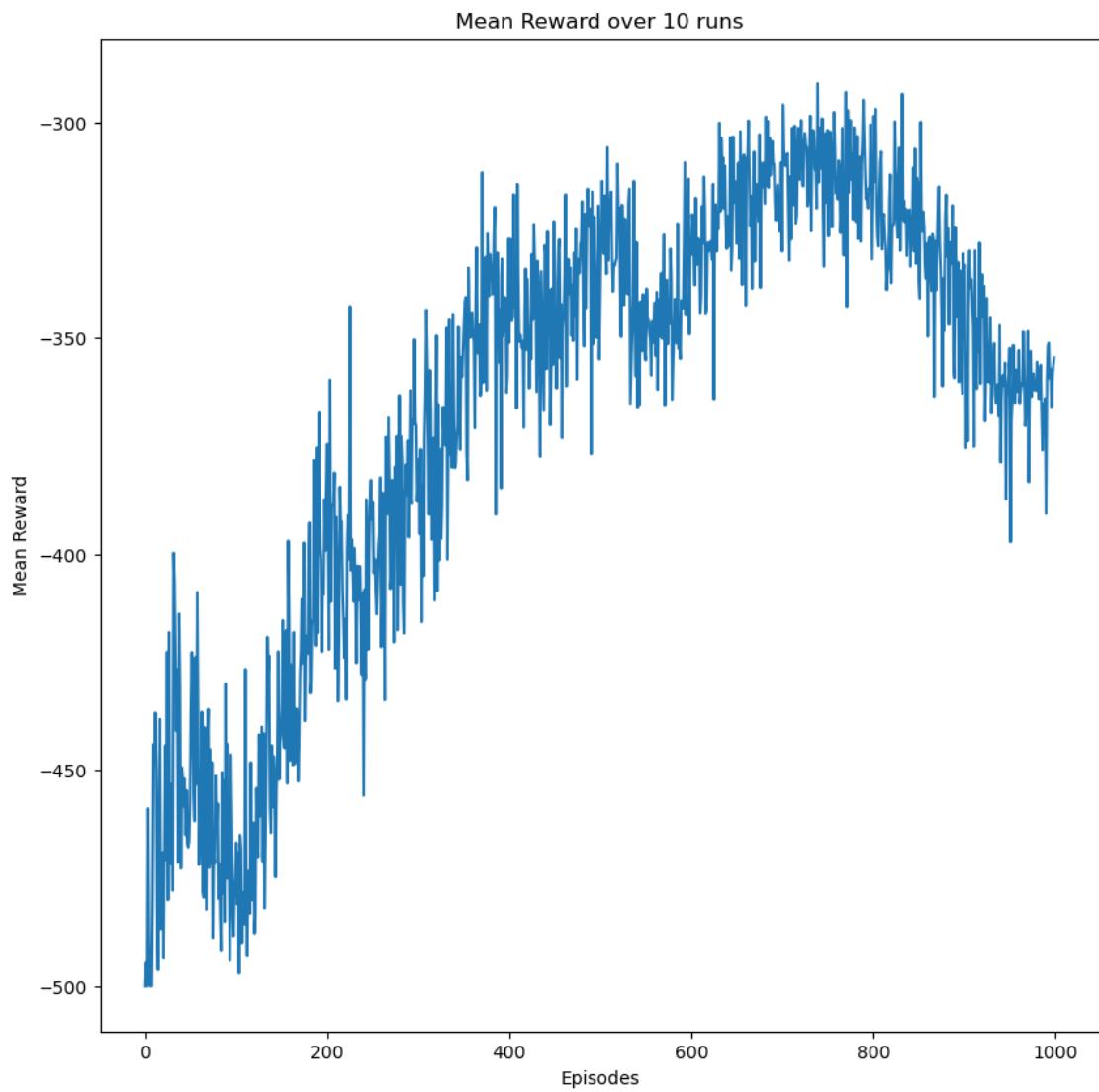
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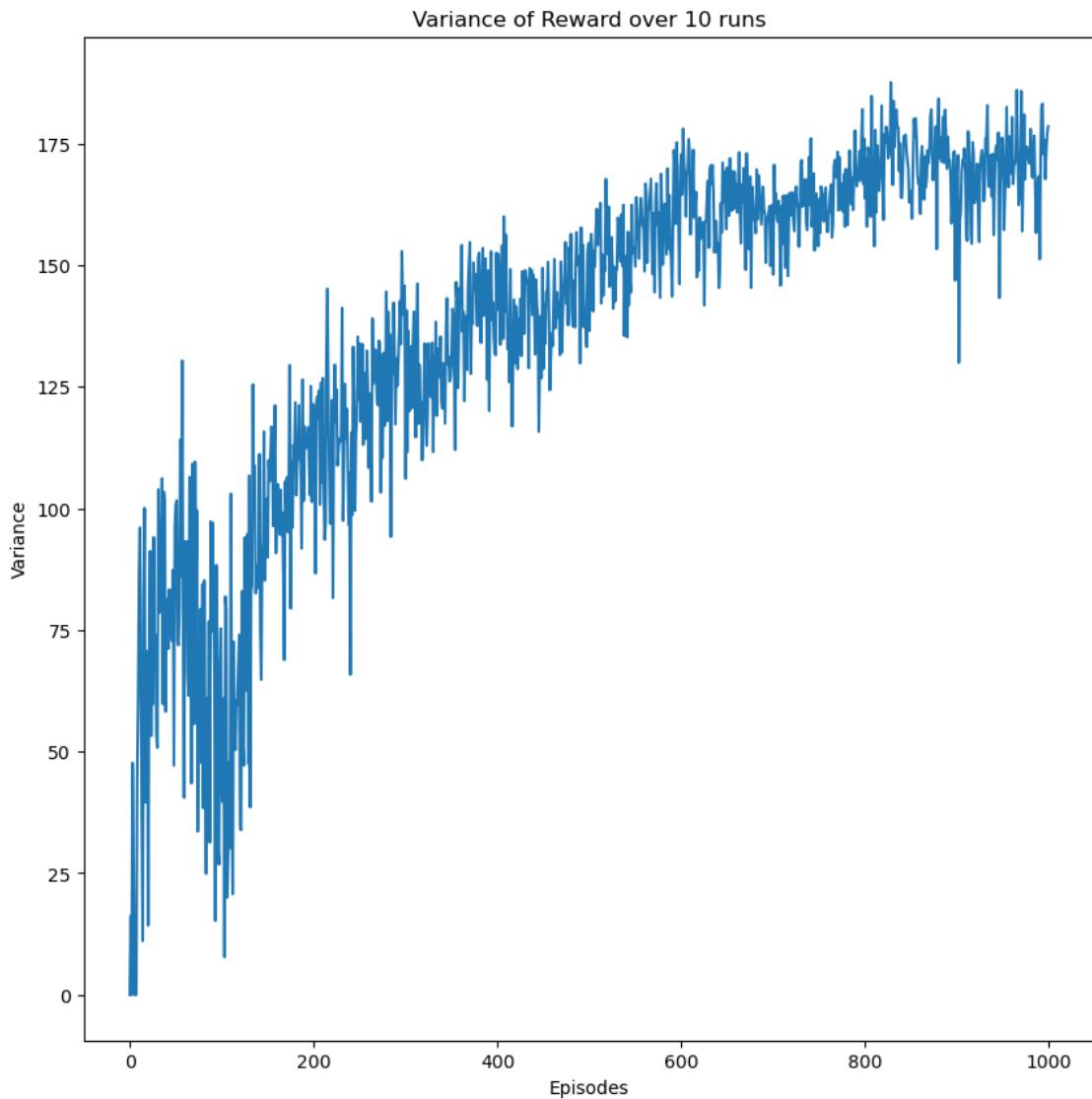
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Episode 50 Reward -500.000000 Average Reward -494.400000
Episode 60 Reward -472.000000 Average Reward -487.600000
Episode 70 Reward -500.000000 Average Reward -496.800000
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Episode 300 Reward -500.000000 Average Reward -478.200000
Episode 310 Reward -500.000000 Average Reward -500.000000
Episode 320 Reward -340.000000 Average Reward -484.000000
Episode 330 Reward -500.000000 Average Reward -500.000000
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Episode 220 Reward -500.000000 Average Reward -489.600000
Episode 230 Reward -500.000000 Average Reward -476.700000
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Episode 330 Reward -500.000000 Average Reward -483.700000
Episode 340 Reward -500.000000 Average Reward -471.100000
Episode 350 Reward -500.000000 Average Reward -472.700000
Episode 360 Reward -500.000000 Average Reward -497.000000
Episode 370 Reward -500.000000 Average Reward -466.900000
Episode 380 Reward -500.000000 Average Reward -500.000000
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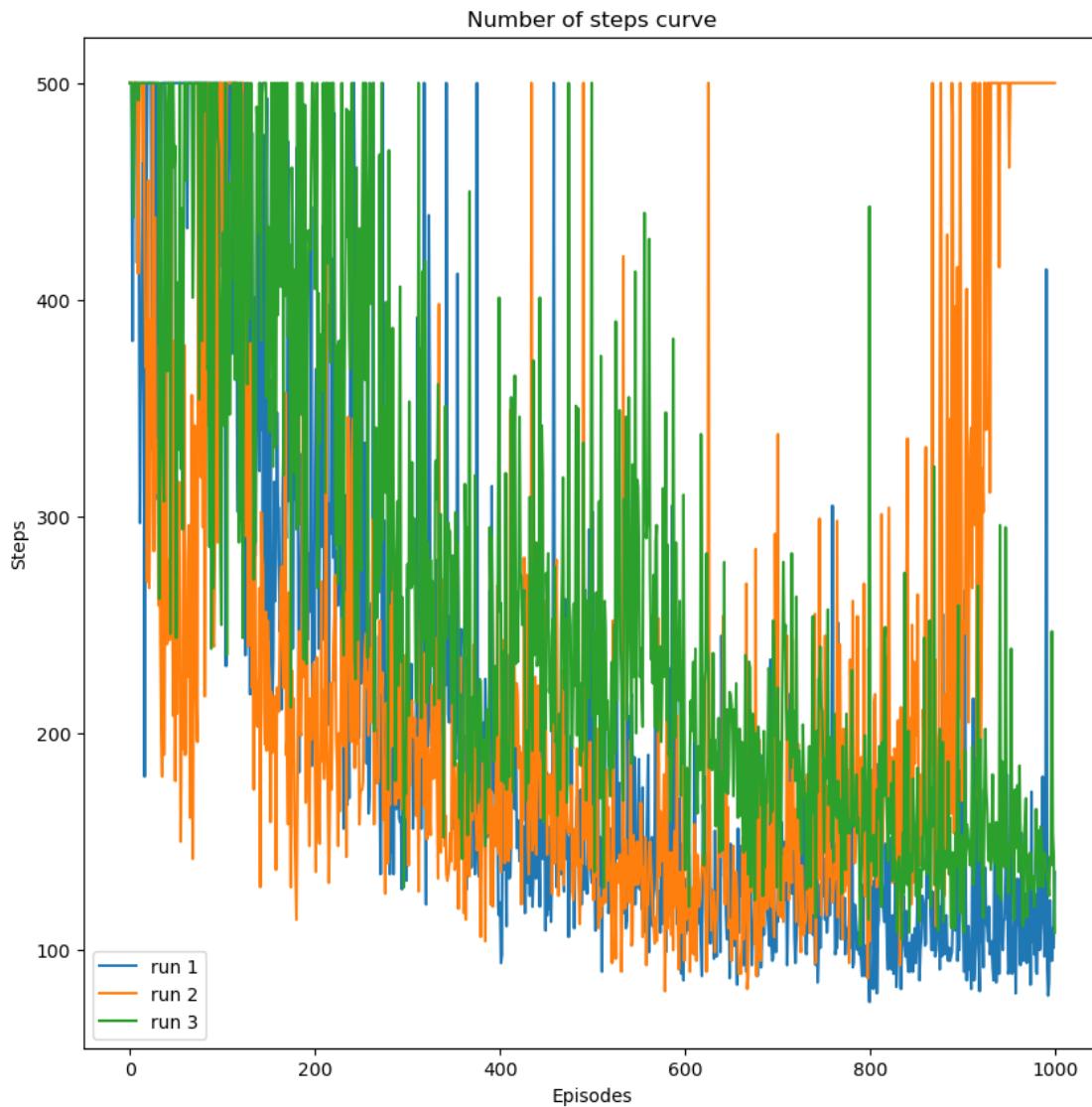
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Episode 900 Reward -500.000000 Average Reward -500.000000
Episode 910 Reward -500.000000 Average Reward -500.000000
Episode 920 Reward -500.000000 Average Reward -500.000000
Episode 930 Reward -500.000000 Average Reward -500.000000
Episode 940 Reward -500.000000 Average Reward -500.000000
Episode 950 Reward -500.000000 Average Reward -500.000000
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Episode 990 Reward -500.000000 Average Reward -500.000000
Episode 1000 Reward -500.000000 Average Reward -500.000000

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```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [512, 512]
LR = 2e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'Acrobot-v1'
SOLVE_CUTOFF = -100.0
STEP = 10

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{hs}-{lr}-{env}-{numep}-{nstep}-{STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	-500.000000	-449.300000
20	-500.000000	-398.900000
30	-421.000000	-355.700000
40	-500.000000	-500.000000
50	-500.000000	-484.500000
60	-500.000000	-500.000000
70	-500.000000	-500.000000
80	-500.000000	-500.000000
90	-500.000000	-500.000000
100	-500.000000	-500.000000
110	-500.000000	-500.000000
120	-500.000000	-476.500000
130	-500.000000	-484.800000
140	-500.000000	-500.000000
150	-500.000000	-500.000000
160	-500.000000	-500.000000
170	-500.000000	-500.000000
180	-500.000000	-500.000000
190	-500.000000	-500.000000
200	-500.000000	-500.000000
210	-500.000000	-500.000000
220	-500.000000	-500.000000
230	-500.000000	-500.000000
240	-500.000000	-500.000000
250	-500.000000	-500.000000
260	-500.000000	-500.000000
270	-500.000000	-500.000000
280	-500.000000	-500.000000

Episode 770 Reward -500.000000 Average Reward -500.000000
Episode 780 Reward -500.000000 Average Reward -500.000000
Episode 790 Reward -500.000000 Average Reward -500.000000
Episode 800 Reward -500.000000 Average Reward -500.000000
Episode 810 Reward -500.000000 Average Reward -500.000000
Episode 820 Reward -500.000000 Average Reward -500.000000
Episode 830 Reward -500.000000 Average Reward -500.000000
Episode 840 Reward -500.000000 Average Reward -500.000000
Episode 850 Reward -500.000000 Average Reward -500.000000
Episode 860 Reward -500.000000 Average Reward -500.000000
Episode 870 Reward -500.000000 Average Reward -500.000000
Episode 880 Reward -500.000000 Average Reward -500.000000
Episode 890 Reward -500.000000 Average Reward -500.000000
Episode 900 Reward -500.000000 Average Reward -500.000000
Episode 910 Reward -500.000000 Average Reward -500.000000
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Episode 980 Reward -500.000000 Average Reward -500.000000
Episode 990 Reward -500.000000 Average Reward -500.000000
Episode 1000 Reward -500.000000 Average Reward -500.000000

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Episode 10 Reward -468.000000 Average Reward -413.900000
Episode 20 Reward -500.000000 Average Reward -493.000000
Episode 30 Reward -500.000000 Average Reward -500.000000
Episode 40 Reward -500.000000 Average Reward -500.000000
Episode 50 Reward -500.000000 Average Reward -500.000000
Episode 60 Reward -500.000000 Average Reward -500.000000
Episode 70 Reward -500.000000 Average Reward -500.000000
Episode 80 Reward -500.000000 Average Reward -500.000000
Episode 90 Reward -500.000000 Average Reward -500.000000
Episode 100 Reward -500.000000 Average Reward -500.000000
Episode 110 Reward -500.000000 Average Reward -500.000000
Episode 120 Reward -500.000000 Average Reward -500.000000
Episode 130 Reward -389.000000 Average Reward -450.200000
Episode 140 Reward -271.000000 Average Reward -396.100000
Episode 150 Reward -394.000000 Average Reward -322.900000
Episode 160 Reward -442.000000 Average Reward -432.300000
Episode 170 Reward -268.000000 Average Reward -416.800000
Episode 180 Reward -500.000000 Average Reward -459.200000
Episode 190 Reward -329.000000 Average Reward -409.900000
Episode 200 Reward -500.000000 Average Reward -403.200000
Episode 210 Reward -500.000000 Average Reward -482.200000
Episode 220 Reward -372.000000 Average Reward -451.100000
Episode 230 Reward -219.000000 Average Reward -353.400000

Episode 240 Reward -272.000000 Average Reward -255.100000
Episode 250 Reward -139.000000 Average Reward -214.300000
Episode 260 Reward -176.000000 Average Reward -217.900000
Episode 270 Reward -207.000000 Average Reward -203.300000
Episode 280 Reward -165.000000 Average Reward -158.500000
Episode 290 Reward -159.000000 Average Reward -172.600000
Episode 300 Reward -190.000000 Average Reward -155.500000
Episode 310 Reward -132.000000 Average Reward -139.500000
Episode 320 Reward -94.000000 Average Reward -115.700000
Episode 330 Reward -111.000000 Average Reward -117.100000
Episode 340 Reward -132.000000 Average Reward -129.600000
Episode 350 Reward -135.000000 Average Reward -137.900000
Episode 360 Reward -170.000000 Average Reward -149.400000
Episode 370 Reward -173.000000 Average Reward -151.000000
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Episode 400 Reward -142.000000 Average Reward -189.100000
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Episode 420 Reward -106.000000 Average Reward -115.400000
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Episode 440 Reward -155.000000 Average Reward -149.000000
Episode 450 Reward -176.000000 Average Reward -139.400000
Episode 460 Reward -146.000000 Average Reward -160.300000
Episode 470 Reward -131.000000 Average Reward -146.500000
Episode 480 Reward -100.000000 Average Reward -122.100000
Episode 490 Reward -153.000000 Average Reward -134.800000
Episode 500 Reward -139.000000 Average Reward -125.800000
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Episode 520 Reward -145.000000 Average Reward -147.100000
Episode 530 Reward -221.000000 Average Reward -191.300000
Episode 540 Reward -176.000000 Average Reward -149.400000
Episode 550 Reward -297.000000 Average Reward -164.100000
Episode 560 Reward -214.000000 Average Reward -163.700000
Episode 570 Reward -258.000000 Average Reward -275.400000
Episode 580 Reward -173.000000 Average Reward -261.300000
Episode 590 Reward -500.000000 Average Reward -313.200000
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Episode 610 Reward -500.000000 Average Reward -442.000000
Episode 620 Reward -320.000000 Average Reward -419.300000
Episode 630 Reward -417.000000 Average Reward -392.600000
Episode 640 Reward -382.000000 Average Reward -400.900000
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Episode 670 Reward -318.000000 Average Reward -399.300000
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Episode 120 Reward -249.000000 Average Reward -264.200000
Episode 130 Reward -178.000000 Average Reward -253.600000

Episode 140 Reward -252.000000 Average Reward -244.700000
Episode 150 Reward -232.000000 Average Reward -292.100000
Episode 160 Reward -277.000000 Average Reward -265.300000
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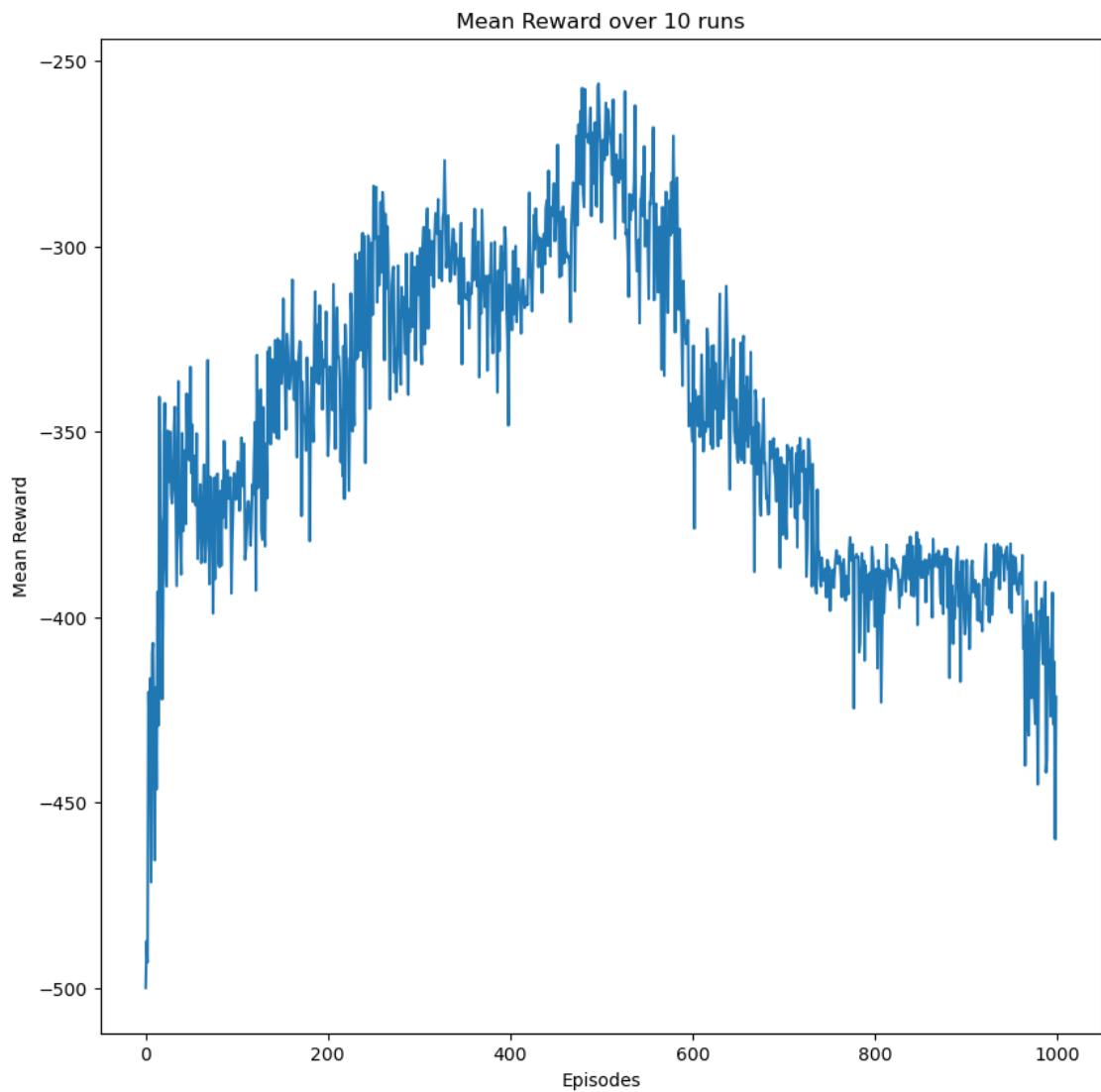
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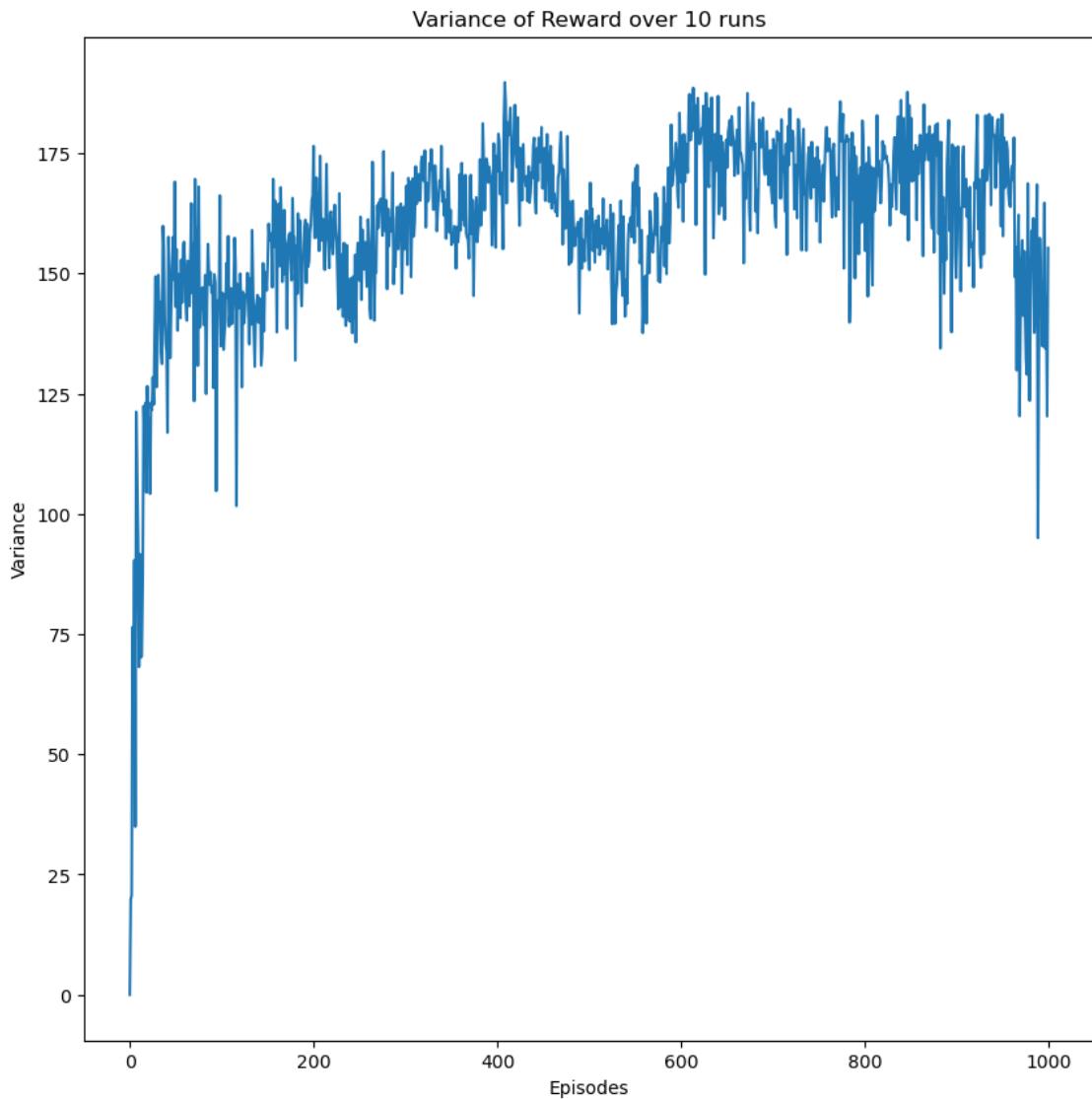
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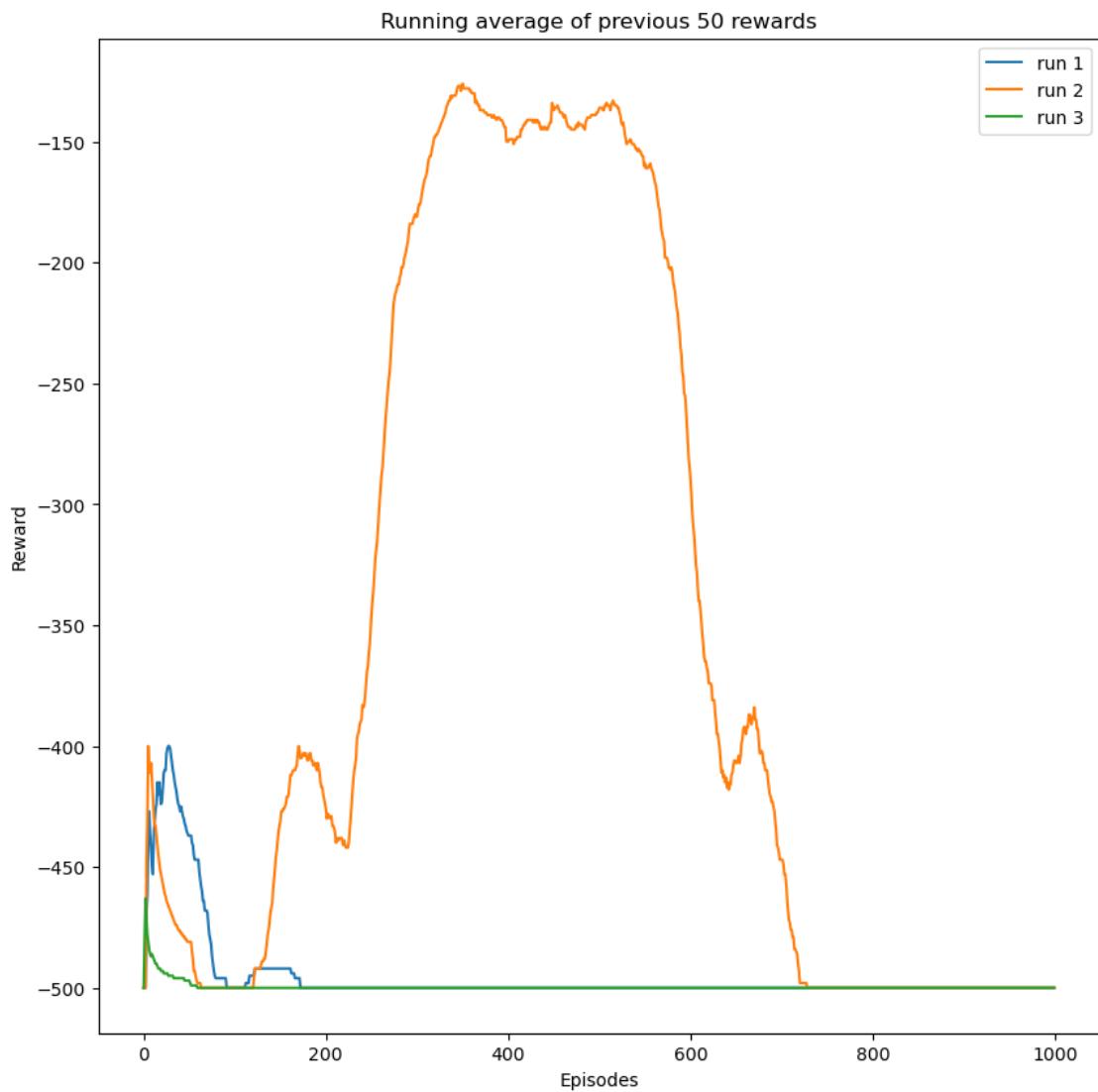
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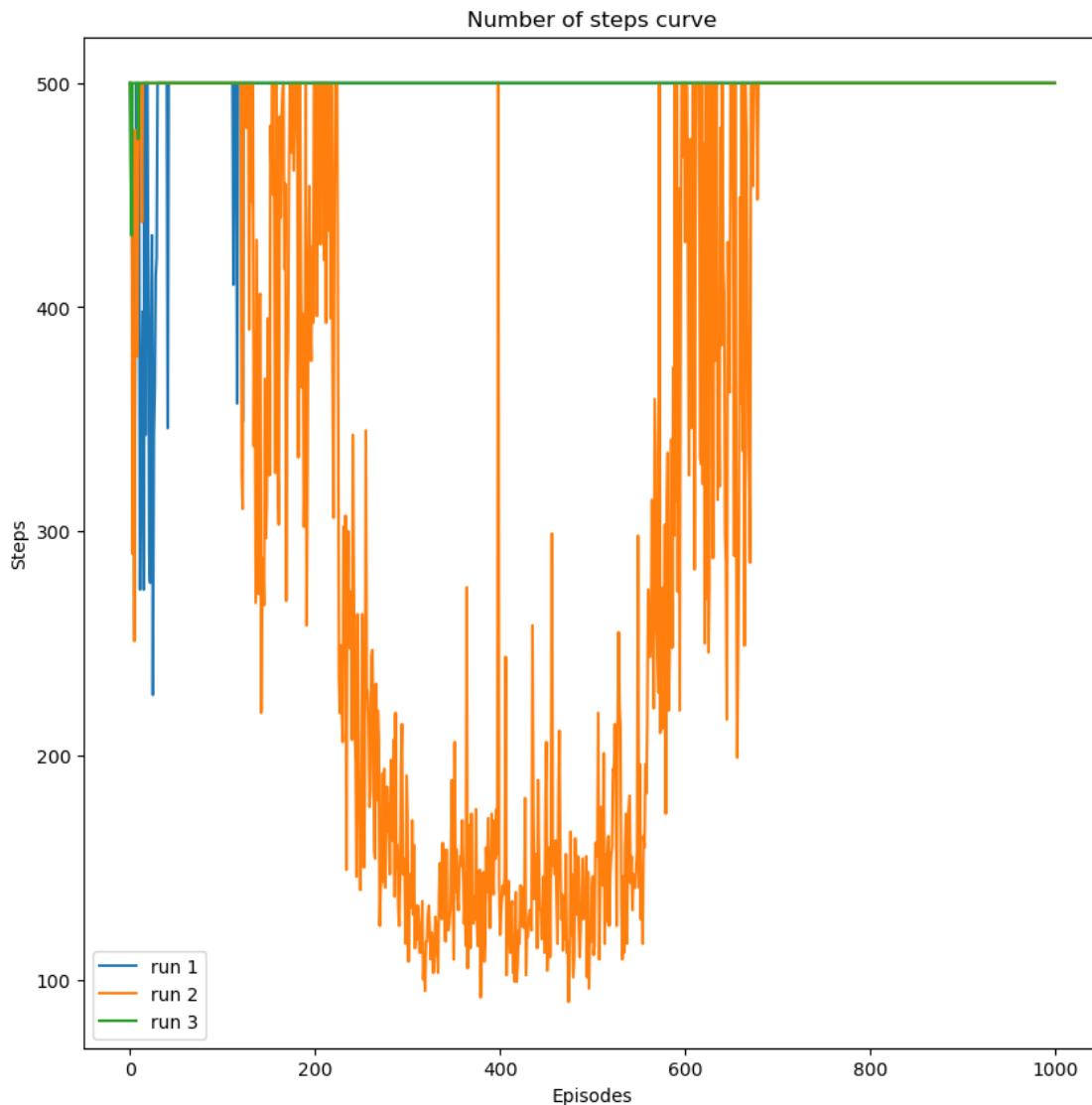
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Episode 510 Reward -128.000000 Average Reward -146.700000
Episode 520 Reward -164.000000 Average Reward -131.500000
Episode 530 Reward -204.000000 Average Reward -154.200000
Episode 540 Reward -317.000000 Average Reward -179.800000
Episode 550 Reward -159.000000 Average Reward -183.000000
Episode 560 Reward -180.000000 Average Reward -173.600000
Episode 570 Reward -185.000000 Average Reward -173.100000
Episode 580 Reward -137.000000 Average Reward -183.200000
Episode 590 Reward -183.000000 Average Reward -175.500000
Episode 600 Reward -177.000000 Average Reward -161.700000
Episode 610 Reward -157.000000 Average Reward -166.800000
Episode 620 Reward -189.000000 Average Reward -168.100000
Episode 630 Reward -173.000000 Average Reward -176.300000
Episode 640 Reward -165.000000 Average Reward -180.700000
Episode 650 Reward -224.000000 Average Reward -204.600000
Episode 660 Reward -222.000000 Average Reward -223.800000
Episode 670 Reward -186.000000 Average Reward -205.800000
Episode 680 Reward -220.000000 Average Reward -204.200000
Episode 690 Reward -161.000000 Average Reward -210.700000
Episode 700 Reward -382.000000 Average Reward -254.400000
Episode 710 Reward -234.000000 Average Reward -252.000000
Episode 720 Reward -268.000000 Average Reward -248.000000
Episode 730 Reward -206.000000 Average Reward -262.000000
Episode 740 Reward -484.000000 Average Reward -404.100000
Episode 750 Reward -500.000000 Average Reward -500.000000
Episode 760 Reward -500.000000 Average Reward -500.000000
Episode 770 Reward -500.000000 Average Reward -500.000000
Episode 780 Reward -500.000000 Average Reward -500.000000
Episode 790 Reward -500.000000 Average Reward -500.000000

Episode 800 Reward -500.000000 Average Reward -500.000000
Episode 810 Reward -500.000000 Average Reward -500.000000
Episode 820 Reward -500.000000 Average Reward -500.000000
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Episode 840 Reward -500.000000 Average Reward -500.000000
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Episode 900 Reward -500.000000 Average Reward -500.000000
Episode 910 Reward -500.000000 Average Reward -500.000000
Episode 920 Reward -500.000000 Average Reward -500.000000
Episode 930 Reward -500.000000 Average Reward -500.000000
Episode 940 Reward -500.000000 Average Reward -500.000000
Episode 950 Reward -500.000000 Average Reward -500.000000
Episode 960 Reward -500.000000 Average Reward -500.000000
Episode 970 Reward -500.000000 Average Reward -500.000000
Episode 980 Reward -500.000000 Average Reward -500.000000
Episode 990 Reward -500.000000 Average Reward -500.000000
Episode 1000 Reward -500.000000 Average Reward -500.000000
0:06:19.759629









```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [1024, 512]
LR = 1e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'Acrobot-v1'
SOLVE_CUTOFF = -100.0
STEP = 10

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{hs}-{lr}-{env}-{numep}-{nstep}-{STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	-369.000000	-455.000000
20	-500.000000	-338.300000
30	-316.000000	-316.000000
40	-500.000000	-441.100000
50	-500.000000	-447.100000
60	-500.000000	-453.200000
70	-341.000000	-418.800000
80	-297.000000	-290.500000
90	-368.000000	-328.300000
100	-204.000000	-294.000000
110	-240.000000	-302.300000
120	-253.000000	-298.600000
130	-340.000000	-334.800000
140	-395.000000	-312.800000
150	-309.000000	-307.400000
160	-500.000000	-338.100000
170	-390.000000	-334.000000
180	-500.000000	-351.600000
190	-234.000000	-357.500000
200	-500.000000	-342.800000
210	-311.000000	-371.200000
220	-500.000000	-464.100000
230	-500.000000	-426.800000
240	-486.000000	-424.900000
250	-500.000000	-482.200000
260	-500.000000	-409.100000
270	-487.000000	-420.300000
280	-432.000000	-396.900000

Episode 290 Reward -370.000000 Average Reward -332.600000
Episode 300 Reward -500.000000 Average Reward -400.400000
Episode 310 Reward -500.000000 Average Reward -429.500000
Episode 320 Reward -500.000000 Average Reward -463.400000
Episode 330 Reward -417.000000 Average Reward -409.100000
Episode 340 Reward -500.000000 Average Reward -454.600000
Episode 350 Reward -316.000000 Average Reward -374.800000
Episode 360 Reward -432.000000 Average Reward -432.800000
Episode 370 Reward -500.000000 Average Reward -428.100000
Episode 380 Reward -500.000000 Average Reward -418.100000
Episode 390 Reward -270.000000 Average Reward -404.400000
Episode 400 Reward -434.000000 Average Reward -422.200000
Episode 410 Reward -344.000000 Average Reward -424.700000
Episode 420 Reward -361.000000 Average Reward -386.000000
Episode 430 Reward -449.000000 Average Reward -441.900000
Episode 440 Reward -500.000000 Average Reward -426.300000
Episode 450 Reward -500.000000 Average Reward -457.500000
Episode 460 Reward -500.000000 Average Reward -413.200000
Episode 470 Reward -500.000000 Average Reward -420.100000
Episode 480 Reward -438.000000 Average Reward -444.000000
Episode 490 Reward -423.000000 Average Reward -459.400000
Episode 500 Reward -500.000000 Average Reward -450.500000
Episode 510 Reward -500.000000 Average Reward -468.100000
Episode 520 Reward -433.000000 Average Reward -434.400000
Episode 530 Reward -500.000000 Average Reward -449.300000
Episode 540 Reward -500.000000 Average Reward -489.500000
Episode 550 Reward -500.000000 Average Reward -492.200000
Episode 560 Reward -500.000000 Average Reward -473.000000
Episode 570 Reward -500.000000 Average Reward -488.400000
Episode 580 Reward -500.000000 Average Reward -500.000000
Episode 590 Reward -500.000000 Average Reward -500.000000
Episode 600 Reward -500.000000 Average Reward -500.000000
Episode 610 Reward -500.000000 Average Reward -500.000000
Episode 620 Reward -500.000000 Average Reward -500.000000
Episode 630 Reward -500.000000 Average Reward -500.000000
Episode 640 Reward -500.000000 Average Reward -500.000000
Episode 650 Reward -500.000000 Average Reward -500.000000
Episode 660 Reward -500.000000 Average Reward -500.000000
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Episode 690 Reward -500.000000 Average Reward -500.000000
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Episode 740 Reward -500.000000 Average Reward -500.000000
Episode 750 Reward -500.000000 Average Reward -500.000000
Episode 760 Reward -500.000000 Average Reward -500.000000

Episode 240 Reward -500.000000 Average Reward -489.700000
Episode 250 Reward -439.000000 Average Reward -463.200000
Episode 260 Reward -385.000000 Average Reward -407.900000
Episode 270 Reward -359.000000 Average Reward -358.200000
Episode 280 Reward -465.000000 Average Reward -465.700000
Episode 290 Reward -449.000000 Average Reward -433.100000
Episode 300 Reward -278.000000 Average Reward -363.800000
Episode 310 Reward -263.000000 Average Reward -352.500000
Episode 320 Reward -403.000000 Average Reward -435.100000
Episode 330 Reward -304.000000 Average Reward -454.400000
Episode 340 Reward -500.000000 Average Reward -439.100000
Episode 350 Reward -500.000000 Average Reward -447.200000
Episode 360 Reward -500.000000 Average Reward -472.000000
Episode 370 Reward -500.000000 Average Reward -499.700000
Episode 380 Reward -500.000000 Average Reward -486.900000
Episode 390 Reward -500.000000 Average Reward -496.700000
Episode 400 Reward -500.000000 Average Reward -500.000000
Episode 410 Reward -500.000000 Average Reward -500.000000
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Episode 440 Reward -500.000000 Average Reward -500.000000
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Episode 630 Reward -500.000000 Average Reward -500.000000
Episode 640 Reward -500.000000 Average Reward -500.000000
Episode 650 Reward -500.000000 Average Reward -500.000000
Episode 660 Reward -500.000000 Average Reward -500.000000
Episode 670 Reward -500.000000 Average Reward -500.000000
Episode 680 Reward -500.000000 Average Reward -500.000000
Episode 690 Reward -500.000000 Average Reward -500.000000
Episode 700 Reward -500.000000 Average Reward -500.000000
Episode 710 Reward -500.000000 Average Reward -500.000000

Episode 190 Reward -421.000000 Average Reward -379.100000
Episode 200 Reward -500.000000 Average Reward -423.400000
Episode 210 Reward -440.000000 Average Reward -314.500000
Episode 220 Reward -245.000000 Average Reward -260.400000
Episode 230 Reward -274.000000 Average Reward -287.200000
Episode 240 Reward -212.000000 Average Reward -213.100000
Episode 250 Reward -309.000000 Average Reward -232.800000
Episode 260 Reward -241.000000 Average Reward -256.300000
Episode 270 Reward -262.000000 Average Reward -226.400000
Episode 280 Reward -258.000000 Average Reward -234.900000
Episode 290 Reward -228.000000 Average Reward -204.400000
Episode 300 Reward -193.000000 Average Reward -240.000000
Episode 310 Reward -244.000000 Average Reward -212.600000
Episode 320 Reward -160.000000 Average Reward -195.000000
Episode 330 Reward -197.000000 Average Reward -217.200000
Episode 340 Reward -169.000000 Average Reward -183.700000
Episode 350 Reward -145.000000 Average Reward -224.700000
Episode 360 Reward -175.000000 Average Reward -229.100000
Episode 370 Reward -158.000000 Average Reward -194.400000
Episode 380 Reward -154.000000 Average Reward -201.100000
Episode 390 Reward -229.000000 Average Reward -223.000000
Episode 400 Reward -159.000000 Average Reward -202.800000
Episode 410 Reward -151.000000 Average Reward -203.700000
Episode 420 Reward -168.000000 Average Reward -212.400000
Episode 430 Reward -217.000000 Average Reward -195.900000
Episode 440 Reward -163.000000 Average Reward -220.100000
Episode 450 Reward -161.000000 Average Reward -186.300000
Episode 460 Reward -225.000000 Average Reward -202.900000
Episode 470 Reward -168.000000 Average Reward -190.800000
Episode 480 Reward -119.000000 Average Reward -204.600000
Episode 490 Reward -199.000000 Average Reward -207.400000
Episode 500 Reward -186.000000 Average Reward -209.600000
Episode 510 Reward -150.000000 Average Reward -186.000000
Episode 520 Reward -209.000000 Average Reward -214.200000
Episode 530 Reward -268.000000 Average Reward -225.700000
Episode 540 Reward -234.000000 Average Reward -228.000000
Episode 550 Reward -299.000000 Average Reward -244.500000
Episode 560 Reward -176.000000 Average Reward -205.000000
Episode 570 Reward -157.000000 Average Reward -208.700000
Episode 580 Reward -156.000000 Average Reward -181.200000
Episode 590 Reward -159.000000 Average Reward -176.800000
Episode 600 Reward -146.000000 Average Reward -155.700000
Episode 610 Reward -110.000000 Average Reward -149.900000
Episode 620 Reward -155.000000 Average Reward -147.900000
Episode 630 Reward -163.000000 Average Reward -132.500000
Episode 640 Reward -122.000000 Average Reward -122.000000
Episode 650 Reward -103.000000 Average Reward -127.800000
Episode 660 Reward -122.000000 Average Reward -126.600000

Episode 670 Reward -140.000000 Average Reward -141.400000
 Episode 680 Reward -111.000000 Average Reward -126.500000
 Episode 690 Reward -123.000000 Average Reward -130.000000
 Episode 700 Reward -103.000000 Average Reward -136.600000
 Episode 710 Reward -125.000000 Average Reward -129.000000
 Episode 720 Reward -140.000000 Average Reward -134.700000
 Episode 730 Reward -133.000000 Average Reward -151.500000
 Episode 740 Reward -139.000000 Average Reward -140.400000
 Episode 750 Reward -153.000000 Average Reward -150.800000
 Episode 760 Reward -149.000000 Average Reward -131.500000
 Episode 770 Reward -117.000000 Average Reward -143.300000
 Episode 780 Reward -151.000000 Average Reward -148.300000
 Episode 790 Reward -241.000000 Average Reward -151.500000
 Episode 800 Reward -105.000000 Average Reward -112.400000
 Episode 810 Reward -123.000000 Average Reward -131.800000
 Episode 820 Reward -103.000000 Average Reward -110.800000
 Episode 830 Reward -132.000000 Average Reward -129.000000
 Episode 840 Reward -99.000000 Average Reward -116.000000
 Episode 850 Reward -95.000000 Average Reward -111.600000
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 Episode 880 Reward -166.000000 Average Reward -152.500000
 Episode 890 Reward -118.000000 Average Reward -166.400000
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 Episode 910 Reward -224.000000 Average Reward -182.600000
 Episode 920 Reward -128.000000 Average Reward -151.400000
 Episode 930 Reward -124.000000 Average Reward -169.600000
 Episode 940 Reward -115.000000 Average Reward -137.000000
 Episode 950 Reward -144.000000 Average Reward -156.400000
 Episode 960 Reward -182.000000 Average Reward -169.300000
 Episode 970 Reward -311.000000 Average Reward -209.800000
 Episode 980 Reward -163.000000 Average Reward -170.800000
 Episode 990 Reward -158.000000 Average Reward -167.900000
 Episode 1000 Reward -138.000000 Average Reward -162.900000
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 Episode 10 Reward -394.000000 Average Reward -457.800000
 Episode 20 Reward -500.000000 Average Reward -442.700000
 Episode 30 Reward -260.000000 Average Reward -362.400000
 Episode 40 Reward -276.000000 Average Reward -334.800000
 Episode 50 Reward -355.000000 Average Reward -319.100000
 Episode 60 Reward -257.000000 Average Reward -261.500000
 Episode 70 Reward -254.000000 Average Reward -296.400000
 Episode 80 Reward -426.000000 Average Reward -266.100000
 Episode 90 Reward -216.000000 Average Reward -339.500000
 Episode 100 Reward -385.000000 Average Reward -331.900000
 Episode 110 Reward -326.000000 Average Reward -360.000000
 Episode 120 Reward -377.000000 Average Reward -424.300000
 Episode 130 Reward -405.000000 Average Reward -455.100000

Episode	140	Reward	-264.000000	Average Reward	-350.700000
Episode	150	Reward	-496.000000	Average Reward	-358.900000
Episode	160	Reward	-347.000000	Average Reward	-368.700000
Episode	170	Reward	-205.000000	Average Reward	-284.500000
Episode	180	Reward	-392.000000	Average Reward	-268.600000
Episode	190	Reward	-226.000000	Average Reward	-261.800000
Episode	200	Reward	-251.000000	Average Reward	-262.600000
Episode	210	Reward	-243.000000	Average Reward	-258.400000
Episode	220	Reward	-256.000000	Average Reward	-271.300000
Episode	230	Reward	-269.000000	Average Reward	-313.600000
Episode	240	Reward	-289.000000	Average Reward	-281.100000
Episode	250	Reward	-228.000000	Average Reward	-229.300000
Episode	260	Reward	-217.000000	Average Reward	-217.700000
Episode	270	Reward	-238.000000	Average Reward	-181.000000
Episode	280	Reward	-144.000000	Average Reward	-181.800000
Episode	290	Reward	-131.000000	Average Reward	-140.200000
Episode	300	Reward	-216.000000	Average Reward	-173.100000
Episode	310	Reward	-150.000000	Average Reward	-189.900000
Episode	320	Reward	-295.000000	Average Reward	-179.400000
Episode	330	Reward	-238.000000	Average Reward	-202.100000
Episode	340	Reward	-193.000000	Average Reward	-194.600000
Episode	350	Reward	-183.000000	Average Reward	-219.400000
Episode	360	Reward	-236.000000	Average Reward	-256.500000
Episode	370	Reward	-214.000000	Average Reward	-231.400000
Episode	380	Reward	-173.000000	Average Reward	-235.600000
Episode	390	Reward	-228.000000	Average Reward	-280.300000
Episode	400	Reward	-235.000000	Average Reward	-222.800000
Episode	410	Reward	-193.000000	Average Reward	-235.100000
Episode	420	Reward	-265.000000	Average Reward	-250.400000
Episode	430	Reward	-255.000000	Average Reward	-270.800000
Episode	440	Reward	-350.000000	Average Reward	-276.900000
Episode	450	Reward	-253.000000	Average Reward	-296.900000
Episode	460	Reward	-271.000000	Average Reward	-327.800000
Episode	470	Reward	-256.000000	Average Reward	-293.800000
Episode	480	Reward	-414.000000	Average Reward	-333.600000
Episode	490	Reward	-218.000000	Average Reward	-274.000000
Episode	500	Reward	-198.000000	Average Reward	-242.700000
Episode	510	Reward	-184.000000	Average Reward	-195.500000
Episode	520	Reward	-176.000000	Average Reward	-197.400000
Episode	530	Reward	-149.000000	Average Reward	-147.800000
Episode	540	Reward	-229.000000	Average Reward	-145.700000
Episode	550	Reward	-133.000000	Average Reward	-137.000000
Episode	560	Reward	-184.000000	Average Reward	-172.100000
Episode	570	Reward	-120.000000	Average Reward	-139.100000
Episode	580	Reward	-103.000000	Average Reward	-177.300000
Episode	590	Reward	-122.000000	Average Reward	-132.100000
Episode	600	Reward	-140.000000	Average Reward	-132.000000
Episode	610	Reward	-108.000000	Average Reward	-125.500000

Episode 620 Reward -90.000000 Average Reward -116.400000
Episode 630 Reward -110.000000 Average Reward -115.900000
Episode 640 Reward -88.000000 Average Reward -111.300000
Episode 650 Reward -98.000000 Average Reward -138.100000
Episode 660 Reward -110.000000 Average Reward -131.300000
Episode 670 Reward -120.000000 Average Reward -144.000000
Episode 680 Reward -175.000000 Average Reward -136.800000
Episode 690 Reward -110.000000 Average Reward -103.900000
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Episode 740 Reward -89.000000 Average Reward -131.200000
Episode 750 Reward -115.000000 Average Reward -124.000000
Episode 760 Reward -157.000000 Average Reward -110.100000
Episode 770 Reward -214.000000 Average Reward -133.800000
Episode 780 Reward -82.000000 Average Reward -127.200000
Episode 790 Reward -165.000000 Average Reward -142.000000
Episode 800 Reward -117.000000 Average Reward -111.800000
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Episode 820 Reward -92.000000 Average Reward -121.300000
Episode 830 Reward -106.000000 Average Reward -101.200000
Episode 840 Reward -101.000000 Average Reward -120.700000
Episode 850 Reward -97.000000 Average Reward -115.300000
Episode 860 Reward -95.000000 Average Reward -113.200000
Episode 870 Reward -85.000000 Average Reward -119.300000
Episode 880 Reward -92.000000 Average Reward -102.600000
Episode 890 Reward -115.000000 Average Reward -102.700000
Episode 900 Reward -70.000000 Average Reward -103.500000
Episode 910 Reward -188.000000 Average Reward -112.300000
Episode 920 Reward -132.000000 Average Reward -132.100000
Episode 930 Reward -85.000000 Average Reward -100.100000
Episode 940 Reward -103.000000 Average Reward -102.600000
Episode 950 Reward -99.000000 Average Reward -110.900000
Episode 960 Reward -106.000000 Average Reward -111.700000
Episode 970 Reward -82.000000 Average Reward -96.200000
Episode 980 Reward -109.000000 Average Reward -102.100000
Episode 990 Reward -99.000000 Average Reward -99.300000
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Episode 10 Reward -399.000000 Average Reward -489.200000
Episode 20 Reward -418.000000 Average Reward -383.200000
Episode 30 Reward -218.000000 Average Reward -252.600000
Episode 40 Reward -250.000000 Average Reward -293.400000
Episode 50 Reward -468.000000 Average Reward -388.500000
Episode 60 Reward -500.000000 Average Reward -497.200000
Episode 70 Reward -500.000000 Average Reward -500.000000
Episode 80 Reward -500.000000 Average Reward -488.900000

Episode 90 Reward -479.000000 Average Reward -495.200000
Episode 100 Reward -500.000000 Average Reward -459.800000
Episode 110 Reward -500.000000 Average Reward -480.700000
Episode 120 Reward -500.000000 Average Reward -475.300000
Episode 130 Reward -500.000000 Average Reward -500.000000
Episode 140 Reward -500.000000 Average Reward -494.200000
Episode 150 Reward -500.000000 Average Reward -471.000000
Episode 160 Reward -500.000000 Average Reward -436.300000
Episode 170 Reward -400.000000 Average Reward -442.600000
Episode 180 Reward -500.000000 Average Reward -452.400000
Episode 190 Reward -500.000000 Average Reward -494.700000
Episode 200 Reward -383.000000 Average Reward -395.600000
Episode 210 Reward -239.000000 Average Reward -341.800000
Episode 220 Reward -306.000000 Average Reward -332.800000
Episode 230 Reward -375.000000 Average Reward -391.300000
Episode 240 Reward -298.000000 Average Reward -314.500000
Episode 250 Reward -265.000000 Average Reward -260.200000
Episode 260 Reward -273.000000 Average Reward -266.400000
Episode 270 Reward -449.000000 Average Reward -316.500000
Episode 280 Reward -500.000000 Average Reward -413.900000
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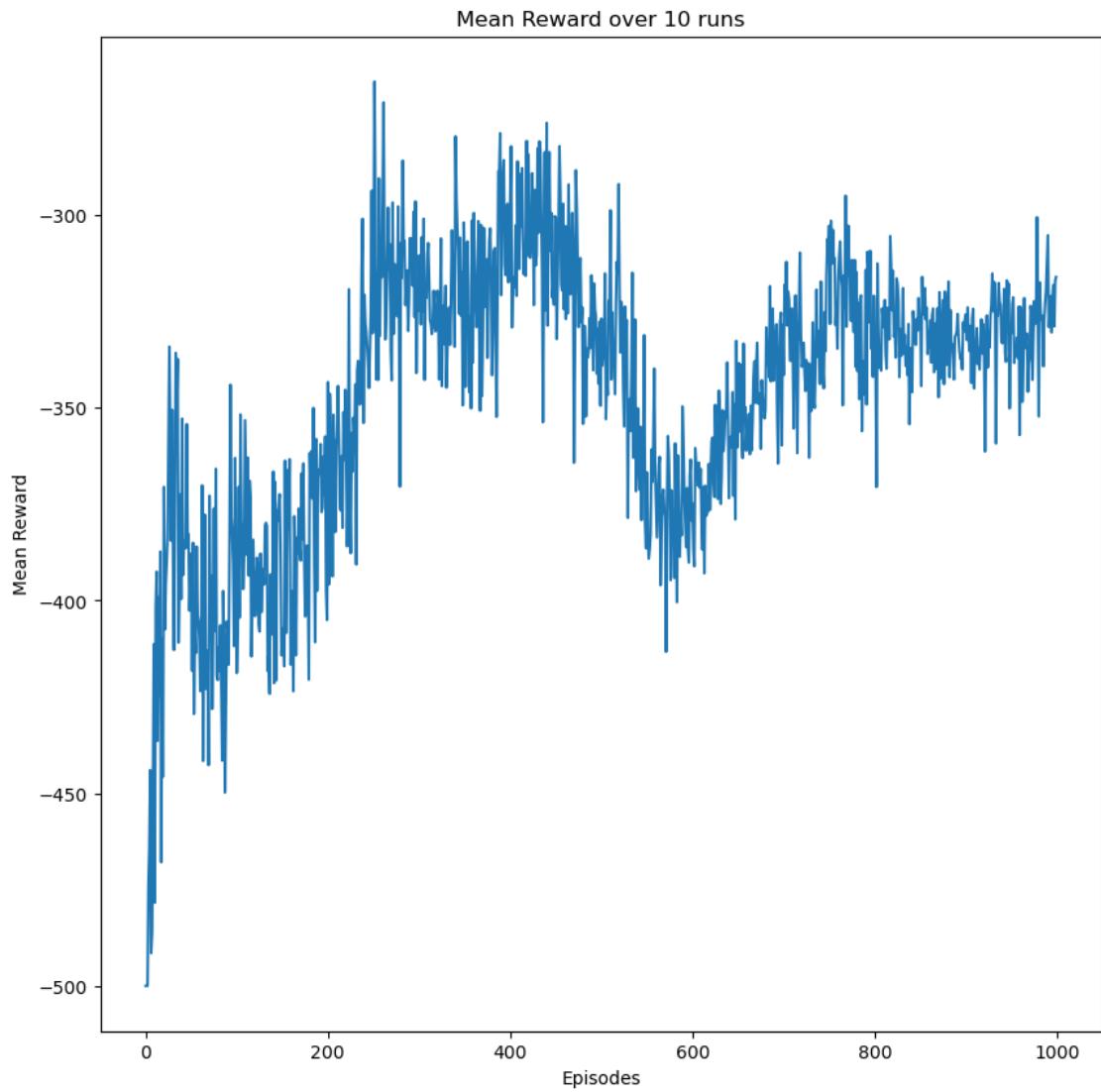
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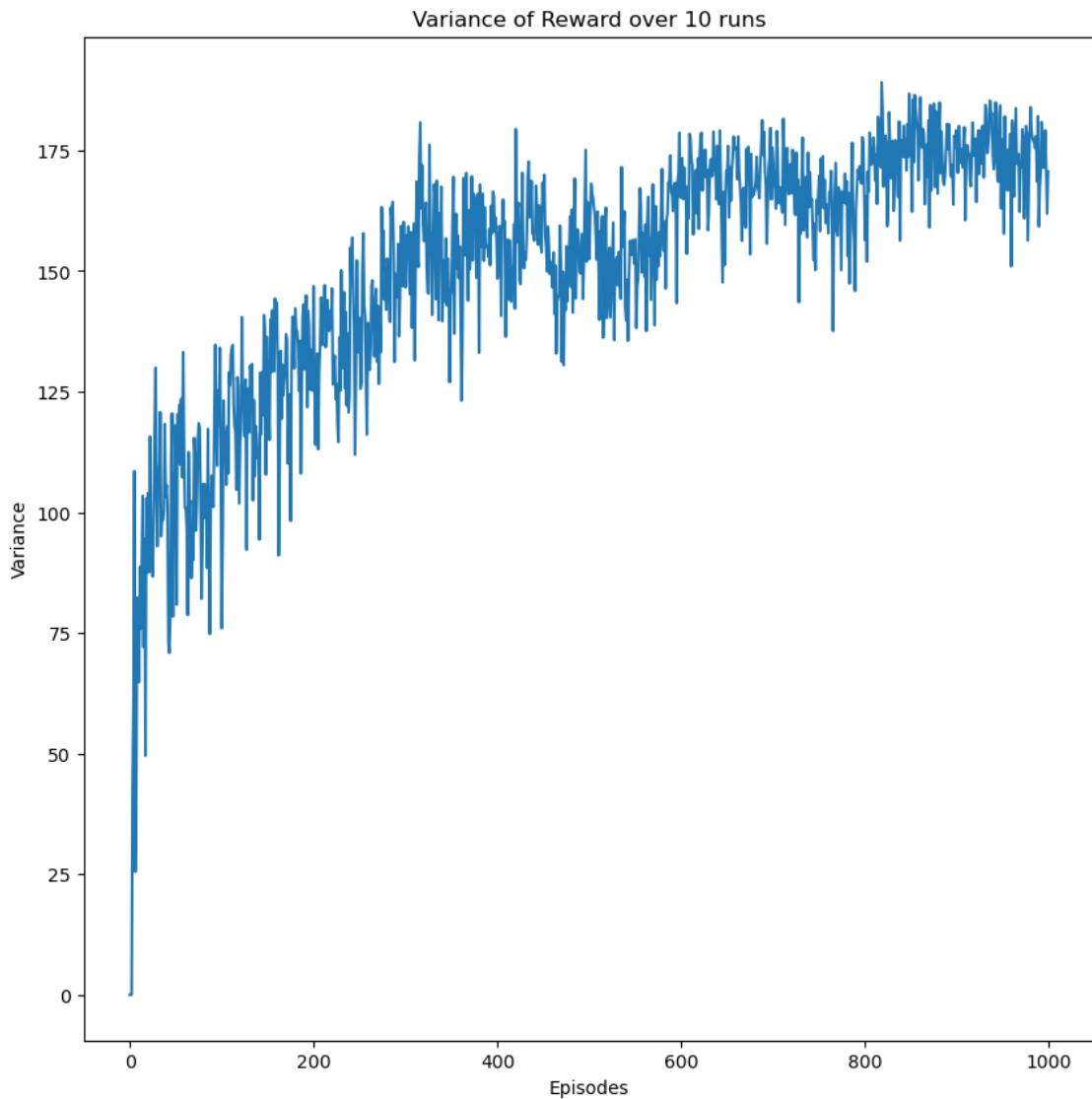
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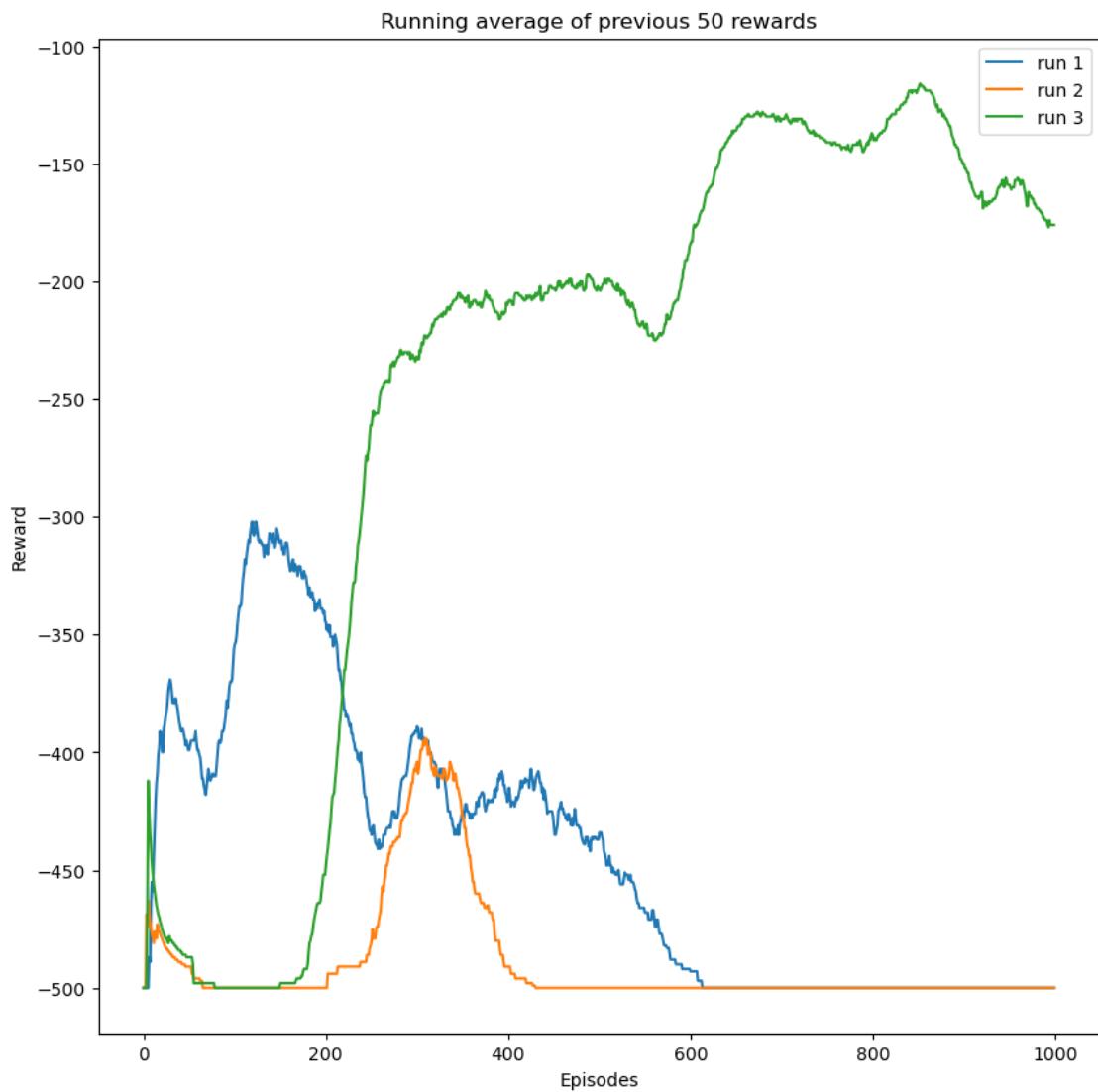
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Episode 160 Reward -165.000000 Average Reward -164.000000
Episode 170 Reward -190.000000 Average Reward -199.700000
Episode 180 Reward -148.000000 Average Reward -201.800000
Episode 190 Reward -165.000000 Average Reward -151.600000
Episode 200 Reward -189.000000 Average Reward -170.500000
Episode 210 Reward -149.000000 Average Reward -203.200000
Episode 220 Reward -154.000000 Average Reward -135.800000
Episode 230 Reward -176.000000 Average Reward -152.200000
Episode 240 Reward -214.000000 Average Reward -159.500000
Episode 250 Reward -145.000000 Average Reward -139.000000
Episode 260 Reward -100.000000 Average Reward -133.600000
Episode 270 Reward -173.000000 Average Reward -184.900000
Episode 280 Reward -229.000000 Average Reward -157.000000
Episode 290 Reward -130.000000 Average Reward -165.400000
Episode 300 Reward -207.000000 Average Reward -142.700000
Episode 310 Reward -120.000000 Average Reward -124.600000

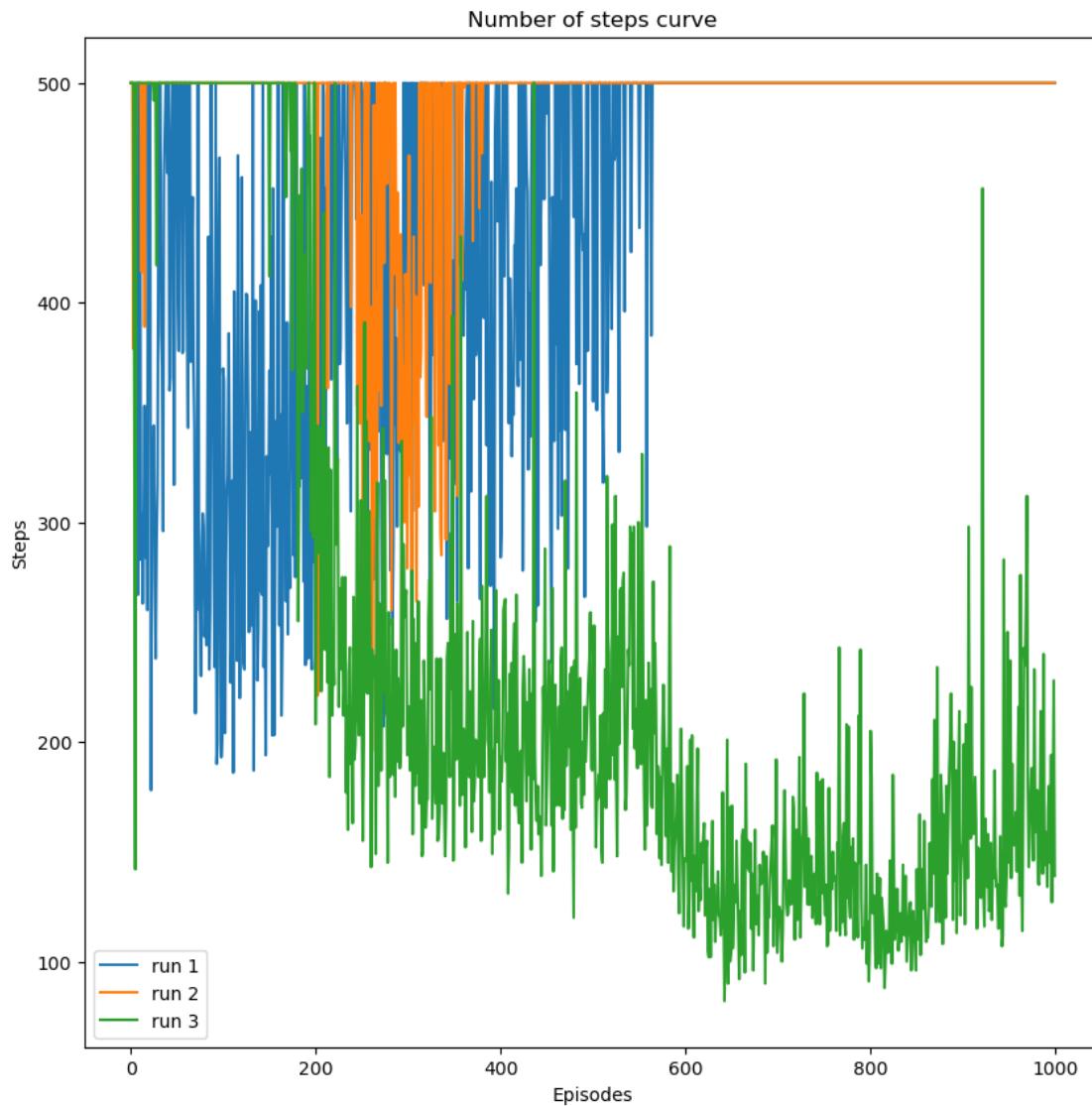
Episode 320 Reward -108.000000 Average Reward -131.600000
Episode 330 Reward -238.000000 Average Reward -140.500000
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Episode 350 Reward -125.000000 Average Reward -142.500000
Episode 360 Reward -99.000000 Average Reward -127.100000
Episode 370 Reward -148.000000 Average Reward -133.100000
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Episode 390 Reward -99.000000 Average Reward -128.400000
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Episode 410 Reward -214.000000 Average Reward -156.500000
Episode 420 Reward -141.000000 Average Reward -136.200000
Episode 430 Reward -129.000000 Average Reward -124.000000
Episode 440 Reward -264.000000 Average Reward -130.600000
Episode 450 Reward -87.000000 Average Reward -127.200000
Episode 460 Reward -133.000000 Average Reward -111.900000
Episode 470 Reward -112.000000 Average Reward -111.400000
Episode 480 Reward -121.000000 Average Reward -115.100000
Episode 490 Reward -81.000000 Average Reward -114.900000
Episode 500 Reward -124.000000 Average Reward -105.800000
Episode 510 Reward -104.000000 Average Reward -104.000000
Episode 520 Reward -80.000000 Average Reward -101.000000
Episode 530 Reward -106.000000 Average Reward -112.500000
Episode 540 Reward -84.000000 Average Reward -91.200000
Episode 550 Reward -111.000000 Average Reward -123.600000
Episode 560 Reward -111.000000 Average Reward -101.900000
Episode 570 Reward -100.000000 Average Reward -109.100000
Episode 580 Reward -99.000000 Average Reward -104.400000
Episode 590 Reward -84.000000 Average Reward -110.000000
Episode 600 Reward -105.000000 Average Reward -101.300000
Episode 610 Reward -86.000000 Average Reward -96.900000
Episode 620 Reward -227.000000 Average Reward -122.800000
Episode 630 Reward -90.000000 Average Reward -92.200000
Episode 640 Reward -102.000000 Average Reward -100.800000
Episode 650 Reward -124.000000 Average Reward -121.000000
Episode 660 Reward -90.000000 Average Reward -97.000000
Episode 670 Reward -106.000000 Average Reward -94.100000
Episode 680 Reward -111.000000 Average Reward -103.600000
Episode 690 Reward -70.000000 Average Reward -100.300000
Episode 700 Reward -105.000000 Average Reward -113.600000
Episode 710 Reward -120.000000 Average Reward -110.400000
Episode 720 Reward -129.000000 Average Reward -104.400000
Episode 730 Reward -98.000000 Average Reward -109.700000
Episode 740 Reward -102.000000 Average Reward -102.500000
Episode 750 Reward -97.000000 Average Reward -106.900000
Episode 760 Reward -91.000000 Average Reward -107.100000
Episode 770 Reward -104.000000 Average Reward -107.100000
Episode 780 Reward -141.000000 Average Reward -98.700000
Episode 790 Reward -106.000000 Average Reward -101.100000

Episode 800 Reward -97.000000 Average Reward -95.600000
Episode 810 Reward -86.000000 Average Reward -103.700000
Episode 820 Reward -70.000000 Average Reward -90.900000
Episode 830 Reward -128.000000 Average Reward -107.700000
Episode 840 Reward -93.000000 Average Reward -124.300000
Episode 850 Reward -125.000000 Average Reward -97.000000
Episode 860 Reward -88.000000 Average Reward -95.200000
Episode 870 Reward -64.000000 Average Reward -95.600000
Episode 880 Reward -156.000000 Average Reward -106.500000
Episode 890 Reward -71.000000 Average Reward -107.600000
Episode 900 Reward -112.000000 Average Reward -103.900000
Episode 910 Reward -99.000000 Average Reward -100.200000
Episode 920 Reward -98.000000 Average Reward -93.300000
Episode 930 Reward -137.000000 Average Reward -108.700000
Episode 940 Reward -115.000000 Average Reward -93.200000
Episode 950 Reward -91.000000 Average Reward -90.500000
Episode 960 Reward -291.000000 Average Reward -120.100000
Episode 970 Reward -93.000000 Average Reward -93.100000
Episode 980 Reward -81.000000 Average Reward -104.100000
Episode 990 Reward -154.000000 Average Reward -98.500000
Episode 1000 Reward -102.000000 Average Reward -106.100000
0:03:55.061275









```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [1024, 1024]
LR = 0.5e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'Acrobot-v1'
SOLVE_CUTOFF = -100.0
STEP = 10

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{hs}-{lr}-{env}-{numep}-{nstep}-{STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	-374.000000	-483.900000
20	-333.000000	-373.400000
30	-215.000000	-334.100000
40	-216.000000	-321.900000
50	-354.000000	-288.500000
60	-178.000000	-267.000000
70	-293.000000	-286.000000
80	-343.000000	-318.200000
90	-314.000000	-378.200000
100	-419.000000	-359.400000
110	-296.000000	-371.200000
120	-450.000000	-412.000000
130	-330.000000	-332.300000
140	-500.000000	-446.100000
150	-310.000000	-414.400000
160	-500.000000	-487.200000
170	-500.000000	-488.000000
180	-500.000000	-500.000000
190	-500.000000	-500.000000
200	-500.000000	-500.000000
210	-500.000000	-500.000000
220	-500.000000	-500.000000
230	-500.000000	-500.000000
240	-500.000000	-500.000000
250	-500.000000	-500.000000
260	-500.000000	-500.000000
270	-500.000000	-500.000000
280	-500.000000	-500.000000

Episode 770 Reward -500.000000 Average Reward -444.200000
Episode 780 Reward -500.000000 Average Reward -429.600000
Episode 790 Reward -500.000000 Average Reward -498.400000
Episode 800 Reward -500.000000 Average Reward -500.000000
Episode 810 Reward -500.000000 Average Reward -500.000000
Episode 820 Reward -500.000000 Average Reward -500.000000
Episode 830 Reward -500.000000 Average Reward -500.000000
Episode 840 Reward -500.000000 Average Reward -500.000000
Episode 850 Reward -500.000000 Average Reward -500.000000
Episode 860 Reward -500.000000 Average Reward -500.000000
Episode 870 Reward -500.000000 Average Reward -499.700000
Episode 880 Reward -500.000000 Average Reward -500.000000
Episode 890 Reward -382.000000 Average Reward -488.200000
Episode 900 Reward -500.000000 Average Reward -495.700000
Episode 910 Reward -365.000000 Average Reward -426.000000
Episode 920 Reward -500.000000 Average Reward -409.100000
Episode 930 Reward -306.000000 Average Reward -334.400000
Episode 940 Reward -400.000000 Average Reward -333.000000
Episode 950 Reward -321.000000 Average Reward -340.500000
Episode 960 Reward -269.000000 Average Reward -339.300000
Episode 970 Reward -405.000000 Average Reward -414.300000
Episode 980 Reward -283.000000 Average Reward -381.000000
Episode 990 Reward -198.000000 Average Reward -316.400000
Episode 1000 Reward -191.000000 Average Reward -234.800000

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Episode 10 Reward -500.000000 Average Reward -479.600000
Episode 20 Reward -500.000000 Average Reward -492.300000
Episode 30 Reward -500.000000 Average Reward -479.700000
Episode 40 Reward -500.000000 Average Reward -476.800000
Episode 50 Reward -500.000000 Average Reward -500.000000
Episode 60 Reward -500.000000 Average Reward -500.000000
Episode 70 Reward -500.000000 Average Reward -500.000000
Episode 80 Reward -500.000000 Average Reward -500.000000
Episode 90 Reward -500.000000 Average Reward -500.000000
Episode 100 Reward -500.000000 Average Reward -491.300000
Episode 110 Reward -500.000000 Average Reward -500.000000
Episode 120 Reward -500.000000 Average Reward -500.000000
Episode 130 Reward -430.000000 Average Reward -488.900000
Episode 140 Reward -500.000000 Average Reward -415.900000
Episode 150 Reward -317.000000 Average Reward -419.200000
Episode 160 Reward -500.000000 Average Reward -497.000000
Episode 170 Reward -500.000000 Average Reward -476.700000
Episode 180 Reward -500.000000 Average Reward -490.700000
Episode 190 Reward -500.000000 Average Reward -489.400000
Episode 200 Reward -500.000000 Average Reward -500.000000
Episode 210 Reward -500.000000 Average Reward -467.600000
Episode 220 Reward -419.000000 Average Reward -464.700000
Episode 230 Reward -322.000000 Average Reward -424.600000

Episode	240	Reward	-500.000000	Average Reward	-421.600000
Episode	250	Reward	-315.000000	Average Reward	-388.000000
Episode	260	Reward	-256.000000	Average Reward	-326.200000
Episode	270	Reward	-334.000000	Average Reward	-338.000000
Episode	280	Reward	-198.000000	Average Reward	-339.700000
Episode	290	Reward	-254.000000	Average Reward	-248.300000
Episode	300	Reward	-227.000000	Average Reward	-272.100000
Episode	310	Reward	-226.000000	Average Reward	-247.200000
Episode	320	Reward	-144.000000	Average Reward	-204.300000
Episode	330	Reward	-139.000000	Average Reward	-172.100000
Episode	340	Reward	-144.000000	Average Reward	-194.000000
Episode	350	Reward	-238.000000	Average Reward	-171.200000
Episode	360	Reward	-258.000000	Average Reward	-199.600000
Episode	370	Reward	-194.000000	Average Reward	-194.400000
Episode	380	Reward	-183.000000	Average Reward	-209.500000
Episode	390	Reward	-365.000000	Average Reward	-247.200000
Episode	400	Reward	-290.000000	Average Reward	-225.200000
Episode	410	Reward	-184.000000	Average Reward	-213.900000
Episode	420	Reward	-235.000000	Average Reward	-220.200000
Episode	430	Reward	-172.000000	Average Reward	-219.800000
Episode	440	Reward	-171.000000	Average Reward	-201.800000
Episode	450	Reward	-255.000000	Average Reward	-243.700000
Episode	460	Reward	-255.000000	Average Reward	-270.800000
Episode	470	Reward	-238.000000	Average Reward	-295.000000
Episode	480	Reward	-143.000000	Average Reward	-179.200000
Episode	490	Reward	-174.000000	Average Reward	-185.800000
Episode	500	Reward	-153.000000	Average Reward	-210.900000
Episode	510	Reward	-166.000000	Average Reward	-207.000000
Episode	520	Reward	-178.000000	Average Reward	-181.500000
Episode	530	Reward	-191.000000	Average Reward	-201.000000
Episode	540	Reward	-180.000000	Average Reward	-156.500000
Episode	550	Reward	-328.000000	Average Reward	-209.800000
Episode	560	Reward	-155.000000	Average Reward	-181.400000
Episode	570	Reward	-147.000000	Average Reward	-188.600000
Episode	580	Reward	-162.000000	Average Reward	-168.100000
Episode	590	Reward	-159.000000	Average Reward	-172.600000
Episode	600	Reward	-142.000000	Average Reward	-171.700000
Episode	610	Reward	-147.000000	Average Reward	-181.200000
Episode	620	Reward	-208.000000	Average Reward	-203.200000
Episode	630	Reward	-166.000000	Average Reward	-160.700000
Episode	640	Reward	-150.000000	Average Reward	-161.800000
Episode	650	Reward	-196.000000	Average Reward	-170.300000
Episode	660	Reward	-196.000000	Average Reward	-155.100000
Episode	670	Reward	-232.000000	Average Reward	-152.200000
Episode	680	Reward	-111.000000	Average Reward	-125.200000
Episode	690	Reward	-141.000000	Average Reward	-137.000000
Episode	700	Reward	-119.000000	Average Reward	-143.800000
Episode	710	Reward	-147.000000	Average Reward	-154.400000

Episode 720 Reward -145.000000 Average Reward -150.200000
Episode 730 Reward -127.000000 Average Reward -149.300000
Episode 740 Reward -103.000000 Average Reward -124.400000
Episode 750 Reward -128.000000 Average Reward -141.600000
Episode 760 Reward -139.000000 Average Reward -148.300000
Episode 770 Reward -116.000000 Average Reward -133.000000
Episode 780 Reward -118.000000 Average Reward -134.800000
Episode 790 Reward -91.000000 Average Reward -134.700000
Episode 800 Reward -114.000000 Average Reward -166.300000
Episode 810 Reward -129.000000 Average Reward -144.300000
Episode 820 Reward -196.000000 Average Reward -125.300000
Episode 830 Reward -208.000000 Average Reward -142.500000
Episode 840 Reward -152.000000 Average Reward -132.200000
Episode 850 Reward -149.000000 Average Reward -155.000000
Episode 860 Reward -125.000000 Average Reward -155.200000
Episode 870 Reward -134.000000 Average Reward -140.700000
Episode 880 Reward -155.000000 Average Reward -139.300000
Episode 890 Reward -162.000000 Average Reward -142.300000
Episode 900 Reward -142.000000 Average Reward -123.800000
Episode 910 Reward -167.000000 Average Reward -145.100000
Episode 920 Reward -136.000000 Average Reward -142.300000
Episode 930 Reward -143.000000 Average Reward -144.800000
Episode 940 Reward -168.000000 Average Reward -169.800000
Episode 950 Reward -124.000000 Average Reward -136.800000
Episode 960 Reward -112.000000 Average Reward -126.500000
Episode 970 Reward -118.000000 Average Reward -111.900000
Episode 980 Reward -100.000000 Average Reward -139.600000
Episode 990 Reward -193.000000 Average Reward -137.200000
Episode 1000 Reward -139.000000 Average Reward -148.400000

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Episode 10 Reward -441.000000 Average Reward -494.100000
Episode 20 Reward -500.000000 Average Reward -390.500000
Episode 30 Reward -241.000000 Average Reward -311.300000
Episode 40 Reward -365.000000 Average Reward -327.200000
Episode 50 Reward -280.000000 Average Reward -324.500000
Episode 60 Reward -228.000000 Average Reward -306.900000
Episode 70 Reward -321.000000 Average Reward -351.100000
Episode 80 Reward -291.000000 Average Reward -363.300000
Episode 90 Reward -323.000000 Average Reward -337.500000
Episode 100 Reward -403.000000 Average Reward -356.800000
Episode 110 Reward -246.000000 Average Reward -328.300000
Episode 120 Reward -346.000000 Average Reward -340.700000
Episode 130 Reward -197.000000 Average Reward -275.600000
Episode 140 Reward -380.000000 Average Reward -304.000000
Episode 150 Reward -278.000000 Average Reward -328.700000
Episode 160 Reward -284.000000 Average Reward -333.600000
Episode 170 Reward -409.000000 Average Reward -406.800000
Episode 180 Reward -500.000000 Average Reward -476.100000

Episode 190 Reward -500.000000 Average Reward -484.000000
Episode 200 Reward -500.000000 Average Reward -487.900000
Episode 210 Reward -500.000000 Average Reward -498.100000
Episode 220 Reward -500.000000 Average Reward -476.600000
Episode 230 Reward -476.000000 Average Reward -493.800000
Episode 240 Reward -500.000000 Average Reward -489.100000
Episode 250 Reward -428.000000 Average Reward -471.300000
Episode 260 Reward -500.000000 Average Reward -484.700000
Episode 270 Reward -496.000000 Average Reward -442.100000
Episode 280 Reward -401.000000 Average Reward -432.200000
Episode 290 Reward -339.000000 Average Reward -405.400000
Episode 300 Reward -471.000000 Average Reward -463.500000
Episode 310 Reward -500.000000 Average Reward -437.700000
Episode 320 Reward -500.000000 Average Reward -448.700000
Episode 330 Reward -500.000000 Average Reward -500.000000
Episode 340 Reward -500.000000 Average Reward -463.100000
Episode 350 Reward -500.000000 Average Reward -467.200000
Episode 360 Reward -500.000000 Average Reward -422.600000
Episode 370 Reward -250.000000 Average Reward -374.200000
Episode 380 Reward -394.000000 Average Reward -378.600000
Episode 390 Reward -408.000000 Average Reward -393.400000
Episode 400 Reward -249.000000 Average Reward -269.500000
Episode 410 Reward -245.000000 Average Reward -281.700000
Episode 420 Reward -427.000000 Average Reward -252.100000
Episode 430 Reward -304.000000 Average Reward -260.600000
Episode 440 Reward -260.000000 Average Reward -261.000000
Episode 450 Reward -354.000000 Average Reward -300.500000
Episode 460 Reward -270.000000 Average Reward -321.700000
Episode 470 Reward -352.000000 Average Reward -353.300000
Episode 480 Reward -305.000000 Average Reward -330.800000
Episode 490 Reward -353.000000 Average Reward -336.900000
Episode 500 Reward -177.000000 Average Reward -302.600000
Episode 510 Reward -293.000000 Average Reward -287.500000
Episode 520 Reward -289.000000 Average Reward -349.300000
Episode 530 Reward -500.000000 Average Reward -368.000000
Episode 540 Reward -500.000000 Average Reward -441.800000
Episode 550 Reward -461.000000 Average Reward -434.100000
Episode 560 Reward -361.000000 Average Reward -418.000000
Episode 570 Reward -500.000000 Average Reward -482.600000
Episode 580 Reward -500.000000 Average Reward -498.300000
Episode 590 Reward -500.000000 Average Reward -500.000000
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Episode 610 Reward -500.000000 Average Reward -500.000000
Episode 620 Reward -500.000000 Average Reward -500.000000
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Episode 670 Reward -500.000000 Average Reward -500.000000
Episode 680 Reward -500.000000 Average Reward -484.800000
Episode 690 Reward -279.000000 Average Reward -458.200000
Episode 700 Reward -500.000000 Average Reward -487.500000
Episode 710 Reward -500.000000 Average Reward -475.900000
Episode 720 Reward -500.000000 Average Reward -500.000000
Episode 730 Reward -500.000000 Average Reward -500.000000
Episode 740 Reward -421.000000 Average Reward -454.200000
Episode 750 Reward -500.000000 Average Reward -499.000000
Episode 760 Reward -500.000000 Average Reward -492.200000
Episode 770 Reward -500.000000 Average Reward -487.800000
Episode 780 Reward -500.000000 Average Reward -500.000000
Episode 790 Reward -500.000000 Average Reward -500.000000
Episode 800 Reward -500.000000 Average Reward -500.000000
Episode 810 Reward -500.000000 Average Reward -500.000000
Episode 820 Reward -321.000000 Average Reward -453.700000
Episode 830 Reward -338.000000 Average Reward -392.000000
Episode 840 Reward -358.000000 Average Reward -361.300000
Episode 850 Reward -473.000000 Average Reward -362.400000
Episode 860 Reward -191.000000 Average Reward -261.900000
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Episode 880 Reward -330.000000 Average Reward -233.500000
Episode 890 Reward -252.000000 Average Reward -311.100000
Episode 900 Reward -500.000000 Average Reward -374.900000
Episode 910 Reward -465.000000 Average Reward -369.500000
Episode 920 Reward -345.000000 Average Reward -442.300000
Episode 930 Reward -379.000000 Average Reward -460.700000
Episode 940 Reward -260.000000 Average Reward -453.300000
Episode 950 Reward -409.000000 Average Reward -490.900000
Episode 960 Reward -500.000000 Average Reward -500.000000
Episode 970 Reward -500.000000 Average Reward -500.000000
Episode 980 Reward -500.000000 Average Reward -500.000000
Episode 990 Reward -500.000000 Average Reward -500.000000
Episode 1000 Reward -500.000000 Average Reward -500.000000

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Episode 10 Reward -461.000000 Average Reward -496.100000
Episode 20 Reward -283.000000 Average Reward -418.000000
Episode 30 Reward -370.000000 Average Reward -449.000000
Episode 40 Reward -280.000000 Average Reward -279.300000
Episode 50 Reward -342.000000 Average Reward -286.300000
Episode 60 Reward -200.000000 Average Reward -225.600000
Episode 70 Reward -182.000000 Average Reward -262.800000
Episode 80 Reward -199.000000 Average Reward -235.700000
Episode 90 Reward -202.000000 Average Reward -235.900000
Episode 100 Reward -194.000000 Average Reward -209.100000
Episode 110 Reward -209.000000 Average Reward -200.300000
Episode 120 Reward -237.000000 Average Reward -232.700000
Episode 130 Reward -178.000000 Average Reward -200.600000

Episode 140 Reward -155.000000 Average Reward -154.400000
Episode 150 Reward -138.000000 Average Reward -161.800000
Episode 160 Reward -208.000000 Average Reward -187.900000
Episode 170 Reward -145.000000 Average Reward -149.000000
Episode 180 Reward -151.000000 Average Reward -165.200000
Episode 190 Reward -114.000000 Average Reward -161.300000
Episode 200 Reward -141.000000 Average Reward -139.000000
Episode 210 Reward -119.000000 Average Reward -140.800000
Episode 220 Reward -174.000000 Average Reward -164.000000
Episode 230 Reward -155.000000 Average Reward -157.400000
Episode 240 Reward -500.000000 Average Reward -188.800000
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Episode 260 Reward -130.000000 Average Reward -144.100000
Episode 270 Reward -174.000000 Average Reward -185.700000
Episode 280 Reward -109.000000 Average Reward -138.600000
Episode 290 Reward -117.000000 Average Reward -153.000000
Episode 300 Reward -135.000000 Average Reward -132.000000
Episode 310 Reward -145.000000 Average Reward -131.900000
Episode 320 Reward -108.000000 Average Reward -151.100000
Episode 330 Reward -171.000000 Average Reward -166.200000
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Episode 350 Reward -104.000000 Average Reward -117.400000
Episode 360 Reward -131.000000 Average Reward -125.300000
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Episode 390 Reward -77.000000 Average Reward -136.700000
Episode 400 Reward -112.000000 Average Reward -119.300000
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Episode 420 Reward -119.000000 Average Reward -121.100000
Episode 430 Reward -119.000000 Average Reward -124.300000
Episode 440 Reward -110.000000 Average Reward -119.000000
Episode 450 Reward -225.000000 Average Reward -121.500000
Episode 460 Reward -115.000000 Average Reward -124.200000
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Episode 480 Reward -118.000000 Average Reward -147.400000
Episode 490 Reward -94.000000 Average Reward -126.000000
Episode 500 Reward -122.000000 Average Reward -129.000000
Episode 510 Reward -87.000000 Average Reward -120.100000
Episode 520 Reward -106.000000 Average Reward -144.700000
Episode 530 Reward -96.000000 Average Reward -101.100000
Episode 540 Reward -200.000000 Average Reward -135.200000
Episode 550 Reward -133.000000 Average Reward -117.100000
Episode 560 Reward -91.000000 Average Reward -119.100000
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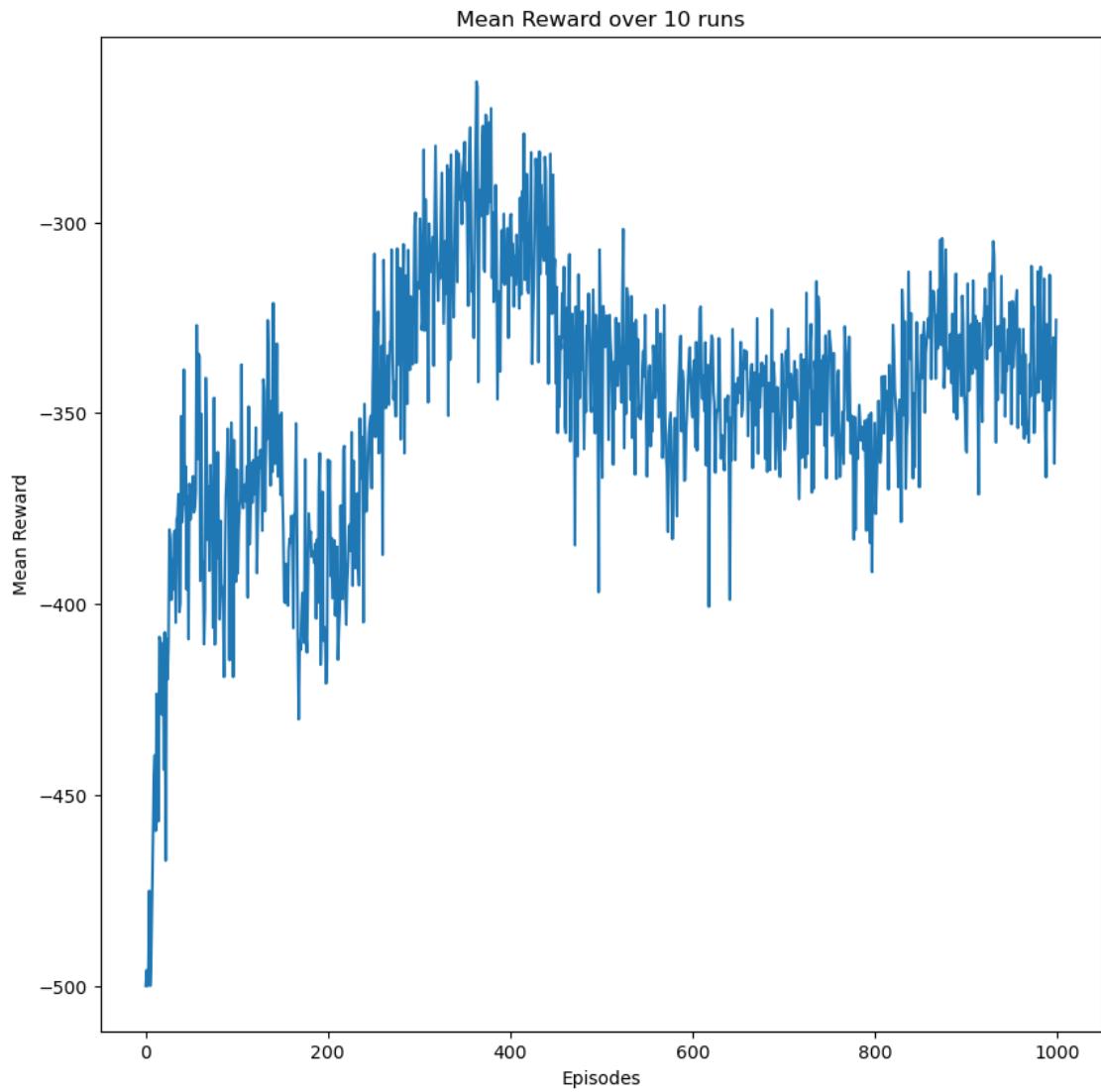
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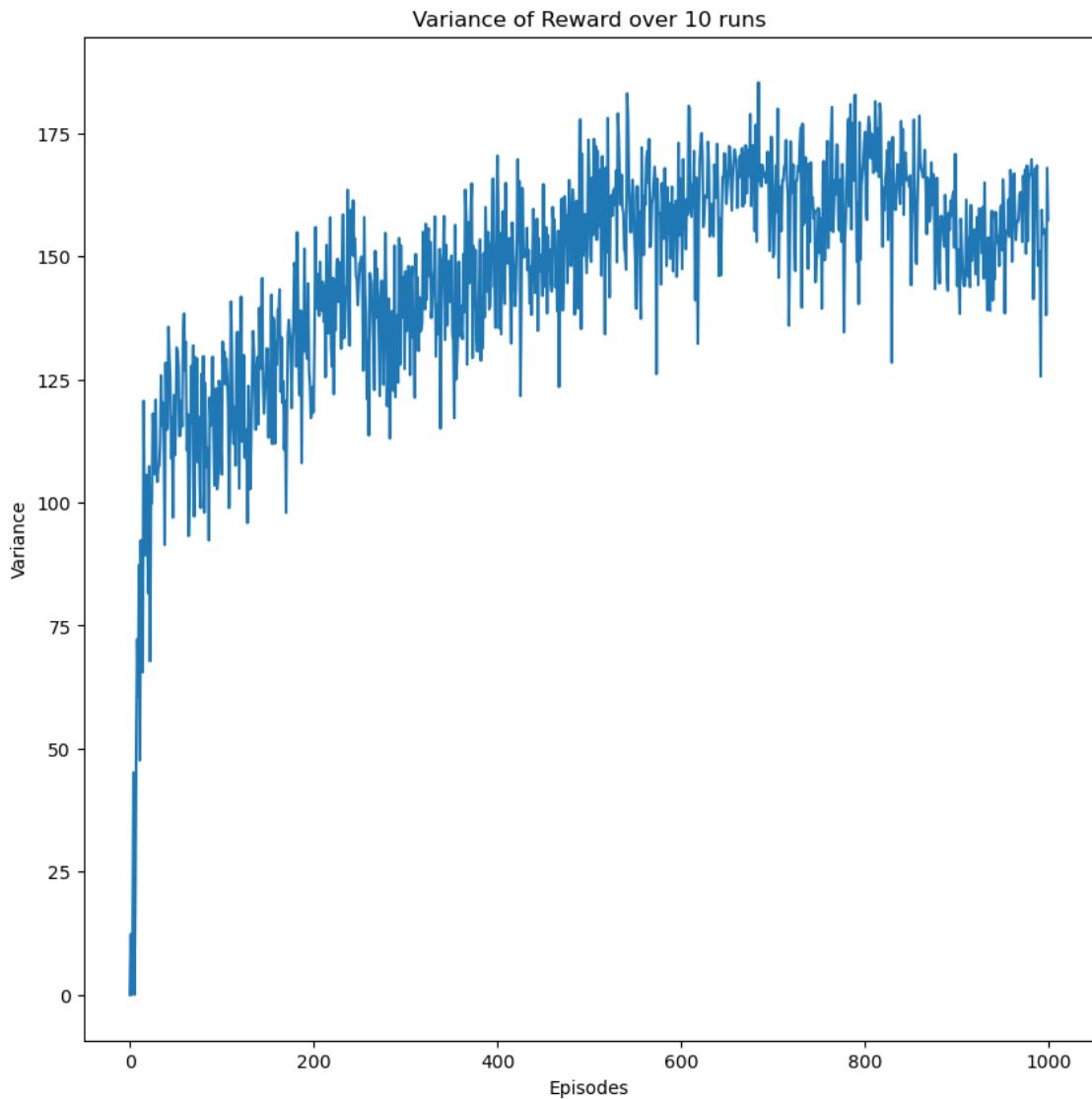
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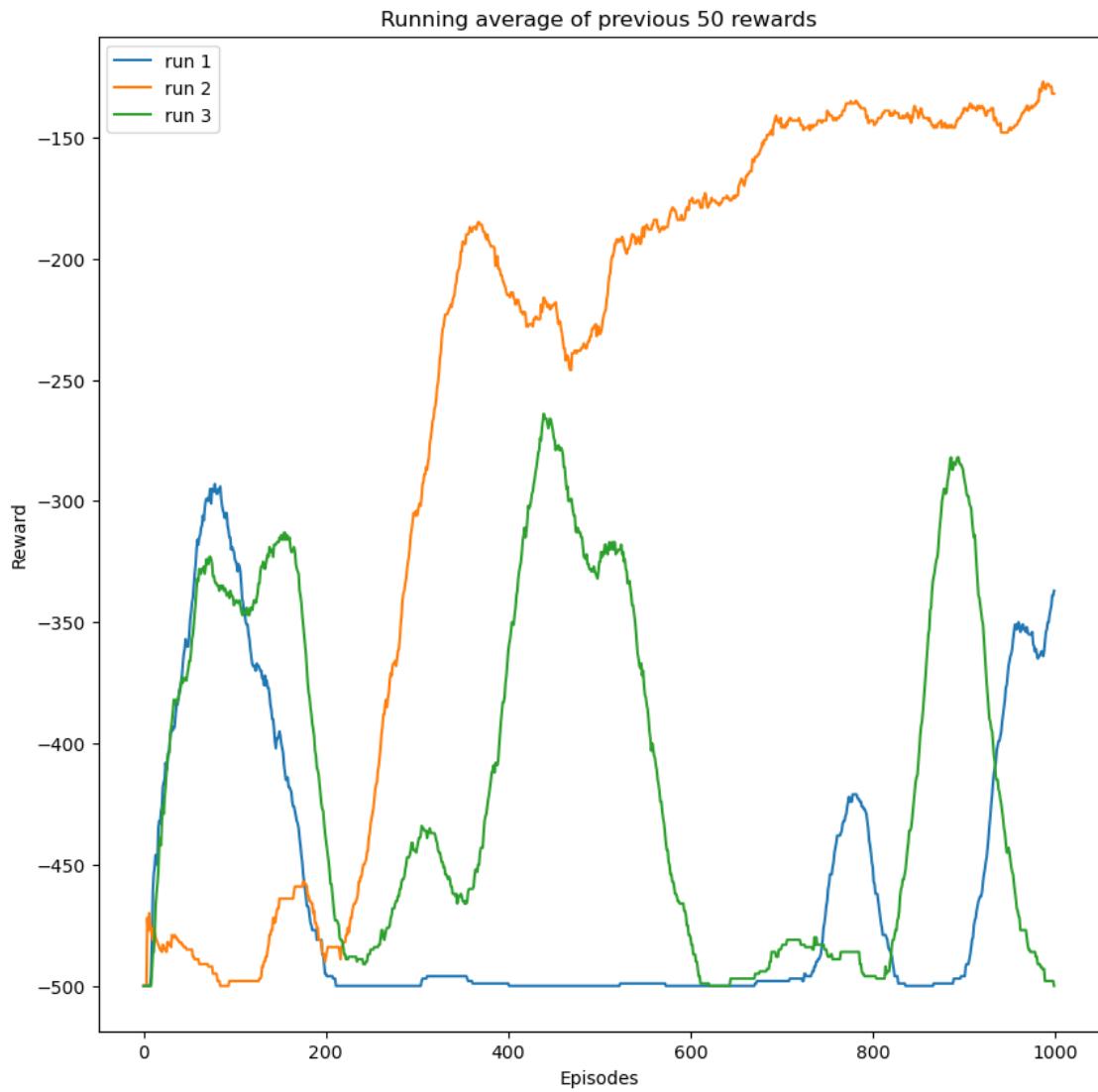
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 Episode 210 Reward -317.000000 Average Reward -223.100000
 Episode 220 Reward -163.000000 Average Reward -213.400000
 Episode 230 Reward -177.000000 Average Reward -213.600000
 Episode 240 Reward -211.000000 Average Reward -198.900000
 Episode 250 Reward -160.000000 Average Reward -168.400000
 Episode 260 Reward -209.000000 Average Reward -194.600000
 Episode 270 Reward -108.000000 Average Reward -158.100000
 Episode 280 Reward -195.000000 Average Reward -184.800000
 Episode 290 Reward -222.000000 Average Reward -206.500000
 Episode 300 Reward -153.000000 Average Reward -150.300000
 Episode 310 Reward -150.000000 Average Reward -134.300000

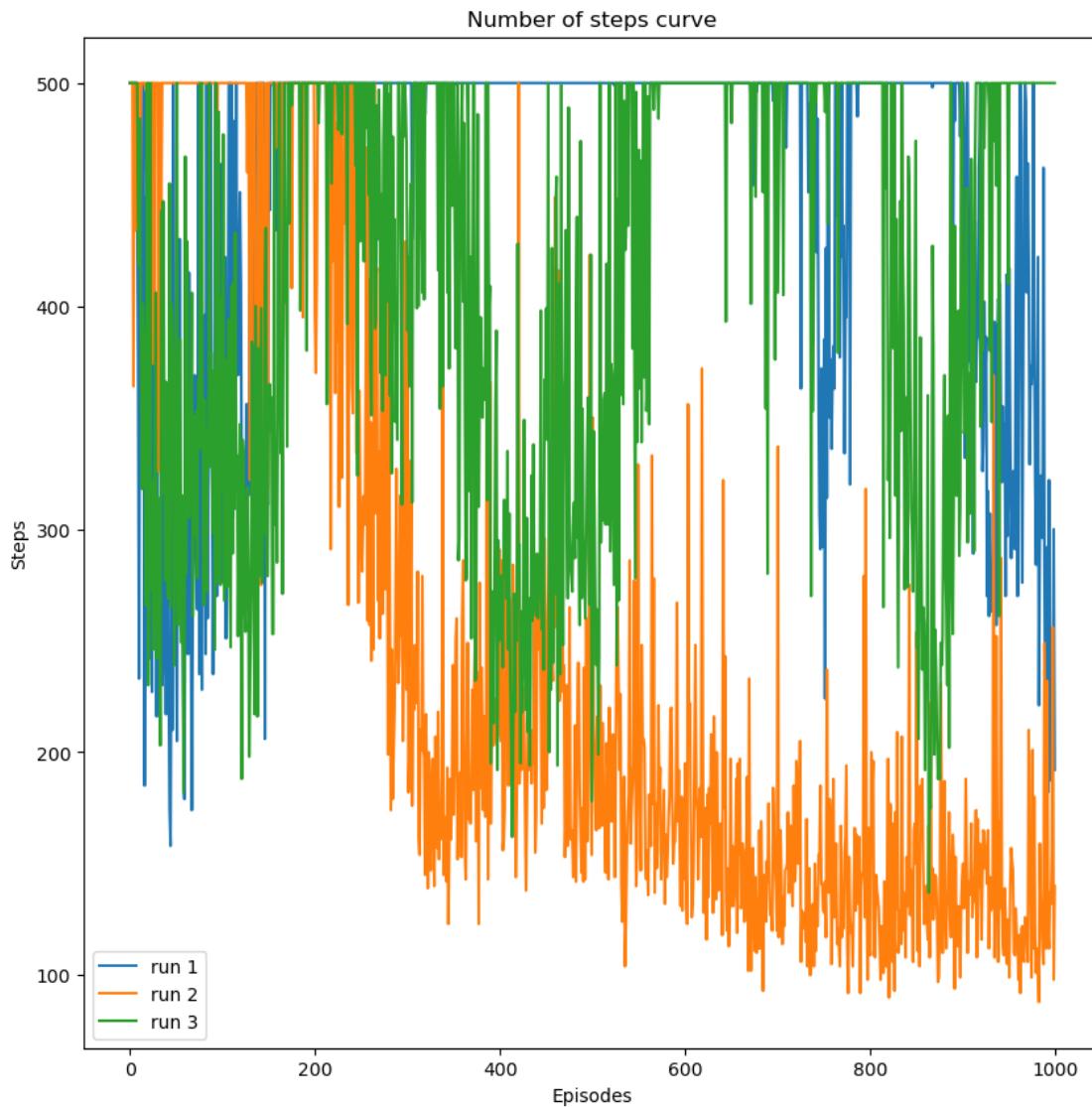
Episode 320 Reward -121.000000 Average Reward -145.500000
Episode 330 Reward -151.000000 Average Reward -127.600000
Episode 340 Reward -250.000000 Average Reward -159.300000
Episode 350 Reward -164.000000 Average Reward -136.000000
Episode 360 Reward -140.000000 Average Reward -154.400000
Episode 370 Reward -180.000000 Average Reward -141.500000
Episode 380 Reward -186.000000 Average Reward -141.100000
Episode 390 Reward -191.000000 Average Reward -161.500000
Episode 400 Reward -107.000000 Average Reward -138.400000
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Episode 440 Reward -112.000000 Average Reward -148.700000
Episode 450 Reward -116.000000 Average Reward -134.300000
Episode 460 Reward -141.000000 Average Reward -131.300000
Episode 470 Reward -122.000000 Average Reward -122.100000
Episode 480 Reward -114.000000 Average Reward -129.700000
Episode 490 Reward -118.000000 Average Reward -151.400000
Episode 500 Reward -126.000000 Average Reward -173.100000
Episode 510 Reward -101.000000 Average Reward -124.200000
Episode 520 Reward -222.000000 Average Reward -149.600000
Episode 530 Reward -93.000000 Average Reward -142.200000
Episode 540 Reward -162.000000 Average Reward -134.500000
Episode 550 Reward -148.000000 Average Reward -128.200000
Episode 560 Reward -174.000000 Average Reward -140.200000
Episode 570 Reward -105.000000 Average Reward -117.500000
Episode 580 Reward -99.000000 Average Reward -160.700000
Episode 590 Reward -128.000000 Average Reward -141.400000
Episode 600 Reward -152.000000 Average Reward -154.500000
Episode 610 Reward -89.000000 Average Reward -152.700000
Episode 620 Reward -128.000000 Average Reward -160.400000
Episode 630 Reward -126.000000 Average Reward -134.600000
Episode 640 Reward -139.000000 Average Reward -139.400000
Episode 650 Reward -111.000000 Average Reward -142.000000
Episode 660 Reward -129.000000 Average Reward -125.800000
Episode 670 Reward -113.000000 Average Reward -124.000000
Episode 680 Reward -107.000000 Average Reward -125.300000
Episode 690 Reward -128.000000 Average Reward -139.300000
Episode 700 Reward -196.000000 Average Reward -145.000000
Episode 710 Reward -185.000000 Average Reward -154.700000
Episode 720 Reward -118.000000 Average Reward -149.700000
Episode 730 Reward -176.000000 Average Reward -164.600000
Episode 740 Reward -154.000000 Average Reward -144.900000
Episode 750 Reward -184.000000 Average Reward -177.500000
Episode 760 Reward -134.000000 Average Reward -213.200000
Episode 770 Reward -105.000000 Average Reward -152.700000
Episode 780 Reward -192.000000 Average Reward -152.800000
Episode 790 Reward -124.000000 Average Reward -156.600000

Episode 800 Reward -154.000000 Average Reward -201.400000
Episode 810 Reward -155.000000 Average Reward -128.100000
Episode 820 Reward -138.000000 Average Reward -135.200000
Episode 830 Reward -500.000000 Average Reward -170.200000
Episode 840 Reward -90.000000 Average Reward -127.100000
Episode 850 Reward -115.000000 Average Reward -110.100000
Episode 860 Reward -100.000000 Average Reward -132.100000
Episode 870 Reward -152.000000 Average Reward -145.400000
Episode 880 Reward -157.000000 Average Reward -165.900000
Episode 890 Reward -184.000000 Average Reward -190.200000
Episode 900 Reward -268.000000 Average Reward -180.800000
Episode 910 Reward -174.000000 Average Reward -195.100000
Episode 920 Reward -174.000000 Average Reward -188.400000
Episode 930 Reward -185.000000 Average Reward -195.700000
Episode 940 Reward -191.000000 Average Reward -248.900000
Episode 950 Reward -414.000000 Average Reward -295.000000
Episode 960 Reward -409.000000 Average Reward -303.000000
Episode 970 Reward -500.000000 Average Reward -364.500000
Episode 980 Reward -248.000000 Average Reward -344.800000
Episode 990 Reward -290.000000 Average Reward -364.100000
Episode 1000 Reward -311.000000 Average Reward -323.600000
0:06:47.316580









```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [1024, 1024]
LR = 1e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'Acrobot-v1'
SOLVE_CUTOFF = -100.0
STEP = 10

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{hs}-{lr}-{env}-{numep}-{nstep}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	-414.000000	-403.900000
20	-253.000000	-243.500000
30	-204.000000	-265.300000
40	-221.000000	-252.100000
50	-260.000000	-223.600000
60	-142.000000	-227.400000
70	-276.000000	-235.800000
80	-229.000000	-197.400000
90	-130.000000	-156.500000
100	-290.000000	-170.800000
110	-170.000000	-155.100000
120	-127.000000	-164.300000
130	-230.000000	-178.600000
140	-105.000000	-193.500000
150	-213.000000	-179.900000
160	-202.000000	-204.400000
170	-119.000000	-169.900000
180	-142.000000	-205.700000
190	-135.000000	-165.800000
200	-187.000000	-149.200000
210	-136.000000	-137.100000
220	-150.000000	-145.500000
230	-173.000000	-137.600000
240	-155.000000	-143.600000
250	-116.000000	-122.700000
260	-147.000000	-128.800000
270	-127.000000	-122.600000
280	-102.000000	-120.900000

Episode 290 Reward -110.000000 Average Reward -140.000000
Episode 300 Reward -122.000000 Average Reward -152.000000
Episode 310 Reward -122.000000 Average Reward -113.800000
Episode 320 Reward -135.000000 Average Reward -116.000000
Episode 330 Reward -144.000000 Average Reward -120.800000
Episode 340 Reward -110.000000 Average Reward -114.300000
Episode 350 Reward -112.000000 Average Reward -123.800000
Episode 360 Reward -105.000000 Average Reward -108.700000
Episode 370 Reward -79.000000 Average Reward -108.600000
Episode 380 Reward -101.000000 Average Reward -106.500000
Episode 390 Reward -95.000000 Average Reward -115.400000
Episode 400 Reward -115.000000 Average Reward -111.700000
Episode 410 Reward -115.000000 Average Reward -119.100000
Episode 420 Reward -98.000000 Average Reward -115.100000
Episode 430 Reward -84.000000 Average Reward -88.400000
Episode 440 Reward -107.000000 Average Reward -95.000000
Episode 450 Reward -105.000000 Average Reward -98.900000
Episode 460 Reward -148.000000 Average Reward -115.900000
Episode 470 Reward -111.000000 Average Reward -109.400000
Episode 480 Reward -78.000000 Average Reward -94.100000
Episode 490 Reward -81.000000 Average Reward -105.900000
Episode 500 Reward -119.000000 Average Reward -103.000000
Episode 510 Reward -119.000000 Average Reward -98.700000
Episode 520 Reward -100.000000 Average Reward -104.800000
Episode 530 Reward -95.000000 Average Reward -110.400000
Episode 540 Reward -115.000000 Average Reward -135.900000
Episode 550 Reward -103.000000 Average Reward -110.200000
Episode 560 Reward -98.000000 Average Reward -95.400000
Episode 570 Reward -74.000000 Average Reward -100.100000
Episode 580 Reward -79.000000 Average Reward -107.800000
Episode 590 Reward -97.000000 Average Reward -118.000000
Episode 600 Reward -77.000000 Average Reward -106.500000
Episode 610 Reward -91.000000 Average Reward -89.800000
Episode 620 Reward -88.000000 Average Reward -127.100000
Episode 630 Reward -82.000000 Average Reward -93.100000
Episode 640 Reward -92.000000 Average Reward -110.800000
Episode 650 Reward -98.000000 Average Reward -106.900000
Episode 660 Reward -76.000000 Average Reward -91.800000
Episode 670 Reward -92.000000 Average Reward -99.000000
Episode 680 Reward -92.000000 Average Reward -86.600000
Episode 690 Reward -93.000000 Average Reward -90.500000
Episode 700 Reward -82.000000 Average Reward -95.200000
Episode 710 Reward -76.000000 Average Reward -90.200000
Episode 720 Reward -95.000000 Average Reward -90.200000
Episode 730 Reward -148.000000 Average Reward -114.600000
Episode 740 Reward -99.000000 Average Reward -106.200000
Episode 750 Reward -84.000000 Average Reward -98.300000
Episode 760 Reward -98.000000 Average Reward -97.900000

Episode 770 Reward -241.000000 Average Reward -110.900000
Episode 780 Reward -104.000000 Average Reward -97.300000
Episode 790 Reward -85.000000 Average Reward -104.100000
Episode 800 Reward -187.000000 Average Reward -114.500000
Episode 810 Reward -101.000000 Average Reward -98.100000
Episode 820 Reward -78.000000 Average Reward -87.400000
Episode 830 Reward -110.000000 Average Reward -89.500000
Episode 840 Reward -63.000000 Average Reward -88.800000
Episode 850 Reward -72.000000 Average Reward -84.800000
Episode 860 Reward -84.000000 Average Reward -85.900000
Episode 870 Reward -66.000000 Average Reward -92.700000
Episode 880 Reward -63.000000 Average Reward -85.500000
Episode 890 Reward -80.000000 Average Reward -91.900000
Episode 900 Reward -112.000000 Average Reward -118.100000
Episode 910 Reward -100.000000 Average Reward -94.300000
Episode 920 Reward -80.000000 Average Reward -103.100000
Episode 930 Reward -99.000000 Average Reward -96.100000
Episode 940 Reward -115.000000 Average Reward -94.900000
Episode 950 Reward -102.000000 Average Reward -96.400000
Episode 960 Reward -84.000000 Average Reward -90.800000
Episode 970 Reward -70.000000 Average Reward -87.200000
Episode 980 Reward -92.000000 Average Reward -89.000000
Episode 990 Reward -147.000000 Average Reward -102.400000
Episode 1000 Reward -73.000000 Average Reward -92.800000
0:04:44.502171

Episode 10 Reward -500.000000 Average Reward -468.700000
Episode 20 Reward -500.000000 Average Reward -498.000000
Episode 30 Reward -500.000000 Average Reward -489.000000
Episode 40 Reward -475.000000 Average Reward -468.500000
Episode 50 Reward -500.000000 Average Reward -500.000000
Episode 60 Reward -500.000000 Average Reward -481.900000
Episode 70 Reward -212.000000 Average Reward -431.200000
Episode 80 Reward -489.000000 Average Reward -452.500000
Episode 90 Reward -366.000000 Average Reward -481.800000
Episode 100 Reward -500.000000 Average Reward -485.900000
Episode 110 Reward -500.000000 Average Reward -500.000000
Episode 120 Reward -500.000000 Average Reward -500.000000
Episode 130 Reward -474.000000 Average Reward -497.400000
Episode 140 Reward -387.000000 Average Reward -488.700000
Episode 150 Reward -500.000000 Average Reward -500.000000
Episode 160 Reward -500.000000 Average Reward -500.000000
Episode 170 Reward -500.000000 Average Reward -500.000000
Episode 180 Reward -500.000000 Average Reward -500.000000
Episode 190 Reward -500.000000 Average Reward -500.000000
Episode 200 Reward -481.000000 Average Reward -414.000000
Episode 210 Reward -228.000000 Average Reward -310.000000
Episode 220 Reward -170.000000 Average Reward -259.700000
Episode 230 Reward -206.000000 Average Reward -234.600000

Episode 240 Reward -221.000000 Average Reward -261.100000
Episode 250 Reward -278.000000 Average Reward -254.000000
Episode 260 Reward -249.000000 Average Reward -280.400000
Episode 270 Reward -192.000000 Average Reward -316.000000
Episode 280 Reward -240.000000 Average Reward -312.100000
Episode 290 Reward -277.000000 Average Reward -273.500000
Episode 300 Reward -276.000000 Average Reward -263.000000
Episode 310 Reward -315.000000 Average Reward -318.800000
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Episode 330 Reward -148.000000 Average Reward -218.700000
Episode 340 Reward -220.000000 Average Reward -213.700000
Episode 350 Reward -172.000000 Average Reward -192.600000
Episode 360 Reward -198.000000 Average Reward -189.800000
Episode 370 Reward -177.000000 Average Reward -206.700000
Episode 380 Reward -119.000000 Average Reward -192.400000
Episode 390 Reward -160.000000 Average Reward -205.800000
Episode 400 Reward -228.000000 Average Reward -215.600000
Episode 410 Reward -190.000000 Average Reward -247.600000
Episode 420 Reward -138.000000 Average Reward -254.100000
Episode 430 Reward -263.000000 Average Reward -221.900000
Episode 440 Reward -220.000000 Average Reward -211.400000
Episode 450 Reward -129.000000 Average Reward -203.900000
Episode 460 Reward -154.000000 Average Reward -184.800000
Episode 470 Reward -115.000000 Average Reward -162.200000
Episode 480 Reward -112.000000 Average Reward -169.200000
Episode 490 Reward -122.000000 Average Reward -147.300000
Episode 500 Reward -119.000000 Average Reward -133.000000
Episode 510 Reward -187.000000 Average Reward -198.900000
Episode 520 Reward -167.000000 Average Reward -172.500000
Episode 530 Reward -130.000000 Average Reward -178.400000
Episode 540 Reward -250.000000 Average Reward -195.400000
Episode 550 Reward -135.000000 Average Reward -179.100000
Episode 560 Reward -168.000000 Average Reward -155.800000
Episode 570 Reward -93.000000 Average Reward -143.100000
Episode 580 Reward -133.000000 Average Reward -179.600000
Episode 590 Reward -202.000000 Average Reward -201.000000
Episode 600 Reward -178.000000 Average Reward -181.900000
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Episode 640 Reward -127.000000 Average Reward -138.600000
Episode 650 Reward -247.000000 Average Reward -186.500000
Episode 660 Reward -165.000000 Average Reward -177.200000
Episode 670 Reward -142.000000 Average Reward -201.800000
Episode 680 Reward -159.000000 Average Reward -171.000000
Episode 690 Reward -160.000000 Average Reward -178.300000
Episode 700 Reward -211.000000 Average Reward -218.200000
Episode 710 Reward -264.000000 Average Reward -234.700000

Episode 720 Reward -206.000000 Average Reward -236.900000
Episode 730 Reward -196.000000 Average Reward -215.100000
Episode 740 Reward -179.000000 Average Reward -180.000000
Episode 750 Reward -178.000000 Average Reward -173.600000
Episode 760 Reward -120.000000 Average Reward -163.700000
Episode 770 Reward -139.000000 Average Reward -150.400000
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Episode 790 Reward -168.000000 Average Reward -161.200000
Episode 800 Reward -161.000000 Average Reward -186.000000
Episode 810 Reward -188.000000 Average Reward -188.700000
Episode 820 Reward -300.000000 Average Reward -279.100000
Episode 830 Reward -500.000000 Average Reward -327.600000
Episode 840 Reward -316.000000 Average Reward -302.400000
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Episode 970 Reward -500.000000 Average Reward -500.000000
Episode 980 Reward -500.000000 Average Reward -500.000000
Episode 990 Reward -500.000000 Average Reward -500.000000
Episode 1000 Reward -500.000000 Average Reward -500.000000

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Episode 10 Reward -500.000000 Average Reward -488.200000
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Episode 30 Reward -500.000000 Average Reward -500.000000
Episode 40 Reward -500.000000 Average Reward -500.000000
Episode 50 Reward -500.000000 Average Reward -500.000000
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Episode 70 Reward -500.000000 Average Reward -500.000000
Episode 80 Reward -500.000000 Average Reward -500.000000
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Episode 140 Reward -500.000000 Average Reward -500.000000
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Episode 670 Reward -500.000000 Average Reward -500.000000
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Episode 850 Reward -500.000000 Average Reward -500.000000
Episode 860 Reward -500.000000 Average Reward -500.000000
Episode 870 Reward -500.000000 Average Reward -500.000000
Episode 880 Reward -500.000000 Average Reward -500.000000
Episode 890 Reward -500.000000 Average Reward -500.000000
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Episode 910 Reward -500.000000 Average Reward -500.000000
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Episode 930 Reward -500.000000 Average Reward -500.000000
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Episode 950 Reward -500.000000 Average Reward -500.000000
Episode 960 Reward -500.000000 Average Reward -500.000000
Episode 970 Reward -500.000000 Average Reward -500.000000
Episode 980 Reward -500.000000 Average Reward -500.000000
Episode 990 Reward -500.000000 Average Reward -500.000000
Episode 1000 Reward -500.000000 Average Reward -500.000000

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Episode 10 Reward -500.000000 Average Reward -500.000000
Episode 20 Reward -309.000000 Average Reward -455.600000
Episode 30 Reward -318.000000 Average Reward -461.700000
Episode 40 Reward -282.000000 Average Reward -408.800000
Episode 50 Reward -497.000000 Average Reward -421.000000
Episode 60 Reward -246.000000 Average Reward -307.000000
Episode 70 Reward -344.000000 Average Reward -391.000000
Episode 80 Reward -451.000000 Average Reward -405.600000
Episode 90 Reward -500.000000 Average Reward -483.500000
Episode 100 Reward -500.000000 Average Reward -500.000000
Episode 110 Reward -500.000000 Average Reward -500.000000
Episode 120 Reward -408.000000 Average Reward -452.800000
Episode 130 Reward -500.000000 Average Reward -470.100000

Episode 620 Reward -459.000000 Average Reward -468.100000
Episode 630 Reward -448.000000 Average Reward -422.200000
Episode 640 Reward -427.000000 Average Reward -457.200000
Episode 650 Reward -500.000000 Average Reward -489.300000
Episode 660 Reward -500.000000 Average Reward -476.600000
Episode 670 Reward -500.000000 Average Reward -459.600000
Episode 680 Reward -469.000000 Average Reward -448.800000
Episode 690 Reward -365.000000 Average Reward -394.800000
Episode 700 Reward -447.000000 Average Reward -449.700000
Episode 710 Reward -389.000000 Average Reward -374.400000
Episode 720 Reward -364.000000 Average Reward -360.900000
Episode 730 Reward -474.000000 Average Reward -396.000000
Episode 740 Reward -500.000000 Average Reward -479.100000
Episode 750 Reward -500.000000 Average Reward -463.700000
Episode 760 Reward -500.000000 Average Reward -486.300000
Episode 770 Reward -500.000000 Average Reward -475.100000
Episode 780 Reward -500.000000 Average Reward -487.000000
Episode 790 Reward -500.000000 Average Reward -479.200000
Episode 800 Reward -500.000000 Average Reward -452.700000
Episode 810 Reward -467.000000 Average Reward -460.400000
Episode 820 Reward -500.000000 Average Reward -500.000000
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Episode 850 Reward -500.000000 Average Reward -500.000000
Episode 860 Reward -500.000000 Average Reward -500.000000
Episode 870 Reward -500.000000 Average Reward -465.800000
Episode 880 Reward -344.000000 Average Reward -459.700000
Episode 890 Reward -490.000000 Average Reward -439.700000
Episode 900 Reward -500.000000 Average Reward -472.200000
Episode 910 Reward -500.000000 Average Reward -462.700000
Episode 920 Reward -452.000000 Average Reward -495.200000
Episode 930 Reward -500.000000 Average Reward -470.600000
Episode 940 Reward -500.000000 Average Reward -471.000000
Episode 950 Reward -299.000000 Average Reward -410.200000
Episode 960 Reward -500.000000 Average Reward -475.000000
Episode 970 Reward -500.000000 Average Reward -495.600000
Episode 980 Reward -500.000000 Average Reward -500.000000
Episode 990 Reward -500.000000 Average Reward -500.000000
Episode 1000 Reward -500.000000 Average Reward -489.400000

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Episode 10 Reward -500.000000 Average Reward -424.200000
Episode 20 Reward -276.000000 Average Reward -286.400000
Episode 30 Reward -389.000000 Average Reward -398.200000
Episode 40 Reward -500.000000 Average Reward -468.100000
Episode 50 Reward -500.000000 Average Reward -403.700000
Episode 60 Reward -403.000000 Average Reward -409.600000
Episode 70 Reward -371.000000 Average Reward -353.500000
Episode 80 Reward -483.000000 Average Reward -424.700000

Episode 90 Reward -500.000000 Average Reward -475.800000
Episode 100 Reward -500.000000 Average Reward -478.800000
Episode 110 Reward -500.000000 Average Reward -500.000000
Episode 120 Reward -500.000000 Average Reward -500.000000
Episode 130 Reward -500.000000 Average Reward -498.300000
Episode 140 Reward -500.000000 Average Reward -469.100000
Episode 150 Reward -500.000000 Average Reward -500.000000
Episode 160 Reward -500.000000 Average Reward -492.200000
Episode 170 Reward -500.000000 Average Reward -480.600000
Episode 180 Reward -224.000000 Average Reward -442.900000
Episode 190 Reward -500.000000 Average Reward -419.200000
Episode 200 Reward -367.000000 Average Reward -429.300000
Episode 210 Reward -226.000000 Average Reward -278.200000
Episode 220 Reward -300.000000 Average Reward -282.200000
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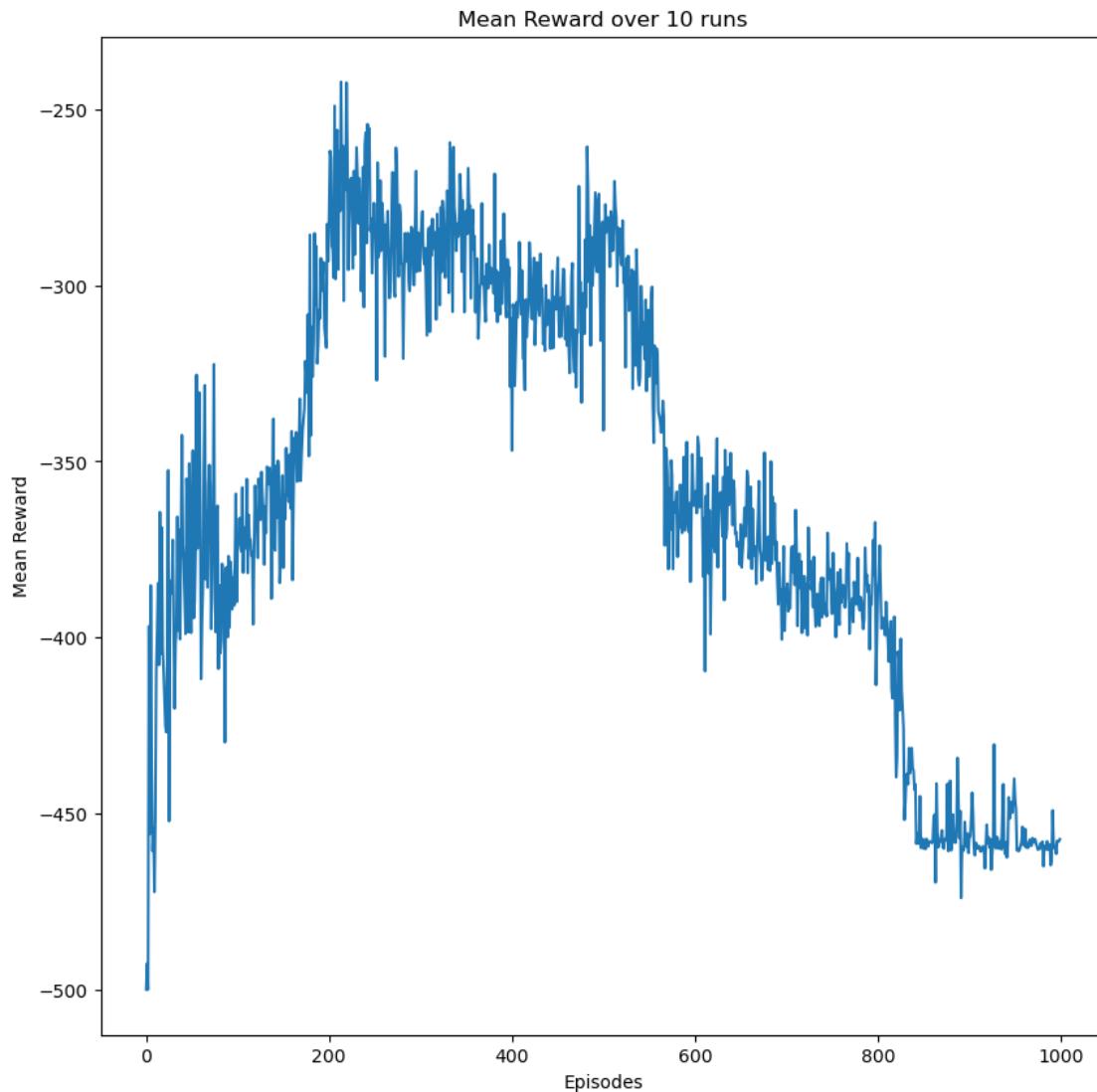
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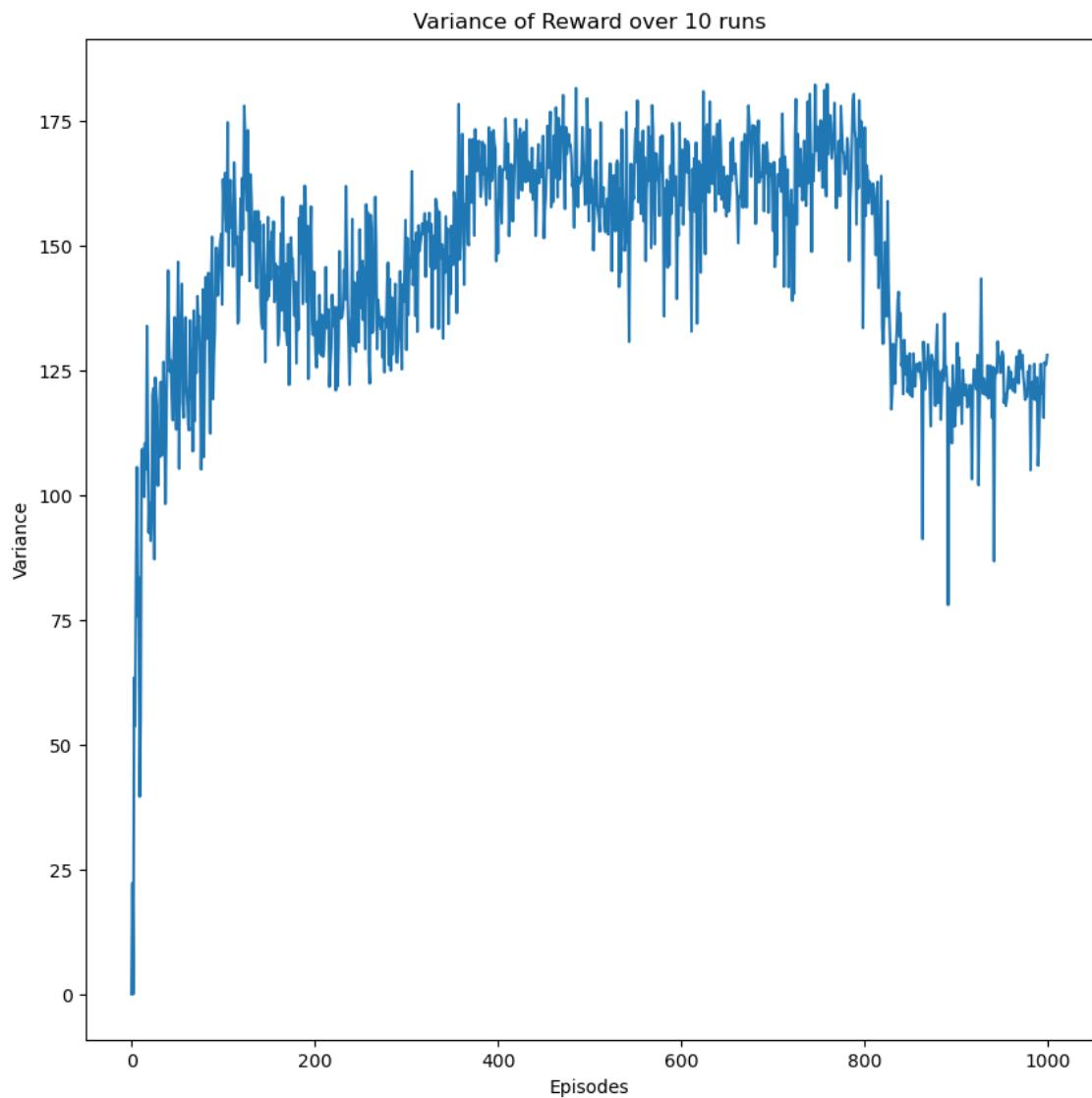
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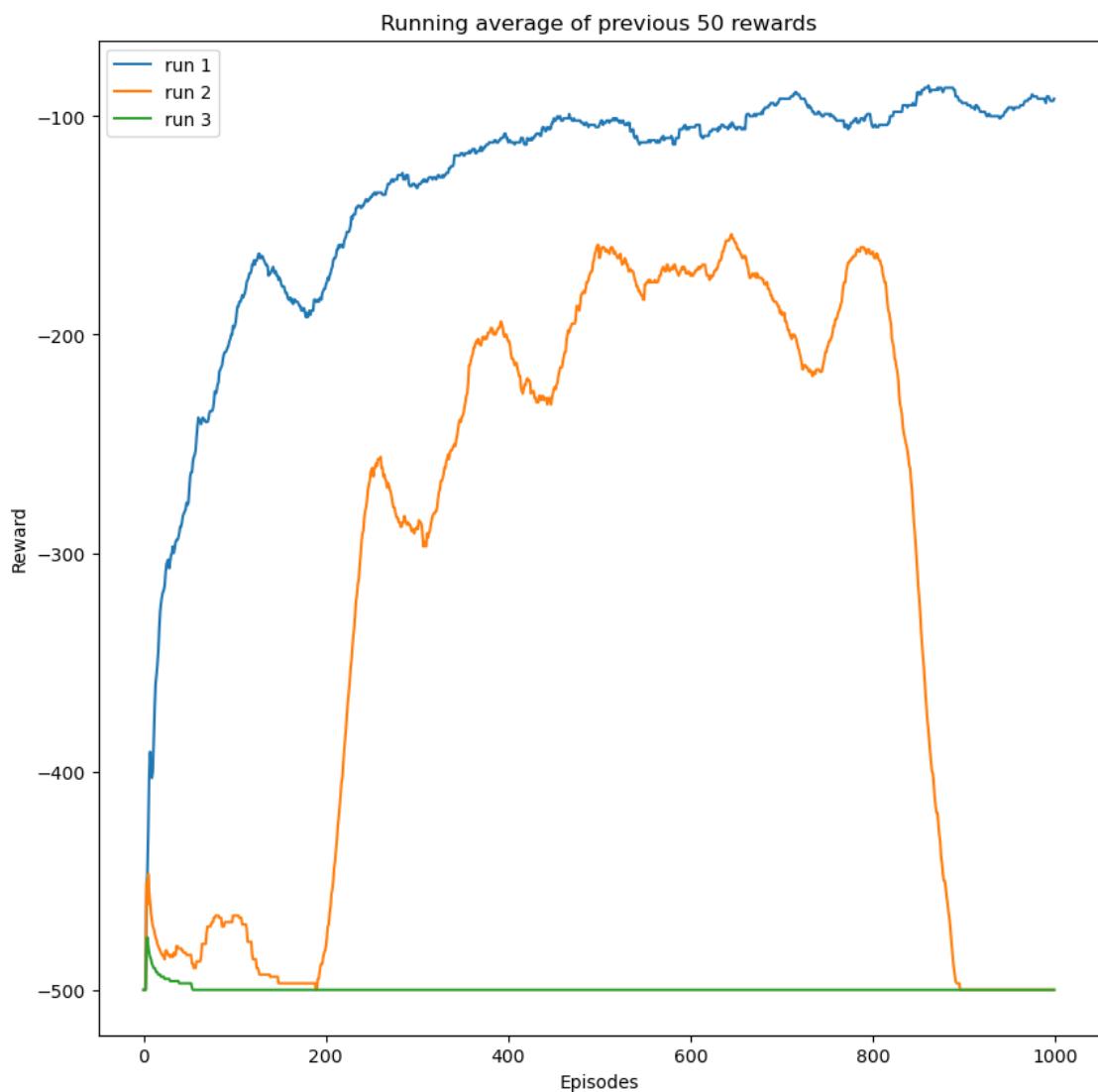
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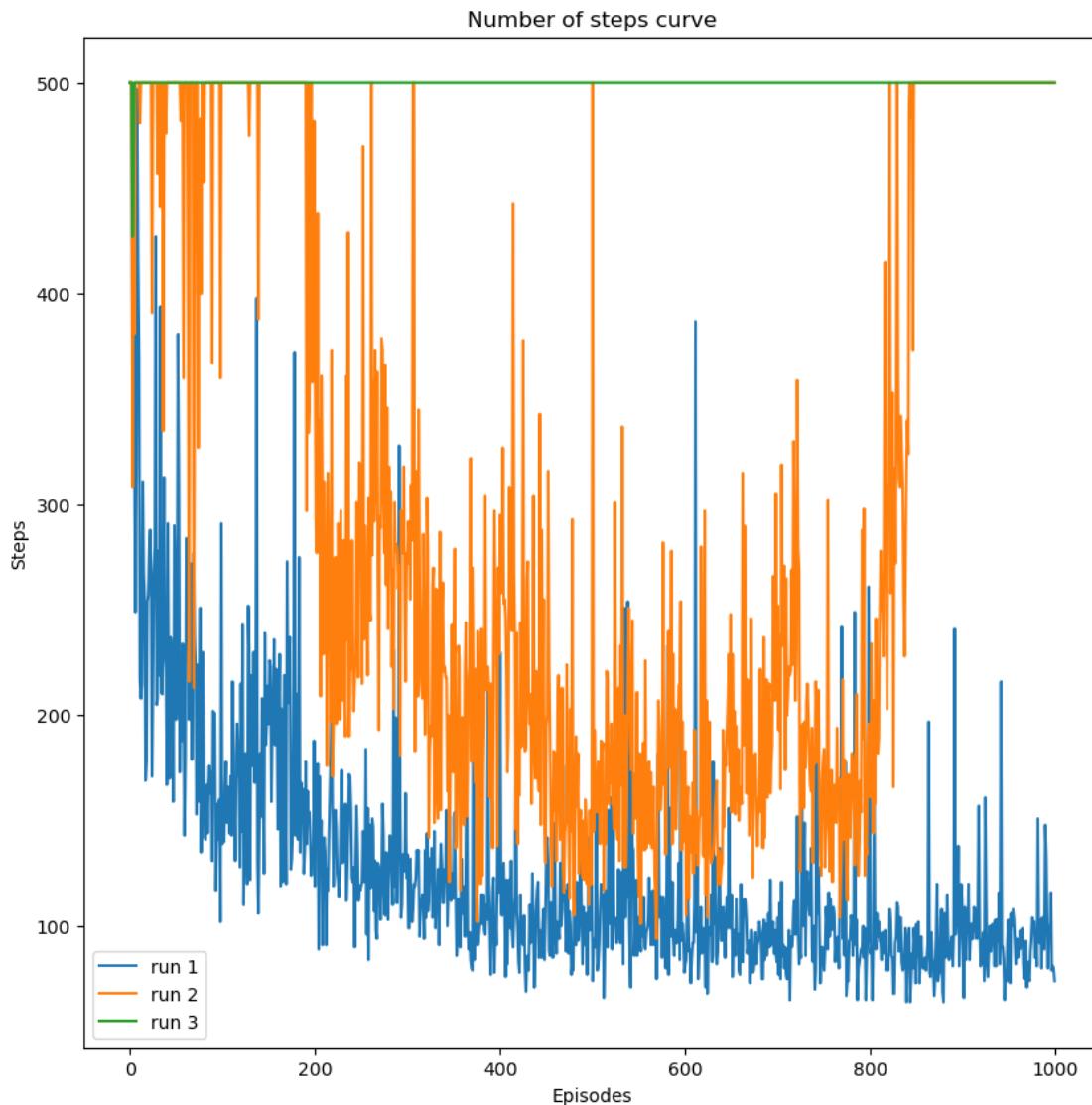
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Episode 410 Reward -213.000000 Average Reward -209.900000
Episode 420 Reward -192.000000 Average Reward -181.300000
Episode 430 Reward -237.000000 Average Reward -214.700000
Episode 440 Reward -198.000000 Average Reward -210.800000
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Episode 460 Reward -354.000000 Average Reward -280.300000
Episode 470 Reward -500.000000 Average Reward -405.000000
Episode 480 Reward -381.000000 Average Reward -332.600000
Episode 490 Reward -342.000000 Average Reward -251.900000
Episode 500 Reward -249.000000 Average Reward -253.500000
Episode 510 Reward -173.000000 Average Reward -229.100000
Episode 520 Reward -215.000000 Average Reward -216.700000
Episode 530 Reward -277.000000 Average Reward -273.300000
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Episode 550 Reward -387.000000 Average Reward -382.400000
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Episode 580 Reward -500.000000 Average Reward -500.000000
Episode 590 Reward -500.000000 Average Reward -500.000000
Episode 600 Reward -500.000000 Average Reward -500.000000
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Episode 850 Reward -500.000000 Average Reward -500.000000
Episode 860 Reward -500.000000 Average Reward -500.000000
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Episode 960 Reward -500.000000 Average Reward -500.000000
Episode 970 Reward -500.000000 Average Reward -500.000000
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Episode 990 Reward -500.000000 Average Reward -500.000000
Episode 1000 Reward -500.000000 Average Reward -500.000000
0:13:03.342944









```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [1024, 1024]
LR = 2e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'Acrobot-v1'
SOLVE_CUTOFF = -100.0
STEP = 10

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{hs}-{lr}-{env}-{numep}-{nstep}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	-167.000000	-285.900000
20	-155.000000	-182.000000
30	-229.000000	-210.400000
40	-231.000000	-188.400000
50	-209.000000	-228.100000
60	-312.000000	-236.800000
70	-216.000000	-264.300000
80	-230.000000	-241.200000
90	-230.000000	-258.100000
100	-276.000000	-215.400000
110	-263.000000	-229.900000
120	-210.000000	-301.700000
130	-201.000000	-252.800000
140	-290.000000	-210.400000
150	-232.000000	-193.500000
160	-201.000000	-221.800000
170	-220.000000	-221.000000
180	-205.000000	-190.700000
190	-140.000000	-155.200000
200	-156.000000	-169.700000
210	-125.000000	-172.500000
220	-112.000000	-129.500000
230	-155.000000	-141.700000
240	-184.000000	-186.600000
250	-299.000000	-235.600000
260	-500.000000	-381.000000
270	-500.000000	-500.000000
280	-500.000000	-500.000000

Episode 720 Reward -500.000000 Average Reward -500.000000
Episode 730 Reward -500.000000 Average Reward -500.000000
Episode 740 Reward -500.000000 Average Reward -500.000000
Episode 750 Reward -500.000000 Average Reward -500.000000
Episode 760 Reward -500.000000 Average Reward -500.000000
Episode 770 Reward -500.000000 Average Reward -500.000000
Episode 780 Reward -500.000000 Average Reward -500.000000
Episode 790 Reward -500.000000 Average Reward -500.000000
Episode 800 Reward -500.000000 Average Reward -500.000000
Episode 810 Reward -500.000000 Average Reward -500.000000
Episode 820 Reward -500.000000 Average Reward -500.000000
Episode 830 Reward -500.000000 Average Reward -500.000000
Episode 840 Reward -500.000000 Average Reward -500.000000
Episode 850 Reward -500.000000 Average Reward -500.000000
Episode 860 Reward -500.000000 Average Reward -500.000000
Episode 870 Reward -500.000000 Average Reward -500.000000
Episode 880 Reward -500.000000 Average Reward -500.000000
Episode 890 Reward -500.000000 Average Reward -500.000000
Episode 900 Reward -500.000000 Average Reward -500.000000
Episode 910 Reward -500.000000 Average Reward -500.000000
Episode 920 Reward -500.000000 Average Reward -500.000000
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Episode 940 Reward -500.000000 Average Reward -500.000000
Episode 950 Reward -500.000000 Average Reward -500.000000
Episode 960 Reward -500.000000 Average Reward -500.000000
Episode 970 Reward -500.000000 Average Reward -500.000000
Episode 980 Reward -500.000000 Average Reward -500.000000
Episode 990 Reward -500.000000 Average Reward -500.000000
Episode 1000 Reward -500.000000 Average Reward -500.000000
0:17:54.302268
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Episode 30 Reward -195.000000 Average Reward -251.400000
Episode 40 Reward -156.000000 Average Reward -177.700000
Episode 50 Reward -203.000000 Average Reward -193.300000
Episode 60 Reward -332.000000 Average Reward -247.700000
Episode 70 Reward -455.000000 Average Reward -398.900000
Episode 80 Reward -420.000000 Average Reward -428.100000
Episode 90 Reward -182.000000 Average Reward -327.300000
Episode 100 Reward -371.000000 Average Reward -372.700000
Episode 110 Reward -500.000000 Average Reward -454.000000
Episode 120 Reward -500.000000 Average Reward -489.500000
Episode 130 Reward -500.000000 Average Reward -489.100000
Episode 140 Reward -500.000000 Average Reward -500.000000
Episode 150 Reward -500.000000 Average Reward -500.000000
Episode 160 Reward -500.000000 Average Reward -500.000000
Episode 170 Reward -500.000000 Average Reward -500.000000
Episode 180 Reward -500.000000 Average Reward -500.000000

Episode 670 Reward -500.000000 Average Reward -500.000000
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 Episode 50 Reward -208.000000 Average Reward -202.500000
 Episode 60 Reward -188.000000 Average Reward -216.700000
 Episode 70 Reward -134.000000 Average Reward -166.900000
 Episode 80 Reward -180.000000 Average Reward -184.200000
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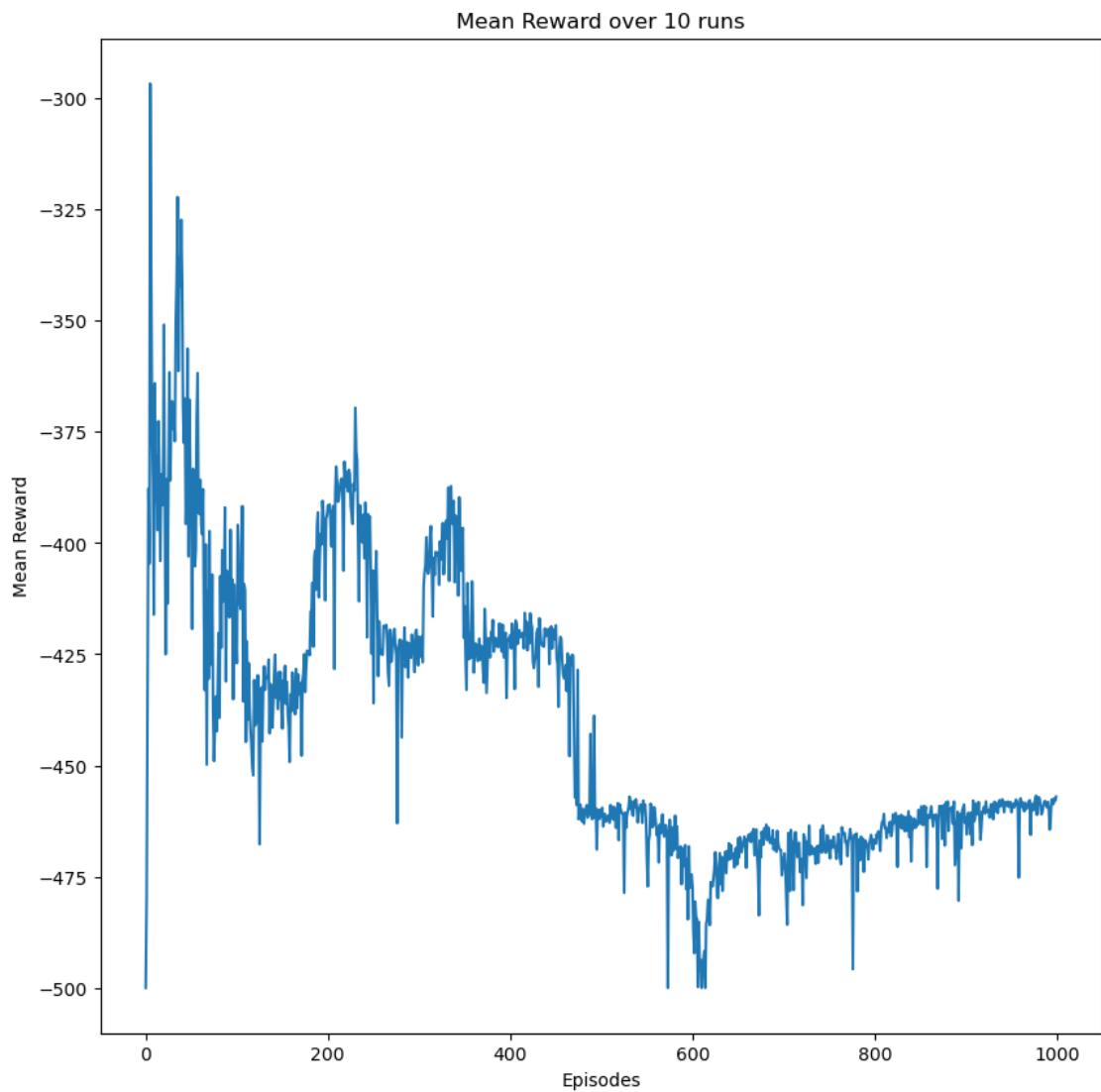
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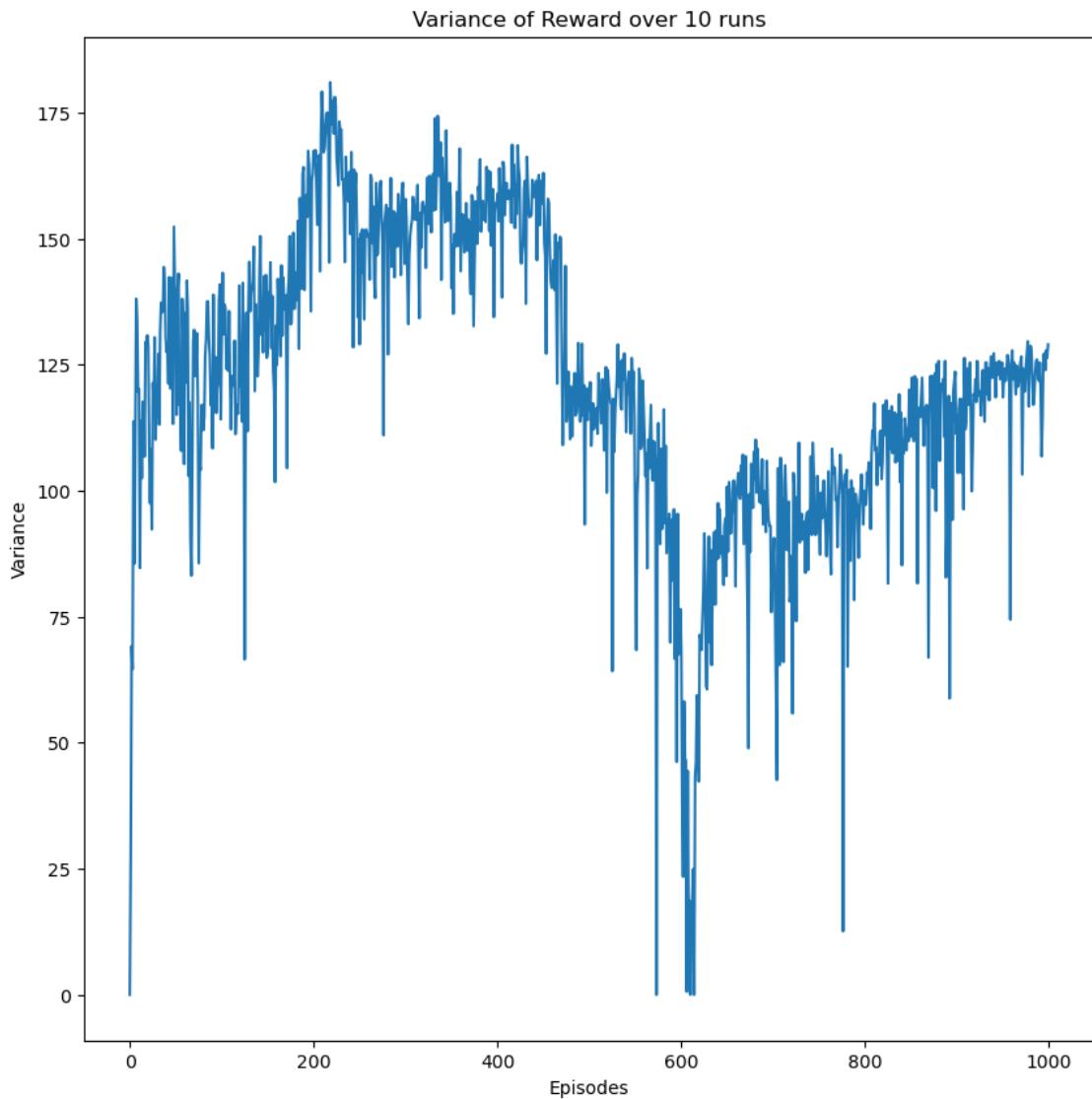
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Episode 750 Reward -173.000000 Average Reward -173.400000
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Episode 770 Reward -171.000000 Average Reward -170.000000
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Episode 790 Reward -169.000000 Average Reward -190.700000
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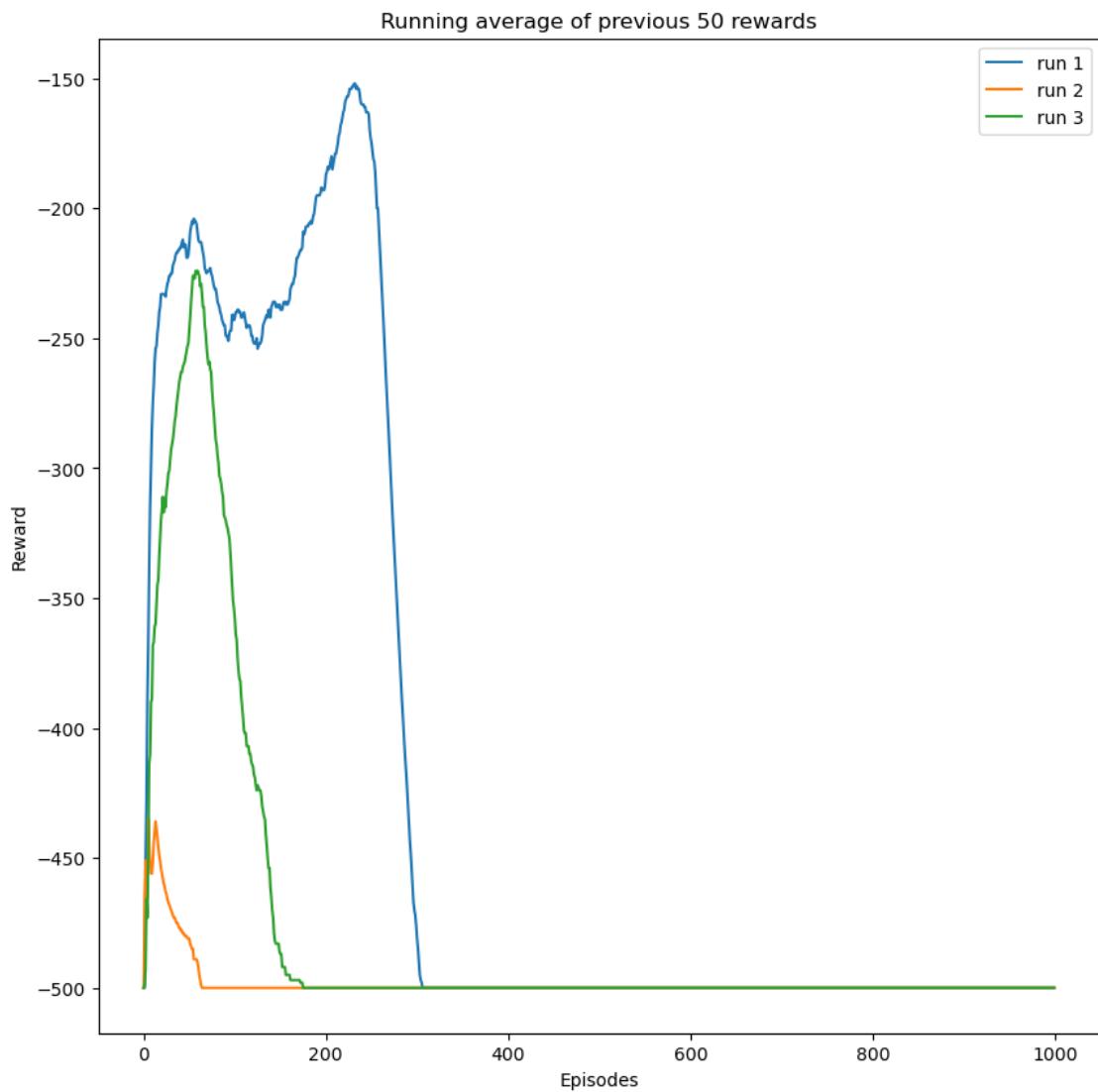
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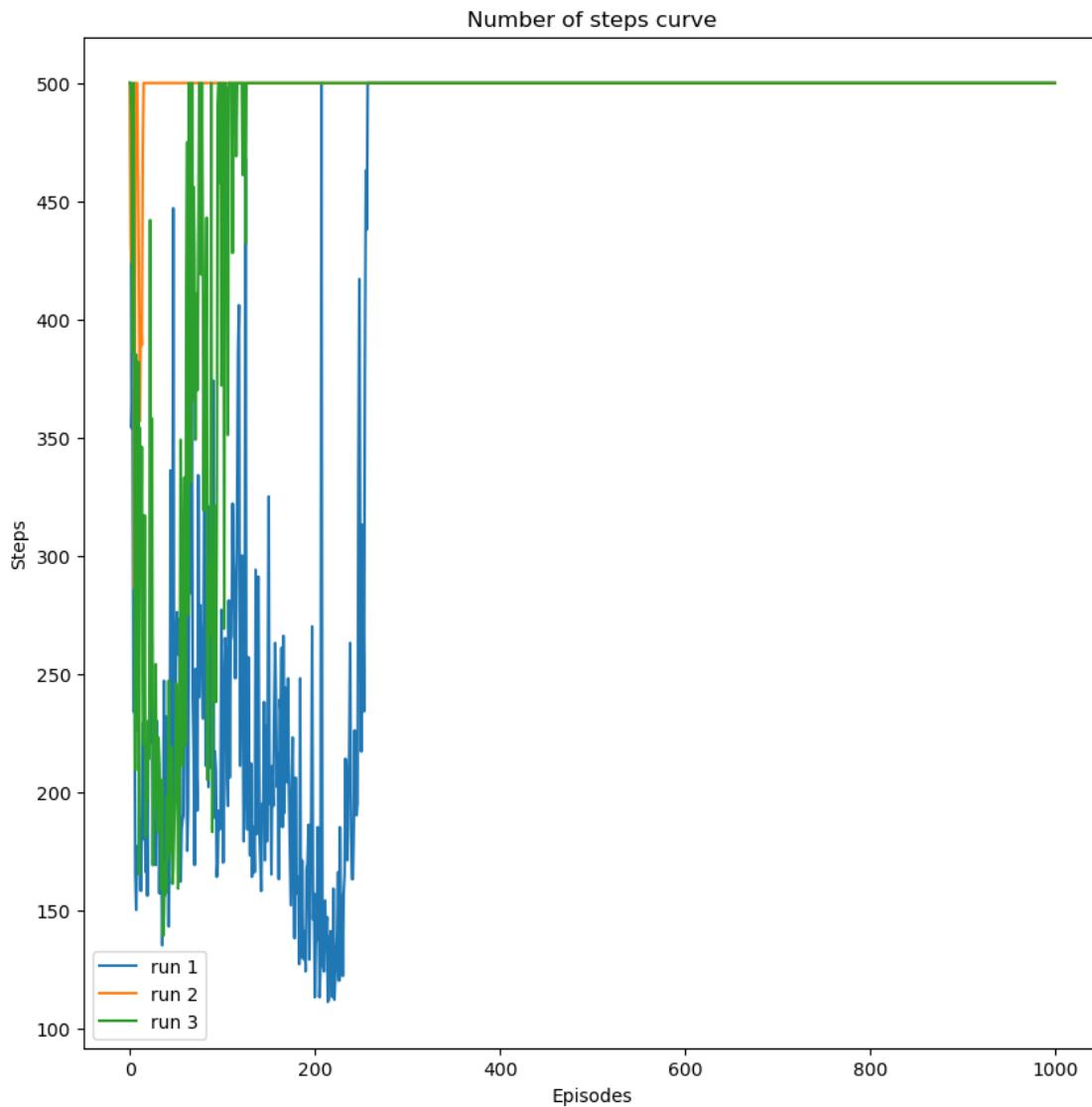
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Episode 130 Reward -500.000000 Average Reward -500.000000
Episode 140 Reward -500.000000 Average Reward -500.000000
Episode 150 Reward -500.000000 Average Reward -500.000000
Episode 160 Reward -500.000000 Average Reward -500.000000
Episode 170 Reward -500.000000 Average Reward -500.000000
Episode 180 Reward -500.000000 Average Reward -500.000000
Episode 190 Reward -500.000000 Average Reward -500.000000
Episode 200 Reward -500.000000 Average Reward -500.000000
Episode 210 Reward -500.000000 Average Reward -500.000000
Episode 220 Reward -500.000000 Average Reward -500.000000
Episode 230 Reward -500.000000 Average Reward -500.000000
Episode 240 Reward -500.000000 Average Reward -500.000000
Episode 250 Reward -500.000000 Average Reward -500.000000
Episode 260 Reward -500.000000 Average Reward -500.000000
Episode 270 Reward -500.000000 Average Reward -500.000000
Episode 280 Reward -500.000000 Average Reward -500.000000
Episode 290 Reward -500.000000 Average Reward -500.000000
Episode 300 Reward -500.000000 Average Reward -500.000000
Episode 310 Reward -500.000000 Average Reward -500.000000
Episode 320 Reward -500.000000 Average Reward -500.000000
Episode 330 Reward -500.000000 Average Reward -500.000000
Episode 340 Reward -500.000000 Average Reward -500.000000
Episode 350 Reward -500.000000 Average Reward -500.000000
Episode 360 Reward -500.000000 Average Reward -500.000000

Episode 800 Reward -500.000000 Average Reward -500.000000
Episode 810 Reward -500.000000 Average Reward -500.000000
Episode 820 Reward -500.000000 Average Reward -500.000000
Episode 830 Reward -500.000000 Average Reward -500.000000
Episode 840 Reward -500.000000 Average Reward -500.000000
Episode 850 Reward -500.000000 Average Reward -500.000000
Episode 860 Reward -500.000000 Average Reward -500.000000
Episode 870 Reward -500.000000 Average Reward -500.000000
Episode 880 Reward -500.000000 Average Reward -500.000000
Episode 890 Reward -500.000000 Average Reward -500.000000
Episode 900 Reward -500.000000 Average Reward -500.000000
Episode 910 Reward -500.000000 Average Reward -500.000000
Episode 920 Reward -500.000000 Average Reward -500.000000
Episode 930 Reward -500.000000 Average Reward -500.000000
Episode 940 Reward -500.000000 Average Reward -500.000000
Episode 950 Reward -500.000000 Average Reward -500.000000
Episode 960 Reward -500.000000 Average Reward -500.000000
Episode 970 Reward -500.000000 Average Reward -500.000000
Episode 980 Reward -500.000000 Average Reward -500.000000
Episode 990 Reward -500.000000 Average Reward -500.000000
Episode 1000 Reward -500.000000 Average Reward -500.000000
0:17:55.457276









```
[ ]: NUM_HIDDEN = 3
HIDDEN_SIZES = [512, 1024, 512]
LR = 1e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'Acrobot-v1'
SOLVE_CUTOFF = -100.0
STEP = 10

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{hs}-{lr}-{env}-{numep}-{nstep}-{STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	-346.000000	-457.900000
20	-500.000000	-492.900000
30	-500.000000	-500.000000
40	-500.000000	-500.000000
50	-500.000000	-500.000000
60	-500.000000	-500.000000
70	-500.000000	-500.000000
80	-500.000000	-500.000000
90	-500.000000	-500.000000
100	-500.000000	-500.000000
110	-500.000000	-500.000000
120	-500.000000	-500.000000
130	-500.000000	-500.000000
140	-500.000000	-500.000000
150	-500.000000	-500.000000
160	-500.000000	-500.000000
170	-500.000000	-500.000000
180	-500.000000	-500.000000
190	-500.000000	-500.000000
200	-500.000000	-500.000000
210	-500.000000	-500.000000
220	-500.000000	-500.000000
230	-500.000000	-500.000000
240	-500.000000	-500.000000
250	-500.000000	-500.000000
260	-500.000000	-500.000000
270	-500.000000	-500.000000
280	-500.000000	-500.000000

Episode 770 Reward -500.000000 Average Reward -500.000000
Episode 780 Reward -500.000000 Average Reward -500.000000
Episode 790 Reward -500.000000 Average Reward -500.000000
Episode 800 Reward -500.000000 Average Reward -500.000000
Episode 810 Reward -500.000000 Average Reward -500.000000
Episode 820 Reward -500.000000 Average Reward -500.000000
Episode 830 Reward -500.000000 Average Reward -500.000000
Episode 840 Reward -500.000000 Average Reward -500.000000
Episode 850 Reward -500.000000 Average Reward -500.000000
Episode 860 Reward -500.000000 Average Reward -500.000000
Episode 870 Reward -500.000000 Average Reward -500.000000
Episode 880 Reward -500.000000 Average Reward -500.000000
Episode 890 Reward -500.000000 Average Reward -500.000000
Episode 900 Reward -500.000000 Average Reward -500.000000
Episode 910 Reward -500.000000 Average Reward -500.000000
Episode 920 Reward -500.000000 Average Reward -500.000000
Episode 930 Reward -500.000000 Average Reward -500.000000
Episode 940 Reward -500.000000 Average Reward -500.000000
Episode 950 Reward -500.000000 Average Reward -500.000000
Episode 960 Reward -500.000000 Average Reward -500.000000
Episode 970 Reward -500.000000 Average Reward -500.000000
Episode 980 Reward -500.000000 Average Reward -500.000000
Episode 990 Reward -500.000000 Average Reward -500.000000
Episode 1000 Reward -500.000000 Average Reward -500.000000
0:17:42.240583

Episode 10 Reward -498.000000 Average Reward -485.200000
Episode 20 Reward -301.000000 Average Reward -425.400000
Episode 30 Reward -305.000000 Average Reward -468.500000
Episode 40 Reward -469.000000 Average Reward -381.400000
Episode 50 Reward -459.000000 Average Reward -429.700000
Episode 60 Reward -500.000000 Average Reward -471.300000
Episode 70 Reward -500.000000 Average Reward -500.000000
Episode 80 Reward -489.000000 Average Reward -478.700000
Episode 90 Reward -500.000000 Average Reward -491.000000
Episode 100 Reward -500.000000 Average Reward -499.400000
Episode 110 Reward -361.000000 Average Reward -465.100000
Episode 120 Reward -500.000000 Average Reward -500.000000
Episode 130 Reward -500.000000 Average Reward -500.000000
Episode 140 Reward -500.000000 Average Reward -500.000000
Episode 150 Reward -500.000000 Average Reward -500.000000
Episode 160 Reward -500.000000 Average Reward -500.000000
Episode 170 Reward -500.000000 Average Reward -500.000000
Episode 180 Reward -500.000000 Average Reward -500.000000
Episode 190 Reward -500.000000 Average Reward -500.000000
Episode 200 Reward -500.000000 Average Reward -500.000000
Episode 210 Reward -500.000000 Average Reward -500.000000
Episode 220 Reward -500.000000 Average Reward -500.000000
Episode 230 Reward -500.000000 Average Reward -500.000000

Episode 720 Reward -500.000000 Average Reward -500.000000
Episode 730 Reward -500.000000 Average Reward -500.000000
Episode 740 Reward -500.000000 Average Reward -500.000000
Episode 750 Reward -500.000000 Average Reward -500.000000
Episode 760 Reward -500.000000 Average Reward -500.000000
Episode 770 Reward -500.000000 Average Reward -500.000000
Episode 780 Reward -500.000000 Average Reward -500.000000
Episode 790 Reward -500.000000 Average Reward -500.000000
Episode 800 Reward -500.000000 Average Reward -500.000000
Episode 810 Reward -500.000000 Average Reward -500.000000
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Episode 830 Reward -500.000000 Average Reward -500.000000
Episode 840 Reward -500.000000 Average Reward -500.000000
Episode 850 Reward -500.000000 Average Reward -500.000000
Episode 860 Reward -500.000000 Average Reward -500.000000
Episode 870 Reward -500.000000 Average Reward -500.000000
Episode 880 Reward -500.000000 Average Reward -500.000000
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Episode 930 Reward -500.000000 Average Reward -500.000000
Episode 940 Reward -500.000000 Average Reward -500.000000
Episode 950 Reward -500.000000 Average Reward -500.000000
Episode 960 Reward -500.000000 Average Reward -500.000000
Episode 970 Reward -500.000000 Average Reward -500.000000
Episode 980 Reward -500.000000 Average Reward -500.000000
Episode 990 Reward -500.000000 Average Reward -500.000000
Episode 1000 Reward -500.000000 Average Reward -500.000000

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Episode 10 Reward -500.000000 Average Reward -496.500000
Episode 20 Reward -500.000000 Average Reward -491.400000
Episode 30 Reward -454.000000 Average Reward -464.200000
Episode 40 Reward -464.000000 Average Reward -376.200000
Episode 50 Reward -336.000000 Average Reward -390.300000
Episode 60 Reward -367.000000 Average Reward -366.400000
Episode 70 Reward -500.000000 Average Reward -435.800000
Episode 80 Reward -349.000000 Average Reward -381.300000
Episode 90 Reward -436.000000 Average Reward -368.700000
Episode 100 Reward -500.000000 Average Reward -437.100000
Episode 110 Reward -500.000000 Average Reward -500.000000
Episode 120 Reward -500.000000 Average Reward -499.200000
Episode 130 Reward -500.000000 Average Reward -500.000000
Episode 140 Reward -500.000000 Average Reward -500.000000
Episode 150 Reward -500.000000 Average Reward -500.000000
Episode 160 Reward -500.000000 Average Reward -500.000000
Episode 170 Reward -500.000000 Average Reward -500.000000
Episode 180 Reward -500.000000 Average Reward -500.000000

Episode 670 Reward -500.000000 Average Reward -500.000000
Episode 680 Reward -500.000000 Average Reward -500.000000
Episode 690 Reward -500.000000 Average Reward -500.000000
Episode 700 Reward -500.000000 Average Reward -500.000000
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Episode 730 Reward -500.000000 Average Reward -500.000000
Episode 740 Reward -500.000000 Average Reward -500.000000
Episode 750 Reward -500.000000 Average Reward -500.000000
Episode 760 Reward -500.000000 Average Reward -500.000000
Episode 770 Reward -500.000000 Average Reward -500.000000
Episode 780 Reward -500.000000 Average Reward -500.000000
Episode 790 Reward -500.000000 Average Reward -500.000000
Episode 800 Reward -500.000000 Average Reward -500.000000
Episode 810 Reward -500.000000 Average Reward -500.000000
Episode 820 Reward -500.000000 Average Reward -500.000000
Episode 830 Reward -500.000000 Average Reward -500.000000
Episode 840 Reward -500.000000 Average Reward -500.000000
Episode 850 Reward -500.000000 Average Reward -500.000000
Episode 860 Reward -500.000000 Average Reward -500.000000
Episode 870 Reward -500.000000 Average Reward -500.000000
Episode 880 Reward -500.000000 Average Reward -500.000000
Episode 890 Reward -500.000000 Average Reward -500.000000
Episode 900 Reward -500.000000 Average Reward -500.000000
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Episode 920 Reward -500.000000 Average Reward -500.000000
Episode 930 Reward -500.000000 Average Reward -500.000000
Episode 940 Reward -500.000000 Average Reward -500.000000
Episode 950 Reward -500.000000 Average Reward -500.000000
Episode 960 Reward -500.000000 Average Reward -500.000000
Episode 970 Reward -500.000000 Average Reward -500.000000
Episode 980 Reward -500.000000 Average Reward -500.000000
Episode 990 Reward -500.000000 Average Reward -500.000000
Episode 1000 Reward -500.000000 Average Reward -500.000000

0:17:34.974016

Episode 10 Reward -476.000000 Average Reward -497.600000
Episode 20 Reward -500.000000 Average Reward -466.200000
Episode 30 Reward -381.000000 Average Reward -454.900000
Episode 40 Reward -500.000000 Average Reward -408.400000
Episode 50 Reward -493.000000 Average Reward -456.600000
Episode 60 Reward -500.000000 Average Reward -474.900000
Episode 70 Reward -500.000000 Average Reward -500.000000
Episode 80 Reward -500.000000 Average Reward -500.000000
Episode 90 Reward -500.000000 Average Reward -500.000000
Episode 100 Reward -500.000000 Average Reward -500.000000
Episode 110 Reward -500.000000 Average Reward -491.400000
Episode 120 Reward -500.000000 Average Reward -460.600000
Episode 130 Reward -500.000000 Average Reward -452.900000

Episode	140	Reward	-380.000000	Average Reward	-464.000000
Episode	150	Reward	-500.000000	Average Reward	-486.100000
Episode	160	Reward	-372.000000	Average Reward	-432.200000
Episode	170	Reward	-500.000000	Average Reward	-386.000000
Episode	180	Reward	-500.000000	Average Reward	-434.200000
Episode	190	Reward	-266.000000	Average Reward	-395.600000
Episode	200	Reward	-361.000000	Average Reward	-403.200000
Episode	210	Reward	-401.000000	Average Reward	-418.500000
Episode	220	Reward	-218.000000	Average Reward	-328.400000
Episode	230	Reward	-293.000000	Average Reward	-280.200000
Episode	240	Reward	-321.000000	Average Reward	-246.900000
Episode	250	Reward	-306.000000	Average Reward	-244.000000
Episode	260	Reward	-263.000000	Average Reward	-220.500000
Episode	270	Reward	-269.000000	Average Reward	-240.600000
Episode	280	Reward	-253.000000	Average Reward	-253.600000
Episode	290	Reward	-197.000000	Average Reward	-299.100000
Episode	300	Reward	-305.000000	Average Reward	-319.300000
Episode	310	Reward	-290.000000	Average Reward	-264.400000
Episode	320	Reward	-261.000000	Average Reward	-271.900000
Episode	330	Reward	-260.000000	Average Reward	-272.200000
Episode	340	Reward	-262.000000	Average Reward	-210.700000
Episode	350	Reward	-293.000000	Average Reward	-208.400000
Episode	360	Reward	-165.000000	Average Reward	-237.400000
Episode	370	Reward	-157.000000	Average Reward	-210.900000
Episode	380	Reward	-172.000000	Average Reward	-185.900000
Episode	390	Reward	-218.000000	Average Reward	-217.800000
Episode	400	Reward	-252.000000	Average Reward	-199.500000
Episode	410	Reward	-196.000000	Average Reward	-190.300000
Episode	420	Reward	-204.000000	Average Reward	-184.900000
Episode	430	Reward	-152.000000	Average Reward	-186.500000
Episode	440	Reward	-224.000000	Average Reward	-192.100000
Episode	450	Reward	-188.000000	Average Reward	-202.600000
Episode	460	Reward	-260.000000	Average Reward	-222.400000
Episode	470	Reward	-202.000000	Average Reward	-228.100000
Episode	480	Reward	-209.000000	Average Reward	-189.500000
Episode	490	Reward	-164.000000	Average Reward	-177.700000
Episode	500	Reward	-175.000000	Average Reward	-207.600000
Episode	510	Reward	-190.000000	Average Reward	-211.300000
Episode	520	Reward	-177.000000	Average Reward	-185.800000
Episode	530	Reward	-169.000000	Average Reward	-180.500000
Episode	540	Reward	-177.000000	Average Reward	-184.100000
Episode	550	Reward	-161.000000	Average Reward	-191.400000
Episode	560	Reward	-186.000000	Average Reward	-179.300000
Episode	570	Reward	-200.000000	Average Reward	-190.600000
Episode	580	Reward	-180.000000	Average Reward	-188.600000
Episode	590	Reward	-214.000000	Average Reward	-208.800000
Episode	600	Reward	-268.000000	Average Reward	-214.500000
Episode	610	Reward	-273.000000	Average Reward	-231.600000

Episode 620 Reward -222.000000 Average Reward -243.500000
 Episode 630 Reward -249.000000 Average Reward -271.800000
 Episode 640 Reward -384.000000 Average Reward -273.800000
 Episode 650 Reward -481.000000 Average Reward -364.600000
 Episode 660 Reward -307.000000 Average Reward -370.200000
 Episode 670 Reward -291.000000 Average Reward -391.700000
 Episode 680 Reward -500.000000 Average Reward -370.000000
 Episode 690 Reward -414.000000 Average Reward -410.100000
 Episode 700 Reward -500.000000 Average Reward -420.800000
 Episode 710 Reward -221.000000 Average Reward -331.900000
 Episode 720 Reward -187.000000 Average Reward -234.500000
 Episode 730 Reward -166.000000 Average Reward -178.500000
 Episode 740 Reward -176.000000 Average Reward -158.400000
 Episode 750 Reward -166.000000 Average Reward -175.600000
 Episode 760 Reward -275.000000 Average Reward -185.900000
 Episode 770 Reward -260.000000 Average Reward -194.000000
 Episode 780 Reward -150.000000 Average Reward -162.300000
 Episode 790 Reward -260.000000 Average Reward -195.000000
 Episode 800 Reward -166.000000 Average Reward -154.900000
 Episode 810 Reward -160.000000 Average Reward -154.700000
 Episode 820 Reward -141.000000 Average Reward -159.800000
 Episode 830 Reward -151.000000 Average Reward -175.500000
 Episode 840 Reward -156.000000 Average Reward -148.300000
 Episode 850 Reward -204.000000 Average Reward -174.200000
 Episode 860 Reward -179.000000 Average Reward -156.100000
 Episode 870 Reward -137.000000 Average Reward -169.800000
 Episode 880 Reward -197.000000 Average Reward -136.400000
 Episode 890 Reward -139.000000 Average Reward -131.800000
 Episode 900 Reward -123.000000 Average Reward -115.000000
 Episode 910 Reward -240.000000 Average Reward -155.300000
 Episode 920 Reward -95.000000 Average Reward -135.000000
 Episode 930 Reward -124.000000 Average Reward -133.500000
 Episode 940 Reward -108.000000 Average Reward -113.400000
 Episode 950 Reward -101.000000 Average Reward -113.000000
 Episode 960 Reward -87.000000 Average Reward -106.300000
 Episode 970 Reward -120.000000 Average Reward -100.900000
 Episode 980 Reward -115.000000 Average Reward -116.100000
 Episode 990 Reward -127.000000 Average Reward -99.000000
 Episode 1000 Reward -192.000000 Average Reward -121.600000
 0:09:44.116251
 Episode 10 Reward -500.000000 Average Reward -468.200000
 Episode 20 Reward -500.000000 Average Reward -437.400000
 Episode 30 Reward -500.000000 Average Reward -500.000000
 Episode 40 Reward -500.000000 Average Reward -476.100000
 Episode 50 Reward -432.000000 Average Reward -470.100000
 Episode 60 Reward -500.000000 Average Reward -492.300000
 Episode 70 Reward -500.000000 Average Reward -473.100000
 Episode 80 Reward -500.000000 Average Reward -402.800000

Episode 90 Reward -206.000000 Average Reward -315.100000
Episode 100 Reward -158.000000 Average Reward -244.700000
Episode 110 Reward -347.000000 Average Reward -290.600000
Episode 120 Reward -480.000000 Average Reward -437.100000
Episode 130 Reward -489.000000 Average Reward -448.400000
Episode 140 Reward -358.000000 Average Reward -366.500000
Episode 150 Reward -239.000000 Average Reward -302.200000
Episode 160 Reward -210.000000 Average Reward -261.600000
Episode 170 Reward -343.000000 Average Reward -301.100000
Episode 180 Reward -186.000000 Average Reward -248.400000
Episode 190 Reward -194.000000 Average Reward -275.000000
Episode 200 Reward -204.000000 Average Reward -231.800000
Episode 210 Reward -171.000000 Average Reward -181.800000
Episode 220 Reward -169.000000 Average Reward -189.300000
Episode 230 Reward -137.000000 Average Reward -157.400000
Episode 240 Reward -156.000000 Average Reward -134.900000
Episode 250 Reward -124.000000 Average Reward -120.500000
Episode 260 Reward -154.000000 Average Reward -141.000000
Episode 270 Reward -82.000000 Average Reward -128.800000
Episode 280 Reward -165.000000 Average Reward -136.000000
Episode 290 Reward -156.000000 Average Reward -150.100000
Episode 300 Reward -113.000000 Average Reward -133.200000
Episode 310 Reward -147.000000 Average Reward -131.400000
Episode 320 Reward -113.000000 Average Reward -140.400000
Episode 330 Reward -152.000000 Average Reward -131.300000
Episode 340 Reward -150.000000 Average Reward -136.500000
Episode 350 Reward -181.000000 Average Reward -135.700000
Episode 360 Reward -142.000000 Average Reward -127.000000
Episode 370 Reward -150.000000 Average Reward -145.100000
Episode 380 Reward -120.000000 Average Reward -149.700000
Episode 390 Reward -191.000000 Average Reward -148.900000
Episode 400 Reward -126.000000 Average Reward -142.800000
Episode 410 Reward -129.000000 Average Reward -145.900000
Episode 420 Reward -98.000000 Average Reward -126.600000
Episode 430 Reward -151.000000 Average Reward -122.600000
Episode 440 Reward -103.000000 Average Reward -126.200000
Episode 450 Reward -236.000000 Average Reward -114.300000
Episode 460 Reward -83.000000 Average Reward -96.300000
Episode 470 Reward -104.000000 Average Reward -155.500000
Episode 480 Reward -112.000000 Average Reward -97.400000
Episode 490 Reward -101.000000 Average Reward -118.200000
Episode 500 Reward -116.000000 Average Reward -100.900000
Episode 510 Reward -103.000000 Average Reward -99.000000
Episode 520 Reward -84.000000 Average Reward -98.000000
Episode 530 Reward -78.000000 Average Reward -94.400000
Episode 540 Reward -91.000000 Average Reward -99.100000
Episode 550 Reward -105.000000 Average Reward -100.500000
Episode 560 Reward -108.000000 Average Reward -96.200000

Episode 570 Reward -104.000000 Average Reward -97.500000
Episode 580 Reward -111.000000 Average Reward -89.200000
Episode 590 Reward -118.000000 Average Reward -108.900000
Episode 600 Reward -87.000000 Average Reward -100.600000
Episode 610 Reward -127.000000 Average Reward -97.100000
Episode 620 Reward -103.000000 Average Reward -96.000000
Episode 630 Reward -85.000000 Average Reward -86.200000
Episode 640 Reward -81.000000 Average Reward -96.500000
Episode 650 Reward -85.000000 Average Reward -100.900000
Episode 660 Reward -80.000000 Average Reward -100.500000
Episode 670 Reward -118.000000 Average Reward -109.800000
Episode 680 Reward -89.000000 Average Reward -93.900000
Episode 690 Reward -86.000000 Average Reward -134.000000
Episode 700 Reward -92.000000 Average Reward -101.200000
Episode 710 Reward -126.000000 Average Reward -132.800000
Episode 720 Reward -166.000000 Average Reward -174.200000
Episode 730 Reward -106.000000 Average Reward -168.200000
Episode 740 Reward -206.000000 Average Reward -165.700000
Episode 750 Reward -198.000000 Average Reward -201.400000
Episode 760 Reward -176.000000 Average Reward -183.800000
Episode 770 Reward -262.000000 Average Reward -181.100000
Episode 780 Reward -131.000000 Average Reward -119.300000
Episode 790 Reward -100.000000 Average Reward -160.600000
Episode 800 Reward -113.000000 Average Reward -127.500000
Episode 810 Reward -92.000000 Average Reward -105.000000
Episode 820 Reward -79.000000 Average Reward -95.200000
Episode 830 Reward -70.000000 Average Reward -91.800000
Episode 840 Reward -86.000000 Average Reward -91.400000
Episode 850 Reward -112.000000 Average Reward -110.000000
Episode 860 Reward -74.000000 Average Reward -88.800000
Episode 870 Reward -111.000000 Average Reward -92.800000
Episode 880 Reward -81.000000 Average Reward -106.100000
Episode 890 Reward -118.000000 Average Reward -103.700000
Episode 900 Reward -113.000000 Average Reward -108.300000
Episode 910 Reward -158.000000 Average Reward -98.800000
Episode 920 Reward -94.000000 Average Reward -83.400000
Episode 930 Reward -94.000000 Average Reward -92.500000
Episode 940 Reward -82.000000 Average Reward -89.600000
Episode 950 Reward -342.000000 Average Reward -119.200000
Episode 960 Reward -99.000000 Average Reward -92.400000
Episode 970 Reward -95.000000 Average Reward -93.300000
Episode 980 Reward -88.000000 Average Reward -109.800000
Episode 990 Reward -87.000000 Average Reward -82.500000
Episode 1000 Reward -82.000000 Average Reward -90.000000
0:06:18.050905
Episode 10 Reward -453.000000 Average Reward -469.500000
Episode 20 Reward -185.000000 Average Reward -270.600000
Episode 30 Reward -245.000000 Average Reward -238.800000

Episode 40 Reward -322.000000 Average Reward -230.600000
Episode 50 Reward -166.000000 Average Reward -237.100000
Episode 60 Reward -194.000000 Average Reward -257.300000
Episode 70 Reward -225.000000 Average Reward -235.900000
Episode 80 Reward -289.000000 Average Reward -207.500000
Episode 90 Reward -166.000000 Average Reward -206.200000
Episode 100 Reward -157.000000 Average Reward -178.600000
Episode 110 Reward -168.000000 Average Reward -205.100000
Episode 120 Reward -193.000000 Average Reward -204.300000
Episode 130 Reward -236.000000 Average Reward -251.400000
Episode 140 Reward -213.000000 Average Reward -245.700000
Episode 150 Reward -186.000000 Average Reward -190.900000
Episode 160 Reward -177.000000 Average Reward -187.300000
Episode 170 Reward -214.000000 Average Reward -201.100000
Episode 180 Reward -154.000000 Average Reward -182.100000
Episode 190 Reward -165.000000 Average Reward -174.500000
Episode 200 Reward -152.000000 Average Reward -150.000000
Episode 210 Reward -133.000000 Average Reward -156.600000
Episode 220 Reward -117.000000 Average Reward -143.700000
Episode 230 Reward -147.000000 Average Reward -157.100000
Episode 240 Reward -143.000000 Average Reward -142.000000
Episode 250 Reward -128.000000 Average Reward -157.100000
Episode 260 Reward -145.000000 Average Reward -163.900000
Episode 270 Reward -185.000000 Average Reward -183.300000
Episode 280 Reward -209.000000 Average Reward -168.100000
Episode 290 Reward -297.000000 Average Reward -258.100000
Episode 300 Reward -500.000000 Average Reward -446.500000
Episode 310 Reward -500.000000 Average Reward -500.000000
Episode 320 Reward -500.000000 Average Reward -500.000000
Episode 330 Reward -500.000000 Average Reward -500.000000
Episode 340 Reward -432.000000 Average Reward -489.400000
Episode 350 Reward -244.000000 Average Reward -368.000000
Episode 360 Reward -374.000000 Average Reward -368.600000
Episode 370 Reward -244.000000 Average Reward -286.600000
Episode 380 Reward -279.000000 Average Reward -360.200000
Episode 390 Reward -254.000000 Average Reward -246.800000
Episode 400 Reward -362.000000 Average Reward -286.700000
Episode 410 Reward -253.000000 Average Reward -276.500000
Episode 420 Reward -180.000000 Average Reward -262.100000
Episode 430 Reward -440.000000 Average Reward -371.700000
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Episode 450 Reward -500.000000 Average Reward -500.000000
Episode 460 Reward -500.000000 Average Reward -500.000000
Episode 470 Reward -500.000000 Average Reward -496.200000
Episode 480 Reward -499.000000 Average Reward -486.700000
Episode 490 Reward -336.000000 Average Reward -437.700000
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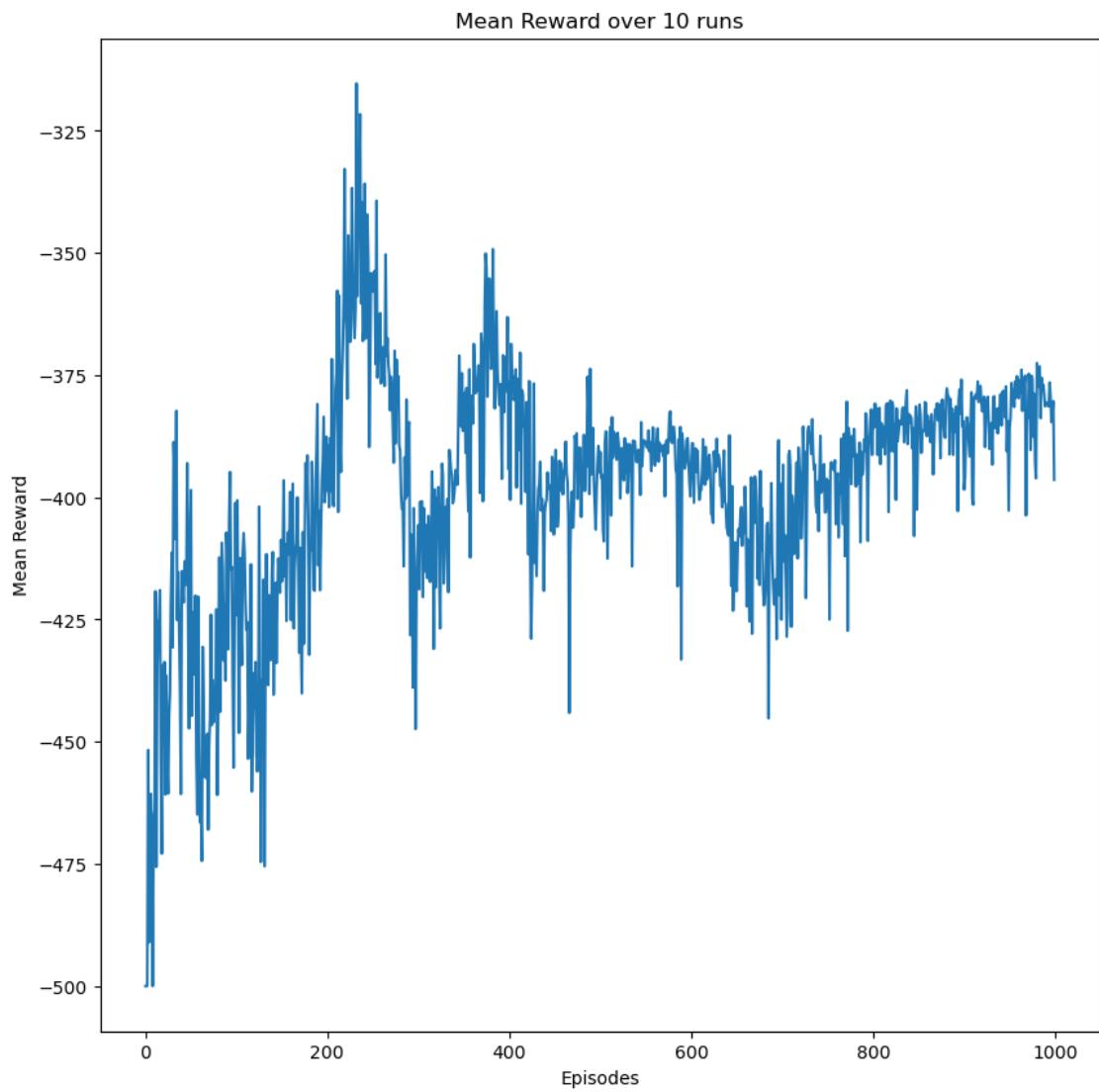
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Episode 130 Reward -278.000000 Average Reward -279.600000
Episode 140 Reward -206.000000 Average Reward -222.600000
Episode 150 Reward -162.000000 Average Reward -225.800000
Episode 160 Reward -230.000000 Average Reward -223.400000
Episode 170 Reward -261.000000 Average Reward -246.300000
Episode 180 Reward -214.000000 Average Reward -252.700000
Episode 190 Reward -184.000000 Average Reward -213.200000
Episode 200 Reward -167.000000 Average Reward -229.000000
Episode 210 Reward -195.000000 Average Reward -197.100000
Episode 220 Reward -175.000000 Average Reward -260.800000
Episode 230 Reward -185.000000 Average Reward -219.600000
Episode 240 Reward -193.000000 Average Reward -229.900000
Episode 250 Reward -200.000000 Average Reward -251.800000
Episode 260 Reward -305.000000 Average Reward -236.500000
Episode 270 Reward -286.000000 Average Reward -240.100000
Episode 280 Reward -266.000000 Average Reward -248.600000
Episode 290 Reward -211.000000 Average Reward -258.900000
Episode 300 Reward -236.000000 Average Reward -264.500000
Episode 310 Reward -167.000000 Average Reward -194.600000
Episode 320 Reward -310.000000 Average Reward -194.000000
Episode 330 Reward -210.000000 Average Reward -176.200000
Episode 340 Reward -157.000000 Average Reward -164.100000
Episode 350 Reward -146.000000 Average Reward -155.800000
Episode 360 Reward -127.000000 Average Reward -138.900000
Episode 370 Reward -114.000000 Average Reward -133.500000
Episode 380 Reward -120.000000 Average Reward -124.100000
Episode 390 Reward -148.000000 Average Reward -137.600000
Episode 400 Reward -202.000000 Average Reward -158.600000
Episode 410 Reward -179.000000 Average Reward -191.800000
Episode 420 Reward -323.000000 Average Reward -279.100000
Episode 430 Reward -318.000000 Average Reward -353.200000
Episode 440 Reward -204.000000 Average Reward -216.800000
Episode 450 Reward -152.000000 Average Reward -173.300000
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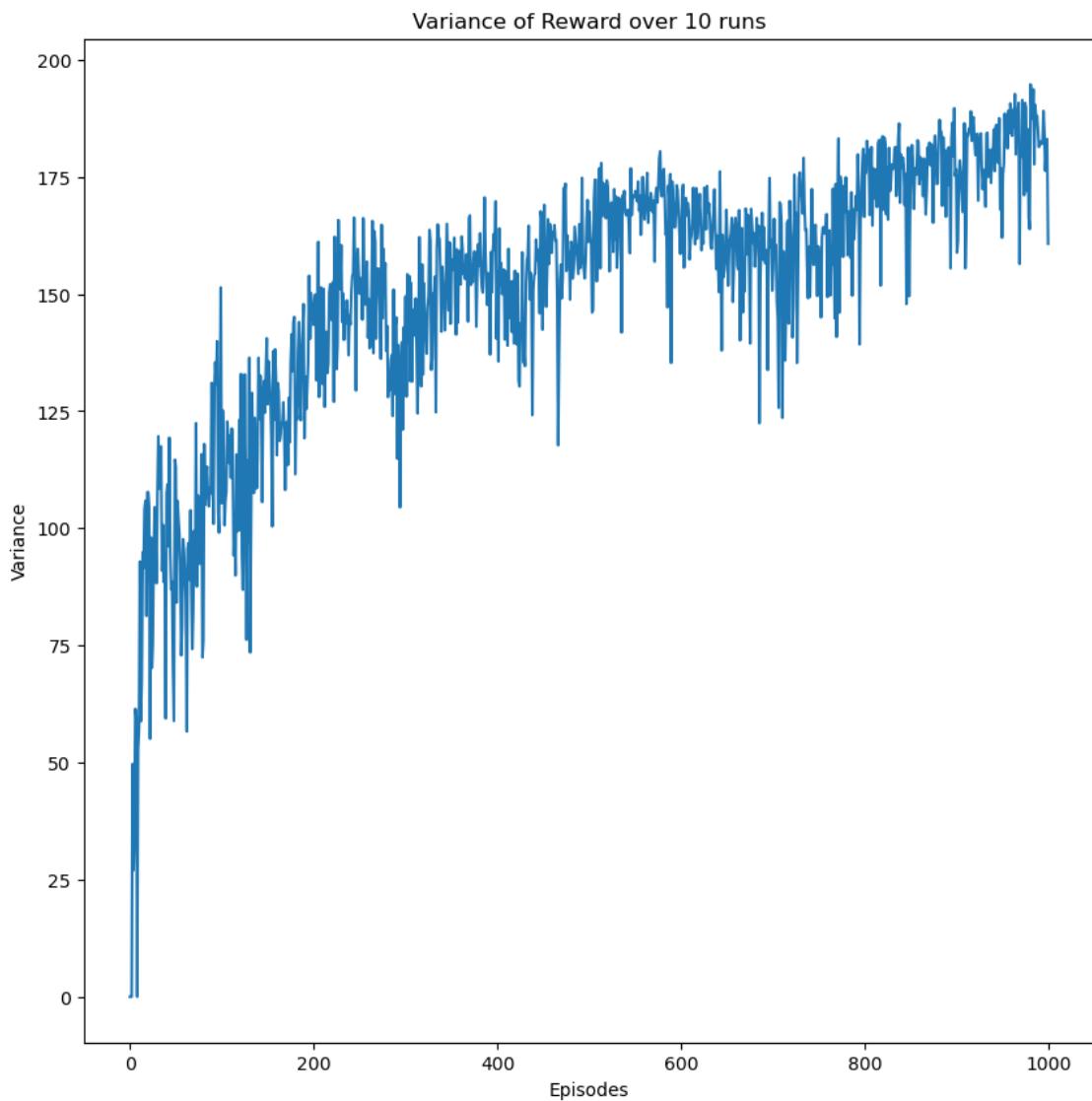
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Episode 490 Reward -136.000000 Average Reward -158.800000
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Episode 510 Reward -155.000000 Average Reward -156.900000
Episode 520 Reward -107.000000 Average Reward -119.800000
Episode 530 Reward -143.000000 Average Reward -146.200000
Episode 540 Reward -143.000000 Average Reward -154.900000
Episode 550 Reward -120.000000 Average Reward -118.900000
Episode 560 Reward -110.000000 Average Reward -119.500000
Episode 570 Reward -111.000000 Average Reward -113.100000
Episode 580 Reward -98.000000 Average Reward -111.000000
Episode 590 Reward -500.000000 Average Reward -145.600000
Episode 600 Reward -143.000000 Average Reward -105.300000
Episode 610 Reward -105.000000 Average Reward -108.100000
Episode 620 Reward -96.000000 Average Reward -105.300000
Episode 630 Reward -102.000000 Average Reward -99.400000
Episode 640 Reward -96.000000 Average Reward -103.900000
Episode 650 Reward -71.000000 Average Reward -114.500000
Episode 660 Reward -91.000000 Average Reward -97.600000
Episode 670 Reward -144.000000 Average Reward -114.000000
Episode 680 Reward -96.000000 Average Reward -101.100000
Episode 690 Reward -117.000000 Average Reward -99.300000
Episode 700 Reward -158.000000 Average Reward -115.400000
Episode 710 Reward -91.000000 Average Reward -101.900000
Episode 720 Reward -85.000000 Average Reward -128.000000
Episode 730 Reward -83.000000 Average Reward -125.300000
Episode 740 Reward -86.000000 Average Reward -108.000000
Episode 750 Reward -98.000000 Average Reward -99.800000
Episode 760 Reward -104.000000 Average Reward -121.300000
Episode 770 Reward -98.000000 Average Reward -110.400000
Episode 780 Reward -79.000000 Average Reward -139.700000
Episode 790 Reward -86.000000 Average Reward -97.100000
Episode 800 Reward -134.000000 Average Reward -112.400000
Episode 810 Reward -96.000000 Average Reward -90.900000
Episode 820 Reward -82.000000 Average Reward -105.000000
Episode 830 Reward -122.000000 Average Reward -102.500000
Episode 840 Reward -87.000000 Average Reward -98.900000
Episode 850 Reward -90.000000 Average Reward -112.100000
Episode 860 Reward -122.000000 Average Reward -101.900000
Episode 870 Reward -81.000000 Average Reward -98.200000
Episode 880 Reward -100.000000 Average Reward -98.800000
Episode 890 Reward -72.000000 Average Reward -92.600000
Episode 900 Reward -108.000000 Average Reward -118.000000
Episode 910 Reward -104.000000 Average Reward -139.400000
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Episode 940 Reward -139.000000 Average Reward -135.200000

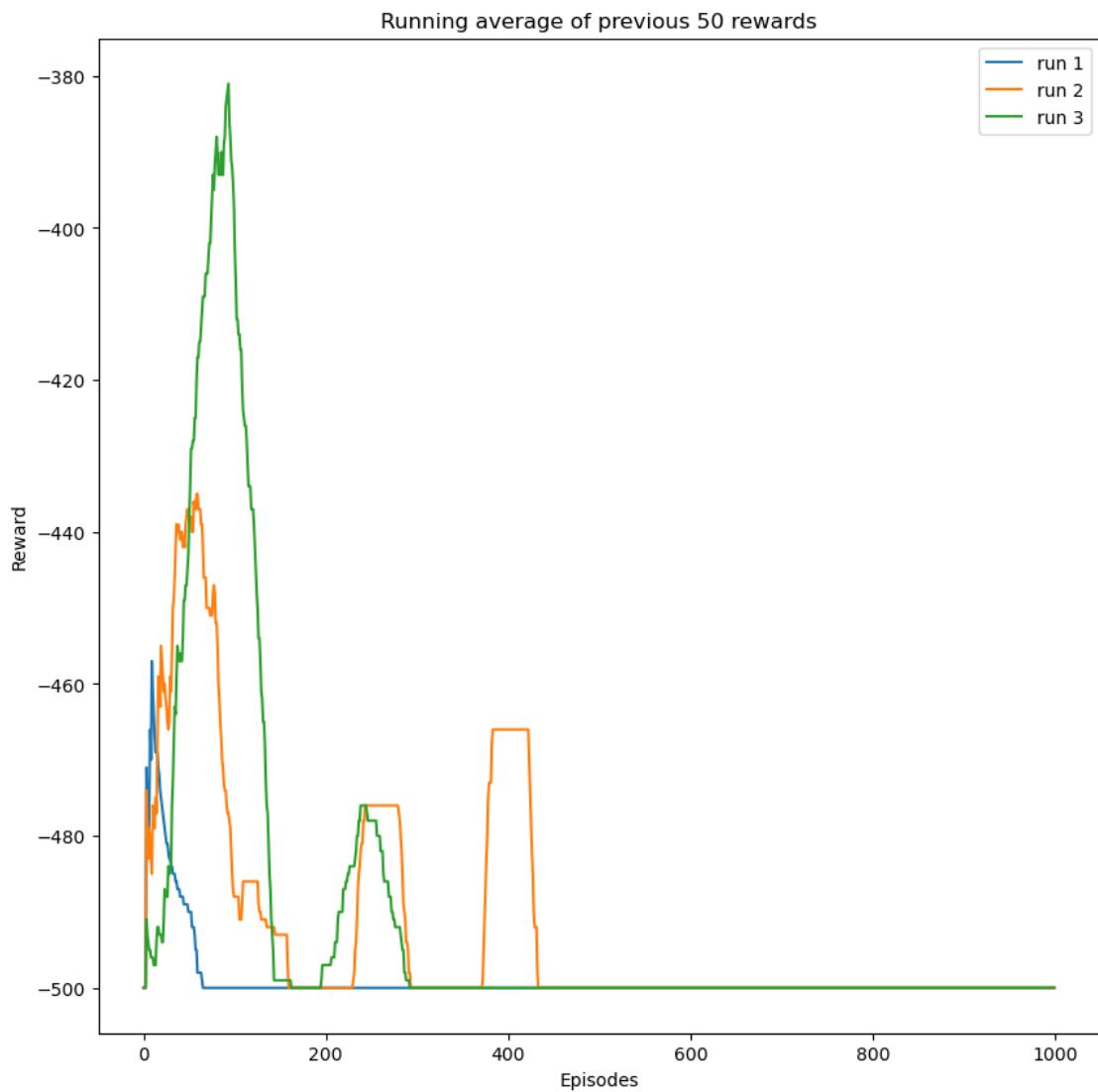
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Episode 940 Reward -500.000000 Average Reward -500.000000
Episode 950 Reward -500.000000 Average Reward -500.000000
Episode 960 Reward -500.000000 Average Reward -500.000000
Episode 970 Reward -500.000000 Average Reward -500.000000
Episode 980 Reward -500.000000 Average Reward -500.000000
Episode 990 Reward -500.000000 Average Reward -500.000000
Episode 1000 Reward -500.000000 Average Reward -500.000000
0:18:14.617337
Episode 10 Reward -385.000000 Average Reward -488.500000
Episode 20 Reward -358.000000 Average Reward -429.800000
Episode 30 Reward -352.000000 Average Reward -421.200000
Episode 40 Reward -500.000000 Average Reward -491.900000
Episode 50 Reward -500.000000 Average Reward -465.400000
Episode 60 Reward -500.000000 Average Reward -472.600000
Episode 70 Reward -500.000000 Average Reward -485.800000
Episode 80 Reward -500.000000 Average Reward -500.000000
Episode 90 Reward -500.000000 Average Reward -500.000000
Episode 100 Reward -500.000000 Average Reward -500.000000
Episode 110 Reward -500.000000 Average Reward -440.900000
Episode 120 Reward -500.000000 Average Reward -490.800000
Episode 130 Reward -500.000000 Average Reward -500.000000
Episode 140 Reward -500.000000 Average Reward -500.000000
Episode 150 Reward -500.000000 Average Reward -500.000000
Episode 160 Reward -500.000000 Average Reward -500.000000
Episode 170 Reward -500.000000 Average Reward -500.000000
Episode 180 Reward -500.000000 Average Reward -500.000000
Episode 190 Reward -500.000000 Average Reward -500.000000
Episode 200 Reward -492.000000 Average Reward -498.400000
Episode 210 Reward -378.000000 Average Reward -470.500000
Episode 220 Reward -263.000000 Average Reward -335.600000
Episode 230 Reward -374.000000 Average Reward -292.800000
Episode 240 Reward -385.000000 Average Reward -348.600000
Episode 250 Reward -309.000000 Average Reward -343.300000
Episode 260 Reward -400.000000 Average Reward -369.400000
Episode 270 Reward -500.000000 Average Reward -418.400000
Episode 280 Reward -500.000000 Average Reward -500.000000
Episode 290 Reward -500.000000 Average Reward -500.000000
Episode 300 Reward -500.000000 Average Reward -500.000000
Episode 310 Reward -500.000000 Average Reward -500.000000
Episode 320 Reward -500.000000 Average Reward -498.800000
Episode 330 Reward -500.000000 Average Reward -490.600000
Episode 340 Reward -500.000000 Average Reward -500.000000
Episode 350 Reward -500.000000 Average Reward -500.000000
Episode 360 Reward -500.000000 Average Reward -500.000000

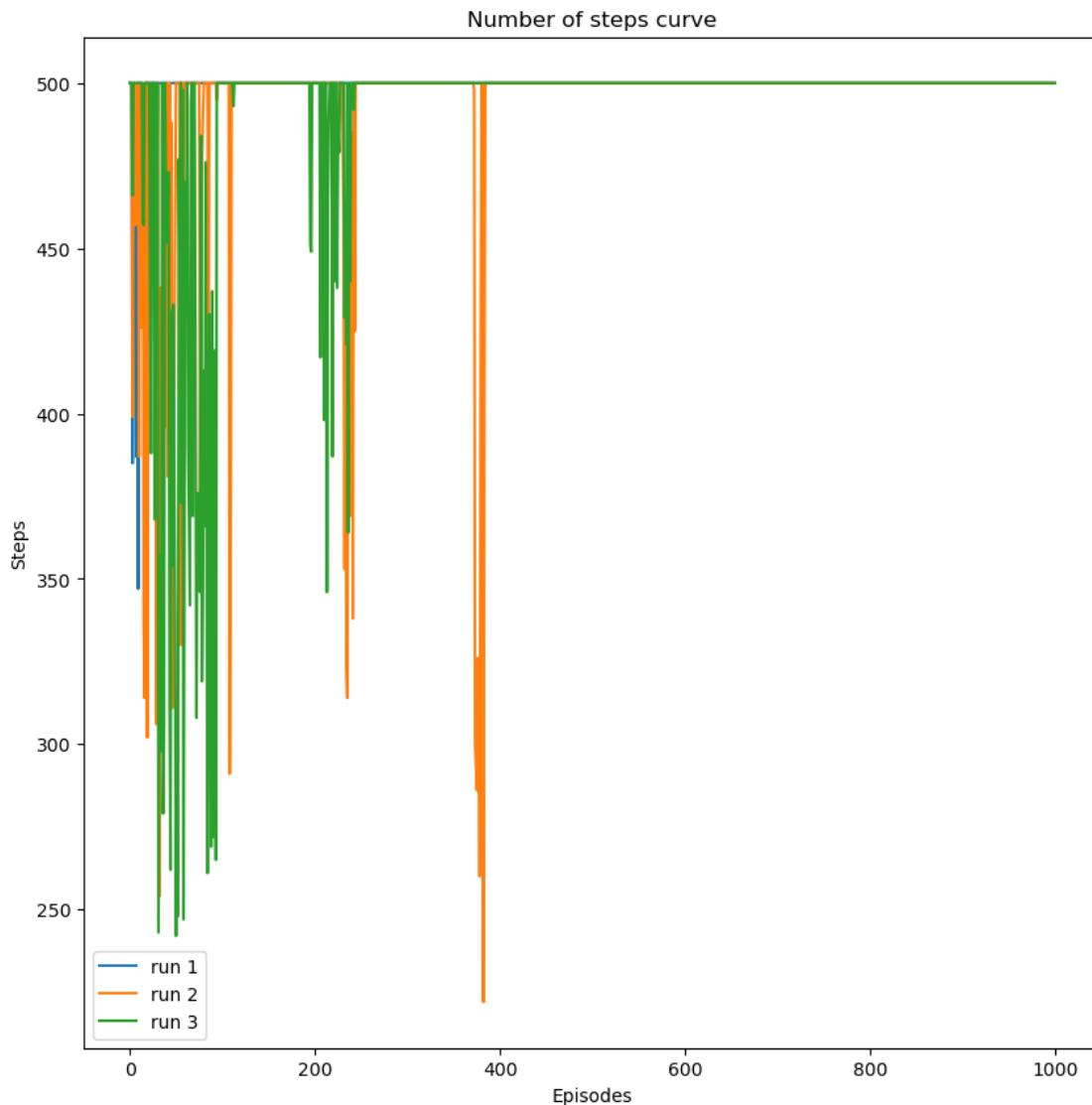
Episode 800 Reward -500.000000 Average Reward -500.000000
Episode 810 Reward -500.000000 Average Reward -500.000000
Episode 820 Reward -500.000000 Average Reward -500.000000
Episode 830 Reward -500.000000 Average Reward -500.000000
Episode 840 Reward -500.000000 Average Reward -500.000000
Episode 850 Reward -500.000000 Average Reward -500.000000
Episode 860 Reward -500.000000 Average Reward -500.000000
Episode 870 Reward -500.000000 Average Reward -500.000000
Episode 880 Reward -500.000000 Average Reward -500.000000
Episode 890 Reward -500.000000 Average Reward -500.000000
Episode 900 Reward -500.000000 Average Reward -500.000000
Episode 910 Reward -500.000000 Average Reward -500.000000
Episode 920 Reward -500.000000 Average Reward -500.000000
Episode 930 Reward -500.000000 Average Reward -500.000000
Episode 940 Reward -500.000000 Average Reward -500.000000
Episode 950 Reward -500.000000 Average Reward -500.000000
Episode 960 Reward -500.000000 Average Reward -500.000000
Episode 970 Reward -500.000000 Average Reward -500.000000
Episode 980 Reward -500.000000 Average Reward -500.000000
Episode 990 Reward -500.000000 Average Reward -500.000000
Episode 1000 Reward -500.000000 Average Reward -500.000000

0:17:49.338117









MountainCar

```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [1024, 512]
LR = 1e-4
NUM_EPISODES = 600
AVG_NUM = 50
ENV_NAME = 'MountainCar-v0'
SOLVE_CUTOFF = -125
STEP = 10

ENV = gym.make(ENV_NAME)
```

```

mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname =
    f'hl={NUM_HIDDEN}_hs={HIDDEN_SIZES}_lr={LR}_env={ENV_NAME}_numep={NUM_EPISODES}_nstep={STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

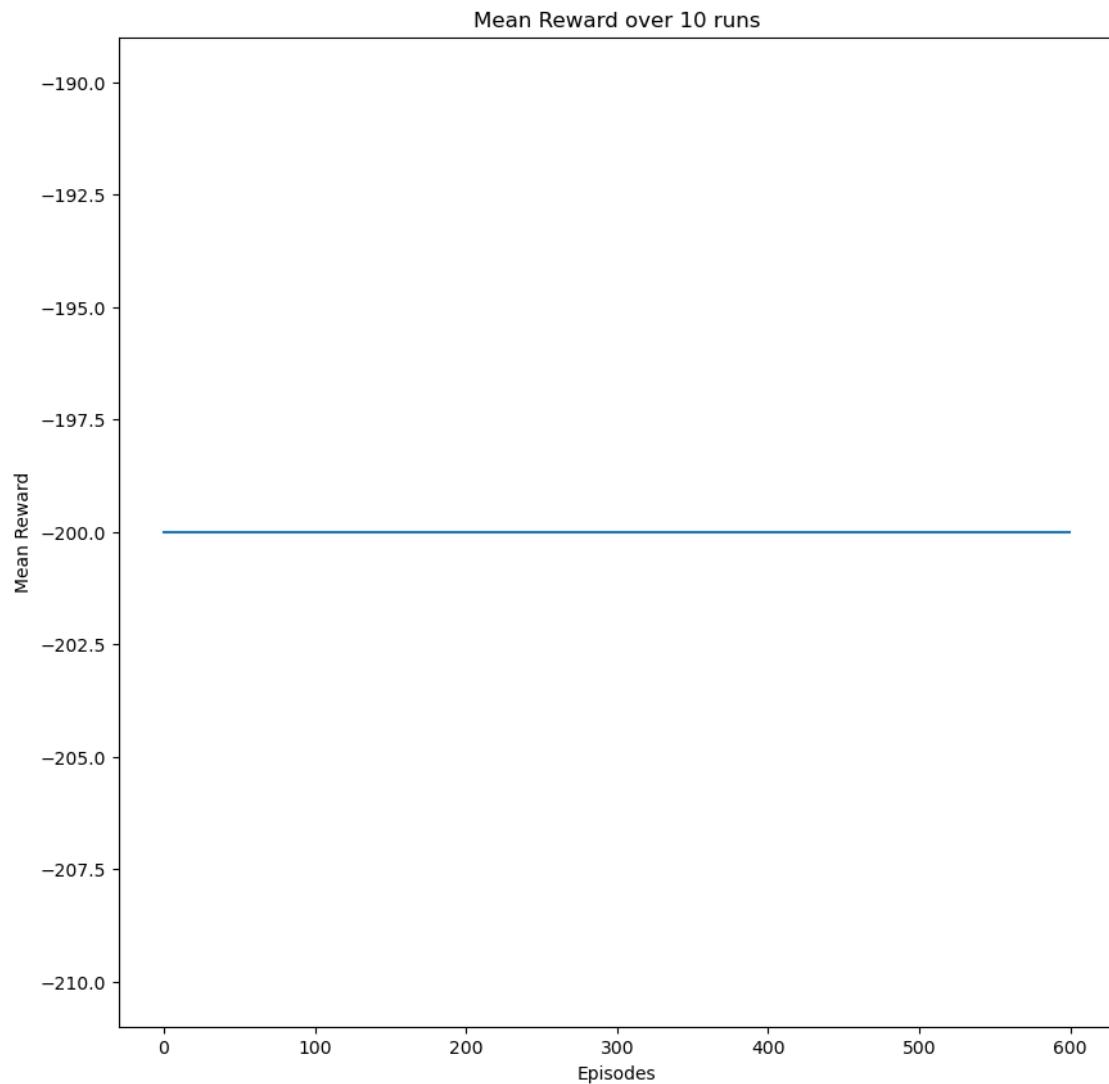
/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

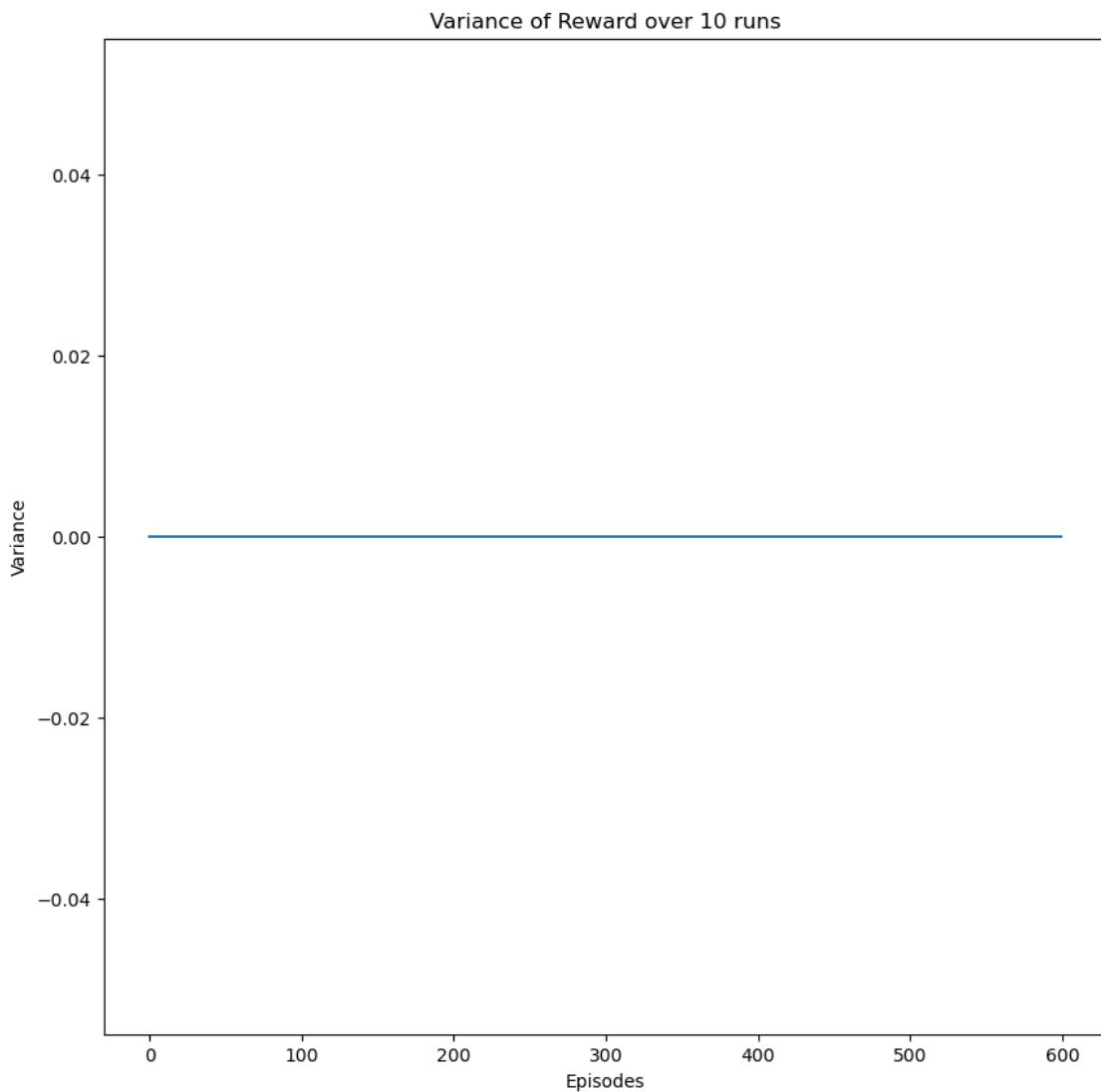
Episode 10 Reward -200.000000 Average Reward -200.000000
 Episode 20 Reward -200.000000 Average Reward -200.000000
 Episode 30 Reward -200.000000 Average Reward -200.000000
 Episode 40 Reward -200.000000 Average Reward -200.000000
 Episode 50 Reward -200.000000 Average Reward -200.000000
 Episode 60 Reward -200.000000 Average Reward -200.000000
 Episode 70 Reward -200.000000 Average Reward -200.000000
 Episode 80 Reward -200.000000 Average Reward -200.000000
 Episode 90 Reward -200.000000 Average Reward -200.000000
 Episode 100 Reward -200.000000 Average Reward -200.000000
 Episode 110 Reward -200.000000 Average Reward -200.000000
 Episode 120 Reward -200.000000 Average Reward -200.000000
 Episode 130 Reward -200.000000 Average Reward -200.000000
 Episode 140 Reward -200.000000 Average Reward -200.000000
 Episode 150 Reward -200.000000 Average Reward -200.000000
 Episode 160 Reward -200.000000 Average Reward -200.000000
 Episode 170 Reward -200.000000 Average Reward -200.000000
 Episode 180 Reward -200.000000 Average Reward -200.000000
 Episode 190 Reward -200.000000 Average Reward -200.000000
 Episode 200 Reward -200.000000 Average Reward -200.000000
 Episode 210 Reward -200.000000 Average Reward -200.000000
 Episode 220 Reward -200.000000 Average Reward -200.000000
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 Episode 240 Reward -200.000000 Average Reward -200.000000
 Episode 250 Reward -200.000000 Average Reward -200.000000

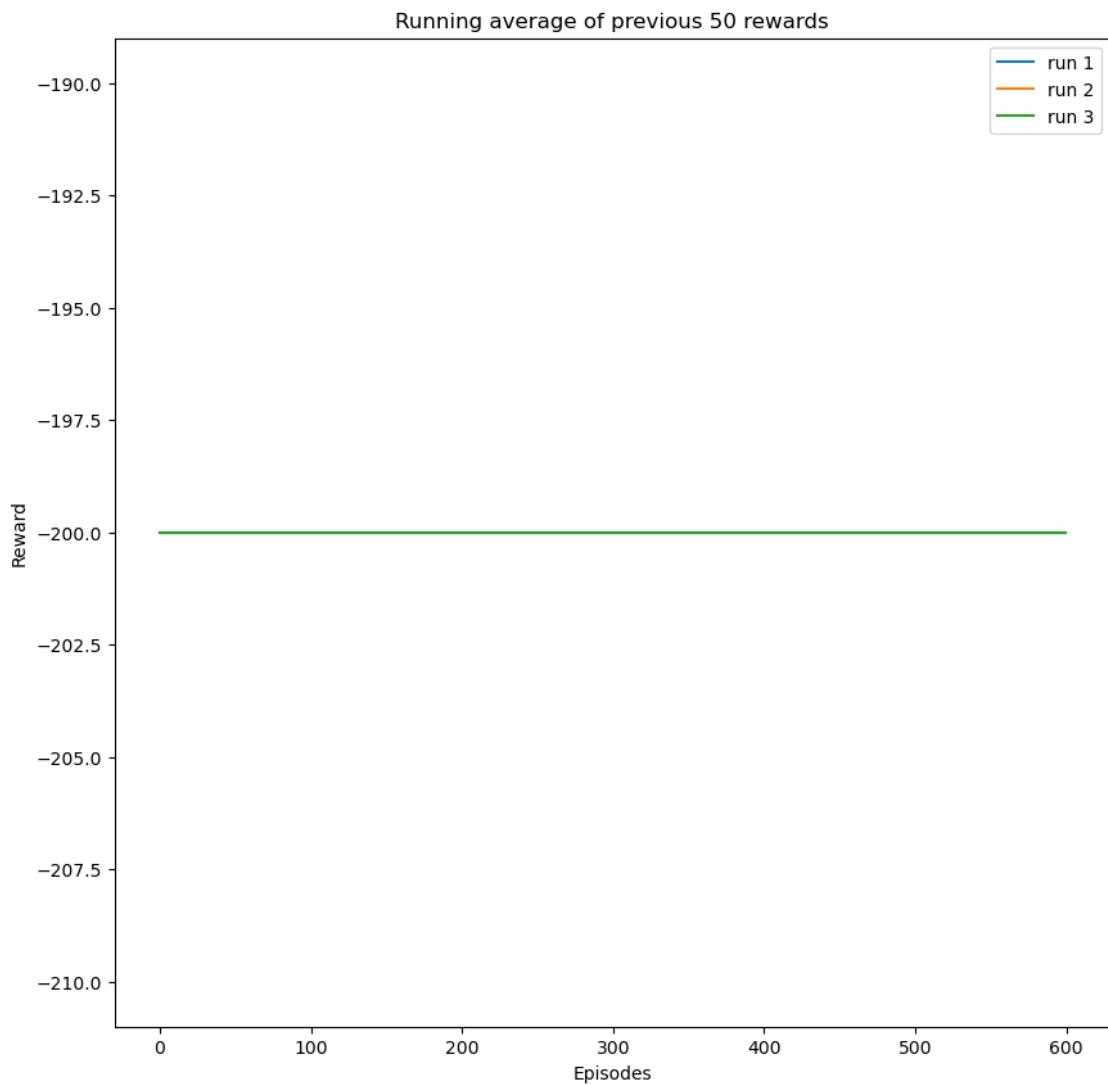
0:03:02.721801

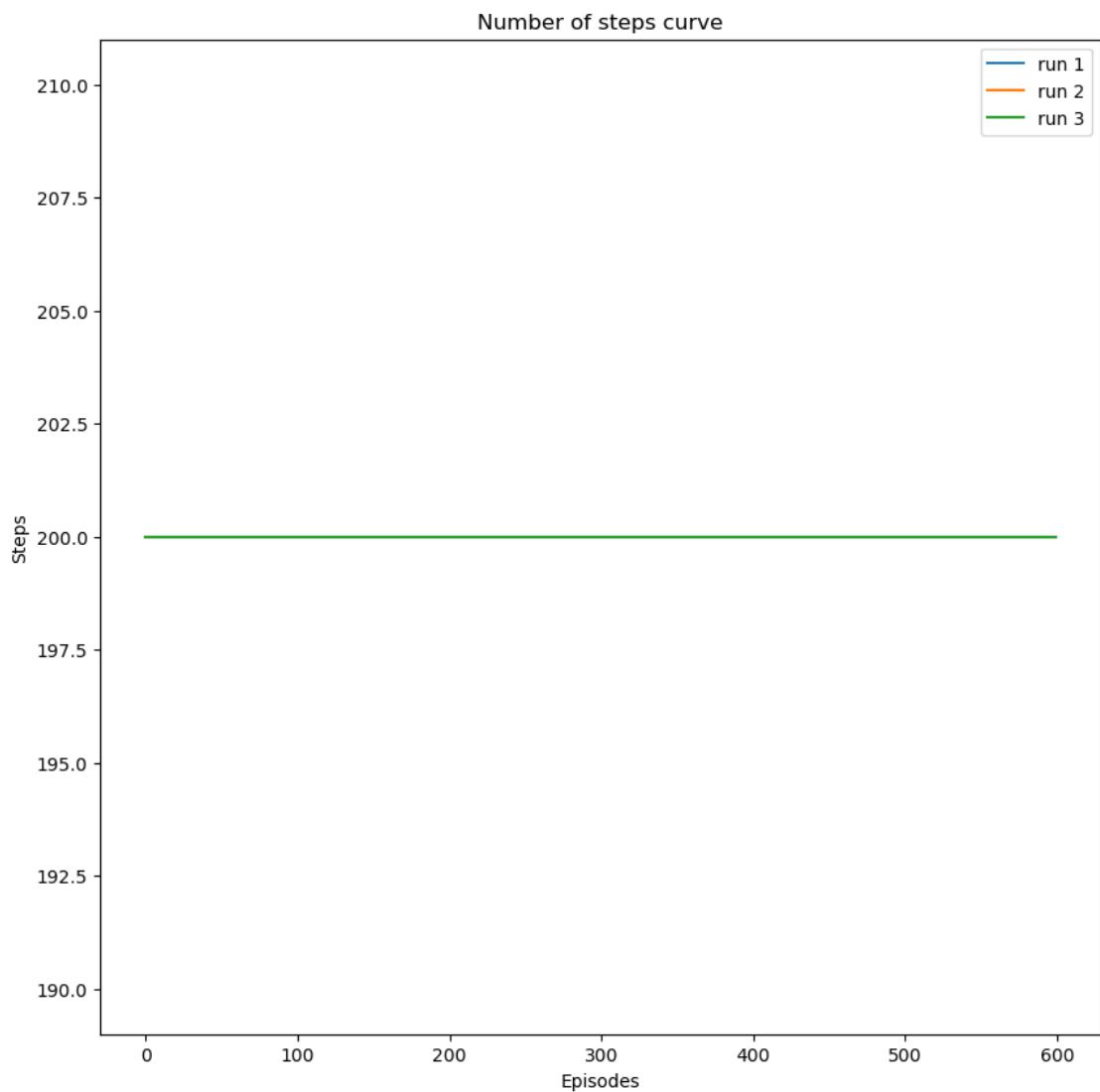
Episode	10	Reward	-200.000000	Average Reward	-200.000000
Episode	20	Reward	-200.000000	Average Reward	-200.000000
Episode	30	Reward	-200.000000	Average Reward	-200.000000
Episode	40	Reward	-200.000000	Average Reward	-200.000000
Episode	50	Reward	-200.000000	Average Reward	-200.000000
Episode	60	Reward	-200.000000	Average Reward	-200.000000
Episode	70	Reward	-200.000000	Average Reward	-200.000000
Episode	80	Reward	-200.000000	Average Reward	-200.000000

Episode 530 Reward -200.000000 Average Reward -200.000000
Episode 540 Reward -200.000000 Average Reward -200.000000
Episode 550 Reward -200.000000 Average Reward -200.000000
Episode 560 Reward -200.000000 Average Reward -200.000000
Episode 570 Reward -200.000000 Average Reward -200.000000
Episode 580 Reward -200.000000 Average Reward -200.000000
Episode 590 Reward -200.000000 Average Reward -200.000000
Episode 600 Reward -200.000000 Average Reward -200.000000
0:03:03.771643









FullReturnACmain

March 26, 2023

```
[ ]: import numpy as np
from collections import namedtuple, deque
import datetime
import gym
import glob
import io
import base64
import matplotlib.pyplot as plt
import tensorflow as tf
from PIL import Image
import tensorflow_probability as tfp
import seaborn as sns
import os
```

```
[ ]: from google.colab import drive
drive.mount('/content/drive')
```

Drive already mounted at /content/drive; to attempt to forcibly remount, call
drive.mount("/content/drive", force_remount=True).

0.1 One-Step Actor-Critic Algorithm

Actor-Critic methods learn both a policy $\pi(a|s; \theta)$ and a state-value function $v(s; w)$ simultaneously. The policy is referred to as the actor that suggests actions given a state. The estimated value function is referred to as the critic. It evaluates actions taken by the actor based on the given policy. In this exercise, both functions are approximated by feedforward neural networks.

- The policy network is parametrized by θ - it takes a state s as input and outputs the probabilities $\pi(a|s; \theta) \forall a$
- The value network is parametrized by w - it takes a state s as input and outputs a scalar value associated with the state, i.e., $v(s; w)$
- The single step TD error can be defined as follows:

$$\delta_t = R_{t+1} + \gamma v(s_{t+1}; w) - v(s_t; w)$$

- The loss function to be minimized at every step ($L_{tot}^{(t)}$) is a summation of two terms, as follows:

$$L_{tot}^{(t)} = L_{actor}^{(t)} + L_{critic}^{(t)}$$

where,

$$L_{actor}^{(t)} = -\log \pi(a_t | s_t; \theta) \delta_t$$
$$L_{critic}^{(t)} = \delta_t^2$$

- NOTE: Here, weights of the first two hidden layers are shared by the policy and the value network
 - First two hidden layer sizes: [1024, 512]
 - Output size of policy network: 2 (Softmax activation)
 - Output size of value network: 1 (Linear activation)

0.1.1 Actor-Critic Network

```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [1024, 512]

class ActorCriticModel(tf.keras.Model):
    """
    Defining policy and value networks
    """

    def __init__(self, action_size):
        super(ActorCriticModel, self).__init__()

        self.fcls = []
        for i in range(NUM_HIDDEN):
            fc = tf.keras.layers.Dense(HIDDEN_SIZES[i], activation='relu')
            self.fcls.append(fc)

        self.pi_out = tf.keras.layers.Dense(action_size) #Output Layer for policy
        self.v_out = tf.keras.layers.Dense(1) #Output Layer for state-value

    def call(self, state):
        """
        Computes policy distribution and state-value for a given state
        """
        out = state
        for l in self.fcls:
            out = l(out)

        pi = self.pi_out(out)
        v = self.v_out(out)

        return pi, v
```

0.1.2 Agent Class

```
[ ]: ENV = gym.make('CartPole-v1')
LR = 1e-4

def env_step(action: np.ndarray):
    """Returns state, reward and done flag given an action."""
    state, reward, done, info = ENV.step(action)
    return (state.astype(np.float32), np.array(reward, np.int32), np.array(done, np.int32))

def tf_env_step(action: tf.Tensor):
    return tf.numpy_function(env_step, [action], [tf.float32, tf.int32, tf.int32])

eps = np.finfo(np.float32).eps.item()
class Agent:
    def __init__(self, action_size):
        self.model = ActorCriticModel(action_size)
        self.loss = tf.keras.losses.Huber(reduction=tf.keras.losses.Reduction.SUM)
        self.optimizer = tf.keras.optimizers.Adam(learning_rate=LR)

    def run_episode(self, initial_state, max_steps=800):
        """Runs a single episode to collect training data."""

        action_probs = tf.TensorArray(dtype=tf.float32, size=0, dynamic_size=True)
        values = tf.TensorArray(dtype=tf.float32, size=0, dynamic_size=True)
        rewards = tf.TensorArray(dtype=tf.int32, size=0, dynamic_size=True)

        initial_state_shape = initial_state.shape
        state = initial_state
        steps = 0
        for t in tf.range(max_steps):
            # Convert state into a batched tensor (batch size = 1)
            state = tf.expand_dims(state, 0)

            # Run the model and to get action probabilities and critic value;
            # and sample next action
            action_logits_t, value = self.model(state)
            action = tf.random.categorical(action_logits_t, 1)[0, 0]
            action_probs_t = tf.nn.softmax(action_logits_t)

            # Store critic values
            values = values.write(t, tf.squeeze(value))

            # Store log probability of the action chosen
            action_probs = action_probs.write(t, tf.gather(action_probs_t, action))
```

```

    action_probs = action_probs.write(t, action_probs_t[0, action])

    # Apply action to the environment to get next state and reward
    state, reward, done = tf_env_step(action)
    state.set_shape(initial_state_shape)

    rewards = rewards.write(t, reward)
    steps += 1
    if tf.cast(done, tf.bool):
        break

    action_probs = action_probs.stack()
    values = values.stack()
    rewards = rewards.stack()

    return action_probs, values, rewards, steps

def compute_full_return(self, rewards, gamma = 0.99):
    """Compute full returns at all timestep."""
    n = tf.shape(rewards)[0]
    returns = tf.TensorArray(dtype=tf.float32, size=n)

    # loop to calculate full returns for all time steps
    rewards = tf.cast(rewards[::-1], dtype=tf.float32)
    disc_ret = tf.constant(0.0)
    disc_ret_shape = disc_ret.shape
    for i in tf.range(n):
        reward = rewards[i]
        disc_ret = reward + gamma * disc_ret
        disc_ret.set_shape(disc_ret_shape)
        returns = returns.write(i, disc_ret)
    returns = returns.stack()[::-1] # reverse return array to ensure
    ↪correct order.

    return returns

def compute_loss(self, action_probs, values, returns):
    """Computes the combined Actor-Critic loss."""
    advantage = returns - values
    action_log_probs = tf.math.log(action_probs)
    actor_loss = -tf.math.reduce_sum(action_log_probs * advantage)
    critic_loss = self.loss(values, returns)
    return actor_loss + critic_loss

@tf.function
def train_step(self, initial_state, gamma=0.99, max_steps=800):

```

```

"""Runs a model training step."""

    with tf.GradientTape() as tape:
        # Run the model for one episode to collect training data
        action_probs, values, rewards, steps = self.
        ↪run_episode(initial_state,max_steps=max_steps)
            # Calculate the expected returns
            returns = self.compute_full_return(rewards, gamma)
            # Convert training data to appropriate TF tensor shapes
            action_probs, values, returns = [tf.expand_dims(x, 1) for x in
            ↪[action_probs, values, returns]]
                # Calculate the loss values to update our network
                loss = self.compute_loss(action_probs, values, returns)
                # Compute the gradients from the loss
                grads = tape.gradient(loss, self.model.trainable_variables)
                # Apply the gradients to the model's parameters
                self.optimizer.apply_gradients(zip(grads, self.model.
                ↪trainable_variables))
                    episode_reward = tf.math.reduce_sum(rewards)
            return episode_reward, steps

```

```

/usr/local/lib/python3.9/dist-packages/gym/core.py:317: DeprecationWarning:
WARN: Initializing wrapper in old step API which returns one bool instead
of two. It is recommended to set `new_step_api=True` to use new step API. This
will be the default behaviour in future.

deprecation(
/usr/local/lib/python3.9/dist-
packages/gym/wrappers/step_api_compatibility.py:39: DeprecationWarning:
WARN: Initializing environment in old step API which returns one bool
instead of two. It is recommended to set `new_step_api=True` to use new step
API. This will be the default behaviour in future.

deprecation(

```

0.1.3 Code to train the agent

```

[ ]: NUM_EPISODES = 1800
      AVG_NUM = 50
      SOLVE_CUTOFF = 195

      # do 1 run of the AC-agent in an environment for num_episodes
      def run_ac_net(tf_seed=42):
          tf.keras.utils.set_random_seed(tf_seed)
          agent = Agent(action_size=ENV.action_space.n)

          tf.compat.v1.reset_default_graph()

```

```

reward_list = []
step_list = []
begin_time = datetime.datetime.now()
ep_count = NUM_EPISODES

for ep in range(1, NUM_EPISODES + 1):
    state = ENV.reset()
    ep_rew, steps = agent.train_step(state, gamma=0.99, max_steps=800)
    reward_list.append(ep_rew)
    step_list.append(steps)

    if ep % 10 == 0:
        avg_rew = np.mean(reward_list[-10:])
        print('Episode ', ep, 'Reward %f' % ep_rew, 'Average Reward %f' % avg_rew)

    if ep % 100:
        avg_100 = np.mean(reward_list[-100:])
        if avg_100 > SOLVE_CUTOFF:
            ep_count = min(ep_count, ep) # keep track of number of episodes to solve environment

time_taken = datetime.datetime.now() - begin_time
print(time_taken)
return reward_list, step_list, ep_count

```

```
[ ]: def rolling_average(reward_list, avg_num=AVG_NUM):
    average_reward_list = np.zeros_like(reward_list)
    for i in range(0, len(reward_list)):
        if i < avg_num:
            average_reward_list[i] = np.mean(reward_list[:i+1])
        else:
            average_reward_list[i] = np.mean(reward_list[(i-avg_num+1):(i+1)])
    return average_reward_list
```

```
[ ]: def do_multiple_runs(env_name, num_runs):
    reward_lists, step_lists, comp_list = [], [], []
    ENV.seed(42)

    for r in range(num_runs):
        r, s, c = run_ac_net()
        reward_lists.append(r)
        step_lists.append(list(map(int,s)))
        comp_list.append(c)

    mean_rewards = np.mean(reward_lists, axis=0)
```

```

var_rewards = np.sqrt(np.var(reward_lists, axis=0))

return mean_rewards, var_rewards, comp_list, reward_lists, step_lists

```

0.2 Plotting Functions and Other Helpers

```

[ ]: PATH = '/content/drive/MyDrive/Colab Notebooks/CS6700/Assignments/Assignment2/
      ↵AC1/'

def gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, □
                           ↵reward_lists, step_lists):

    m_fig, m_ax = plt.subplots(figsize=(10,10))
    v_fig, v_ax = plt.subplots(figsize=(10,10))
    m_ax.set_title(f'Mean Reward over 10 runs')
    m_ax.set_xlabel('Episodes')
    m_ax.set_ylabel('Mean Reward')
    v_ax.set_title(f'Variance of Reward over 10 runs')
    v_ax.set_xlabel('Episodes')
    v_ax.set_ylabel('Variance')

    sns.lineplot(data=mean_rewards, ax=m_ax)
    sns.lineplot(data=var_rewards, ax=v_ax)

    m_fig.savefig(PATH+'/'+fname+'/mean_reward.png')
    v_fig.savefig(PATH+'/'+fname+'/var_reward.png')

    sc_fig, sc_ax = plt.subplots(figsize=(10,10))
    st_fig, st_ax = plt.subplots(figsize=(10,10))
    sc_ax.set_title(f'Running average of previous {AVG_NUM} rewards')
    sc_ax.set_xlabel('Episodes')
    sc_ax.set_ylabel('Reward')
    st_ax.set_title(f'Number of steps curve')
    st_ax.set_xlabel('Episodes')
    st_ax.set_ylabel('Steps')

    run_count = len(reward_lists)
    labels = [f'run {i+1}' for i in range(3)]
    for idx in range(min(run_count, 3)):

        score_list = rolling_average(reward_lists[idx])
        step_list = step_lists[idx]
        sns.lineplot(data=score_list, label=labels[idx], ax=sc_ax)
        sns.lineplot(data=step_list, label=labels[idx], ax=st_ax)

    sc_fig.savefig(PATH+'/'+fname+'/sc_fig.png')

```

```

st_fig.savefig(PATH+'/'+fname+'/st_fig.png')

with open(PATH+'/'+fname+'/'+config.txt', 'w') as f:
    for s in data:
        f.write(s + '\n')

```

0.3 Experiments

[]: # STEP = 50000 for bookkeeping only. Code uses full return

CartPole

```

[ ]: NUM_HIDDEN = 1
HIDDEN_SIZES = [1024]
LR = 1e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'CartPole-v1'
SOLVE_CUTOFF = 195.0
STEP = 50000

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'hl={NUM_HIDDEN}_hs={HIDDEN_SIZES}_lr={LR}_env={ENV_NAME}_numep={NUM_EPISODES}_nstep={STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
in the future. Please use `env.reset(seed=seed)` instead.

"Function `env.seed(seed)` is marked as deprecated and will be removed in the
future. "

```

Episode 10 Reward 11.000000 Average Reward 28.200000
 Episode 20 Reward 15.000000 Average Reward 27.800000
 Episode 30 Reward 29.000000 Average Reward 25.100000

Episode 40 Reward 14.000000 Average Reward 24.900000
Episode 50 Reward 24.000000 Average Reward 24.600000
Episode 60 Reward 13.000000 Average Reward 25.700000
Episode 70 Reward 24.000000 Average Reward 18.800000
Episode 80 Reward 11.000000 Average Reward 16.800000
Episode 90 Reward 13.000000 Average Reward 23.000000
Episode 100 Reward 26.000000 Average Reward 26.800000
Episode 110 Reward 22.000000 Average Reward 31.000000
Episode 120 Reward 28.000000 Average Reward 30.300000
Episode 130 Reward 24.000000 Average Reward 21.400000
Episode 140 Reward 14.000000 Average Reward 28.600000
Episode 150 Reward 17.000000 Average Reward 26.500000
Episode 160 Reward 14.000000 Average Reward 32.200000
Episode 170 Reward 39.000000 Average Reward 23.000000
Episode 180 Reward 22.000000 Average Reward 31.400000
Episode 190 Reward 33.000000 Average Reward 44.700000
Episode 200 Reward 20.000000 Average Reward 37.600000
Episode 210 Reward 33.000000 Average Reward 37.800000
Episode 220 Reward 29.000000 Average Reward 29.700000
Episode 230 Reward 41.000000 Average Reward 35.200000
Episode 240 Reward 45.000000 Average Reward 32.300000
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Episode 270 Reward 33.000000 Average Reward 43.100000
Episode 280 Reward 19.000000 Average Reward 32.500000
Episode 290 Reward 14.000000 Average Reward 28.400000
Episode 300 Reward 39.000000 Average Reward 42.700000
Episode 310 Reward 163.000000 Average Reward 57.300000
Episode 320 Reward 20.000000 Average Reward 35.700000
Episode 330 Reward 37.000000 Average Reward 41.000000
Episode 340 Reward 11.000000 Average Reward 37.200000
Episode 350 Reward 53.000000 Average Reward 42.800000
Episode 360 Reward 39.000000 Average Reward 46.400000
Episode 370 Reward 54.000000 Average Reward 57.000000
Episode 380 Reward 15.000000 Average Reward 51.800000
Episode 390 Reward 24.000000 Average Reward 57.500000
Episode 400 Reward 70.000000 Average Reward 46.700000
Episode 410 Reward 42.000000 Average Reward 72.700000
Episode 420 Reward 69.000000 Average Reward 66.100000
Episode 430 Reward 24.000000 Average Reward 52.300000
Episode 440 Reward 44.000000 Average Reward 59.800000
Episode 450 Reward 38.000000 Average Reward 42.300000
Episode 460 Reward 24.000000 Average Reward 63.500000
Episode 470 Reward 52.000000 Average Reward 58.800000
Episode 480 Reward 74.000000 Average Reward 61.600000
Episode 490 Reward 31.000000 Average Reward 52.900000
Episode 500 Reward 27.000000 Average Reward 89.000000
Episode 510 Reward 102.000000 Average Reward 68.100000

Episode 520 Reward 19.000000 Average Reward 66.700000
Episode 530 Reward 129.000000 Average Reward 70.600000
Episode 540 Reward 290.000000 Average Reward 101.800000
Episode 550 Reward 21.000000 Average Reward 80.300000
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Episode 570 Reward 31.000000 Average Reward 73.700000
Episode 580 Reward 52.000000 Average Reward 89.000000
Episode 590 Reward 89.000000 Average Reward 71.800000
Episode 600 Reward 90.000000 Average Reward 97.600000
Episode 610 Reward 55.000000 Average Reward 90.700000
Episode 620 Reward 143.000000 Average Reward 114.500000
Episode 630 Reward 188.000000 Average Reward 133.600000
Episode 640 Reward 50.000000 Average Reward 98.300000
Episode 650 Reward 24.000000 Average Reward 105.500000
Episode 660 Reward 62.000000 Average Reward 131.800000
Episode 670 Reward 108.000000 Average Reward 107.300000
Episode 680 Reward 133.000000 Average Reward 105.900000
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Episode 700 Reward 244.000000 Average Reward 182.700000
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Episode 750 Reward 215.000000 Average Reward 208.800000
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Episode 800 Reward 129.000000 Average Reward 246.100000
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Episode 820 Reward 497.000000 Average Reward 233.500000
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Episode 850 Reward 132.000000 Average Reward 272.900000
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Episode 650 Reward 161.000000 Average Reward 124.300000
Episode 660 Reward 171.000000 Average Reward 143.900000
Episode 670 Reward 89.000000 Average Reward 159.800000
Episode 680 Reward 174.000000 Average Reward 174.900000
Episode 690 Reward 94.000000 Average Reward 209.800000
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Episode 710 Reward 285.000000 Average Reward 171.100000
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Episode 840 Reward 247.000000 Average Reward 298.000000
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Episode 970 Reward 351.000000 Average Reward 373.000000
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Episode 390 Reward 55.000000 Average Reward 47.900000
Episode 400 Reward 39.000000 Average Reward 67.900000
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Episode 950 Reward 451.000000 Average Reward 312.600000
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Episode 110 Reward 30.000000 Average Reward 22.800000

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Episode 170 Reward 19.000000 Average Reward 35.300000
Episode 180 Reward 41.000000 Average Reward 27.500000
Episode 190 Reward 18.000000 Average Reward 35.600000
Episode 200 Reward 42.000000 Average Reward 39.900000
Episode 210 Reward 26.000000 Average Reward 43.300000
Episode 220 Reward 28.000000 Average Reward 29.500000
Episode 230 Reward 87.000000 Average Reward 39.200000
Episode 240 Reward 52.000000 Average Reward 51.200000
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Episode 260 Reward 28.000000 Average Reward 34.600000
Episode 270 Reward 48.000000 Average Reward 48.100000
Episode 280 Reward 54.000000 Average Reward 35.400000
Episode 290 Reward 42.000000 Average Reward 44.300000
Episode 300 Reward 60.000000 Average Reward 30.500000
Episode 310 Reward 20.000000 Average Reward 57.300000
Episode 320 Reward 88.000000 Average Reward 56.400000
Episode 330 Reward 12.000000 Average Reward 41.400000
Episode 340 Reward 36.000000 Average Reward 52.700000
Episode 350 Reward 61.000000 Average Reward 51.200000
Episode 360 Reward 154.000000 Average Reward 57.300000
Episode 370 Reward 160.000000 Average Reward 52.600000
Episode 380 Reward 36.000000 Average Reward 50.300000
Episode 390 Reward 59.000000 Average Reward 54.600000
Episode 400 Reward 98.000000 Average Reward 55.400000
Episode 410 Reward 54.000000 Average Reward 56.900000
Episode 420 Reward 37.000000 Average Reward 52.600000
Episode 430 Reward 33.000000 Average Reward 48.400000
Episode 440 Reward 40.000000 Average Reward 51.800000
Episode 450 Reward 75.000000 Average Reward 77.600000
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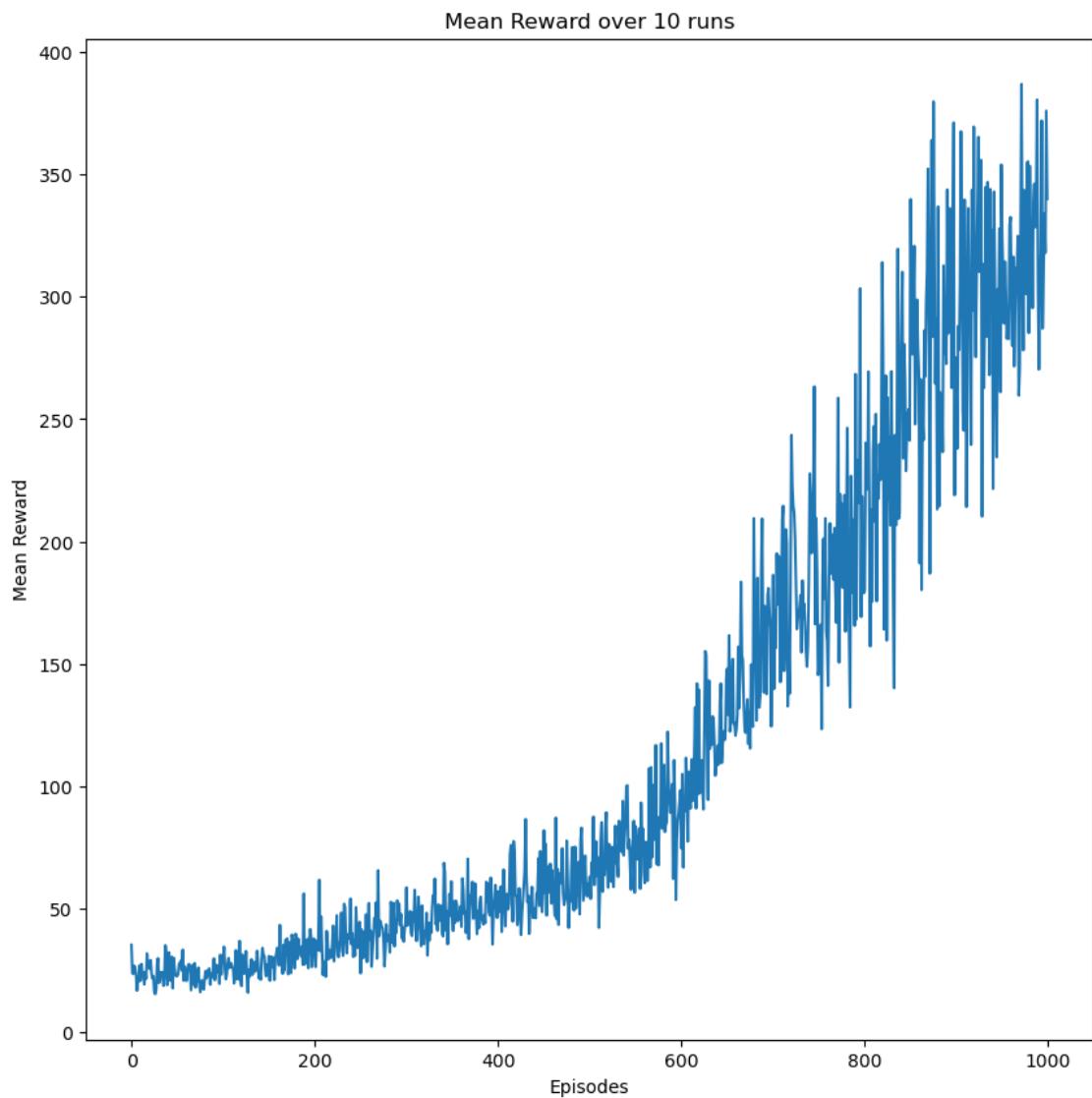
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Episode 700 Reward 164.000000 Average Reward 150.100000
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Episode 720 Reward 206.000000 Average Reward 183.100000
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Episode 740 Reward 71.000000 Average Reward 158.300000
Episode 750 Reward 152.000000 Average Reward 230.400000
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Episode 780 Reward 103.000000 Average Reward 172.200000
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Episode 900 Reward 294.000000 Average Reward 314.600000
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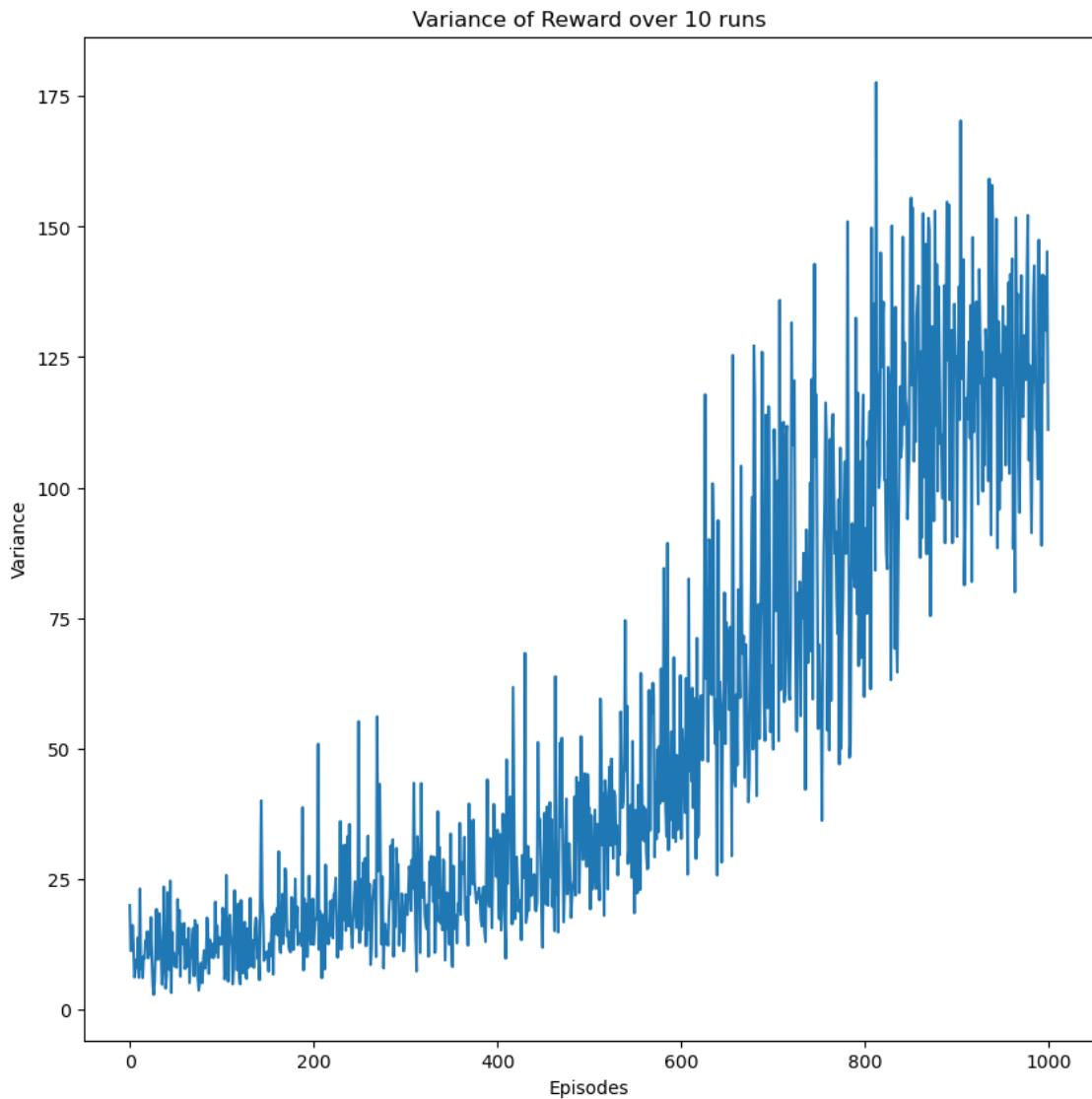
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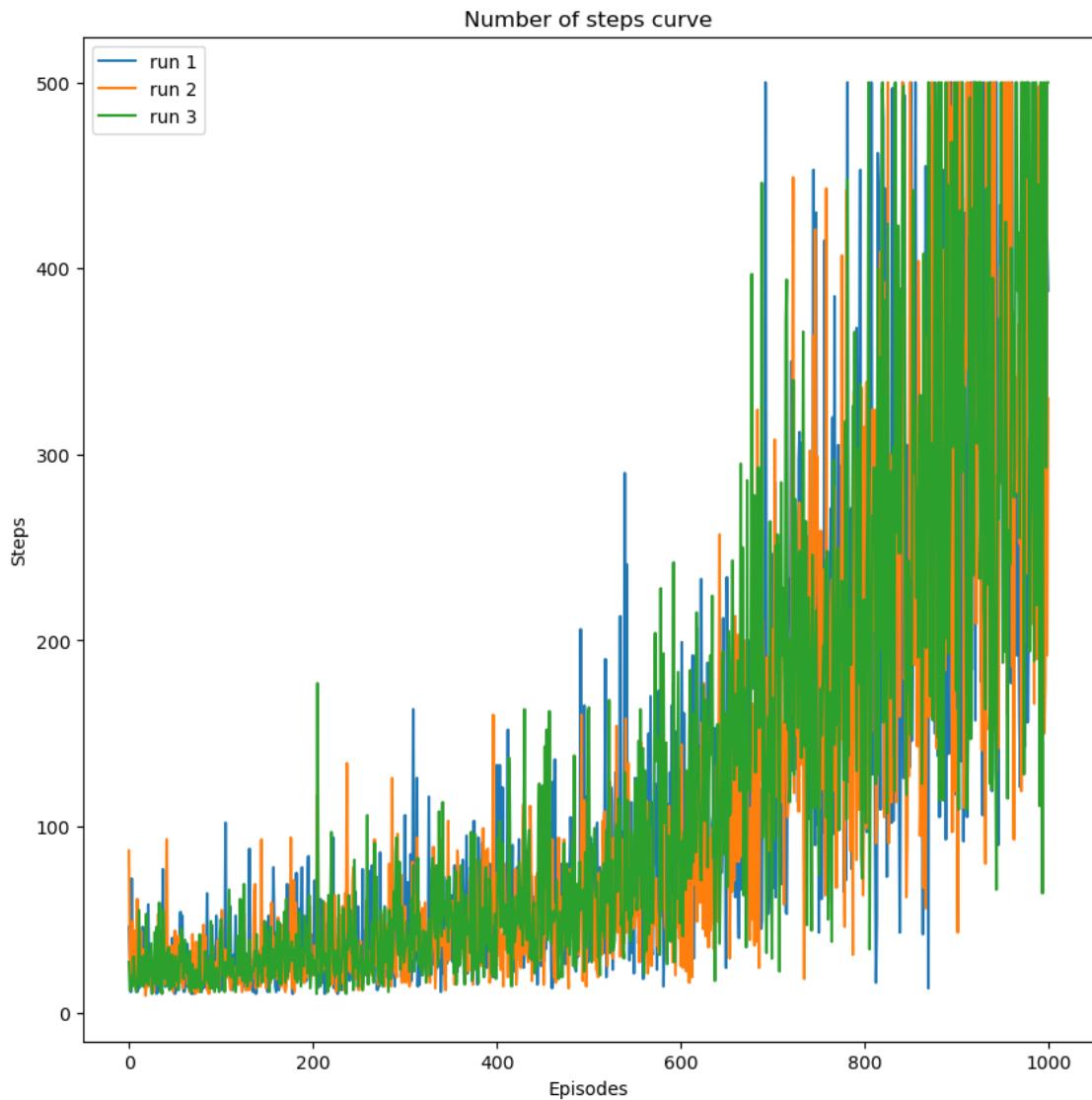
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Episode 110 Reward 9.000000 Average Reward 23.400000
Episode 120 Reward 11.000000 Average Reward 27.100000
Episode 130 Reward 30.000000 Average Reward 25.700000
Episode 140 Reward 13.000000 Average Reward 27.800000
Episode 150 Reward 33.000000 Average Reward 41.600000
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Episode 170 Reward 49.000000 Average Reward 31.100000
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Episode 200 Reward 29.000000 Average Reward 34.000000
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Episode 290 Reward 38.000000 Average Reward 45.400000
Episode 300 Reward 73.000000 Average Reward 56.000000
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Episode 340 Reward 24.000000 Average Reward 53.900000
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Episode 400 Reward 52.000000 Average Reward 40.800000
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Episode 440 Reward 21.000000 Average Reward 62.200000
Episode 450 Reward 60.000000 Average Reward 48.800000
Episode 460 Reward 91.000000 Average Reward 52.400000
Episode 470 Reward 25.000000 Average Reward 46.500000
Episode 480 Reward 54.000000 Average Reward 55.600000
Episode 490 Reward 81.000000 Average Reward 58.300000
Episode 500 Reward 45.000000 Average Reward 54.200000
Episode 510 Reward 71.000000 Average Reward 69.200000
Episode 520 Reward 35.000000 Average Reward 79.100000
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Episode 540 Reward 62.000000 Average Reward 67.900000

Episode 550 Reward 48.000000 Average Reward 89.700000
Episode 560 Reward 56.000000 Average Reward 65.700000
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Episode 590 Reward 128.000000 Average Reward 79.700000
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Episode 610 Reward 131.000000 Average Reward 93.000000
Episode 620 Reward 136.000000 Average Reward 99.500000
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Episode 640 Reward 128.000000 Average Reward 141.500000
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Episode 700 Reward 228.000000 Average Reward 173.300000
Episode 710 Reward 131.000000 Average Reward 181.700000
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Episode 760 Reward 129.000000 Average Reward 126.900000
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Episode 790 Reward 87.000000 Average Reward 147.600000
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Episode 840 Reward 269.000000 Average Reward 202.800000
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Episode 870 Reward 201.000000 Average Reward 326.200000
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Episode 890 Reward 89.000000 Average Reward 284.400000
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Episode 920 Reward 500.000000 Average Reward 272.100000
Episode 930 Reward 500.000000 Average Reward 390.400000
Episode 940 Reward 190.000000 Average Reward 332.100000
Episode 950 Reward 171.000000 Average Reward 225.700000
Episode 960 Reward 157.000000 Average Reward 203.000000
Episode 970 Reward 202.000000 Average Reward 196.500000
Episode 980 Reward 144.000000 Average Reward 156.300000
Episode 990 Reward 34.000000 Average Reward 170.600000
Episode 1000 Reward 186.000000 Average Reward 161.500000
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```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [512, 512]
LR = 0.5e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'CartPole-v1'
SOLVE_CUTOFF = 195.0
STEP = 50000

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{hs}-{lr}-{env}-{numep}-{nstep}-{STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	11.000000	28.800000
20	15.000000	27.200000
30	30.000000	25.200000
40	32.000000	26.400000
50	24.000000	23.000000
60	11.000000	26.300000
70	17.000000	24.500000
80	28.000000	23.300000
90	40.000000	26.300000
100	16.000000	21.300000
110	12.000000	23.700000
120	16.000000	18.300000
130	20.000000	34.000000
140	19.000000	23.600000
150	28.000000	29.200000
160	43.000000	35.300000
170	22.000000	37.300000
180	42.000000	31.000000
190	53.000000	29.700000
200	82.000000	32.400000
210	49.000000	35.100000
220	24.000000	38.300000
230	26.000000	38.900000
240	36.000000	40.900000
250	29.000000	40.500000
260	31.000000	39.000000
270	31.000000	33.000000
280	46.000000	30.200000

Episode 290 Reward 78.000000 Average Reward 53.600000
Episode 300 Reward 51.000000 Average Reward 55.000000
Episode 310 Reward 69.000000 Average Reward 58.100000
Episode 320 Reward 72.000000 Average Reward 47.500000
Episode 330 Reward 33.000000 Average Reward 58.100000
Episode 340 Reward 55.000000 Average Reward 55.600000
Episode 350 Reward 78.000000 Average Reward 55.800000
Episode 360 Reward 25.000000 Average Reward 72.400000
Episode 370 Reward 22.000000 Average Reward 63.000000
Episode 380 Reward 176.000000 Average Reward 70.900000
Episode 390 Reward 75.000000 Average Reward 75.500000
Episode 400 Reward 53.000000 Average Reward 74.000000
Episode 410 Reward 14.000000 Average Reward 61.200000
Episode 420 Reward 69.000000 Average Reward 99.700000
Episode 430 Reward 34.000000 Average Reward 74.100000
Episode 440 Reward 29.000000 Average Reward 100.200000
Episode 450 Reward 114.000000 Average Reward 97.900000
Episode 460 Reward 279.000000 Average Reward 131.700000
Episode 470 Reward 38.000000 Average Reward 128.200000
Episode 480 Reward 131.000000 Average Reward 149.200000
Episode 490 Reward 268.000000 Average Reward 147.000000
Episode 500 Reward 108.000000 Average Reward 134.300000
Episode 510 Reward 219.000000 Average Reward 223.200000
Episode 520 Reward 178.000000 Average Reward 145.900000
Episode 530 Reward 212.000000 Average Reward 192.100000
Episode 540 Reward 500.000000 Average Reward 216.500000
Episode 550 Reward 190.000000 Average Reward 219.800000
Episode 560 Reward 298.000000 Average Reward 187.100000
Episode 570 Reward 146.000000 Average Reward 255.700000
Episode 580 Reward 209.000000 Average Reward 284.200000
Episode 590 Reward 197.000000 Average Reward 248.300000
Episode 600 Reward 181.000000 Average Reward 171.600000
Episode 610 Reward 254.000000 Average Reward 192.400000
Episode 620 Reward 281.000000 Average Reward 217.000000
Episode 630 Reward 191.000000 Average Reward 209.700000
Episode 640 Reward 183.000000 Average Reward 186.600000
Episode 650 Reward 232.000000 Average Reward 222.400000
Episode 660 Reward 135.000000 Average Reward 223.600000
Episode 670 Reward 76.000000 Average Reward 198.400000
Episode 680 Reward 105.000000 Average Reward 233.900000
Episode 690 Reward 453.000000 Average Reward 229.600000
Episode 700 Reward 356.000000 Average Reward 238.700000
Episode 710 Reward 202.000000 Average Reward 354.800000
Episode 720 Reward 319.000000 Average Reward 331.700000
Episode 730 Reward 453.000000 Average Reward 328.800000
Episode 740 Reward 397.000000 Average Reward 402.600000
Episode 750 Reward 298.000000 Average Reward 305.600000
Episode 760 Reward 183.000000 Average Reward 359.700000

Episode 770 Reward 146.000000 Average Reward 284.700000
Episode 780 Reward 181.000000 Average Reward 234.300000
Episode 790 Reward 160.000000 Average Reward 170.200000
Episode 800 Reward 231.000000 Average Reward 179.500000
Episode 810 Reward 202.000000 Average Reward 185.500000
Episode 820 Reward 276.000000 Average Reward 221.100000
Episode 830 Reward 328.000000 Average Reward 291.400000
Episode 840 Reward 252.000000 Average Reward 245.500000
Episode 850 Reward 500.000000 Average Reward 282.000000
Episode 860 Reward 490.000000 Average Reward 379.200000
Episode 870 Reward 367.000000 Average Reward 314.900000
Episode 880 Reward 191.000000 Average Reward 241.900000
Episode 890 Reward 148.000000 Average Reward 167.000000
Episode 900 Reward 99.000000 Average Reward 118.200000
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Episode 240 Reward 64.000000 Average Reward 36.500000
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Episode 330 Reward 91.000000 Average Reward 69.600000
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Episode 380 Reward 63.000000 Average Reward 78.200000
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Episode 410 Reward 150.000000 Average Reward 115.000000
Episode 420 Reward 131.000000 Average Reward 96.800000
Episode 430 Reward 87.000000 Average Reward 143.400000
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Episode 470 Reward 229.000000 Average Reward 173.300000
Episode 480 Reward 295.000000 Average Reward 238.300000
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Episode 560 Reward 210.000000 Average Reward 185.400000
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Episode 720 Reward 172.000000 Average Reward 171.400000
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Episode 50 Reward 13.000000 Average Reward 16.100000
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Episode 70 Reward 19.000000 Average Reward 34.500000
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Episode 170 Reward 69.000000 Average Reward 37.800000
Episode 180 Reward 11.000000 Average Reward 26.500000

Episode 190 Reward 44.000000 Average Reward 32.100000
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Episode 210 Reward 66.000000 Average Reward 33.400000
Episode 220 Reward 45.000000 Average Reward 40.800000
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Episode 240 Reward 22.000000 Average Reward 22.200000
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Episode 640 Reward 329.000000 Average Reward 249.000000
Episode 650 Reward 500.000000 Average Reward 301.000000
Episode 660 Reward 281.000000 Average Reward 301.100000

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Episode 720 Reward 269.000000 Average Reward 307.800000
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Episode 410 Reward 72.000000 Average Reward 100.800000

Episode 420 Reward 135.000000 Average Reward 121.200000
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Episode 570 Reward 151.000000 Average Reward 208.500000
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Episode 590 Reward 387.000000 Average Reward 284.000000
Episode 600 Reward 500.000000 Average Reward 315.700000
Episode 610 Reward 172.000000 Average Reward 284.000000
Episode 620 Reward 312.000000 Average Reward 180.900000
Episode 630 Reward 379.000000 Average Reward 294.800000
Episode 640 Reward 371.000000 Average Reward 252.600000
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Episode 690 Reward 173.000000 Average Reward 302.500000
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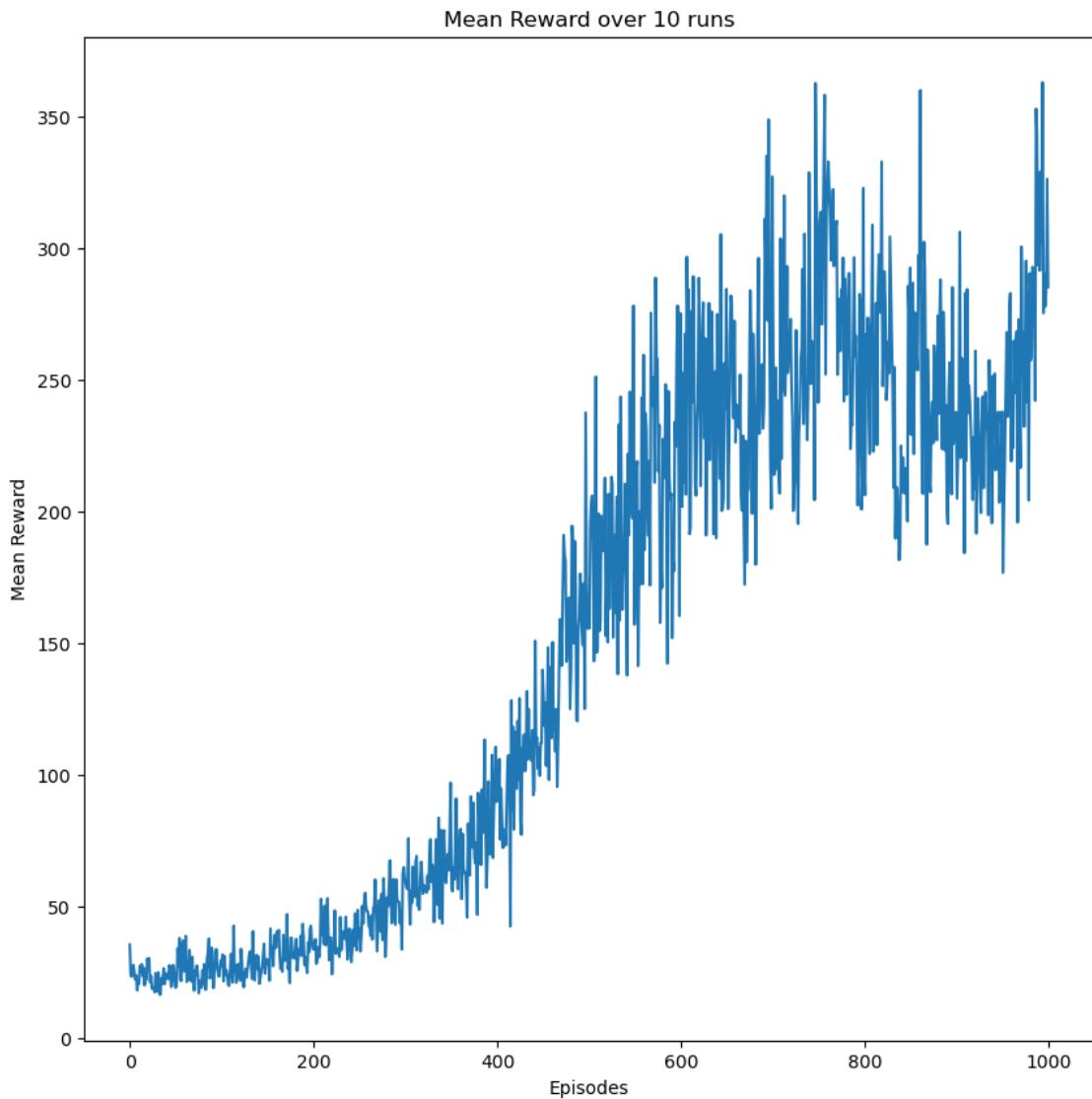
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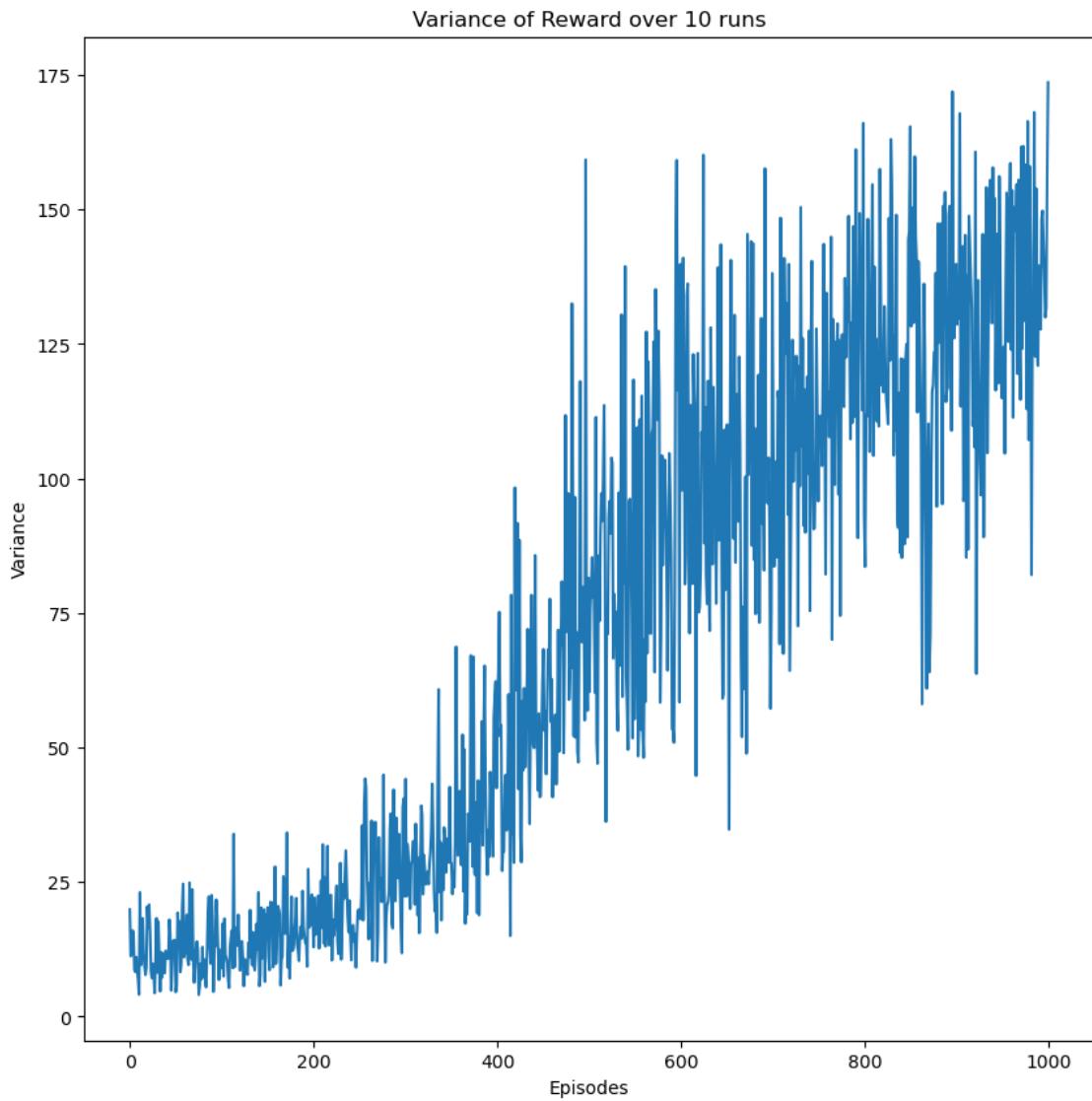
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Episode 610 Reward 245.000000 Average Reward 225.400000
Episode 620 Reward 197.000000 Average Reward 295.100000
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Episode 690 Reward 32.000000 Average Reward 190.900000
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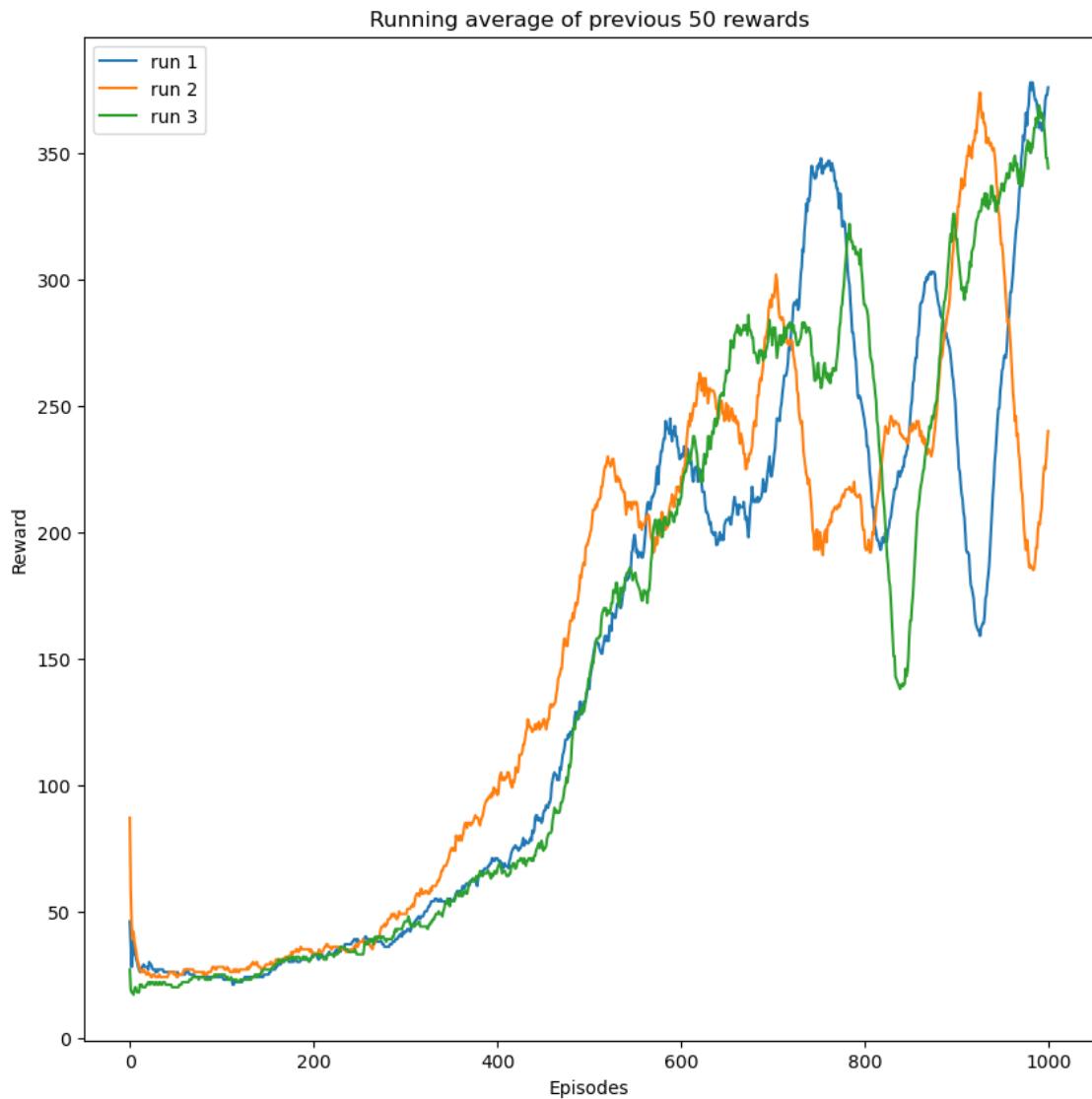
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Episode 80 Reward 38.000000 Average Reward 26.100000
Episode 90 Reward 19.000000 Average Reward 34.800000
Episode 100 Reward 48.000000 Average Reward 22.500000
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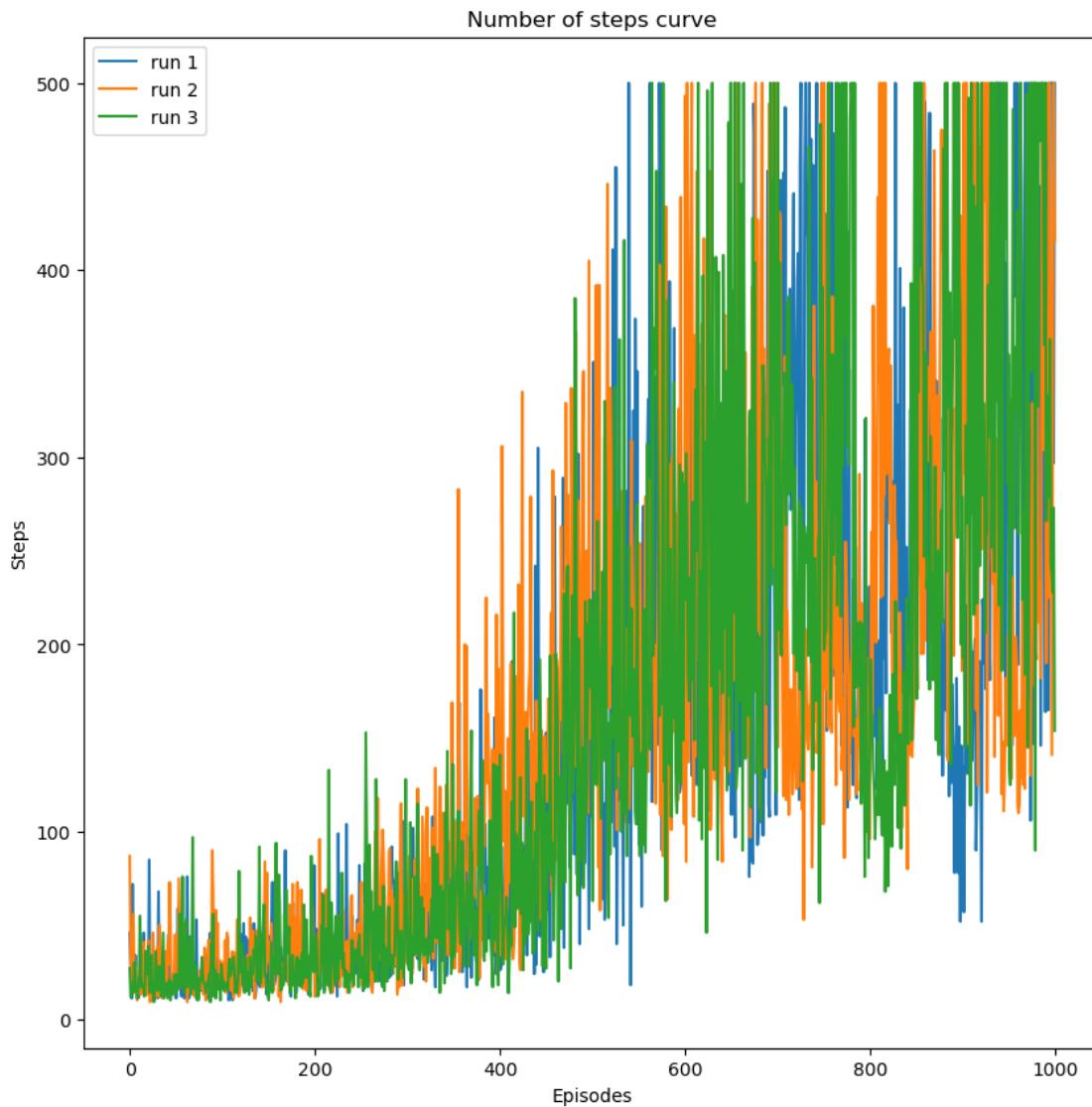
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Episode 890 Reward 70.000000 Average Reward 139.200000
Episode 900 Reward 127.000000 Average Reward 131.900000
Episode 910 Reward 273.000000 Average Reward 177.300000
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Episode 940 Reward 443.000000 Average Reward 343.400000
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Episode 1000 Reward 500.000000 Average Reward 426.300000
0:02:22.651461









```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [512, 512]
LR = 1e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'CartPole-v1'
SOLVE_CUTOFF = 195.0
STEP = 50000

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{hs}-{lr}-{env}-{numep}-{nstep}-{STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	40.000000	35.400000
20	10.000000	22.600000
30	59.000000	28.200000
40	45.000000	45.700000
50	21.000000	33.000000
60	20.000000	22.000000
70	28.000000	27.800000
80	27.000000	36.400000
90	23.000000	44.300000
100	38.000000	33.000000
110	37.000000	45.000000
120	95.000000	55.200000
130	44.000000	56.300000
140	63.000000	51.500000
150	69.000000	47.100000
160	48.000000	48.800000
170	25.000000	53.100000
180	54.000000	60.700000
190	53.000000	71.800000
200	47.000000	58.900000
210	97.000000	79.800000
220	52.000000	72.900000
230	62.000000	93.300000
240	103.000000	123.300000
250	154.000000	130.800000
260	387.000000	178.300000
270	223.000000	157.000000
280	234.000000	175.200000

Episode 290 Reward 384.000000 Average Reward 227.800000
Episode 300 Reward 227.000000 Average Reward 181.800000
Episode 310 Reward 217.000000 Average Reward 201.000000
Episode 320 Reward 173.000000 Average Reward 155.700000
Episode 330 Reward 228.000000 Average Reward 212.200000
Episode 340 Reward 235.000000 Average Reward 305.400000
Episode 350 Reward 289.000000 Average Reward 261.600000
Episode 360 Reward 257.000000 Average Reward 317.400000
Episode 370 Reward 308.000000 Average Reward 228.100000
Episode 380 Reward 306.000000 Average Reward 255.800000
Episode 390 Reward 198.000000 Average Reward 296.100000
Episode 400 Reward 192.000000 Average Reward 266.300000
Episode 410 Reward 225.000000 Average Reward 312.000000
Episode 420 Reward 309.000000 Average Reward 340.900000
Episode 430 Reward 180.000000 Average Reward 338.800000
Episode 440 Reward 443.000000 Average Reward 318.900000
Episode 450 Reward 317.000000 Average Reward 324.200000
Episode 460 Reward 228.000000 Average Reward 249.600000
Episode 470 Reward 153.000000 Average Reward 163.000000
Episode 480 Reward 421.000000 Average Reward 301.400000
Episode 490 Reward 268.000000 Average Reward 257.900000
Episode 500 Reward 416.000000 Average Reward 397.100000
Episode 510 Reward 422.000000 Average Reward 360.100000
Episode 520 Reward 500.000000 Average Reward 317.500000
Episode 530 Reward 500.000000 Average Reward 412.800000
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Episode 550 Reward 295.000000 Average Reward 357.000000
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Episode 570 Reward 31.000000 Average Reward 50.500000
Episode 580 Reward 24.000000 Average Reward 21.300000
Episode 590 Reward 24.000000 Average Reward 24.500000
Episode 600 Reward 56.000000 Average Reward 33.800000
Episode 610 Reward 21.000000 Average Reward 29.700000
Episode 620 Reward 20.000000 Average Reward 28.900000
Episode 630 Reward 105.000000 Average Reward 38.900000
Episode 640 Reward 41.000000 Average Reward 40.800000
Episode 650 Reward 32.000000 Average Reward 40.000000
Episode 660 Reward 39.000000 Average Reward 56.000000
Episode 670 Reward 44.000000 Average Reward 33.000000
Episode 680 Reward 32.000000 Average Reward 29.700000
Episode 690 Reward 24.000000 Average Reward 28.700000
Episode 700 Reward 29.000000 Average Reward 33.800000
Episode 710 Reward 36.000000 Average Reward 35.600000
Episode 720 Reward 52.000000 Average Reward 33.300000
Episode 730 Reward 27.000000 Average Reward 28.500000
Episode 740 Reward 26.000000 Average Reward 30.300000
Episode 750 Reward 21.000000 Average Reward 30.500000
Episode 760 Reward 29.000000 Average Reward 40.200000

Episode 770 Reward 32.000000 Average Reward 42.200000
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Episode 230 Reward 160.000000 Average Reward 138.500000

Episode 240 Reward 108.000000 Average Reward 173.700000
Episode 250 Reward 155.000000 Average Reward 119.700000
Episode 260 Reward 45.000000 Average Reward 135.500000
Episode 270 Reward 257.000000 Average Reward 202.100000
Episode 280 Reward 301.000000 Average Reward 151.100000
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Episode 370 Reward 132.000000 Average Reward 292.200000
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Episode 410 Reward 143.000000 Average Reward 245.700000
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Episode 710 Reward 500.000000 Average Reward 363.800000

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Episode 510 Reward 500.000000 Average Reward 455.000000
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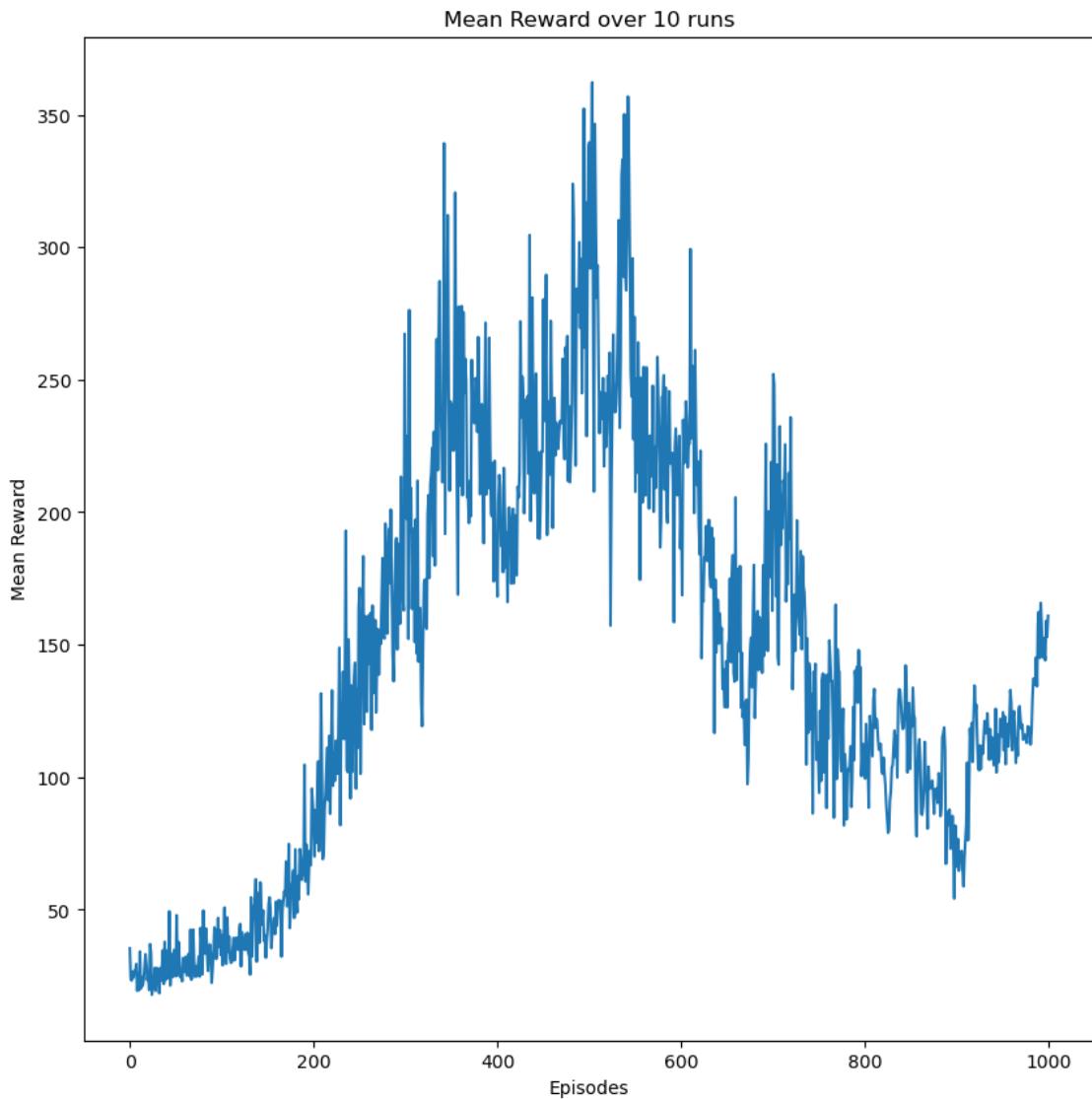
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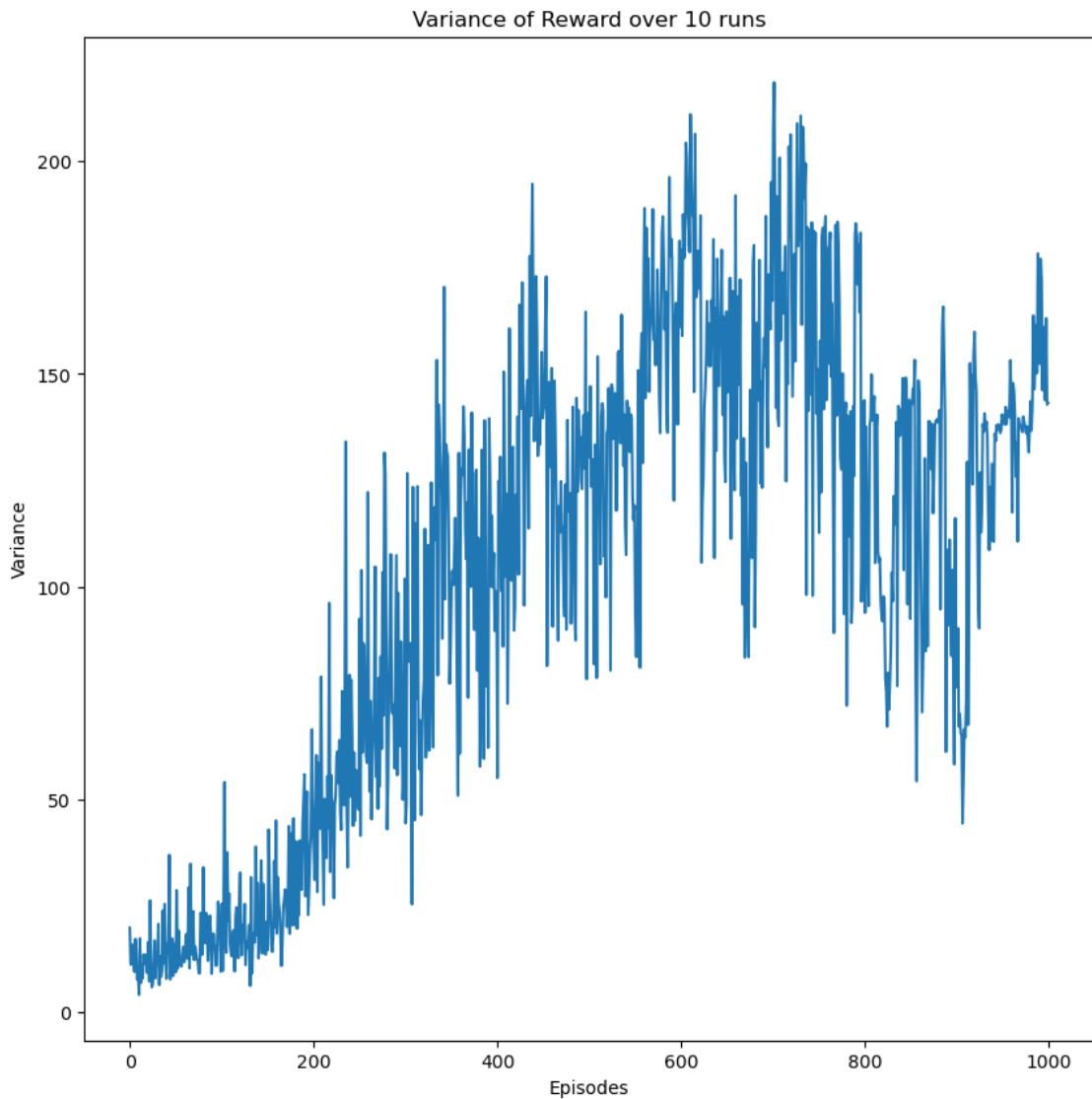
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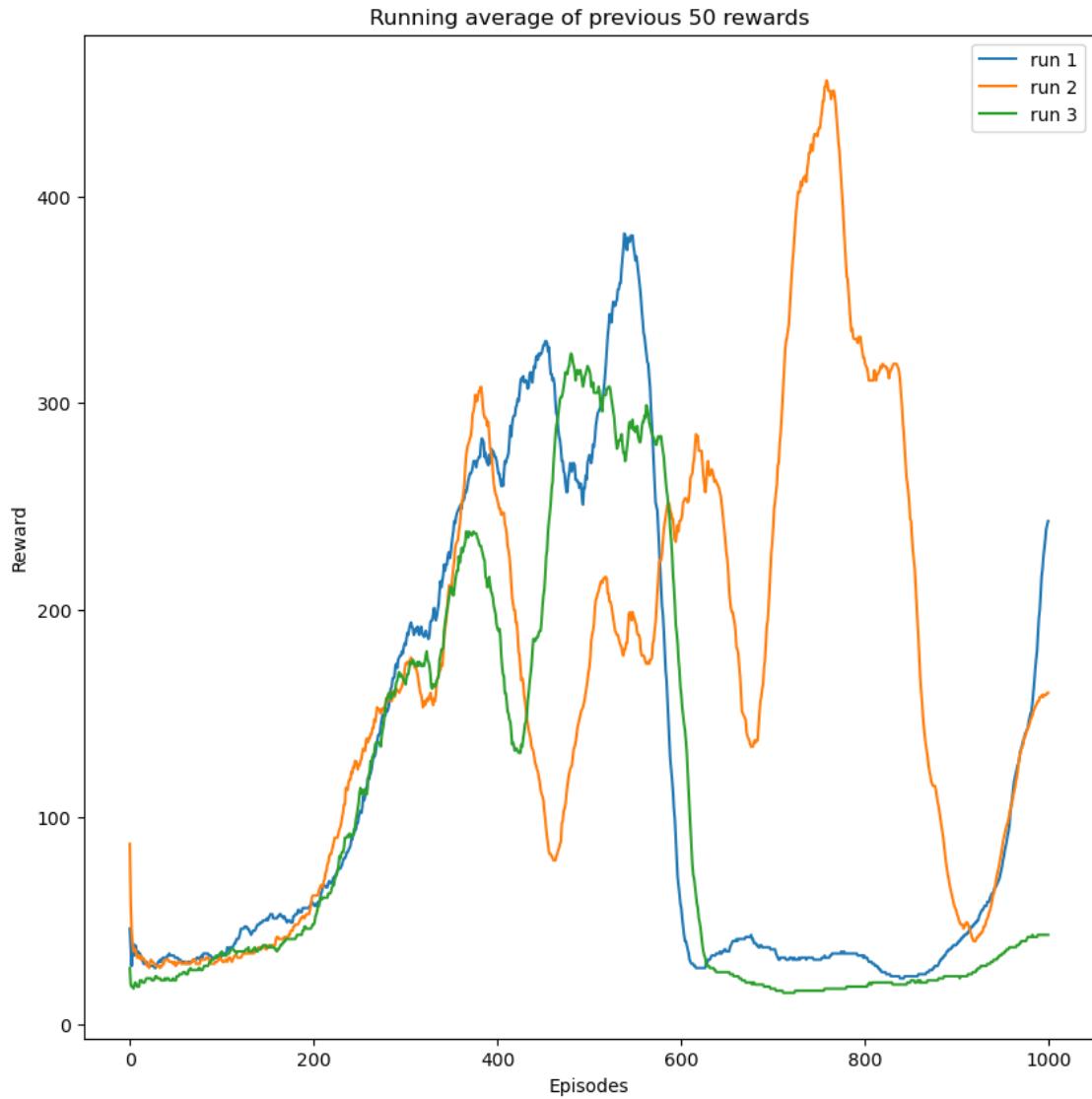
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Episode 80 Reward 56.000000 Average Reward 35.400000
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Episode 110 Reward 30.000000 Average Reward 22.700000
Episode 120 Reward 24.000000 Average Reward 27.700000
Episode 130 Reward 40.000000 Average Reward 38.100000
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Episode 200 Reward 66.000000 Average Reward 70.900000
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Episode 280 Reward 128.000000 Average Reward 140.600000
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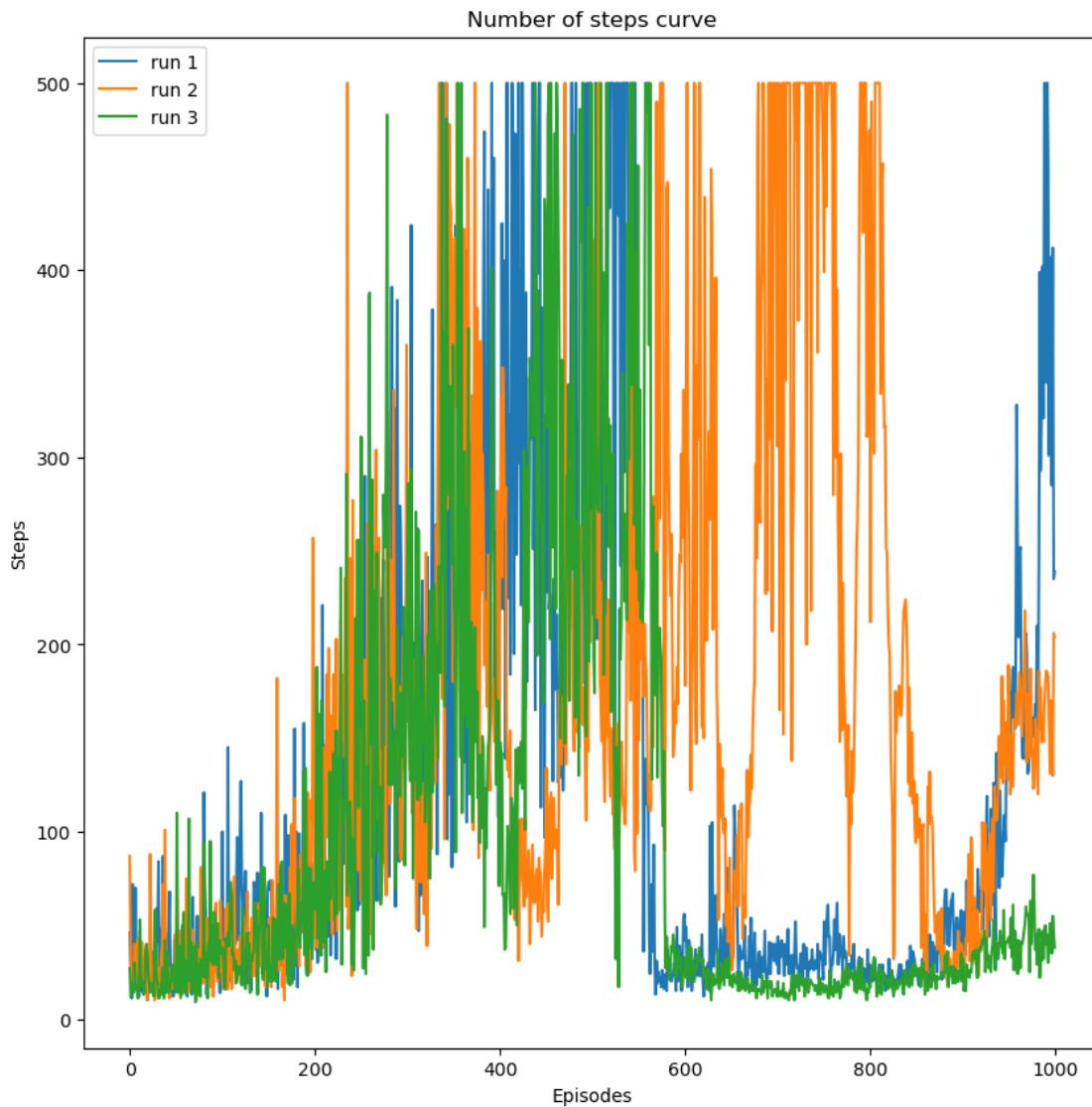
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Episode 590 Reward 500.000000 Average Reward 469.200000
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Episode 1000 Reward 36.000000 Average Reward 27.500000
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```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [512, 512]
LR = 2e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'CartPole-v1'
SOLVE_CUTOFF = 195.0
STEP = 50000

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{hs}-{lr}-{env}-{numep}-{nstep}-{STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	60.000000	37.400000
20	31.000000	35.500000
30	43.000000	28.900000
40	22.000000	40.700000
50	16.000000	31.300000
60	16.000000	31.500000
70	39.000000	26.900000
80	50.000000	57.400000
90	50.000000	41.000000
100	98.000000	72.500000
110	59.000000	83.300000
120	66.000000	103.300000
130	120.000000	96.500000
140	177.000000	160.000000
150	170.000000	150.200000
160	57.000000	124.500000
170	165.000000	119.100000
180	149.000000	135.300000
190	184.000000	184.300000
200	258.000000	197.400000
210	208.000000	261.300000
220	193.000000	335.500000
230	263.000000	257.700000
240	500.000000	327.500000
250	96.000000	288.900000
260	285.000000	295.400000
270	353.000000	314.700000
280	184.000000	171.900000

Episode 290 Reward 15.000000 Average Reward 72.100000
Episode 300 Reward 117.000000 Average Reward 75.300000
Episode 310 Reward 219.000000 Average Reward 140.400000
Episode 320 Reward 111.000000 Average Reward 126.300000
Episode 330 Reward 227.000000 Average Reward 141.800000
Episode 340 Reward 193.000000 Average Reward 350.700000
Episode 350 Reward 214.000000 Average Reward 183.300000
Episode 360 Reward 229.000000 Average Reward 219.100000
Episode 370 Reward 43.000000 Average Reward 121.100000
Episode 380 Reward 10.000000 Average Reward 19.300000
Episode 390 Reward 24.000000 Average Reward 23.600000
Episode 400 Reward 50.000000 Average Reward 42.800000
Episode 410 Reward 68.000000 Average Reward 63.200000
Episode 420 Reward 76.000000 Average Reward 63.500000
Episode 430 Reward 82.000000 Average Reward 63.700000
Episode 440 Reward 124.000000 Average Reward 89.500000
Episode 450 Reward 86.000000 Average Reward 103.900000
Episode 460 Reward 118.000000 Average Reward 110.500000
Episode 470 Reward 181.000000 Average Reward 132.100000
Episode 480 Reward 203.000000 Average Reward 150.800000
Episode 490 Reward 421.000000 Average Reward 208.100000
Episode 500 Reward 281.000000 Average Reward 279.100000
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Episode 570 Reward 125.000000 Average Reward 169.600000
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Episode 610 Reward 208.000000 Average Reward 204.300000
Episode 620 Reward 224.000000 Average Reward 205.200000
Episode 630 Reward 193.000000 Average Reward 295.700000
Episode 640 Reward 200.000000 Average Reward 320.400000
Episode 650 Reward 327.000000 Average Reward 261.300000
Episode 660 Reward 251.000000 Average Reward 291.600000
Episode 670 Reward 425.000000 Average Reward 374.700000
Episode 680 Reward 390.000000 Average Reward 349.200000
Episode 690 Reward 288.000000 Average Reward 351.300000
Episode 700 Reward 167.000000 Average Reward 294.900000
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Episode 720 Reward 202.000000 Average Reward 167.500000
Episode 730 Reward 332.000000 Average Reward 293.800000
Episode 740 Reward 31.000000 Average Reward 276.900000
Episode 750 Reward 11.000000 Average Reward 15.500000
Episode 760 Reward 10.000000 Average Reward 10.700000

Episode 770 Reward 9.000000 Average Reward 9.400000
Episode 780 Reward 10.000000 Average Reward 9.400000
Episode 790 Reward 8.000000 Average Reward 9.200000
Episode 800 Reward 10.000000 Average Reward 9.700000
Episode 810 Reward 10.000000 Average Reward 9.900000
Episode 820 Reward 10.000000 Average Reward 9.200000
Episode 830 Reward 10.000000 Average Reward 9.700000
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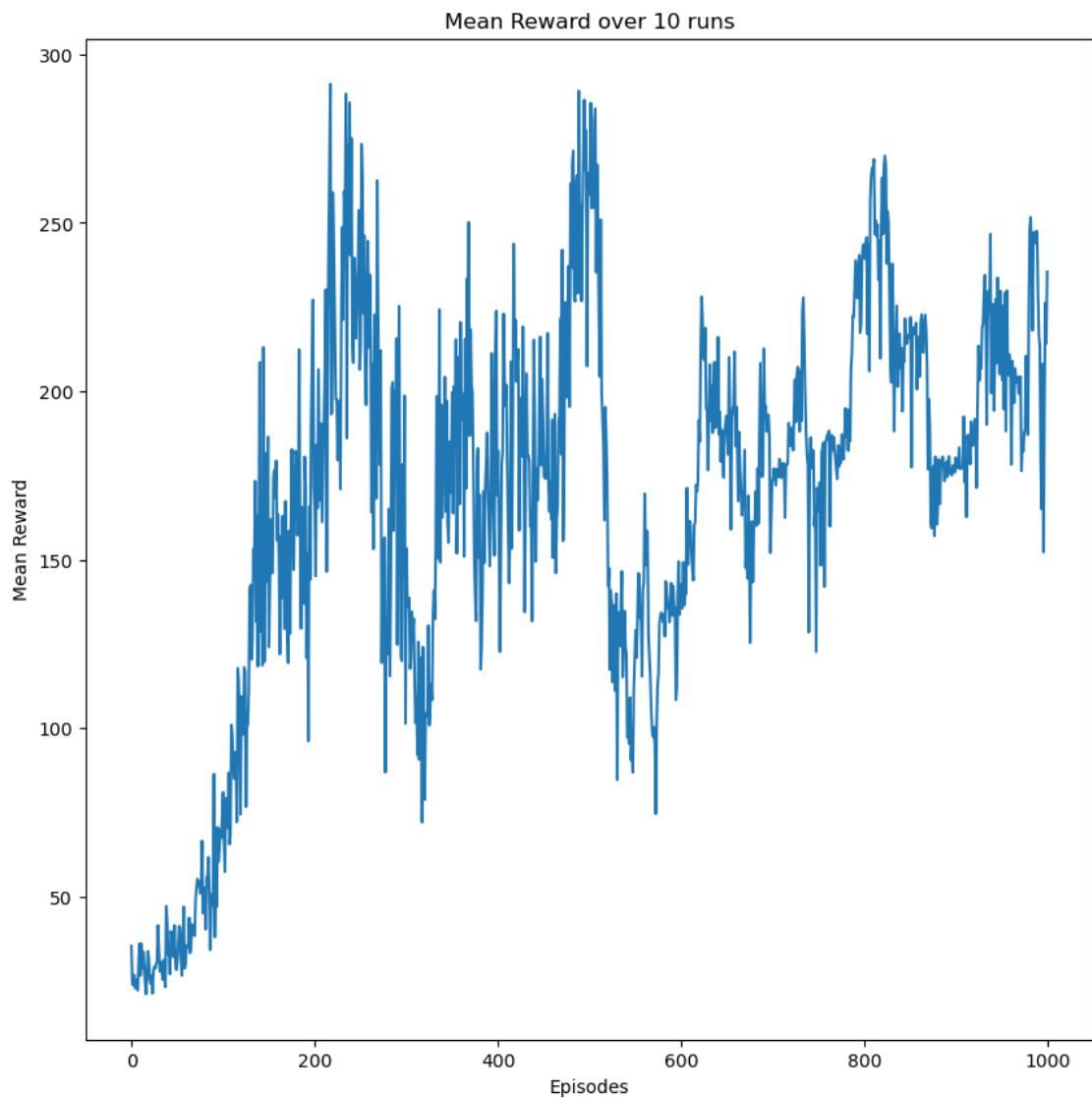
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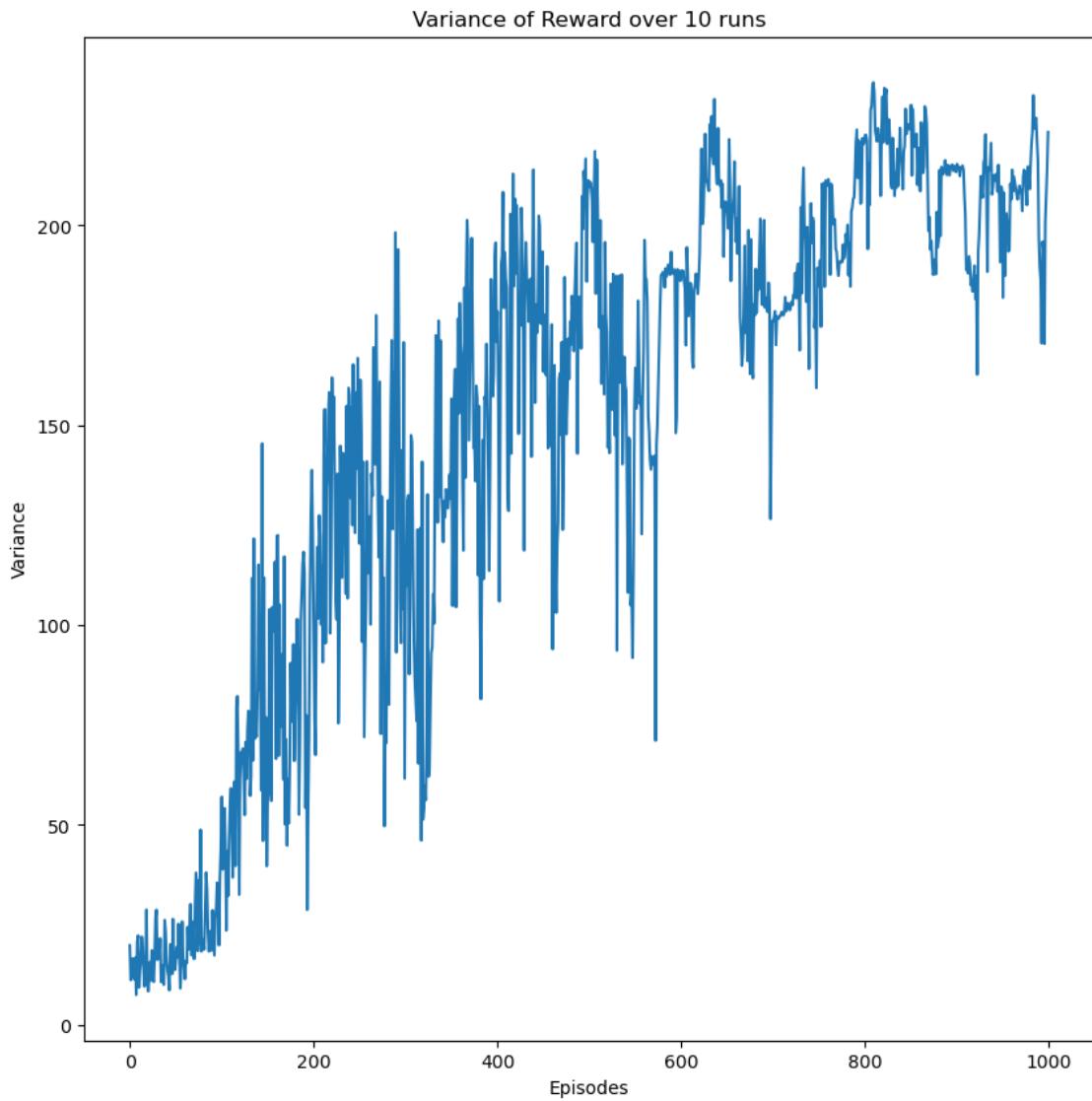
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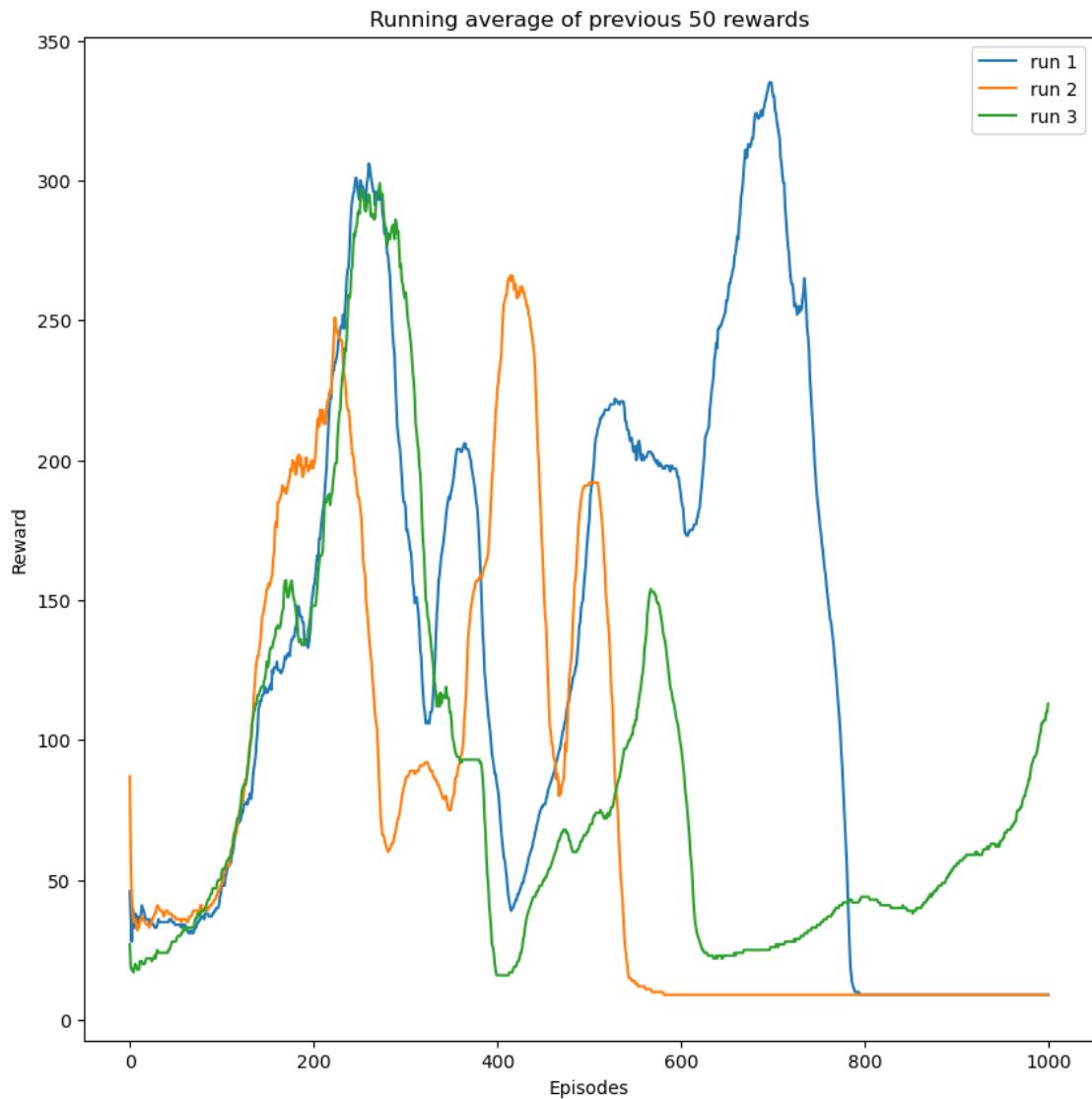
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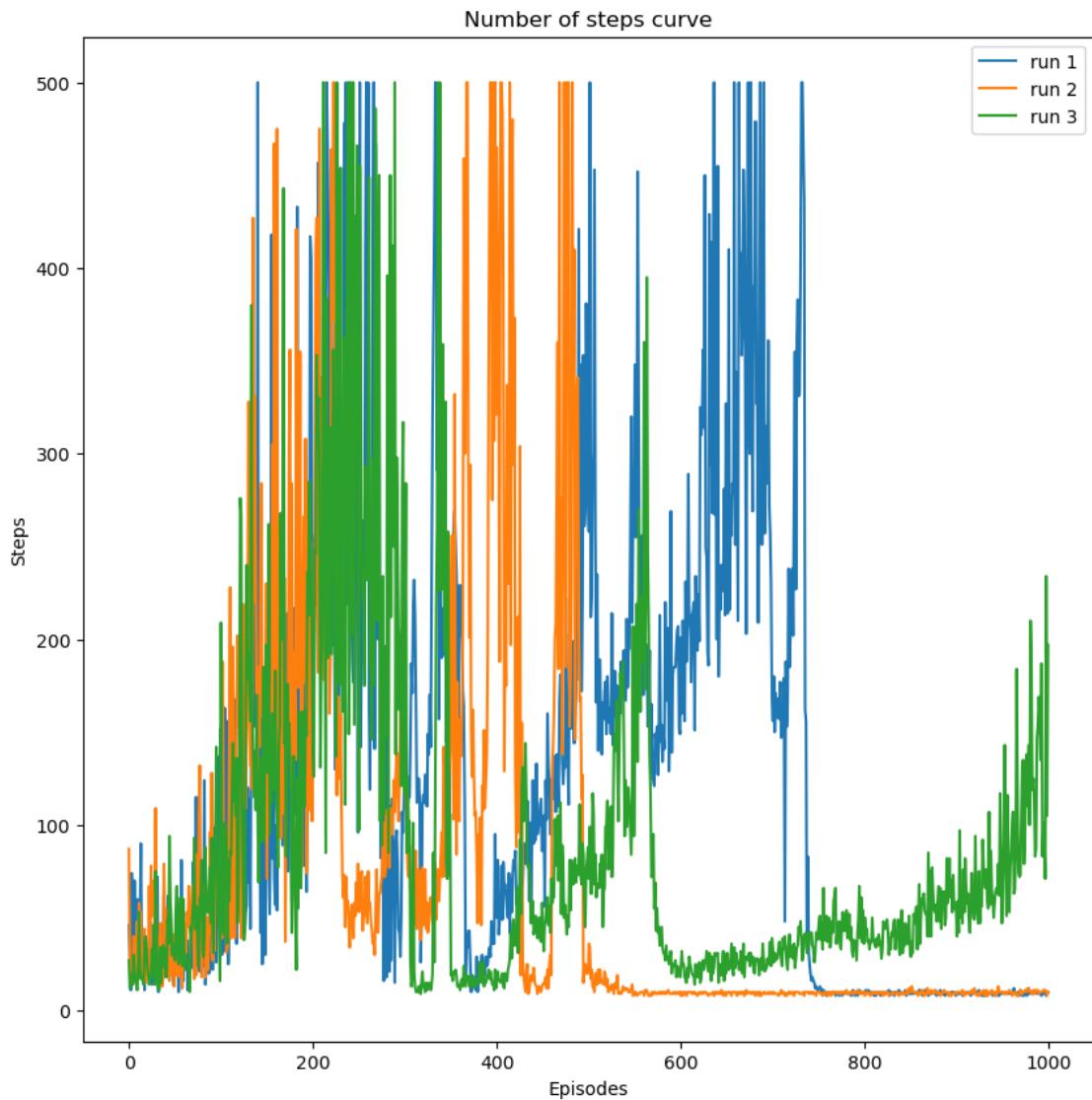
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```
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HIDDEN_SIZES = [1024, 512]
LR = 1e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'CartPole-v1'
SOLVE_CUTOFF = 195.0
STEP = 50000

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{hs}-{lr}-{env}-{numep}-{nstep}-{STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	60.000000	37.400000
20	19.000000	27.300000
30	21.000000	23.000000
40	22.000000	23.400000
50	14.000000	31.900000
60	15.000000	31.600000
70	20.000000	23.000000
80	21.000000	30.600000
90	33.000000	31.600000
100	23.000000	50.000000
110	31.000000	30.100000
120	42.000000	32.900000
130	18.000000	44.800000
140	41.000000	36.700000
150	103.000000	53.500000
160	42.000000	50.300000
170	53.000000	71.300000
180	104.000000	69.400000
190	185.000000	78.400000
200	49.000000	85.300000
210	66.000000	84.800000
220	130.000000	136.100000
230	65.000000	84.500000
240	78.000000	91.600000
250	112.000000	126.300000
260	134.000000	110.300000
270	80.000000	93.400000
280	226.000000	146.000000

Episode 290 Reward 168.000000 Average Reward 199.900000
Episode 300 Reward 317.000000 Average Reward 241.500000
Episode 310 Reward 321.000000 Average Reward 271.100000
Episode 320 Reward 385.000000 Average Reward 421.600000
Episode 330 Reward 355.000000 Average Reward 347.900000
Episode 340 Reward 145.000000 Average Reward 172.400000
Episode 350 Reward 51.000000 Average Reward 111.500000
Episode 360 Reward 63.000000 Average Reward 66.100000
Episode 370 Reward 60.000000 Average Reward 56.200000
Episode 380 Reward 42.000000 Average Reward 65.700000
Episode 390 Reward 97.000000 Average Reward 73.700000
Episode 400 Reward 141.000000 Average Reward 107.200000
Episode 410 Reward 350.000000 Average Reward 277.900000
Episode 420 Reward 500.000000 Average Reward 404.500000
Episode 430 Reward 381.000000 Average Reward 353.900000
Episode 440 Reward 500.000000 Average Reward 354.500000
Episode 450 Reward 379.000000 Average Reward 384.400000
Episode 460 Reward 500.000000 Average Reward 393.100000
Episode 470 Reward 500.000000 Average Reward 441.700000
Episode 480 Reward 291.000000 Average Reward 389.200000
Episode 490 Reward 182.000000 Average Reward 202.800000
Episode 500 Reward 500.000000 Average Reward 390.400000
Episode 510 Reward 500.000000 Average Reward 431.100000
Episode 520 Reward 476.000000 Average Reward 385.000000
Episode 530 Reward 313.000000 Average Reward 354.400000
Episode 540 Reward 362.000000 Average Reward 418.000000
Episode 550 Reward 500.000000 Average Reward 388.700000
Episode 560 Reward 338.000000 Average Reward 433.500000
Episode 570 Reward 500.000000 Average Reward 400.600000
Episode 580 Reward 132.000000 Average Reward 226.300000
Episode 590 Reward 27.000000 Average Reward 129.000000
Episode 600 Reward 114.000000 Average Reward 108.800000
Episode 610 Reward 104.000000 Average Reward 108.300000
Episode 620 Reward 51.000000 Average Reward 84.900000
Episode 630 Reward 127.000000 Average Reward 93.700000
Episode 640 Reward 235.000000 Average Reward 129.800000
Episode 650 Reward 500.000000 Average Reward 387.100000
Episode 660 Reward 500.000000 Average Reward 482.700000
Episode 670 Reward 500.000000 Average Reward 475.800000
Episode 680 Reward 343.000000 Average Reward 484.300000
Episode 690 Reward 328.000000 Average Reward 329.700000
Episode 700 Reward 500.000000 Average Reward 400.300000
Episode 710 Reward 303.000000 Average Reward 417.700000
Episode 720 Reward 499.000000 Average Reward 444.500000
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Episode 810 Reward 268.000000 Average Reward 412.400000
Episode 820 Reward 500.000000 Average Reward 412.800000
Episode 830 Reward 500.000000 Average Reward 454.500000
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Episode 990 Reward 120.000000 Average Reward 259.400000
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Episode 10 Reward 48.000000 Average Reward 34.100000
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Episode 60 Reward 15.000000 Average Reward 29.400000
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Episode 80 Reward 18.000000 Average Reward 27.100000
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Episode 110 Reward 91.000000 Average Reward 56.300000
Episode 120 Reward 67.000000 Average Reward 51.600000
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Episode 150 Reward 92.000000 Average Reward 62.700000
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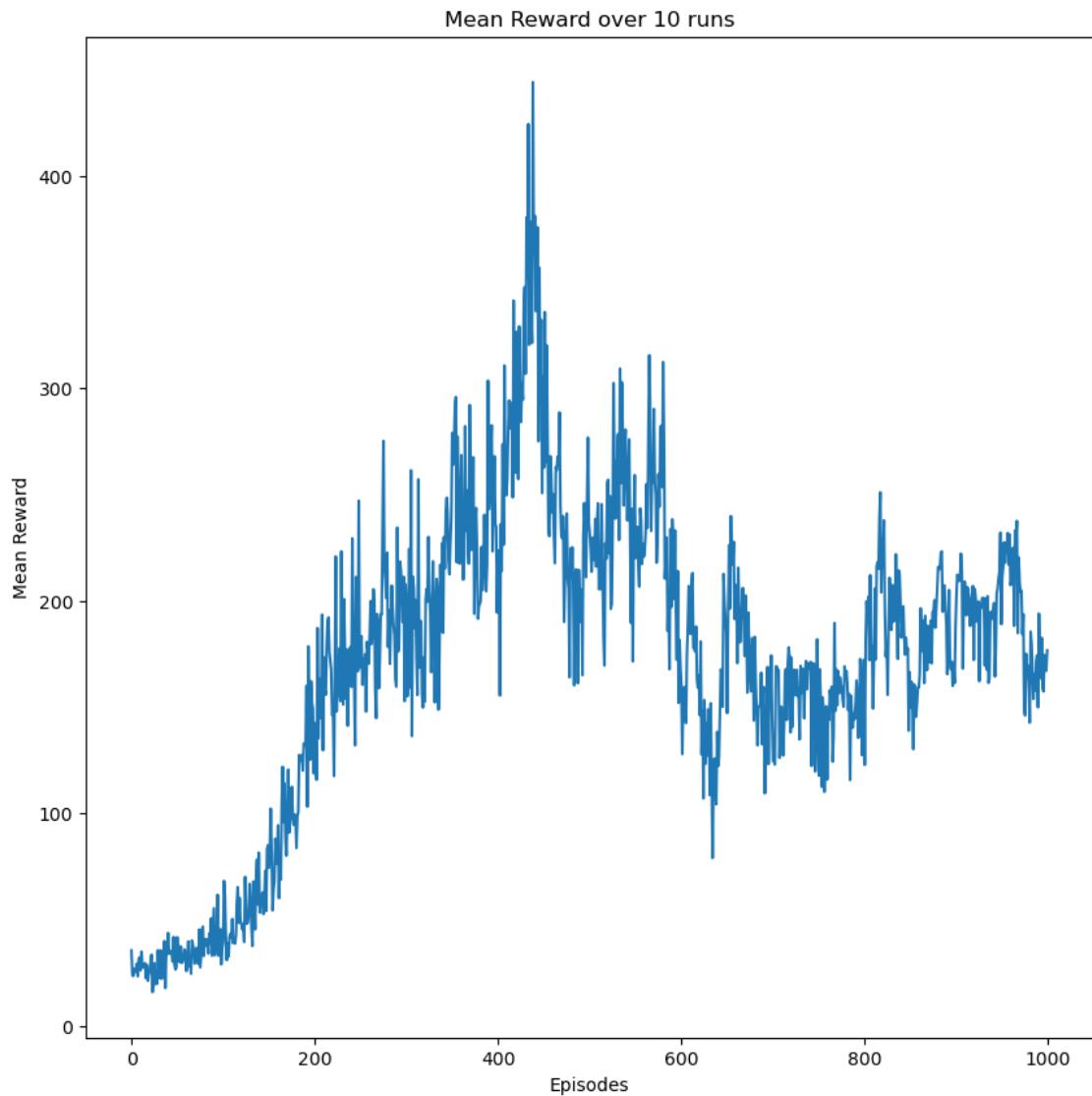
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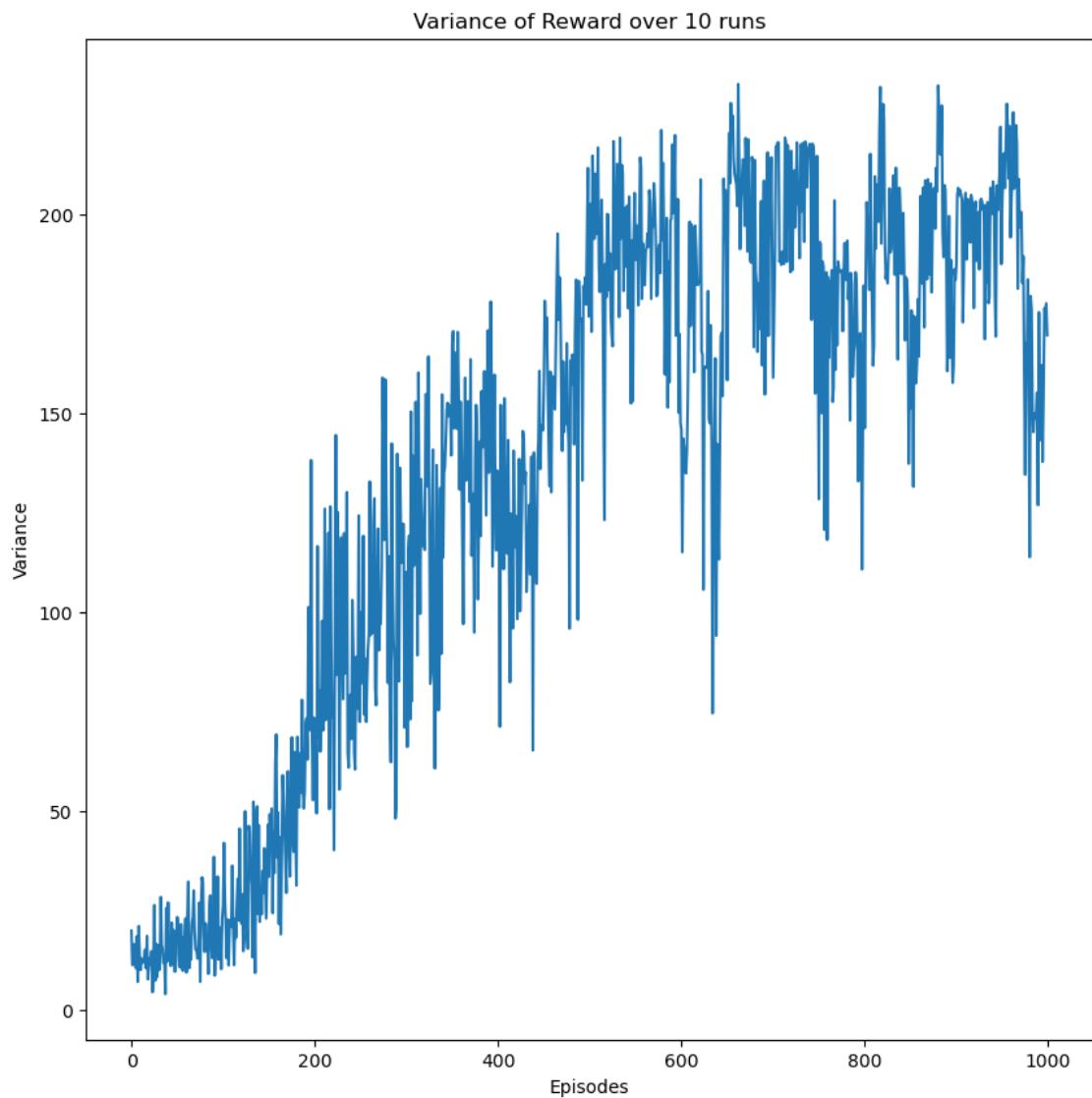
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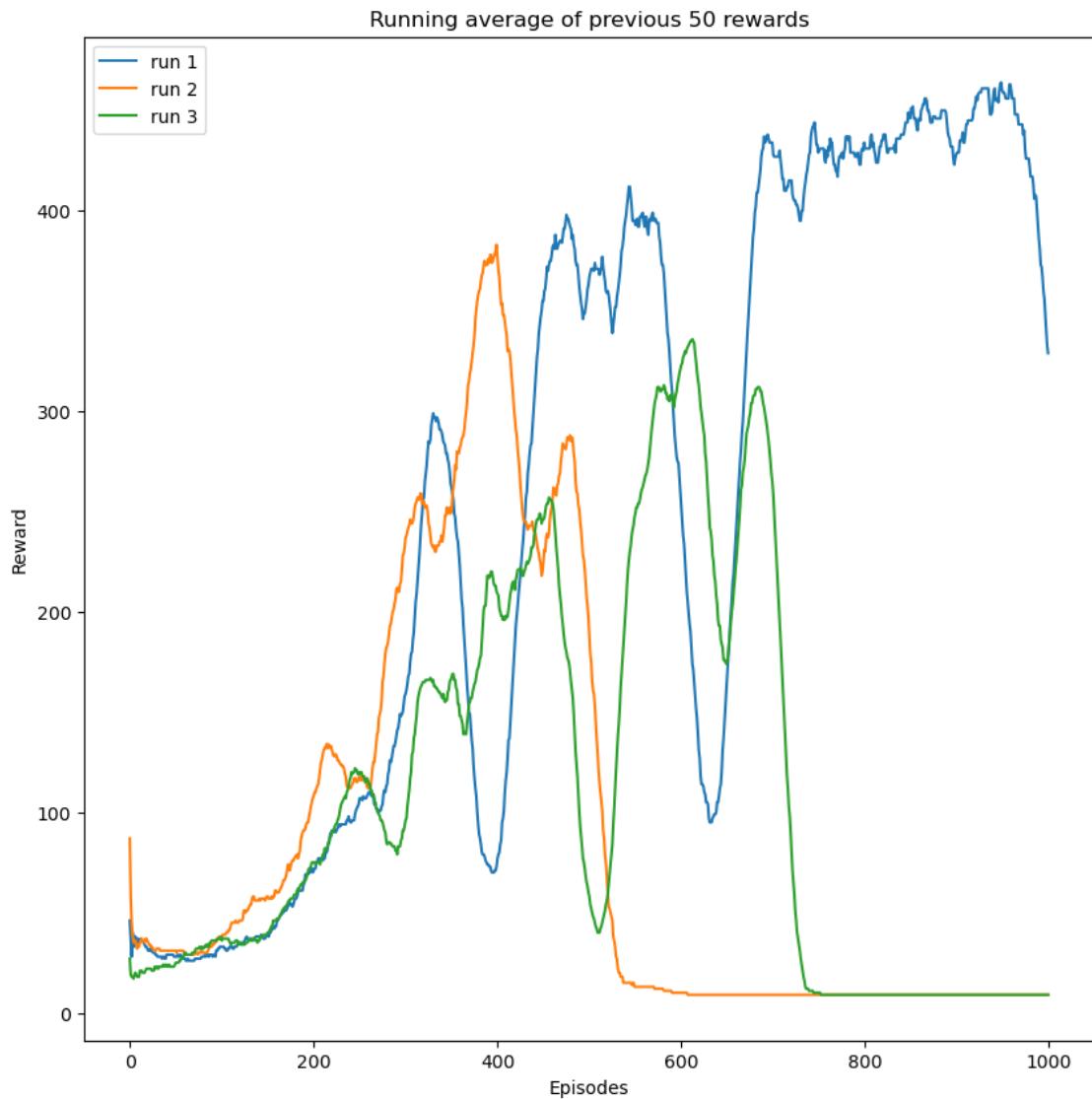
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Episode 290 Reward 145.000000 Average Reward 299.500000
Episode 300 Reward 70.000000 Average Reward 95.700000
Episode 310 Reward 76.000000 Average Reward 56.600000

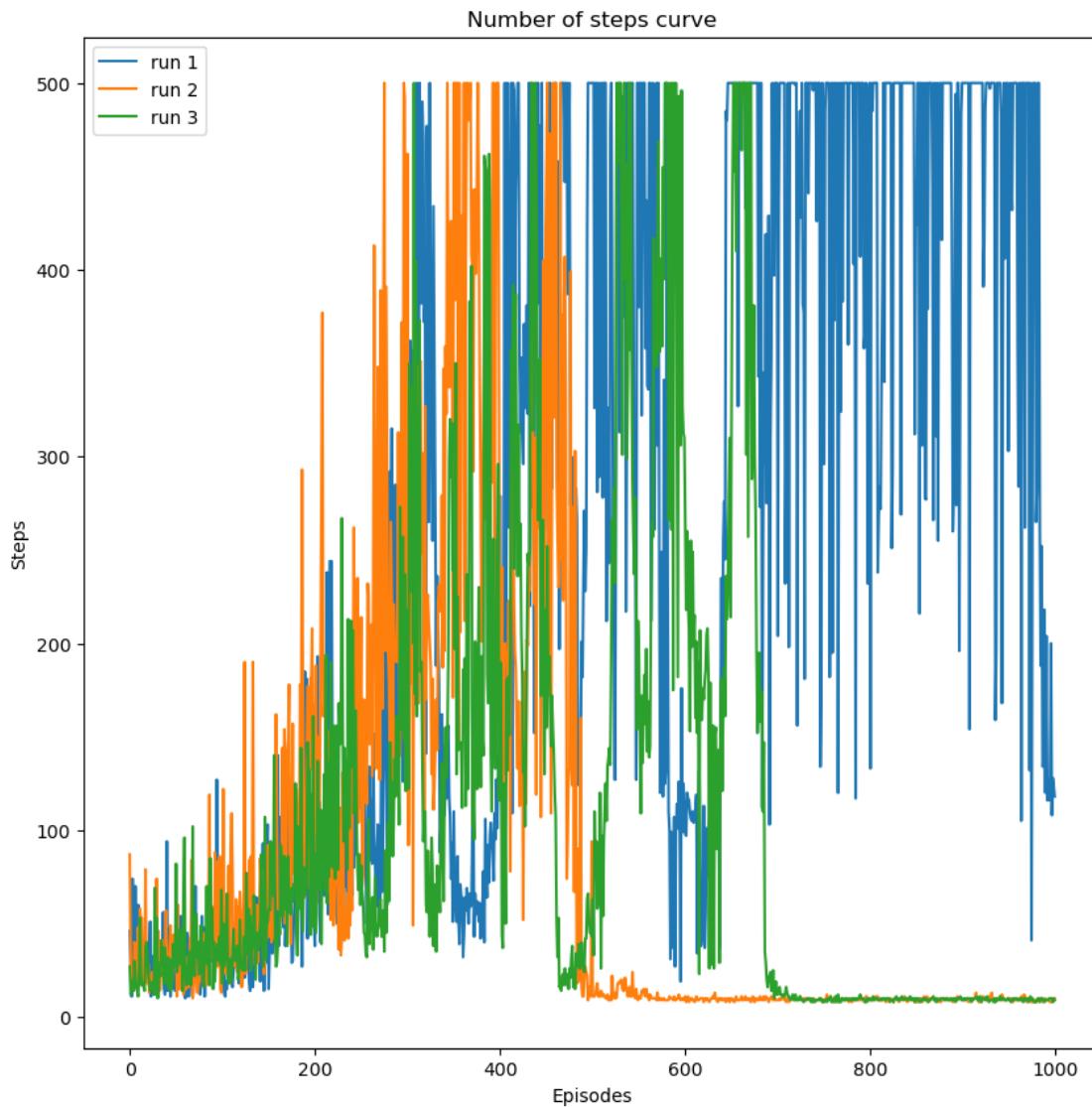
Episode 320 Reward 57.000000 Average Reward 53.800000
Episode 330 Reward 45.000000 Average Reward 56.600000
Episode 340 Reward 64.000000 Average Reward 60.500000
Episode 350 Reward 111.000000 Average Reward 76.000000
Episode 360 Reward 97.000000 Average Reward 92.500000
Episode 370 Reward 274.000000 Average Reward 159.900000
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Episode 390 Reward 50.000000 Average Reward 71.900000
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Episode 410 Reward 106.000000 Average Reward 94.500000
Episode 420 Reward 322.000000 Average Reward 164.100000
Episode 430 Reward 500.000000 Average Reward 375.400000
Episode 440 Reward 296.000000 Average Reward 356.000000
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Episode 470 Reward 167.000000 Average Reward 258.200000
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Episode 490 Reward 500.000000 Average Reward 335.300000
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Episode 560 Reward 378.000000 Average Reward 307.300000
Episode 570 Reward 212.000000 Average Reward 282.400000
Episode 580 Reward 500.000000 Average Reward 356.100000
Episode 590 Reward 31.000000 Average Reward 199.100000
Episode 600 Reward 101.000000 Average Reward 82.200000
Episode 610 Reward 471.000000 Average Reward 184.400000
Episode 620 Reward 242.000000 Average Reward 359.400000
Episode 630 Reward 92.000000 Average Reward 179.700000
Episode 640 Reward 462.000000 Average Reward 250.700000
Episode 650 Reward 236.000000 Average Reward 294.800000
Episode 660 Reward 219.000000 Average Reward 370.100000
Episode 670 Reward 205.000000 Average Reward 354.000000
Episode 680 Reward 500.000000 Average Reward 318.200000
Episode 690 Reward 500.000000 Average Reward 433.300000
Episode 700 Reward 500.000000 Average Reward 402.000000
Episode 710 Reward 500.000000 Average Reward 374.400000
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Episode 750 Reward 500.000000 Average Reward 439.600000
Episode 760 Reward 300.000000 Average Reward 415.100000
Episode 770 Reward 500.000000 Average Reward 500.000000
Episode 780 Reward 468.000000 Average Reward 496.800000
Episode 790 Reward 500.000000 Average Reward 473.900000

Episode 800 Reward 211.000000 Average Reward 345.300000
Episode 810 Reward 107.000000 Average Reward 315.700000
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Episode 830 Reward 378.000000 Average Reward 369.000000
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Episode 850 Reward 256.000000 Average Reward 261.000000
Episode 860 Reward 500.000000 Average Reward 389.100000
Episode 870 Reward 500.000000 Average Reward 495.300000
Episode 880 Reward 500.000000 Average Reward 500.000000
Episode 890 Reward 360.000000 Average Reward 430.700000
Episode 900 Reward 258.000000 Average Reward 218.300000
Episode 910 Reward 500.000000 Average Reward 482.600000
Episode 920 Reward 500.000000 Average Reward 500.000000
Episode 930 Reward 500.000000 Average Reward 500.000000
Episode 940 Reward 500.000000 Average Reward 487.400000
Episode 950 Reward 500.000000 Average Reward 500.000000
Episode 960 Reward 500.000000 Average Reward 486.700000
Episode 970 Reward 380.000000 Average Reward 485.300000
Episode 980 Reward 251.000000 Average Reward 257.300000
Episode 990 Reward 288.000000 Average Reward 262.900000
Episode 1000 Reward 207.000000 Average Reward 236.800000
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```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [1024, 1024]
LR = 0.5e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'CartPole-v1'
SOLVE_CUTOFF = 195.0
STEP = 50000

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{hs}-{lr}-{env}-{numep}-{nstep}-{STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	33.000000	28.600000
20	12.000000	21.500000
30	24.000000	32.700000
40	15.000000	24.600000
50	38.000000	33.700000
60	26.000000	34.100000
70	15.000000	39.500000
80	54.000000	42.700000
90	37.000000	35.400000
100	17.000000	30.400000
110	29.000000	28.100000
120	37.000000	40.000000
130	19.000000	37.500000
140	33.000000	38.200000
150	52.000000	35.800000
160	37.000000	53.500000
170	58.000000	46.800000
180	34.000000	63.600000
190	47.000000	48.000000
200	153.000000	67.400000
210	62.000000	79.700000
220	119.000000	119.400000
230	52.000000	91.700000
240	121.000000	111.100000
250	38.000000	108.800000
260	70.000000	75.400000
270	52.000000	92.600000
280	148.000000	97.000000

Episode 290 Reward 257.000000 Average Reward 136.500000
Episode 300 Reward 156.000000 Average Reward 167.300000
Episode 310 Reward 31.000000 Average Reward 198.800000
Episode 320 Reward 203.000000 Average Reward 183.300000
Episode 330 Reward 119.000000 Average Reward 187.600000
Episode 340 Reward 87.000000 Average Reward 130.600000
Episode 350 Reward 190.000000 Average Reward 162.600000
Episode 360 Reward 141.000000 Average Reward 227.700000
Episode 370 Reward 216.000000 Average Reward 151.500000
Episode 380 Reward 225.000000 Average Reward 248.900000
Episode 390 Reward 100.000000 Average Reward 177.300000
Episode 400 Reward 111.000000 Average Reward 131.400000
Episode 410 Reward 132.000000 Average Reward 122.400000
Episode 420 Reward 269.000000 Average Reward 165.000000
Episode 430 Reward 500.000000 Average Reward 285.700000
Episode 440 Reward 62.000000 Average Reward 286.600000
Episode 450 Reward 170.000000 Average Reward 178.300000
Episode 460 Reward 218.000000 Average Reward 157.300000
Episode 470 Reward 195.000000 Average Reward 195.200000
Episode 480 Reward 445.000000 Average Reward 326.300000
Episode 490 Reward 123.000000 Average Reward 268.300000
Episode 500 Reward 195.000000 Average Reward 185.600000
Episode 510 Reward 339.000000 Average Reward 197.500000
Episode 520 Reward 238.000000 Average Reward 191.700000
Episode 530 Reward 379.000000 Average Reward 246.300000
Episode 540 Reward 497.000000 Average Reward 306.500000
Episode 550 Reward 500.000000 Average Reward 344.400000
Episode 560 Reward 349.000000 Average Reward 363.100000
Episode 570 Reward 500.000000 Average Reward 369.300000
Episode 580 Reward 380.000000 Average Reward 380.300000
Episode 590 Reward 137.000000 Average Reward 316.700000
Episode 600 Reward 133.000000 Average Reward 144.800000
Episode 610 Reward 129.000000 Average Reward 123.400000
Episode 620 Reward 128.000000 Average Reward 95.600000
Episode 630 Reward 147.000000 Average Reward 167.700000
Episode 640 Reward 153.000000 Average Reward 264.700000
Episode 650 Reward 115.000000 Average Reward 102.600000
Episode 660 Reward 116.000000 Average Reward 101.600000
Episode 670 Reward 132.000000 Average Reward 113.100000
Episode 680 Reward 121.000000 Average Reward 126.900000
Episode 690 Reward 129.000000 Average Reward 105.900000
Episode 700 Reward 142.000000 Average Reward 127.200000
Episode 710 Reward 338.000000 Average Reward 153.100000
Episode 720 Reward 314.000000 Average Reward 235.300000
Episode 730 Reward 284.000000 Average Reward 234.700000
Episode 740 Reward 225.000000 Average Reward 211.100000
Episode 750 Reward 209.000000 Average Reward 342.000000
Episode 760 Reward 104.000000 Average Reward 127.400000

Episode 770 Reward 66.000000 Average Reward 82.300000
Episode 780 Reward 87.000000 Average Reward 79.600000
Episode 790 Reward 134.000000 Average Reward 99.700000
Episode 800 Reward 52.000000 Average Reward 103.300000
Episode 810 Reward 101.000000 Average Reward 73.700000
Episode 820 Reward 49.000000 Average Reward 68.900000
Episode 830 Reward 95.000000 Average Reward 94.700000
Episode 840 Reward 124.000000 Average Reward 136.700000
Episode 850 Reward 124.000000 Average Reward 146.200000
Episode 860 Reward 124.000000 Average Reward 150.900000
Episode 870 Reward 167.000000 Average Reward 169.800000
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Episode 900 Reward 258.000000 Average Reward 193.100000
Episode 910 Reward 126.000000 Average Reward 136.000000
Episode 920 Reward 106.000000 Average Reward 119.700000
Episode 930 Reward 219.000000 Average Reward 149.700000
Episode 940 Reward 226.000000 Average Reward 183.200000
Episode 950 Reward 187.000000 Average Reward 275.000000
Episode 960 Reward 500.000000 Average Reward 415.400000
Episode 970 Reward 157.000000 Average Reward 186.000000
Episode 980 Reward 29.000000 Average Reward 109.400000
Episode 990 Reward 46.000000 Average Reward 56.400000
Episode 1000 Reward 38.000000 Average Reward 36.700000

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Episode 70 Reward 18.000000 Average Reward 36.200000
Episode 80 Reward 18.000000 Average Reward 31.300000
Episode 90 Reward 10.000000 Average Reward 26.000000
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Episode 110 Reward 68.000000 Average Reward 33.900000
Episode 120 Reward 24.000000 Average Reward 28.500000
Episode 130 Reward 33.000000 Average Reward 37.600000
Episode 140 Reward 36.000000 Average Reward 55.100000
Episode 150 Reward 21.000000 Average Reward 42.600000
Episode 160 Reward 18.000000 Average Reward 27.000000
Episode 170 Reward 39.000000 Average Reward 56.000000
Episode 180 Reward 65.000000 Average Reward 43.000000
Episode 190 Reward 27.000000 Average Reward 64.800000
Episode 200 Reward 36.000000 Average Reward 63.700000
Episode 210 Reward 110.000000 Average Reward 82.700000
Episode 220 Reward 68.000000 Average Reward 75.600000
Episode 230 Reward 64.000000 Average Reward 76.600000

Episode 240 Reward 117.000000 Average Reward 85.800000
Episode 250 Reward 129.000000 Average Reward 102.900000
Episode 260 Reward 59.000000 Average Reward 131.700000
Episode 270 Reward 70.000000 Average Reward 107.900000
Episode 280 Reward 111.000000 Average Reward 123.800000
Episode 290 Reward 264.000000 Average Reward 157.200000
Episode 300 Reward 164.000000 Average Reward 162.700000
Episode 310 Reward 98.000000 Average Reward 228.600000
Episode 320 Reward 72.000000 Average Reward 156.600000
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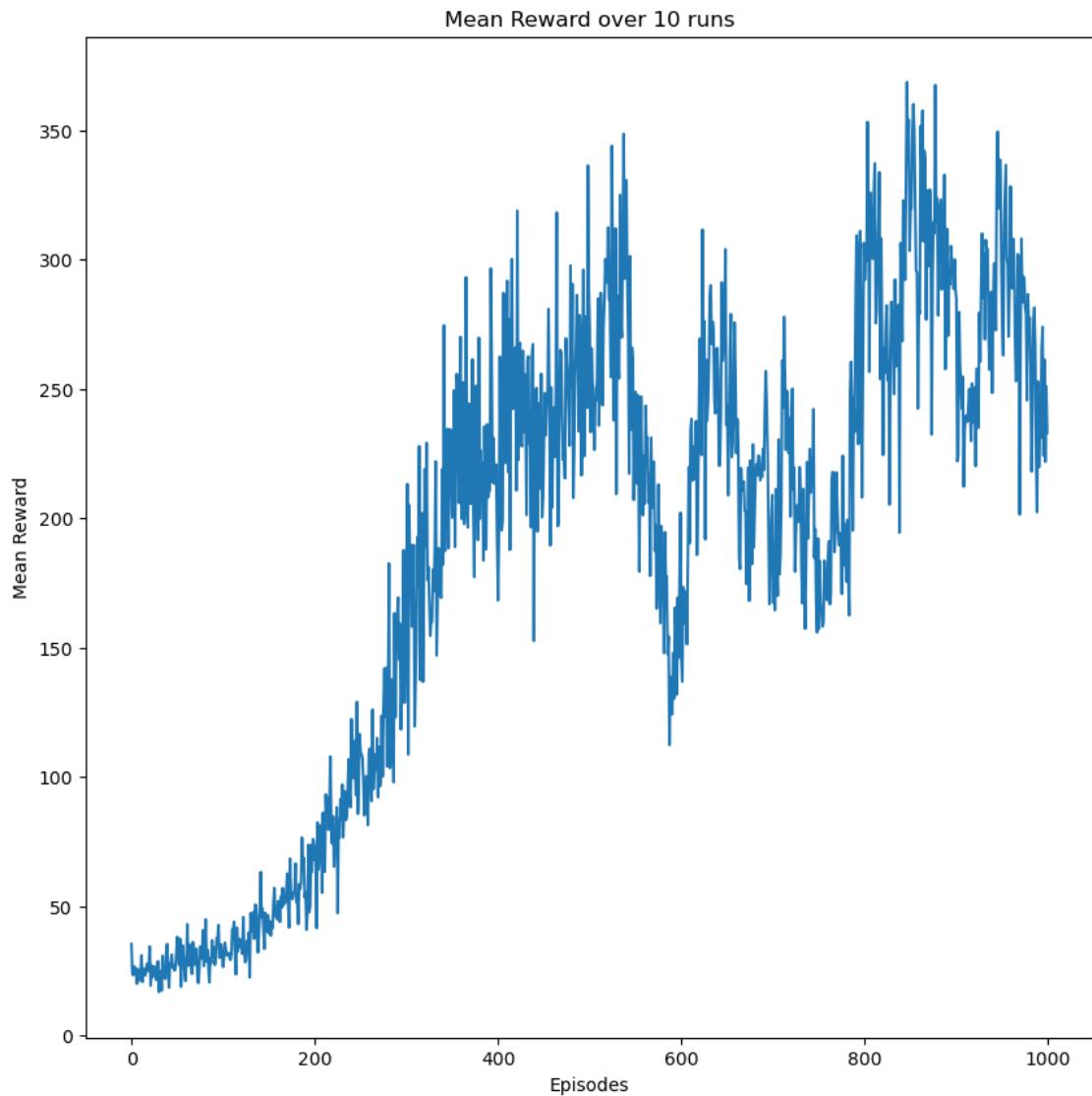
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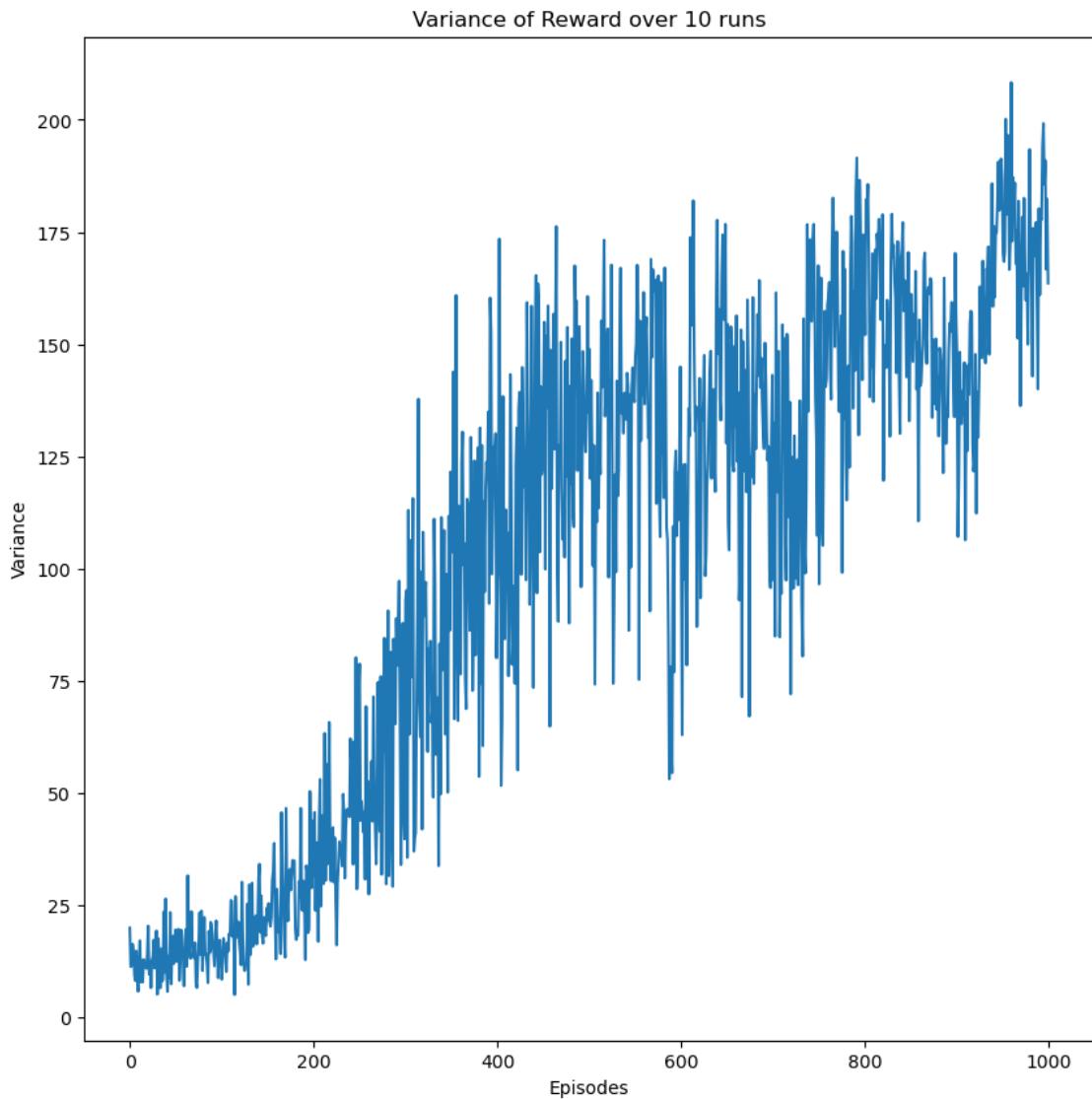
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Episode 480 Reward 396.000000 Average Reward 321.700000
Episode 490 Reward 425.000000 Average Reward 326.900000
Episode 500 Reward 296.000000 Average Reward 355.400000
Episode 510 Reward 365.000000 Average Reward 321.400000
Episode 520 Reward 214.000000 Average Reward 360.300000
Episode 530 Reward 222.000000 Average Reward 341.500000
Episode 540 Reward 237.000000 Average Reward 320.900000
Episode 550 Reward 227.000000 Average Reward 323.400000
Episode 560 Reward 500.000000 Average Reward 398.300000
Episode 570 Reward 500.000000 Average Reward 381.700000
Episode 580 Reward 377.000000 Average Reward 417.500000
Episode 590 Reward 186.000000 Average Reward 327.500000
Episode 600 Reward 141.000000 Average Reward 131.100000
Episode 610 Reward 384.000000 Average Reward 210.700000
Episode 620 Reward 403.000000 Average Reward 390.400000
Episode 630 Reward 356.000000 Average Reward 253.700000
Episode 640 Reward 170.000000 Average Reward 219.500000
Episode 650 Reward 354.000000 Average Reward 363.100000
Episode 660 Reward 391.000000 Average Reward 305.900000
Episode 670 Reward 188.000000 Average Reward 202.900000
Episode 680 Reward 131.000000 Average Reward 115.000000
Episode 690 Reward 258.000000 Average Reward 139.300000
Episode 700 Reward 294.000000 Average Reward 282.000000
Episode 710 Reward 172.000000 Average Reward 233.800000
Episode 720 Reward 225.000000 Average Reward 311.600000
Episode 730 Reward 156.000000 Average Reward 197.500000
Episode 740 Reward 126.000000 Average Reward 146.100000
Episode 750 Reward 125.000000 Average Reward 117.000000
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Episode 770 Reward 42.000000 Average Reward 43.900000
Episode 780 Reward 138.000000 Average Reward 76.300000
Episode 790 Reward 116.000000 Average Reward 106.500000
Episode 800 Reward 432.000000 Average Reward 244.200000
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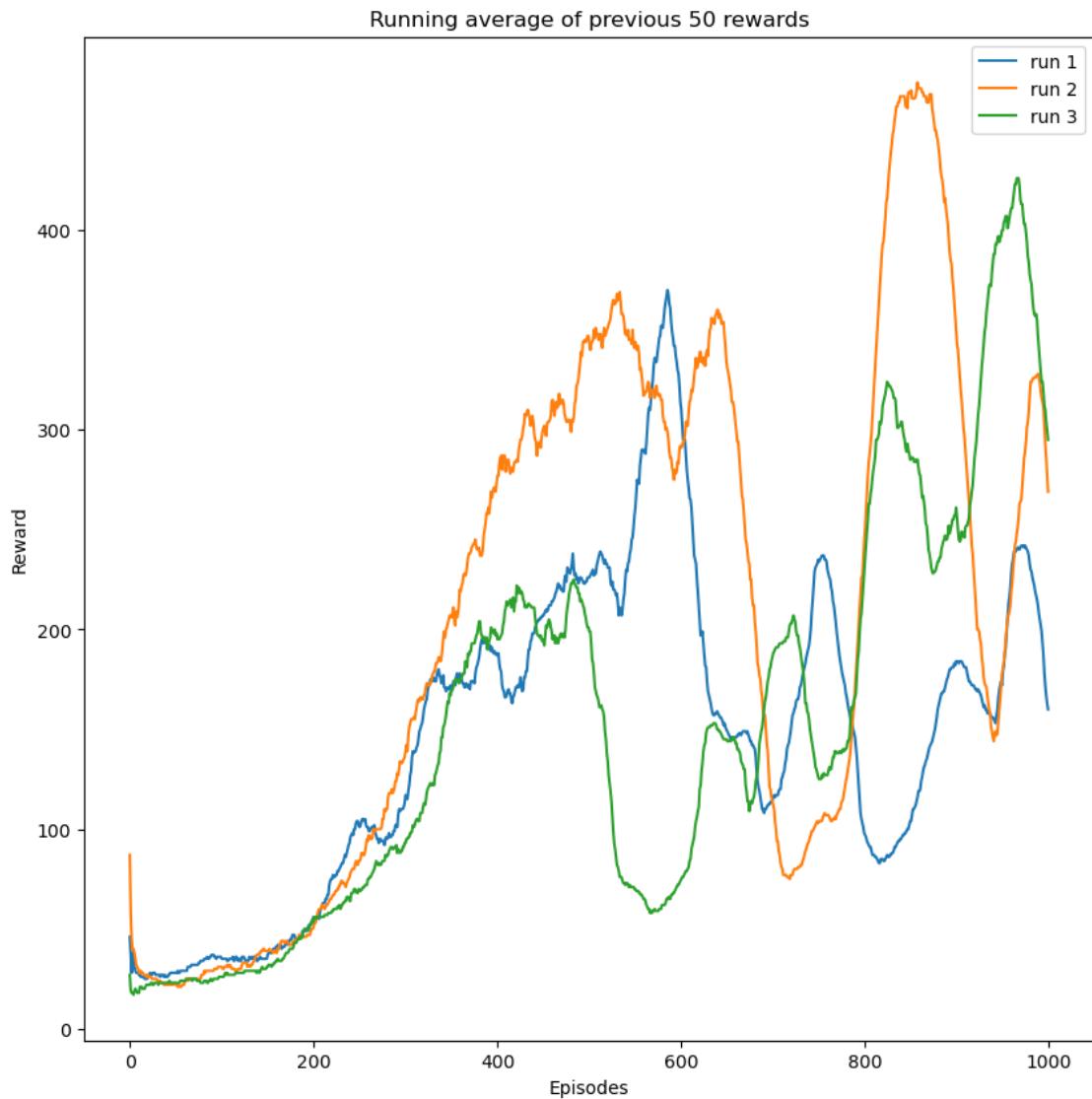
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Episode 150 Reward 62.000000 Average Reward 57.900000
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Episode 230 Reward 52.000000 Average Reward 68.600000
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Episode 250 Reward 48.000000 Average Reward 80.700000
Episode 260 Reward 131.000000 Average Reward 96.500000
Episode 270 Reward 124.000000 Average Reward 145.400000
Episode 280 Reward 74.000000 Average Reward 96.100000
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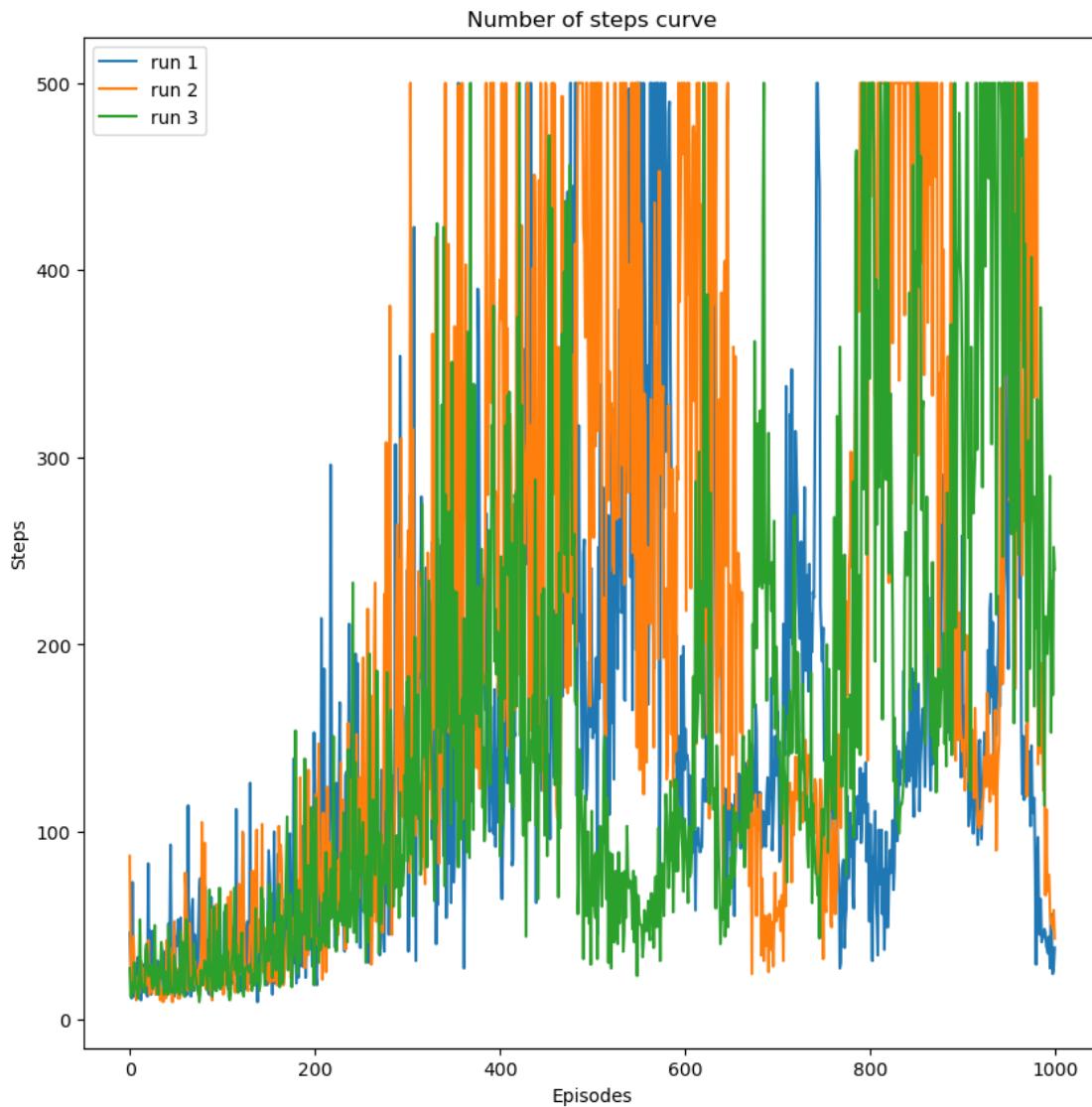
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Episode 360 Reward 265.000000 Average Reward 261.200000
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Episode 440 Reward 232.000000 Average Reward 362.300000
Episode 450 Reward 243.000000 Average Reward 365.500000
Episode 460 Reward 72.000000 Average Reward 119.400000
Episode 470 Reward 53.000000 Average Reward 72.900000
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Episode 580 Reward 105.000000 Average Reward 175.900000
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Episode 640 Reward 61.000000 Average Reward 78.900000
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Episode 690 Reward 165.000000 Average Reward 311.900000
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Episode 720 Reward 202.000000 Average Reward 234.100000
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Episode 950 Reward 26.000000 Average Reward 65.200000
Episode 960 Reward 28.000000 Average Reward 52.700000
Episode 970 Reward 96.000000 Average Reward 61.600000
Episode 980 Reward 106.000000 Average Reward 122.800000
Episode 990 Reward 186.000000 Average Reward 132.200000
Episode 1000 Reward 277.000000 Average Reward 185.000000
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```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [1024, 1024]
LR = 1e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'CartPole-v1'
SOLVE_CUTOFF = 195.0
STEP = 50000

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{hs}-{lr}-{env}-{numep}-{nstep}-{STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	60.000000	37.400000
20	40.000000	44.700000
30	33.000000	37.200000
40	34.000000	27.800000
50	23.000000	42.100000
60	39.000000	29.800000
70	18.000000	39.300000
80	27.000000	47.400000
90	71.000000	38.100000
100	43.000000	47.700000
110	53.000000	76.800000
120	81.000000	77.500000
130	67.000000	64.300000
140	77.000000	70.100000
150	86.000000	105.400000
160	166.000000	166.300000
170	65.000000	73.000000
180	176.000000	84.800000
190	325.000000	222.600000
200	347.000000	196.500000
210	205.000000	293.400000
220	282.000000	217.700000
230	113.000000	207.400000
240	203.000000	199.700000
250	486.000000	335.600000
260	313.000000	275.900000
270	100.000000	155.200000
280	194.000000	107.800000

Episode 290 Reward 121.000000 Average Reward 143.500000
Episode 300 Reward 500.000000 Average Reward 240.100000
Episode 310 Reward 128.000000 Average Reward 275.200000
Episode 320 Reward 226.000000 Average Reward 132.900000
Episode 330 Reward 500.000000 Average Reward 350.600000
Episode 340 Reward 390.000000 Average Reward 355.000000
Episode 350 Reward 186.000000 Average Reward 225.300000
Episode 360 Reward 128.000000 Average Reward 112.700000
Episode 370 Reward 311.000000 Average Reward 306.000000
Episode 380 Reward 411.000000 Average Reward 441.200000
Episode 390 Reward 318.000000 Average Reward 290.300000
Episode 400 Reward 463.000000 Average Reward 433.900000
Episode 410 Reward 500.000000 Average Reward 442.000000
Episode 420 Reward 264.000000 Average Reward 409.200000
Episode 430 Reward 21.000000 Average Reward 96.500000
Episode 440 Reward 17.000000 Average Reward 20.600000
Episode 450 Reward 20.000000 Average Reward 17.500000
Episode 460 Reward 36.000000 Average Reward 24.600000
Episode 470 Reward 152.000000 Average Reward 73.400000
Episode 480 Reward 330.000000 Average Reward 214.500000
Episode 490 Reward 500.000000 Average Reward 489.600000
Episode 500 Reward 500.000000 Average Reward 451.300000
Episode 510 Reward 500.000000 Average Reward 463.500000
Episode 520 Reward 219.000000 Average Reward 347.200000
Episode 530 Reward 181.000000 Average Reward 205.700000
Episode 540 Reward 164.000000 Average Reward 124.200000
Episode 550 Reward 108.000000 Average Reward 143.000000
Episode 560 Reward 26.000000 Average Reward 47.800000
Episode 570 Reward 24.000000 Average Reward 32.600000
Episode 580 Reward 19.000000 Average Reward 23.400000
Episode 590 Reward 18.000000 Average Reward 21.000000
Episode 600 Reward 24.000000 Average Reward 18.500000
Episode 610 Reward 29.000000 Average Reward 21.300000
Episode 620 Reward 16.000000 Average Reward 17.700000
Episode 630 Reward 17.000000 Average Reward 14.000000
Episode 640 Reward 11.000000 Average Reward 12.500000
Episode 650 Reward 8.000000 Average Reward 10.300000
Episode 660 Reward 13.000000 Average Reward 9.800000
Episode 670 Reward 17.000000 Average Reward 14.100000
Episode 680 Reward 18.000000 Average Reward 14.100000
Episode 690 Reward 19.000000 Average Reward 15.500000
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Episode 750 Reward 13.000000 Average Reward 31.000000
Episode 760 Reward 23.000000 Average Reward 24.100000

Episode 770 Reward 22.000000 Average Reward 25.200000
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Episode 790 Reward 24.000000 Average Reward 23.600000
Episode 800 Reward 22.000000 Average Reward 24.500000
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Episode 820 Reward 23.000000 Average Reward 21.100000
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Episode 960 Reward 500.000000 Average Reward 482.500000
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Episode 50 Reward 28.000000 Average Reward 33.100000
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Episode 100 Reward 63.000000 Average Reward 65.500000
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Episode 140 Reward 57.000000 Average Reward 91.700000
Episode 150 Reward 123.000000 Average Reward 96.900000
Episode 160 Reward 186.000000 Average Reward 100.000000
Episode 170 Reward 110.000000 Average Reward 181.200000
Episode 180 Reward 108.000000 Average Reward 146.000000
Episode 190 Reward 113.000000 Average Reward 83.700000
Episode 200 Reward 194.000000 Average Reward 104.400000
Episode 210 Reward 153.000000 Average Reward 286.400000
Episode 220 Reward 198.000000 Average Reward 257.600000
Episode 230 Reward 104.000000 Average Reward 211.700000

Episode 240 Reward 295.000000 Average Reward 204.000000
Episode 250 Reward 305.000000 Average Reward 278.200000
Episode 260 Reward 476.000000 Average Reward 313.200000
Episode 270 Reward 168.000000 Average Reward 291.100000
Episode 280 Reward 439.000000 Average Reward 272.000000
Episode 290 Reward 342.000000 Average Reward 312.300000
Episode 300 Reward 500.000000 Average Reward 302.900000
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Episode 320 Reward 358.000000 Average Reward 227.100000
Episode 330 Reward 72.000000 Average Reward 280.500000
Episode 340 Reward 58.000000 Average Reward 62.600000
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Episode 380 Reward 50.000000 Average Reward 79.500000
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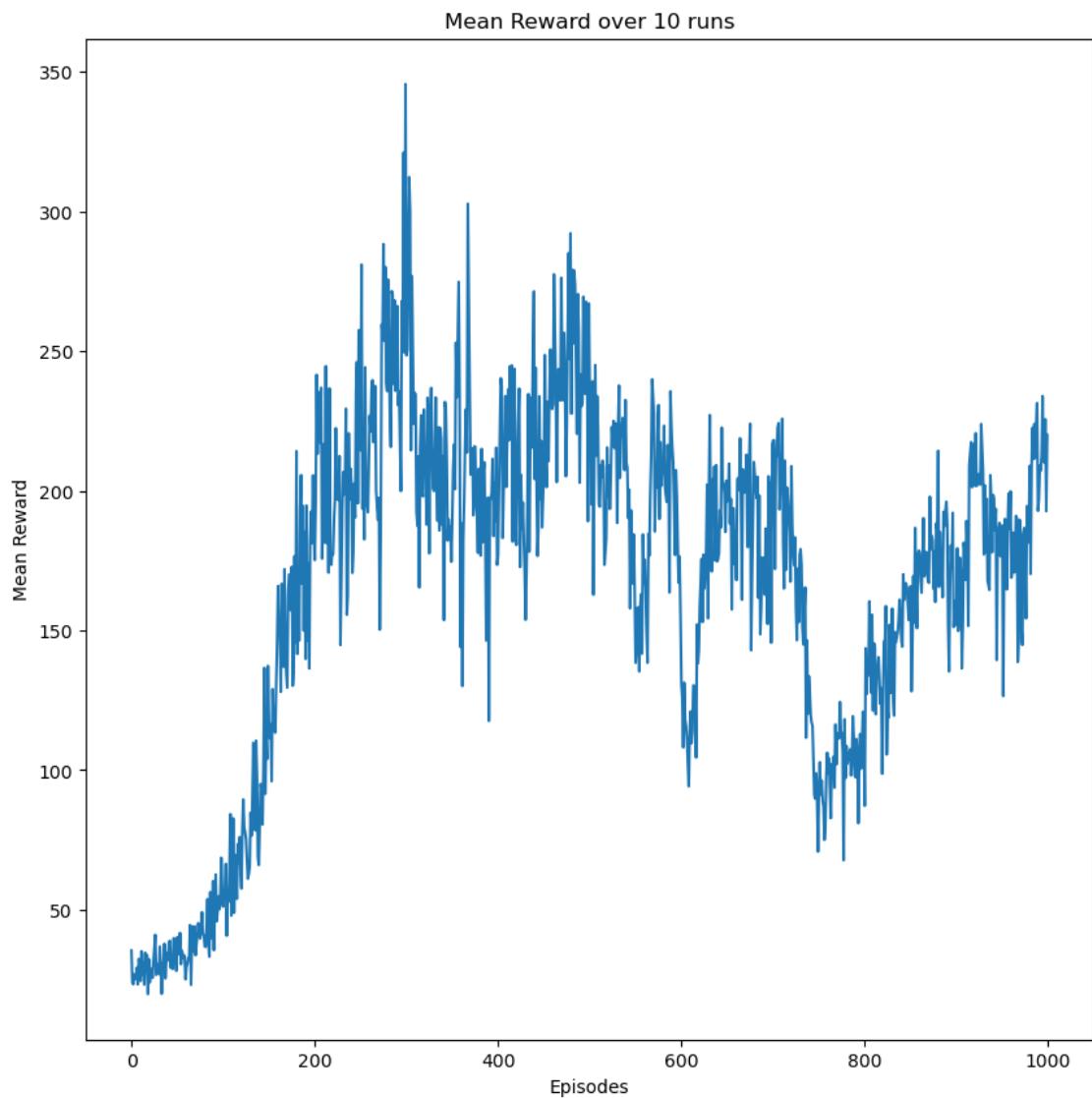
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Episode 700 Reward 500.000000 Average Reward 430.000000
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Episode 740 Reward 500.000000 Average Reward 468.000000
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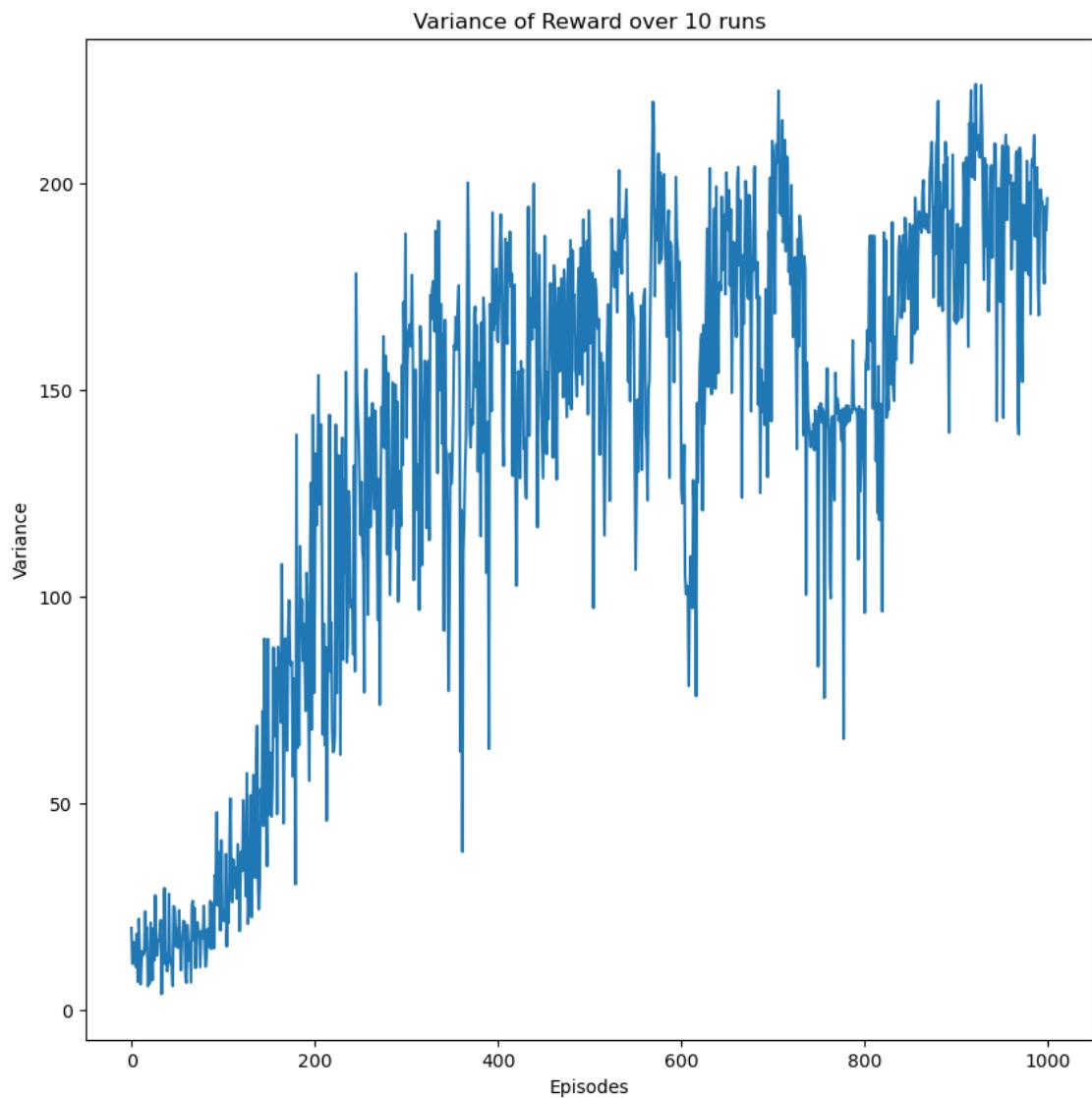
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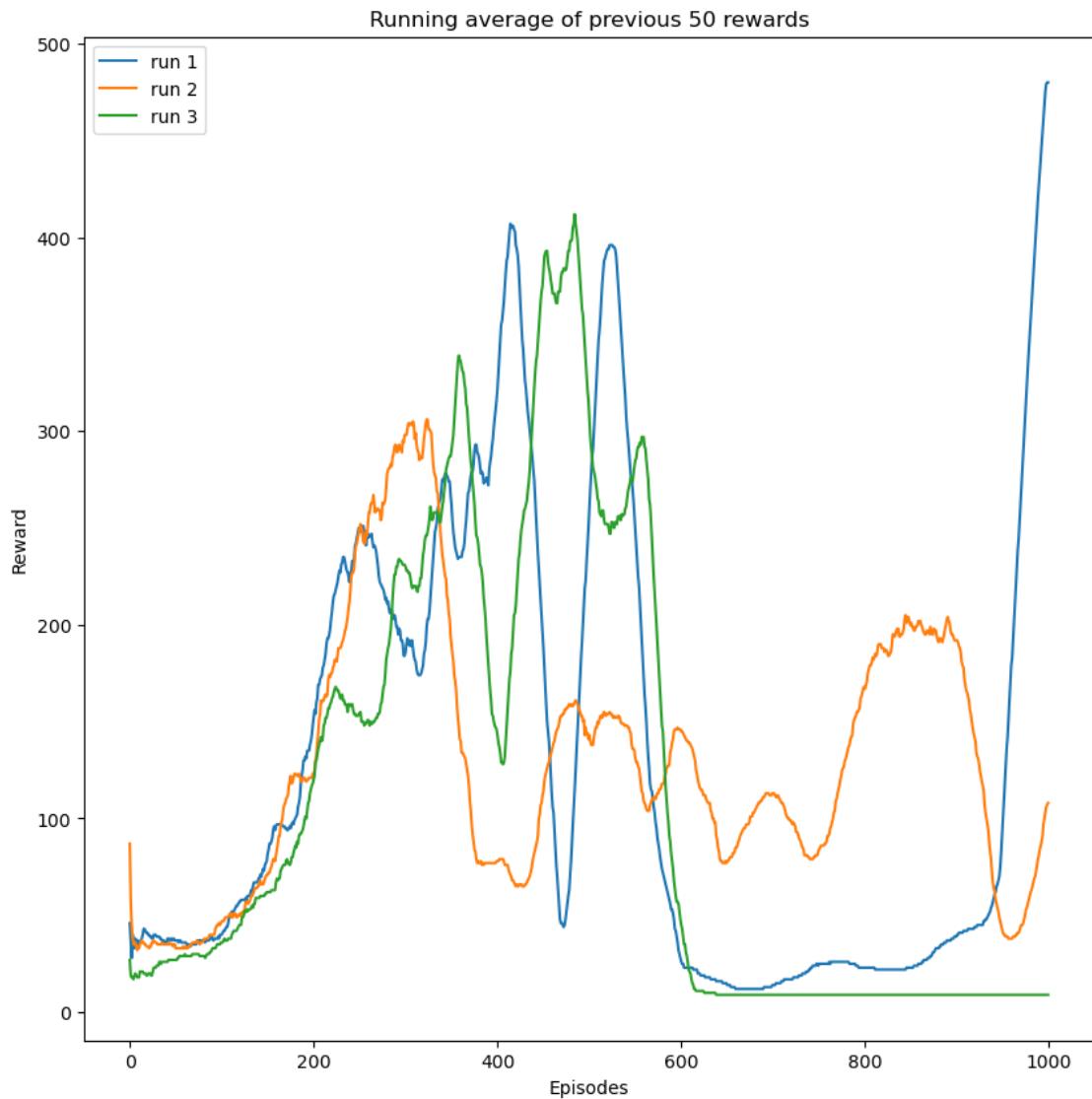
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Episode 280 Reward 230.000000 Average Reward 228.400000
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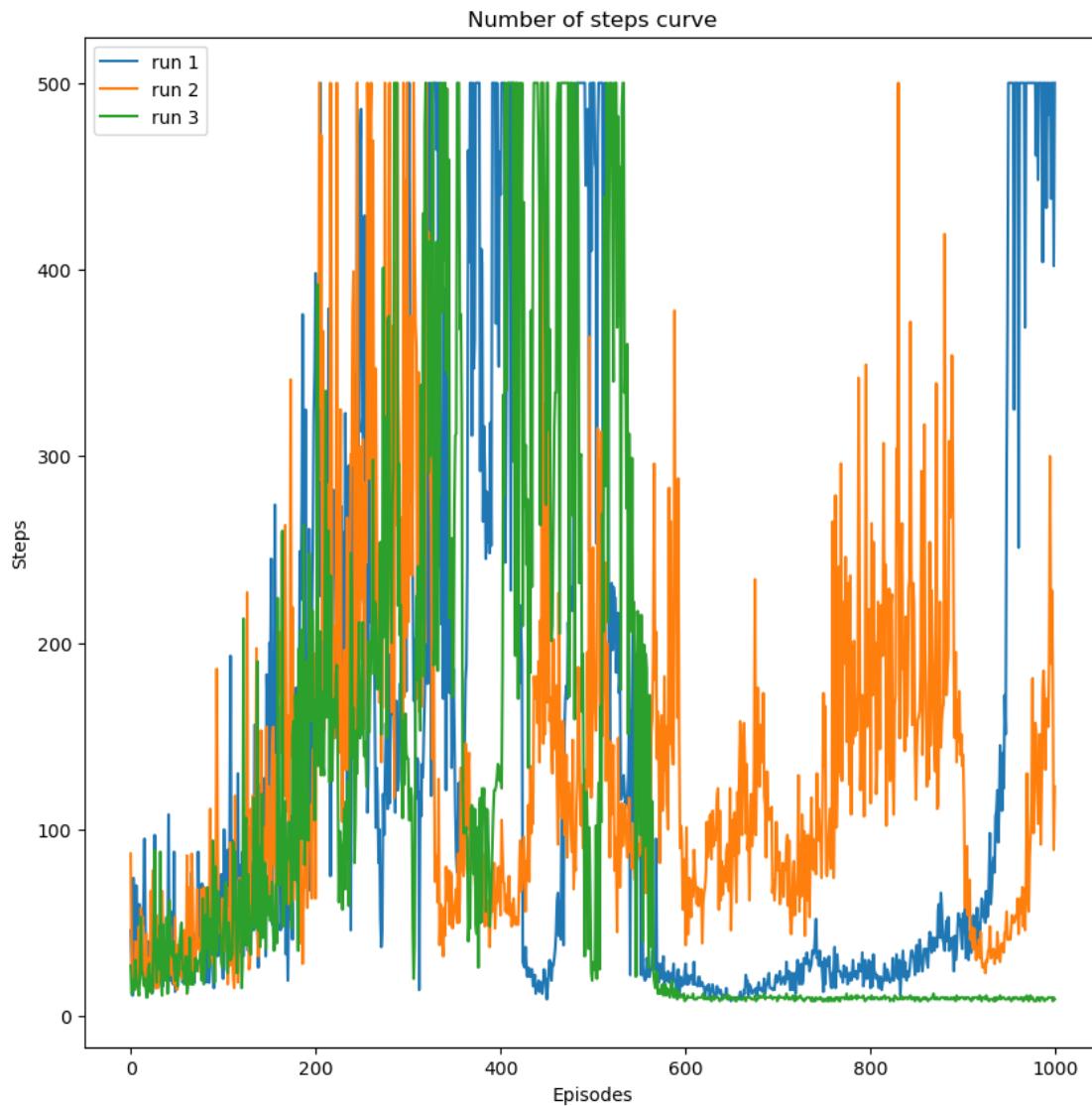
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Episode 390 Reward 25.000000 Average Reward 30.900000
Episode 400 Reward 47.000000 Average Reward 37.500000
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Episode 980 Reward 32.000000 Average Reward 35.500000
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Episode 1000 Reward 216.000000 Average Reward 156.100000
0:05:17.198606









```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [1024, 1024]
LR = 2e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'CartPole-v1'
SOLVE_CUTOFF = 195.0
STEP = 50000

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{hs}-{lr}-{env}-{numep}-{nstep}-{STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	47.000000	43.000000
20	41.000000	29.000000
30	53.000000	34.600000
40	57.000000	46.500000
50	44.000000	44.300000
60	51.000000	60.700000
70	63.000000	64.800000
80	100.000000	70.200000
90	117.000000	127.600000
100	359.000000	183.600000
110	99.000000	104.300000
120	128.000000	121.800000
130	217.000000	204.300000
140	132.000000	226.200000
150	40.000000	123.700000
160	21.000000	25.300000
170	26.000000	21.100000
180	35.000000	31.800000
190	29.000000	30.600000
200	27.000000	27.100000
210	22.000000	27.200000
220	32.000000	29.800000
230	50.000000	39.800000
240	43.000000	44.400000
250	61.000000	50.300000
260	39.000000	41.400000
270	56.000000	50.300000
280	45.000000	58.800000

Episode 290 Reward 58.000000 Average Reward 68.300000
Episode 300 Reward 81.000000 Average Reward 77.700000
Episode 310 Reward 314.000000 Average Reward 234.900000
Episode 320 Reward 9.000000 Average Reward 53.300000
Episode 330 Reward 39.000000 Average Reward 31.800000
Episode 340 Reward 30.000000 Average Reward 32.500000
Episode 350 Reward 36.000000 Average Reward 35.300000
Episode 360 Reward 38.000000 Average Reward 47.900000
Episode 370 Reward 135.000000 Average Reward 75.500000
Episode 380 Reward 172.000000 Average Reward 228.800000
Episode 390 Reward 185.000000 Average Reward 391.200000
Episode 400 Reward 383.000000 Average Reward 375.800000
Episode 410 Reward 477.000000 Average Reward 324.000000
Episode 420 Reward 500.000000 Average Reward 480.200000
Episode 430 Reward 388.000000 Average Reward 488.800000
Episode 440 Reward 34.000000 Average Reward 180.300000
Episode 450 Reward 110.000000 Average Reward 64.100000
Episode 460 Reward 113.000000 Average Reward 108.600000
Episode 470 Reward 151.000000 Average Reward 139.200000
Episode 480 Reward 122.000000 Average Reward 165.900000
Episode 490 Reward 140.000000 Average Reward 131.700000
Episode 500 Reward 119.000000 Average Reward 146.100000
Episode 510 Reward 145.000000 Average Reward 159.000000
Episode 520 Reward 172.000000 Average Reward 163.300000
Episode 530 Reward 306.000000 Average Reward 220.200000
Episode 540 Reward 226.000000 Average Reward 209.100000
Episode 550 Reward 234.000000 Average Reward 236.500000
Episode 560 Reward 295.000000 Average Reward 241.900000
Episode 570 Reward 128.000000 Average Reward 230.200000
Episode 580 Reward 28.000000 Average Reward 36.700000
Episode 590 Reward 54.000000 Average Reward 33.800000
Episode 600 Reward 37.000000 Average Reward 62.700000
Episode 610 Reward 27.000000 Average Reward 39.400000
Episode 620 Reward 35.000000 Average Reward 30.300000
Episode 630 Reward 43.000000 Average Reward 39.300000
Episode 640 Reward 40.000000 Average Reward 40.600000
Episode 650 Reward 76.000000 Average Reward 45.600000
Episode 660 Reward 128.000000 Average Reward 102.700000
Episode 670 Reward 177.000000 Average Reward 151.700000
Episode 680 Reward 153.000000 Average Reward 191.600000
Episode 690 Reward 170.000000 Average Reward 156.900000
Episode 700 Reward 237.000000 Average Reward 250.700000
Episode 710 Reward 326.000000 Average Reward 304.500000
Episode 720 Reward 156.000000 Average Reward 232.300000
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Episode 760 Reward 389.000000 Average Reward 313.900000

Episode 770 Reward 224.000000 Average Reward 260.600000
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Episode 190 Reward 325.000000 Average Reward 256.600000
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Episode 330 Reward 10.000000 Average Reward 9.300000
Episode 340 Reward 10.000000 Average Reward 8.900000
Episode 350 Reward 9.000000 Average Reward 9.500000
Episode 360 Reward 8.000000 Average Reward 9.300000
Episode 370 Reward 9.000000 Average Reward 9.300000
Episode 380 Reward 10.000000 Average Reward 9.900000
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Episode 400 Reward 9.000000 Average Reward 9.300000
Episode 410 Reward 10.000000 Average Reward 9.400000
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Episode 800 Reward 26.000000 Average Reward 22.500000
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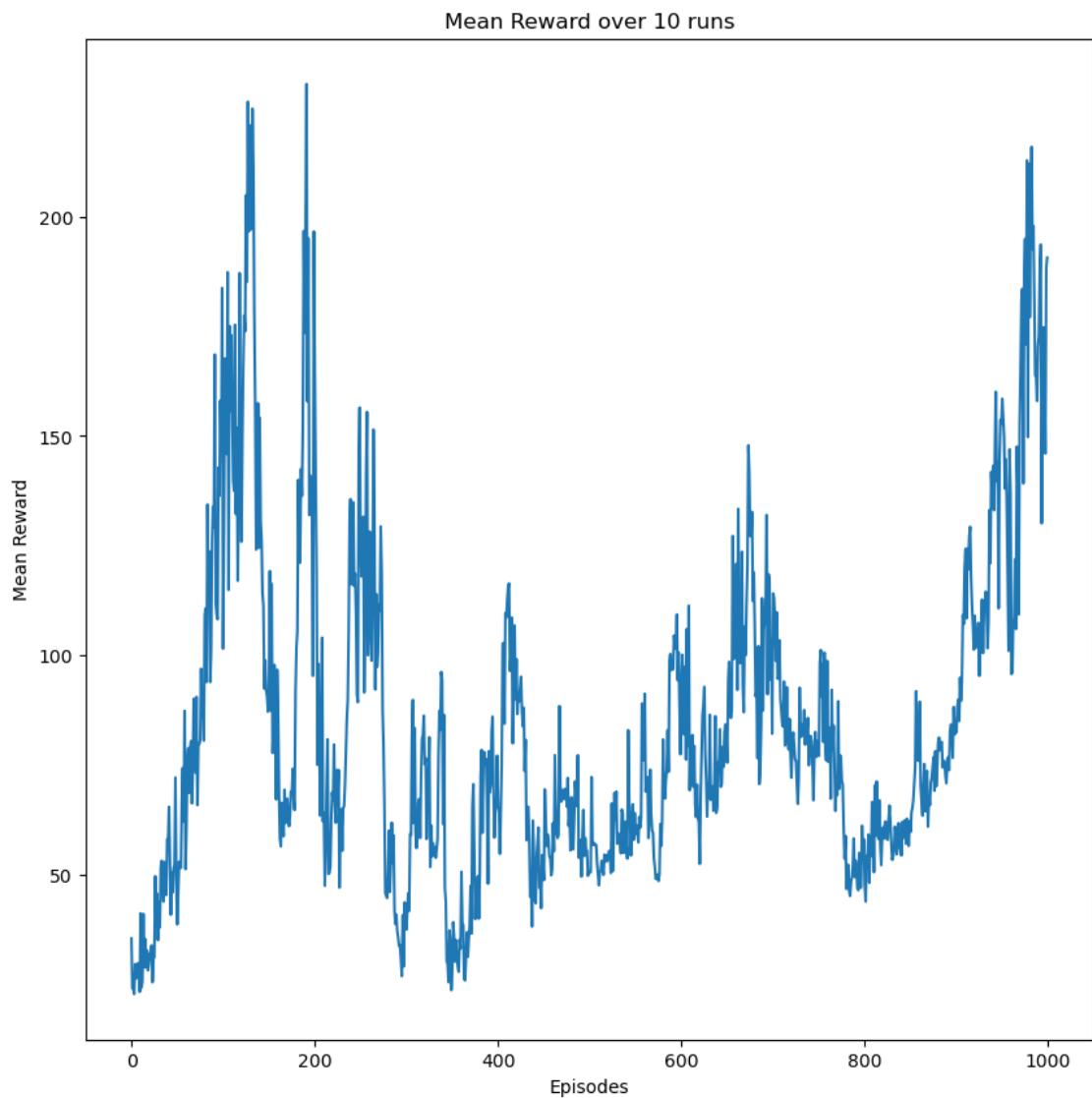
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Episode 720 Reward 36.000000 Average Reward 41.900000
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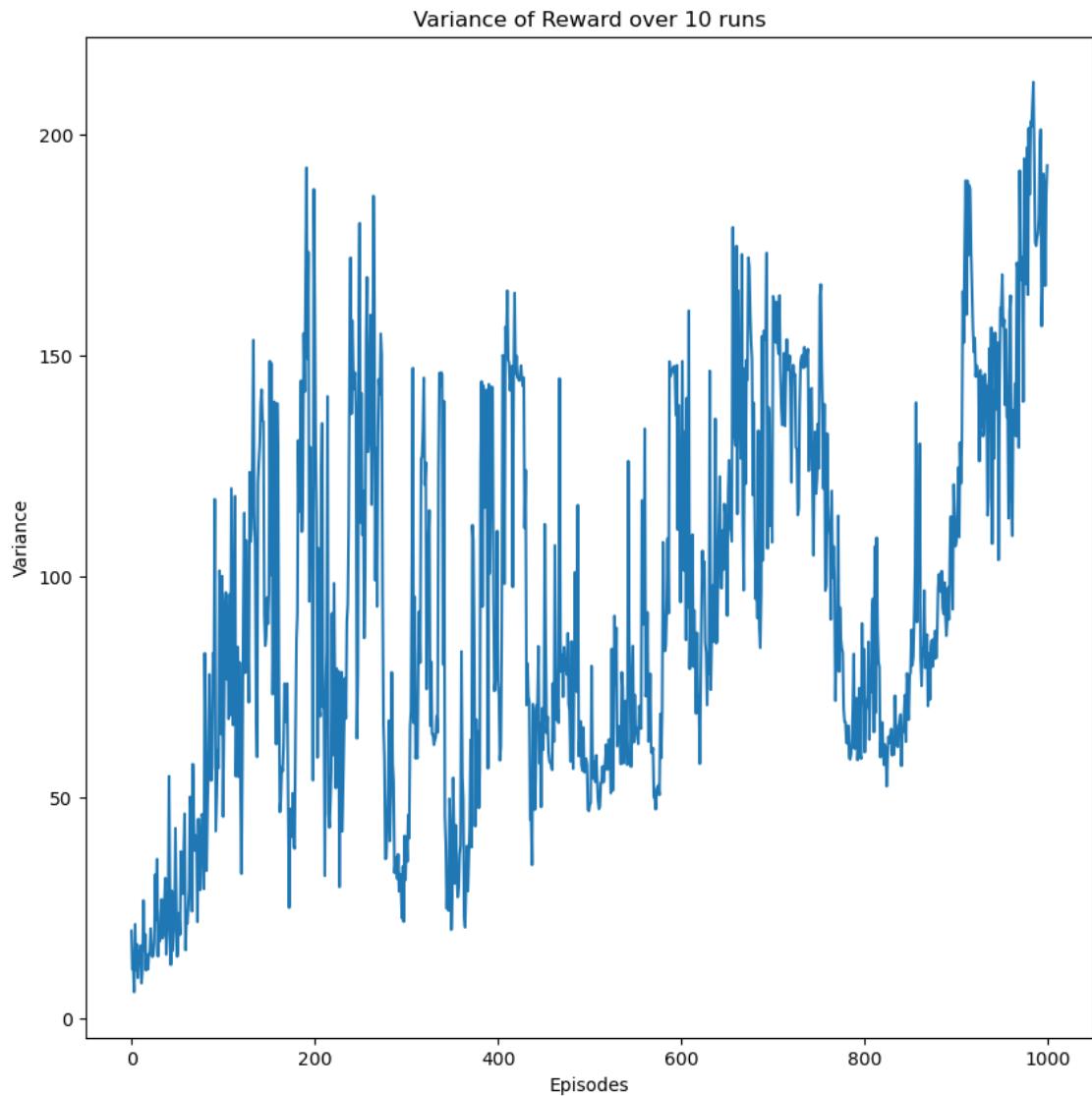
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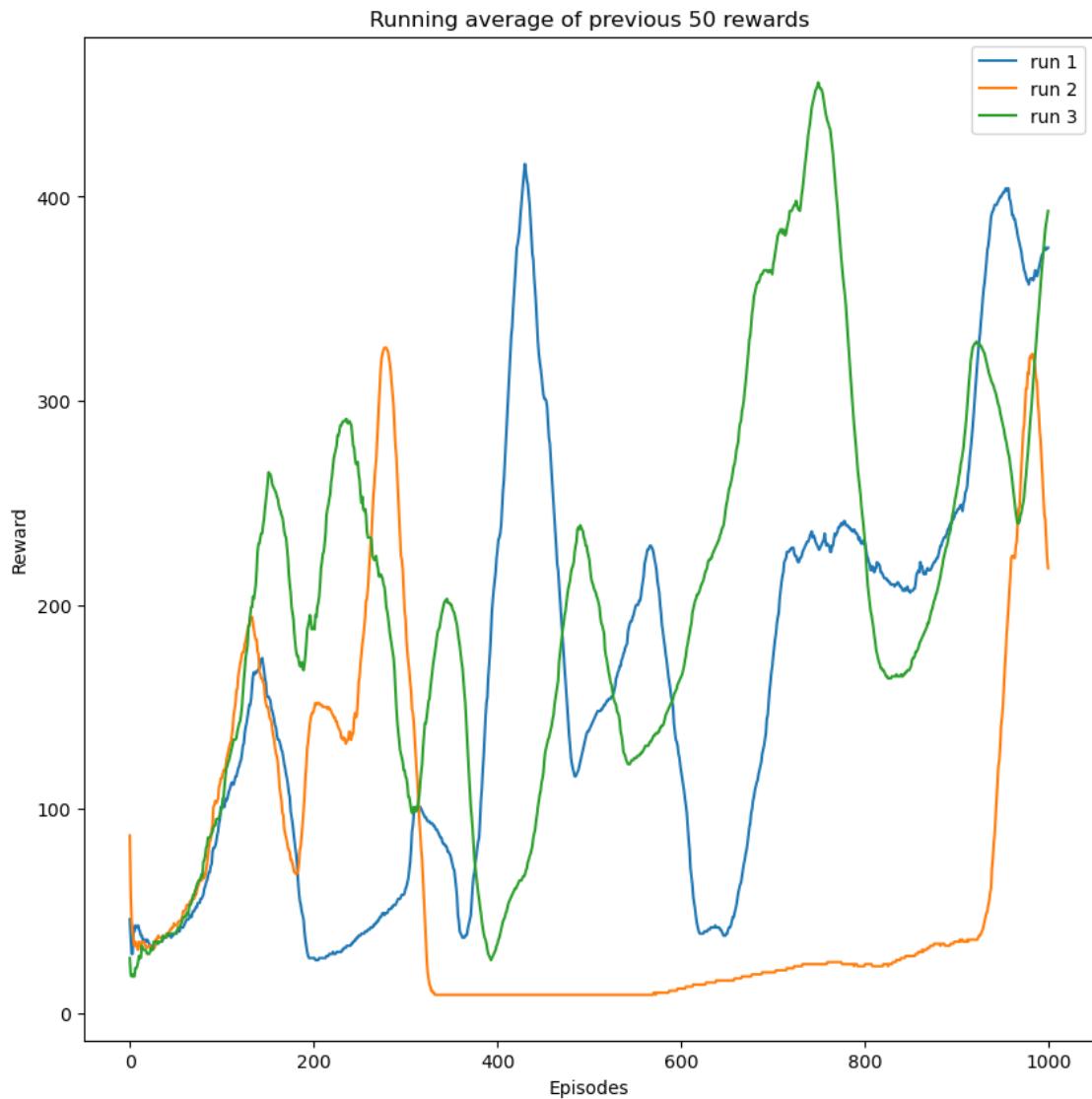
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Episode 80 Reward 131.000000 Average Reward 55.700000
Episode 90 Reward 165.000000 Average Reward 109.700000
Episode 100 Reward 46.000000 Average Reward 101.700000
Episode 110 Reward 97.000000 Average Reward 100.200000
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Episode 170 Reward 53.000000 Average Reward 41.600000
Episode 180 Reward 99.000000 Average Reward 62.800000
Episode 190 Reward 145.000000 Average Reward 97.700000
Episode 200 Reward 500.000000 Average Reward 172.800000
Episode 210 Reward 50.000000 Average Reward 128.200000
Episode 220 Reward 29.000000 Average Reward 28.200000
Episode 230 Reward 11.000000 Average Reward 13.700000
Episode 240 Reward 8.000000 Average Reward 9.600000
Episode 250 Reward 8.000000 Average Reward 9.300000
Episode 260 Reward 10.000000 Average Reward 9.300000
Episode 270 Reward 10.000000 Average Reward 9.800000
Episode 280 Reward 8.000000 Average Reward 9.400000
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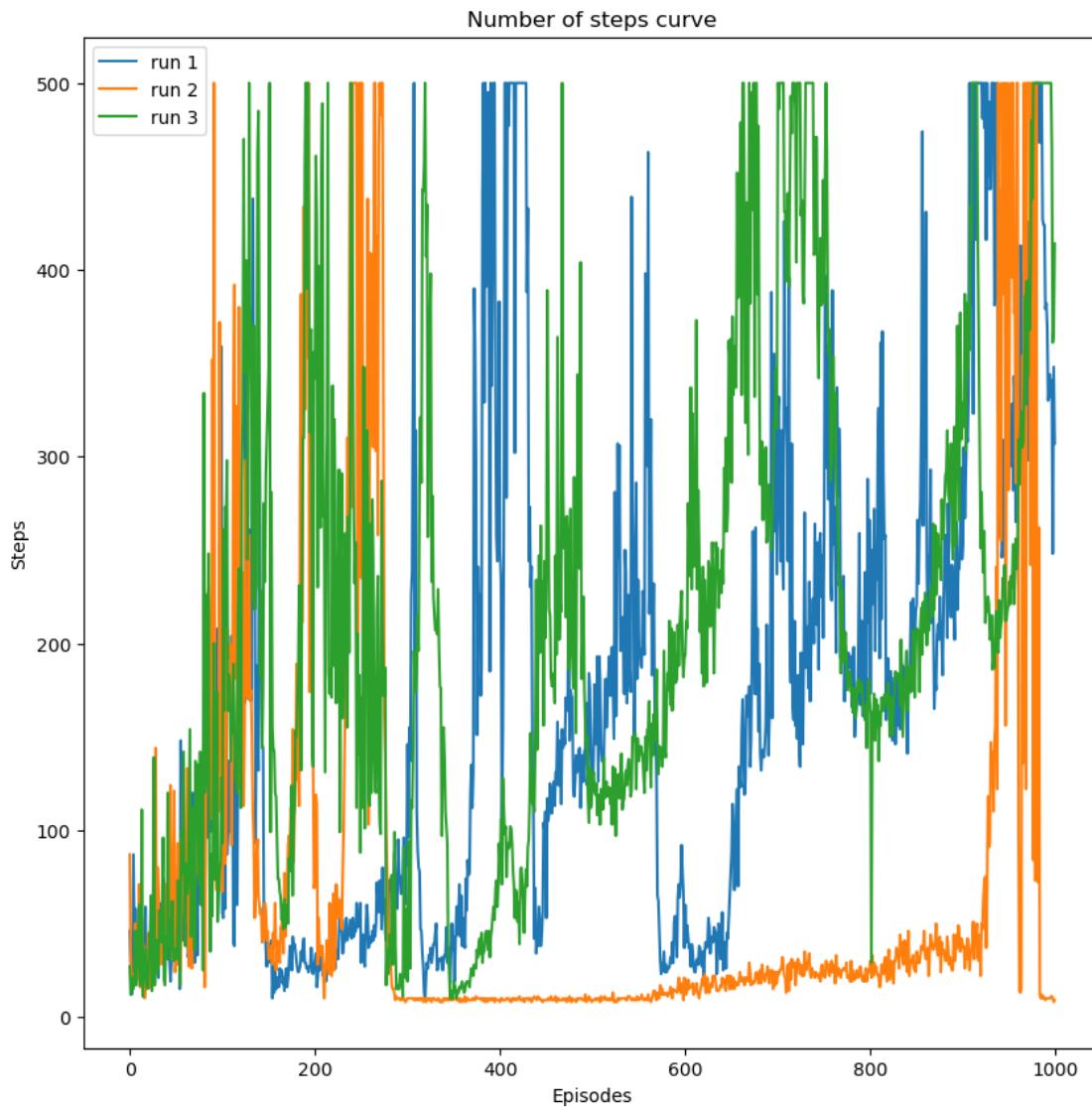
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Episode 480 Reward 10.000000 Average Reward 10.000000
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Episode 770 Reward 126.000000 Average Reward 115.900000
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Episode 930 Reward 14.000000 Average Reward 17.300000
Episode 940 Reward 19.000000 Average Reward 18.100000
Episode 950 Reward 18.000000 Average Reward 17.500000
Episode 960 Reward 19.000000 Average Reward 16.700000
Episode 970 Reward 16.000000 Average Reward 18.700000
Episode 980 Reward 15.000000 Average Reward 16.700000
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Episode 1000 Reward 17.000000 Average Reward 18.400000
0:01:04.120658









```
[ ]: NUM_HIDDEN = 3
HIDDEN_SIZES = [512, 1024, 512]
LR = 1e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'CartPole-v1'
SOLVE_CUTOFF = 195.0
STEP = 50000

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{NUM_HIDDEN}_{HIDDEN_SIZES}_{LR}_{ENV_NAME}_{NUM_EPISODES}_{NSTEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	15.000000	28.800000
20	90.000000	34.700000
30	19.000000	21.400000
40	17.000000	26.200000
50	25.000000	41.000000
60	33.000000	28.700000
70	17.000000	32.300000
80	77.000000	53.500000
90	136.000000	61.900000
100	60.000000	48.200000
110	86.000000	69.400000
120	65.000000	83.400000
130	73.000000	77.600000
140	103.000000	115.100000
150	37.000000	59.700000
160	59.000000	39.200000
170	107.000000	102.500000
180	91.000000	100.000000
190	38.000000	81.000000
200	28.000000	38.300000
210	10.000000	13.500000
220	9.000000	9.300000
230	10.000000	10.100000
240	9.000000	9.300000
250	8.000000	9.100000
260	10.000000	9.200000
270	9.000000	9.800000
280	11.000000	9.300000

Episode 290 Reward 9.000000 Average Reward 9.300000
Episode 300 Reward 10.000000 Average Reward 9.600000
Episode 310 Reward 10.000000 Average Reward 9.700000
Episode 320 Reward 11.000000 Average Reward 10.900000
Episode 330 Reward 9.000000 Average Reward 9.800000
Episode 340 Reward 11.000000 Average Reward 9.800000
Episode 350 Reward 11.000000 Average Reward 10.000000
Episode 360 Reward 10.000000 Average Reward 10.100000
Episode 370 Reward 24.000000 Average Reward 14.300000
Episode 380 Reward 19.000000 Average Reward 15.600000
Episode 390 Reward 18.000000 Average Reward 20.800000
Episode 400 Reward 17.000000 Average Reward 17.700000
Episode 410 Reward 25.000000 Average Reward 20.600000
Episode 420 Reward 15.000000 Average Reward 25.700000
Episode 430 Reward 33.000000 Average Reward 28.400000
Episode 440 Reward 26.000000 Average Reward 28.300000
Episode 450 Reward 27.000000 Average Reward 30.900000
Episode 460 Reward 29.000000 Average Reward 38.700000
Episode 470 Reward 50.000000 Average Reward 37.100000
Episode 480 Reward 52.000000 Average Reward 44.400000
Episode 490 Reward 53.000000 Average Reward 56.300000
Episode 500 Reward 60.000000 Average Reward 62.400000
Episode 510 Reward 86.000000 Average Reward 82.800000
Episode 520 Reward 29.000000 Average Reward 33.500000
Episode 530 Reward 48.000000 Average Reward 67.200000
Episode 540 Reward 60.000000 Average Reward 85.300000
Episode 550 Reward 90.000000 Average Reward 91.800000
Episode 560 Reward 255.000000 Average Reward 105.000000
Episode 570 Reward 83.000000 Average Reward 104.800000
Episode 580 Reward 14.000000 Average Reward 61.800000
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Episode 610 Reward 9.000000 Average Reward 9.400000
Episode 620 Reward 9.000000 Average Reward 9.100000
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Episode 650 Reward 11.000000 Average Reward 9.400000
Episode 660 Reward 10.000000 Average Reward 9.900000
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Episode 680 Reward 8.000000 Average Reward 9.500000
Episode 690 Reward 10.000000 Average Reward 9.500000
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Episode 750 Reward 17.000000 Average Reward 11.100000
Episode 760 Reward 9.000000 Average Reward 12.000000

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Episode 60 Reward 47.000000 Average Reward 31.500000
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Episode 160 Reward 500.000000 Average Reward 110.000000
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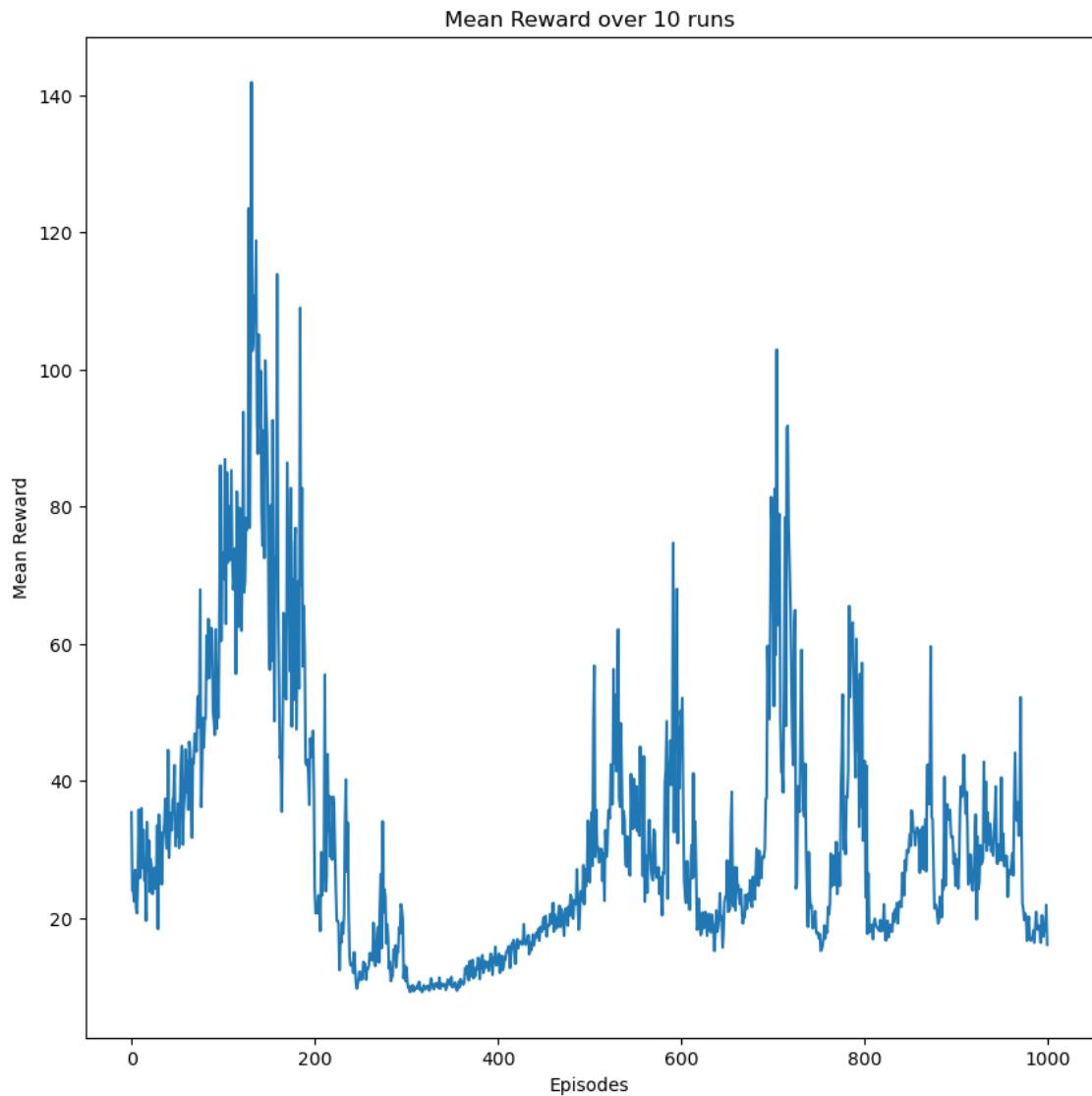
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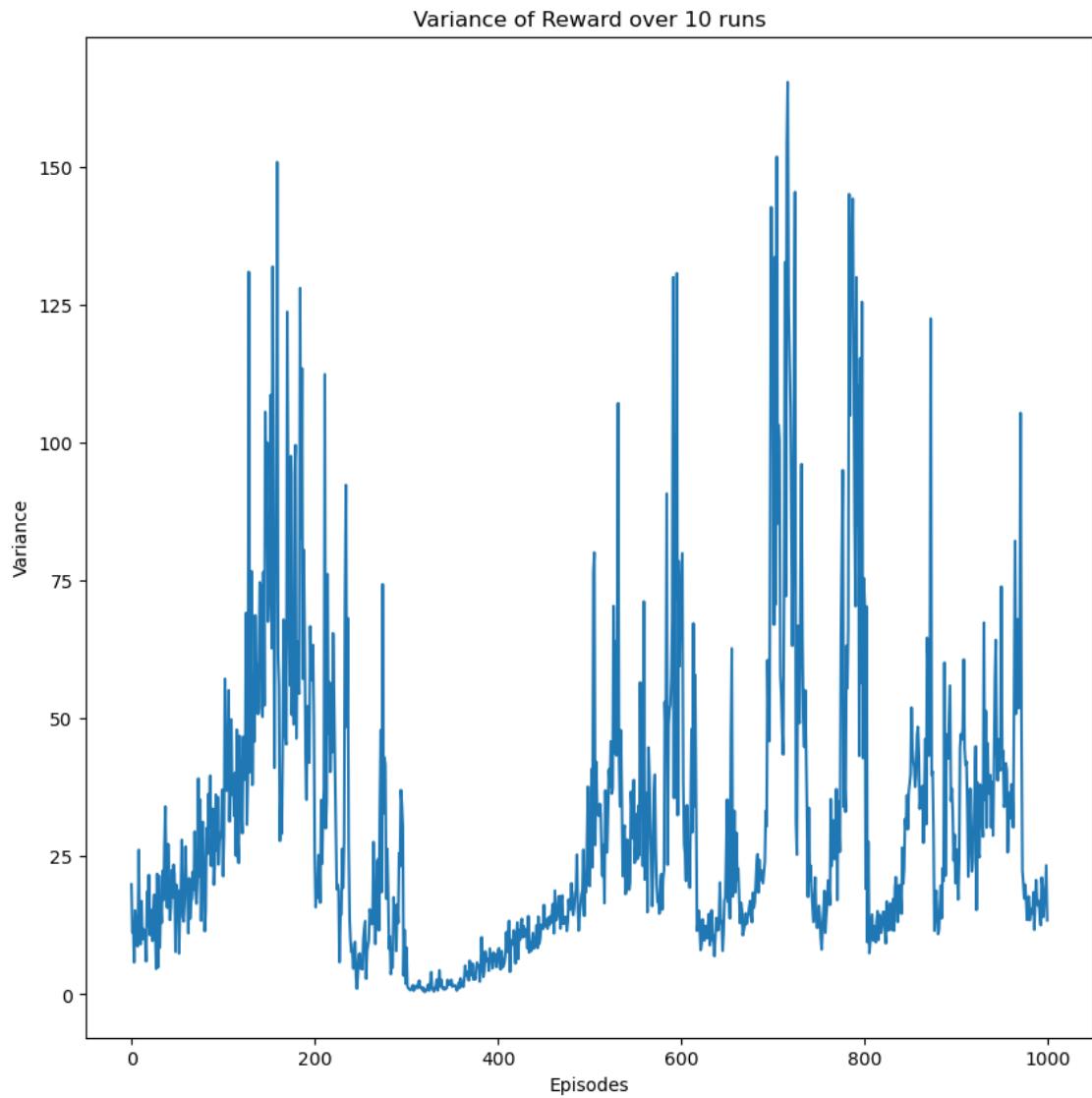
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Episode 660 Reward 12.000000 Average Reward 18.800000
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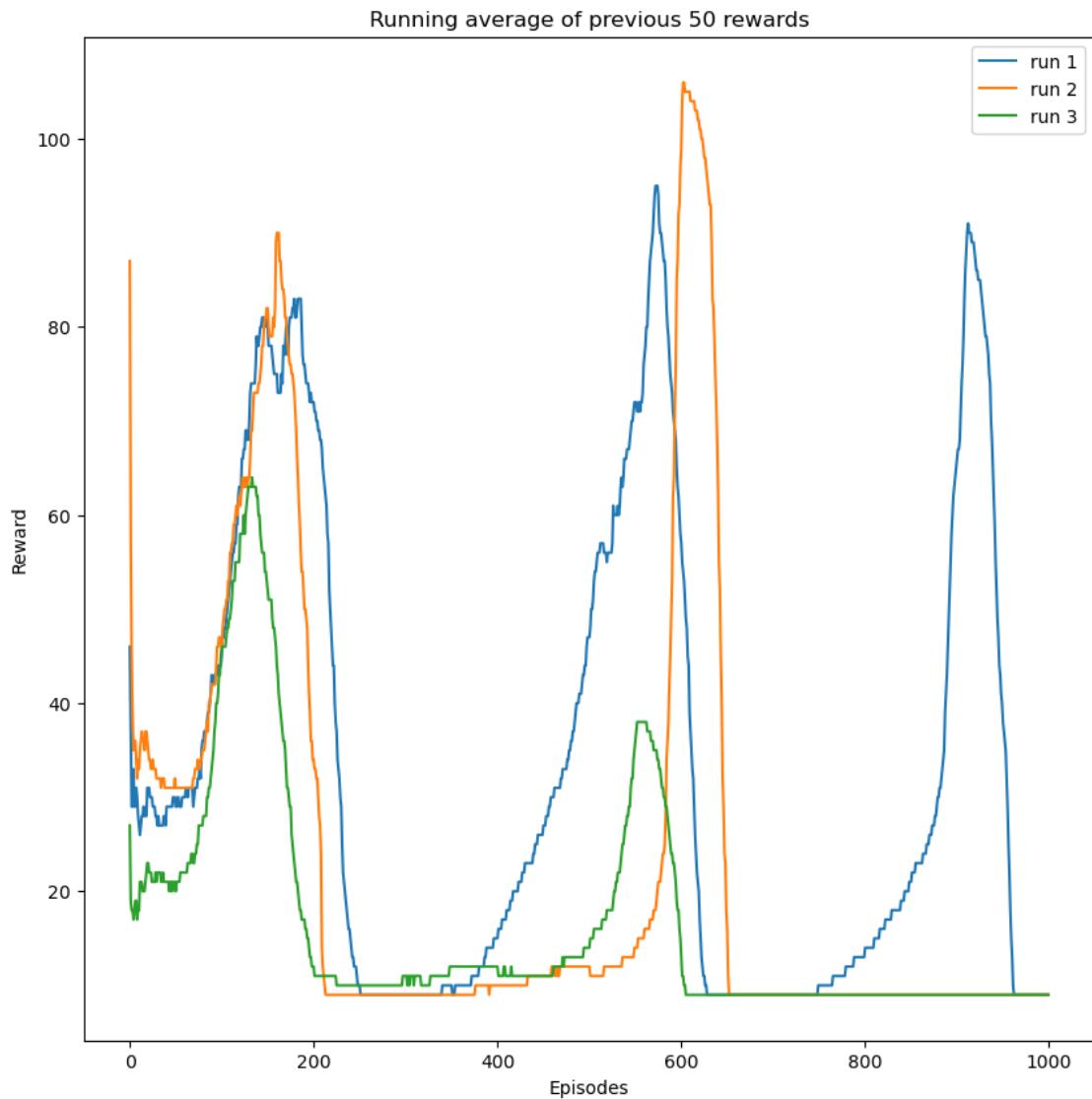
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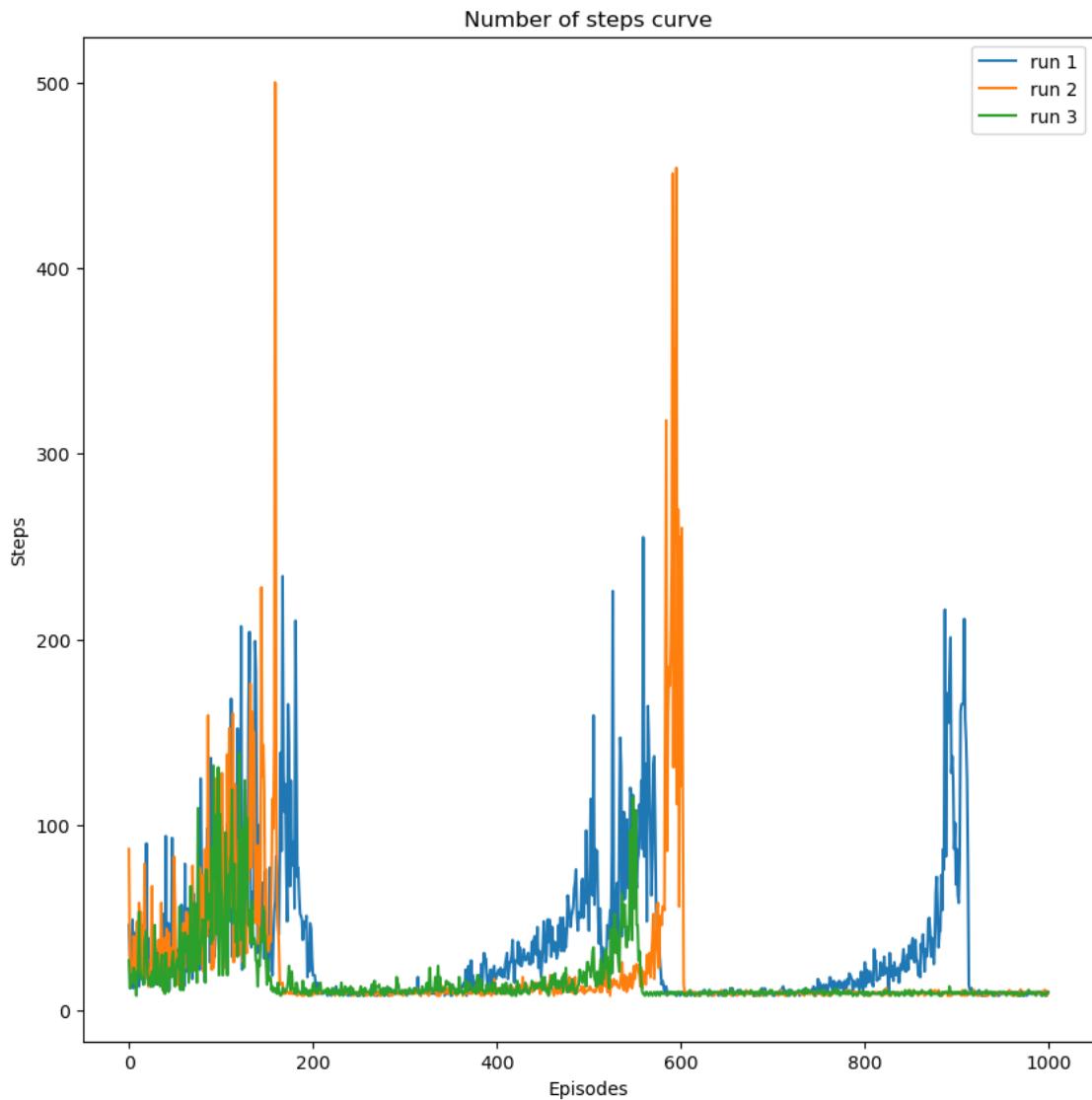
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Episode 600 Reward 20.000000 Average Reward 17.400000
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Episode 1000 Reward 9.000000 Average Reward 9.700000
0:01:13.907346









Acrobot

```
[ ]: NUM_HIDDEN = 1
HIDDEN_SIZES = [1024]
LR = 1e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'Acrobot-v1'
SOLVE_CUTOFF = -100.0
STEP = 50000

ENV = gym.make(ENV_NAME)
```

```

mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname =
    f'hl={NUM_HIDDEN}_hs={HIDDEN_SIZES}_lr={LR}_env={ENV_NAME}_numep={NUM_EPISODES}_nstep={STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	-463.000000	-491.500000
20	-500.000000	-421.100000
30	-288.000000	-364.500000
40	-321.000000	-395.500000
50	-205.000000	-361.900000
60	-437.000000	-375.300000
70	-230.000000	-327.500000
80	-424.000000	-418.700000
90	-337.000000	-400.400000
100	-365.000000	-378.300000
110	-500.000000	-429.500000
120	-500.000000	-405.900000
130	-500.000000	-401.800000
140	-500.000000	-413.700000
150	-401.000000	-393.200000
160	-319.000000	-451.100000
170	-346.000000	-425.100000
180	-500.000000	-483.000000
190	-500.000000	-482.500000
200	-500.000000	-481.800000
210	-500.000000	-486.300000
220	-500.000000	-410.900000
230	-345.000000	-404.400000
240	-350.000000	-366.100000
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Episode 800 Reward -134.000000 Average Reward -137.000000
Episode 810 Reward -165.000000 Average Reward -152.500000

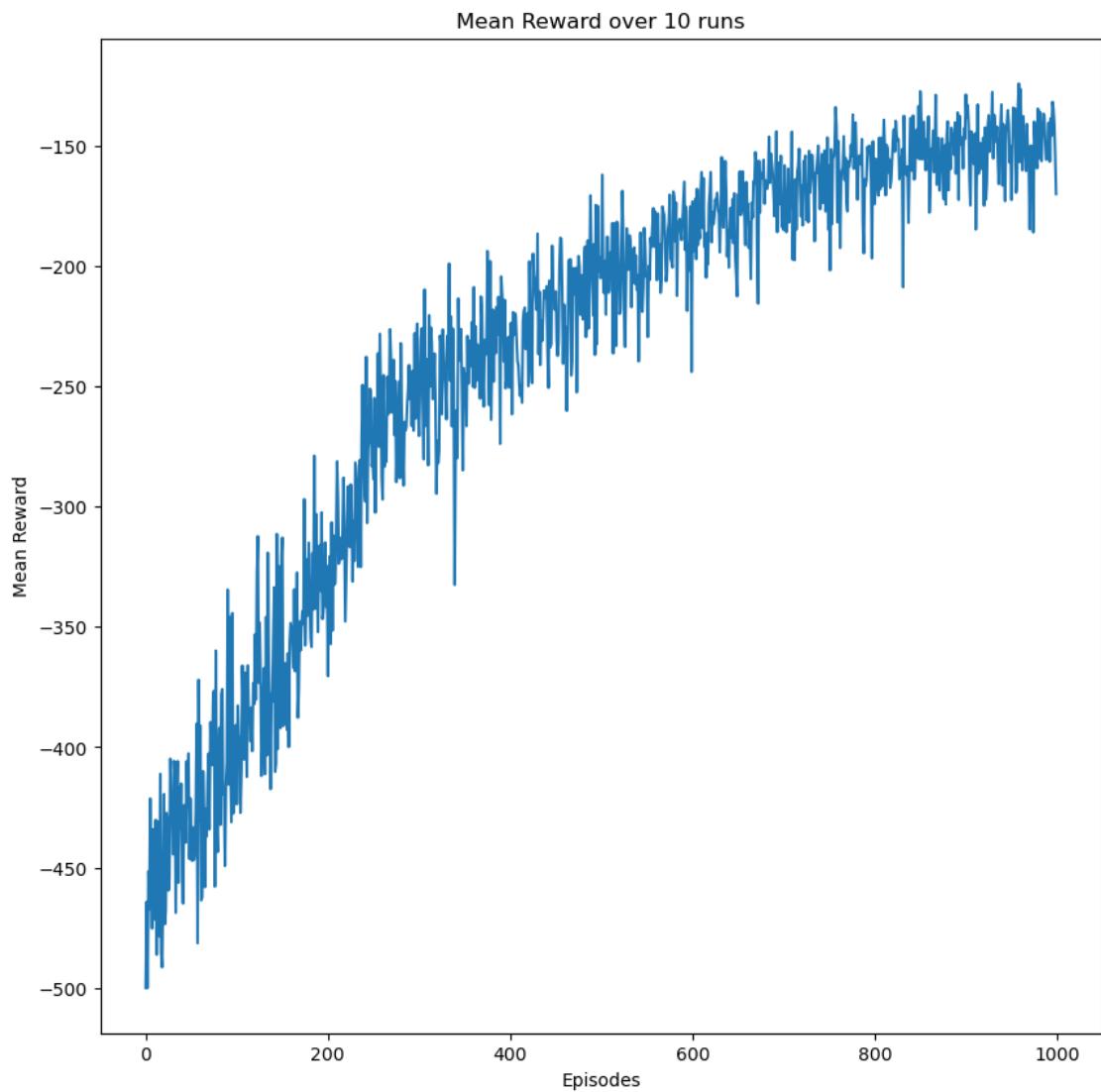
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Episode 860 Reward -119.000000 Average Reward -152.500000
Episode 870 Reward -137.000000 Average Reward -133.000000
Episode 880 Reward -129.000000 Average Reward -155.500000
Episode 890 Reward -151.000000 Average Reward -130.800000
Episode 900 Reward -156.000000 Average Reward -137.000000
Episode 910 Reward -128.000000 Average Reward -136.800000
Episode 920 Reward -124.000000 Average Reward -134.900000
Episode 930 Reward -133.000000 Average Reward -139.400000
Episode 940 Reward -118.000000 Average Reward -127.600000
Episode 950 Reward -133.000000 Average Reward -133.300000
Episode 960 Reward -143.000000 Average Reward -154.000000
Episode 970 Reward -160.000000 Average Reward -148.900000
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Episode 1000 Reward -245.000000 Average Reward -136.700000

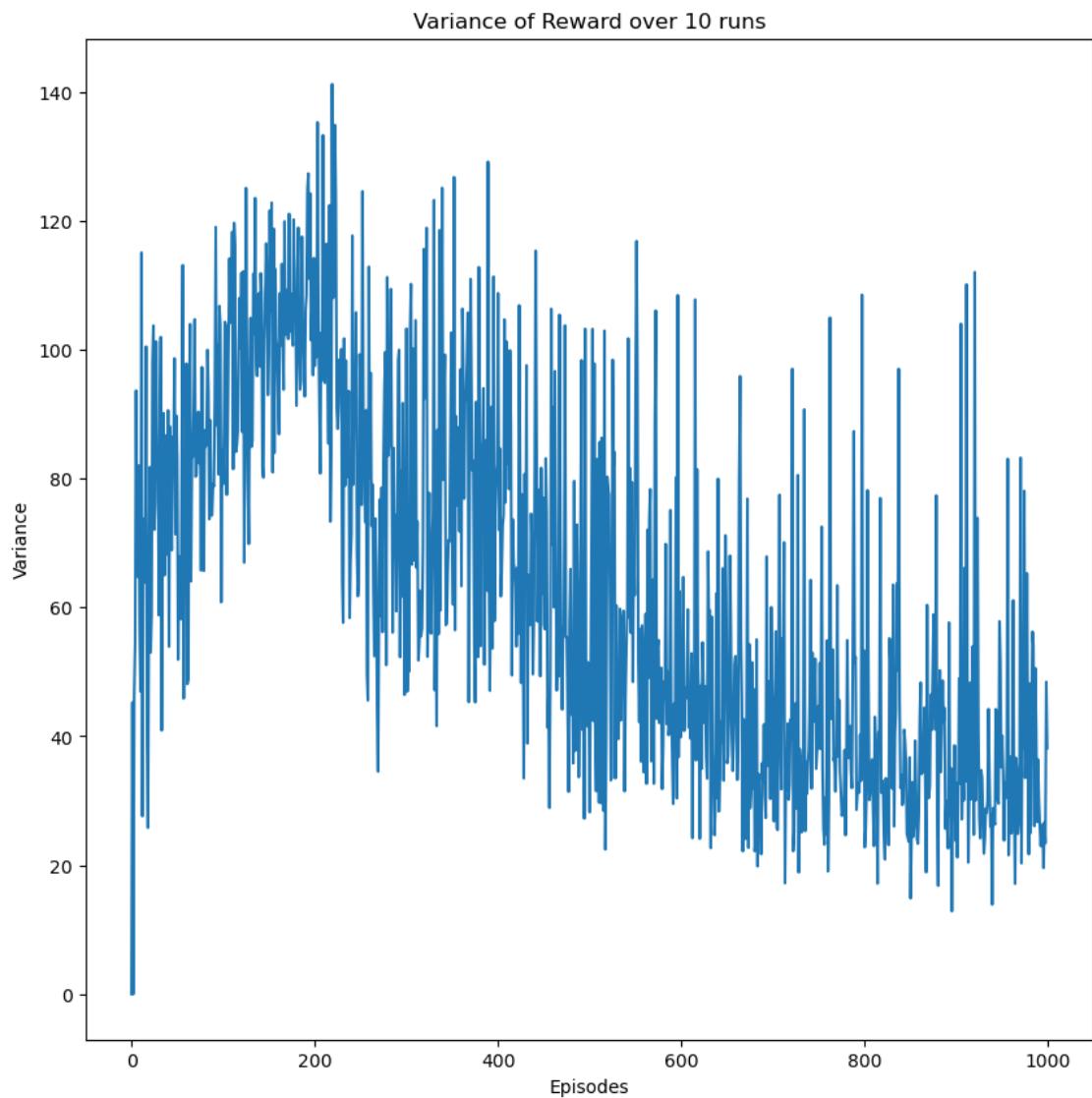
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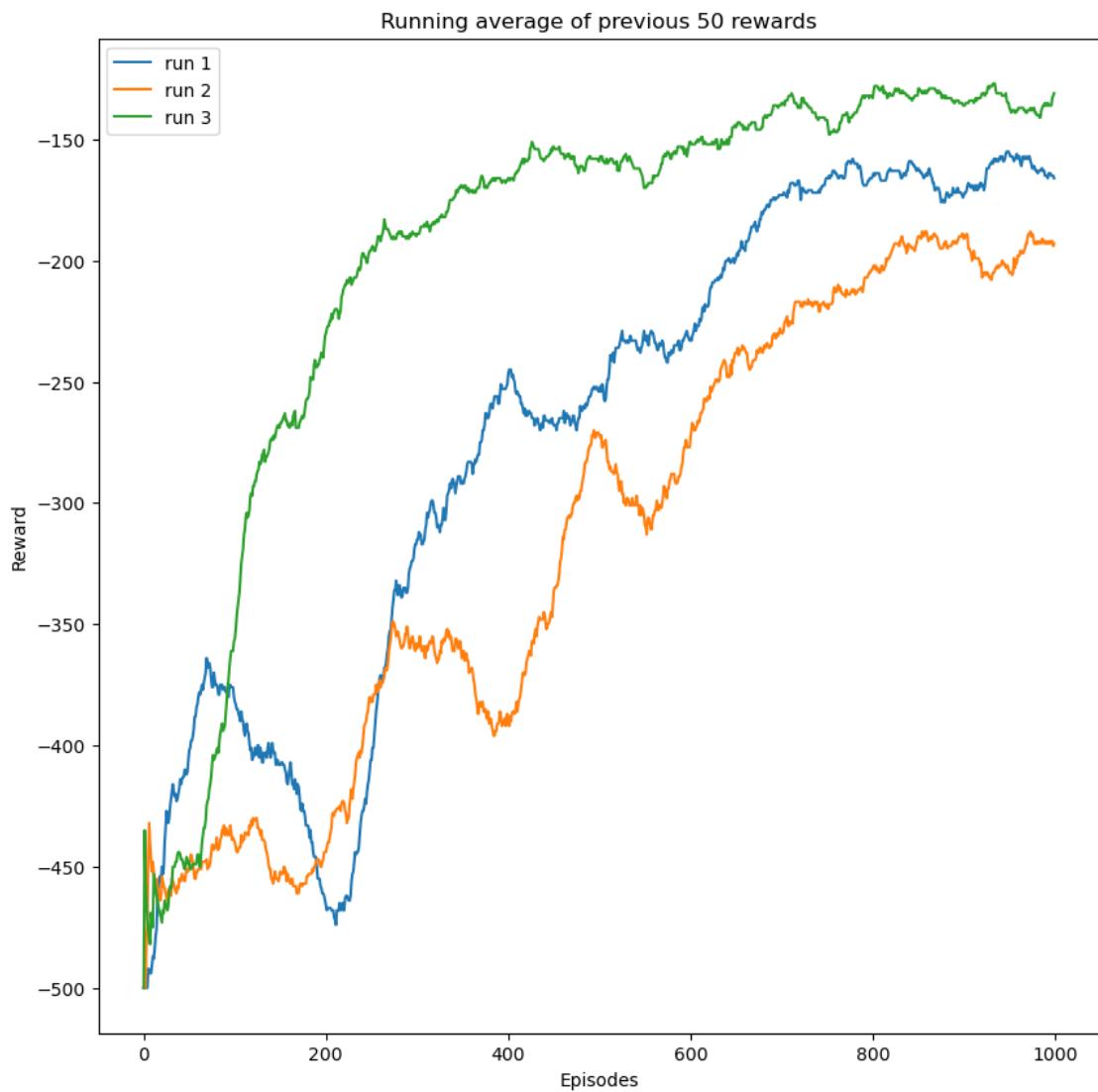
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Episode 50 Reward -314.000000 Average Reward -481.400000
Episode 60 Reward -500.000000 Average Reward -487.500000
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Episode 100 Reward -420.000000 Average Reward -492.000000
Episode 110 Reward -500.000000 Average Reward -500.000000
Episode 120 Reward -500.000000 Average Reward -500.000000
Episode 130 Reward -500.000000 Average Reward -483.600000
Episode 140 Reward -500.000000 Average Reward -500.000000
Episode 150 Reward -500.000000 Average Reward -484.700000
Episode 160 Reward -500.000000 Average Reward -494.400000
Episode 170 Reward -500.000000 Average Reward -470.700000
Episode 180 Reward -500.000000 Average Reward -439.400000
Episode 190 Reward -480.000000 Average Reward -420.100000
Episode 200 Reward -500.000000 Average Reward -467.800000
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Episode 230 Reward -330.000000 Average Reward -376.800000
Episode 240 Reward -252.000000 Average Reward -312.900000
Episode 250 Reward -383.000000 Average Reward -326.400000
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Episode 270 Reward -242.000000 Average Reward -260.600000
Episode 280 Reward -183.000000 Average Reward -279.100000

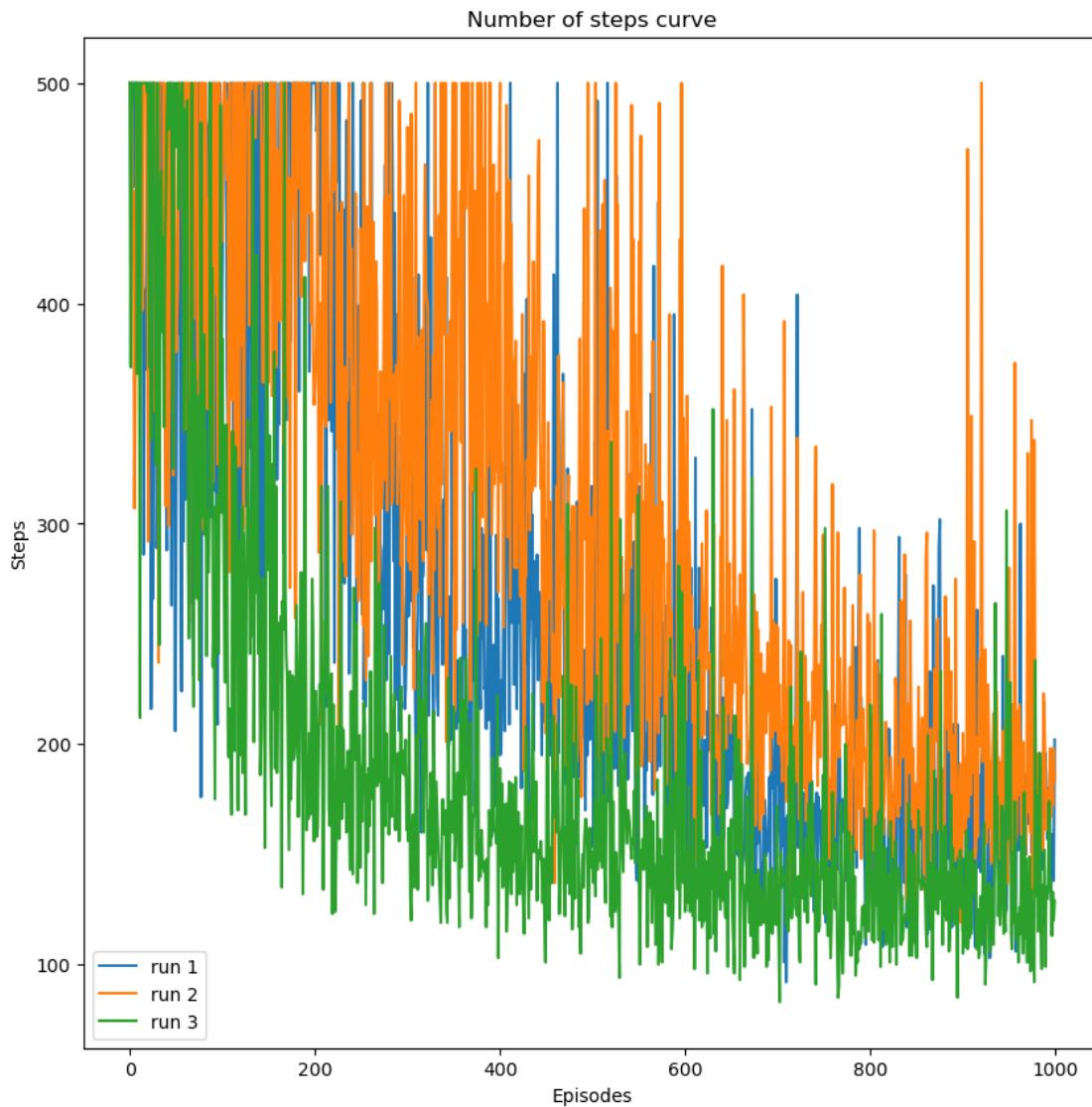
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Episode 310 Reward -251.000000 Average Reward -214.000000
Episode 320 Reward -130.000000 Average Reward -226.200000
Episode 330 Reward -250.000000 Average Reward -227.200000
Episode 340 Reward -205.000000 Average Reward -239.800000
Episode 350 Reward -238.000000 Average Reward -261.600000
Episode 360 Reward -227.000000 Average Reward -227.700000
Episode 370 Reward -295.000000 Average Reward -233.600000
Episode 380 Reward -299.000000 Average Reward -223.300000
Episode 390 Reward -189.000000 Average Reward -187.100000
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Episode 470 Reward -297.000000 Average Reward -267.900000
Episode 480 Reward -244.000000 Average Reward -256.200000
Episode 490 Reward -265.000000 Average Reward -231.700000
Episode 500 Reward -218.000000 Average Reward -232.100000
Episode 510 Reward -214.000000 Average Reward -191.300000
Episode 520 Reward -188.000000 Average Reward -199.000000
Episode 530 Reward -208.000000 Average Reward -217.200000
Episode 540 Reward -224.000000 Average Reward -194.000000
Episode 550 Reward -183.000000 Average Reward -181.000000
Episode 560 Reward -203.000000 Average Reward -185.600000
Episode 570 Reward -102.000000 Average Reward -188.600000
Episode 580 Reward -161.000000 Average Reward -178.200000
Episode 590 Reward -185.000000 Average Reward -186.100000
Episode 600 Reward -264.000000 Average Reward -182.600000
Episode 610 Reward -139.000000 Average Reward -181.200000
Episode 620 Reward -138.000000 Average Reward -163.800000
Episode 630 Reward -127.000000 Average Reward -172.700000
Episode 640 Reward -168.000000 Average Reward -191.800000
Episode 650 Reward -173.000000 Average Reward -200.500000
Episode 660 Reward -133.000000 Average Reward -150.900000
Episode 670 Reward -136.000000 Average Reward -169.700000
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Episode 720 Reward -163.000000 Average Reward -178.900000
Episode 730 Reward -156.000000 Average Reward -161.900000
Episode 740 Reward -251.000000 Average Reward -155.900000
Episode 750 Reward -190.000000 Average Reward -147.400000
Episode 760 Reward -217.000000 Average Reward -160.200000

Episode 770 Reward -143.000000 Average Reward -154.100000
Episode 780 Reward -162.000000 Average Reward -167.500000
Episode 790 Reward -186.000000 Average Reward -171.200000
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Episode 850 Reward -216.000000 Average Reward -141.800000
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Episode 930 Reward -102.000000 Average Reward -151.600000
Episode 940 Reward -109.000000 Average Reward -149.100000
Episode 950 Reward -159.000000 Average Reward -140.900000
Episode 960 Reward -106.000000 Average Reward -135.400000
Episode 970 Reward -156.000000 Average Reward -136.500000
Episode 980 Reward -94.000000 Average Reward -142.600000
Episode 990 Reward -122.000000 Average Reward -135.600000
Episode 1000 Reward -139.000000 Average Reward -147.900000
0:02:48.690752









```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [512, 512]
LR = 0.5e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'Acrobot-v1'
SOLVE_CUTOFF = -100.0
STEP = 50000

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{PATH}/{fname}'
os.mkdir(PATH+'/' + fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	-405.000000	-490.500000
20	-500.000000	-497.900000
30	-445.000000	-444.100000
40	-500.000000	-406.300000
50	-439.000000	-392.400000
60	-500.000000	-422.800000
70	-500.000000	-407.800000
80	-213.000000	-336.600000
90	-264.000000	-351.100000
100	-297.000000	-318.700000
110	-500.000000	-314.200000
120	-282.000000	-251.800000
130	-191.000000	-300.900000
140	-333.000000	-279.900000
150	-304.000000	-225.000000
160	-230.000000	-214.600000
170	-292.000000	-222.200000
180	-184.000000	-180.700000
190	-217.000000	-227.400000
200	-190.000000	-221.800000
210	-193.000000	-260.100000
220	-182.000000	-198.300000
230	-221.000000	-215.500000
240	-225.000000	-235.000000
250	-196.000000	-184.000000
260	-241.000000	-187.600000
270	-171.000000	-196.400000
280	-197.000000	-189.000000

Episode 290 Reward -152.000000 Average Reward -164.800000
Episode 300 Reward -173.000000 Average Reward -164.400000
Episode 310 Reward -205.000000 Average Reward -181.200000
Episode 320 Reward -181.000000 Average Reward -163.200000
Episode 330 Reward -158.000000 Average Reward -202.400000
Episode 340 Reward -187.000000 Average Reward -183.000000
Episode 350 Reward -161.000000 Average Reward -176.100000
Episode 360 Reward -128.000000 Average Reward -193.500000
Episode 370 Reward -166.000000 Average Reward -171.400000
Episode 380 Reward -122.000000 Average Reward -148.100000
Episode 390 Reward -347.000000 Average Reward -185.800000
Episode 400 Reward -204.000000 Average Reward -170.200000
Episode 410 Reward -132.000000 Average Reward -155.200000
Episode 420 Reward -102.000000 Average Reward -138.700000
Episode 430 Reward -123.000000 Average Reward -131.300000
Episode 440 Reward -126.000000 Average Reward -142.900000
Episode 450 Reward -146.000000 Average Reward -129.300000
Episode 460 Reward -108.000000 Average Reward -124.800000
Episode 470 Reward -97.000000 Average Reward -145.800000
Episode 480 Reward -138.000000 Average Reward -156.400000
Episode 490 Reward -97.000000 Average Reward -137.500000
Episode 500 Reward -117.000000 Average Reward -146.900000
Episode 510 Reward -126.000000 Average Reward -138.100000
Episode 520 Reward -144.000000 Average Reward -146.800000
Episode 530 Reward -148.000000 Average Reward -142.600000
Episode 540 Reward -118.000000 Average Reward -136.100000
Episode 550 Reward -130.000000 Average Reward -153.400000
Episode 560 Reward -176.000000 Average Reward -139.100000
Episode 570 Reward -162.000000 Average Reward -150.600000
Episode 580 Reward -128.000000 Average Reward -162.400000
Episode 590 Reward -155.000000 Average Reward -133.300000
Episode 600 Reward -126.000000 Average Reward -133.200000
Episode 610 Reward -126.000000 Average Reward -131.500000
Episode 620 Reward -132.000000 Average Reward -124.400000
Episode 630 Reward -188.000000 Average Reward -137.900000
Episode 640 Reward -132.000000 Average Reward -136.900000
Episode 650 Reward -146.000000 Average Reward -149.600000
Episode 660 Reward -154.000000 Average Reward -129.100000
Episode 670 Reward -103.000000 Average Reward -127.900000
Episode 680 Reward -154.000000 Average Reward -173.000000
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Episode 740 Reward -134.000000 Average Reward -136.300000
Episode 750 Reward -130.000000 Average Reward -137.400000
Episode 760 Reward -89.000000 Average Reward -120.200000

Episode 770 Reward -94.000000 Average Reward -123.400000
Episode 780 Reward -118.000000 Average Reward -122.700000
Episode 790 Reward -148.000000 Average Reward -137.800000
Episode 800 Reward -107.000000 Average Reward -134.100000
Episode 810 Reward -126.000000 Average Reward -125.100000
Episode 820 Reward -91.000000 Average Reward -137.000000
Episode 830 Reward -131.000000 Average Reward -127.300000
Episode 840 Reward -186.000000 Average Reward -126.500000
Episode 850 Reward -113.000000 Average Reward -122.700000
Episode 860 Reward -118.000000 Average Reward -119.500000
Episode 870 Reward -93.000000 Average Reward -121.100000
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Episode 890 Reward -133.000000 Average Reward -131.300000
Episode 900 Reward -118.000000 Average Reward -110.500000
Episode 910 Reward -100.000000 Average Reward -124.200000
Episode 920 Reward -118.000000 Average Reward -114.400000
Episode 930 Reward -157.000000 Average Reward -120.000000
Episode 940 Reward -93.000000 Average Reward -140.800000
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Episode 40 Reward -316.000000 Average Reward -414.700000
Episode 50 Reward -348.000000 Average Reward -441.800000
Episode 60 Reward -377.000000 Average Reward -441.000000
Episode 70 Reward -452.000000 Average Reward -490.300000
Episode 80 Reward -500.000000 Average Reward -485.700000
Episode 90 Reward -359.000000 Average Reward -432.900000
Episode 100 Reward -471.000000 Average Reward -393.600000
Episode 110 Reward -421.000000 Average Reward -379.400000
Episode 120 Reward -283.000000 Average Reward -356.700000
Episode 130 Reward -342.000000 Average Reward -381.000000
Episode 140 Reward -460.000000 Average Reward -385.500000
Episode 150 Reward -329.000000 Average Reward -359.900000
Episode 160 Reward -290.000000 Average Reward -344.200000
Episode 170 Reward -221.000000 Average Reward -273.000000
Episode 180 Reward -347.000000 Average Reward -374.900000
Episode 190 Reward -319.000000 Average Reward -356.900000
Episode 200 Reward -218.000000 Average Reward -277.800000
Episode 210 Reward -249.000000 Average Reward -268.800000
Episode 220 Reward -310.000000 Average Reward -279.000000
Episode 230 Reward -249.000000 Average Reward -241.300000

Episode 240 Reward -184.000000 Average Reward -264.800000
Episode 250 Reward -232.000000 Average Reward -212.300000
Episode 260 Reward -221.000000 Average Reward -273.300000
Episode 270 Reward -190.000000 Average Reward -226.100000
Episode 280 Reward -217.000000 Average Reward -217.200000
Episode 290 Reward -164.000000 Average Reward -220.800000
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Episode 310 Reward -230.000000 Average Reward -184.200000
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Episode 940 Reward -142.000000 Average Reward -155.200000
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Episode 970 Reward -182.000000 Average Reward -146.200000
Episode 980 Reward -169.000000 Average Reward -153.600000
Episode 990 Reward -156.000000 Average Reward -132.500000
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Episode 50 Reward -320.000000 Average Reward -315.600000
Episode 60 Reward -306.000000 Average Reward -316.300000
Episode 70 Reward -349.000000 Average Reward -329.200000
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Episode 670 Reward -137.000000 Average Reward -119.000000
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Episode 880 Reward -141.000000 Average Reward -122.500000
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Episode 940 Reward -116.000000 Average Reward -125.100000

Episode 950 Reward -113.000000 Average Reward -109.500000
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 Episode 290 Reward -500.000000 Average Reward -495.400000
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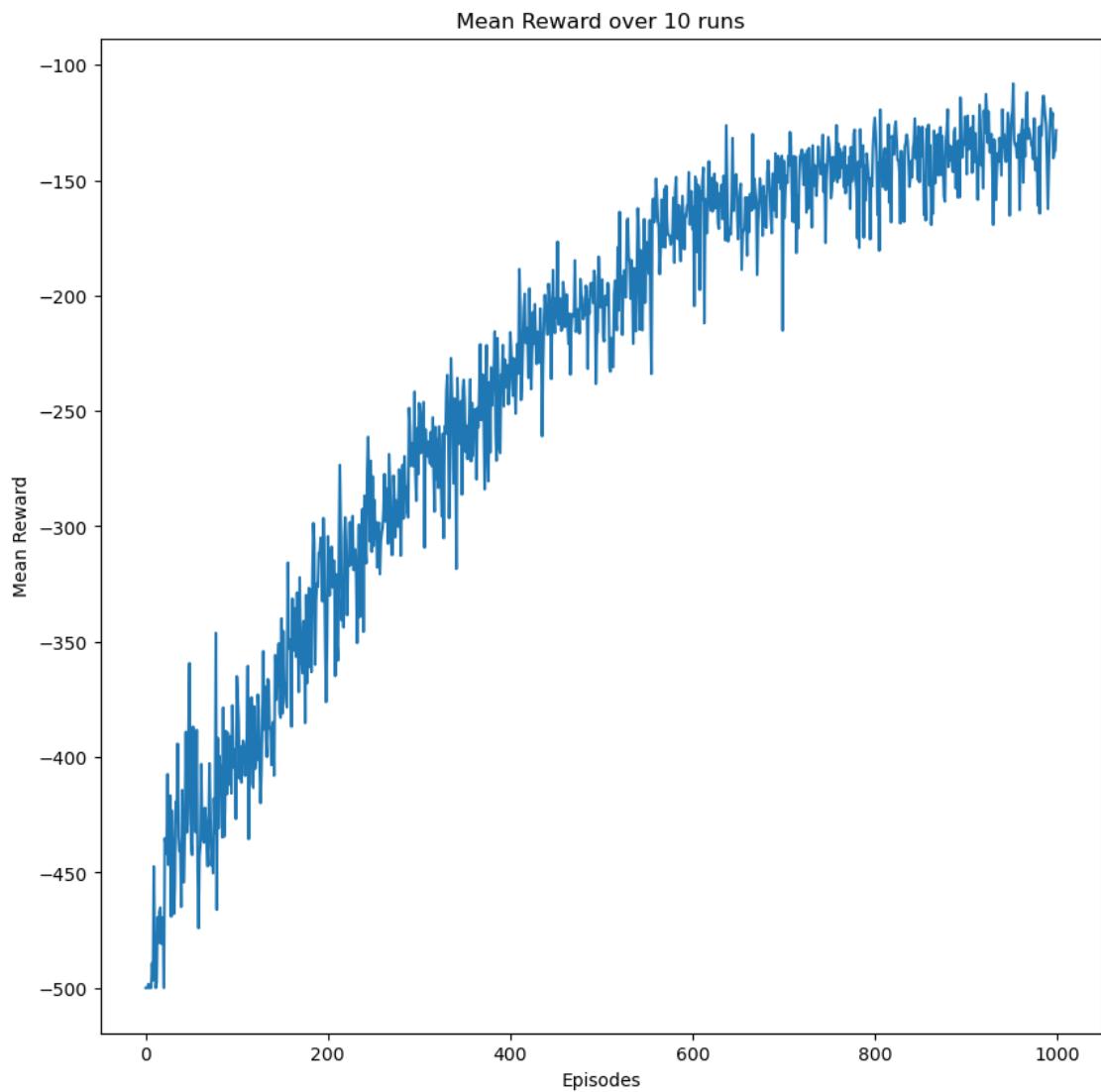
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Episode 470 Reward -247.000000 Average Reward -263.900000
Episode 480 Reward -241.000000 Average Reward -230.600000
Episode 490 Reward -286.000000 Average Reward -263.400000
Episode 500 Reward -187.000000 Average Reward -194.700000
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Episode 520 Reward -145.000000 Average Reward -228.300000
Episode 530 Reward -177.000000 Average Reward -228.700000
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Episode 580 Reward -181.000000 Average Reward -186.900000
Episode 590 Reward -205.000000 Average Reward -178.700000
Episode 600 Reward -172.000000 Average Reward -206.500000
Episode 610 Reward -201.000000 Average Reward -198.400000
Episode 620 Reward -156.000000 Average Reward -181.200000
Episode 630 Reward -148.000000 Average Reward -175.400000
Episode 640 Reward -214.000000 Average Reward -215.100000
Episode 650 Reward -228.000000 Average Reward -158.600000
Episode 660 Reward -126.000000 Average Reward -157.500000
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Episode 680 Reward -179.000000 Average Reward -176.000000
Episode 690 Reward -164.000000 Average Reward -164.300000
Episode 700 Reward -157.000000 Average Reward -140.800000
Episode 710 Reward -159.000000 Average Reward -167.500000
Episode 720 Reward -171.000000 Average Reward -161.800000
Episode 730 Reward -195.000000 Average Reward -148.500000
Episode 740 Reward -167.000000 Average Reward -149.600000
Episode 750 Reward -142.000000 Average Reward -162.600000
Episode 760 Reward -139.000000 Average Reward -153.700000
Episode 770 Reward -160.000000 Average Reward -156.400000
Episode 780 Reward -133.000000 Average Reward -145.100000
Episode 790 Reward -131.000000 Average Reward -160.100000
Episode 800 Reward -144.000000 Average Reward -147.500000
Episode 810 Reward -216.000000 Average Reward -166.100000
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Episode 840 Reward -199.000000 Average Reward -196.700000

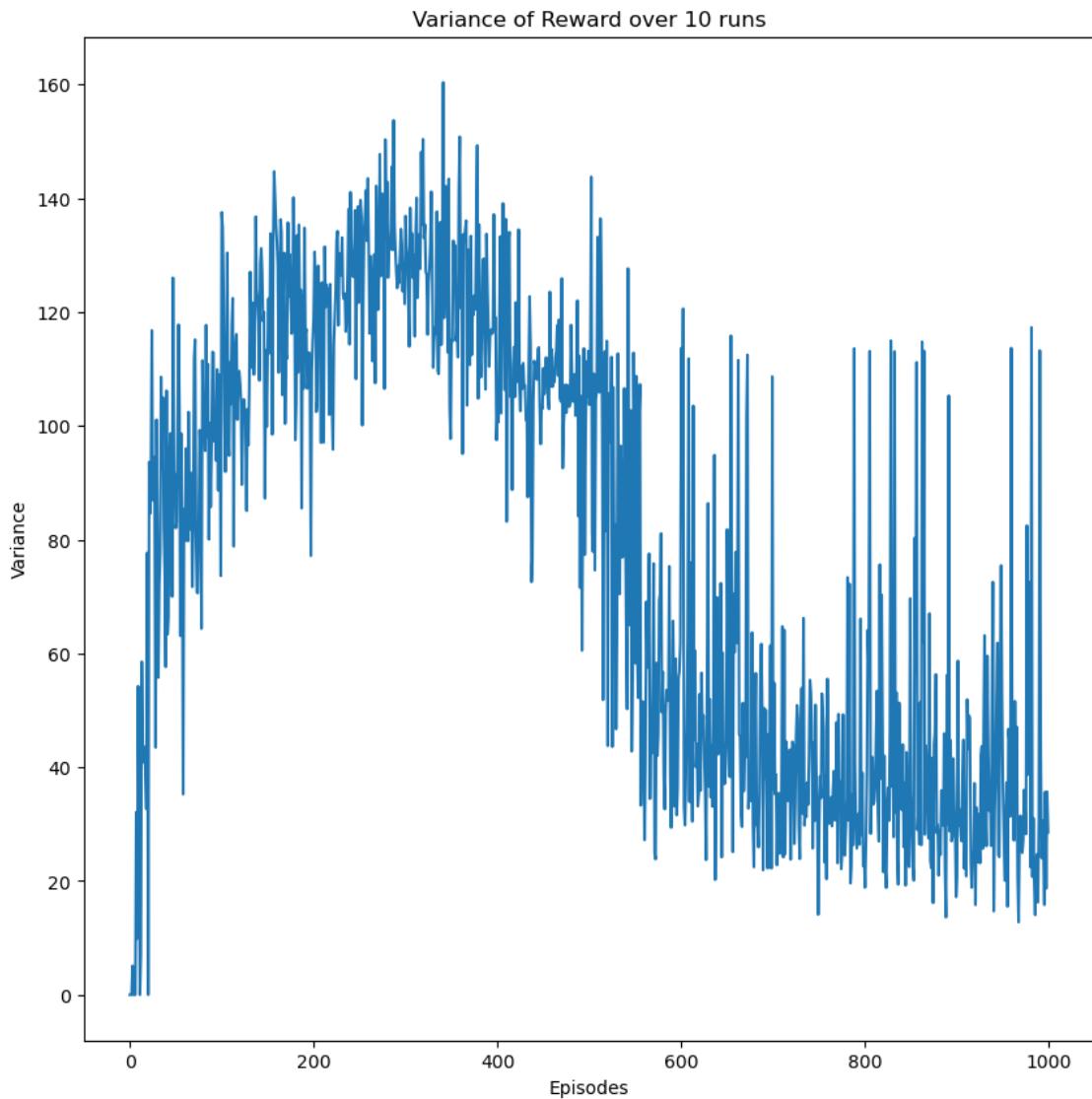
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 Episode 890 Reward -305.000000 Average Reward -157.700000
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 Episode 930 Reward -142.000000 Average Reward -144.400000
 Episode 940 Reward -192.000000 Average Reward -152.000000
 Episode 950 Reward -109.000000 Average Reward -179.400000
 Episode 960 Reward -134.000000 Average Reward -122.600000
 Episode 970 Reward -110.000000 Average Reward -135.200000
 Episode 980 Reward -144.000000 Average Reward -140.100000
 Episode 990 Reward -169.000000 Average Reward -136.900000
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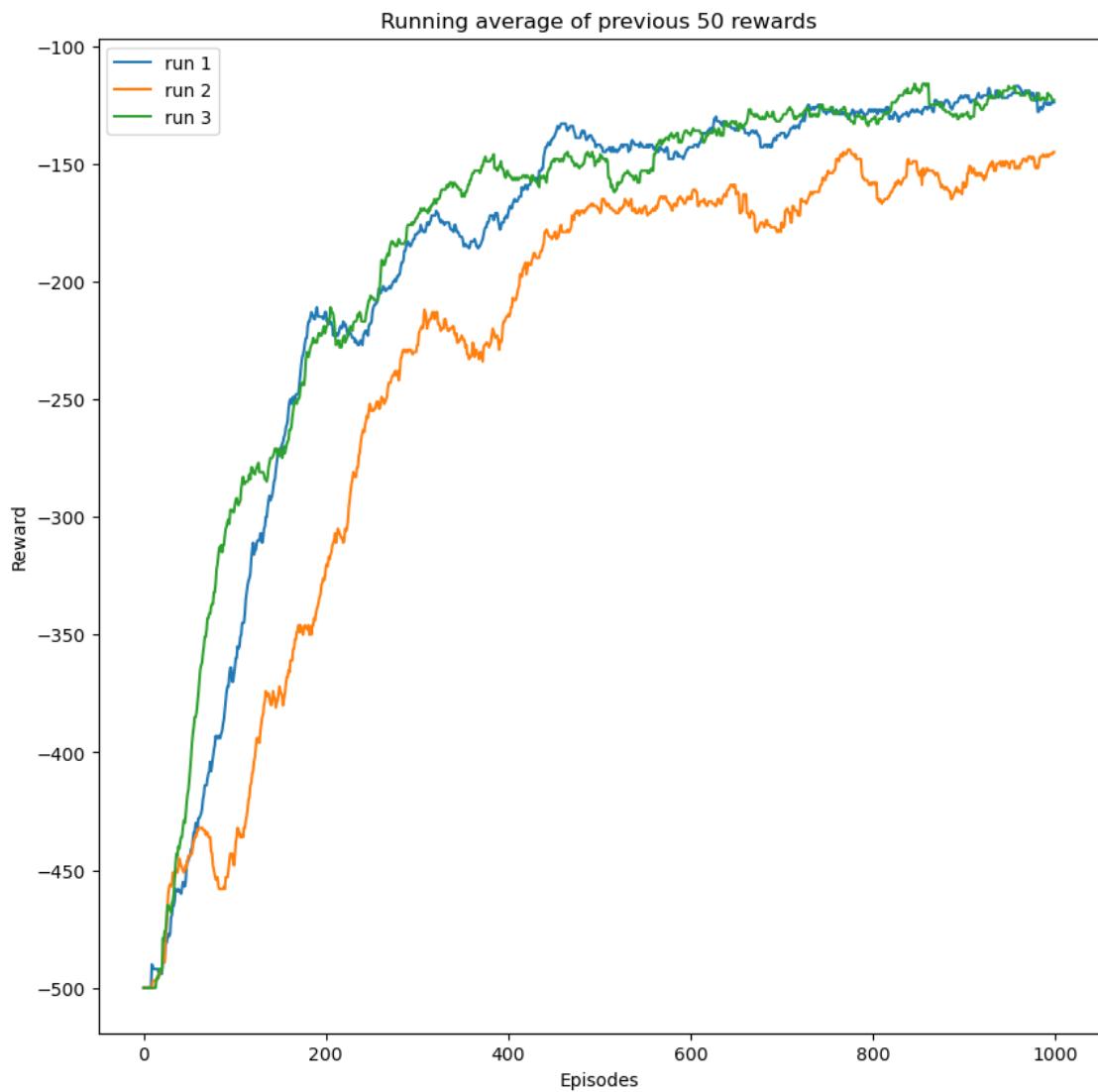
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 Episode 50 Reward -500.000000 Average Reward -457.400000
 Episode 60 Reward -500.000000 Average Reward -411.600000
 Episode 70 Reward -500.000000 Average Reward -472.700000
 Episode 80 Reward -297.000000 Average Reward -452.500000
 Episode 90 Reward -500.000000 Average Reward -477.400000
 Episode 100 Reward -369.000000 Average Reward -442.300000
 Episode 110 Reward -500.000000 Average Reward -454.500000
 Episode 120 Reward -500.000000 Average Reward -483.000000
 Episode 130 Reward -389.000000 Average Reward -432.700000
 Episode 140 Reward -500.000000 Average Reward -482.400000
 Episode 150 Reward -334.000000 Average Reward -439.600000
 Episode 160 Reward -500.000000 Average Reward -437.700000
 Episode 170 Reward -272.000000 Average Reward -405.200000
 Episode 180 Reward -264.000000 Average Reward -380.500000
 Episode 190 Reward -252.000000 Average Reward -325.200000
 Episode 200 Reward -500.000000 Average Reward -339.500000
 Episode 210 Reward -443.000000 Average Reward -300.700000
 Episode 220 Reward -305.000000 Average Reward -306.800000
 Episode 230 Reward -267.000000 Average Reward -279.000000
 Episode 240 Reward -229.000000 Average Reward -266.300000
 Episode 250 Reward -241.000000 Average Reward -266.500000
 Episode 260 Reward -369.000000 Average Reward -288.700000
 Episode 270 Reward -216.000000 Average Reward -268.700000
 Episode 280 Reward -313.000000 Average Reward -242.300000
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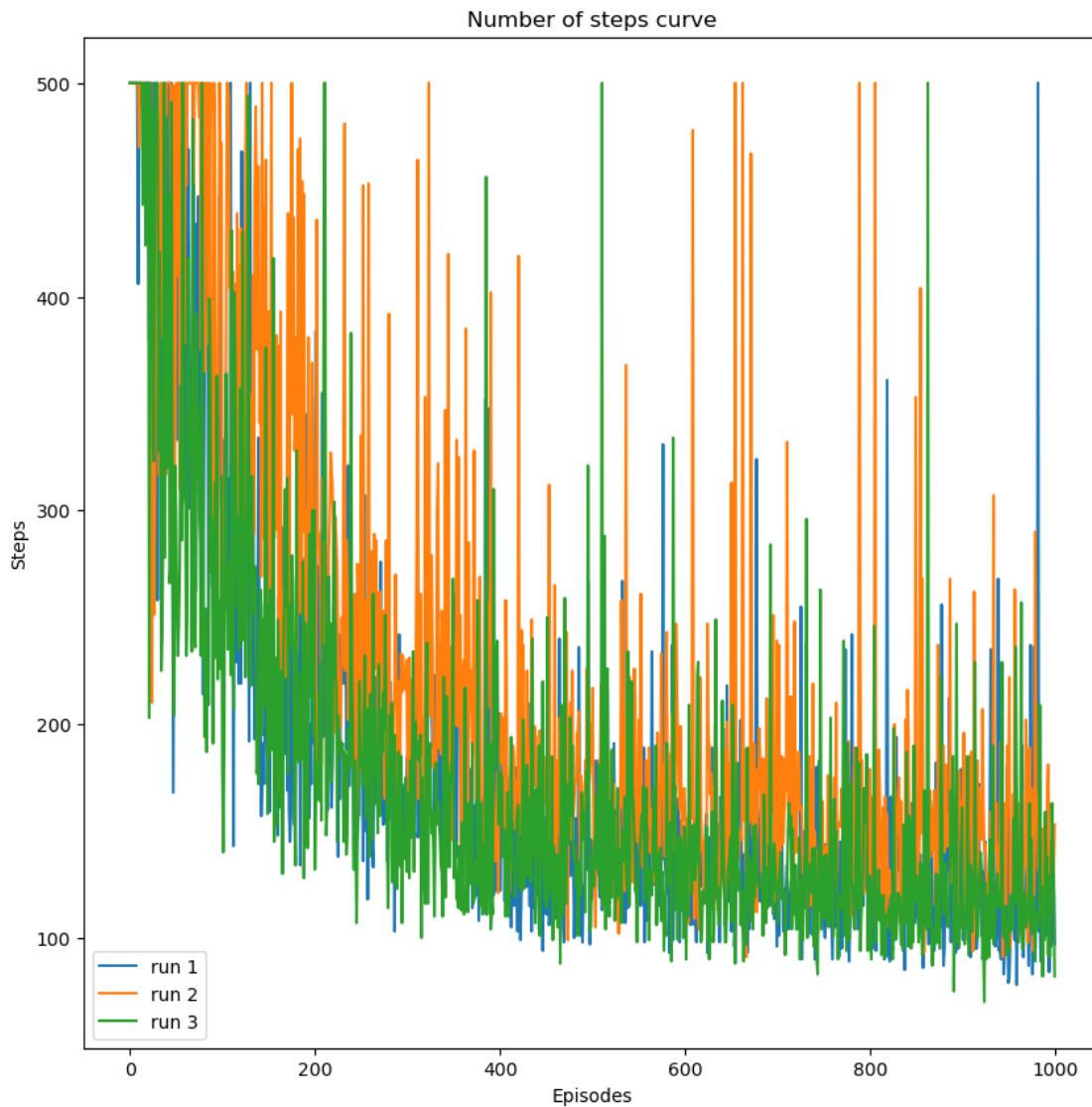
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Episode 360 Reward -147.000000 Average Reward -164.200000
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Episode 380 Reward -239.000000 Average Reward -170.300000
Episode 390 Reward -125.000000 Average Reward -161.900000
Episode 400 Reward -176.000000 Average Reward -167.400000
Episode 410 Reward -209.000000 Average Reward -164.300000
Episode 420 Reward -168.000000 Average Reward -149.200000
Episode 430 Reward -119.000000 Average Reward -147.900000
Episode 440 Reward -200.000000 Average Reward -176.300000
Episode 450 Reward -216.000000 Average Reward -176.300000
Episode 460 Reward -102.000000 Average Reward -147.700000
Episode 470 Reward -166.000000 Average Reward -138.400000
Episode 480 Reward -118.000000 Average Reward -149.800000
Episode 490 Reward -120.000000 Average Reward -148.400000
Episode 500 Reward -110.000000 Average Reward -173.000000
Episode 510 Reward -192.000000 Average Reward -147.000000
Episode 520 Reward -132.000000 Average Reward -168.100000
Episode 530 Reward -129.000000 Average Reward -144.200000
Episode 540 Reward -149.000000 Average Reward -172.600000
Episode 550 Reward -190.000000 Average Reward -133.500000
Episode 560 Reward -119.000000 Average Reward -146.200000
Episode 570 Reward -106.000000 Average Reward -137.000000
Episode 580 Reward -109.000000 Average Reward -154.700000
Episode 590 Reward -120.000000 Average Reward -155.800000
Episode 600 Reward -95.000000 Average Reward -128.300000
Episode 610 Reward -112.000000 Average Reward -126.400000
Episode 620 Reward -148.000000 Average Reward -120.000000
Episode 630 Reward -159.000000 Average Reward -136.900000
Episode 640 Reward -156.000000 Average Reward -122.800000
Episode 650 Reward -142.000000 Average Reward -146.200000
Episode 660 Reward -134.000000 Average Reward -142.300000
Episode 670 Reward -153.000000 Average Reward -147.900000
Episode 680 Reward -211.000000 Average Reward -142.200000
Episode 690 Reward -184.000000 Average Reward -137.900000
Episode 700 Reward -235.000000 Average Reward -126.900000
Episode 710 Reward -105.000000 Average Reward -128.500000
Episode 720 Reward -147.000000 Average Reward -134.400000
Episode 730 Reward -157.000000 Average Reward -132.600000
Episode 740 Reward -131.000000 Average Reward -130.500000
Episode 750 Reward -111.000000 Average Reward -125.300000
Episode 760 Reward -126.000000 Average Reward -141.800000
Episode 770 Reward -93.000000 Average Reward -121.500000
Episode 780 Reward -166.000000 Average Reward -136.200000
Episode 790 Reward -144.000000 Average Reward -132.600000

Episode 800 Reward -105.000000 Average Reward -134.000000
Episode 810 Reward -120.000000 Average Reward -122.300000
Episode 820 Reward -92.000000 Average Reward -128.700000
Episode 830 Reward -93.000000 Average Reward -125.500000
Episode 840 Reward -120.000000 Average Reward -122.400000
Episode 850 Reward -114.000000 Average Reward -121.700000
Episode 860 Reward -101.000000 Average Reward -121.500000
Episode 870 Reward -97.000000 Average Reward -103.600000
Episode 880 Reward -114.000000 Average Reward -121.300000
Episode 890 Reward -110.000000 Average Reward -121.800000
Episode 900 Reward -91.000000 Average Reward -115.200000
Episode 910 Reward -115.000000 Average Reward -118.200000
Episode 920 Reward -251.000000 Average Reward -166.500000
Episode 930 Reward -105.000000 Average Reward -125.600000
Episode 940 Reward -109.000000 Average Reward -142.800000
Episode 950 Reward -164.000000 Average Reward -115.900000
Episode 960 Reward -101.000000 Average Reward -116.700000
Episode 970 Reward -92.000000 Average Reward -116.800000
Episode 980 Reward -109.000000 Average Reward -112.000000
Episode 990 Reward -111.000000 Average Reward -115.800000
Episode 1000 Reward -113.000000 Average Reward -109.100000
0:03:18.249810









```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [512, 512]
LR = 1e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'Acrobot-v1'
SOLVE_CUTOFF = -100.0
STEP = 50000

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{hs}-{lr}-{env}-{numep}-{nstep}-{STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	-438.000000	-447.600000
20	-500.000000	-500.000000
30	-500.000000	-485.700000
40	-500.000000	-448.100000
50	-428.000000	-420.300000
60	-500.000000	-393.400000
70	-281.000000	-445.800000
80	-455.000000	-379.200000
90	-241.000000	-367.400000
100	-269.000000	-243.100000
110	-198.000000	-240.100000
120	-250.000000	-205.500000
130	-260.000000	-207.400000
140	-140.000000	-195.900000
150	-166.000000	-196.800000
160	-264.000000	-204.900000
170	-187.000000	-191.800000
180	-111.000000	-161.100000
190	-194.000000	-178.100000
200	-145.000000	-160.300000
210	-175.000000	-174.000000
220	-157.000000	-170.300000
230	-168.000000	-165.800000
240	-95.000000	-157.600000
250	-102.000000	-135.700000
260	-124.000000	-144.000000
270	-121.000000	-170.100000
280	-171.000000	-148.800000

Episode 290 Reward -172.000000 Average Reward -149.100000
Episode 300 Reward -142.000000 Average Reward -159.200000
Episode 310 Reward -138.000000 Average Reward -144.800000
Episode 320 Reward -109.000000 Average Reward -150.500000
Episode 330 Reward -141.000000 Average Reward -128.600000
Episode 340 Reward -121.000000 Average Reward -146.200000
Episode 350 Reward -138.000000 Average Reward -132.000000
Episode 360 Reward -149.000000 Average Reward -130.400000
Episode 370 Reward -115.000000 Average Reward -129.500000
Episode 380 Reward -102.000000 Average Reward -131.100000
Episode 390 Reward -122.000000 Average Reward -152.200000
Episode 400 Reward -117.000000 Average Reward -121.700000
Episode 410 Reward -219.000000 Average Reward -143.600000
Episode 420 Reward -118.000000 Average Reward -108.600000
Episode 430 Reward -104.000000 Average Reward -115.900000
Episode 440 Reward -151.000000 Average Reward -133.600000
Episode 450 Reward -144.000000 Average Reward -121.500000
Episode 460 Reward -138.000000 Average Reward -130.100000
Episode 470 Reward -88.000000 Average Reward -114.300000
Episode 480 Reward -103.000000 Average Reward -130.800000
Episode 490 Reward -106.000000 Average Reward -130.900000
Episode 500 Reward -109.000000 Average Reward -119.500000
Episode 510 Reward -147.000000 Average Reward -128.000000
Episode 520 Reward -168.000000 Average Reward -120.500000
Episode 530 Reward -99.000000 Average Reward -117.300000
Episode 540 Reward -109.000000 Average Reward -117.000000
Episode 550 Reward -97.000000 Average Reward -124.800000
Episode 560 Reward -500.000000 Average Reward -160.000000
Episode 570 Reward -95.000000 Average Reward -124.500000
Episode 580 Reward -135.000000 Average Reward -112.800000
Episode 590 Reward -127.000000 Average Reward -119.200000
Episode 600 Reward -102.000000 Average Reward -103.600000
Episode 610 Reward -90.000000 Average Reward -110.800000
Episode 620 Reward -145.000000 Average Reward -120.700000
Episode 630 Reward -104.000000 Average Reward -111.100000
Episode 640 Reward -106.000000 Average Reward -118.200000
Episode 650 Reward -101.000000 Average Reward -110.800000
Episode 660 Reward -106.000000 Average Reward -157.800000
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Episode 680 Reward -130.000000 Average Reward -110.700000
Episode 690 Reward -90.000000 Average Reward -130.300000
Episode 700 Reward -90.000000 Average Reward -114.800000
Episode 710 Reward -99.000000 Average Reward -112.000000
Episode 720 Reward -101.000000 Average Reward -95.500000
Episode 730 Reward -89.000000 Average Reward -105.800000
Episode 740 Reward -134.000000 Average Reward -108.000000
Episode 750 Reward -184.000000 Average Reward -108.700000
Episode 760 Reward -120.000000 Average Reward -115.600000

Episode 770 Reward -112.000000 Average Reward -106.400000
Episode 780 Reward -88.000000 Average Reward -102.900000
Episode 790 Reward -103.000000 Average Reward -104.900000
Episode 800 Reward -106.000000 Average Reward -97.200000
Episode 810 Reward -105.000000 Average Reward -114.000000
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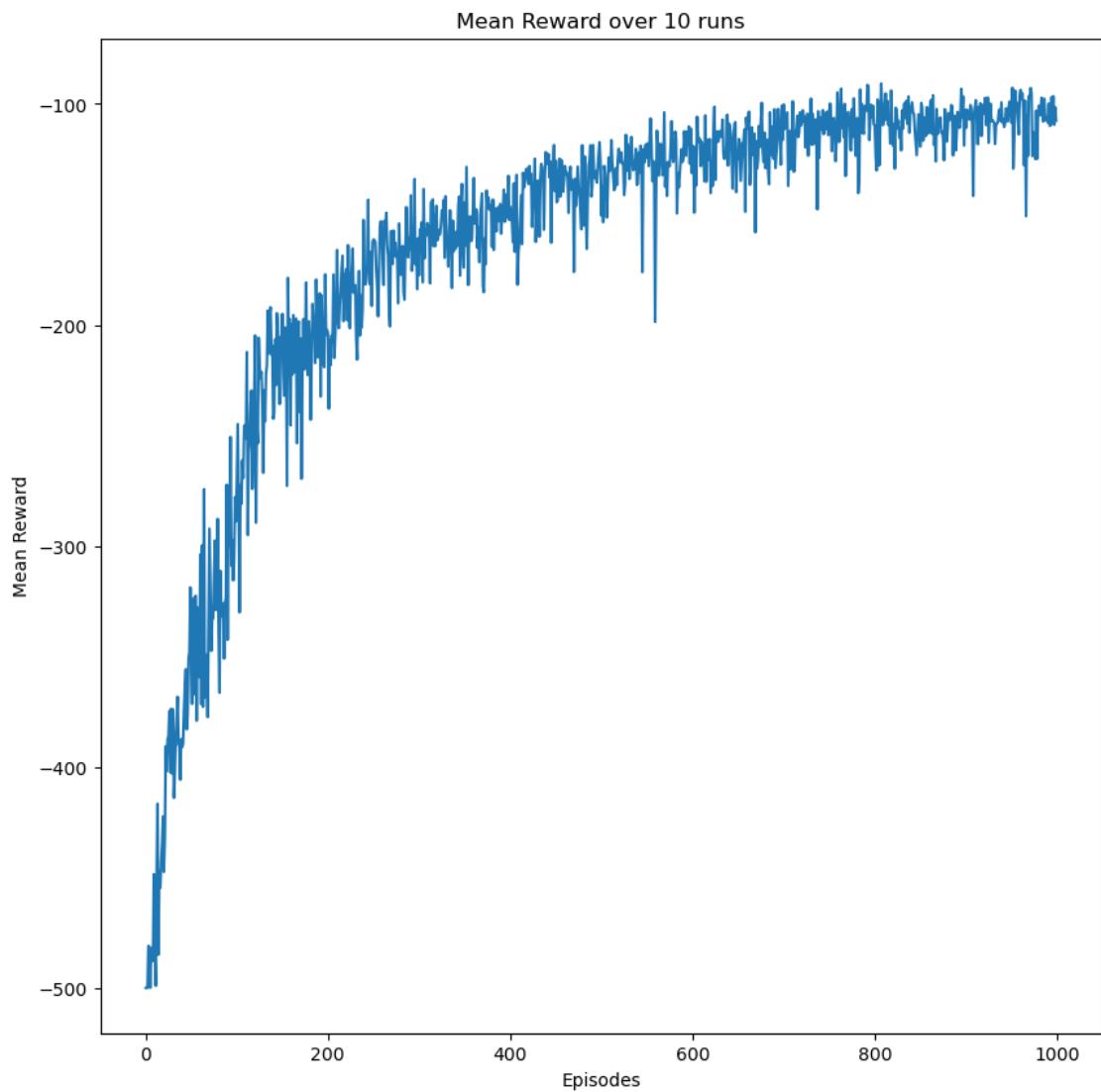
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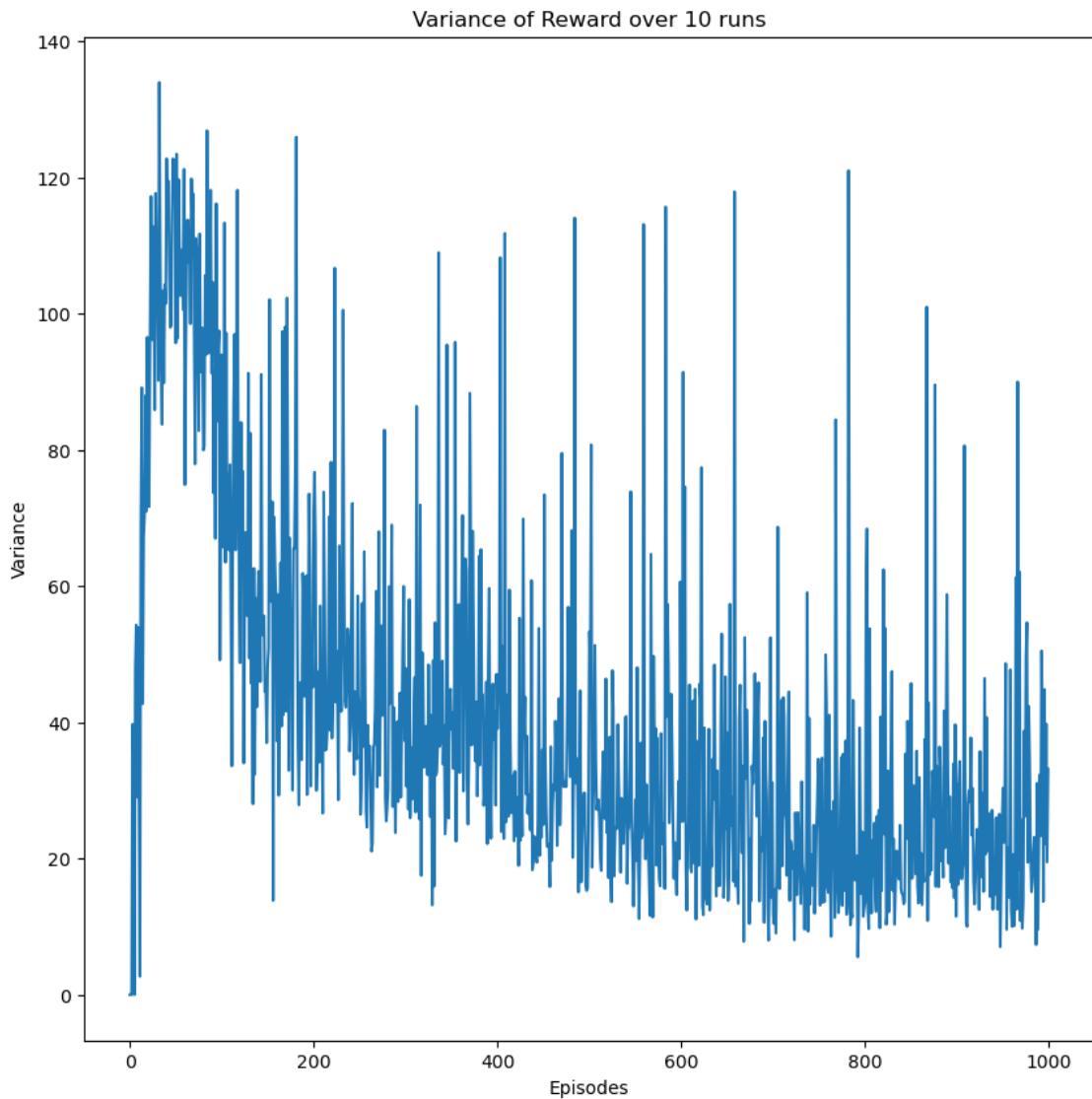
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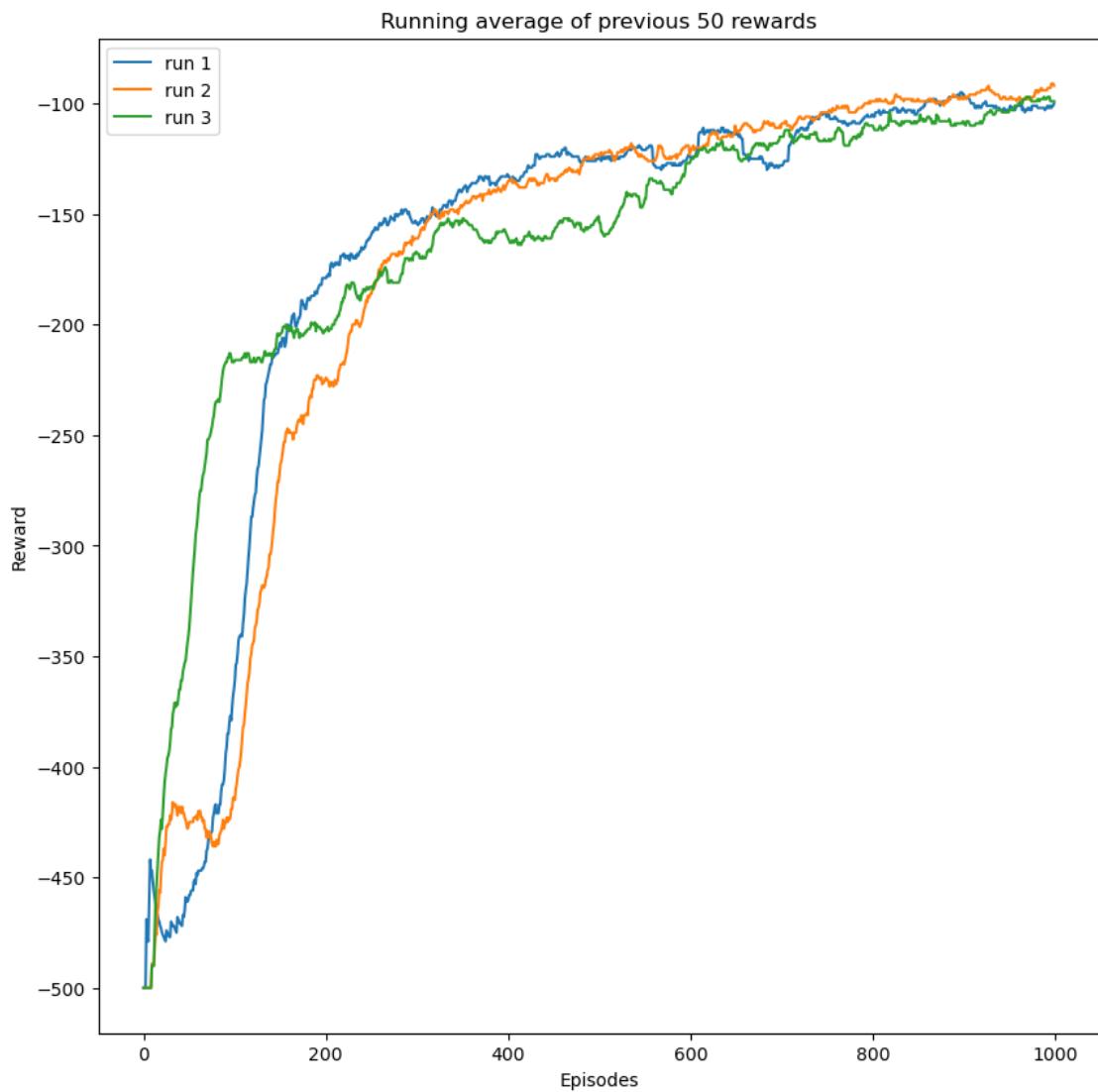
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 Episode 260 Reward -136.000000 Average Reward -201.800000
 Episode 270 Reward -212.000000 Average Reward -203.200000
 Episode 280 Reward -230.000000 Average Reward -230.400000
 Episode 290 Reward -204.000000 Average Reward -253.100000
 Episode 300 Reward -214.000000 Average Reward -234.200000
 Episode 310 Reward -252.000000 Average Reward -235.900000

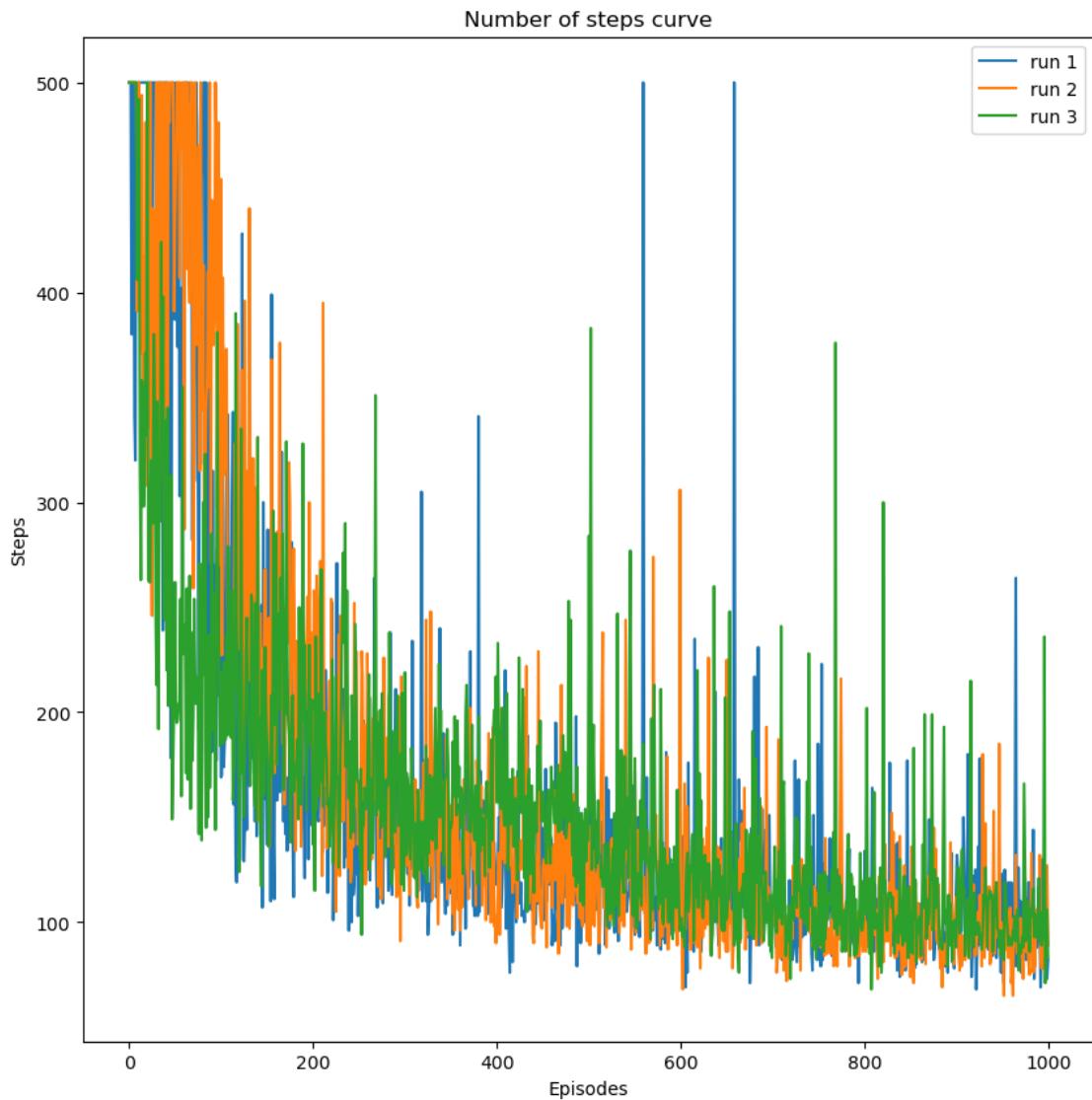
Episode 320 Reward -192.000000 Average Reward -205.700000
Episode 330 Reward -152.000000 Average Reward -203.000000
Episode 340 Reward -165.000000 Average Reward -201.200000
Episode 350 Reward -254.000000 Average Reward -236.400000
Episode 360 Reward -184.000000 Average Reward -234.300000
Episode 370 Reward -236.000000 Average Reward -273.600000
Episode 380 Reward -234.000000 Average Reward -266.700000
Episode 390 Reward -183.000000 Average Reward -218.400000
Episode 400 Reward -232.000000 Average Reward -224.600000
Episode 410 Reward -197.000000 Average Reward -229.000000
Episode 420 Reward -143.000000 Average Reward -186.700000
Episode 430 Reward -221.000000 Average Reward -181.400000
Episode 440 Reward -129.000000 Average Reward -154.900000
Episode 450 Reward -138.000000 Average Reward -142.900000
Episode 460 Reward -156.000000 Average Reward -180.800000
Episode 470 Reward -158.000000 Average Reward -167.100000
Episode 480 Reward -169.000000 Average Reward -205.600000
Episode 490 Reward -222.000000 Average Reward -200.700000
Episode 500 Reward -123.000000 Average Reward -149.600000
Episode 510 Reward -173.000000 Average Reward -184.700000
Episode 520 Reward -126.000000 Average Reward -140.600000
Episode 530 Reward -178.000000 Average Reward -163.800000
Episode 540 Reward -139.000000 Average Reward -143.700000
Episode 550 Reward -88.000000 Average Reward -125.800000
Episode 560 Reward -108.000000 Average Reward -129.500000
Episode 570 Reward -115.000000 Average Reward -121.700000
Episode 580 Reward -149.000000 Average Reward -115.900000
Episode 590 Reward -96.000000 Average Reward -119.700000
Episode 600 Reward -152.000000 Average Reward -123.200000
Episode 610 Reward -140.000000 Average Reward -131.800000
Episode 620 Reward -102.000000 Average Reward -123.600000
Episode 630 Reward -110.000000 Average Reward -147.000000
Episode 640 Reward -113.000000 Average Reward -110.900000
Episode 650 Reward -135.000000 Average Reward -136.500000
Episode 660 Reward -140.000000 Average Reward -132.100000
Episode 670 Reward -218.000000 Average Reward -129.300000
Episode 680 Reward -132.000000 Average Reward -105.800000
Episode 690 Reward -117.000000 Average Reward -133.000000
Episode 700 Reward -104.000000 Average Reward -105.200000
Episode 710 Reward -132.000000 Average Reward -115.700000
Episode 720 Reward -132.000000 Average Reward -138.400000
Episode 730 Reward -112.000000 Average Reward -105.800000
Episode 740 Reward -84.000000 Average Reward -110.000000
Episode 750 Reward -80.000000 Average Reward -103.200000
Episode 760 Reward -92.000000 Average Reward -106.700000
Episode 770 Reward -223.000000 Average Reward -120.100000
Episode 780 Reward -185.000000 Average Reward -113.300000
Episode 790 Reward -102.000000 Average Reward -104.700000

Episode 800 Reward -129.000000 Average Reward -112.500000
Episode 810 Reward -109.000000 Average Reward -123.700000
Episode 820 Reward -109.000000 Average Reward -118.100000
Episode 830 Reward -252.000000 Average Reward -126.600000
Episode 840 Reward -111.000000 Average Reward -103.700000
Episode 850 Reward -142.000000 Average Reward -113.300000
Episode 860 Reward -115.000000 Average Reward -110.000000
Episode 870 Reward -87.000000 Average Reward -101.500000
Episode 880 Reward -135.000000 Average Reward -112.100000
Episode 890 Reward -93.000000 Average Reward -98.900000
Episode 900 Reward -116.000000 Average Reward -106.900000
Episode 910 Reward -125.000000 Average Reward -97.900000
Episode 920 Reward -107.000000 Average Reward -109.400000
Episode 930 Reward -143.000000 Average Reward -115.000000
Episode 940 Reward -106.000000 Average Reward -108.200000
Episode 950 Reward -162.000000 Average Reward -113.700000
Episode 960 Reward -92.000000 Average Reward -104.700000
Episode 970 Reward -95.000000 Average Reward -113.700000
Episode 980 Reward -107.000000 Average Reward -113.900000
Episode 990 Reward -87.000000 Average Reward -102.900000
Episode 1000 Reward -91.000000 Average Reward -97.000000
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```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [512, 512]
LR = 2e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'Acrobot-v1'
SOLVE_CUTOFF = -100.0
STEP = 50000

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{hs}-{lr}-{env}-{numep}-{nstep}-{STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	-382.000000	-410.300000
20	-233.000000	-256.200000
30	-243.000000	-216.900000
40	-133.000000	-167.200000
50	-145.000000	-157.300000
60	-174.000000	-175.000000
70	-195.000000	-156.100000
80	-164.000000	-174.700000
90	-315.000000	-243.600000
100	-354.000000	-290.400000
110	-500.000000	-396.600000
120	-388.000000	-438.300000
130	-338.000000	-438.600000
140	-291.000000	-317.300000
150	-191.000000	-258.100000
160	-186.000000	-209.000000
170	-217.000000	-193.400000
180	-165.000000	-172.000000
190	-136.000000	-180.000000
200	-159.000000	-136.800000
210	-117.000000	-127.000000
220	-139.000000	-140.000000
230	-139.000000	-122.000000
240	-101.000000	-110.200000
250	-100.000000	-109.300000
260	-117.000000	-153.700000
270	-165.000000	-121.100000
280	-122.000000	-120.300000

Episode 290 Reward -369.000000 Average Reward -151.000000
Episode 300 Reward -118.000000 Average Reward -132.800000
Episode 310 Reward -131.000000 Average Reward -112.600000
Episode 320 Reward -176.000000 Average Reward -108.700000
Episode 330 Reward -100.000000 Average Reward -96.300000
Episode 340 Reward -99.000000 Average Reward -120.200000
Episode 350 Reward -93.000000 Average Reward -115.000000
Episode 360 Reward -124.000000 Average Reward -112.800000
Episode 370 Reward -115.000000 Average Reward -110.400000
Episode 380 Reward -95.000000 Average Reward -107.900000
Episode 390 Reward -113.000000 Average Reward -110.700000
Episode 400 Reward -112.000000 Average Reward -93.800000
Episode 410 Reward -88.000000 Average Reward -100.500000
Episode 420 Reward -113.000000 Average Reward -113.400000
Episode 430 Reward -137.000000 Average Reward -117.400000
Episode 440 Reward -104.000000 Average Reward -107.900000
Episode 450 Reward -87.000000 Average Reward -89.500000
Episode 460 Reward -106.000000 Average Reward -99.800000
Episode 470 Reward -100.000000 Average Reward -100.200000
Episode 480 Reward -95.000000 Average Reward -99.600000
Episode 490 Reward -96.000000 Average Reward -90.500000
Episode 500 Reward -91.000000 Average Reward -87.800000
Episode 510 Reward -65.000000 Average Reward -107.500000
Episode 520 Reward -87.000000 Average Reward -86.700000
Episode 530 Reward -81.000000 Average Reward -101.200000
Episode 540 Reward -85.000000 Average Reward -102.500000
Episode 550 Reward -75.000000 Average Reward -83.600000
Episode 560 Reward -98.000000 Average Reward -107.100000
Episode 570 Reward -88.000000 Average Reward -110.900000
Episode 580 Reward -77.000000 Average Reward -105.100000
Episode 590 Reward -92.000000 Average Reward -81.200000
Episode 600 Reward -88.000000 Average Reward -90.000000
Episode 610 Reward -79.000000 Average Reward -95.700000
Episode 620 Reward -96.000000 Average Reward -84.900000
Episode 630 Reward -79.000000 Average Reward -86.200000
Episode 640 Reward -100.000000 Average Reward -95.100000
Episode 650 Reward -68.000000 Average Reward -85.400000
Episode 660 Reward -102.000000 Average Reward -86.600000
Episode 670 Reward -83.000000 Average Reward -90.200000
Episode 680 Reward -89.000000 Average Reward -94.900000
Episode 690 Reward -91.000000 Average Reward -85.600000
Episode 700 Reward -157.000000 Average Reward -102.900000
Episode 710 Reward -96.000000 Average Reward -108.000000
Episode 720 Reward -65.000000 Average Reward -82.200000
Episode 730 Reward -74.000000 Average Reward -89.200000
Episode 740 Reward -81.000000 Average Reward -86.700000
Episode 750 Reward -72.000000 Average Reward -92.300000
Episode 760 Reward -74.000000 Average Reward -87.700000

Episode 770 Reward -106.000000 Average Reward -93.600000
Episode 780 Reward -83.000000 Average Reward -87.100000
Episode 790 Reward -93.000000 Average Reward -100.500000
Episode 800 Reward -98.000000 Average Reward -95.500000
Episode 810 Reward -101.000000 Average Reward -85.200000
Episode 820 Reward -76.000000 Average Reward -99.900000
Episode 830 Reward -76.000000 Average Reward -89.300000
Episode 840 Reward -100.000000 Average Reward -89.400000
Episode 850 Reward -94.000000 Average Reward -89.700000
Episode 860 Reward -86.000000 Average Reward -88.200000
Episode 870 Reward -76.000000 Average Reward -97.200000
Episode 880 Reward -92.000000 Average Reward -97.800000
Episode 890 Reward -64.000000 Average Reward -77.900000
Episode 900 Reward -85.000000 Average Reward -87.900000
Episode 910 Reward -88.000000 Average Reward -94.300000
Episode 920 Reward -64.000000 Average Reward -86.700000
Episode 930 Reward -90.000000 Average Reward -85.000000
Episode 940 Reward -105.000000 Average Reward -80.500000
Episode 950 Reward -94.000000 Average Reward -92.100000
Episode 960 Reward -118.000000 Average Reward -99.300000
Episode 970 Reward -74.000000 Average Reward -108.100000
Episode 980 Reward -187.000000 Average Reward -147.100000
Episode 990 Reward -317.000000 Average Reward -188.600000
Episode 1000 Reward -111.000000 Average Reward -278.700000

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Episode 10 Reward -262.000000 Average Reward -392.100000
Episode 20 Reward -133.000000 Average Reward -226.300000
Episode 30 Reward -243.000000 Average Reward -212.800000
Episode 40 Reward -231.000000 Average Reward -232.900000
Episode 50 Reward -204.000000 Average Reward -199.700000
Episode 60 Reward -248.000000 Average Reward -244.400000
Episode 70 Reward -156.000000 Average Reward -172.200000
Episode 80 Reward -147.000000 Average Reward -149.900000
Episode 90 Reward -170.000000 Average Reward -168.300000
Episode 100 Reward -162.000000 Average Reward -133.400000
Episode 110 Reward -149.000000 Average Reward -158.100000
Episode 120 Reward -109.000000 Average Reward -127.600000
Episode 130 Reward -124.000000 Average Reward -140.400000
Episode 140 Reward -120.000000 Average Reward -132.700000
Episode 150 Reward -127.000000 Average Reward -136.200000
Episode 160 Reward -122.000000 Average Reward -126.200000
Episode 170 Reward -199.000000 Average Reward -143.900000
Episode 180 Reward -107.000000 Average Reward -123.400000
Episode 190 Reward -120.000000 Average Reward -133.400000
Episode 200 Reward -130.000000 Average Reward -132.300000
Episode 210 Reward -121.000000 Average Reward -122.600000
Episode 220 Reward -106.000000 Average Reward -131.100000
Episode 230 Reward -110.000000 Average Reward -103.800000

Episode 240 Reward -90.000000 Average Reward -117.900000
Episode 250 Reward -85.000000 Average Reward -109.600000
Episode 260 Reward -85.000000 Average Reward -96.200000
Episode 270 Reward -104.000000 Average Reward -112.600000
Episode 280 Reward -102.000000 Average Reward -98.600000
Episode 290 Reward -95.000000 Average Reward -111.900000
Episode 300 Reward -88.000000 Average Reward -99.800000
Episode 310 Reward -105.000000 Average Reward -100.500000
Episode 320 Reward -85.000000 Average Reward -97.200000
Episode 330 Reward -102.000000 Average Reward -95.400000
Episode 340 Reward -111.000000 Average Reward -106.400000
Episode 350 Reward -84.000000 Average Reward -93.400000
Episode 360 Reward -93.000000 Average Reward -90.400000
Episode 370 Reward -81.000000 Average Reward -95.800000
Episode 380 Reward -73.000000 Average Reward -91.400000
Episode 390 Reward -77.000000 Average Reward -91.300000
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Episode 410 Reward -85.000000 Average Reward -86.300000
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Episode 450 Reward -104.000000 Average Reward -93.800000
Episode 460 Reward -103.000000 Average Reward -89.300000
Episode 470 Reward -78.000000 Average Reward -91.600000
Episode 480 Reward -166.000000 Average Reward -108.600000
Episode 490 Reward -88.000000 Average Reward -83.900000
Episode 500 Reward -108.000000 Average Reward -89.400000
Episode 510 Reward -87.000000 Average Reward -93.100000
Episode 520 Reward -103.000000 Average Reward -91.200000
Episode 530 Reward -64.000000 Average Reward -86.400000
Episode 540 Reward -97.000000 Average Reward -87.700000
Episode 550 Reward -88.000000 Average Reward -95.900000
Episode 560 Reward -111.000000 Average Reward -98.600000
Episode 570 Reward -96.000000 Average Reward -94.700000
Episode 580 Reward -156.000000 Average Reward -108.800000
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Episode 610 Reward -102.000000 Average Reward -88.600000
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Episode 630 Reward -91.000000 Average Reward -86.100000
Episode 640 Reward -100.000000 Average Reward -118.300000
Episode 650 Reward -69.000000 Average Reward -101.400000
Episode 660 Reward -107.000000 Average Reward -109.600000
Episode 670 Reward -76.000000 Average Reward -85.200000
Episode 680 Reward -64.000000 Average Reward -83.700000
Episode 690 Reward -66.000000 Average Reward -92.500000
Episode 700 Reward -81.000000 Average Reward -84.400000
Episode 710 Reward -95.000000 Average Reward -96.200000

Episode 720 Reward -94.000000 Average Reward -80.800000
Episode 730 Reward -86.000000 Average Reward -93.700000
Episode 740 Reward -99.000000 Average Reward -96.400000
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Episode 780 Reward -88.000000 Average Reward -117.200000
Episode 790 Reward -116.000000 Average Reward -128.300000
Episode 800 Reward -83.000000 Average Reward -94.500000
Episode 810 Reward -81.000000 Average Reward -105.500000
Episode 820 Reward -99.000000 Average Reward -91.300000
Episode 830 Reward -75.000000 Average Reward -105.200000
Episode 840 Reward -99.000000 Average Reward -96.200000
Episode 850 Reward -124.000000 Average Reward -100.000000
Episode 860 Reward -118.000000 Average Reward -105.800000
Episode 870 Reward -83.000000 Average Reward -99.200000
Episode 880 Reward -105.000000 Average Reward -96.300000
Episode 890 Reward -83.000000 Average Reward -81.700000
Episode 900 Reward -81.000000 Average Reward -87.400000
Episode 910 Reward -96.000000 Average Reward -86.500000
Episode 920 Reward -76.000000 Average Reward -87.000000
Episode 930 Reward -93.000000 Average Reward -82.400000
Episode 940 Reward -117.000000 Average Reward -97.000000
Episode 950 Reward -84.000000 Average Reward -95.200000
Episode 960 Reward -120.000000 Average Reward -84.000000
Episode 970 Reward -140.000000 Average Reward -102.400000
Episode 980 Reward -80.000000 Average Reward -85.200000
Episode 990 Reward -85.000000 Average Reward -88.400000
Episode 1000 Reward -81.000000 Average Reward -87.500000

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Episode 10 Reward -246.000000 Average Reward -443.200000
Episode 20 Reward -306.000000 Average Reward -342.800000
Episode 30 Reward -297.000000 Average Reward -302.200000
Episode 40 Reward -229.000000 Average Reward -262.300000
Episode 50 Reward -167.000000 Average Reward -257.800000
Episode 60 Reward -211.000000 Average Reward -216.800000
Episode 70 Reward -131.000000 Average Reward -155.800000
Episode 80 Reward -137.000000 Average Reward -147.800000
Episode 90 Reward -122.000000 Average Reward -156.100000
Episode 100 Reward -167.000000 Average Reward -146.500000
Episode 110 Reward -224.000000 Average Reward -195.000000
Episode 120 Reward -120.000000 Average Reward -151.700000
Episode 130 Reward -131.000000 Average Reward -158.200000
Episode 140 Reward -189.000000 Average Reward -177.900000
Episode 150 Reward -225.000000 Average Reward -157.500000
Episode 160 Reward -152.000000 Average Reward -165.200000
Episode 170 Reward -117.000000 Average Reward -147.700000
Episode 180 Reward -125.000000 Average Reward -156.300000

Episode 190 Reward -235.000000 Average Reward -169.100000
Episode 200 Reward -141.000000 Average Reward -203.900000
Episode 210 Reward -142.000000 Average Reward -178.100000
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Episode 240 Reward -217.000000 Average Reward -168.800000
Episode 250 Reward -148.000000 Average Reward -179.100000
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Episode 270 Reward -210.000000 Average Reward -204.900000
Episode 280 Reward -166.000000 Average Reward -182.000000
Episode 290 Reward -270.000000 Average Reward -202.900000
Episode 300 Reward -214.000000 Average Reward -185.200000
Episode 310 Reward -193.000000 Average Reward -197.400000
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Episode 330 Reward -307.000000 Average Reward -225.900000
Episode 340 Reward -183.000000 Average Reward -203.100000
Episode 350 Reward -139.000000 Average Reward -169.300000
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Episode 370 Reward -164.000000 Average Reward -172.900000
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Episode 420 Reward -146.000000 Average Reward -183.300000
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Episode 460 Reward -145.000000 Average Reward -156.200000
Episode 470 Reward -155.000000 Average Reward -175.900000
Episode 480 Reward -158.000000 Average Reward -166.600000
Episode 490 Reward -182.000000 Average Reward -212.100000
Episode 500 Reward -186.000000 Average Reward -215.000000
Episode 510 Reward -157.000000 Average Reward -232.700000
Episode 520 Reward -190.000000 Average Reward -194.500000
Episode 530 Reward -154.000000 Average Reward -190.500000
Episode 540 Reward -210.000000 Average Reward -193.400000
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Episode 650 Reward -78.000000 Average Reward -91.700000
Episode 660 Reward -83.000000 Average Reward -83.800000

Episode 670 Reward -78.000000 Average Reward -104.200000
Episode 680 Reward -104.000000 Average Reward -88.200000
Episode 690 Reward -75.000000 Average Reward -92.000000
Episode 700 Reward -82.000000 Average Reward -91.800000
Episode 710 Reward -85.000000 Average Reward -86.300000
Episode 720 Reward -77.000000 Average Reward -92.800000
Episode 730 Reward -109.000000 Average Reward -85.300000
Episode 740 Reward -84.000000 Average Reward -106.700000
Episode 750 Reward -183.000000 Average Reward -97.600000
Episode 760 Reward -94.000000 Average Reward -94.400000
Episode 770 Reward -95.000000 Average Reward -110.200000
Episode 780 Reward -73.000000 Average Reward -102.900000
Episode 790 Reward -89.000000 Average Reward -97.400000
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Episode 810 Reward -85.000000 Average Reward -101.900000
Episode 820 Reward -227.000000 Average Reward -111.800000
Episode 830 Reward -83.000000 Average Reward -85.000000
Episode 840 Reward -87.000000 Average Reward -93.800000
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Episode 910 Reward -78.000000 Average Reward -96.000000
Episode 920 Reward -87.000000 Average Reward -89.400000
Episode 930 Reward -105.000000 Average Reward -116.300000
Episode 940 Reward -63.000000 Average Reward -110.200000
Episode 950 Reward -90.000000 Average Reward -94.200000
Episode 960 Reward -85.000000 Average Reward -81.700000
Episode 970 Reward -77.000000 Average Reward -84.800000
Episode 980 Reward -94.000000 Average Reward -91.200000
Episode 990 Reward -83.000000 Average Reward -91.900000
Episode 1000 Reward -64.000000 Average Reward -87.300000

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Episode 10 Reward -352.000000 Average Reward -456.200000
Episode 20 Reward -267.000000 Average Reward -362.500000
Episode 30 Reward -349.000000 Average Reward -359.700000
Episode 40 Reward -198.000000 Average Reward -268.400000
Episode 50 Reward -257.000000 Average Reward -209.400000
Episode 60 Reward -166.000000 Average Reward -196.300000
Episode 70 Reward -201.000000 Average Reward -194.200000
Episode 80 Reward -176.000000 Average Reward -192.300000
Episode 90 Reward -143.000000 Average Reward -175.900000
Episode 100 Reward -167.000000 Average Reward -192.600000
Episode 110 Reward -186.000000 Average Reward -214.300000
Episode 120 Reward -281.000000 Average Reward -213.600000
Episode 130 Reward -135.000000 Average Reward -211.000000

Episode 140 Reward -182.000000 Average Reward -197.300000
Episode 150 Reward -161.000000 Average Reward -179.800000
Episode 160 Reward -203.000000 Average Reward -231.400000
Episode 170 Reward -206.000000 Average Reward -219.100000
Episode 180 Reward -170.000000 Average Reward -209.800000
Episode 190 Reward -191.000000 Average Reward -213.600000
Episode 200 Reward -159.000000 Average Reward -190.400000
Episode 210 Reward -192.000000 Average Reward -185.000000
Episode 220 Reward -143.000000 Average Reward -192.900000
Episode 230 Reward -122.000000 Average Reward -190.400000
Episode 240 Reward -463.000000 Average Reward -189.600000
Episode 250 Reward -198.000000 Average Reward -198.900000
Episode 260 Reward -222.000000 Average Reward -164.500000
Episode 270 Reward -178.000000 Average Reward -146.500000
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Episode 290 Reward -135.000000 Average Reward -142.000000
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Episode 570 Reward -156.000000 Average Reward -148.300000
Episode 580 Reward -132.000000 Average Reward -139.800000
Episode 590 Reward -144.000000 Average Reward -139.800000
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Episode 610 Reward -154.000000 Average Reward -122.700000
Episode 620 Reward -98.000000 Average Reward -108.900000
Episode 630 Reward -104.000000 Average Reward -98.500000
Episode 640 Reward -104.000000 Average Reward -109.500000
Episode 650 Reward -161.000000 Average Reward -121.700000
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Episode 670 Reward -187.000000 Average Reward -146.700000
Episode 680 Reward -120.000000 Average Reward -146.100000
Episode 690 Reward -92.000000 Average Reward -104.700000
Episode 700 Reward -175.000000 Average Reward -147.600000
Episode 710 Reward -100.000000 Average Reward -137.100000
Episode 720 Reward -98.000000 Average Reward -98.000000
Episode 730 Reward -78.000000 Average Reward -92.300000
Episode 740 Reward -111.000000 Average Reward -107.800000
Episode 750 Reward -74.000000 Average Reward -83.400000
Episode 760 Reward -108.000000 Average Reward -99.800000
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Episode 800 Reward -84.000000 Average Reward -89.600000
Episode 810 Reward -98.000000 Average Reward -85.800000
Episode 820 Reward -67.000000 Average Reward -99.500000
Episode 830 Reward -85.000000 Average Reward -79.600000
Episode 840 Reward -77.000000 Average Reward -86.100000
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Episode 890 Reward -105.000000 Average Reward -95.400000

Episode 900 Reward -80.000000 Average Reward -90.300000
Episode 910 Reward -96.000000 Average Reward -97.800000
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Episode 300 Reward -99.000000 Average Reward -107.400000
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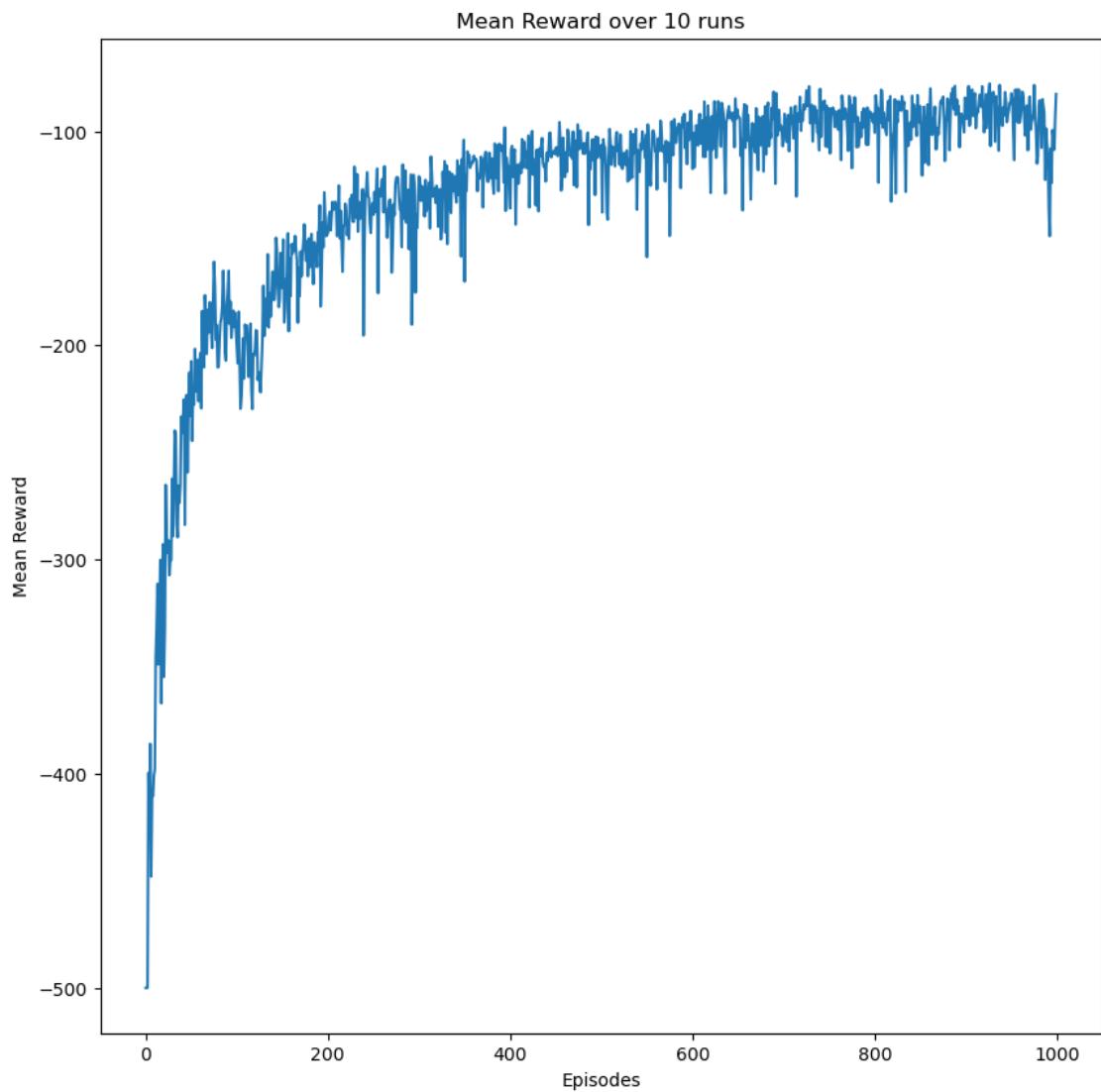
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Episode 530 Reward -202.000000 Average Reward -106.100000
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Episode 590 Reward -82.000000 Average Reward -81.800000
Episode 600 Reward -98.000000 Average Reward -88.100000
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Episode 620 Reward -148.000000 Average Reward -100.700000
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Episode 720 Reward -87.000000 Average Reward -83.400000
Episode 730 Reward -95.000000 Average Reward -89.400000
Episode 740 Reward -76.000000 Average Reward -81.200000
Episode 750 Reward -93.000000 Average Reward -90.200000
Episode 760 Reward -78.000000 Average Reward -96.400000
Episode 770 Reward -92.000000 Average Reward -89.800000
Episode 780 Reward -103.000000 Average Reward -88.800000
Episode 790 Reward -84.000000 Average Reward -82.500000
Episode 800 Reward -64.000000 Average Reward -97.500000
Episode 810 Reward -79.000000 Average Reward -97.100000
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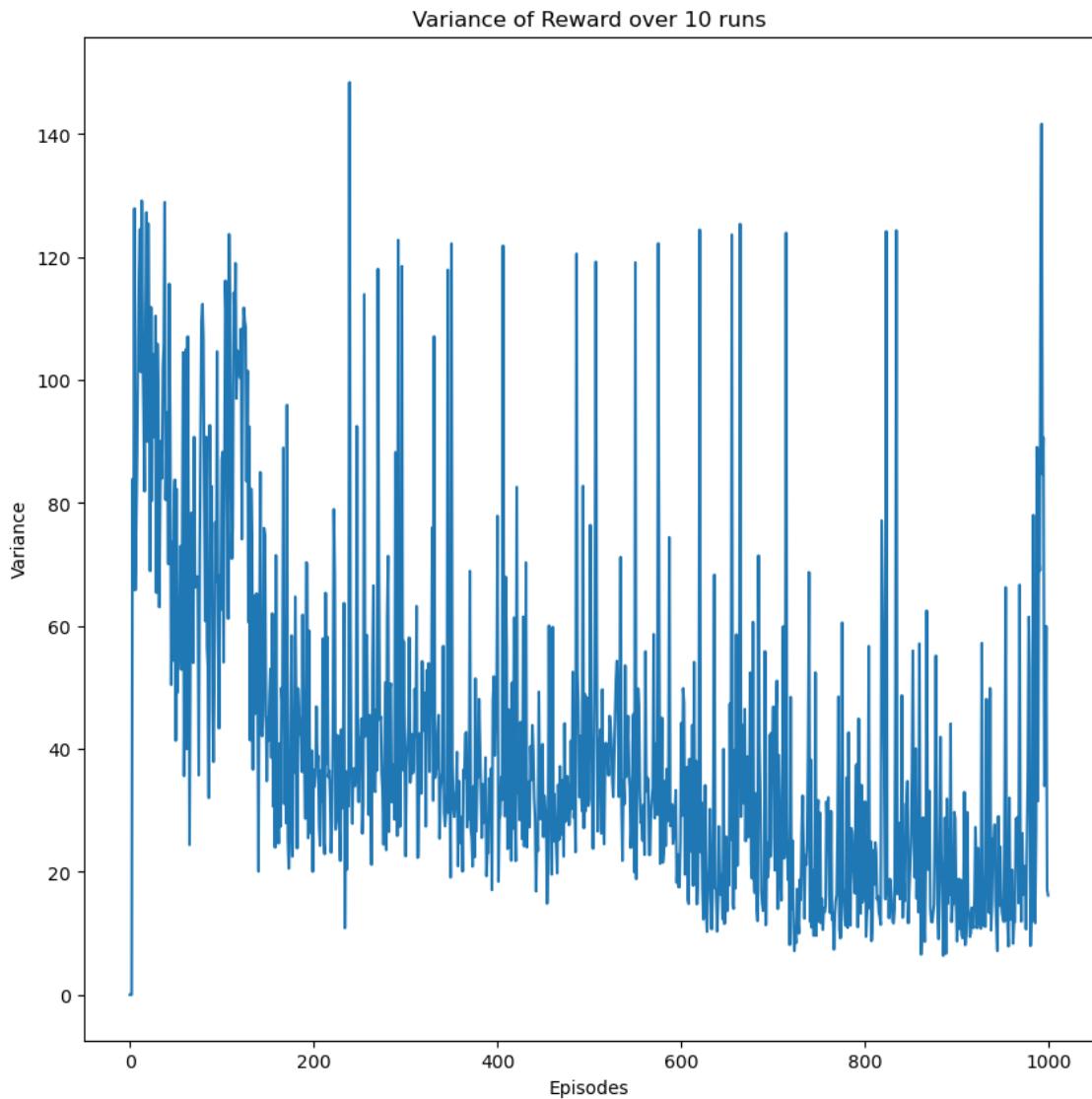
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Episode 890 Reward -66.000000 Average Reward -76.500000
Episode 900 Reward -62.000000 Average Reward -88.400000
Episode 910 Reward -77.000000 Average Reward -83.100000
Episode 920 Reward -95.000000 Average Reward -82.000000
Episode 930 Reward -73.000000 Average Reward -88.700000
Episode 940 Reward -74.000000 Average Reward -86.600000
Episode 950 Reward -86.000000 Average Reward -90.100000
Episode 960 Reward -65.000000 Average Reward -90.500000
Episode 970 Reward -85.000000 Average Reward -100.700000
Episode 980 Reward -100.000000 Average Reward -93.000000
Episode 990 Reward -64.000000 Average Reward -83.600000
Episode 1000 Reward -111.000000 Average Reward -138.200000
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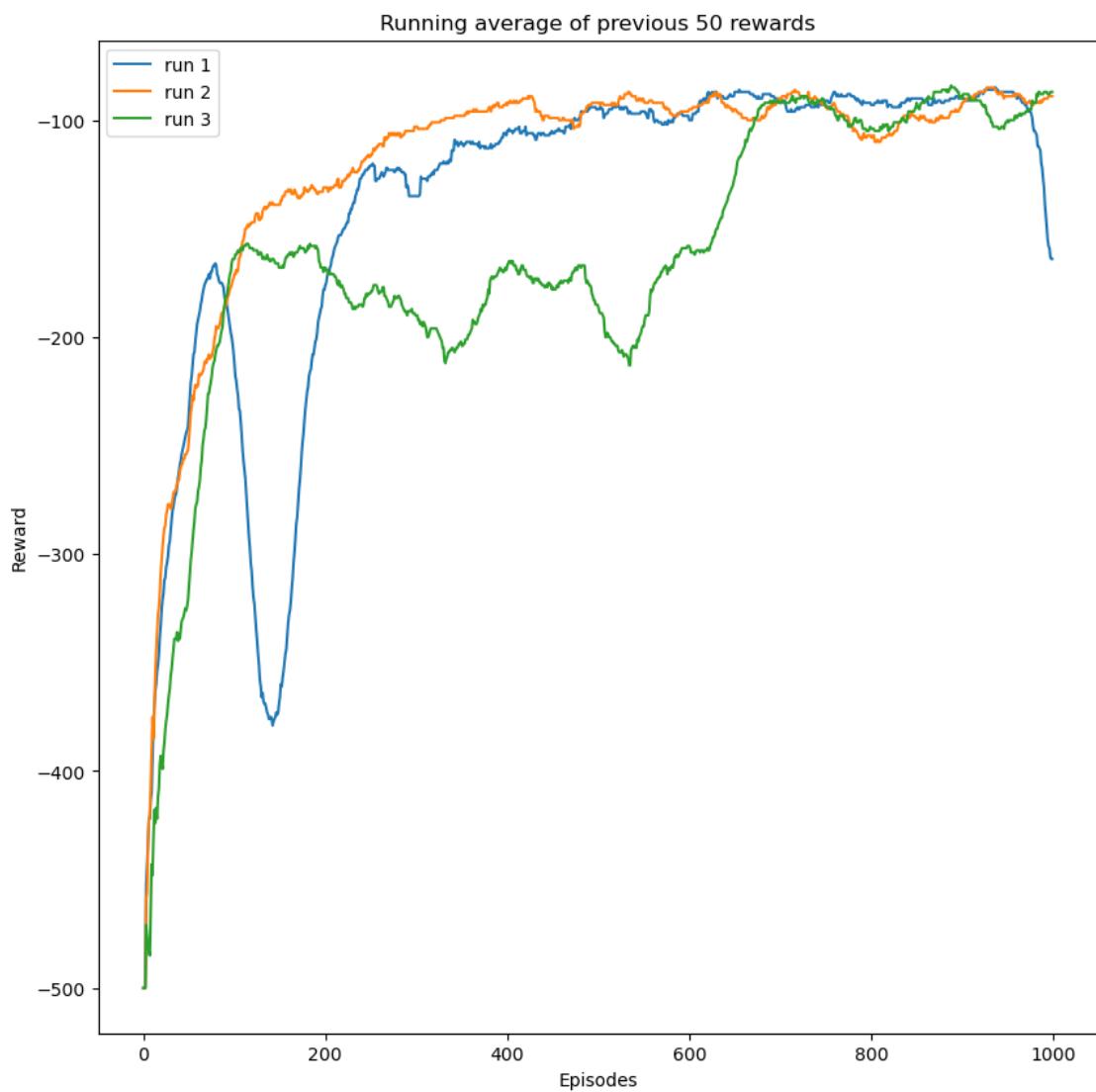
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Episode 50 Reward -222.000000 Average Reward -212.000000
Episode 60 Reward -251.000000 Average Reward -229.100000
Episode 70 Reward -154.000000 Average Reward -220.000000
Episode 80 Reward -470.000000 Average Reward -231.700000
Episode 90 Reward -112.000000 Average Reward -173.500000
Episode 100 Reward -231.000000 Average Reward -174.400000
Episode 110 Reward -136.000000 Average Reward -181.300000
Episode 120 Reward -126.000000 Average Reward -164.300000
Episode 130 Reward -166.000000 Average Reward -151.600000
Episode 140 Reward -117.000000 Average Reward -147.200000
Episode 150 Reward -203.000000 Average Reward -155.300000
Episode 160 Reward -177.000000 Average Reward -171.800000
Episode 170 Reward -196.000000 Average Reward -151.600000
Episode 180 Reward -98.000000 Average Reward -126.300000
Episode 190 Reward -147.000000 Average Reward -137.900000
Episode 200 Reward -200.000000 Average Reward -156.300000
Episode 210 Reward -128.000000 Average Reward -121.100000
Episode 220 Reward -110.000000 Average Reward -128.500000
Episode 230 Reward -91.000000 Average Reward -128.000000
Episode 240 Reward -86.000000 Average Reward -107.100000
Episode 250 Reward -126.000000 Average Reward -116.200000
Episode 260 Reward -110.000000 Average Reward -103.500000
Episode 270 Reward -109.000000 Average Reward -128.700000
Episode 280 Reward -113.000000 Average Reward -105.900000
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Episode 300 Reward -102.000000 Average Reward -141.600000
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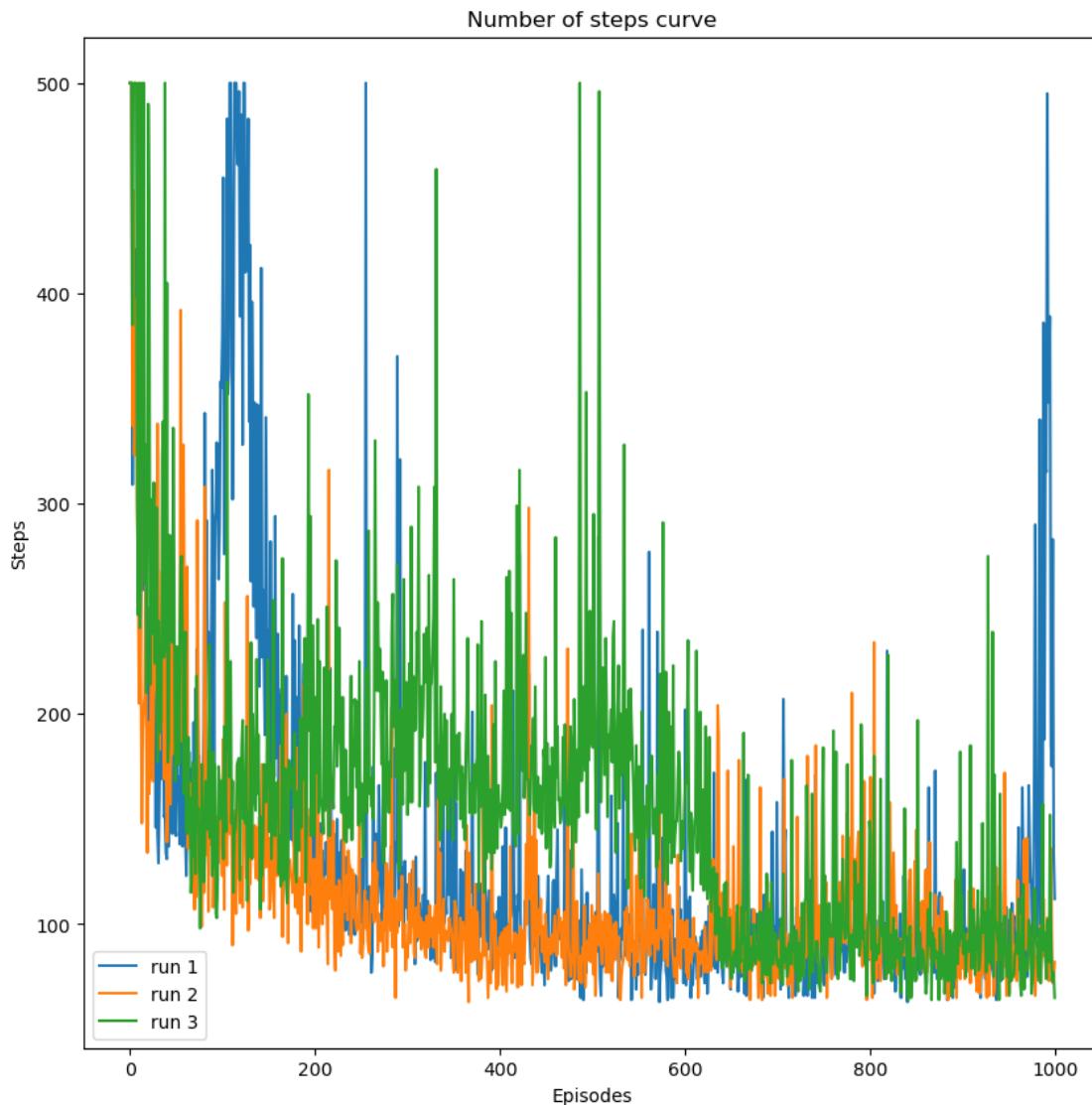
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Episode 360 Reward -101.000000 Average Reward -96.700000
Episode 370 Reward -86.000000 Average Reward -89.800000
Episode 380 Reward -107.000000 Average Reward -124.000000
Episode 390 Reward -110.000000 Average Reward -93.700000
Episode 400 Reward -150.000000 Average Reward -102.400000
Episode 410 Reward -99.000000 Average Reward -95.200000
Episode 420 Reward -94.000000 Average Reward -97.100000
Episode 430 Reward -90.000000 Average Reward -91.000000
Episode 440 Reward -178.000000 Average Reward -95.800000
Episode 450 Reward -91.000000 Average Reward -98.100000
Episode 460 Reward -101.000000 Average Reward -95.600000
Episode 470 Reward -75.000000 Average Reward -86.500000
Episode 480 Reward -80.000000 Average Reward -90.200000
Episode 490 Reward -121.000000 Average Reward -97.500000
Episode 500 Reward -87.000000 Average Reward -85.300000
Episode 510 Reward -92.000000 Average Reward -98.100000
Episode 520 Reward -79.000000 Average Reward -88.800000
Episode 530 Reward -91.000000 Average Reward -91.200000
Episode 540 Reward -106.000000 Average Reward -90.000000
Episode 550 Reward -99.000000 Average Reward -93.900000
Episode 560 Reward -97.000000 Average Reward -102.100000
Episode 570 Reward -99.000000 Average Reward -87.300000
Episode 580 Reward -97.000000 Average Reward -95.900000
Episode 590 Reward -88.000000 Average Reward -85.200000
Episode 600 Reward -135.000000 Average Reward -91.900000
Episode 610 Reward -188.000000 Average Reward -109.800000
Episode 620 Reward -80.000000 Average Reward -89.800000
Episode 630 Reward -82.000000 Average Reward -95.400000
Episode 640 Reward -89.000000 Average Reward -90.500000
Episode 650 Reward -70.000000 Average Reward -92.100000
Episode 660 Reward -95.000000 Average Reward -144.400000
Episode 670 Reward -66.000000 Average Reward -94.700000
Episode 680 Reward -95.000000 Average Reward -91.900000
Episode 690 Reward -63.000000 Average Reward -82.900000
Episode 700 Reward -99.000000 Average Reward -89.200000
Episode 710 Reward -93.000000 Average Reward -87.400000
Episode 720 Reward -80.000000 Average Reward -139.300000
Episode 730 Reward -137.000000 Average Reward -95.600000
Episode 740 Reward -90.000000 Average Reward -83.700000
Episode 750 Reward -113.000000 Average Reward -90.500000
Episode 760 Reward -81.000000 Average Reward -92.000000
Episode 770 Reward -79.000000 Average Reward -91.100000
Episode 780 Reward -105.000000 Average Reward -84.900000
Episode 790 Reward -83.000000 Average Reward -98.000000

Episode 800 Reward -109.000000 Average Reward -98.600000
Episode 810 Reward -145.000000 Average Reward -95.100000
Episode 820 Reward -254.000000 Average Reward -119.300000
Episode 830 Reward -122.000000 Average Reward -115.700000
Episode 840 Reward -110.000000 Average Reward -125.000000
Episode 850 Reward -139.000000 Average Reward -118.800000
Episode 860 Reward -116.000000 Average Reward -136.300000
Episode 870 Reward -145.000000 Average Reward -131.800000
Episode 880 Reward -87.000000 Average Reward -126.000000
Episode 890 Reward -95.000000 Average Reward -107.500000
Episode 900 Reward -87.000000 Average Reward -92.800000
Episode 910 Reward -72.000000 Average Reward -93.300000
Episode 920 Reward -84.000000 Average Reward -93.200000
Episode 930 Reward -65.000000 Average Reward -89.200000
Episode 940 Reward -89.000000 Average Reward -83.300000
Episode 950 Reward -77.000000 Average Reward -86.500000
Episode 960 Reward -90.000000 Average Reward -93.700000
Episode 970 Reward -104.000000 Average Reward -92.700000
Episode 980 Reward -80.000000 Average Reward -88.500000
Episode 990 Reward -73.000000 Average Reward -83.500000
Episode 1000 Reward -72.000000 Average Reward -95.700000
0:02:06.729464









```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [1024, 512]
LR = 1e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'Acrobot-v1'
SOLVE_CUTOFF = -100.0
STEP = 50000

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{NUM_HIDDEN}_{HIDDEN_SIZES}_{LR}_{ENV_NAME}_{NUM_EPISODES}_{NSTEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	-359.000000	-440.900000
20	-236.000000	-299.800000
30	-179.000000	-251.800000
40	-238.000000	-196.500000
50	-202.000000	-213.000000
60	-201.000000	-229.600000
70	-137.000000	-166.700000
80	-182.000000	-175.800000
90	-174.000000	-146.300000
100	-199.000000	-168.100000
110	-171.000000	-164.700000
120	-113.000000	-150.900000
130	-163.000000	-173.300000
140	-183.000000	-156.900000
150	-135.000000	-156.500000
160	-107.000000	-140.000000
170	-133.000000	-137.000000
180	-118.000000	-133.600000
190	-108.000000	-129.700000
200	-139.000000	-122.400000
210	-126.000000	-122.300000
220	-108.000000	-129.600000
230	-131.000000	-152.300000
240	-95.000000	-175.900000
250	-100.000000	-128.500000
260	-113.000000	-129.100000
270	-121.000000	-131.600000
280	-156.000000	-145.900000

Episode 290 Reward -118.000000 Average Reward -138.200000
Episode 300 Reward -111.000000 Average Reward -138.800000
Episode 310 Reward -125.000000 Average Reward -161.000000
Episode 320 Reward -129.000000 Average Reward -128.000000
Episode 330 Reward -152.000000 Average Reward -117.000000
Episode 340 Reward -116.000000 Average Reward -113.200000
Episode 350 Reward -119.000000 Average Reward -151.500000
Episode 360 Reward -120.000000 Average Reward -134.000000
Episode 370 Reward -500.000000 Average Reward -164.700000
Episode 380 Reward -107.000000 Average Reward -136.700000
Episode 390 Reward -128.000000 Average Reward -112.600000
Episode 400 Reward -138.000000 Average Reward -126.600000
Episode 410 Reward -165.000000 Average Reward -135.600000
Episode 420 Reward -101.000000 Average Reward -126.900000
Episode 430 Reward -113.000000 Average Reward -115.400000
Episode 440 Reward -134.000000 Average Reward -121.100000
Episode 450 Reward -115.000000 Average Reward -118.900000
Episode 460 Reward -146.000000 Average Reward -123.700000
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Episode 480 Reward -118.000000 Average Reward -116.600000
Episode 490 Reward -135.000000 Average Reward -129.500000
Episode 500 Reward -89.000000 Average Reward -116.500000
Episode 510 Reward -90.000000 Average Reward -106.700000
Episode 520 Reward -106.000000 Average Reward -115.000000
Episode 530 Reward -125.000000 Average Reward -108.200000
Episode 540 Reward -104.000000 Average Reward -120.600000
Episode 550 Reward -87.000000 Average Reward -115.200000
Episode 560 Reward -91.000000 Average Reward -96.000000
Episode 570 Reward -105.000000 Average Reward -110.900000
Episode 580 Reward -96.000000 Average Reward -125.500000
Episode 590 Reward -105.000000 Average Reward -101.800000
Episode 600 Reward -81.000000 Average Reward -107.600000
Episode 610 Reward -87.000000 Average Reward -107.800000
Episode 620 Reward -114.000000 Average Reward -103.900000
Episode 630 Reward -86.000000 Average Reward -94.100000
Episode 640 Reward -108.000000 Average Reward -104.100000
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Episode 670 Reward -123.000000 Average Reward -111.700000
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Episode 770 Reward -105.000000 Average Reward -104.700000
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Episode 840 Reward -103.000000 Average Reward -84.100000
Episode 850 Reward -99.000000 Average Reward -104.000000
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Episode 960 Reward -106.000000 Average Reward -89.600000
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Episode 60 Reward -223.000000 Average Reward -234.200000
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Episode 80 Reward -176.000000 Average Reward -236.400000
Episode 90 Reward -346.000000 Average Reward -257.200000
Episode 100 Reward -327.000000 Average Reward -332.100000
Episode 110 Reward -199.000000 Average Reward -232.600000
Episode 120 Reward -229.000000 Average Reward -241.100000
Episode 130 Reward -166.000000 Average Reward -239.600000
Episode 140 Reward -218.000000 Average Reward -225.600000
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Episode 170 Reward -228.000000 Average Reward -214.100000
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Episode 190 Reward -257.000000 Average Reward -197.100000
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Episode 230 Reward -134.000000 Average Reward -233.900000

Episode 240 Reward -140.000000 Average Reward -215.300000
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Episode 260 Reward -186.000000 Average Reward -195.200000
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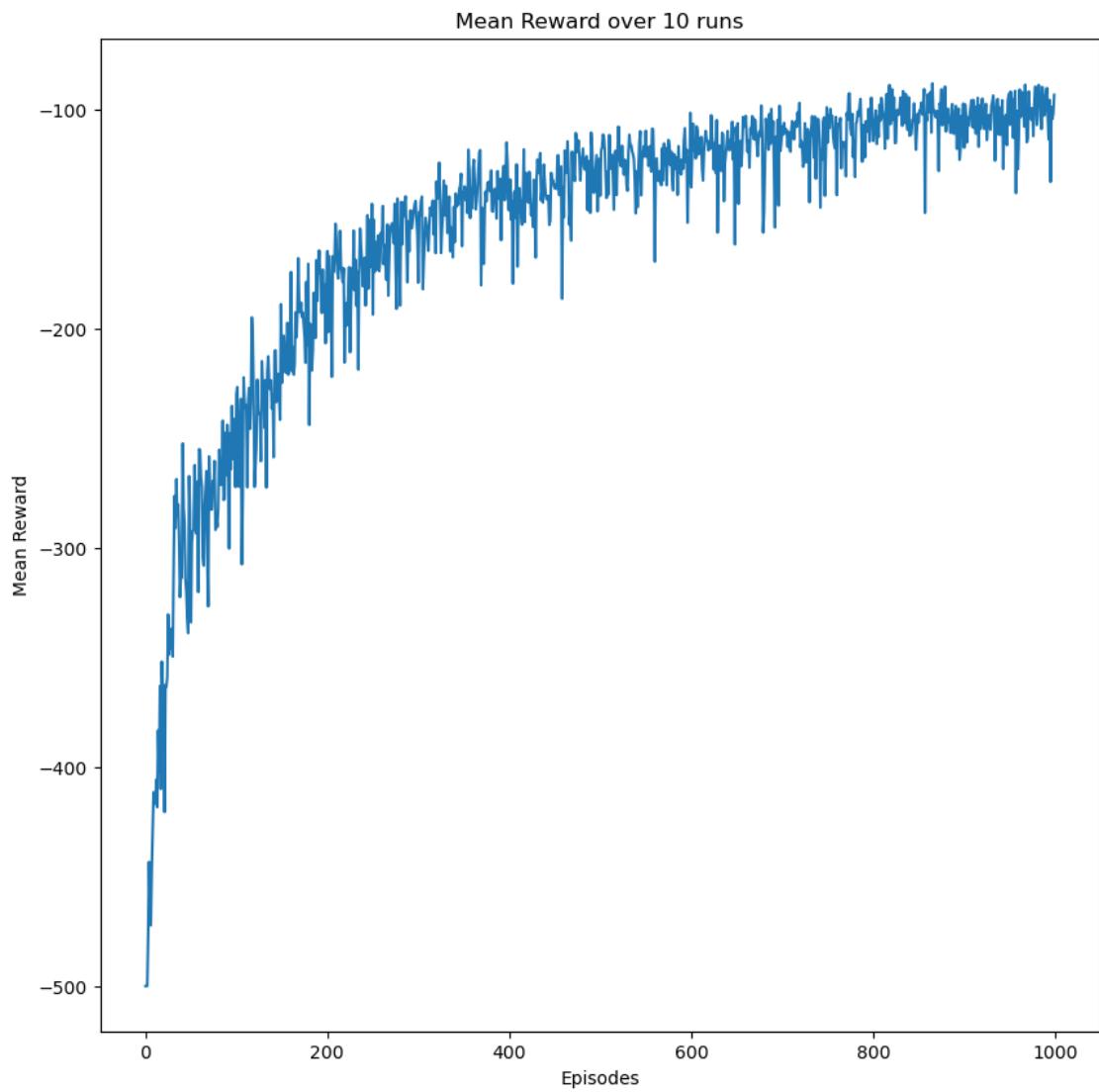
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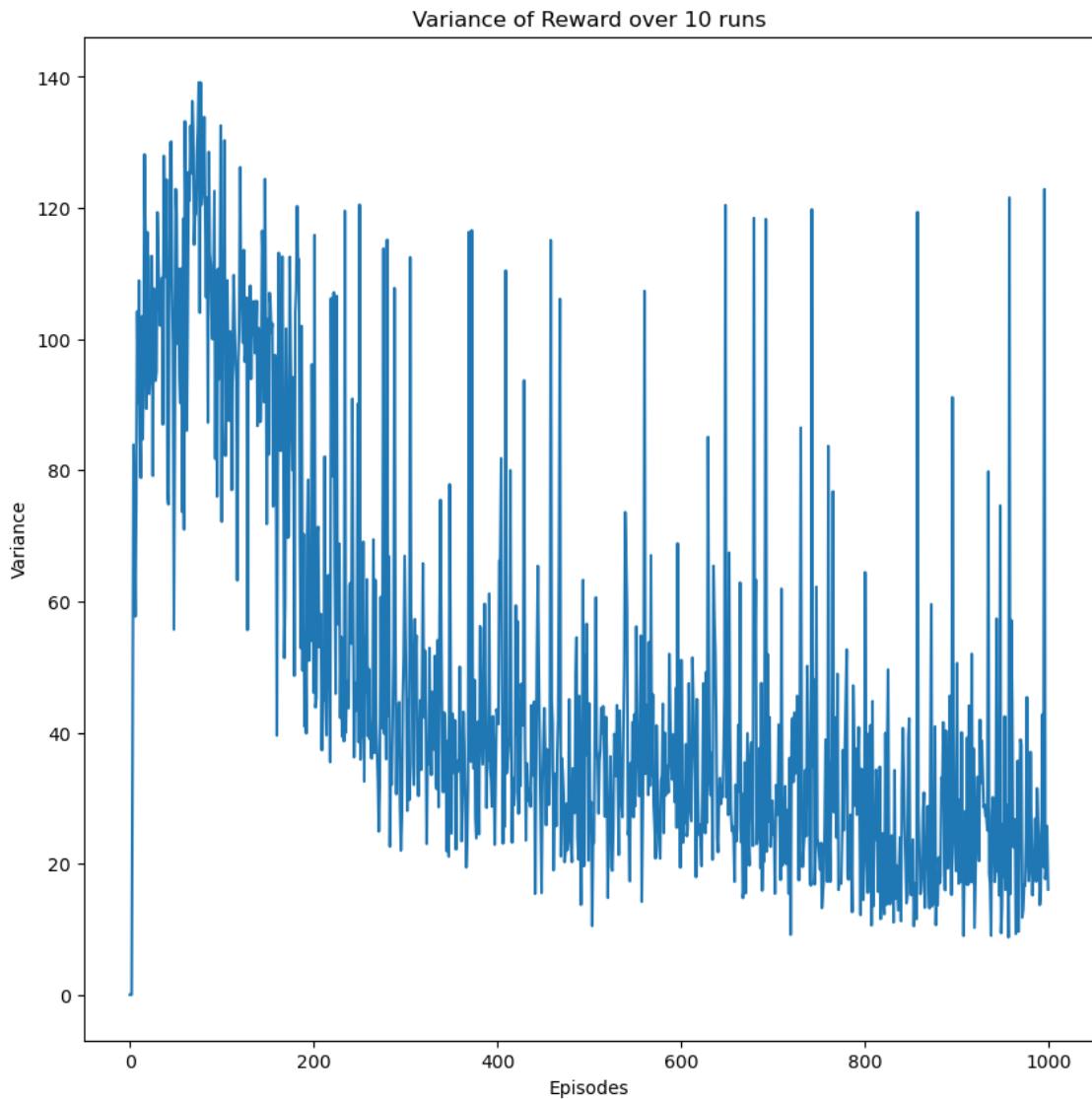
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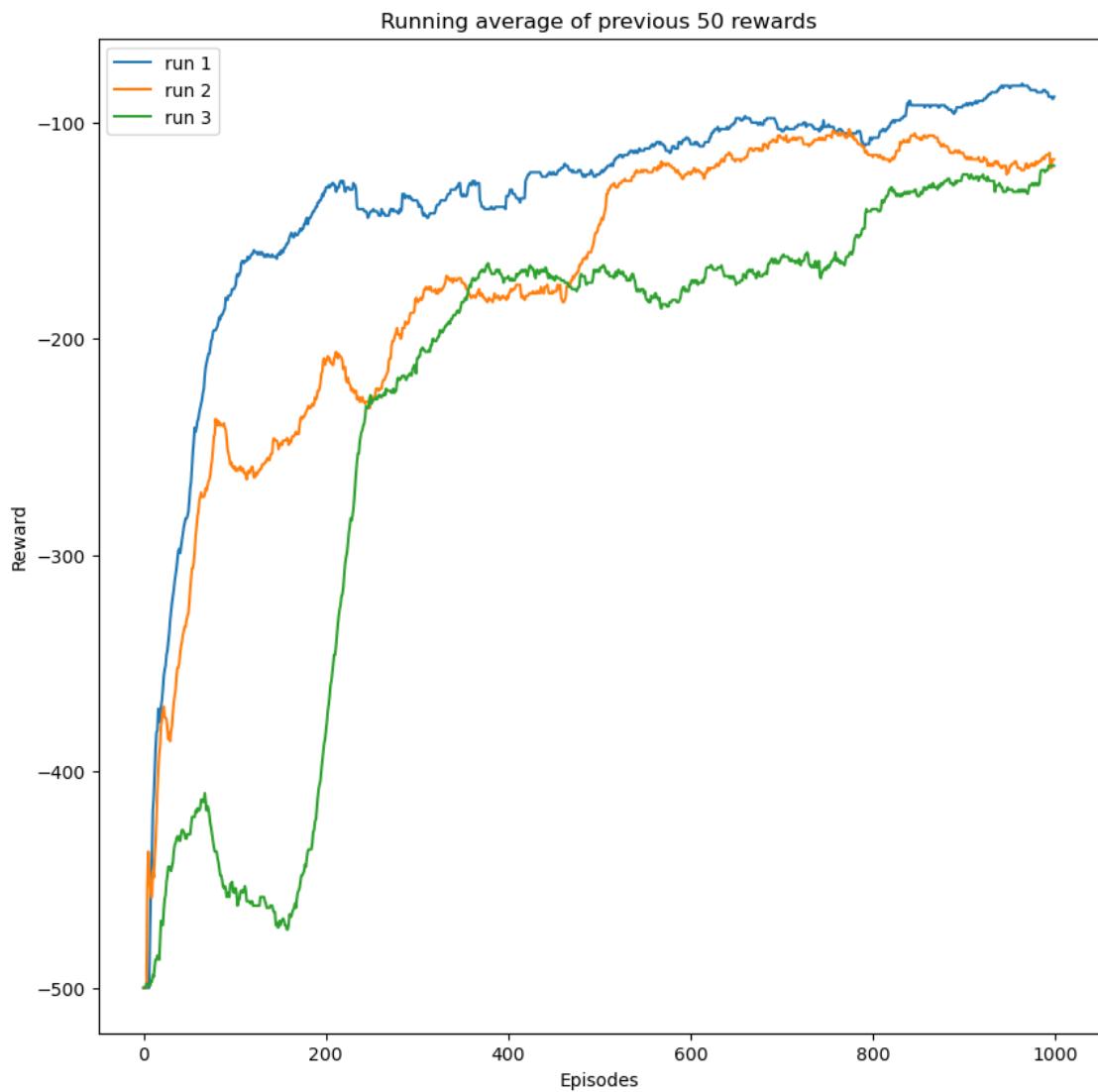
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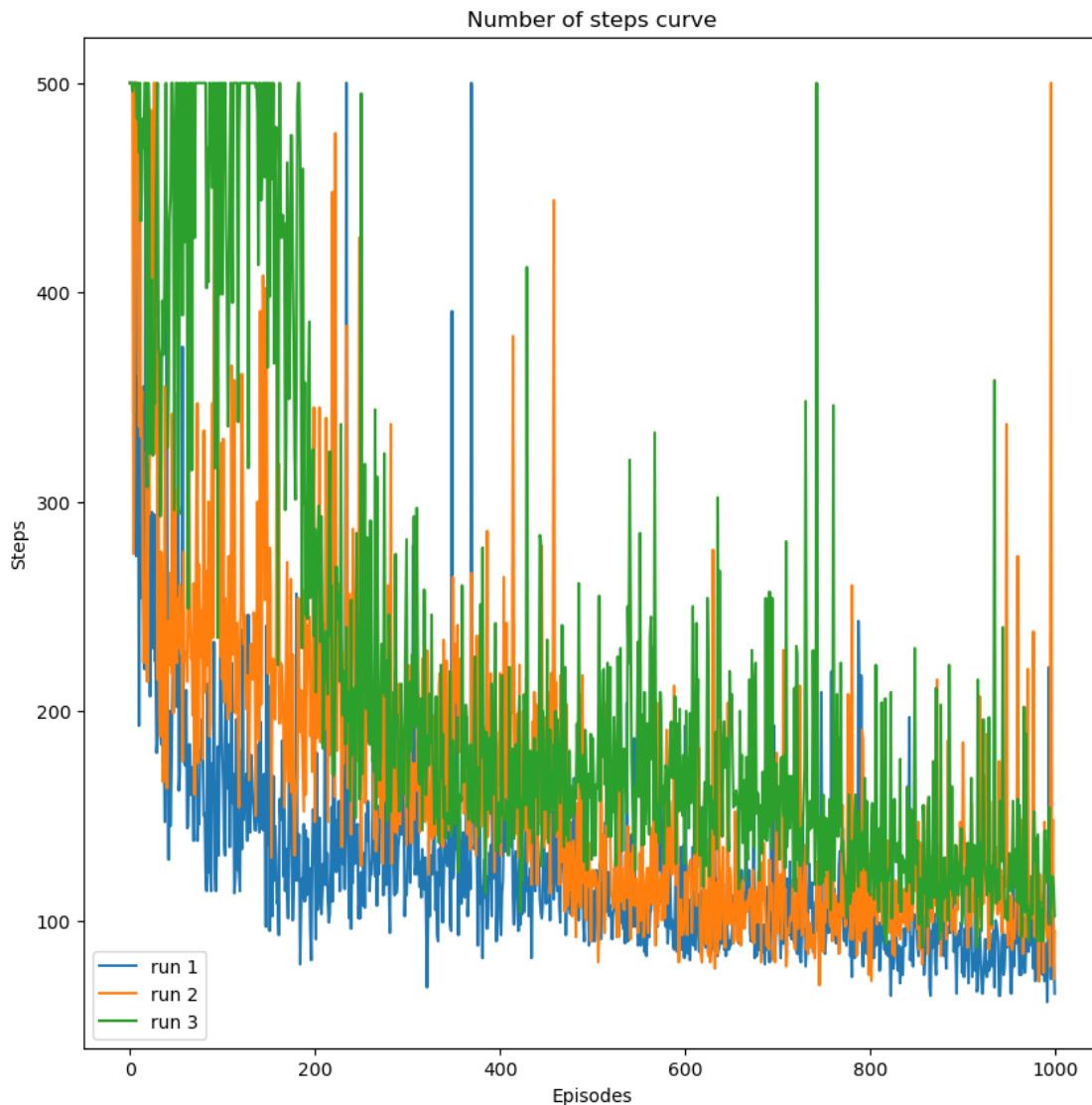
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Episode 810 Reward -115.000000 Average Reward -125.000000
Episode 820 Reward -140.000000 Average Reward -96.000000
Episode 830 Reward -91.000000 Average Reward -92.500000
Episode 840 Reward -107.000000 Average Reward -102.700000
Episode 850 Reward -87.000000 Average Reward -102.000000
Episode 860 Reward -95.000000 Average Reward -93.300000
Episode 870 Reward -122.000000 Average Reward -102.300000
Episode 880 Reward -80.000000 Average Reward -97.600000
Episode 890 Reward -108.000000 Average Reward -113.900000
Episode 900 Reward -121.000000 Average Reward -148.500000
Episode 910 Reward -88.000000 Average Reward -100.600000
Episode 920 Reward -93.000000 Average Reward -101.500000
Episode 930 Reward -102.000000 Average Reward -103.700000
Episode 940 Reward -84.000000 Average Reward -99.900000
Episode 950 Reward -81.000000 Average Reward -110.100000
Episode 960 Reward -74.000000 Average Reward -97.200000
Episode 970 Reward -99.000000 Average Reward -96.400000
Episode 980 Reward -76.000000 Average Reward -96.100000
Episode 990 Reward -110.000000 Average Reward -94.400000
Episode 1000 Reward -108.000000 Average Reward -94.400000
0:03:08.471739









```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [1024, 1024]
LR = 0.5e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'Acrobot-v1'
SOLVE_CUTOFF = -100.0
STEP = 50000

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{hs}-{lr}-{env}-{numep}-{nstep}-{STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	-470.000000	-497.000000
20	-500.000000	-444.500000
30	-271.000000	-380.600000
40	-500.000000	-365.000000
50	-500.000000	-414.900000
60	-271.000000	-312.700000
70	-321.000000	-327.700000
80	-405.000000	-322.700000
90	-241.000000	-252.100000
100	-236.000000	-225.900000
110	-174.000000	-263.000000
120	-238.000000	-234.900000
130	-246.000000	-228.200000
140	-225.000000	-207.500000
150	-192.000000	-216.500000
160	-282.000000	-193.500000
170	-171.000000	-174.300000
180	-163.000000	-181.800000
190	-178.000000	-191.100000
200	-188.000000	-167.200000
210	-142.000000	-176.500000
220	-136.000000	-158.900000
230	-108.000000	-139.800000
240	-132.000000	-155.500000
250	-170.000000	-147.900000
260	-141.000000	-129.100000
270	-131.000000	-151.100000
280	-100.000000	-129.900000

Episode 290 Reward -132.000000 Average Reward -115.200000
Episode 300 Reward -97.000000 Average Reward -132.700000
Episode 310 Reward -119.000000 Average Reward -122.600000
Episode 320 Reward -159.000000 Average Reward -132.500000
Episode 330 Reward -121.000000 Average Reward -126.500000
Episode 340 Reward -121.000000 Average Reward -136.000000
Episode 350 Reward -124.000000 Average Reward -129.800000
Episode 360 Reward -112.000000 Average Reward -110.500000
Episode 370 Reward -138.000000 Average Reward -131.100000
Episode 380 Reward -111.000000 Average Reward -119.400000
Episode 390 Reward -87.000000 Average Reward -123.800000
Episode 400 Reward -111.000000 Average Reward -120.100000
Episode 410 Reward -134.000000 Average Reward -115.500000
Episode 420 Reward -95.000000 Average Reward -117.200000
Episode 430 Reward -128.000000 Average Reward -126.600000
Episode 440 Reward -109.000000 Average Reward -109.900000
Episode 450 Reward -136.000000 Average Reward -112.300000
Episode 460 Reward -149.000000 Average Reward -131.300000
Episode 470 Reward -119.000000 Average Reward -118.400000
Episode 480 Reward -116.000000 Average Reward -107.800000
Episode 490 Reward -147.000000 Average Reward -137.700000
Episode 500 Reward -103.000000 Average Reward -115.100000
Episode 510 Reward -100.000000 Average Reward -109.700000
Episode 520 Reward -90.000000 Average Reward -108.600000
Episode 530 Reward -146.000000 Average Reward -115.200000
Episode 540 Reward -110.000000 Average Reward -114.700000
Episode 550 Reward -100.000000 Average Reward -116.200000
Episode 560 Reward -89.000000 Average Reward -113.400000
Episode 570 Reward -105.000000 Average Reward -114.900000
Episode 580 Reward -92.000000 Average Reward -112.000000
Episode 590 Reward -100.000000 Average Reward -105.900000
Episode 600 Reward -122.000000 Average Reward -114.100000
Episode 610 Reward -80.000000 Average Reward -101.900000
Episode 620 Reward -119.000000 Average Reward -96.000000
Episode 630 Reward -93.000000 Average Reward -100.500000
Episode 640 Reward -131.000000 Average Reward -102.800000
Episode 650 Reward -106.000000 Average Reward -110.300000
Episode 660 Reward -112.000000 Average Reward -96.800000
Episode 670 Reward -90.000000 Average Reward -110.600000
Episode 680 Reward -90.000000 Average Reward -109.500000
Episode 690 Reward -101.000000 Average Reward -123.600000
Episode 700 Reward -75.000000 Average Reward -105.100000
Episode 710 Reward -90.000000 Average Reward -105.300000
Episode 720 Reward -274.000000 Average Reward -149.400000
Episode 730 Reward -121.000000 Average Reward -110.600000
Episode 740 Reward -204.000000 Average Reward -116.400000
Episode 750 Reward -82.000000 Average Reward -96.000000
Episode 760 Reward -129.000000 Average Reward -107.200000

Episode 770 Reward -106.000000 Average Reward -106.700000
 Episode 780 Reward -101.000000 Average Reward -94.200000
 Episode 790 Reward -77.000000 Average Reward -86.400000
 Episode 800 Reward -106.000000 Average Reward -89.800000
 Episode 810 Reward -74.000000 Average Reward -99.900000
 Episode 820 Reward -85.000000 Average Reward -95.600000
 Episode 830 Reward -86.000000 Average Reward -93.900000
 Episode 840 Reward -88.000000 Average Reward -89.700000
 Episode 850 Reward -89.000000 Average Reward -87.200000
 Episode 860 Reward -96.000000 Average Reward -92.400000
 Episode 870 Reward -92.000000 Average Reward -96.400000
 Episode 880 Reward -68.000000 Average Reward -98.600000
 Episode 890 Reward -85.000000 Average Reward -90.700000
 Episode 900 Reward -102.000000 Average Reward -90.800000
 Episode 910 Reward -90.000000 Average Reward -90.100000
 Episode 920 Reward -117.000000 Average Reward -88.400000
 Episode 930 Reward -96.000000 Average Reward -93.600000
 Episode 940 Reward -123.000000 Average Reward -98.200000
 Episode 950 Reward -85.000000 Average Reward -98.900000
 Episode 960 Reward -107.000000 Average Reward -112.500000
 Episode 970 Reward -94.000000 Average Reward -93.500000
 Episode 980 Reward -86.000000 Average Reward -90.600000
 Episode 990 Reward -181.000000 Average Reward -102.100000
 Episode 1000 Reward -96.000000 Average Reward -92.800000
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Episode 10 Reward -426.000000 Average Reward -491.700000
 Episode 20 Reward -302.000000 Average Reward -409.600000
 Episode 30 Reward -431.000000 Average Reward -374.700000
 Episode 40 Reward -500.000000 Average Reward -382.200000
 Episode 50 Reward -409.000000 Average Reward -377.600000
 Episode 60 Reward -285.000000 Average Reward -326.900000
 Episode 70 Reward -247.000000 Average Reward -390.200000
 Episode 80 Reward -500.000000 Average Reward -480.700000
 Episode 90 Reward -431.000000 Average Reward -459.100000
 Episode 100 Reward -235.000000 Average Reward -401.300000
 Episode 110 Reward -388.000000 Average Reward -374.200000
 Episode 120 Reward -145.000000 Average Reward -262.900000
 Episode 130 Reward -298.000000 Average Reward -297.300000
 Episode 140 Reward -171.000000 Average Reward -277.900000
 Episode 150 Reward -267.000000 Average Reward -269.700000
 Episode 160 Reward -249.000000 Average Reward -225.500000
 Episode 170 Reward -255.000000 Average Reward -261.800000
 Episode 180 Reward -248.000000 Average Reward -239.600000
 Episode 190 Reward -203.000000 Average Reward -203.900000
 Episode 200 Reward -199.000000 Average Reward -222.100000
 Episode 210 Reward -145.000000 Average Reward -188.300000
 Episode 220 Reward -255.000000 Average Reward -231.000000
 Episode 230 Reward -287.000000 Average Reward -208.100000

Episode 240 Reward -224.000000 Average Reward -231.500000
Episode 250 Reward -182.000000 Average Reward -176.500000
Episode 260 Reward -136.000000 Average Reward -196.700000
Episode 270 Reward -157.000000 Average Reward -172.700000
Episode 280 Reward -153.000000 Average Reward -196.600000
Episode 290 Reward -119.000000 Average Reward -162.800000
Episode 300 Reward -143.000000 Average Reward -153.300000
Episode 310 Reward -138.000000 Average Reward -146.800000
Episode 320 Reward -268.000000 Average Reward -164.100000
Episode 330 Reward -182.000000 Average Reward -176.700000
Episode 340 Reward -159.000000 Average Reward -152.900000
Episode 350 Reward -234.000000 Average Reward -175.800000
Episode 360 Reward -164.000000 Average Reward -154.500000
Episode 370 Reward -125.000000 Average Reward -153.900000
Episode 380 Reward -144.000000 Average Reward -175.600000
Episode 390 Reward -115.000000 Average Reward -159.900000
Episode 400 Reward -206.000000 Average Reward -161.800000
Episode 410 Reward -137.000000 Average Reward -132.600000
Episode 420 Reward -173.000000 Average Reward -152.400000
Episode 430 Reward -156.000000 Average Reward -139.600000
Episode 440 Reward -127.000000 Average Reward -135.800000
Episode 450 Reward -104.000000 Average Reward -130.700000
Episode 460 Reward -151.000000 Average Reward -134.400000
Episode 470 Reward -147.000000 Average Reward -175.700000
Episode 480 Reward -145.000000 Average Reward -149.000000
Episode 490 Reward -212.000000 Average Reward -146.400000
Episode 500 Reward -178.000000 Average Reward -175.900000
Episode 510 Reward -101.000000 Average Reward -141.700000
Episode 520 Reward -125.000000 Average Reward -145.800000
Episode 530 Reward -111.000000 Average Reward -129.300000
Episode 540 Reward -88.000000 Average Reward -124.300000
Episode 550 Reward -114.000000 Average Reward -130.500000
Episode 560 Reward -136.000000 Average Reward -131.100000
Episode 570 Reward -120.000000 Average Reward -143.600000
Episode 580 Reward -153.000000 Average Reward -143.500000
Episode 590 Reward -106.000000 Average Reward -122.300000
Episode 600 Reward -229.000000 Average Reward -138.200000
Episode 610 Reward -145.000000 Average Reward -114.700000
Episode 620 Reward -115.000000 Average Reward -154.900000
Episode 630 Reward -184.000000 Average Reward -122.500000
Episode 640 Reward -105.000000 Average Reward -116.000000
Episode 650 Reward -121.000000 Average Reward -129.300000
Episode 660 Reward -115.000000 Average Reward -120.100000
Episode 670 Reward -126.000000 Average Reward -138.500000
Episode 680 Reward -139.000000 Average Reward -121.100000
Episode 690 Reward -122.000000 Average Reward -132.200000
Episode 700 Reward -113.000000 Average Reward -147.700000
Episode 710 Reward -119.000000 Average Reward -108.800000

Episode 720 Reward -144.000000 Average Reward -120.100000
 Episode 730 Reward -265.000000 Average Reward -140.300000
 Episode 740 Reward -116.000000 Average Reward -108.300000
 Episode 750 Reward -156.000000 Average Reward -129.600000
 Episode 760 Reward -105.000000 Average Reward -104.600000
 Episode 770 Reward -98.000000 Average Reward -118.900000
 Episode 780 Reward -111.000000 Average Reward -132.600000
 Episode 790 Reward -122.000000 Average Reward -131.800000
 Episode 800 Reward -160.000000 Average Reward -124.500000
 Episode 810 Reward -103.000000 Average Reward -112.300000
 Episode 820 Reward -100.000000 Average Reward -116.900000
 Episode 830 Reward -78.000000 Average Reward -108.200000
 Episode 840 Reward -107.000000 Average Reward -132.400000
 Episode 850 Reward -105.000000 Average Reward -122.600000
 Episode 860 Reward -99.000000 Average Reward -145.300000
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 Episode 880 Reward -93.000000 Average Reward -106.900000
 Episode 890 Reward -112.000000 Average Reward -115.500000
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 Episode 910 Reward -95.000000 Average Reward -143.200000
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 Episode 930 Reward -152.000000 Average Reward -104.100000
 Episode 940 Reward -94.000000 Average Reward -131.700000
 Episode 950 Reward -106.000000 Average Reward -103.900000
 Episode 960 Reward -101.000000 Average Reward -111.600000
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 Episode 50 Reward -353.000000 Average Reward -341.000000
 Episode 60 Reward -244.000000 Average Reward -347.900000
 Episode 70 Reward -412.000000 Average Reward -432.900000
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 Episode 120 Reward -314.000000 Average Reward -263.500000
 Episode 130 Reward -274.000000 Average Reward -245.600000
 Episode 140 Reward -357.000000 Average Reward -276.700000
 Episode 150 Reward -252.000000 Average Reward -286.700000
 Episode 160 Reward -215.000000 Average Reward -233.900000
 Episode 170 Reward -213.000000 Average Reward -213.700000
 Episode 180 Reward -209.000000 Average Reward -251.000000

Episode	190	Reward	-238.000000	Average Reward	-250.500000
Episode	200	Reward	-232.000000	Average Reward	-268.600000
Episode	210	Reward	-333.000000	Average Reward	-332.400000
Episode	220	Reward	-318.000000	Average Reward	-353.400000
Episode	230	Reward	-379.000000	Average Reward	-355.600000
Episode	240	Reward	-343.000000	Average Reward	-339.800000
Episode	250	Reward	-321.000000	Average Reward	-329.600000
Episode	260	Reward	-357.000000	Average Reward	-258.900000
Episode	270	Reward	-266.000000	Average Reward	-269.000000
Episode	280	Reward	-254.000000	Average Reward	-248.200000
Episode	290	Reward	-216.000000	Average Reward	-206.900000
Episode	300	Reward	-193.000000	Average Reward	-209.100000
Episode	310	Reward	-299.000000	Average Reward	-219.900000
Episode	320	Reward	-154.000000	Average Reward	-178.100000
Episode	330	Reward	-184.000000	Average Reward	-193.500000
Episode	340	Reward	-156.000000	Average Reward	-188.700000
Episode	350	Reward	-182.000000	Average Reward	-204.400000
Episode	360	Reward	-128.000000	Average Reward	-188.400000
Episode	370	Reward	-218.000000	Average Reward	-208.100000
Episode	380	Reward	-248.000000	Average Reward	-176.000000
Episode	390	Reward	-170.000000	Average Reward	-180.500000
Episode	400	Reward	-183.000000	Average Reward	-162.900000
Episode	410	Reward	-160.000000	Average Reward	-164.400000
Episode	420	Reward	-174.000000	Average Reward	-160.900000
Episode	430	Reward	-120.000000	Average Reward	-150.100000
Episode	440	Reward	-153.000000	Average Reward	-165.600000
Episode	450	Reward	-135.000000	Average Reward	-156.300000
Episode	460	Reward	-155.000000	Average Reward	-158.600000
Episode	470	Reward	-168.000000	Average Reward	-137.900000
Episode	480	Reward	-148.000000	Average Reward	-121.200000
Episode	490	Reward	-166.000000	Average Reward	-142.200000
Episode	500	Reward	-120.000000	Average Reward	-137.600000
Episode	510	Reward	-192.000000	Average Reward	-138.300000
Episode	520	Reward	-500.000000	Average Reward	-160.400000
Episode	530	Reward	-124.000000	Average Reward	-136.000000
Episode	540	Reward	-130.000000	Average Reward	-127.100000
Episode	550	Reward	-135.000000	Average Reward	-137.900000
Episode	560	Reward	-162.000000	Average Reward	-140.200000
Episode	570	Reward	-129.000000	Average Reward	-125.600000
Episode	580	Reward	-91.000000	Average Reward	-129.900000
Episode	590	Reward	-120.000000	Average Reward	-109.600000
Episode	600	Reward	-210.000000	Average Reward	-135.000000
Episode	610	Reward	-112.000000	Average Reward	-123.000000
Episode	620	Reward	-134.000000	Average Reward	-133.900000
Episode	630	Reward	-94.000000	Average Reward	-145.700000
Episode	640	Reward	-169.000000	Average Reward	-125.200000
Episode	650	Reward	-109.000000	Average Reward	-121.900000
Episode	660	Reward	-101.000000	Average Reward	-111.000000

Episode 670 Reward -101.000000 Average Reward -125.200000
 Episode 680 Reward -110.000000 Average Reward -123.300000
 Episode 690 Reward -104.000000 Average Reward -121.200000
 Episode 700 Reward -105.000000 Average Reward -122.500000
 Episode 710 Reward -91.000000 Average Reward -121.100000
 Episode 720 Reward -121.000000 Average Reward -118.000000
 Episode 730 Reward -85.000000 Average Reward -128.800000
 Episode 740 Reward -123.000000 Average Reward -120.700000
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 Episode 760 Reward -141.000000 Average Reward -122.800000
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 Episode 860 Reward -98.000000 Average Reward -107.700000
 Episode 870 Reward -153.000000 Average Reward -112.700000
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 Episode 890 Reward -101.000000 Average Reward -101.000000
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 Episode 940 Reward -164.000000 Average Reward -133.400000
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 Episode 960 Reward -153.000000 Average Reward -113.700000
 Episode 970 Reward -90.000000 Average Reward -95.100000
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 Episode 70 Reward -322.000000 Average Reward -433.800000
 Episode 80 Reward -352.000000 Average Reward -470.400000
 Episode 90 Reward -336.000000 Average Reward -349.200000
 Episode 100 Reward -393.000000 Average Reward -357.000000
 Episode 110 Reward -293.000000 Average Reward -307.800000
 Episode 120 Reward -237.000000 Average Reward -288.300000
 Episode 130 Reward -236.000000 Average Reward -242.400000

Episode 140 Reward -166.000000 Average Reward -211.700000
Episode 150 Reward -261.000000 Average Reward -215.300000
Episode 160 Reward -216.000000 Average Reward -198.000000
Episode 170 Reward -168.000000 Average Reward -215.000000
Episode 180 Reward -218.000000 Average Reward -223.400000
Episode 190 Reward -284.000000 Average Reward -210.000000
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Episode 210 Reward -181.000000 Average Reward -197.400000
Episode 220 Reward -141.000000 Average Reward -179.800000
Episode 230 Reward -107.000000 Average Reward -170.800000
Episode 240 Reward -243.000000 Average Reward -181.900000
Episode 250 Reward -135.000000 Average Reward -153.700000
Episode 260 Reward -215.000000 Average Reward -163.400000
Episode 270 Reward -192.000000 Average Reward -158.100000
Episode 280 Reward -189.000000 Average Reward -189.100000
Episode 290 Reward -189.000000 Average Reward -162.600000
Episode 300 Reward -100.000000 Average Reward -152.500000
Episode 310 Reward -125.000000 Average Reward -142.000000
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Episode 330 Reward -110.000000 Average Reward -141.200000
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Episode 360 Reward -142.000000 Average Reward -140.400000
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Episode 390 Reward -191.000000 Average Reward -142.700000
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Episode 410 Reward -92.000000 Average Reward -128.800000
Episode 420 Reward -127.000000 Average Reward -138.400000
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Episode 440 Reward -107.000000 Average Reward -148.300000
Episode 450 Reward -116.000000 Average Reward -131.600000
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Episode 490 Reward -119.000000 Average Reward -140.800000
Episode 500 Reward -140.000000 Average Reward -137.300000
Episode 510 Reward -121.000000 Average Reward -135.900000
Episode 520 Reward -134.000000 Average Reward -137.900000
Episode 530 Reward -120.000000 Average Reward -129.200000
Episode 540 Reward -142.000000 Average Reward -121.200000
Episode 550 Reward -112.000000 Average Reward -117.700000
Episode 560 Reward -114.000000 Average Reward -145.900000
Episode 570 Reward -113.000000 Average Reward -134.300000
Episode 580 Reward -124.000000 Average Reward -126.100000
Episode 590 Reward -127.000000 Average Reward -106.900000
Episode 600 Reward -128.000000 Average Reward -121.800000
Episode 610 Reward -144.000000 Average Reward -127.600000

Episode 620 Reward -193.000000 Average Reward -123.000000
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Episode 640 Reward -158.000000 Average Reward -130.400000
Episode 650 Reward -116.000000 Average Reward -121.100000
Episode 660 Reward -121.000000 Average Reward -124.700000
Episode 670 Reward -113.000000 Average Reward -111.000000
Episode 680 Reward -97.000000 Average Reward -130.000000
Episode 690 Reward -127.000000 Average Reward -138.100000
Episode 700 Reward -154.000000 Average Reward -117.500000
Episode 710 Reward -109.000000 Average Reward -113.300000
Episode 720 Reward -96.000000 Average Reward -112.500000
Episode 730 Reward -90.000000 Average Reward -112.200000
Episode 740 Reward -130.000000 Average Reward -105.000000
Episode 750 Reward -175.000000 Average Reward -115.700000
Episode 760 Reward -119.000000 Average Reward -113.400000
Episode 770 Reward -87.000000 Average Reward -98.500000
Episode 780 Reward -104.000000 Average Reward -109.900000
Episode 790 Reward -174.000000 Average Reward -121.900000
Episode 800 Reward -96.000000 Average Reward -118.900000
Episode 810 Reward -114.000000 Average Reward -97.900000
Episode 820 Reward -117.000000 Average Reward -105.800000
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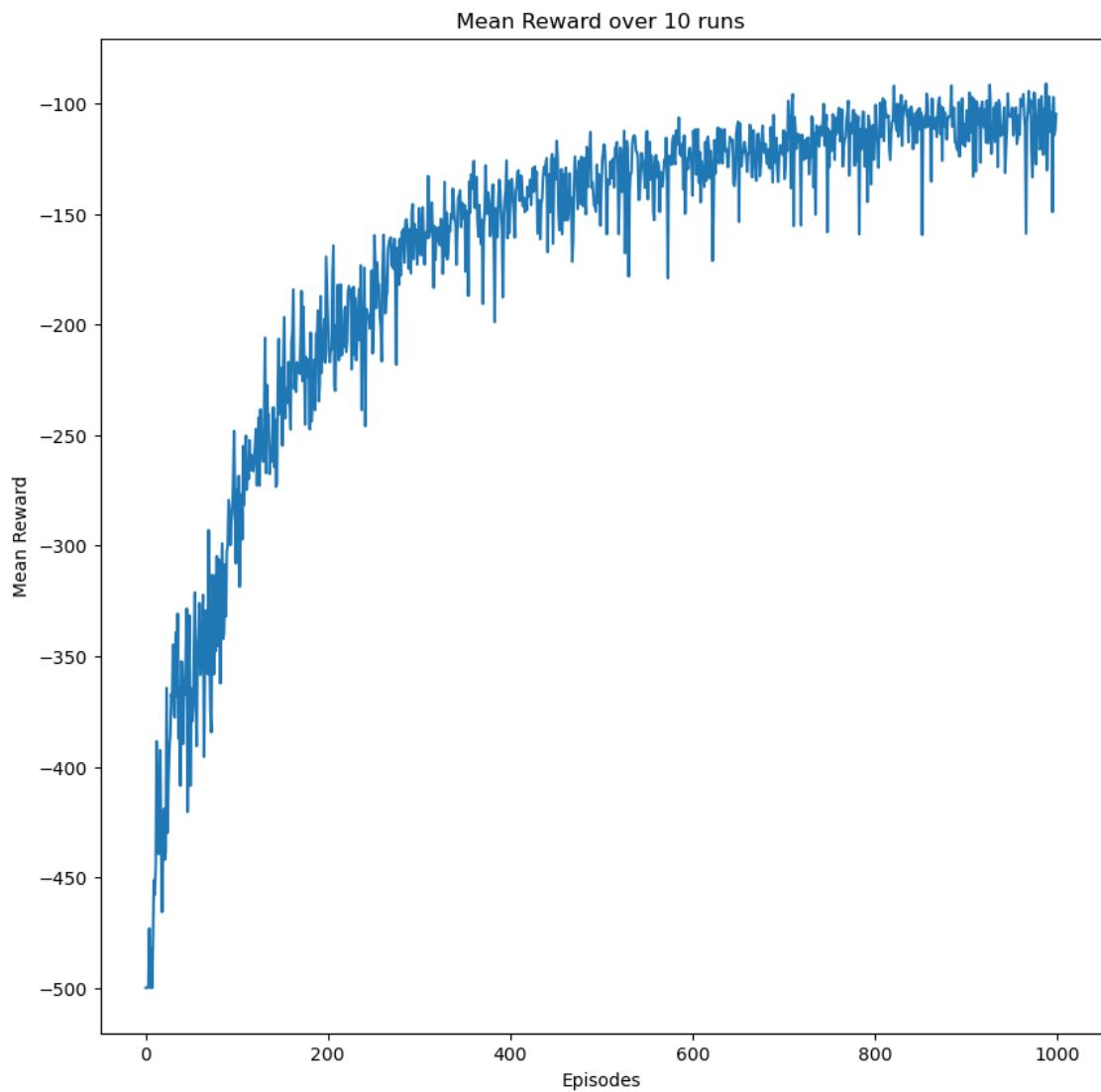
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Episode 220 Reward -199.000000 Average Reward -223.500000
Episode 230 Reward -392.000000 Average Reward -245.000000
Episode 240 Reward -326.000000 Average Reward -263.800000
Episode 250 Reward -234.000000 Average Reward -195.900000
Episode 260 Reward -269.000000 Average Reward -214.600000
Episode 270 Reward -153.000000 Average Reward -204.700000
Episode 280 Reward -162.000000 Average Reward -228.000000
Episode 290 Reward -225.000000 Average Reward -187.600000
Episode 300 Reward -177.000000 Average Reward -184.800000
Episode 310 Reward -250.000000 Average Reward -216.200000
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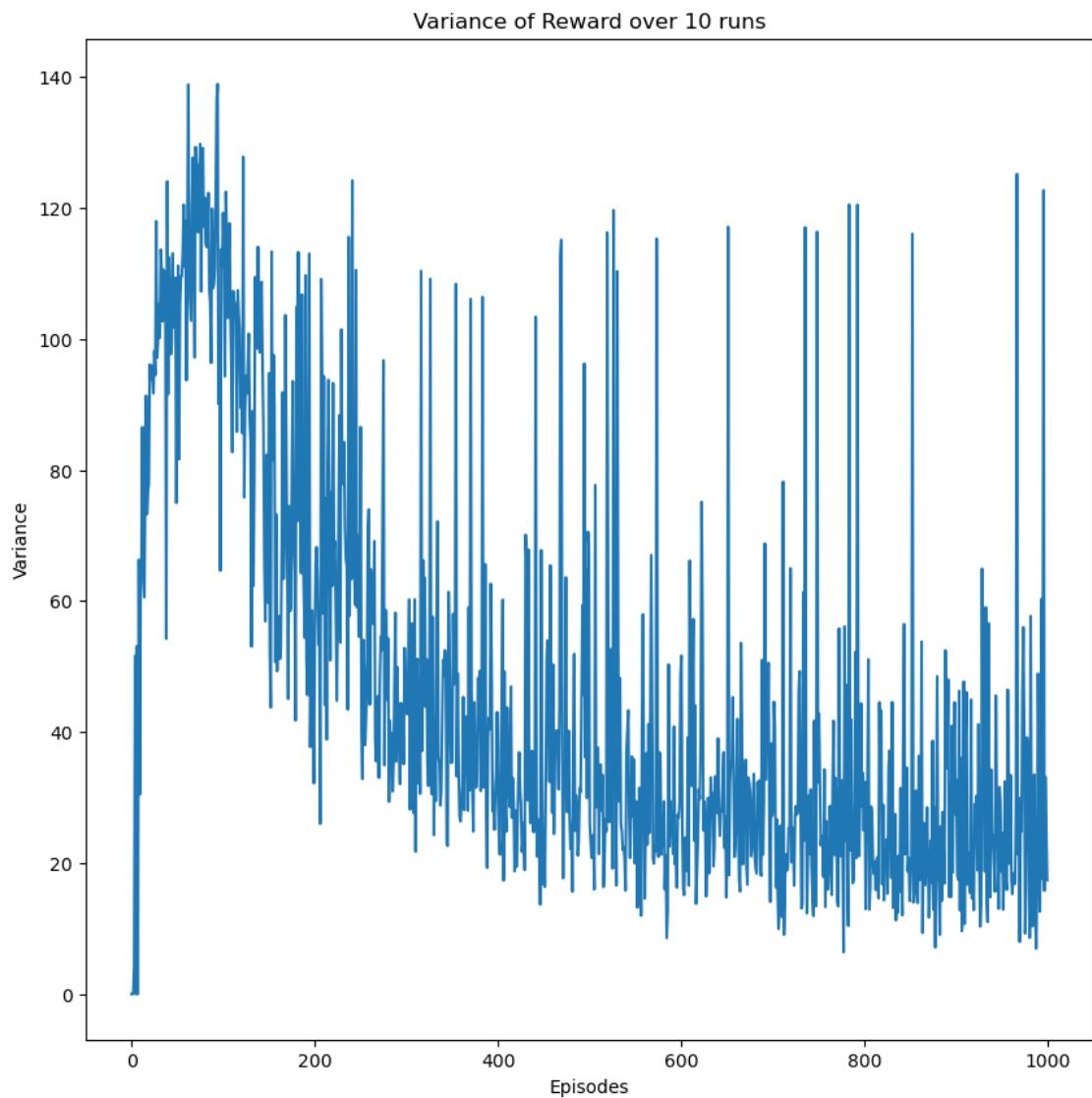
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Episode 670 Reward -124.000000 Average Reward -130.200000
Episode 680 Reward -206.000000 Average Reward -143.800000
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Episode 770 Reward -100.000000 Average Reward -120.600000
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Episode 790 Reward -145.000000 Average Reward -149.700000
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Episode 810 Reward -74.000000 Average Reward -113.800000
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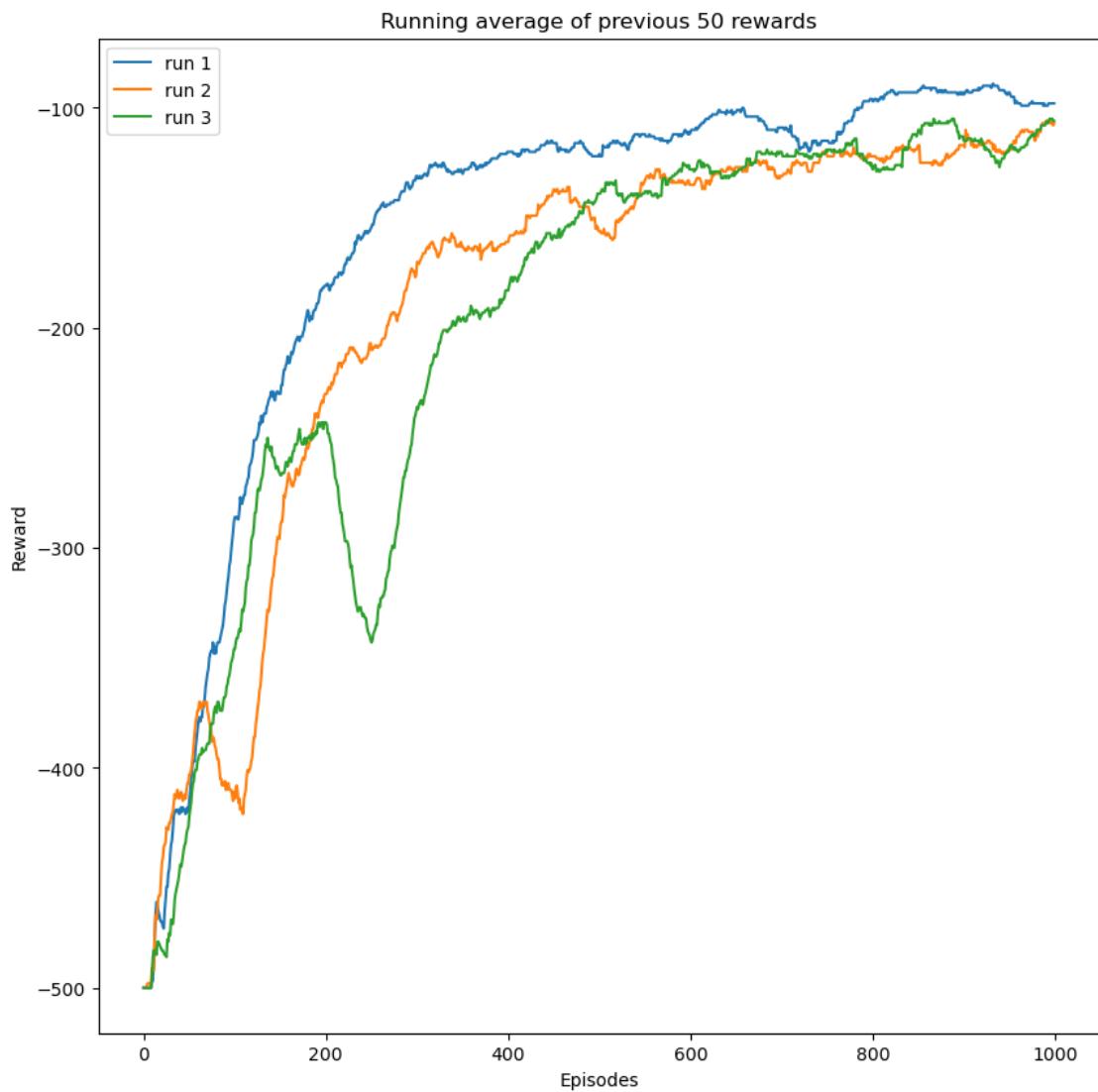
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Episode 150 Reward -155.000000 Average Reward -142.200000
Episode 160 Reward -176.000000 Average Reward -162.700000
Episode 170 Reward -140.000000 Average Reward -127.500000
Episode 180 Reward -156.000000 Average Reward -149.800000
Episode 190 Reward -131.000000 Average Reward -159.800000
Episode 200 Reward -172.000000 Average Reward -148.500000
Episode 210 Reward -179.000000 Average Reward -156.800000
Episode 220 Reward -166.000000 Average Reward -148.400000
Episode 230 Reward -157.000000 Average Reward -133.400000
Episode 240 Reward -107.000000 Average Reward -116.600000
Episode 250 Reward -155.000000 Average Reward -185.900000
Episode 260 Reward -294.000000 Average Reward -154.500000
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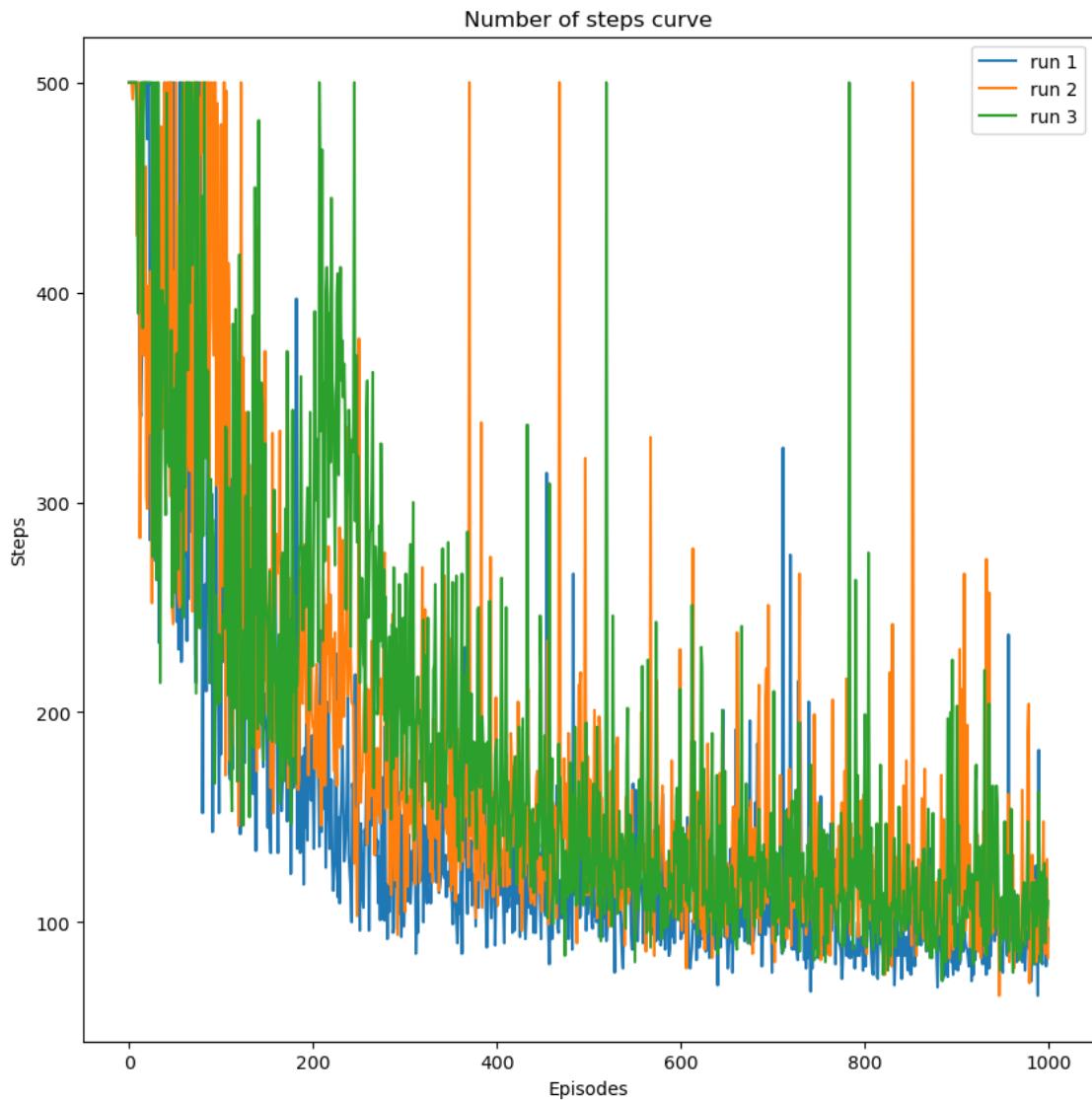
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Episode 360 Reward -114.000000 Average Reward -116.800000
Episode 370 Reward -139.000000 Average Reward -119.000000
Episode 380 Reward -117.000000 Average Reward -142.300000
Episode 390 Reward -112.000000 Average Reward -110.300000
Episode 400 Reward -101.000000 Average Reward -119.100000
Episode 410 Reward -120.000000 Average Reward -117.100000
Episode 420 Reward -137.000000 Average Reward -123.000000
Episode 430 Reward -140.000000 Average Reward -122.700000
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Episode 450 Reward -115.000000 Average Reward -118.200000
Episode 460 Reward -113.000000 Average Reward -120.900000
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Episode 490 Reward -93.000000 Average Reward -106.700000
Episode 500 Reward -100.000000 Average Reward -116.800000
Episode 510 Reward -116.000000 Average Reward -116.500000
Episode 520 Reward -98.000000 Average Reward -112.700000
Episode 530 Reward -113.000000 Average Reward -101.400000
Episode 540 Reward -127.000000 Average Reward -100.300000
Episode 550 Reward -151.000000 Average Reward -109.200000
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Episode 570 Reward -119.000000 Average Reward -117.500000
Episode 580 Reward -93.000000 Average Reward -106.800000
Episode 590 Reward -91.000000 Average Reward -123.400000
Episode 600 Reward -98.000000 Average Reward -105.500000
Episode 610 Reward -323.000000 Average Reward -128.000000
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Episode 670 Reward -85.000000 Average Reward -123.100000
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Episode 770 Reward -80.000000 Average Reward -96.500000
Episode 780 Reward -88.000000 Average Reward -92.100000
Episode 790 Reward -105.000000 Average Reward -101.100000

Episode 800 Reward -108.000000 Average Reward -144.000000
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Episode 890 Reward -213.000000 Average Reward -105.700000
Episode 900 Reward -162.000000 Average Reward -99.400000
Episode 910 Reward -87.000000 Average Reward -105.600000
Episode 920 Reward -94.000000 Average Reward -101.800000
Episode 930 Reward -114.000000 Average Reward -97.200000
Episode 940 Reward -78.000000 Average Reward -88.100000
Episode 950 Reward -135.000000 Average Reward -110.200000
Episode 960 Reward -79.000000 Average Reward -91.900000
Episode 970 Reward -97.000000 Average Reward -101.300000
Episode 980 Reward -157.000000 Average Reward -124.800000
Episode 990 Reward -95.000000 Average Reward -119.600000
Episode 1000 Reward -118.000000 Average Reward -94.300000
0:04:10.572704









```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [1024, 1024]
LR = 1e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'Acrobot-v1'
SOLVE_CUTOFF = -100.0
STEP = 50000

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{hs}-{lr}-{env}-{numep}-{nstep}-{STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	-391.000000	-440.100000
20	-458.000000	-474.900000
30	-500.000000	-488.700000
40	-500.000000	-486.200000
50	-318.000000	-481.800000
60	-500.000000	-466.000000
70	-453.000000	-495.300000
80	-410.000000	-471.500000
90	-260.000000	-400.400000
100	-219.000000	-302.600000
110	-186.000000	-177.400000
120	-143.000000	-175.100000
130	-181.000000	-173.000000
140	-172.000000	-181.500000
150	-276.000000	-201.400000
160	-149.000000	-193.400000
170	-148.000000	-177.700000
180	-176.000000	-191.300000
190	-184.000000	-185.800000
200	-195.000000	-197.500000
210	-169.000000	-154.600000
220	-176.000000	-166.700000
230	-204.000000	-169.600000
240	-188.000000	-175.200000
250	-139.000000	-163.900000
260	-148.000000	-163.500000
270	-155.000000	-181.500000
280	-170.000000	-177.500000

Episode 290 Reward -162.000000 Average Reward -187.300000
Episode 300 Reward -162.000000 Average Reward -151.700000
Episode 310 Reward -173.000000 Average Reward -183.700000
Episode 320 Reward -126.000000 Average Reward -153.600000
Episode 330 Reward -145.000000 Average Reward -193.100000
Episode 340 Reward -114.000000 Average Reward -140.100000
Episode 350 Reward -218.000000 Average Reward -152.700000
Episode 360 Reward -143.000000 Average Reward -140.100000
Episode 370 Reward -106.000000 Average Reward -132.900000
Episode 380 Reward -109.000000 Average Reward -128.200000
Episode 390 Reward -102.000000 Average Reward -120.800000
Episode 400 Reward -103.000000 Average Reward -128.900000
Episode 410 Reward -110.000000 Average Reward -122.800000
Episode 420 Reward -91.000000 Average Reward -111.400000
Episode 430 Reward -98.000000 Average Reward -136.200000
Episode 440 Reward -91.000000 Average Reward -95.400000
Episode 450 Reward -97.000000 Average Reward -96.400000
Episode 460 Reward -134.000000 Average Reward -94.000000
Episode 470 Reward -83.000000 Average Reward -107.500000
Episode 480 Reward -95.000000 Average Reward -100.200000
Episode 490 Reward -87.000000 Average Reward -118.200000
Episode 500 Reward -80.000000 Average Reward -108.100000
Episode 510 Reward -86.000000 Average Reward -90.600000
Episode 520 Reward -88.000000 Average Reward -91.400000
Episode 530 Reward -87.000000 Average Reward -94.000000
Episode 540 Reward -90.000000 Average Reward -111.700000
Episode 550 Reward -124.000000 Average Reward -97.000000
Episode 560 Reward -103.000000 Average Reward -95.200000
Episode 570 Reward -77.000000 Average Reward -82.600000
Episode 580 Reward -106.000000 Average Reward -89.800000
Episode 590 Reward -74.000000 Average Reward -105.900000
Episode 600 Reward -88.000000 Average Reward -97.500000
Episode 610 Reward -76.000000 Average Reward -90.000000
Episode 620 Reward -93.000000 Average Reward -109.700000
Episode 630 Reward -85.000000 Average Reward -95.900000
Episode 640 Reward -149.000000 Average Reward -91.300000
Episode 650 Reward -80.000000 Average Reward -82.800000
Episode 660 Reward -98.000000 Average Reward -107.400000
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Episode 980 Reward -93.000000 Average Reward -101.100000
Episode 990 Reward -89.000000 Average Reward -87.900000
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Episode 50 Reward -232.000000 Average Reward -258.600000
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Episode 70 Reward -257.000000 Average Reward -282.300000
Episode 80 Reward -206.000000 Average Reward -266.300000
Episode 90 Reward -266.000000 Average Reward -237.800000
Episode 100 Reward -192.000000 Average Reward -229.400000
Episode 110 Reward -150.000000 Average Reward -187.400000
Episode 120 Reward -157.000000 Average Reward -184.100000
Episode 130 Reward -137.000000 Average Reward -206.600000
Episode 140 Reward -205.000000 Average Reward -178.100000
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Episode 720 Reward -105.000000 Average Reward -110.000000
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Episode 980 Reward -82.000000 Average Reward -93.300000
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Episode 310 Reward -161.000000 Average Reward -162.600000
Episode 320 Reward -129.000000 Average Reward -132.500000
Episode 330 Reward -202.000000 Average Reward -145.200000
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Episode 350 Reward -116.000000 Average Reward -154.500000
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Episode 400 Reward -133.000000 Average Reward -126.000000
Episode 410 Reward -143.000000 Average Reward -161.000000
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Episode 430 Reward -110.000000 Average Reward -133.900000
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Episode 460 Reward -109.000000 Average Reward -127.800000

Episode 470 Reward -131.000000 Average Reward -121.700000
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Episode 490 Reward -111.000000 Average Reward -134.900000
Episode 500 Reward -136.000000 Average Reward -130.800000
Episode 510 Reward -127.000000 Average Reward -129.800000
Episode 520 Reward -107.000000 Average Reward -146.300000
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Episode 540 Reward -101.000000 Average Reward -122.400000
Episode 550 Reward -100.000000 Average Reward -109.500000
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Episode 570 Reward -102.000000 Average Reward -139.700000
Episode 580 Reward -87.000000 Average Reward -100.100000
Episode 590 Reward -86.000000 Average Reward -111.900000
Episode 600 Reward -96.000000 Average Reward -132.500000
Episode 610 Reward -120.000000 Average Reward -125.700000
Episode 620 Reward -148.000000 Average Reward -138.900000
Episode 630 Reward -160.000000 Average Reward -134.200000
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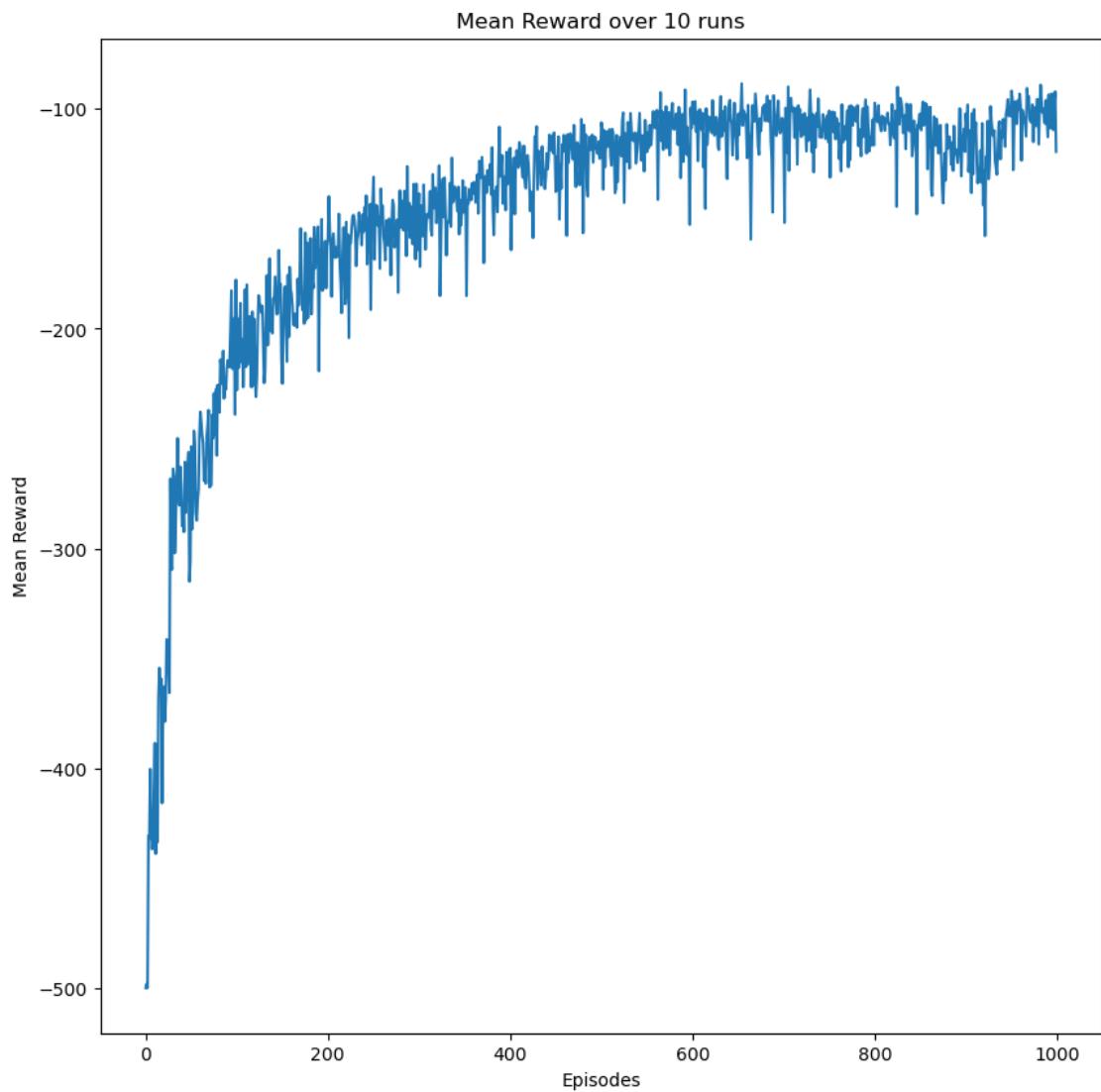
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Episode 490 Reward -89.000000 Average Reward -99.500000
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Episode 590 Reward -79.000000 Average Reward -92.100000
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Episode 750 Reward -112.000000 Average Reward -90.600000
Episode 760 Reward -65.000000 Average Reward -80.800000
Episode 770 Reward -105.000000 Average Reward -94.800000
Episode 780 Reward -102.000000 Average Reward -88.000000
Episode 790 Reward -86.000000 Average Reward -80.700000
Episode 800 Reward -81.000000 Average Reward -85.600000
Episode 810 Reward -91.000000 Average Reward -100.500000
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Episode 840 Reward -74.000000 Average Reward -91.400000

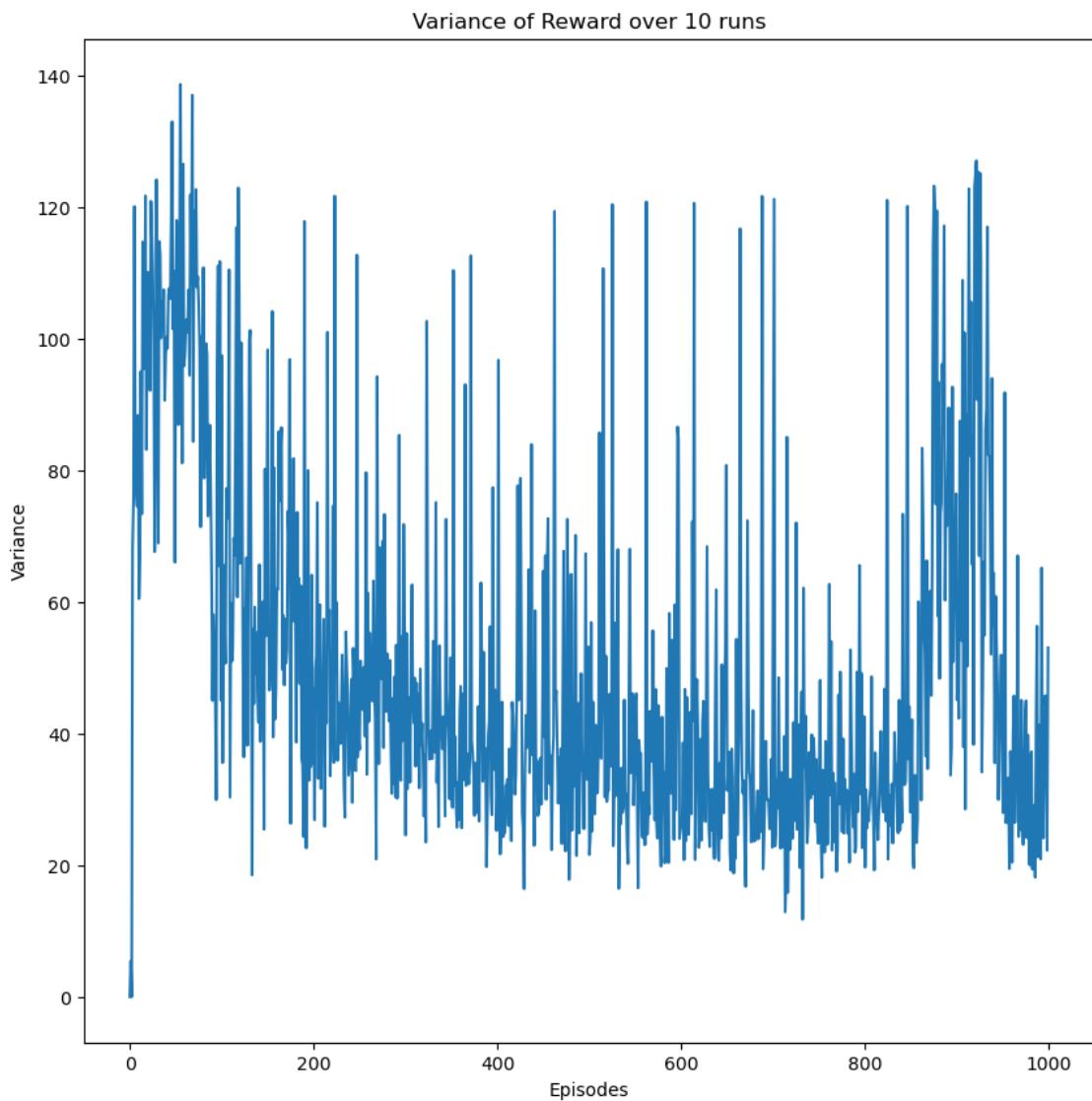
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Episode 900 Reward -95.000000 Average Reward -87.000000
Episode 910 Reward -92.000000 Average Reward -86.700000
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Episode 930 Reward -85.000000 Average Reward -88.000000
Episode 940 Reward -95.000000 Average Reward -108.100000
Episode 950 Reward -92.000000 Average Reward -90.300000
Episode 960 Reward -100.000000 Average Reward -82.600000
Episode 970 Reward -82.000000 Average Reward -95.700000
Episode 980 Reward -86.000000 Average Reward -84.000000
Episode 990 Reward -76.000000 Average Reward -88.300000
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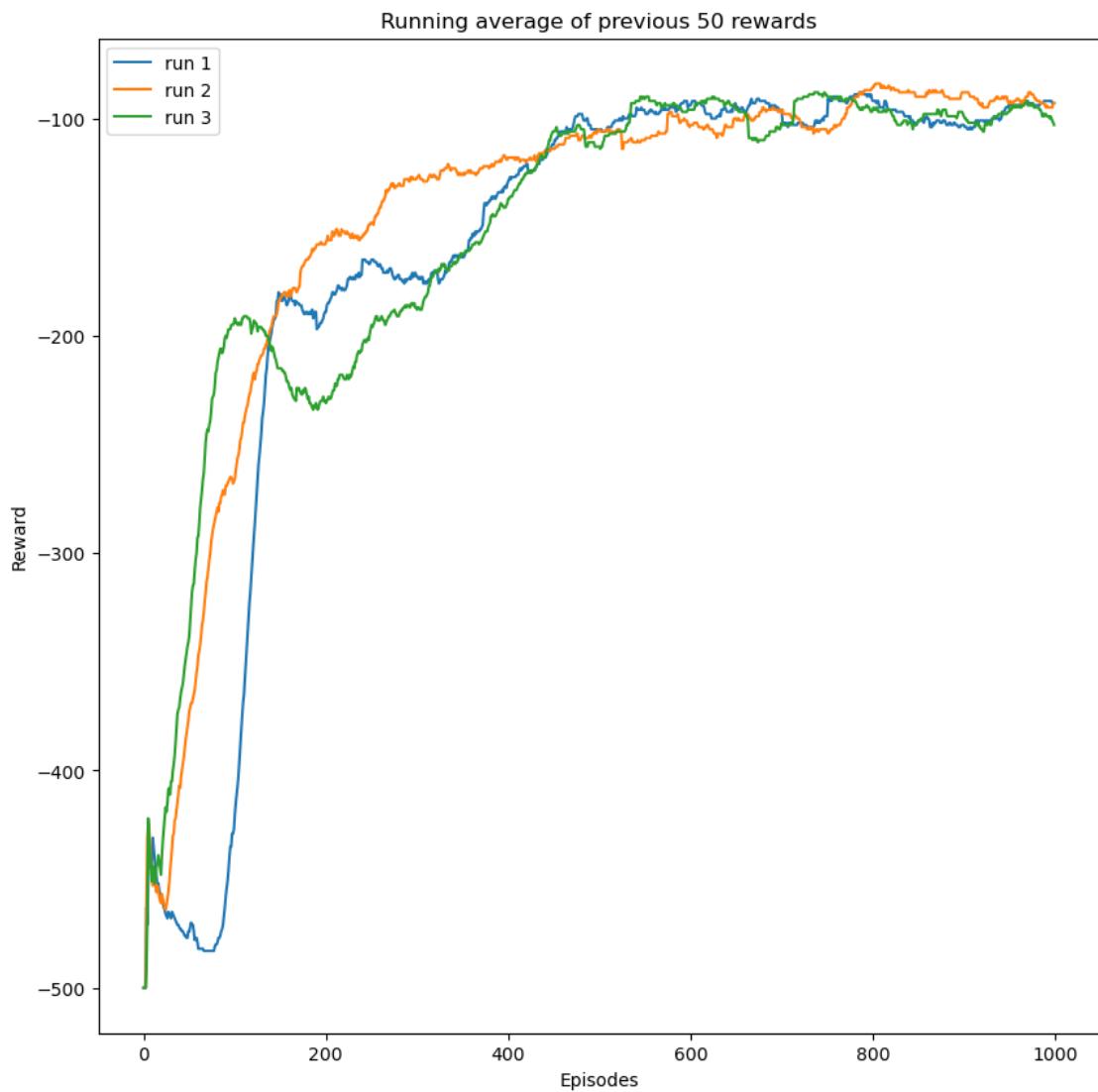
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Episode 50 Reward -299.000000 Average Reward -212.900000
Episode 60 Reward -249.000000 Average Reward -195.900000
Episode 70 Reward -159.000000 Average Reward -169.100000
Episode 80 Reward -158.000000 Average Reward -175.500000
Episode 90 Reward -171.000000 Average Reward -181.300000
Episode 100 Reward -206.000000 Average Reward -221.400000
Episode 110 Reward -214.000000 Average Reward -229.800000
Episode 120 Reward -258.000000 Average Reward -296.200000
Episode 130 Reward -251.000000 Average Reward -249.000000
Episode 140 Reward -221.000000 Average Reward -255.300000
Episode 150 Reward -195.000000 Average Reward -204.500000
Episode 160 Reward -279.000000 Average Reward -258.700000
Episode 170 Reward -316.000000 Average Reward -328.600000
Episode 180 Reward -232.000000 Average Reward -276.500000
Episode 190 Reward -153.000000 Average Reward -246.900000
Episode 200 Reward -193.000000 Average Reward -221.500000
Episode 210 Reward -202.000000 Average Reward -230.500000
Episode 220 Reward -265.000000 Average Reward -249.700000
Episode 230 Reward -164.000000 Average Reward -208.800000
Episode 240 Reward -176.000000 Average Reward -206.200000
Episode 250 Reward -190.000000 Average Reward -196.200000
Episode 260 Reward -203.000000 Average Reward -225.900000
Episode 270 Reward -181.000000 Average Reward -200.800000
Episode 280 Reward -146.000000 Average Reward -215.800000
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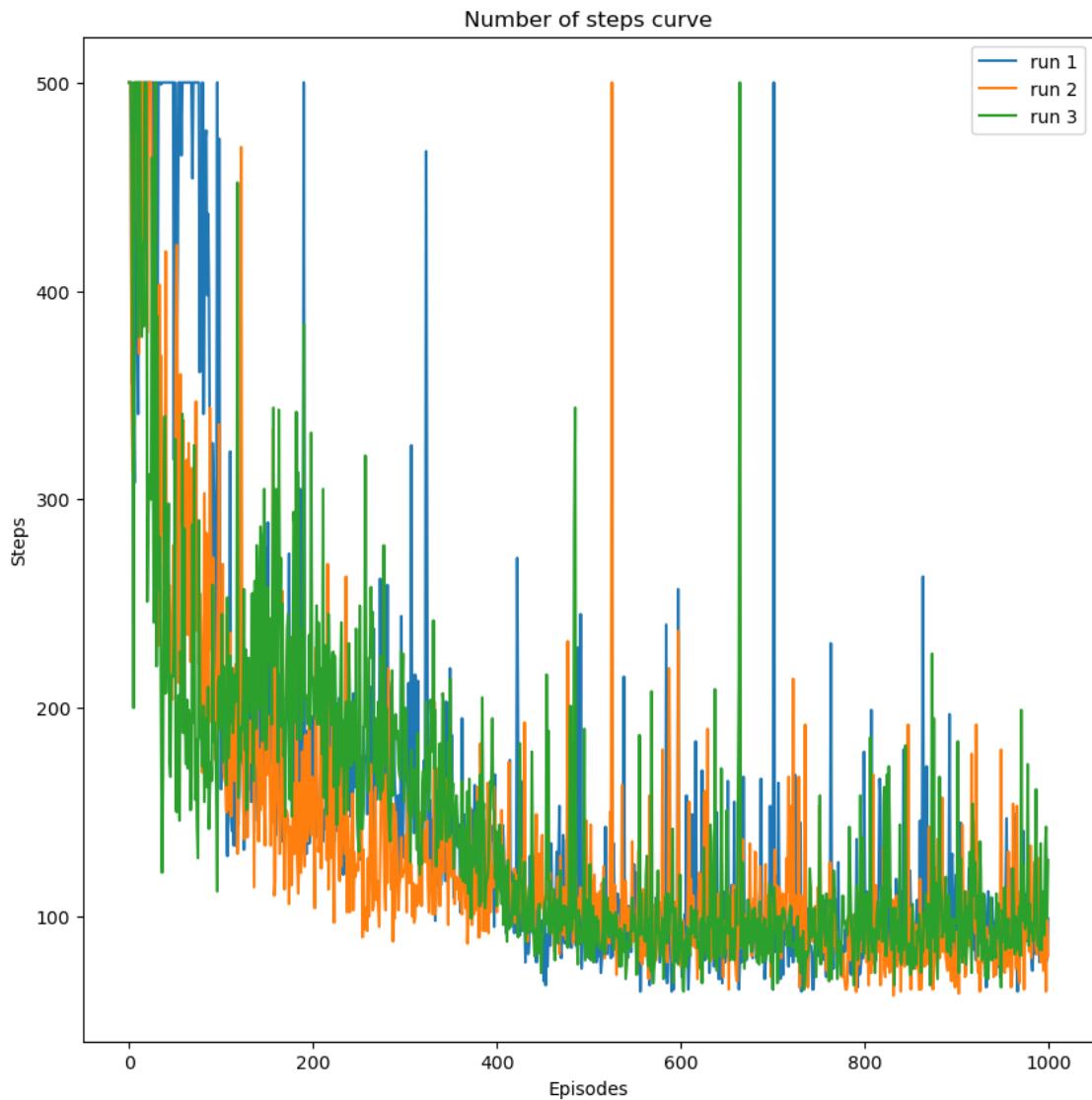
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Episode 360 Reward -171.000000 Average Reward -172.600000
Episode 370 Reward -168.000000 Average Reward -187.400000
Episode 380 Reward -173.000000 Average Reward -176.000000
Episode 390 Reward -190.000000 Average Reward -211.800000
Episode 400 Reward -151.000000 Average Reward -211.600000
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Episode 420 Reward -182.000000 Average Reward -168.100000
Episode 430 Reward -149.000000 Average Reward -206.700000
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Episode 450 Reward -150.000000 Average Reward -169.800000
Episode 460 Reward -143.000000 Average Reward -219.300000
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Episode 480 Reward -147.000000 Average Reward -171.600000
Episode 490 Reward -139.000000 Average Reward -160.200000
Episode 500 Reward -138.000000 Average Reward -179.900000
Episode 510 Reward -168.000000 Average Reward -166.900000
Episode 520 Reward -175.000000 Average Reward -232.800000
Episode 530 Reward -186.000000 Average Reward -185.000000
Episode 540 Reward -162.000000 Average Reward -177.600000
Episode 550 Reward -204.000000 Average Reward -191.100000
Episode 560 Reward -176.000000 Average Reward -182.900000
Episode 570 Reward -272.000000 Average Reward -166.300000
Episode 580 Reward -195.000000 Average Reward -172.800000
Episode 590 Reward -182.000000 Average Reward -171.000000
Episode 600 Reward -152.000000 Average Reward -184.300000
Episode 610 Reward -174.000000 Average Reward -179.100000
Episode 620 Reward -142.000000 Average Reward -197.600000
Episode 630 Reward -136.000000 Average Reward -170.800000
Episode 640 Reward -170.000000 Average Reward -178.300000
Episode 650 Reward -356.000000 Average Reward -191.600000
Episode 660 Reward -123.000000 Average Reward -150.000000
Episode 670 Reward -152.000000 Average Reward -163.400000
Episode 680 Reward -155.000000 Average Reward -173.900000
Episode 690 Reward -147.000000 Average Reward -164.100000
Episode 700 Reward -169.000000 Average Reward -165.500000
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Episode 720 Reward -172.000000 Average Reward -172.500000
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Episode 790 Reward -157.000000 Average Reward -165.000000

Episode 800 Reward -178.000000 Average Reward -156.200000
Episode 810 Reward -143.000000 Average Reward -165.500000
Episode 820 Reward -179.000000 Average Reward -170.200000
Episode 830 Reward -189.000000 Average Reward -201.300000
Episode 840 Reward -174.000000 Average Reward -172.000000
Episode 850 Reward -163.000000 Average Reward -196.500000
Episode 860 Reward -212.000000 Average Reward -184.100000
Episode 870 Reward -256.000000 Average Reward -252.400000
Episode 880 Reward -272.000000 Average Reward -361.400000
Episode 890 Reward -328.000000 Average Reward -349.600000
Episode 900 Reward -347.000000 Average Reward -306.300000
Episode 910 Reward -173.000000 Average Reward -288.600000
Episode 920 Reward -500.000000 Average Reward -370.800000
Episode 930 Reward -306.000000 Average Reward -389.200000
Episode 940 Reward -274.000000 Average Reward -343.900000
Episode 950 Reward -207.000000 Average Reward -229.600000
Episode 960 Reward -184.000000 Average Reward -172.200000
Episode 970 Reward -163.000000 Average Reward -189.100000
Episode 980 Reward -151.000000 Average Reward -178.700000
Episode 990 Reward -175.000000 Average Reward -179.600000
Episode 1000 Reward -210.000000 Average Reward -194.300000
0:06:38.597387









```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [1024, 1024]
LR = 2e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'Acrobot-v1'
SOLVE_CUTOFF = -100.0
STEP = 50000

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{hs}-{lr}-{env}-{numep}-{nstep}-{STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	-210.000000	-352.000000
20	-163.000000	-215.900000
30	-170.000000	-184.300000
40	-150.000000	-190.900000
50	-192.000000	-169.300000
60	-300.000000	-173.900000
70	-146.000000	-155.800000
80	-151.000000	-190.700000
90	-228.000000	-205.700000
100	-166.000000	-198.200000
110	-201.000000	-230.700000
120	-202.000000	-208.800000
130	-230.000000	-225.800000
140	-299.000000	-261.100000
150	-201.000000	-186.700000
160	-170.000000	-176.500000
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200	-223.000000	-225.300000
210	-243.000000	-247.000000
220	-228.000000	-248.400000
230	-121.000000	-176.900000
240	-148.000000	-195.500000
250	-145.000000	-158.700000
260	-123.000000	-160.100000
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Episode 780 Reward -500.000000 Average Reward -500.000000
Episode 790 Reward -500.000000 Average Reward -500.000000
Episode 800 Reward -500.000000 Average Reward -500.000000
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Episode 550 Reward -96.000000 Average Reward -89.500000
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Episode 580 Reward -89.000000 Average Reward -94.800000
Episode 590 Reward -63.000000 Average Reward -78.100000
Episode 600 Reward -76.000000 Average Reward -81.000000
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Episode 410 Reward -95.000000 Average Reward -98.800000

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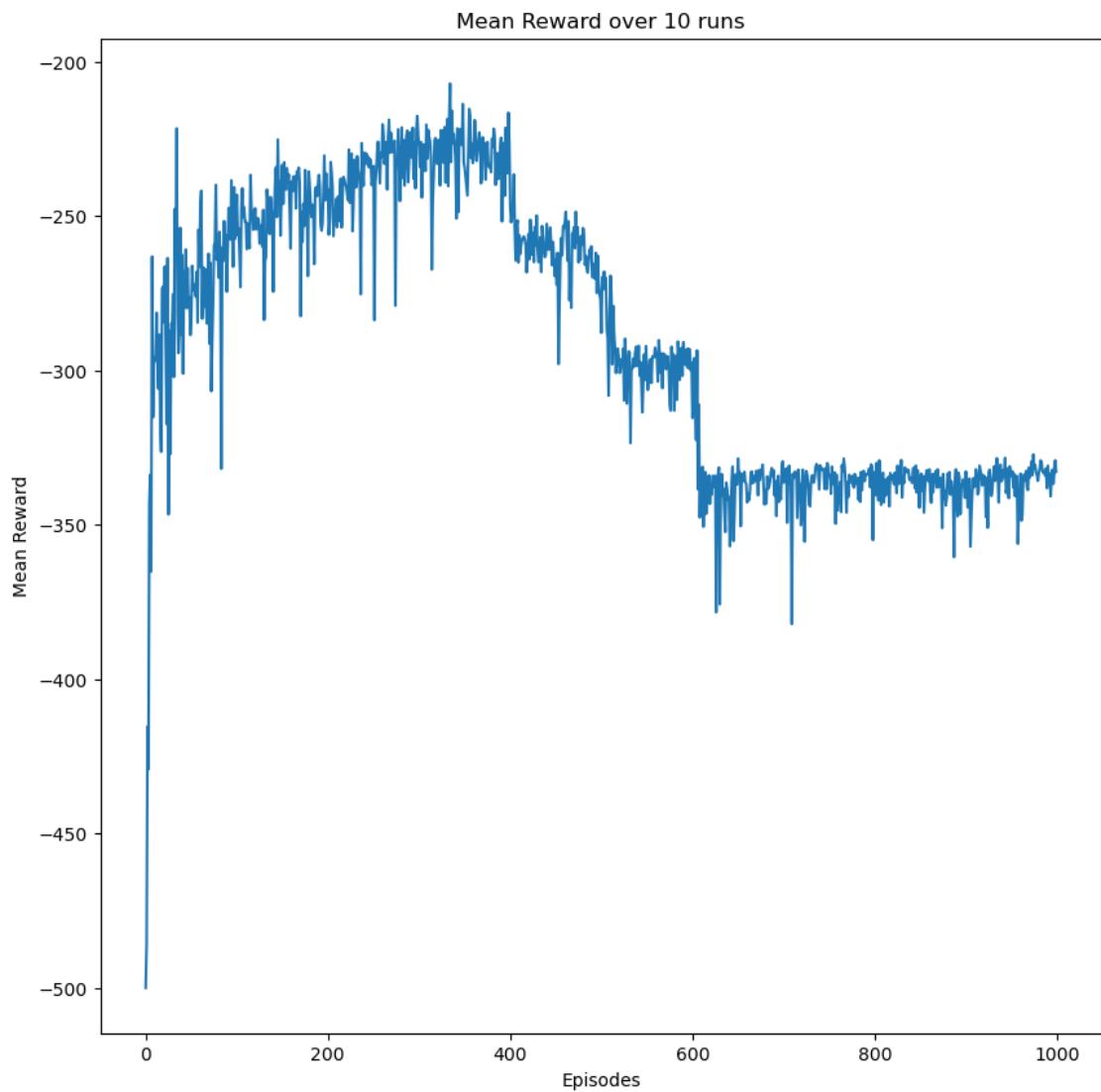
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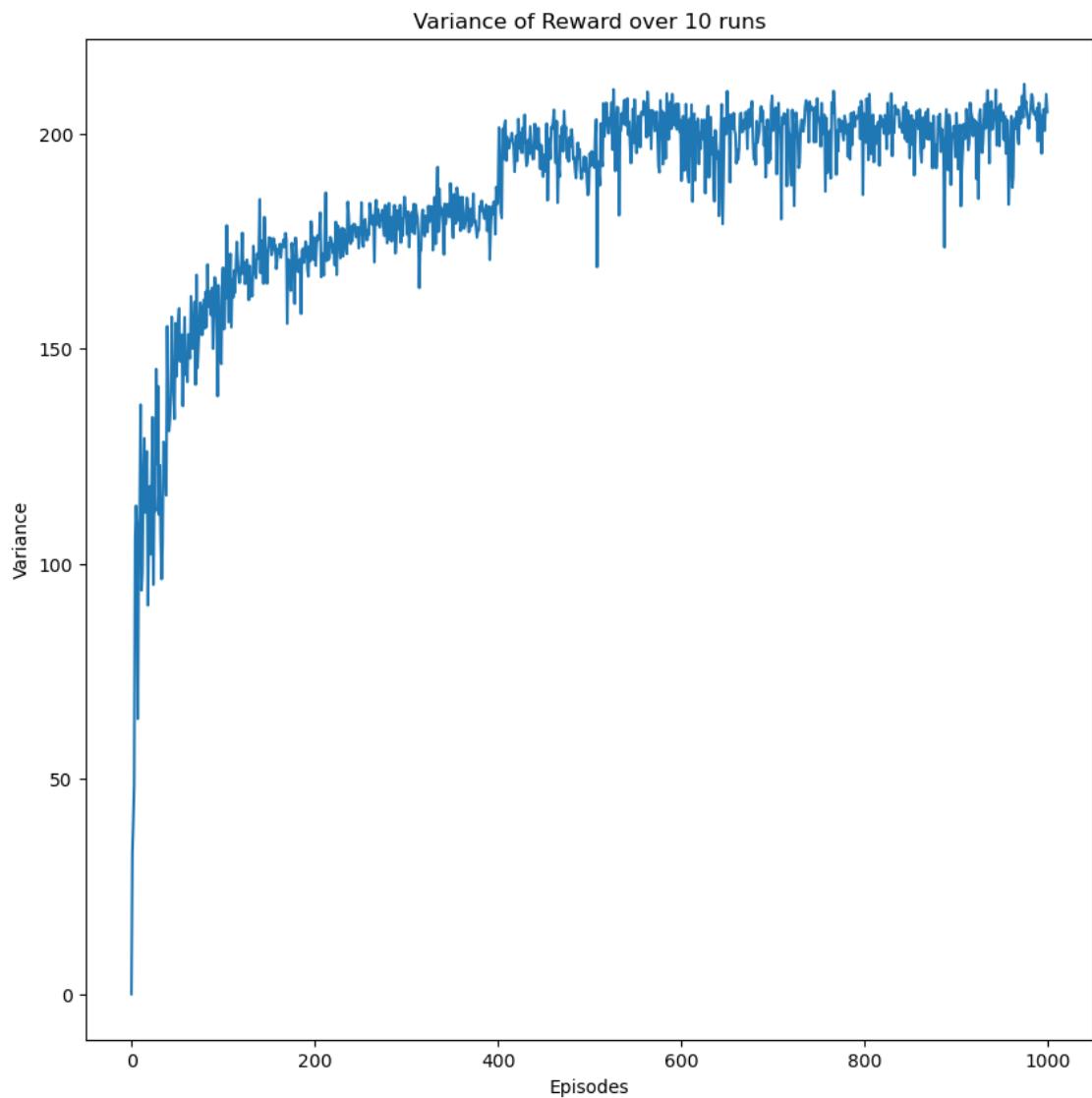
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Episode 270 Reward -102.000000 Average Reward -103.600000
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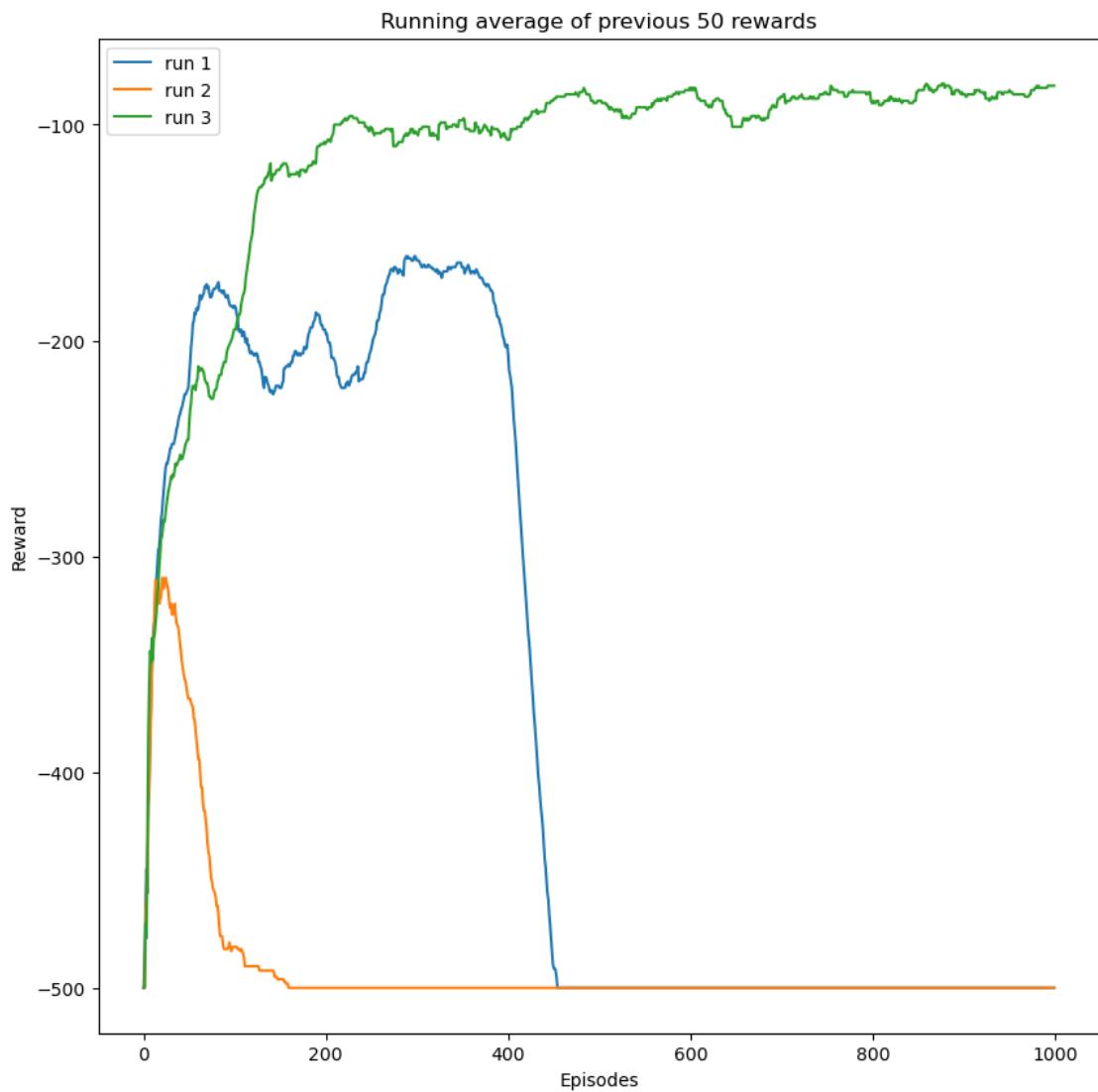
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Episode 390 Reward -90.000000 Average Reward -103.000000
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Episode 440 Reward -118.000000 Average Reward -93.900000
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Episode 550 Reward -82.000000 Average Reward -83.200000
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Episode 590 Reward -84.000000 Average Reward -82.300000
Episode 600 Reward -93.000000 Average Reward -84.900000
Episode 610 Reward -78.000000 Average Reward -97.800000
Episode 620 Reward -101.000000 Average Reward -107.700000
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Episode 640 Reward -82.000000 Average Reward -87.000000
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Episode 690 Reward -73.000000 Average Reward -99.800000
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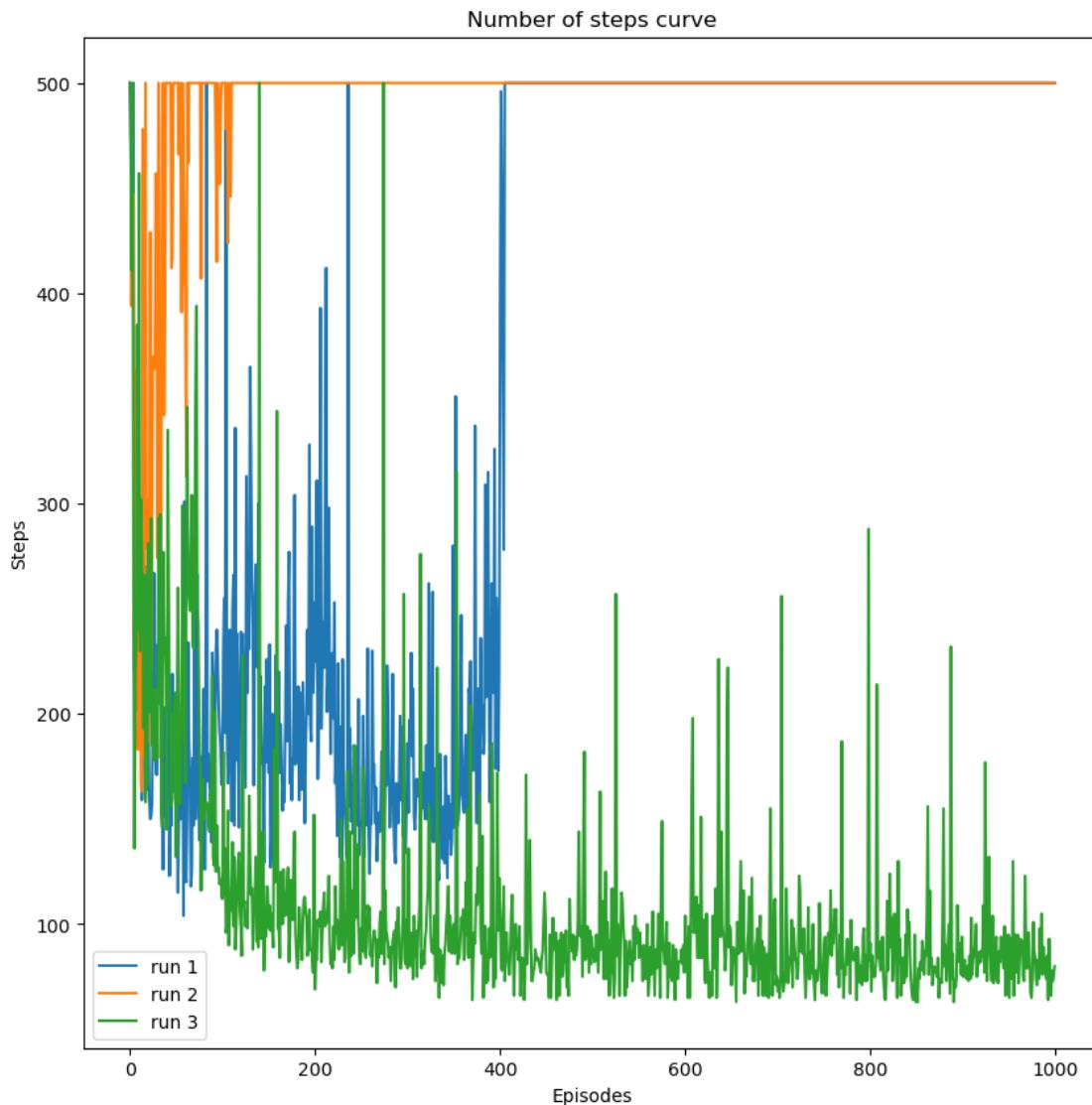
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Episode 890 Reward -83.000000 Average Reward -99.500000
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Episode 910 Reward -73.000000 Average Reward -129.000000
Episode 920 Reward -75.000000 Average Reward -81.500000
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Episode 970 Reward -83.000000 Average Reward -110.100000
Episode 980 Reward -104.000000 Average Reward -86.200000
Episode 990 Reward -104.000000 Average Reward -82.500000
Episode 1000 Reward -68.000000 Average Reward -96.300000

0:03:19.667440









```
[ ]: NUM_HIDDEN = 3
HIDDEN_SIZES = [512, 1024, 512]
LR = 1e-4
NUM_EPISODES = 1000
AVG_NUM = 50
ENV_NAME = 'Acrobot-v1'
SOLVE_CUTOFF = -100.0
STEP = 50000

ENV = gym.make(ENV_NAME)
mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)
```

```

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname = f'{hl}-{hs}-{lr}-{env}-{numep}-{nstep}-{STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode	Reward	Average Reward
10	-500.000000	-489.700000
20	-489.000000	-376.100000
30	-398.000000	-276.100000
40	-500.000000	-266.500000
50	-241.000000	-268.700000
60	-152.000000	-236.900000
70	-230.000000	-289.400000
80	-295.000000	-269.600000
90	-362.000000	-298.200000
100	-283.000000	-265.300000
110	-377.000000	-304.100000
120	-162.000000	-264.300000
130	-500.000000	-236.700000
140	-285.000000	-270.200000
150	-219.000000	-234.300000
160	-167.000000	-218.300000
170	-160.000000	-177.100000
180	-201.000000	-182.300000
190	-117.000000	-180.000000
200	-199.000000	-156.600000
210	-208.000000	-184.800000
220	-149.000000	-164.100000
230	-162.000000	-160.600000
240	-166.000000	-156.200000
250	-154.000000	-163.300000
260	-154.000000	-189.900000
270	-200.000000	-185.900000
280	-150.000000	-183.900000

Episode 290 Reward -148.000000 Average Reward -166.500000
Episode 300 Reward -135.000000 Average Reward -163.300000
Episode 310 Reward -164.000000 Average Reward -178.900000
Episode 320 Reward -127.000000 Average Reward -150.500000
Episode 330 Reward -161.000000 Average Reward -143.400000
Episode 340 Reward -204.000000 Average Reward -188.000000
Episode 350 Reward -218.000000 Average Reward -177.500000
Episode 360 Reward -202.000000 Average Reward -182.700000
Episode 370 Reward -176.000000 Average Reward -178.700000
Episode 380 Reward -151.000000 Average Reward -165.500000
Episode 390 Reward -143.000000 Average Reward -146.500000
Episode 400 Reward -108.000000 Average Reward -140.600000
Episode 410 Reward -106.000000 Average Reward -138.600000
Episode 420 Reward -111.000000 Average Reward -143.600000
Episode 430 Reward -123.000000 Average Reward -157.300000
Episode 440 Reward -150.000000 Average Reward -128.100000
Episode 450 Reward -137.000000 Average Reward -141.100000
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Episode 520 Reward -136.000000 Average Reward -116.500000
Episode 530 Reward -102.000000 Average Reward -125.400000
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Episode 550 Reward -118.000000 Average Reward -132.500000
Episode 560 Reward -122.000000 Average Reward -149.000000
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Episode 110 Reward -116.000000 Average Reward -220.300000
Episode 120 Reward -115.000000 Average Reward -169.200000
Episode 130 Reward -208.000000 Average Reward -164.800000
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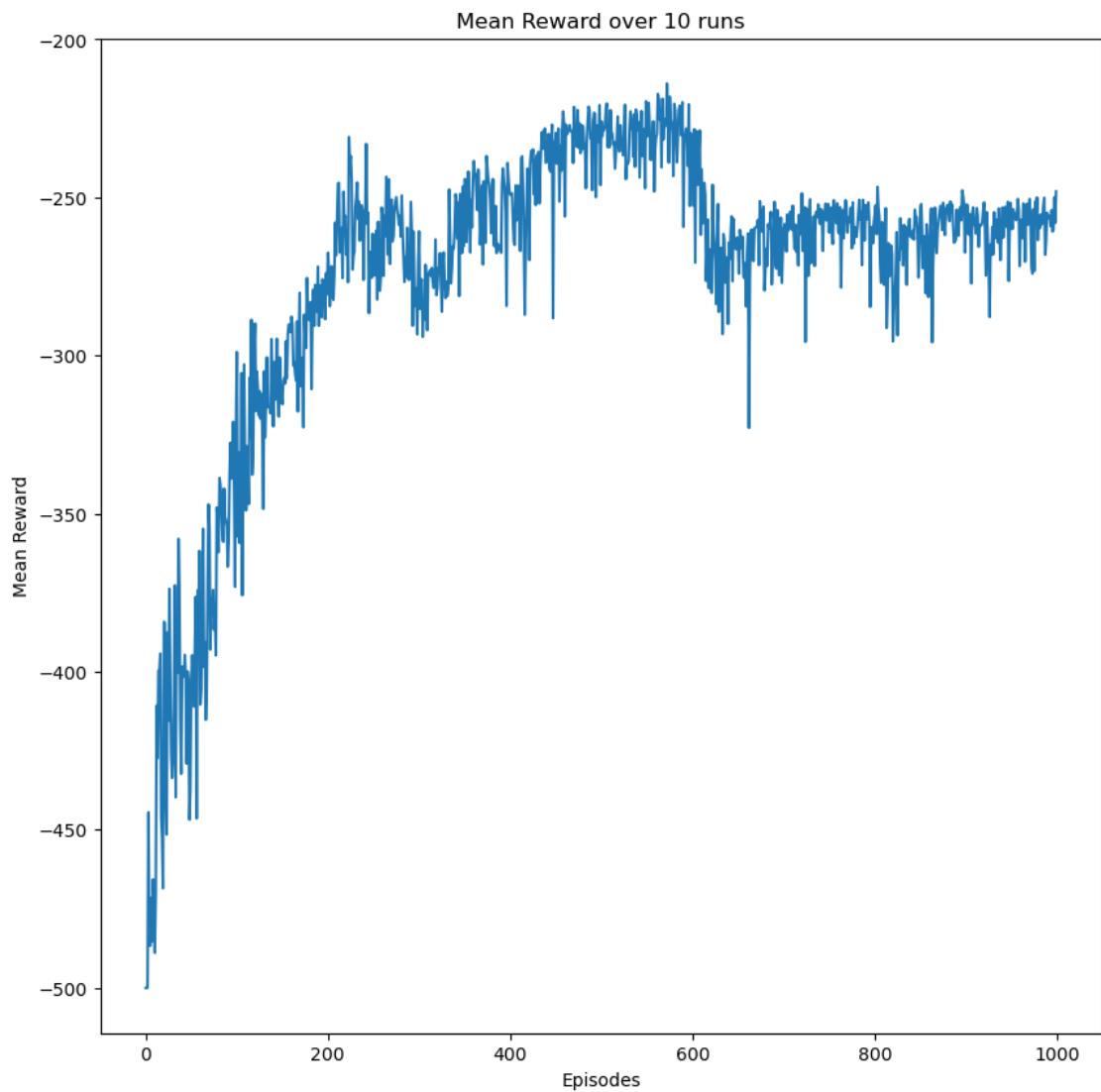
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Episode 940 Reward -95.000000 Average Reward -90.400000
Episode 950 Reward -82.000000 Average Reward -85.700000
Episode 960 Reward -96.000000 Average Reward -83.200000
Episode 970 Reward -101.000000 Average Reward -97.000000
Episode 980 Reward -162.000000 Average Reward -98.300000
Episode 990 Reward -102.000000 Average Reward -112.400000
Episode 1000 Reward -64.000000 Average Reward -94.000000
0:04:00.663175
Episode 10 Reward -458.000000 Average Reward -460.000000
Episode 20 Reward -500.000000 Average Reward -386.600000
Episode 30 Reward -283.000000 Average Reward -337.800000
Episode 40 Reward -380.000000 Average Reward -333.100000
Episode 50 Reward -287.000000 Average Reward -370.700000
Episode 60 Reward -354.000000 Average Reward -296.900000
Episode 70 Reward -226.000000 Average Reward -309.600000
Episode 80 Reward -289.000000 Average Reward -259.800000
Episode 90 Reward -156.000000 Average Reward -190.400000
Episode 100 Reward -140.000000 Average Reward -238.200000
Episode 110 Reward -198.000000 Average Reward -213.100000
Episode 120 Reward -151.000000 Average Reward -220.100000
Episode 130 Reward -121.000000 Average Reward -181.300000
Episode 140 Reward -180.000000 Average Reward -194.900000
Episode 150 Reward -214.000000 Average Reward -175.900000
Episode 160 Reward -130.000000 Average Reward -162.700000
Episode 170 Reward -131.000000 Average Reward -165.600000
Episode 180 Reward -145.000000 Average Reward -177.700000
Episode 190 Reward -180.000000 Average Reward -174.400000
Episode 200 Reward -178.000000 Average Reward -159.400000
Episode 210 Reward -154.000000 Average Reward -147.000000
Episode 220 Reward -196.000000 Average Reward -144.600000
Episode 230 Reward -111.000000 Average Reward -165.600000
Episode 240 Reward -143.000000 Average Reward -163.900000
Episode 250 Reward -143.000000 Average Reward -153.300000
Episode 260 Reward -101.000000 Average Reward -154.400000
Episode 270 Reward -119.000000 Average Reward -125.200000
Episode 280 Reward -133.000000 Average Reward -130.300000
Episode 290 Reward -147.000000 Average Reward -136.800000
Episode 300 Reward -148.000000 Average Reward -123.100000
Episode 310 Reward -156.000000 Average Reward -124.300000
Episode 320 Reward -131.000000 Average Reward -120.100000
Episode 330 Reward -143.000000 Average Reward -108.700000
Episode 340 Reward -97.000000 Average Reward -113.600000
Episode 350 Reward -122.000000 Average Reward -125.200000
Episode 360 Reward -138.000000 Average Reward -113.700000

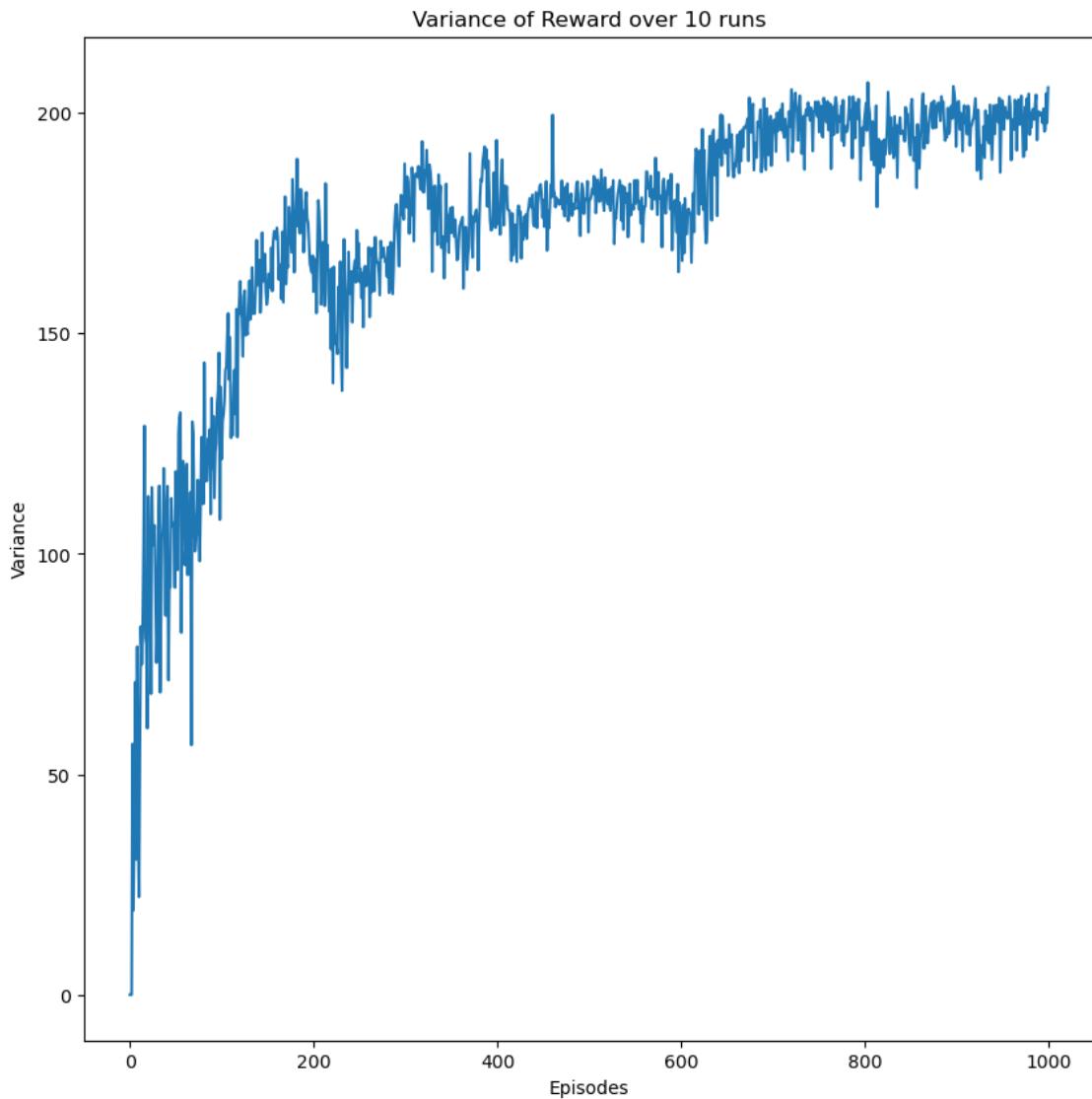
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Episode 390 Reward -69.000000 Average Reward -96.200000
Episode 400 Reward -84.000000 Average Reward -95.300000
Episode 410 Reward -126.000000 Average Reward -117.000000
Episode 420 Reward -143.000000 Average Reward -116.700000
Episode 430 Reward -99.000000 Average Reward -107.600000
Episode 440 Reward -105.000000 Average Reward -101.600000
Episode 450 Reward -94.000000 Average Reward -105.800000
Episode 460 Reward -71.000000 Average Reward -101.400000
Episode 470 Reward -102.000000 Average Reward -94.900000
Episode 480 Reward -92.000000 Average Reward -96.200000
Episode 490 Reward -101.000000 Average Reward -103.200000
Episode 500 Reward -250.000000 Average Reward -118.000000
Episode 510 Reward -90.000000 Average Reward -96.500000
Episode 520 Reward -102.000000 Average Reward -112.200000
Episode 530 Reward -198.000000 Average Reward -112.800000
Episode 540 Reward -102.000000 Average Reward -99.500000
Episode 550 Reward -92.000000 Average Reward -107.000000
Episode 560 Reward -101.000000 Average Reward -130.200000
Episode 570 Reward -96.000000 Average Reward -95.500000
Episode 580 Reward -153.000000 Average Reward -112.200000
Episode 590 Reward -86.000000 Average Reward -92.500000
Episode 600 Reward -86.000000 Average Reward -105.000000
Episode 610 Reward -76.000000 Average Reward -139.600000
Episode 620 Reward -102.000000 Average Reward -114.300000
Episode 630 Reward -146.000000 Average Reward -99.300000
Episode 640 Reward -86.000000 Average Reward -98.400000
Episode 650 Reward -98.000000 Average Reward -94.700000
Episode 660 Reward -326.000000 Average Reward -121.200000
Episode 670 Reward -126.000000 Average Reward -106.500000
Episode 680 Reward -115.000000 Average Reward -111.100000
Episode 690 Reward -120.000000 Average Reward -140.500000
Episode 700 Reward -232.000000 Average Reward -144.300000
Episode 710 Reward -126.000000 Average Reward -128.800000
Episode 720 Reward -158.000000 Average Reward -132.400000
Episode 730 Reward -92.000000 Average Reward -102.700000
Episode 740 Reward -135.000000 Average Reward -112.700000
Episode 750 Reward -87.000000 Average Reward -98.500000
Episode 760 Reward -86.000000 Average Reward -109.900000
Episode 770 Reward -85.000000 Average Reward -110.300000
Episode 780 Reward -91.000000 Average Reward -107.200000
Episode 790 Reward -167.000000 Average Reward -94.100000
Episode 800 Reward -124.000000 Average Reward -104.200000
Episode 810 Reward -103.000000 Average Reward -132.100000
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Episode 840 Reward -128.000000 Average Reward -144.000000

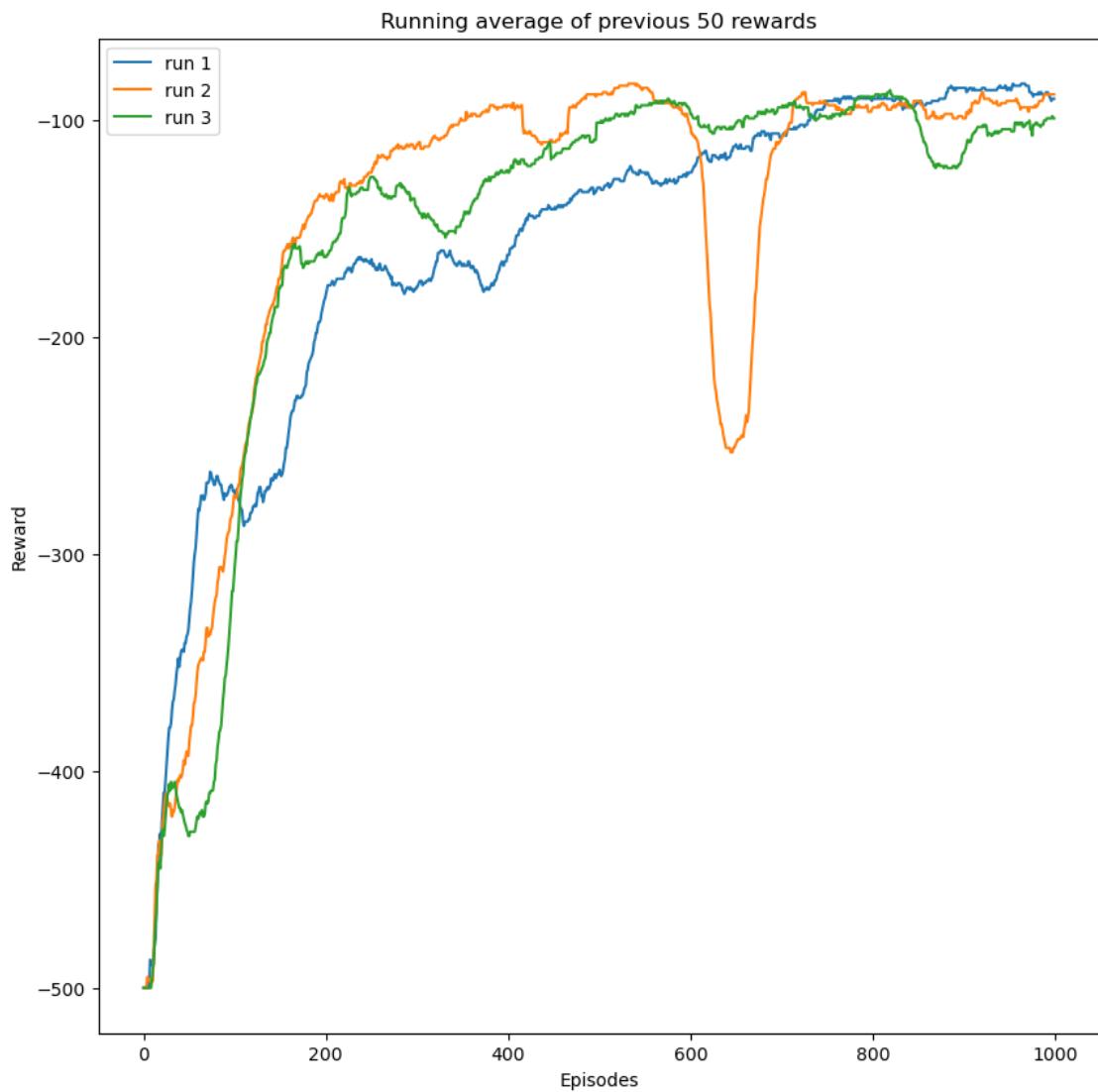
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Episode 880 Reward -92.000000 Average Reward -111.200000
Episode 890 Reward -92.000000 Average Reward -103.100000
Episode 900 Reward -199.000000 Average Reward -108.400000
Episode 910 Reward -108.000000 Average Reward -104.400000
Episode 920 Reward -93.000000 Average Reward -103.400000
Episode 930 Reward -120.000000 Average Reward -120.400000
Episode 940 Reward -99.000000 Average Reward -109.000000
Episode 950 Reward -106.000000 Average Reward -127.600000
Episode 960 Reward -89.000000 Average Reward -108.700000
Episode 970 Reward -78.000000 Average Reward -95.700000
Episode 980 Reward -150.000000 Average Reward -100.800000
Episode 990 Reward -108.000000 Average Reward -106.000000
Episode 1000 Reward -78.000000 Average Reward -86.100000
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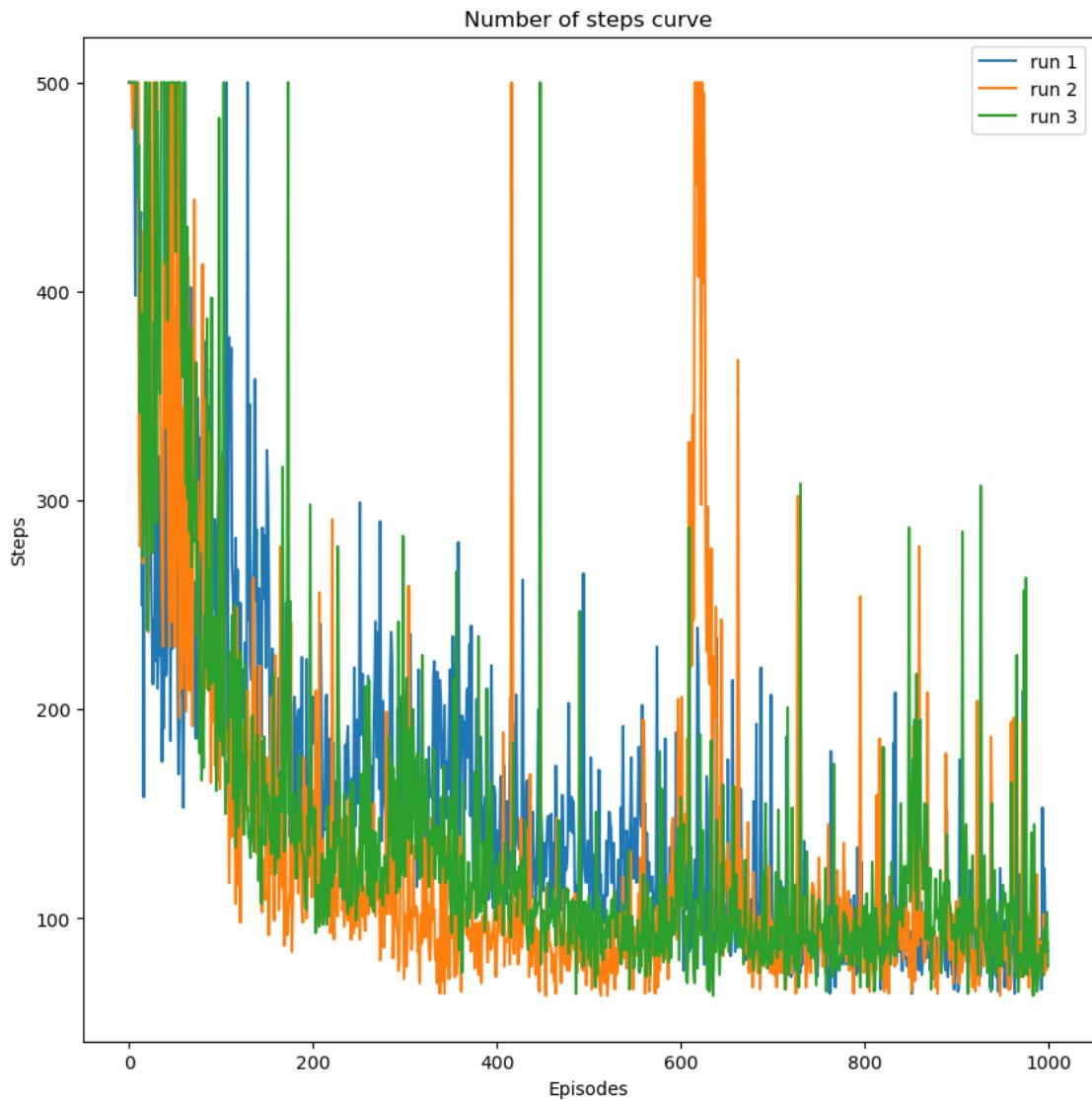
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Episode 50 Reward -500.000000 Average Reward -411.200000
Episode 60 Reward -459.000000 Average Reward -448.700000
Episode 70 Reward -500.000000 Average Reward -457.700000
Episode 80 Reward -500.000000 Average Reward -494.600000
Episode 90 Reward -500.000000 Average Reward -463.400000
Episode 100 Reward -417.000000 Average Reward -394.800000
Episode 110 Reward -446.000000 Average Reward -398.400000
Episode 120 Reward -364.000000 Average Reward -375.700000
Episode 130 Reward -500.000000 Average Reward -478.900000
Episode 140 Reward -500.000000 Average Reward -500.000000
Episode 150 Reward -500.000000 Average Reward -500.000000
Episode 160 Reward -500.000000 Average Reward -500.000000
Episode 170 Reward -500.000000 Average Reward -498.200000
Episode 180 Reward -450.000000 Average Reward -495.000000
Episode 190 Reward -386.000000 Average Reward -488.600000
Episode 200 Reward -428.000000 Average Reward -453.100000
Episode 210 Reward -341.000000 Average Reward -381.700000
Episode 220 Reward -269.000000 Average Reward -306.500000
Episode 230 Reward -462.000000 Average Reward -303.000000
Episode 240 Reward -353.000000 Average Reward -286.200000
Episode 250 Reward -356.000000 Average Reward -323.200000
Episode 260 Reward -196.000000 Average Reward -295.200000
Episode 270 Reward -236.000000 Average Reward -252.900000
Episode 280 Reward -285.000000 Average Reward -258.300000
Episode 290 Reward -474.000000 Average Reward -334.800000
Episode 300 Reward -500.000000 Average Reward -442.900000
Episode 310 Reward -500.000000 Average Reward -490.800000

Episode 800 Reward -500.000000 Average Reward -500.000000
Episode 810 Reward -500.000000 Average Reward -500.000000
Episode 820 Reward -500.000000 Average Reward -500.000000
Episode 830 Reward -500.000000 Average Reward -500.000000
Episode 840 Reward -500.000000 Average Reward -500.000000
Episode 850 Reward -500.000000 Average Reward -500.000000
Episode 860 Reward -500.000000 Average Reward -500.000000
Episode 870 Reward -500.000000 Average Reward -500.000000
Episode 880 Reward -500.000000 Average Reward -500.000000
Episode 890 Reward -500.000000 Average Reward -500.000000
Episode 900 Reward -500.000000 Average Reward -500.000000
Episode 910 Reward -500.000000 Average Reward -500.000000
Episode 920 Reward -500.000000 Average Reward -500.000000
Episode 930 Reward -500.000000 Average Reward -500.000000
Episode 940 Reward -500.000000 Average Reward -500.000000
Episode 950 Reward -500.000000 Average Reward -500.000000
Episode 960 Reward -500.000000 Average Reward -500.000000
Episode 970 Reward -500.000000 Average Reward -500.000000
Episode 980 Reward -500.000000 Average Reward -500.000000
Episode 990 Reward -500.000000 Average Reward -500.000000
Episode 1000 Reward -500.000000 Average Reward -500.000000
0:13:11.408414









MountainCar

```
[ ]: NUM_HIDDEN = 2
HIDDEN_SIZES = [1024, 512]
LR = 1e-4
NUM_EPISODES = 600
AVG_NUM = 50
ENV_NAME = 'MountainCar-v0'
SOLVE_CUTOFF = -125
STEP = 50000

ENV = gym.make(ENV_NAME)
```

```

mean_rewards, var_rewards, comp_list, reward_lists, step_lists = do_multiple_runs(env_name=ENV_NAME, num_runs=10)

data = [f'Number of Hidden Layers - {NUM_HIDDEN}', f'Hidden Sizes - {HIDDEN_SIZES}', f'Learning Rate - {LR}', f'Run number of episodes to solve - {comp_list}', f'Mean number of episodes to solve- {np.mean(comp_list)}', f'Number of episodes - {NUM_EPISODES}', f'Environment Name - {ENV_NAME}', f'NSTEP = {STEP}']

fname =
    f'hl={NUM_HIDDEN}_hs={HIDDEN_SIZES}_lr={LR}_env={ENV_NAME}_numep={NUM_EPISODES}_nstep={STEP}'
os.mkdir(PATH+'/'+fname)
gen_plots_and_save_data(fname, data, mean_rewards, var_rewards, reward_lists, step_lists)

```

/opt/conda/lib/python3.7/site-packages/gym/core.py:173: DeprecationWarning:
 WARN: Function `env.seed(seed)` is marked as deprecated and will be removed
 in the future. Please use `env.reset(seed=seed)` instead.
 "Function `env.seed(seed)` is marked as deprecated and will be removed in the
 future. "

Episode 10 Reward -200.000000 Average Reward -200.000000
 Episode 20 Reward -200.000000 Average Reward -200.000000
 Episode 30 Reward -200.000000 Average Reward -200.000000
 Episode 40 Reward -200.000000 Average Reward -200.000000
 Episode 50 Reward -200.000000 Average Reward -200.000000
 Episode 60 Reward -200.000000 Average Reward -200.000000
 Episode 70 Reward -200.000000 Average Reward -200.000000
 Episode 80 Reward -200.000000 Average Reward -200.000000
 Episode 90 Reward -200.000000 Average Reward -200.000000
 Episode 100 Reward -200.000000 Average Reward -200.000000
 Episode 110 Reward -200.000000 Average Reward -200.000000
 Episode 120 Reward -200.000000 Average Reward -200.000000
 Episode 130 Reward -200.000000 Average Reward -200.000000
 Episode 140 Reward -200.000000 Average Reward -200.000000
 Episode 150 Reward -200.000000 Average Reward -200.000000
 Episode 160 Reward -200.000000 Average Reward -200.000000
 Episode 170 Reward -200.000000 Average Reward -200.000000
 Episode 180 Reward -200.000000 Average Reward -200.000000
 Episode 190 Reward -200.000000 Average Reward -200.000000
 Episode 200 Reward -200.000000 Average Reward -200.000000
 Episode 210 Reward -200.000000 Average Reward -200.000000
 Episode 220 Reward -200.000000 Average Reward -200.000000
 Episode 230 Reward -200.000000 Average Reward -200.000000
 Episode 240 Reward -200.000000 Average Reward -200.000000
 Episode 250 Reward -200.000000 Average Reward -200.000000

Episode	10	Reward	-200.000000	Average Reward	-200.000000
Episode	20	Reward	-200.000000	Average Reward	-200.000000
Episode	30	Reward	-200.000000	Average Reward	-200.000000
Episode	40	Reward	-200.000000	Average Reward	-200.000000
Episode	50	Reward	-200.000000	Average Reward	-200.000000
Episode	60	Reward	-200.000000	Average Reward	-200.000000
Episode	70	Reward	-200.000000	Average Reward	-200.000000
Episode	80	Reward	-200.000000	Average Reward	-200.000000
Episode	90	Reward	-200.000000	Average Reward	-200.000000
Episode	100	Reward	-200.000000	Average Reward	-200.000000
Episode	110	Reward	-200.000000	Average Reward	-200.000000
Episode	120	Reward	-200.000000	Average Reward	-200.000000

0:02:11.913416

Episode	10	Reward	-200.000000	Average Reward	-200.000000
Episode	20	Reward	-200.000000	Average Reward	-200.000000
Episode	30	Reward	-200.000000	Average Reward	-200.000000
Episode	40	Reward	-200.000000	Average Reward	-200.000000
Episode	50	Reward	-200.000000	Average Reward	-200.000000
Episode	60	Reward	-200.000000	Average Reward	-200.000000
Episode	70	Reward	-200.000000	Average Reward	-200.000000
Episode	80	Reward	-200.000000	Average Reward	-200.000000

Episode 530 Reward -200.000000 Average Reward -200.000000
Episode 540 Reward -200.000000 Average Reward -200.000000
Episode 550 Reward -200.000000 Average Reward -200.000000
Episode 560 Reward -200.000000 Average Reward -200.000000
Episode 570 Reward -200.000000 Average Reward -200.000000
Episode 580 Reward -200.000000 Average Reward -200.000000
Episode 590 Reward -200.000000 Average Reward -200.000000
Episode 600 Reward -200.000000 Average Reward -200.000000
0:02:09.597248

