5-Load-in-NEST

December 31, 2019

0.1 Load-in-NEST

In this notebook we load some of the pretrained networks in NEST.

Experiment List: 1. DQN-Training (How to train a conventional DQN and a spiking DQN using Surrogate Gradients (DSQN).) 2. Load-DQN (How to load a previously saved D(S)QN and how to save a replay dataset.) 3. Train-Classifier (How to train a spiking or non-spiking classifier on the saved replay data set.) 4. SNN-Conversion (How to convert a DQN and a Classifier to a SNN.) 5. Load in NEST (How to load a converted or directly trained spiking network in NEST.) 6. Conversion in pyNN with NEST or SpyNNaker (How to load spiking network in pyNN using NEST or SpyNNaker as backend.)

[1]:
```
import torch
import os
import sys
import random
import matplotlib.pyplot as plt
# hack to perform relative imports
sys.path.append('../../')
from Code import Nestwork, load_agent, FullyConnected, SQN

# set seeds
torch.manual_seed(1)
random.seed(1)
gym_seed = 1

# device: automatically runs on GPU, if a GPU is detected, else uses CPU
device = torch.device("cuda" if torch.cuda.is_available() else "cpu")

# switch to the Result Directory
os.chdir('./../../Results/')
```

```
Detected PyNN version 0.9.5 and Neo version 0.6.1
```

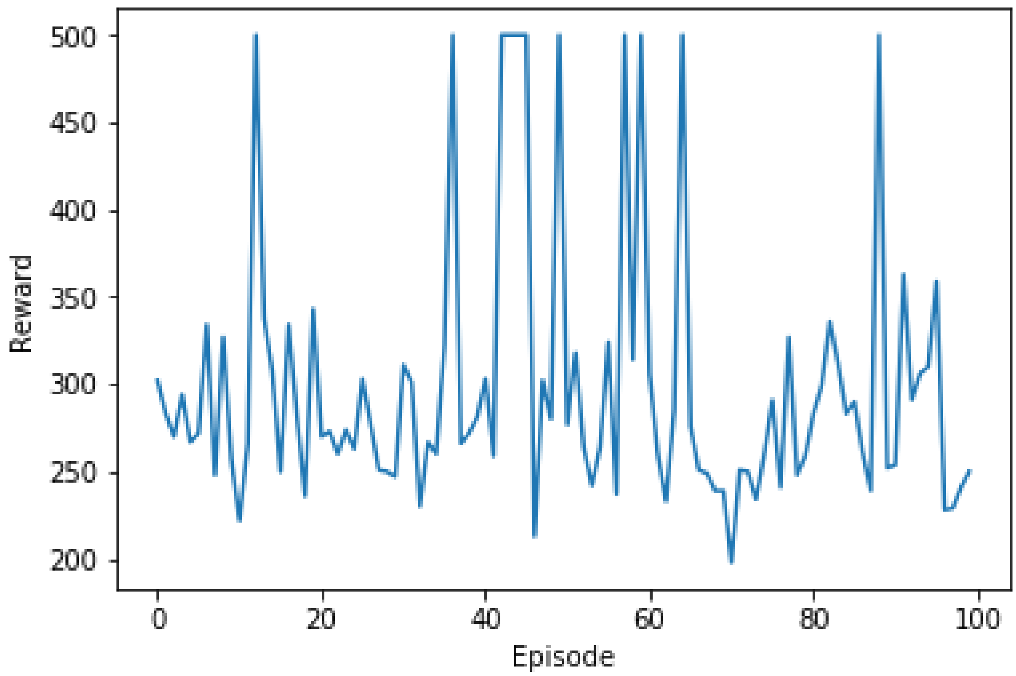
To begin with, we load a network obtained by conversion from a classifier which was obtained in the previous tutorial (SNN-Conversion).

[2]:
```
# specify the file, where the network is saved
file = './CartPole-A/Classifier-Converted/model.pt'
```

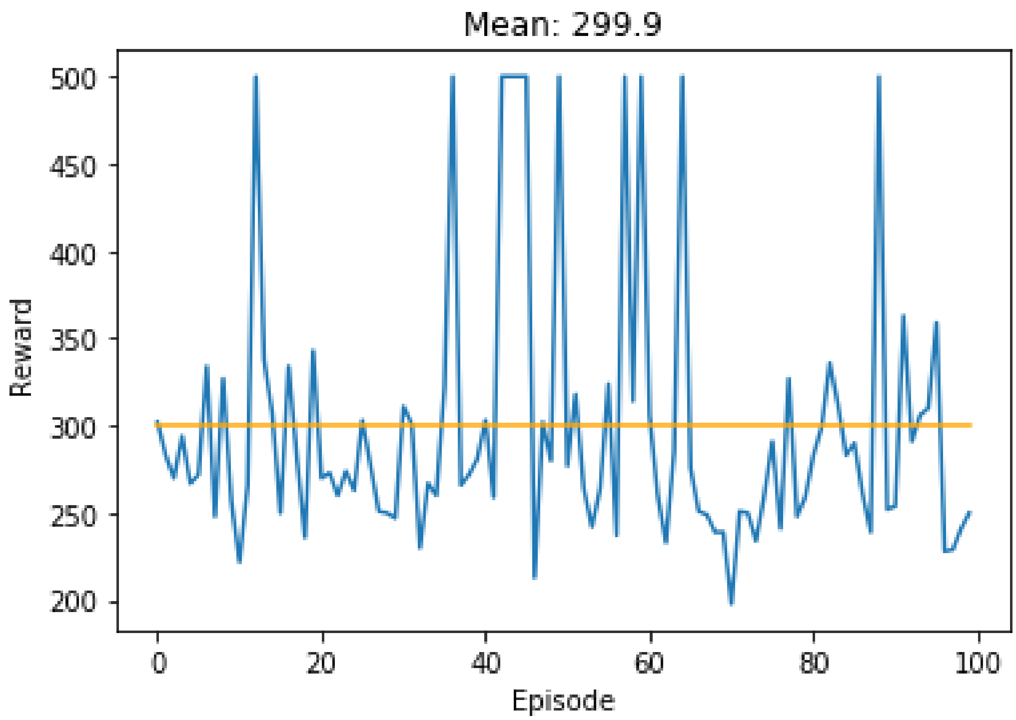
```
# set hyperparameters of NEST:
# encoding/decoding methods are limited to constant input currents and potential␣
 ↪outputs.
# set correct architecture
architecture = [4,16,16,2]
# set simulation time in ms, changing the resolution is not supported in our code
simulation_time = 100
# the neuron type can be set to 'iaf_psc_delta' or 'pp_psc_delta' and determines␣
 ↪the neuron type in the hidden layers
# this also fixes the reset method to reset-to-zero and to reset-by-subtraction␣
 ↪respectively
# for converted DQNs the type pp_psc_delta should be chosen, for classifier it␣
 ↪makes not much difference.
neuron_type = 'iaf_psc_delta'

# set up network in NEST
nestwork = Nestwork(architecture,file,simulation_time,neuron_type=neuron_type)
```

The NEST agent can be loaded equivalently to all other agents using the function load_agent (see tutorial 2: Load-DQN) as it implements the method 'forward'. We compare it to the original Classifier by setting compare_against to the original classifier agent.

[3]:
```
# Load the original classifier
# specify correct architecture
architecture = [4, 16, 16, 2]
# load weights
classifier = FullyConnected(architecture).to(device)
classifier.load_state_dict(torch.load('./CartPole-A/Classifier/trained/model.
 ↪pt'))

# run the NEST agent and compare against the original classifier
env = 'CartPole-v0'
load_agent(env,nestwork,device,epsilon=0,gym_seed=gym_seed,save_replay=False,
           max_steps=500,num_episodes=100, render=True,␣
 ↪compare_against=classifier)
```



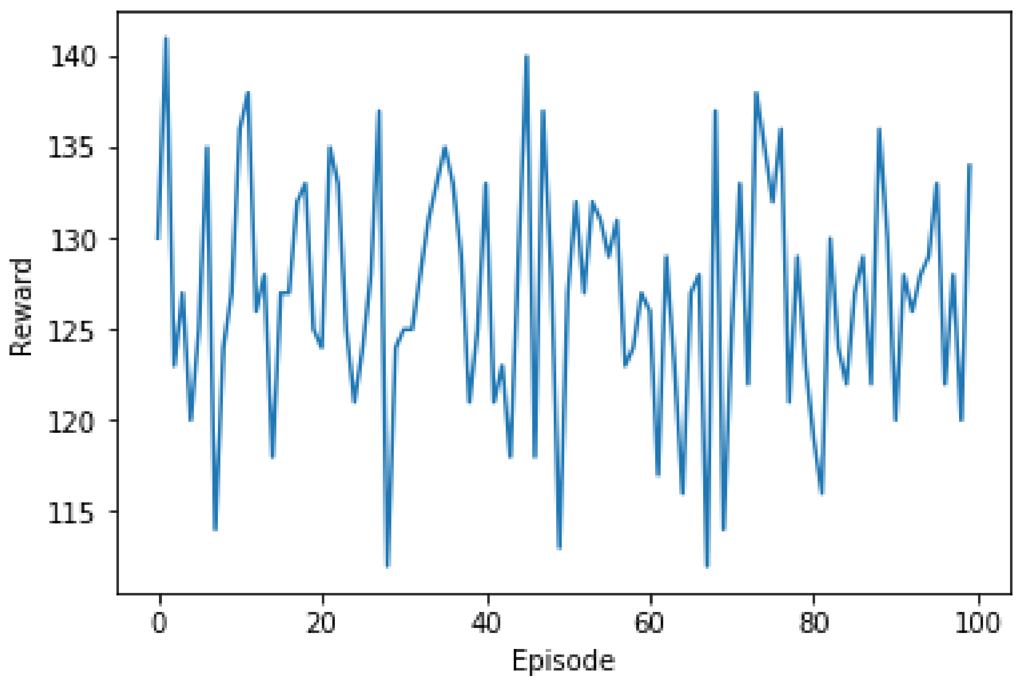

```
Similarity (Conversion Accuracy) after 29990 iterations: 88.62620873624542%
Complete
Mean:  299.9
Std:  77.74531068388198
Similarity (Conversion Accuracy) after 29990 iterations: 88.62620873624542%
```



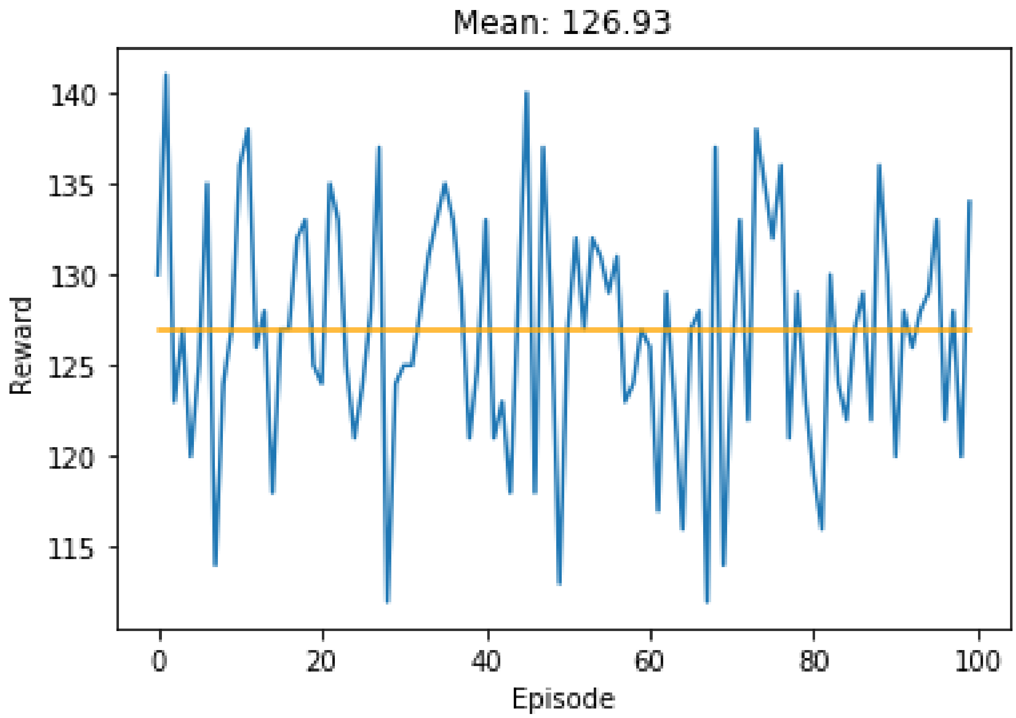
Likewise, we can convert the DQN directly. Next, we also run a directly trained DSQN in NEST.

[2]:
```
# specify the file, where the network is saved
file = './CartPole-A/DSQN-Surrogate-Gradients/trained/model.pt'

# set hyperparameters of NEST:
# encoding/decoding methods are limited to constant input currents and potential␣
↪outputs.
# set correct architecture
architecture = [4,17,17,2]
# set simulation time in ms, changing the resolution is not supported in our code
simulation_time = 100
# this time both neuron types work similarly bad, we use pp_psc_delta
neuron_type = 'pp_psc_delta'

# set up network in NEST, as we load a SpyTorch trained network we have to add␣
↪the bias to each observation
# additionally we have to specify that the network has no biases, as this is a␣
↪special case when initializing Nestwork
nestwork = Nestwork(architecture,file,simulation_time,neuron_type=neuron_type,␣
↪add_bias_as_observation=True,
                    has_biases=False)

# Load the original DSQN to compare against
```

```
# specify correct architecture
architecture = [4, 17, 17, 2]
# load weights
dsqn = SQN(architecture, device=device, alpha=0, beta=1, simulation_time=20,
                    add_bias_as_observation=True,␣
 ↪encoding='constant',decoding='potential',
                    reset='subtraction',threshold=1,has_biases=False)
dsqn.load_state_dict(torch.load('./CartPole-A/DSQN-Surrogate-Gradients/trained/
 ↪model.pt'))

# run the NEST agent and compare against the original classifier
env = 'CartPole-v0'
load_agent(env,nestwork,device,epsilon=0,gym_seed=gym_seed,save_replay=False,
            max_steps=500,num_episodes=100, render=True, compare_against=dsqn)
```




```
Similarity (Conversion Accuracy) after 12693 iterations: 65.83156070274954%
Complete
Mean:  126.93
Std:  6.440489033442957
Similarity (Conversion Accuracy) after 12693 iterations: 65.83156070274954%
```


Mean: 126.93
140
135
130
125
120
115
Reward
0
20
40
60
80
100
Episode