weighted-ddqn-stableb2-ddqnparms-

March 27, 2022

0.0.1 Exploration

```
[1]: !git clone https://github.com/openai/baselines.git
     %cd baselines
     !pip install -e .
     !pip install stable-baselines
     !pip install --upgrade tensorflow==1.14.0
     !pip install gym
```

```
fatal: destination path 'baselines' already exists and is not an empty
directory.
/project/baselines
Obtaining file:///project/baselines
Collecting gym<0.16.0,>=0.15.4
  Downloading gym-0.15.7.tar.gz (1.6 MB)
     |                        | 1.6 MB 12.0 MB/s eta 0:00:01
|                            | 972 kB 12.0 MB/s eta 0:00:01
Requirement already satisfied: scipy in /opt/conda/lib/python3.7/site-
packages (from baselines==0.1.6) (1.4.1)
Requirement already satisfied: tqdm in /opt/conda/lib/python3.7/site-packages
(from baselines==0.1.6) (4.46.1)
Requirement already satisfied: joblib in /opt/conda/lib/python3.7/site-packages
(from baselines==0.1.6) (0.15.1)
Requirement already satisfied: cloudpickle in /opt/conda/lib/python3.7/site-
packages (from baselines==0.1.6) (1.4.1)
Requirement already satisfied: click in /opt/conda/lib/python3.7/site-packages
(from baselines==0.1.6) (7.1.2)
Collecting opencv-python
  Downloading
opencv_python-4.5.5.64-cp36-abi3-manylinux_2_17_x86_64.manylinux2014_x86_64.whl
(60.5 MB)
     |                    | 60.5 MB 41.1 MB/s eta 0:00:01    |
| 3.5 MB 33.0 MB/s eta 0:00:02      |                                | 15.9 MB
33.0 MB/s eta 0:00:02      |                              | 17.9 MB 33.0 MB/s
eta 0:00:02      |                          | 29.9 MB 33.0 MB/s eta 0:00:01
|                    | 40.2 MB 41.1 MB/s eta 0:00:01
|                  | 50.2 MB 41.1 MB/s eta 0:00:01
|                  | 54.2 MB 41.1 MB/s eta 0:00:01
```

```
|                         | 60.3 MB 41.1 MB/s eta 0:00:01
Requirement already satisfied: numpy>=1.10.4 in
/opt/conda/lib/python3.7/site-packages (from
gym<0.16.0,>=0.15.4->baselines==0.1.6) (1.18.5)
Requirement already satisfied: six in /opt/conda/lib/python3.7/site-packages
(from gym<0.16.0,>=0.15.4->baselines==0.1.6) (1.15.0)
Collecting pyglet<=1.5.0,>=1.4.0
  Downloading pyglet-1.5.0-py2.py3-none-any.whl (1.0 MB)
      |                         | 1.0 MB 31.5 MB/s eta 0:00:01
Collecting future
  Downloading future-0.18.2.tar.gz (829 kB)
      |                         | 829 kB 31.4 MB/s eta 0:00:01
Building wheels for collected packages: gym, future
  Building wheel for gym (setup.py) … done
  Created wheel for gym: filename=gym-0.15.7-py3-none-any.whl size=1648839
sha256=a2e6c736913d507adee7f8a29c74c700b037ae23f207655079462db7a538312e
  Stored in directory: /home/rppeeter/.cache/pip/wheels/be/72/05/d3dfcfc2a31bbf8
86112b6373881bdf2e9e00d2c943f3b4f91
  Building wheel for future (setup.py) … done
  Created wheel for future: filename=future-0.18.2-py3-none-any.whl
size=491058
sha256=1a92c94813597fe149dad347e628625158e89c1e3ac5272afae993a7af5e59c6
  Stored in directory: /home/rppeeter/.cache/pip/wheels/56/b0/fe/4410d17b32f1f0c
3cf54cdfb2bc04d7b4b8f4ae377e2229ba0
Successfully built gym future
ERROR: gym 0.15.7 has requirement cloudpickle~=1.2.0, but you'll have

cloudpickle 1.4.1 which is incompatible.
Installing collected packages: future, pyglet, gym, opencv-python, baselines
  Running setup.py develop for baselines
Successfully installed baselines future-0.18.2 gym-0.15.7 opencv-python-4.5.5.64
pyglet-1.5.0
Collecting stable-baselines
  Downloading stable_baselines-2.10.2-py3-none-any.whl (240 kB)
      |                         | 240 kB 10.9 MB/s eta 0:00:01
Requirement already satisfied: cloudpickle>=0.5.5 in
/opt/conda/lib/python3.7/site-packages (from stable-baselines) (1.4.1)
Requirement already satisfied: matplotlib in /opt/conda/lib/python3.7/site-
packages (from stable-baselines) (3.2.1)
Requirement already satisfied: numpy in /opt/conda/lib/python3.7/site-packages
(from stable-baselines) (1.18.5)
Requirement already satisfied: pandas in /opt/conda/lib/python3.7/site-packages
(from stable-baselines) (1.0.4)
Requirement already satisfied: opencv-python in /opt/conda/lib/python3.7/site-
packages (from stable-baselines) (4.5.5.64)
Requirement already satisfied: joblib in /opt/conda/lib/python3.7/site-packages
(from stable-baselines) (0.15.1)
Requirement already satisfied: gym[atari,classic_control]>=0.11 in
```

```
/opt/conda/lib/python3.7/site-packages (from stable-baselines) (0.15.7)
Requirement already satisfied: scipy in /opt/conda/lib/python3.7/site-packages
(from stable-baselines) (1.4.1)
Requirement already satisfied: pyparsing!=2.0.4,!=2.1.2,!=2.1.6,>=2.0.1 in
/opt/conda/lib/python3.7/site-packages (from matplotlib->stable-baselines)
(2.4.7)
Requirement already satisfied: cycler>=0.10 in /opt/conda/lib/python3.7/site-
packages (from matplotlib->stable-baselines) (0.10.0)
Requirement already satisfied: kiwisolver>=1.0.1 in
/opt/conda/lib/python3.7/site-packages (from matplotlib->stable-baselines)
(1.2.0)
Requirement already satisfied: python-dateutil>=2.1 in
/opt/conda/lib/python3.7/site-packages (from matplotlib->stable-baselines)
(2.8.1)
Requirement already satisfied: pytz>=2017.2 in /opt/conda/lib/python3.7/site-
packages (from pandas->stable-baselines) (2020.1)
Requirement already satisfied: pyglet<=1.5.0,>=1.4.0 in
/opt/conda/lib/python3.7/site-packages (from
gym[atari,classic_control]>=0.11->stable-baselines) (1.5.0)
Requirement already satisfied: six in /opt/conda/lib/python3.7/site-packages
(from gym[atari,classic_control]>=0.11->stable-baselines) (1.15.0)
Requirement already satisfied: Pillow; extra == "atari" in
/opt/conda/lib/python3.7/site-packages (from
gym[atari,classic_control]>=0.11->stable-baselines) (7.1.2)
Collecting atari-py~=0.2.0; extra == "atari"
  Downloading
atari_py-0.2.9-cp37-cp37m-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (2.8
MB)
     |                        | 2.8 MB 32.5 MB/s eta 0:00:01
|                        | 1.9 MB 32.5 MB/s eta 0:00:01
Requirement already satisfied: future in /opt/conda/lib/python3.7/site-
packages (from pyglet<=1.5.0,>=1.4.0->gym[atari,classic_control]>=0.11->stable-
baselines) (0.18.2)
Installing collected packages: stable-baselines, atari-py
Successfully installed atari-py-0.2.9 stable-baselines-2.10.2
Collecting tensorflow==1.14.0
  Downloading tensorflow-1.14.0-cp37-cp37m-manylinux1_x86_64.whl (109.3 MB)
     |                        | 109.3 MB 114 kB/s  eta 0:00:01  |
| 4.4 MB 5.5 MB/s eta 0:00:19      |                                | 6.4 MB 5.5
MB/s eta 0:00:19      |                              | 26.7 MB 5.5 MB/s eta
0:00:15      |                              | 30.8 MB 5.5 MB/s eta 0:00:15
|                         | 34.7 MB 5.5 MB/s eta 0:00:14
|                         | 38.9 MB 40.5 MB/s eta 0:00:02
|                        | 49.1 MB 40.5 MB/s eta 0:00:02
|                        | 57.1 MB 40.5 MB/s eta 0:00:02
|                       | 75.3 MB 40.5 MB/s eta 0:00:01
|                       | 77.2 MB 40.5 MB/s eta 0:00:01
|                 | 105.3 MB 40.5 MB/s eta 0:00:01
```

```
|                            | 107.1 MB 40.5 MB/s eta 0:00:01
Requirement already satisfied, skipping upgrade: six>=1.10.0 in
/opt/conda/lib/python3.7/site-packages (from tensorflow==1.14.0) (1.15.0)
Requirement already satisfied, skipping upgrade: wrapt>=1.11.1 in
/opt/conda/lib/python3.7/site-packages (from tensorflow==1.14.0) (1.12.1)
Requirement already satisfied, skipping upgrade: keras-preprocessing>=1.0.5 in
/opt/conda/lib/python3.7/site-packages (from tensorflow==1.14.0) (1.1.2)
Requirement already satisfied, skipping upgrade: protobuf>=3.6.1 in
/opt/conda/lib/python3.7/site-packages (from tensorflow==1.14.0) (3.11.4)
Requirement already satisfied, skipping upgrade: numpy<2.0,>=1.14.5 in
/opt/conda/lib/python3.7/site-packages (from tensorflow==1.14.0) (1.18.5)
Collecting keras-applications>=1.0.6
  Downloading Keras_Applications-1.0.8-py3-none-any.whl (50 kB)
     |                        | 50 kB 13.4 MB/s eta 0:00:01
Requirement already satisfied, skipping upgrade: grpcio>=1.8.6 in
/opt/conda/lib/python3.7/site-packages (from tensorflow==1.14.0) (1.29.0)
Requirement already satisfied, skipping upgrade: gast>=0.2.0 in
/opt/conda/lib/python3.7/site-packages (from tensorflow==1.14.0) (0.3.3)
Collecting tensorboard<1.15.0,>=1.14.0
  Downloading tensorboard-1.14.0-py3-none-any.whl (3.1 MB)
     |                        | 3.1 MB 31.4 MB/s eta 0:00:01
Collecting astor>=0.6.0
  Downloading astor-0.8.1-py2.py3-none-any.whl (27 kB)
Requirement already satisfied, skipping upgrade: wheel>=0.26 in
/opt/conda/lib/python3.7/site-packages (from tensorflow==1.14.0) (0.34.2)
Collecting tensorflow-estimator<1.15.0rc0,>=1.14.0rc0
  Downloading tensorflow_estimator-1.14.0-py2.py3-none-any.whl (488 kB)
     |                        | 488 kB 30.2 MB/s eta 0:00:01
Requirement already satisfied, skipping upgrade: google-pasta>=0.1.6 in
/opt/conda/lib/python3.7/site-packages (from tensorflow==1.14.0) (0.2.0)
Requirement already satisfied, skipping upgrade: absl-py>=0.7.0 in
/opt/conda/lib/python3.7/site-packages (from tensorflow==1.14.0) (0.9.0)
Requirement already satisfied, skipping upgrade: termcolor>=1.1.0 in
/opt/conda/lib/python3.7/site-packages (from tensorflow==1.14.0) (1.1.0)
Requirement already satisfied, skipping upgrade: setuptools in
/opt/conda/lib/python3.7/site-packages (from
protobuf>=3.6.1->tensorflow==1.14.0) (47.1.1.post20200529)
Requirement already satisfied, skipping upgrade: h5py in
/opt/conda/lib/python3.7/site-packages (from keras-
applications>=1.0.6->tensorflow==1.14.0) (2.10.0)
Requirement already satisfied, skipping upgrade: markdown>=2.6.8 in
/opt/conda/lib/python3.7/site-packages (from
tensorboard<1.15.0,>=1.14.0->tensorflow==1.14.0) (3.2.2)
Requirement already satisfied, skipping upgrade: werkzeug>=0.11.15 in
/opt/conda/lib/python3.7/site-packages (from
tensorboard<1.15.0,>=1.14.0->tensorflow==1.14.0) (1.0.1)
Requirement already satisfied, skipping upgrade: importlib-metadata;
python_version < "3.8" in /opt/conda/lib/python3.7/site-packages (from
```

markdown>=2.6.8->tensorboard<1.15.0,>=1.14.0->tensorflow==1.14.0) (1.6.1)
Requirement already satisfied, skipping upgrade: zipp>=0.5 in
/opt/conda/lib/python3.7/site-packages (from importlib-metadata; python_version
< "3.8"->markdown>=2.6.8->tensorboard<1.15.0,>=1.14.0->tensorflow==1.14.0)
(3.1.0)
Installing collected packages: keras-applications, tensorboard, astor,
tensorflow-estimator, tensorflow
  Attempting uninstall: tensorboard
    Found existing installation: tensorboard 2.2.2
    Uninstalling tensorboard-2.2.2:
      Successfully uninstalled tensorboard-2.2.2
  Attempting uninstall: tensorflow-estimator
    Found existing installation: tensorflow-estimator 2.2.0
    Uninstalling tensorflow-estimator-2.2.0:
      Successfully uninstalled tensorflow-estimator-2.2.0
  Attempting uninstall: tensorflow
    Found existing installation: tensorflow 2.2.0
    Uninstalling tensorflow-2.2.0:
      Successfully uninstalled tensorflow-2.2.0
Successfully installed astor-0.8.1 keras-applications-1.0.8 tensorboard-1.14.0
tensorflow-1.14.0 tensorflow-estimator-1.14.0
Requirement already satisfied: gym in /opt/conda/lib/python3.7/site-packages
(0.15.7)
Requirement already satisfied: scipy in /opt/conda/lib/python3.7/site-packages
(from gym) (1.4.1)
Requirement already satisfied: pyglet<=1.5.0,>=1.4.0 in
/opt/conda/lib/python3.7/site-packages (from gym) (1.5.0)
Collecting cloudpickle~=1.2.0
  Downloading cloudpickle-1.2.2-py2.py3-none-any.whl (25 kB)
Requirement already satisfied: six in /opt/conda/lib/python3.7/site-packages
(from gym) (1.15.0)
Requirement already satisfied: numpy>=1.10.4 in /opt/conda/lib/python3.7/site-
packages (from gym) (1.18.5)
Requirement already satisfied: future in /opt/conda/lib/python3.7/site-packages
(from pyglet<=1.5.0,>=1.4.0->gym) (0.18.2)
ERROR: distributed 2.18.0 has requirement cloudpickle>=1.3.0, but you'll

have cloudpickle 1.2.2 which is incompatible.
Installing collected packages: cloudpickle
  Attempting uninstall: cloudpickle
    Found existing installation: cloudpickle 1.4.1
    Uninstalling cloudpickle-1.4.1:
      Successfully uninstalled cloudpickle-1.4.1
Successfully installed cloudpickle-1.2.2

```python
import os
import time
import gym
```

```python
import random
import numpy as np
import pandas as pd
from tensorflow import keras
from tensorflow.keras import layers

from stable_baselines.deepq.policies import MlpPolicy
from stable_baselines.common.vec_env.dummy_vec_env import DummyVecEnv

from stable_baselines import deepq
from stable_baselines import bench
from stable_baselines import logger
import tensorflow as tf

from baselines.common.tf_util import make_session
```

/opt/conda/lib/python3.7/site-
packages/tensorflow/python/framework/dtypes.py:516: FutureWarning: Passing
(type, 1) or '1type' as a synonym of type is deprecated; in a future version of
numpy, it will be understood as (type, (1,)) / '(1,)type'.
  _np_qint8 = np.dtype([("qint8", np.int8, 1)])
/opt/conda/lib/python3.7/site-
packages/tensorflow/python/framework/dtypes.py:517: FutureWarning: Passing
(type, 1) or '1type' as a synonym of type is deprecated; in a future version of
numpy, it will be understood as (type, (1,)) / '(1,)type'.
  _np_quint8 = np.dtype([("quint8", np.uint8, 1)])
/opt/conda/lib/python3.7/site-
packages/tensorflow/python/framework/dtypes.py:518: FutureWarning: Passing
(type, 1) or '1type' as a synonym of type is deprecated; in a future version of
numpy, it will be understood as (type, (1,)) / '(1,)type'.
  _np_qint16 = np.dtype([("qint16", np.int16, 1)])
/opt/conda/lib/python3.7/site-
packages/tensorflow/python/framework/dtypes.py:519: FutureWarning: Passing
(type, 1) or '1type' as a synonym of type is deprecated; in a future version of
numpy, it will be understood as (type, (1,)) / '(1,)type'.
  _np_quint16 = np.dtype([("quint16", np.uint16, 1)])
/opt/conda/lib/python3.7/site-
packages/tensorflow/python/framework/dtypes.py:520: FutureWarning: Passing
(type, 1) or '1type' as a synonym of type is deprecated; in a future version of
numpy, it will be understood as (type, (1,)) / '(1,)type'.
  _np_qint32 = np.dtype([("qint32", np.int32, 1)])
/opt/conda/lib/python3.7/site-
packages/tensorflow/python/framework/dtypes.py:525: FutureWarning: Passing
(type, 1) or '1type' as a synonym of type is deprecated; in a future version of
numpy, it will be understood as (type, (1,)) / '(1,)type'.
  np_resource = np.dtype([("resource", np.ubyte, 1)])
/opt/conda/lib/python3.7/site-

```
packages/tensorboard/compat/tensorflow_stub/dtypes.py:541: FutureWarning:
Passing (type, 1) or '1type' as a synonym of type is deprecated; in a future
version of numpy, it will be understood as (type, (1,)) / '(1,)type'.
  _np_qint8 = np.dtype([("qint8", np.int8, 1)])
/opt/conda/lib/python3.7/site-
packages/tensorboard/compat/tensorflow_stub/dtypes.py:542: FutureWarning:
Passing (type, 1) or '1type' as a synonym of type is deprecated; in a future
version of numpy, it will be understood as (type, (1,)) / '(1,)type'.
  _np_quint8 = np.dtype([("quint8", np.uint8, 1)])
/opt/conda/lib/python3.7/site-
packages/tensorboard/compat/tensorflow_stub/dtypes.py:543: FutureWarning:
Passing (type, 1) or '1type' as a synonym of type is deprecated; in a future
version of numpy, it will be understood as (type, (1,)) / '(1,)type'.
  _np_qint16 = np.dtype([("qint16", np.int16, 1)])
/opt/conda/lib/python3.7/site-
packages/tensorboard/compat/tensorflow_stub/dtypes.py:544: FutureWarning:
Passing (type, 1) or '1type' as a synonym of type is deprecated; in a future
version of numpy, it will be understood as (type, (1,)) / '(1,)type'.
  _np_quint16 = np.dtype([("quint16", np.uint16, 1)])
/opt/conda/lib/python3.7/site-
packages/tensorboard/compat/tensorflow_stub/dtypes.py:545: FutureWarning:
Passing (type, 1) or '1type' as a synonym of type is deprecated; in a future
version of numpy, it will be understood as (type, (1,)) / '(1,)type'.
  _np_qint32 = np.dtype([("qint32", np.int32, 1)])
/opt/conda/lib/python3.7/site-
packages/tensorboard/compat/tensorflow_stub/dtypes.py:550: FutureWarning:
Passing (type, 1) or '1type' as a synonym of type is deprecated; in a future
version of numpy, it will be understood as (type, (1,)) / '(1,)type'.
  np_resource = np.dtype([("resource", np.ubyte, 1)])
/opt/conda/lib/python3.7/site-packages/stable_baselines/__init__.py:33:
UserWarning: stable-baselines is in maintenance mode, please use [Stable-
Baselines3 (SB3)](https://github.com/DLR-RM/stable-baselines3) for an up-to-date
version. You can find a [migration guide](https://stable-
baselines3.readthedocs.io/en/master/guide/migration.html) in SB3 documentation.
  "stable-baselines is in maintenance mode, please use [Stable-Baselines3
(SB3)](https://github.com/DLR-RM/stable-baselines3) for an up-to-date version.
You can find a [migration guide](https://stable-
baselines3.readthedocs.io/en/master/guide/migration.html) in SB3 documentation."
```

```
[3]: data = pd.read_csv("/project/datasets/clean-ids-collection/cic-ddos2019/clean/
     ↪cicddos2019.csv")
     data.head(5)
```

```
[3]:    Protocol                   Timestamp  Flow Duration  Total Fwd Packets  \
     0         0  2018-11-03 09:18:16.964447      114456999                 45
     1         0  2018-11-03 09:18:18.506537      114347504                 56
     2         6  2018-11-03 09:18:18.610576       36435473                  6
```

```
3        6  2018-11-03 09:18:18.610579        36434705                6
4        6  2018-11-03 09:18:18.610581        36434626                6

   Total Backward Packets  Fwd Packets Length Total  Bwd Packets Length Total  \
0                       0                        0.0                        0.0
1                       0                        0.0                        0.0
2                       2                      116.0                       92.0
3                       2                      116.0                       92.0
4                       2                      116.0                       92.0

   Fwd Packet Length Max  Fwd Packet Length Min  Fwd Packet Length Mean  …  \
0                    0.0                    0.0                0.000000  …
1                    0.0                    0.0                0.000000  …
2                   46.0                    6.0               19.333334  …
3                   46.0                    6.0               19.333334  …
4                   46.0                    6.0               19.333334  …

   Fwd Seg Size Min  Active Mean  Active Std  Active Max  Active Min  \
0                 0    8185.5835   28337.111     98168.0         3.0
1                 0   35028.4180  121314.914    420255.0         4.0
2                20   62416.0000       0.000     62416.0     62416.0
3                20   62413.0000       0.000     62413.0     62413.0
4                20   62409.0000       0.000     62409.0     62409.0

     Idle Mean   Idle Std     Idle Max     Idle Min   Label
0    9529897.0  351582.62  10001143.0    9048097.0  Benign
1    9493930.0  351541.10   9978130.0    8820294.0  Benign
2   36373056.0       0.00  36373056.0   36373056.0  Benign
3   36372292.0       0.00  36372292.0   36372292.0  Benign
4   36372216.0       0.00  36372216.0   36372216.0  Benign

[5 rows x 69 columns]
```

[4]:
```
data.info()
data.describe()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 138007 entries, 0 to 138006
Data columns (total 69 columns):
 #   Column                   Non-Null Count   Dtype
---  ------                   --------------   -----
 0   Protocol                 138007 non-null  int64
 1   Timestamp                138007 non-null  object
 2   Flow Duration            138007 non-null  int64
 3   Total Fwd Packets        138007 non-null  int64
 4   Total Backward Packets   138007 non-null  int64
 5   Fwd Packets Length Total 138007 non-null  float64
```

```
6   Bwd Packets Length Total   138007 non-null   float64
7   Fwd Packet Length Max      138007 non-null   float64
8   Fwd Packet Length Min      138007 non-null   float64
9   Fwd Packet Length Mean     138007 non-null   float64
10  Fwd Packet Length Std      138007 non-null   float64
11  Bwd Packet Length Max      138007 non-null   float64
12  Bwd Packet Length Min      138007 non-null   float64
13  Bwd Packet Length Mean     138007 non-null   float64
14  Bwd Packet Length Std      138007 non-null   float64
15  Flow Bytes/s               138007 non-null   float64
16  Flow Packets/s             138007 non-null   float64
17  Flow IAT Mean              138007 non-null   float64
18  Flow IAT Std               138007 non-null   float64
19  Flow IAT Max               138007 non-null   float64
20  Flow IAT Min               138007 non-null   float64
21  Fwd IAT Total              138007 non-null   float64
22  Fwd IAT Mean               138007 non-null   float64
23  Fwd IAT Std                138007 non-null   float64
24  Fwd IAT Max                138007 non-null   float64
25  Fwd IAT Min                138007 non-null   float64
26  Bwd IAT Total              138007 non-null   float64
27  Bwd IAT Mean               138007 non-null   float64
28  Bwd IAT Std                138007 non-null   float64
29  Bwd IAT Max                138007 non-null   float64
30  Bwd IAT Min                138007 non-null   float64
31  Fwd PSH Flags              138007 non-null   int64
32  Fwd Header Length          138007 non-null   int64
33  Bwd Header Length          138007 non-null   int64
34  Fwd Packets/s              138007 non-null   float64
35  Bwd Packets/s              138007 non-null   float64
36  Packet Length Min          138007 non-null   float64
37  Packet Length Max          138007 non-null   float64
38  Packet Length Mean         138007 non-null   float64
39  Packet Length Std          138007 non-null   float64
40  Packet Length Variance     138007 non-null   float64
41  FIN Flag Count             138007 non-null   int64
42  SYN Flag Count             138007 non-null   int64
43  RST Flag Count             138007 non-null   int64
44  PSH Flag Count             138007 non-null   int64
45  ACK Flag Count             138007 non-null   int64
46  URG Flag Count             138007 non-null   int64
47  ECE Flag Count             138007 non-null   int64
48  Down/Up Ratio              138007 non-null   float64
49  Avg Packet Size            138007 non-null   float64
50  Avg Fwd Segment Size       138007 non-null   float64
51  Avg Bwd Segment Size       138007 non-null   float64
52  Subflow Fwd Packets        138007 non-null   int64
53  Subflow Fwd Bytes          138007 non-null   int64
```

```
54  Subflow Bwd Packets      138007 non-null  int64
55  Subflow Bwd Bytes        138007 non-null  int64
56  Init Fwd Win Bytes       138007 non-null  int64
57  Init Bwd Win Bytes       138007 non-null  int64
58  Fwd Act Data Packets     138007 non-null  int64
59  Fwd Seg Size Min         138007 non-null  int64
60  Active Mean              138007 non-null  float64
61  Active Std               138007 non-null  float64
62  Active Max               138007 non-null  float64
63  Active Min               138007 non-null  float64
64  Idle Mean                138007 non-null  float64
65  Idle Std                 138007 non-null  float64
66  Idle Max                 138007 non-null  float64
67  Idle Min                 138007 non-null  float64
68  Label                    138007 non-null  object
dtypes: float64(45), int64(22), object(2)
memory usage: 72.7+ MB
```

[4]:

	Protocol	Flow Duration	Total Fwd Packets	\
count	138007.000000	1.380070e+05	138007.000000	
mean	11.592050	1.035663e+07	13.812169	
std	5.607782	2.853154e+07	70.298079	
min	0.000000	1.000000e+00	1.000000	
25%	6.000000	1.178000e+03	2.000000	
50%	17.000000	2.489200e+04	3.000000	
75%	17.000000	2.999380e+06	8.000000	
max	17.000000	1.199987e+08	20444.000000	

	Total Backward Packets	Fwd Packets Length Total	\
count	138007.000000	1.380070e+05	
mean	6.636576	4.019830e+03	
std	99.503208	5.151998e+04	
min	0.000000	0.000000e+00	
25%	0.000000	1.800000e+01	
50%	2.000000	8.600000e+01	
75%	2.000000	2.064000e+03	
max	31700.000000	1.526642e+07	

	Bwd Packets Length Total	Fwd Packet Length Max	Fwd Packet Length Min	\
count	1.380070e+05	138007.000000	138007.000000	
mean	5.102600e+03	249.273218	132.853515	
std	1.880790e+05	419.156188	234.493611	
min	0.000000e+00	0.000000	0.000000	
25%	0.000000e+00	6.000000	0.000000	
50%	0.000000e+00	43.000000	30.000000	
75%	1.660000e+02	440.000000	152.000000	
max	5.842950e+07	32120.000000	2131.000000	

```
        Fwd Packet Length Mean  Fwd Packet Length Std  …  \
count            138007.000000          138007.000000  …
mean                161.376744              37.345936  …
std                 241.043532             116.216344  …
min                   0.000000               0.000000  …
25%                   6.000000               0.000000  …
50%                  39.000000               0.000000  …
75%                 349.500000              14.433757  …
max                3015.290500            2221.556200  …

        Fwd Act Data Packets  Fwd Seg Size Min   Active Mean    Active Std  \
count          138007.000000      1.380070e+05  1.380070e+05  1.380070e+05
mean               10.525227     -1.175840e+07  7.345821e+04  3.066152e+04
std                62.973954      1.112129e+08  5.176193e+05  2.392317e+05
min                 0.000000     -1.408238e+09  0.000000e+00  0.000000e+00
25%                 1.000000      2.000000e+01  0.000000e+00  0.000000e+00
50%                 1.000000      2.000000e+01  0.000000e+00  0.000000e+00
75%                 5.000000      2.000000e+01  0.000000e+00  0.000000e+00
max             18766.000000      1.480000e+03  4.050800e+07  1.100562e+07

          Active Max    Active Min     Idle Mean      Idle Std      Idle Max  \
count   1.380070e+05  1.380070e+05  1.380070e+05  1.380070e+05  1.380070e+05
mean    1.140858e+05  5.479838e+04  3.445620e+06  3.282404e+05  3.770891e+06
std     6.900226e+05  4.802156e+05  1.157949e+07  2.158705e+06  1.230392e+07
min     0.000000e+00  0.000000e+00  0.000000e+00  0.000000e+00  0.000000e+00
25%     0.000000e+00  0.000000e+00  0.000000e+00  0.000000e+00  0.000000e+00
50%     0.000000e+00  0.000000e+00  0.000000e+00  0.000000e+00  0.000000e+00
75%     0.000000e+00  0.000000e+00  0.000000e+00  0.000000e+00  0.000000e+00
max     4.050800e+07  4.050800e+07  1.192194e+08  6.961402e+07  1.192194e+08

            Idle Min
count   1.380070e+05
mean    3.153606e+06
std     1.120812e+07
min     0.000000e+00
25%     0.000000e+00
50%     0.000000e+00
75%     0.000000e+00
max     1.192194e+08

[8 rows x 67 columns]
```

Preprocessing done by Laurens D'Hooge

0.1 Creating the model

- Build an agent to classify network flow automatically
- Feed a packet that gets classified
- Want the classification to be equal to the label

```python
[5]: def balancing_dataset_sampler_df(df, train_frac=0.2, val_frac=0.1, test_frac=0.
     →7):
         col = df.columns[-1]
         cols = df.columns[:-1]
         vc = df[col].value_counts()
         n = vc.iloc[-1]
         m = vc.iloc[0]
         initial_cut = df.loc[df[col] == vc.index[0]].sample(n=int(m-n),
     →replace=False)
         df = df.drop(index=initial_cut.index)

         train_df = df.groupby(col).apply(lambda x: x.sample(n=int(n*train_frac),
     →replace=False))
         train_df.reset_index(level=0, inplace=True, drop=True)
         df = df.drop(index=train_df.index)

         validation_df = df.groupby(col).apply(lambda x: x.sample(n=int(n*val_frac),
     →replace=False))
         validation_df.reset_index(level=0, inplace=True, drop=True)
         df = df.drop(index=validation_df.index)

         test_df = df.groupby(col).apply(lambda x: x.sample(n=int(n*test_frac),
     →replace=False))
         test_df.reset_index(level=0, inplace=True, drop=True)
         df = df.drop(index=test_df.index)

         return train_df[cols], train_df[col], validation_df[cols],
     →validation_df[col], test_df[cols], test_df[col]
```

```python
[6]: data.drop('Timestamp', inplace=True, axis=1)
     print(data['Label'].value_counts())
     data['Label'] = data['Label'].astype('object')
     atk_idx = data.loc[data['Label'] != "Benign"].index
     data.loc[atk_idx, 'Label'] = 1.0
     data.loc[data.index.difference(atk_idx), 'Label'] = 0.0
     data['Label'] = data['Label'].astype(dtype=np.float32)

     x_train, y_train, x_val, y_val, x_test, y_test =
      →balancing_dataset_sampler_df(data, train_frac=0.9, val_frac=0.0, test_frac=0.
      →1)
```

```
Benign              95095
DrDoS_NTP           13687
TFTP                13027
Syn                  6713
UDP                  2158
MSSQL                1763
DrDoS_UDP            1174
UDP-lag              1097
DrDoS_MSSQL           927
DrDoS_DNS             552
LDAP                  484
DrDoS_SSDP            413
DrDoS_SNMP            392
Portmap               215
DrDoS_LDAP            174
NetBIOS                73
DrDoS_NetBIOS          51
UDPLag                 10
WebDDoS                 2
Name: Label, dtype: int64
```

[7]:
```python
print("Training")
print(x_train.shape)
print(y_train.shape)
print("Validation")
print(x_val.shape)
print(y_val.shape)
print("Testing")
print(x_test.shape)
print(y_test.shape)
```

```
Training
(77240, 67)
(77240,)
Validation
(0, 67)
(0,)
Testing
(8582, 67)
(8582,)
```

[8]:
```python
# all attacks
# attacks_dict = {
#     'Benign': 0,
#     'Portmap': 1,
#     'NetBIOS': 2,
#     'LDAP': 3,
```

```
#       'MSSQL': 4,
#       'UDP': 5,
#       'UDPLag': 6,
#       'Syn': 7,
#       'DrDoS_NTP': 8,
#       'DrDoS_DNS': 9,
#       'DrDoS_LDAP': 10,
#       'DrDoS_MSSQL': 11,
#       'DrDoS_NetBIOS': 12,
#       'DrDoS_SNMP': 13,
#       'DrDoS_SSDP': 14,
#       'DrDoS_UDP': 15,
#       'UDP-lag': 16,
#       'WebDDoS': 17,
#       'TFTP': 18,
# }
```

[9]:
```
# x_train = np.expand_dims(x_train, -1)
# x_test = np.expand_dims(x_test, -1)
# x_val = np.expand_dims(x_val, -1)
```

[10]:
```
# y_train = np.expand_dims(y_train, -1)
# y_test = np.expand_dims(y_test, -1)
```

[11]:
```
print(x_train.shape)
```

```
(77240, 67)
```

[12]:
```
print(x_train.index)
print(y_train.index)
y_train = y_train.to_frame()
y_test = y_test.to_frame()
```

```
Int64Index([ 14022,  38656,  54284, 135377,  44853,   1193,  50828,  45391,
            123835,  14332,
             …
            115610,  78735,  81704, 113436, 105959,  28717,  71518,  90696,
            113194, 120403],
           dtype='int64', length=77240)
Int64Index([ 14022,  38656,  54284, 135377,  44853,   1193,  50828,  45391,
            123835,  14332,
             …
            115610,  78735,  81704, 113436, 105959,  28717,  71518,  90696,
            113194, 120403],
           dtype='int64', length=77240)
```

```
[13]: # custom keys -> replace by index

      x_train = x_train.set_index([pd.Index(range (0, len(x_train)))])
      y_train = y_train.set_index([pd.Index(range (0, len(y_train)))])
      x_test = x_test.set_index([pd.Index(range (0, len(x_test)))])
      y_test = y_test.set_index([pd.Index(range (0, len(y_test)))])
```

```
[14]: print(x_train.index)
      print(y_train.index)
```

```
RangeIndex(start=0, stop=77240, step=1)
RangeIndex(start=0, stop=77240, step=1)
```

```
[15]: print(y_train)
```

```
        Label
0         0.0
1         0.0
2         0.0
3         0.0
4         0.0
...        ...
77235     1.0
77236     1.0
77237     1.0
77238     1.0
77239     1.0

[77240 rows x 1 columns]
```

```
[16]: print(y_train.iloc[17162,:])
```

```
Label    0.0
Name: 17162, dtype: float32
```

```
[17]: print(y_train.index)
      print(x_train.index)
```

```
RangeIndex(start=0, stop=77240, step=1)
RangeIndex(start=0, stop=77240, step=1)
```

0.1.1 Custom environment

```
[18]: class IdsEnv(gym.Env):
          def __init__(self, images_per_episode=1, dataset=(x_train, y_train),␣
      ↪random=True):
```

```python
        # Actions we can take, classify as malicious or non-malicious (later
↪also the correct attack)
        # change to 19 if detectiong all different attacks
        self.action_space = gym.spaces.Discrete(2)
        # All the features we have, 67 features and 1 label. Label should not
↪be included
        self.observation_space = gym.spaces.Box(low=float('-inf'),
↪high=float('inf'), shape=(67,))
        self.images_per_episode = images_per_episode
        self.step_count = 0

        self.x, self.y = dataset
        self.random = random
        self.dataset_idx = 0

    def step(self, action):
        done = False
        reward = int(action == self.expected_action)

        obs = self._next_obs()

        self.step_count += 1
        if self.step_count >= self.images_per_episode:
            done = True

        return obs, reward, done, {}

    def _next_obs(self):
        if self.random:
            next_obs_idx = random.randint(0, len(self.x) - 1)
            self.expected_action = int(self.y.iloc[next_obs_idx,:])
            obs = self.x.iloc[next_obs_idx,:]

        else:
            obs = self.x.iloc[self.dataset_idx]
            self.expected_action = int(self.y.iloc[self.dataset_idx])

            self.dataset_idx += 1
            if self.dataset_idx >= len(self.x):
                raise StopIteration()

        return obs

    def reset(self):
        self.step_count = 0

        obs = self._next_obs()
```

```
        return obs
```

Train classifier using dqn

```python
[19]: def ids_dqn():
      #     logger.configure(dir=os.path.join(os.getcwd(),'Training/Logs/ids_dqn'),
      →format_strs=['stdout', 'tensorboard'])
          env = IdsEnv(images_per_episode=4096)
      #     env = bench.Monitor(env, logger.get_dir())

          model = deepq.DQN(
              MlpPolicy,
              env,
              verbose=1,
              learning_rate=0.00025,
              buffer_size=1000000,
              learning_starts=50000,
              batch_size=32,
              gamma=0.99,
              train_freq=4,
              target_network_update_freq=30000, # 10k to 30k
              exploration_fraction=0.01, # 0.1 to 0.01
              exploration_initial_eps=1.0,
              exploration_final_eps=0.05,
          ).learn(
              total_timesteps=int(1.0e6),
              log_interval=10
          )

          model.save('ddqn_stableb2_ids.pkl')
          env.close()

          return model

      start_time = time.time()
      dqn_model = ids_dqn()
      print("DQN Training Time:", time.time() - start_time)
```

WARNING:tensorflow:From /opt/conda/lib/python3.7/site-
packages/stable_baselines/common/tf_util.py:191: The name tf.ConfigProto is
deprecated. Please use tf.compat.v1.ConfigProto instead.

WARNING:tensorflow:From /opt/conda/lib/python3.7/site-
packages/stable_baselines/common/tf_util.py:200: The name tf.Session is
deprecated. Please use tf.compat.v1.Session instead.

WARNING:tensorflow:From /opt/conda/lib/python3.7/site-
packages/stable_baselines/deepq/dqn.py:129: The name tf.train.AdamOptimizer is

deprecated. Please use tf.compat.v1.train.AdamOptimizer instead.

WARNING:tensorflow:From /opt/conda/lib/python3.7/site-
packages/stable_baselines/deepq/build_graph.py:358: The name tf.variable_scope
is deprecated. Please use tf.compat.v1.variable_scope instead.

WARNING:tensorflow:From /opt/conda/lib/python3.7/site-
packages/stable_baselines/deepq/build_graph.py:359: The name tf.placeholder is
deprecated. Please use tf.compat.v1.placeholder instead.

WARNING:tensorflow:From /opt/conda/lib/python3.7/site-
packages/stable_baselines/deepq/build_graph.py:139: The name tf.get_variable is
deprecated. Please use tf.compat.v1.get_variable instead.

WARNING:tensorflow:From /opt/conda/lib/python3.7/site-
packages/stable_baselines/deepq/policies.py:109: flatten (from
tensorflow.python.layers.core) is deprecated and will be removed in a future
version.
Instructions for updating:
Use keras.layers.flatten instead.
WARNING:tensorflow:Entity <bound method Flatten.call of
<tensorflow.python.layers.core.Flatten object at 0x7fcb126cbd10>> could not be
transformed and will be executed as-is. Please report this to the AutgoGraph
team. When filing the bug, set the verbosity to 10 (on Linux, `export
AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound
method Flatten.call of <tensorflow.python.layers.core.Flatten object at
0x7fcb126cbd10>>: AttributeError: module 'gast' has no attribute 'Num'
WARNING: Entity <bound method Flatten.call of
<tensorflow.python.layers.core.Flatten object at 0x7fcb126cbd10>> could not be
transformed and will be executed as-is. Please report this to the AutgoGraph
team. When filing the bug, set the verbosity to 10 (on Linux, `export
AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound
method Flatten.call of <tensorflow.python.layers.core.Flatten object at
0x7fcb126cbd10>>: AttributeError: module 'gast' has no attribute 'Num'

/opt/conda/lib/python3.7/site-packages/gym/logger.py:30: UserWarning: WARN:
Box bound precision lowered by casting to float32
  warnings.warn(colorize('%s: %s'%('WARN', msg % args), 'yellow'))

WARNING:tensorflow:Entity <bound method Dense.call of
<tensorflow.python.layers.core.Dense object at 0x7fcb126b5c10>> could not be
transformed and will be executed as-is. Please report this to the AutgoGraph
team. When filing the bug, set the verbosity to 10 (on Linux, `export
AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound
method Dense.call of <tensorflow.python.layers.core.Dense object at
0x7fcb126b5c10>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING: Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense
object at 0x7fcb126b5c10>> could not be transformed and will be executed as-is.

Please report this to the AutgoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb126b5c10>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING:tensorflow:Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb126fa490>> could not be transformed and will be executed as-is. Please report this to the AutgoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb126fa490>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING: Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb126fa490>> could not be transformed and will be executed as-is. Please report this to the AutgoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb126fa490>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING:tensorflow:Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb126fa690>> could not be transformed and will be executed as-is. Please report this to the AutgoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb126fa690>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING: Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb126fa690>> could not be transformed and will be executed as-is. Please report this to the AutgoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb126fa690>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING:tensorflow:Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb126fafd0>> could not be transformed and will be executed as-is. Please report this to the AutgoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb126fafd0>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING: Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb126fafd0>> could not be transformed and will be executed as-is. Please report this to the AutgoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb126fafd0>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING:tensorflow:Entity <bound method Dense.call of

<tensorflow.python.layers.core.Dense object at 0x7fcb126fa690>> could not be transformed and will be executed as-is. Please report this to the AutgoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb126fa690>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING: Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb126fa690>> could not be transformed and will be executed as-is. Please report this to the AutgoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb126fa690>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING:tensorflow:Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb12693150>> could not be transformed and will be executed as-is. Please report this to the AutgoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb12693150>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING: Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb12693150>> could not be transformed and will be executed as-is. Please report this to the AutgoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb12693150>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING:tensorflow:From /opt/conda/lib/python3.7/site-packages/stable_baselines/deepq/build_graph.py:149: add_dispatch_support.<locals>.wrapper (from tensorflow.python.ops.array_ops) is deprecated and will be removed in a future version.
Instructions for updating:
Use tf.where in 2.0, which has the same broadcast rule as np.where
WARNING:tensorflow:Entity <bound method Flatten.call of <tensorflow.python.layers.core.Flatten object at 0x7fcb124f28d0>> could not be transformed and will be executed as-is. Please report this to the AutgoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound method Flatten.call of <tensorflow.python.layers.core.Flatten object at 0x7fcb124f28d0>>: AttributeError: module 'gast' has no attribute 'Num'
WARNING: Entity <bound method Flatten.call of <tensorflow.python.layers.core.Flatten object at 0x7fcb124f28d0>> could not be transformed and will be executed as-is. Please report this to the AutgoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound method Flatten.call of <tensorflow.python.layers.core.Flatten object at 0x7fcb124f28d0>>: AttributeError: module 'gast' has no attribute 'Num'
WARNING:tensorflow:Entity <bound method Dense.call of

<tensorflow.python.layers.core.Dense object at 0x7fcb12551150>> could not be transformed and will be executed as-is. Please report this to the AutgoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb12551150>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING: Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb12551150>> could not be transformed and will be executed as-is. Please report this to the AutgoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb12551150>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING:tensorflow:Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb125519d0>> could not be transformed and will be executed as-is. Please report this to the AutgoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb125519d0>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING: Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb125519d0>> could not be transformed and will be executed as-is. Please report this to the AutgoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb125519d0>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING:tensorflow:Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb12551350>> could not be transformed and will be executed as-is. Please report this to the AutgoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb12551350>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING: Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb12551350>> could not be transformed and will be executed as-is. Please report this to the AutoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb12551350>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING:tensorflow:Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb12551750>> could not be transformed and will be executed as-is. Please report this to the AutgoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb12551750>>: AssertionError: Bad argument number for Name: 3, expecting 4

WARNING: Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb12551750>> could not be transformed and will be executed as-is. Please report this to the AutgoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb12551750>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING:tensorflow:Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb12551890>> could not be transformed and will be executed as-is. Please report this to the AutgoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb12551890>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING: Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb12551890>> could not be transformed and will be executed as-is. Please report this to the AutgoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb12551890>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING:tensorflow:Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb12551890>> could not be transformed and will be executed as-is. Please report this to the AutgoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb12551890>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING: Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb12551890>> could not be transformed and will be executed as-is. Please report this to the AutgoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb12551890>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING:tensorflow:Entity <bound method Flatten.call of <tensorflow.python.layers.core.Flatten object at 0x7fcb125518d0>> could not be transformed and will be executed as-is. Please report this to the AutgoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound method Flatten.call of <tensorflow.python.layers.core.Flatten object at 0x7fcb125518d0>>: AttributeError: module 'gast' has no attribute 'Num'
WARNING: Entity <bound method Flatten.call of <tensorflow.python.layers.core.Flatten object at 0x7fcb125518d0>> could not be transformed and will be executed as-is. Please report this to the AutgoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound method Flatten.call of <tensorflow.python.layers.core.Flatten object at

0x7fcb125518d0>>: AttributeError: module 'gast' has no attribute 'Num'
WARNING:tensorflow:Entity <bound method Dense.call of
<tensorflow.python.layers.core.Dense object at 0x7fcb126222d0>> could not be
transformed and will be executed as-is. Please report this to the AutgoGraph
team. When filing the bug, set the verbosity to 10 (on Linux, `export
AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound
method Dense.call of <tensorflow.python.layers.core.Dense object at
0x7fcb126222d0>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING: Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense
object at 0x7fcb126222d0>> could not be transformed and will be executed as-is.
Please report this to the AutgoGraph team. When filing the bug, set the
verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full
output. Cause: converting <bound method Dense.call of
<tensorflow.python.layers.core.Dense object at 0x7fcb126222d0>>: AssertionError:
Bad argument number for Name: 3, expecting 4
WARNING:tensorflow:Entity <bound method Dense.call of
<tensorflow.python.layers.core.Dense object at 0x7fcb12622cd0>> could not be
transformed and will be executed as-is. Please report this to the AutgoGraph
team. When filing the bug, set the verbosity to 10 (on Linux, `export
AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound
method Dense.call of <tensorflow.python.layers.core.Dense object at
0x7fcb12622cd0>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING: Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense
object at 0x7fcb12622cd0>> could not be transformed and will be executed as-is.
Please report this to the AutgoGraph team. When filing the bug, set the
verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full
output. Cause: converting <bound method Dense.call of
<tensorflow.python.layers.core.Dense object at 0x7fcb12622cd0>>: AssertionError:
Bad argument number for Name: 3, expecting 4
WARNING:tensorflow:Entity <bound method Dense.call of
<tensorflow.python.layers.core.Dense object at 0x7fcb12622cd0>> could not be
transformed and will be executed as-is. Please report this to the AutgoGraph
team. When filing the bug, set the verbosity to 10 (on Linux, `export
AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound
method Dense.call of <tensorflow.python.layers.core.Dense object at
0x7fcb12622cd0>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING: Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense
object at 0x7fcb12622cd0>> could not be transformed and will be executed as-is.
Please report this to the AutgoGraph team. When filing the bug, set the
verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full
output. Cause: converting <bound method Dense.call of
<tensorflow.python.layers.core.Dense object at 0x7fcb12622cd0>>: AssertionError:
Bad argument number for Name: 3, expecting 4
WARNING:tensorflow:Entity <bound method Dense.call of
<tensorflow.python.layers.core.Dense object at 0x7fcb126227d0>> could not be
transformed and will be executed as-is. Please report this to the AutgoGraph
team. When filing the bug, set the verbosity to 10 (on Linux, `export
AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound

method Dense.call of <tensorflow.python.layers.core.Dense object at
0x7fcb126227d0>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING: Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense
object at 0x7fcb126227d0>> could not be transformed and will be executed as-is.
Please report this to the AutgoGraph team. When filing the bug, set the
verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full
output. Cause: converting <bound method Dense.call of
<tensorflow.python.layers.core.Dense object at 0x7fcb126227d0>>: AssertionError:
Bad argument number for Name: 3, expecting 4
WARNING:tensorflow:Entity <bound method Dense.call of
<tensorflow.python.layers.core.Dense object at 0x7fcb126222d0>> could not be
transformed and will be executed as-is. Please report this to the AutgoGraph
team. When filing the bug, set the verbosity to 10 (on Linux, `export
AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound
method Dense.call of <tensorflow.python.layers.core.Dense object at
0x7fcb126222d0>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING: Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense
object at 0x7fcb126222d0>> could not be transformed and will be executed as-is.
Please report this to the AutgoGraph team. When filing the bug, set the
verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full
output. Cause: converting <bound method Dense.call of
<tensorflow.python.layers.core.Dense object at 0x7fcb126222d0>>: AssertionError:
Bad argument number for Name: 3, expecting 4
WARNING:tensorflow:Entity <bound method Dense.call of
<tensorflow.python.layers.core.Dense object at 0x7fcb12622210>> could not be
transformed and will be executed as-is. Please report this to the AutgoGraph
team. When filing the bug, set the verbosity to 10 (on Linux, `export
AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound
method Dense.call of <tensorflow.python.layers.core.Dense object at
0x7fcb12622210>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING: Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense
object at 0x7fcb12622210>> could not be transformed and will be executed as-is.
Please report this to the AutgoGraph team. When filing the bug, set the
verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full
output. Cause: converting <bound method Dense.call of
<tensorflow.python.layers.core.Dense object at 0x7fcb12622210>>: AssertionError:
Bad argument number for Name: 3, expecting 4
WARNING:tensorflow:Entity <bound method Flatten.call of
<tensorflow.python.layers.core.Flatten object at 0x7fcb1250ea10>> could not be
transformed and will be executed as-is. Please report this to the AutgoGraph
team. When filing the bug, set the verbosity to 10 (on Linux, `export
AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound
method Flatten.call of <tensorflow.python.layers.core.Flatten object at
0x7fcb1250ea10>>: AttributeError: module 'gast' has no attribute 'Num'
WARNING: Entity <bound method Flatten.call of
<tensorflow.python.layers.core.Flatten object at 0x7fcb1250ea10>> could not be
transformed and will be executed as-is. Please report this to the AutgoGraph
team. When filing the bug, set the verbosity to 10 (on Linux, `export

AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound method Flatten.call of <tensorflow.python.layers.core.Flatten object at 0x7fcb1250ea10>>: AttributeError: module 'gast' has no attribute 'Num'
WARNING:tensorflow:Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb12414990>> could not be transformed and will be executed as-is. Please report this to the AutgoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb12414990>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING: Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb12414990>> could not be transformed and will be executed as-is. Please report this to the AutgoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb12414990>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING:tensorflow:Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb12335390>> could not be transformed and will be executed as-is. Please report this to the AutgoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb12335390>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING: Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb12335390>> could not be transformed and will be executed as-is. Please report this to the AutgoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb12335390>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING:tensorflow:Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb12335390>> could not be transformed and will be executed as-is. Please report this to the AutgoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb12335390>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING: Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb12335390>> could not be transformed and will be executed as-is. Please report this to the AutgoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb12335390>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING:tensorflow:Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb125a4950>> could not be transformed and will be executed as-is. Please report this to the AutgoGraph

team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb125a4950>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING: Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb125a4950>> could not be transformed and will be executed as-is. Please report this to the AutgoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb125a4950>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING:tensorflow:Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb124342d0>> could not be transformed and will be executed as-is. Please report this to the AutgoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb124342d0>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING: Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb124342d0>> could not be transformed and will be executed as-is. Please report this to the AutgoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb124342d0>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING:tensorflow:Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb1261ed90>> could not be transformed and will be executed as-is. Please report this to the AutgoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb1261ed90>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING: Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb1261ed90>> could not be transformed and will be executed as-is. Please report this to the AutgoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7fcb1261ed90>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING:tensorflow:From /opt/conda/lib/python3.7/site-packages/stable_baselines/deepq/build_graph.py:415: The name tf.summary.scalar is deprecated. Please use tf.compat.v1.summary.scalar instead.

WARNING:tensorflow:From /opt/conda/lib/python3.7/site-packages/stable_baselines/deepq/build_graph.py:449: The name tf.summary.merge_all is deprecated. Please use tf.compat.v1.summary.merge_all instead.

```
--------------------------------------
| % time spent exploring  | 5        |
| episodes                | 10       |
| mean 100 episode reward | 2.18e+03 |
| steps                   | 36864    |
--------------------------------------

--------------------------------------
| % time spent exploring  | 5        |
| episodes                | 20       |
| mean 100 episode reward | 1.92e+03 |
| steps                   | 77824    |
--------------------------------------

--------------------------------------
| % time spent exploring  | 5        |
| episodes                | 30       |
| mean 100 episode reward | 1.8e+03  |
| steps                   | 118784   |
--------------------------------------

--------------------------------------
| % time spent exploring  | 5        |
| episodes                | 40       |
| mean 100 episode reward | 1.73e+03 |
| steps                   | 159744   |
--------------------------------------

--------------------------------------
| % time spent exploring  | 5        |
| episodes                | 50       |
| mean 100 episode reward | 1.7e+03  |
| steps                   | 200704   |
--------------------------------------

--------------------------------------
| % time spent exploring  | 5        |
| episodes                | 60       |
| mean 100 episode reward | 1.68e+03 |
| steps                   | 241664   |
--------------------------------------

--------------------------------------
| % time spent exploring  | 5        |
| episodes                | 70       |
| mean 100 episode reward | 1.67e+03 |
| steps                   | 282624   |
--------------------------------------

--------------------------------------
| % time spent exploring  | 5        |
| episodes                | 80       |
| mean 100 episode reward | 1.67e+03 |
| steps                   | 323584   |
--------------------------------------
```

```
--------------------------------------
| % time spent exploring  | 5       |
| episodes                | 90      |
| mean 100 episode reward | 1.75e+03 |
| steps                   | 364544  |
--------------------------------------

--------------------------------------
| % time spent exploring  | 5       |
| episodes                | 100     |
| mean 100 episode reward | 1.84e+03 |
| steps                   | 405504  |
--------------------------------------

--------------------------------------
| % time spent exploring  | 5       |
| episodes                | 110     |
| mean 100 episode reward | 1.83e+03 |
| steps                   | 446464  |
--------------------------------------

--------------------------------------
| % time spent exploring  | 5       |
| episodes                | 120     |
| mean 100 episode reward | 1.86e+03 |
| steps                   | 487424  |
--------------------------------------

--------------------------------------
| % time spent exploring  | 5       |
| episodes                | 130     |
| mean 100 episode reward | 1.92e+03 |
| steps                   | 528384  |
--------------------------------------

--------------------------------------
| % time spent exploring  | 5       |
| episodes                | 140     |
| mean 100 episode reward | 1.98e+03 |
| steps                   | 569344  |
--------------------------------------

--------------------------------------
| % time spent exploring  | 5       |
| episodes                | 150     |
| mean 100 episode reward | 2.04e+03 |
| steps                   | 610304  |
--------------------------------------

--------------------------------------
| % time spent exploring  | 5       |
| episodes                | 160     |
| mean 100 episode reward | 2.19e+03 |
| steps                   | 651264  |
--------------------------------------
```

```
--------------------------------------
| % time spent exploring  | 5       |
| episodes                | 170     |
| mean 100 episode reward | 2.35e+03 |
| steps                   | 692224  |
--------------------------------------

--------------------------------------
| % time spent exploring  | 5       |
| episodes                | 180     |
| mean 100 episode reward | 2.48e+03 |
| steps                   | 733184  |
--------------------------------------

--------------------------------------
| % time spent exploring  | 5       |
| episodes                | 190     |
| mean 100 episode reward | 2.53e+03 |
| steps                   | 774144  |
--------------------------------------

--------------------------------------
| % time spent exploring  | 5       |
| episodes                | 200     |
| mean 100 episode reward | 2.56e+03 |
| steps                   | 815104  |
--------------------------------------

--------------------------------------
| % time spent exploring  | 5       |
| episodes                | 210     |
| mean 100 episode reward | 2.65e+03 |
| steps                   | 856064  |
--------------------------------------

--------------------------------------
| % time spent exploring  | 5       |
| episodes                | 220     |
| mean 100 episode reward | 2.73e+03 |
| steps                   | 897024  |
--------------------------------------

--------------------------------------
| % time spent exploring  | 5       |
| episodes                | 230     |
| mean 100 episode reward | 2.82e+03 |
| steps                   | 937984  |
--------------------------------------

--------------------------------------
| % time spent exploring  | 5       |
| episodes                | 240     |
| mean 100 episode reward | 2.92e+03 |
| steps                   | 978944  |
--------------------------------------
```

```
DQN Training Time: 3738.603359937668
```

```
[20]: def ids_dqn_eval(dqn_model):
          attempts, correct = 0,0

          env = IdsEnv(images_per_episode=1, dataset=(x_test, y_test), random=False)

          try:
              while True:
                  obs, done = env.reset(), False
                  while not done:
                      obs, rew, done, _ = env.step(dqn_model.predict(obs)[0])

                      attempts += 1
                      if rew > 0:
                          correct += 1

          except StopIteration:
              print()
              print('validation done...')
              print('Accuracy: {0}%'.format((float(correct) / attempts) * 100))

      ids_dqn_eval(dqn_model)
```

```
/opt/conda/lib/python3.7/site-packages/gym/logger.py:30: UserWarning: WARN:
Box bound precision lowered by casting to float32
  warnings.warn(colorize('%s: %s'%('WARN', msg % args), 'yellow'))


validation done…
Accuracy: 89.9067599067599%
```