weighted-dqn-1e6-4096-defaultparams-rerun

March 27, 2022

0.0.1 Exploration

```
[1]: !git clone https://github.com/openai/baselines.git
     %cd baselines
     !pip install -e .
     !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
Requirement already satisfied: gym<0.16.0,>=0.15.4 in
/opt/conda/lib/python3.7/site-packages (from baselines==0.1.6) (0.15.7)
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) (1.2.2)
Requirement already satisfied: click in /opt/conda/lib/python3.7/site-packages
(from baselines==0.1.6) (7.1.2)
Requirement already satisfied: opencv-python in /opt/conda/lib/python3.7/site-
packages (from baselines==0.1.6) (4.5.5.64)
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)
Requirement already satisfied: pyglet<=1.5.0,>=1.4.0 in
/opt/conda/lib/python3.7/site-packages (from
gym<0.16.0,>=0.15.4->baselines==0.1.6) (1.5.0)
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: future in /opt/conda/lib/python3.7/site-packages
(from pyglet<=1.5.0,>=1.4.0->gym<0.16.0,>=0.15.4->baselines==0.1.6) (0.18.2)
Installing collected packages: baselines
  Attempting uninstall: baselines
    Found existing installation: baselines 0.1.6
```

```
    Uninstalling baselines-0.1.6:
      Successfully uninstalled baselines-0.1.6
  Running setup.py develop for baselines
Successfully installed baselines
Requirement already up-to-date: tensorflow==1.14.0 in
/opt/conda/lib/python3.7/site-packages (1.14.0)
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: 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: 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: gast>=0.2.0 in
/opt/conda/lib/python3.7/site-packages (from tensorflow==1.14.0) (0.3.3)
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: 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: tensorflow-
estimator<1.15.0rc0,>=1.14.0rc0 in /opt/conda/lib/python3.7/site-packages (from
tensorflow==1.14.0) (1.14.0)
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: astor>=0.6.0 in
/opt/conda/lib/python3.7/site-packages (from tensorflow==1.14.0) (0.8.1)
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: keras-applications>=1.0.6 in
/opt/conda/lib/python3.7/site-packages (from tensorflow==1.14.0) (1.0.8)
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)
Requirement already satisfied, skipping upgrade: tensorboard<1.15.0,>=1.14.0 in
/opt/conda/lib/python3.7/site-packages (from tensorflow==1.14.0) (1.14.0)
Requirement already satisfied, skipping upgrade: wheel>=0.26 in
/opt/conda/lib/python3.7/site-packages (from tensorflow==1.14.0) (0.34.2)
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)
Requirement already satisfied: gym in /opt/conda/lib/python3.7/site-packages
(0.15.7)
Requirement already satisfied: pyglet<=1.5.0,>=1.4.0 in
/opt/conda/lib/python3.7/site-packages (from gym) (1.5.0)
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: scipy in /opt/conda/lib/python3.7/site-packages
(from gym) (1.4.1)
Requirement already satisfied: cloudpickle~=1.2.0 in
/opt/conda/lib/python3.7/site-packages (from gym) (1.2.2)
Requirement already satisfied: future in /opt/conda/lib/python3.7/site-packages
(from pyglet<=1.5.0,>=1.4.0->gym) (0.18.2)

```python
[2]: import os
import time
import gym
import random
import numpy as np
import pandas as pd
from tensorflow import keras
from tensorflow.keras import layers

from baselines.ppo2 import ppo2
from baselines.common.vec_env.dummy_vec_env import DummyVecEnv

from baselines import deepq
from baselines import bench
from 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)])
```

```
[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]
```

```
[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)
```

```
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]: 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
(17164, 67)
```

```
(17164,)
Validation
(8582, 67)
(8582,)
Testing
(60076, 67)
(60076,)
```

```python
[8]:  # 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,
      # }
```

```python
[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)
```

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

```python
[ ]:
```

0.1.1 Custom environment

```python
[11]: 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[next_obs_idx])
            obs = self.x[next_obs_idx]

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

```
[12]: 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.learn(
              env,
              "mlp",
              total_timesteps=int(1.0e5),
              print_freq=10,
          )

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

          return model

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

Logging to /project/baselines/Training/Logs/ids_dqn
WARNING:tensorflow:From /project/baselines/baselines/common/tf_util.py:53: The
name tf.get_default_session is deprecated. Please use
tf.compat.v1.get_default_session instead.

WARNING:tensorflow:From /project/baselines/baselines/common/tf_util.py:63: The
name tf.ConfigProto is deprecated. Please use tf.compat.v1.ConfigProto instead.

WARNING:tensorflow:From /project/baselines/baselines/common/tf_util.py:70: The
name tf.InteractiveSession is deprecated. Please use
tf.compat.v1.InteractiveSession instead.

WARNING:tensorflow:From /project/baselines/baselines/common/misc_util.py:58: The
name tf.set_random_seed is deprecated. Please use tf.compat.v1.set_random_seed
instead.

WARNING:tensorflow:From /project/baselines/baselines/deepq/deepq.py:205: The
name tf.train.AdamOptimizer is deprecated. Please use
tf.compat.v1.train.AdamOptimizer instead.

WARNING:tensorflow:From /project/baselines/baselines/deepq/build_graph.py:176:
The name tf.variable_scope is deprecated. Please use tf.compat.v1.variable_scope

13

instead.

WARNING:tensorflow:From /project/baselines/baselines/common/input.py:57:
to_float (from tensorflow.python.ops.math_ops) is deprecated and will be removed
in a future version.
Instructions for updating:
Use `tf.cast` instead.
WARNING:tensorflow:From /project/baselines/baselines/common/models.py:94:
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 0x7ff88c6921d0>> 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
0x7ff88c6921d0>>: AttributeError: module 'gast' has no attribute 'Num'
WARNING: Entity <bound method Flatten.call of
<tensorflow.python.layers.core.Flatten object at 0x7ff88c6921d0>> 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
0x7ff88c6921d0>>: 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 Flatten.call of
<tensorflow.python.layers.core.Flatten object at 0x7ff88bdbb410>> 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
0x7ff88bdbb410>>: AttributeError: module 'gast' has no attribute 'Num'
WARNING: Entity <bound method Flatten.call of
<tensorflow.python.layers.core.Flatten object at 0x7ff88bdbb410>> 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
0x7ff88bdbb410>>: AttributeError: module 'gast' has no attribute 'Num'
WARNING:tensorflow:Entity <bound method Dense.call of
<tensorflow.python.layers.core.Dense object at 0x7ff88bdbb7d0>> 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 0x7ff88bdbb7d0>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING: Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7ff88bdbb7d0>> 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 0x7ff88bdbb7d0>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING:tensorflow:Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7ff88bdbb7d0>> 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 0x7ff88bdbb7d0>>: AssertionError: Bad argument number for Name: 3, expecting 4
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WARNING:tensorflow:Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7ff88bdbb710>> 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 0x7ff88bdbb710>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING: Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7ff88bdbb710>> 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 0x7ff88bdbb710>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING:tensorflow:Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7ff88bdbb710>> 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 0x7ff88bdbb710>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING: Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7ff88bdbb710>> 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 0x7ff88bdbb710>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING:tensorflow:From /project/baselines/baselines/deepq/build_graph.py:189: 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 0x7ff88bda1390>> 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 0x7ff88bda1390>>: AttributeError: module 'gast' has no attribute 'Num'
WARNING: Entity <bound method Flatten.call of <tensorflow.python.layers.core.Flatten object at 0x7ff88bda1390>> 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 0x7ff88bda1390>>: AttributeError: module 'gast' has no attribute 'Num'
WARNING:tensorflow:Entity <bound method Flatten.call of <tensorflow.python.layers.core.Flatten object at 0x7ff88bcd1c50>> 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 0x7ff88bcd1c50>>: AttributeError: module 'gast' has no attribute 'Num'
WARNING: Entity <bound method Flatten.call of <tensorflow.python.layers.core.Flatten object at 0x7ff88bcd1c50>> 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 0x7ff88bcd1c50>>: AttributeError: module 'gast' has no attribute 'Num'
WARNING:tensorflow:Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7ff88be43dd0>> 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 0x7ff88be43dd0>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING: Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7ff88be43dd0>> 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 0x7ff88be43dd0>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING:tensorflow:Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7ff88bd325d0>> 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 0x7ff88bd325d0>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING: Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7ff88bd325d0>> 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 0x7ff88bd325d0>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING:tensorflow:Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7ff88bd21110>> 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 0x7ff88bd21110>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING: Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7ff88bd21110>> 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 0x7ff88bd21110>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING:tensorflow:Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7ff88bd325d0>> 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 0x7ff88bd325d0>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING: Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7ff88bd325d0>> 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 0x7ff88bd325d0>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING:tensorflow:Entity <bound method Flatten.call of <tensorflow.python.layers.core.Flatten object at 0x7ff88be54150>> 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 0x7ff88be54150>>: AttributeError: module 'gast' has no attribute 'Num'
WARNING: Entity <bound method Flatten.call of <tensorflow.python.layers.core.Flatten object at 0x7ff88be54150>> 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 0x7ff88be54150>>: AttributeError: module 'gast' has no attribute 'Num'
WARNING:tensorflow:Entity <bound method Flatten.call of <tensorflow.python.layers.core.Flatten object at 0x7ff88bc5eb10>> 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 0x7ff88bc5eb10>>: AttributeError: module 'gast' has no attribute 'Num'
WARNING: Entity <bound method Flatten.call of <tensorflow.python.layers.core.Flatten object at 0x7ff88bc5eb10>> 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 0x7ff88bc5eb10>>: AttributeError: module 'gast' has no attribute 'Num'
WARNING:tensorflow:Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7ff88bbf9450>> 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 0x7ff88bbf9450>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING: Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7ff88bbf9450>> 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 0x7ff88bbf9450>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING:tensorflow:Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense object at 0x7ff88bc5e490>> 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 0x7ff88bc5e490>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING: Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense

object at 0x7ff88bc5e490>> 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 0x7ff88bc5e490>>: AssertionError:
Bad argument number for Name: 3, expecting 4
WARNING:tensorflow:Entity <bound method Dense.call of
<tensorflow.python.layers.core.Dense object at 0x7ff88bcc6790>> 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
0x7ff88bcc6790>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING: Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense
object at 0x7ff88bcc6790>> 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 0x7ff88bcc6790>>: AssertionError:
Bad argument number for Name: 3, expecting 4
WARNING:tensorflow:Entity <bound method Dense.call of
<tensorflow.python.layers.core.Dense object at 0x7ff88bd32ad0>> 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
0x7ff88bd32ad0>>: AssertionError: Bad argument number for Name: 3, expecting 4
WARNING: Entity <bound method Dense.call of <tensorflow.python.layers.core.Dense
object at 0x7ff88bd32ad0>> 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 0x7ff88bd32ad0>>: AssertionError:
Bad argument number for Name: 3, expecting 4
WARNING:tensorflow:Entity <bound method Flatten.call of
<tensorflow.python.layers.core.Flatten object at 0x7ff88bd21610>> 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
0x7ff88bd21610>>: AttributeError: module 'gast' has no attribute 'Num'
WARNING: Entity <bound method Flatten.call of
<tensorflow.python.layers.core.Flatten object at 0x7ff88bd21610>> 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
0x7ff88bd21610>>: AttributeError: module 'gast' has no attribute 'Num'

WARNING:tensorflow:Entity <bound method Flatten.call of
<tensorflow.python.layers.core.Flatten object at 0x7ff88be59350>> could not be
transformed and will be executed as-is. Please report this to the AutgoGraph
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```
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/opt/conda/lib/python3.7/site-packages/numpy/core/fromnumeric.py:3335:
RuntimeWarning: Mean of empty slice.
  out=out, **kwargs)
/opt/conda/lib/python3.7/site-packages/numpy/core/_methods.py:161:
RuntimeWarning: invalid value encountered in double_scalars
  ret = ret.dtype.type(ret / rcount)

--------------------------------------
| % time spent exploring | 2        |
| episodes               | 10       |
| mean 100 episode reward | 3.61e+03 |
| steps                  | 3.69e+04 |
--------------------------------------
--------------------------------------
| % time spent exploring | 2        |
| episodes               | 20       |
| mean 100 episode reward | 3.74e+03 |
| steps                  | 7.78e+04 |
--------------------------------------
DQN Training Time: 471.9158549308777
```

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

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

```python
    try:
        while True:
            obs, done = env.reset(), False
            while not done:
                obs, rew, done, _ = env.step(dqn_model(obs[None])[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: 93.9374771115624%