```
Jupyter Project1 (2) Last Checkpoint: 19 minutes ago
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                                                                                                                     JupyterLab 🖸 🀞 Python 3 (ipykernel) 🔘
    [1]: import pandas as pd
          from sklearn.preprocessing import LabelEncoder
          from sklearn.model_selection import train_test_split
          from sklearn.preprocessing import MinMaxScaler
          import tensorflow as tf
          from tensorflow import keras
          from tensorflow.keras.models import Sequential
          from tensorflow.keras.layers import Dense
          import modAL
          import numpy as np
          from modAL.models import ActiveLearner
          from modAL.uncertainty import uncertainty_sampling
          from scikeras.wrappers import KerasClassifier
          from sklearn.metrics import confusion_matrix,ConfusionMatrixDisplay
          from imblearn.over_sampling import SMOTE
          from sklearn.metrics import classification_report
    [2]: df=pd.read_csv("C:\\users/rsaur/Downloads/NF-UNSW-NB15 -Dataset/NF-UNSW-NB15 -Dataset.csv")
          df
    [2]:
                  IPV4_SRC_ADDR L4_SRC_PORT IPV4_DST_ADDR L4_DST_PORT PROTOCOL L7_PROTO IN_BYTES OUT_BYTES IN_PKTS OUT_PKTS TCP_FLAGS FLOW_DURAT
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    [3]: df['Attack'].value_counts()
    [3]: Attack
          Benign
                          1550712
                            24736
          Exploits
                            19463
          Fuzzers
                            12291
          Reconnaissance
                            5570
          Generic
          DoS
                            5051
          Analysis
                            1995
          Backdoor
                            1782
          Shellcode
                            1365
                             153
          Worms
          Name: count, dtype: int64
    [4]: df1=df.copy()
         df1
    [4]:
                  IPV4_SRC_ADDR L4_SRC_PORT IPV4_DST_ADDR L4_DST_PORT PROTOCOL L7_PROTO IN_BYTES OUT_BYTES IN_PKTS OUT_PKTS TCP_FLAGS FLOW_DURA1
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    [5]: x=df1.drop(["Label","Attack"],axis=1)
    [5]:
                  IPV4_SRC_ADDR L4_SRC_PORT IPV4_DST_ADDR L4_DST_PORT PROTOCOL L7_PROTO IN_BYTES OUT_BYTES IN_PKTS OUT_PKTS TCP_FLAGS FLOW_DURA1
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    [6]: y=df1[["Label"]]
    [6]:
                  Label
                     0
               3
                     0
          1623113
          1623114
          1623115
    [7]: y.value_counts()
    [7]: Label
                  1550712
                   72406
          Name: count, dtype: int64
    [8]: y.shape,x.shape
    [8]: ((1623118, 1), (1623118, 12))
    [9]: label_encoder=LabelEncoder()
         x["IPV4_SRC_ADDR"]=label_encoder.fit_transform(x["IPV4_SRC_ADDR"])
         x["IPV4_DST_ADDR"]=label_encoder.fit_transform(x["IPV4_DST_ADDR"])
   [10]: x["IPV4_SRC_ADDR"].value_counts(), x["IPV4_DST_ADDR"].value_counts()
                   103
                    87
           11
                   76
           12
                   73
                    60
                    46
           10
           14
                    24
           16
                    20
           29
                    19
           13
          Name: count, dtype: int64,
          IPV4_DST_ADDR
                153450
               153394
               153378
                153309
   [11]: smote = SMOTE(sampling_strategy= 'minority')
         x_new,y_new = smote.fit_resample(x,y)
         y_new.value_counts()
   [11]: Label
                  1550712
                  1550712
          Name: count, dtype: int64
   [12]: scaler=MinMaxScaler(feature_range=(0,1))
         x_scaled=scaler.fit_transform(x_new)
         x_scaled
   [12]: array([[1.28205128e-01, 9.47173266e-01, 8.97435897e-01, ...,
                 7.25689405e-04, 8.06451613e-01, 3.49247209e-06],
                [4.35897436e-01, 4.92622263e-01, 8.97435897e-01, ...,
                 1.81422351e-04, 8.06451613e-01, 0.00000000e+00],
                [1.28205128e-01, 3.20439460e-04, 7.94871795e-01, ...,
                 1.99564586e-03, 8.06451613e-01, 2.58675766e-04],
                [6.66666667e-01, 1.91836423e-01, 2.05128205e-01, ...,
                1.45137881e-02, 8.70967742e-01, 3.88595728e-04],
                [6.66666667e-01, 7.20134279e-01, 2.56410256e-01, ...,
                 1.08853411e-03, 6.12903226e-01, 1.55997087e-04],
                [6.66666667e-01, 8.26626993e-01, 2.56410256e-01, ...,
                 2.08635704e-03, 8.70967742e-01, 4.30505393e-04]])
   [13]: x_train,x_pool,y_train,y_pool=train_test_split(x_scaled,y_new,train_size=0.1,random_state=42,shuffle=True,stratify=y_new)
   [14]: def model_ANN():
             model= keras.Sequential([
                 keras.layers.Dense(50,activation='relu',input_shape=(12,)),
                 keras.layers.Dense(50,activation='relu',input_shape=(12,)),
                 keras.layers.Dense(1,activation='sigmoid')
          ])
             model.compile(optimizer='adam',loss='binary_crossentropy',metrics=['accuracy'])
             #model.fit(x_train,y_train,batch_size=100,epochs=10)
             return model
          classifier=KerasClassifier(model_ANN())
          C:\Users\rsaur\anaconda3\Lib\site-packages\keras\src\layers\core\dense.py:87: UserWarning: Do not pass an `input_shape`/`input_dim` argument to a layer. Wh
          en using Sequential models, prefer using an `Input(shape)` object as the first layer in the model instead.
           super().__init__(activity_regularizer=activity_regularizer, **kwargs)
   [15]: learner= ActiveLearner(
             estimator=classifier,
             query_strategy=uncertainty_sampling,
             x_training=x_train,
             y_training=y_train,
             verbose=1
   [16]: n_queries=30
         for idx in range(n_queries):
             query_idx ,query_sample = learner.query(x_pool,n_instances=100,verbose=0)
             learner.teach(x_pool,y_pool,only_new=True,verbose=1)
             x_pool=np.delete(x_pool,query_idx,axis=0)
             y_pool=np.delete(y_pool,query_idx,axis=0)
          87228/87228 ———— 65s 727us/step - accuracy: 0.9828 - loss: 0.0644
          87225/87225 — 62s 714us/step - accuracy: 0.9885 - loss: 0.0421
          87222/87222 ---- 64s 736us/step - accuracy: 0.9891 - loss: 0.0394
          87219/87219 ---- 69s 784us/step - accuracy: 0.9892 - loss: 0.0387
          87216/87216 ————— 64s 727us/step - accuracy: 0.9895 - loss: 0.0379
          87212/87212 ---- 63s 726us/step - accuracy: 0.9895 - loss: 0.0377
          87209/87209 — 65s 741us/step - accuracy: 0.9896 - loss: 0.0372
          87206/87206 —————— 65s 749us/step - accuracy: 0.9896 - loss: 0.0372
          87203/87203 ---- 66s 757us/step - accuracy: 0.9896 - loss: 0.0369
          87200/87200 ----- 87s 995us/step - accuracy: 0.9897 - loss: 0.0367
          87197/87197 ---- 69s 788us/step - accuracy: 0.9896 - loss: 0.0368
          87194/87194 ———— 70s 804us/step - accuracy: 0.9896 - loss: 0.0371
          87191/87191 ---- 75s 855us/step - accuracy: 0.9897 - loss: 0.0377
          87187/87187 ————— 73s 836us/step - accuracy: 0.9896 - loss: 0.0373
          87184/87184 ----- 75s 859us/step - accuracy: 0.9895 - loss: 0.0370
          87181/87181 — 76s 874us/step - accuracy: 0.9896 - loss: 0.0367
          87178/87178 ----- 75s 855us/step - accuracy: 0.9896 - loss: 0.0368
          87175/87175 ————— 76s 865us/step - accuracy: 0.9895 - loss: 0.0369
          87172/87172 ————— 82s 937us/step - accuracy: 0.9898 - loss: 0.0364
          87169/87169 — 78s 894us/step - accuracy: 0.9897 - loss: 0.0361
          87166/87166 — 74s 853us/step - accuracy: 0.9897 - loss: 0.0362
          87159/87159 ----- 83s 952us/step - accuracy: 0.9897 - loss: 0.0366
          87153/87153 ----- 81s 924us/step - accuracy: 0.9899 - loss: 0.0358
          87150/87150 — 77s 882us/step - accuracy: 0.9898 - loss: 0.0362
          87147/87147 ----- 78s 894us/step - accuracy: 0.9898 - loss: 0.0360
          87141/87141 — 85s 969us/step - accuracy: 0.9898 - loss: 0.0357
          87137/87137 ----- 83s 947us/step - accuracy: 0.9899 - loss: 0.0356
   [17]: score=learner.score(x_pool,y_pool)
          print("score:",score*100,"%")
          87134/87134 — 59s 675us/step
          score: 98.99640710659826 %
   [18]: y_pred=learner.predict(x_pool)
                                      - 65s 746us/step
          87134/87134 ---
   [19]: category_names=["Benign","Attack"]
          report=classification_report(y_pool,y_pred,target_names=category_names,labels=[0,1],digits=4)
          print(report)
                                 recall f1-score support
                      precision
               Benign
                         0.9998
                                  0.9802
                                           0.9899
                                                   1393919
               Attack
                         0.9805
                                  0.9998
                                           0.9901 1394363
                                                   2788282
                                           0.9900
             accuracy
                                           0.9900
                                                   2788282
            macro avg
                         0.9902
                                  0.9900
                                           0.9900 2788282
          weighted avg
                                  0.9900
                         0.9902
    [20]: confusion_matrix=ConfusionMatrixDisplay.from_predictions(y_pool,y_pred)
          confusion_matrix
          print("Benign = 0")
          print("Attack = 1")
          Benign = 0
          Attack = 1
                                                                1e6
                                                                    - 1.2
                                               27657
                       1.4e+06
                                                                    - 1.0
                                                                    - 0.8
          True label
                                                                    - 0.6
                                                                    - 0.4
                         326
                                              1.4e+06
                                                                    - 0.2
                                Predicted label
```