```
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
from google.colab import files
```

```
dataset = files.upload()
```

Choose Files No file chosen Upload widget is only available when the cell has been executed in the current browser session. Please rerun this cell to enable

```
dataset=pd.read_csv('data.csv')
```

```
# DATA PREPROCESSING
#*******************
#*******************
X = dataset.iloc[:, 2:32]
y = dataset.iloc[:, 1]

# Encoding categorical data
from sklearn.preprocessing import LabelEncoder, OneHotEncoder
labelencoder_X_1 = LabelEncoder()
y = labelencoder_X_1.fit_transform(y)
```

```
# Splitting the dataset into the Training set and Test set
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size = 0.2, random_state = 25

# Feature Scaling
from sklearn.preprocessing import StandardScaler
sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)

# MAKING THE ARTIFICIAL NEURAL NETWORK
# ************************************
# ************************************

# Importing the Keras libraries and packages
import keras
from keras.models import Sequential
from keras.layers import Dense

# Initialising the ANN
classifier = Sequential()

# Adding the input layer and the first hidden layer
classifier.add(Dense(units = 6, kernel_initializer = 'he_uniform', activation = 'relu', inpu

# Adding the second hidden layer
```

```
# Adding the second hidden layer
classifier.add(Dense(units = 6, kernel_initializer = 'he_uniform', activation = 'relu'))

# Adding the third hidden layer
classifier.add(Dense(units = 6, kernel_initializer = 'he_uniform', activation = 'relu'))

# Adding the output layer
classifier.add(Dense(units = 1, kernel_initializer = 'uniform', activation = 'sigmoid'))

# Compiling the ANN
classifier.compile(optimizer = 'adam', loss = 'binary_crossentropy', metrics = ['accuracy'])

# Fitting the ANN to the Training set
classifier.fit(X_train, y_train, batch_size = 8, epochs = 108)

# Part 3 - Making predictions and evaluating the model

# Predicting the Test set results
y_pred = classifier.predict(X_test)
y_pred = (y_pred > 0.5)

# Making the Confusion Matrix
from sklearn.metrics import confusion_matrix
cm = confusion_matrix(y_test, y_pred)
```

```
Epoch 1/108
455/455 [==============================] - 1s 1ms/step - loss: 0.6751 - acc: 0.8769
Epoch 2/108
```

```
455/455 [==============================] - 0s 145us/step - loss: 0.5865 - acc: 0.9495
Epoch 3/108
455/455 [==============================] - 0s 164us/step - loss: 0.4026 - acc: 0.9582
Epoch 4/108
455/455 [==============================] - 0s 152us/step - loss: 0.2367 - acc: 0.9648
Epoch 5/108
455/455 [==============================] - 0s 154us/step - loss: 0.1522 - acc: 0.9692
Epoch 6/108
455/455 [==============================] - 0s 148us/step - loss: 0.1144 - acc: 0.9692
Epoch 7/108
455/455 [==============================] - 0s 149us/step - loss: 0.0941 - acc: 0.9714
Epoch 8/108
455/455 [==============================] - 0s 157us/step - loss: 0.0805 - acc: 0.9736
Epoch 9/108
455/455 [==============================] - 0s 157us/step - loss: 0.0700 - acc: 0.9802
Epoch 10/108
455/455 [==============================] - 0s 151us/step - loss: 0.0628 - acc: 0.9824
Epoch 11/108
455/455 [==============================] - 0s 158us/step - loss: 0.0579 - acc: 0.9846
Epoch 12/108
455/455 [==============================] - 0s 147us/step - loss: 0.0530 - acc: 0.9868
Epoch 13/108
455/455 [==============================] - 0s 142us/step - loss: 0.0501 - acc: 0.9868
Epoch 14/108
455/455 [==============================] - 0s 145us/step - loss: 0.0472 - acc: 0.9890
Epoch 15/108
455/455 [==============================] - 0s 149us/step - loss: 0.0450 - acc: 0.9912
Epoch 16/108
455/455 [==============================] - 0s 148us/step - loss: 0.0436 - acc: 0.9912
Epoch 17/108
```

```
455/455 [==============================] - 0s 148us/step - loss: 0.0411 - acc: 0.9912
Epoch 18/108
455/455 [==============================] - 0s 143us/step - loss: 0.0396 - acc: 0.9912
Epoch 19/108
455/455 [==============================] - 0s 142us/step - loss: 0.0384 - acc: 0.9912
Epoch 20/108
455/455 [==============================] - 0s 148us/step - loss: 0.0368 - acc: 0.9912
Epoch 21/108
455/455 [==============================] - 0s 139us/step - loss: 0.0357 - acc: 0.9912
Epoch 22/108
455/455 [==============================] - 0s 144us/step - loss: 0.0347 - acc: 0.9912
Epoch 23/108
455/455 [==============================] - 0s 143us/step - loss: 0.0337 - acc: 0.9912
Epoch 24/108
455/455 [==============================] - 0s 149us/step - loss: 0.0328 - acc: 0.9912
Epoch 25/108
455/455 [==============================] - 0s 139us/step - loss: 0.0321 - acc: 0.9912
Epoch 26/108
455/455 [==============================] - 0s 153us/step - loss: 0.0313 - acc: 0.9912
Epoch 27/108
455/455 [==============================] - 0s 149us/step - loss: 0.0307 - acc: 0.9934
Epoch 28/108
455/455 [==============================] - 0s 143us/step - loss: 0.0299 - acc: 0.9934
Epoch 29/108
455/455 [==============================] - 0s 146us/step - loss: 0.0292 - acc: 0.9934
Epoch 30/108
```

```
y_pred = classifier.predict(X_test)
y_pred = (y_pred > 0.5)

# Making the Confusion Matrix
```

```
# Making the Confusion Matrix
from sklearn.metrics import confusion_matrix
cm = confusion_matrix(y_test, y_pred)
```

```
# CONFUSION_MATRIX_CALL(CHECKING THE CORRECT PREDICTIONS)
cm
```

```
array([[74,  1],
       [ 3, 36]])
```

```
X_test
```

```
array([[-0.83324375,  0.12287913, -0.87061379, ..., -1.35466845,
        -0.57274292, -0.44781347],
       [-0.79088587, -2.03496685, -0.78717958, ..., -0.412373  ,
         0.15893818,  0.08245286],
       [-0.50567614, -1.02429981, -0.5716412 , ..., -1.16700922,
        -0.02438061, -0.93146298],
       ...,
       [ 1.13216192, -0.14774972,  1.13344324, ...,  0.24781833,
         0.16690857, -0.22987983],
       [-0.09339277, -0.7560659 , -0.17246576, ..., -1.09240699,
        -0.59665407, -1.02469662],
       [-0.47178984, -0.29863129, -0.53851291, ..., -1.53878985,
        -1.0892237 , -1.66684331]])
```

```
y_pred
```

```
array([[False],
       [False],
       [False],
       [False],
       [False],
       [False],
       [False],
       [False],
       [False],
       [False],
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```

```
# SAVING THE ARTIFICIAL NEURAL NETWORK CALLS
from keras.models import load_model
model = classifier.save('breast_cancer_model.h5')  # creates a HDF5 file 'my_model.h5'
```

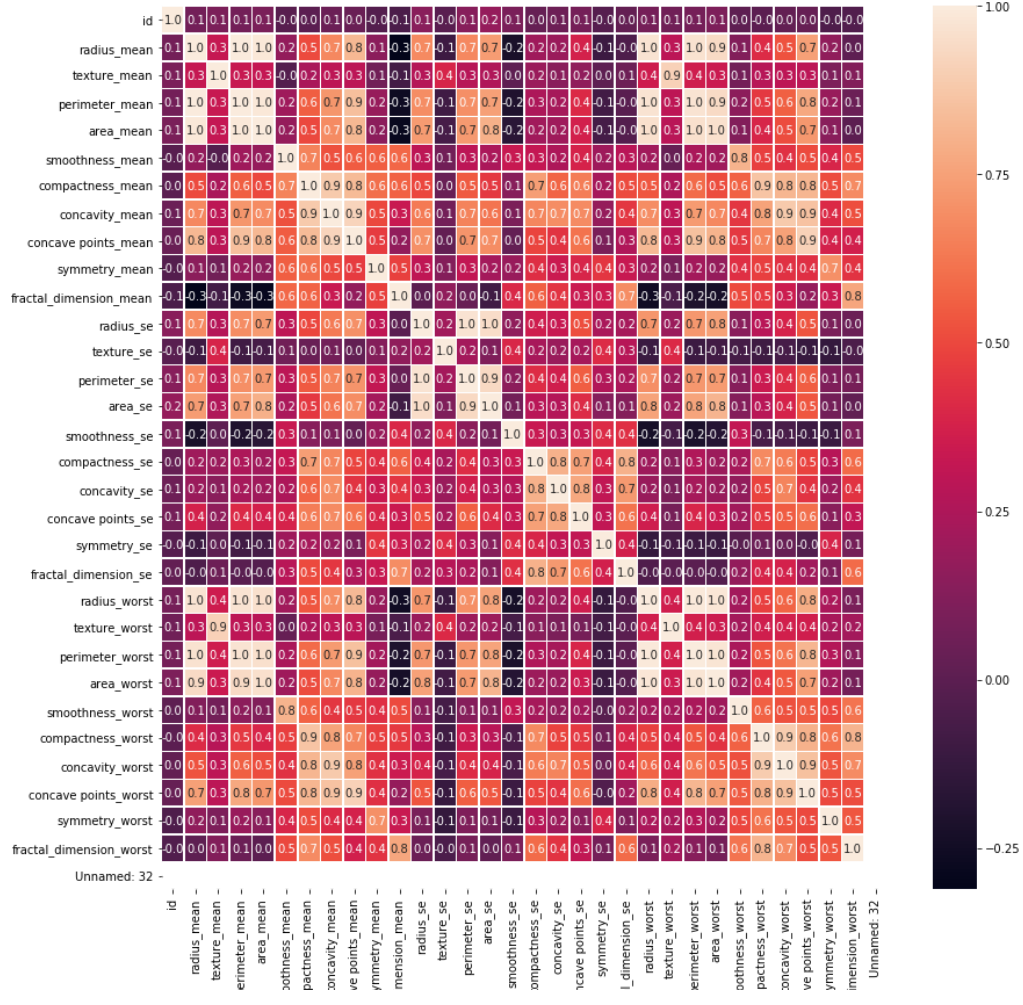
```
y_test
```

```
array([0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 0, 0, 0, 0, 1, 0, 0,
       0, 1, 1, 1, 0, 1, 0, 1, 1, 0, 0, 1, 1, 1, 0, 0, 1, 0, 0, 1, 0, 0,
       1, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 1, 0, 0, 1, 1, 0, 1, 0, 0, 0,
       0, 1, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 1,
       0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 1, 1, 0, 1, 0, 1, 1, 1, 0, 1, 0,
       0, 1, 0, 0])
```

```
from google.colab import files
files.download( "breast_cancer_model.h5" )
```

```
# VISUALIZING THE BREAST_CANCER DATASET
f,ax = plt.subplots(figsize=(14, 14))
sns.heatmap(dataset.corr(), annot=True, linewidths=.5, fmt= '.1f',ax=ax)
```

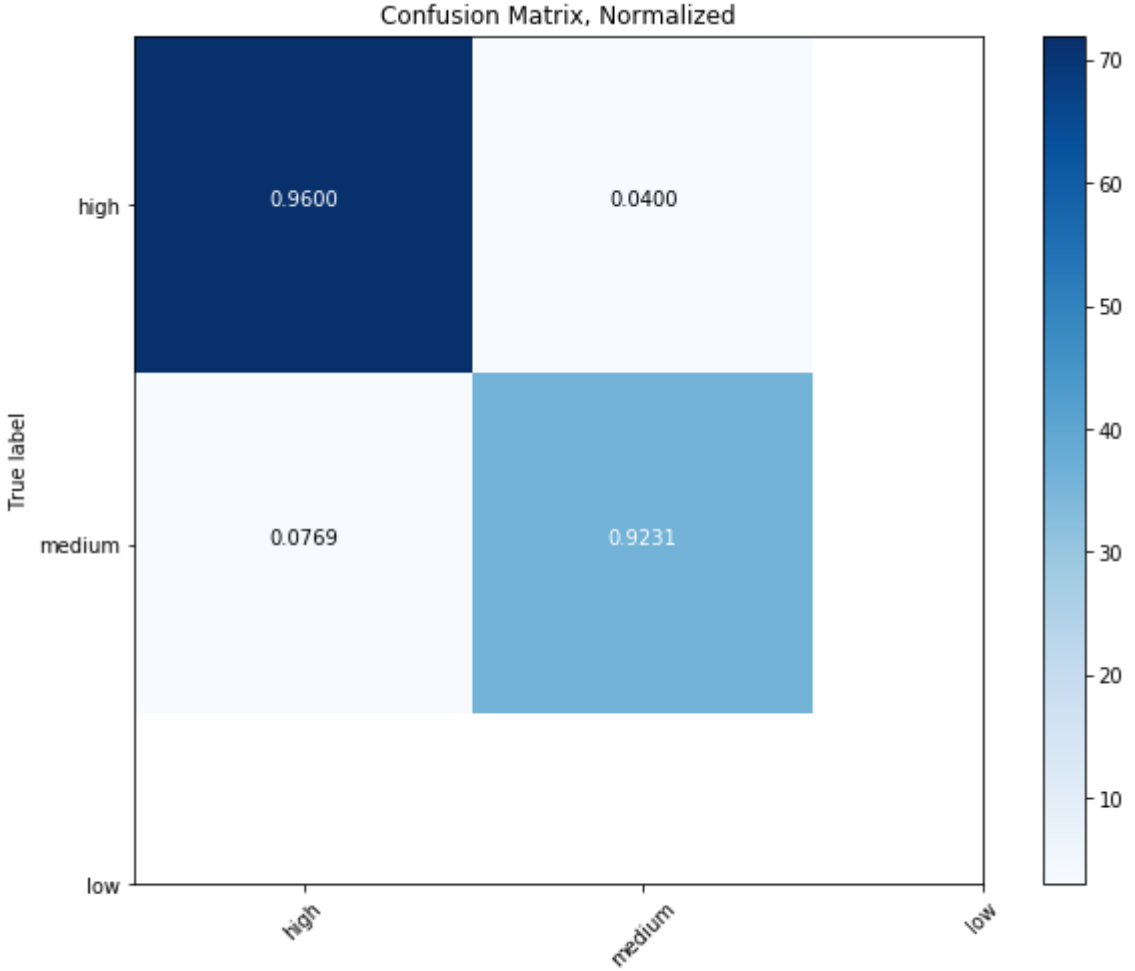
<matplotlib.axes._subplots.AxesSubplot at 0x7f94787a2438>




```
# VISUALIZING AND PLOTTING THE ARTIFICIAL NEURAL NETWORK RESULTS
import numpy as np



def plot_confusion_matrix(cm,
                          target_names
```

```
                          target_names,
                          title='Confusion matrix',
                          cmap=None,
                          normalize=True):

    import matplotlib.pyplot as plt
    import numpy as np
    import itertools

    accuracy = np.trace(cm) / float(np.sum(cm))
    misclass = 1 - accuracy

    if cmap is None:
        cmap = plt.get_cmap('Blues')

    plt.figure(figsize=(9, 7))
    plt.imshow(cm, interpolation='nearest', cmap=cmap)
    plt.title(title)
    plt.colorbar()

    if target_names is not None:
        tick_marks = np.arange(len(target_names))
        plt.xticks(tick_marks, target_names, rotation=45)
        plt.yticks(tick_marks, target_names)

    if normalize:
        cm = cm.astype('float') / cm.sum(axis=1)[:, np.newaxis]
```

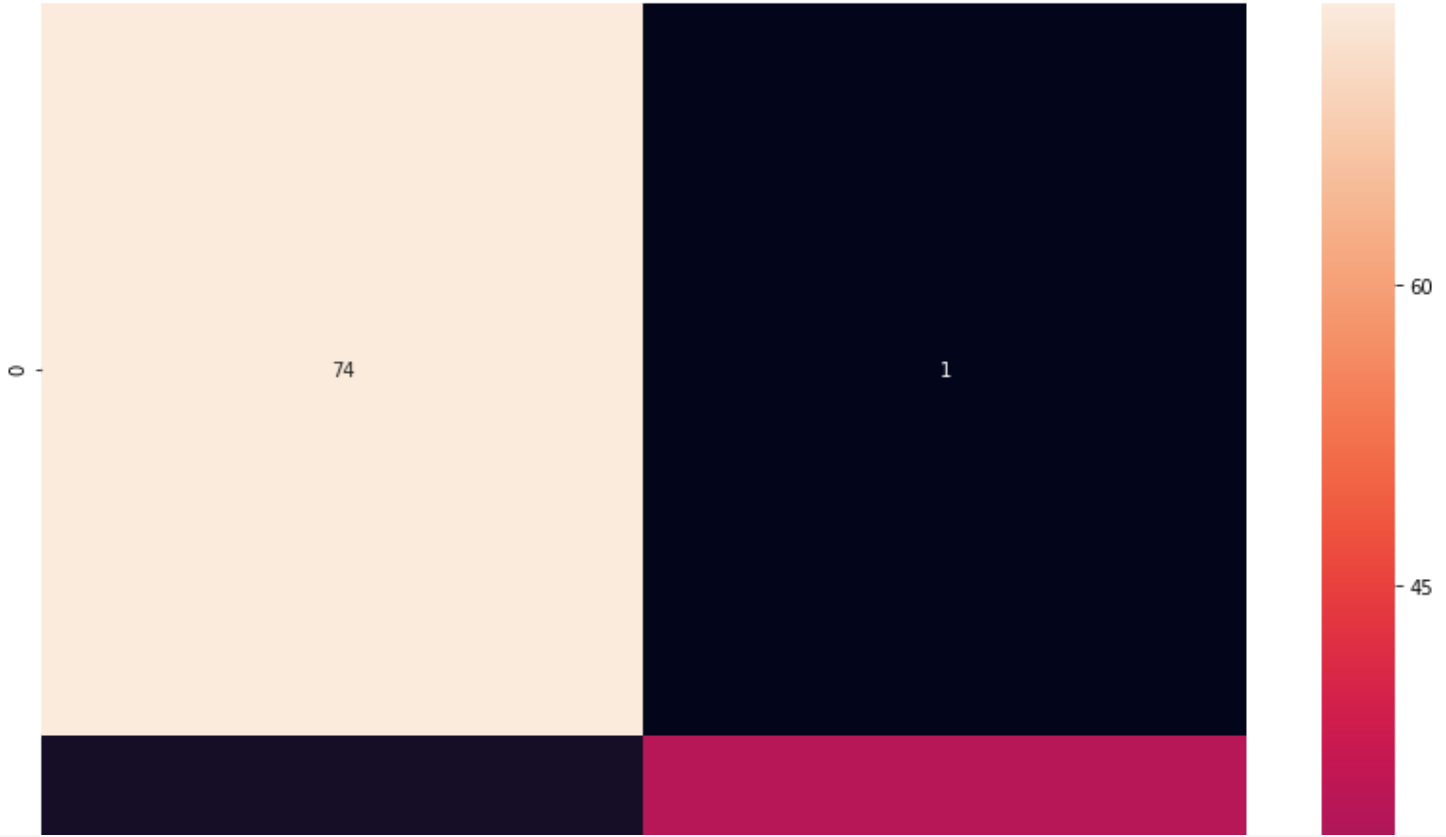
```
    thresh = cm.max() / 1.5 if normalize else cm.max() / 2
    for i, j in itertools.product(range(cm.shape[0]), range(cm.shape[1])):
        if normalize:
            plt.text(j, i, "{:0.4f}".format(cm[i, j]),
                     horizontalalignment="center",
                     color="white" if cm[i, j] > thresh else "black")
        else:
            plt.text(j, i, "{:,}".format(cm[i, j]),
                     horizontalalignment="center",
                     color="white" if cm[i, j] > thresh else "black")


    plt.tight_layout()
    plt.ylabel('True label')
    plt.xlabel('Predicted label\naccuracy={:0.4f}; misclass={:0.4f}'.format(accuracy, miscla
    plt.show()

plot_confusion_matrix(cm,
                      normalize    = True,
                      target_names = ['high', 'medium', 'low'],
                      title        = "Confusion Matrix, Normalized")
```




```
# VISUALIZING PREDICTION RESULTS
```

```
# CONFUSION MATRIX
import seaborn as sns

f,ax = plt.subplots(figsize=(14, 14))
sns.heatmap(cm,annot=True,fmt="d")
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f9476312358>
```




```
# CITATIONS
# *********
```

```
@article{scikit-learn,
 title={Scikit-learn: Machine Learning in {P}ython},
 author={Pedregosa, F. and Varoquaux, G. and Gramfort, A. and Michel, V.
         and Thirion, B. and Grisel, O. and Blondel, M. and Prettenhofer, P.
         and Weiss, R. and Dubourg, V. and Vanderplas, J. and Passos, A. and
         Cournapeau, D. and Brucher, M. and Perrot, M. and Duchesnay, E.},
 journal={Journal of Machine Learning Research},
 volume={12},
 pages={2825--2830},
 year={2011}
}


_@misc{chollet2015keras,
  title={Keras},
  author={Chollet, Fran\c{c}ois and others},
  year={2015},
  howpublished={\url{https://keras.io}},
}
```