

Practical 1: Performing classification using feed forward neural network

```
!pip install keras
```

```
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Requirement already satisfied: absl-py in c:\users\complab14\appdata\local\programs\python\python310\lib\site-packages (from keras) (2.1.0)
Requirement already satisfied: numpy in c:\users\complab14\appdata\local\programs\python\python310\lib\site-packages (from keras) (2.0.1)
Requirement already satisfied: rich in c:\users\complab14\appdata\local\programs\python\python310\lib\site-packages (from keras) (13.7.1)
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Requirement already satisfied: pygments<3.0.0,>=2.13.0 in c:\users\complab14\appdata\local\programs\python\python310\lib\site-packages (from keras) (2.17.0)
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```

```
!pip install tensorflow
```

```
Collecting tensorflow
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----- 30.7/61.0 kB ? eta -:-:-
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Requirement already satisfied: idna<4,>=2.5 in c:\users\complab14\appdata\local\programs\python\python310\lib\site-packages (from requests>=2.31.0->tensorflow) (3.10.1)
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Collecting werkzeug>=1.0.1 (from tensorboard<2.18,>=2.17->tensorflow-intel==2.17.0->tensorflow)
```

```
!pip install pandas
```

```

Collecting pandas
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Requirement already satisfied: python-dateutil>=2.8.2 in c:\users\complab14\appdata\local\programs\python\python310\lib\site-packages (from pandas)
Collecting pytz>=2020.1 (from pandas)
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Collecting tzdata>=2022.7 (from pandas)
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Requirement already satisfied: six>=1.5 in c:\users\complab14\appdata\local\programs\python\python310\lib\site-packages (from python-dateutil)
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```

!pip install scikit-learn

```

Collecting scikit-learn
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Requirement already satisfied: numpy>=1.19.5 in c:\users\complab14\appdata\local\programs\python\python310\lib\site-packages (from scikit-learn)
Collecting scipy>=1.6.0 (from scikit-learn)
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```

```
from sklearn.datasets import load_breast_cancer
```

```
dataset = load_breast_cancer()
```

```
X = dataset.data
```

```
X.shape
```

```
(569, 30)
```

```
y = dataset.target
```

```
y.shape
```

```
(569,)
```

```
from sklearn.model_selection import train_test_split
```

```
xtrain,xtest,ytrain,ytest = train_test_split(X,y,test_size = 0.25,random_state = 1)
```

```
xtrain.shape
```

```
(426, 30)
```

```
xtest.shape
```

```
(143, 30)
```

```
from keras.models import Sequential #to create nn with supervised learning we use sequential
```

```
from keras.layers import Dense #All the neurons in one layer are connected to the all the neurons in the other layer
```

```
nnmodel = Sequential()
```

```
nnmodel.add(Dense(18,activation = 'relu',input_dim = 30)) #input_dim - as the first hidden layer is connected to the input layer
```

```
nnmodel.add(Dense(12,activation = 'relu'))
```

```
nnmodel.add(Dense(1,activation = 'sigmoid'))
```

```
C:\Users\CompLab14\AppData\Local\Programs\Python\Python310\lib\site-packages\keras\src\layers\core\dense.py:87: UserWarning: Do not pass an
super().__init__(activity_regularizer=activity_regularizer, **kwargs)
```

```
nnmodel.compile(loss = 'binary_crossentropy',optimizer = 'adam',metrics = ['accuracy'])
```

```
nnmodel.fit(xtrain,ytrain,epochs = 500, batch_size = 40)
```

```
Epoch 1/500
11/11 ————— 1s 1ms/step - accuracy: 0.7080 - loss: 1.2605
Epoch 2/500
11/11 ————— 0s 1ms/step - accuracy: 0.7714 - loss: 1.0531
Epoch 3/500
11/11 ————— 0s 997us/step - accuracy: 0.8589 - loss: 0.7262
Epoch 4/500
11/11 ————— 0s 959us/step - accuracy: 0.8387 - loss: 0.9361
Epoch 5/500
11/11 ————— 0s 998us/step - accuracy: 0.8980 - loss: 0.5564
Epoch 6/500
11/11 ————— 0s 961us/step - accuracy: 0.8906 - loss: 0.4768
Epoch 7/500
11/11 ————— 0s 1ms/step - accuracy: 0.8828 - loss: 0.4631
Epoch 8/500
11/11 ————— 0s 1ms/step - accuracy: 0.9141 - loss: 0.2999
Epoch 9/500
11/11 ————— 0s 1ms/step - accuracy: 0.8730 - loss: 0.3670
Epoch 10/500
11/11 ————— 0s 925us/step - accuracy: 0.8983 - loss: 0.3570
Epoch 11/500
11/11 ————— 0s 931us/step - accuracy: 0.9121 - loss: 0.2628
Epoch 12/500
11/11 ————— 0s 895us/step - accuracy: 0.9346 - loss: 0.2178
Epoch 13/500
11/11 ————— 0s 950us/step - accuracy: 0.9051 - loss: 0.2924
Epoch 14/500
11/11 ————— 0s 957us/step - accuracy: 0.9284 - loss: 0.2435
Epoch 15/500
11/11 ————— 0s 1ms/step - accuracy: 0.8941 - loss: 0.3219
Epoch 16/500
11/11 ————— 0s 994us/step - accuracy: 0.8878 - loss: 0.2929
Epoch 17/500
11/11 ————— 0s 1ms/step - accuracy: 0.9106 - loss: 0.2187
Epoch 18/500
11/11 ————— 0s 951us/step - accuracy: 0.8846 - loss: 0.3420
Epoch 19/500
11/11 ————— 0s 861us/step - accuracy: 0.9043 - loss: 0.2612
Epoch 20/500
11/11 ————— 0s 840us/step - accuracy: 0.9351 - loss: 0.2010
Epoch 21/500
11/11 ————— 0s 1ms/step - accuracy: 0.9243 - loss: 0.2273
Epoch 22/500
11/11 ————— 0s 998us/step - accuracy: 0.9025 - loss: 0.2860
Epoch 23/500
11/11 ————— 0s 1ms/step - accuracy: 0.9136 - loss: 0.2568
Epoch 24/500
11/11 ————— 0s 982us/step - accuracy: 0.9110 - loss: 0.2571
Epoch 25/500
11/11 ————— 0s 998us/step - accuracy: 0.9240 - loss: 0.1947
Epoch 26/500
11/11 ————— 0s 924us/step - accuracy: 0.8946 - loss: 0.2509
Epoch 27/500
11/11 ————— 0s 1000us/step - accuracy: 0.9272 - loss: 0.1881
Epoch 28/500
11/11 ————— 0s 997us/step - accuracy: 0.9243 - loss: 0.1930
Epoch 29/500
11/11 ————— 0s 898us/step - accuracy: 0.9209 - loss: 0.2054
```

```
predictions = nnmodel.predict(xtest)
```

```
5/5 ————— 0s 7ms/step
```

```
predictions
```

```
array([[9.9118406e-01],
       [9.9019416e-02],
       [9.9888164e-01],
       [1.2234003e-04],
       [2.3296836e-01],
       [1.7278180e-04],
       [3.1044945e-04],
       [3.1863570e-02],
       [9.9868256e-01],
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       [9.9855793e-01],
       [2.3015065e-01],
```

```
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[9.5783663e-01],
[9.6732700e-01],
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[9.9526912e-01],
[3.3161804e-04],
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[2.8444327e-02],
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[6.3317931e-01],
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[9.9976021e-01],
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[9.9461752e-01],
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[3.0555308e-01],
[9.5868570e-01],
[9.9985486e-01],
[9.7054899e-01],
[7.0251644e-02],
[8.0470036e-06],
[5.1259138e-13],
[9.9189860e-01],
[9.9973392e-01],
[9.9748760e-01],
[9.9922711e-01],
[9.9906629e-01],
```

ytest

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

class_labels = []

predictions.size

```
143
```

```
for i in range(predictions.size):
    if(predictions[i]>=0.5):
        class_labels.append(1)
    else:
        class_labels.append(0)
```

class_labels

```
[1,
 0,
 1,
 0,
 0,
 0,
 0,
 1,
 1,
 1,
 1,
 0,
 0,
 0,
```

```
➡ array([[52, 3],  
         [ 3, 85]], dtype=int64)
```