```python
In [2]:  from numpy import loadtxt
         from tensorflow.keras.models import Sequential
         from tensorflow.keras.layers import Dense
```

```python
In [5]:  dataset=loadtxt('diabetes.csv', delimiter=',')
```

```python
In [6]:  x = dataset[:, 0:8]
         y = dataset[:, 8]
```

```python
In [7]:  print(type(x))
```

```
<class 'numpy.ndarray'>
```

```python
In [8]:  print(x.shape)
```

```
(768, 8)
```

```python
In [9]:  model = Sequential()
```

```python
In [10]: model.add(Dense(12, input_shape=(8,), activation='relu'))
```

```
C:\Users\sd616\anaconda\lib\site-packages\keras\src\layers\core\dense.py:87: UserW
arning: Do not pass an `input_shape`/`input_dim` argument to a layer. When using S
equential models, prefer using an `Input(shape)` object as the first layer in the
model instead.
  super().__init__(activity_regularizer=activity_regularizer, **kwargs)
```

```python
In [11]: model.add(Dense(8, activation='relu'))
```

```python
In [12]: model.add(Dense(1, activation='sigmoid'))
```

```python
In [13]: model.compile(loss='binary_crossentropy', optimizer='adam', metrics=['accuracy'])
```

```python
In [14]: model.fit(x, y, epochs=150, batch_size=10)
```

Loading [MathJax]/jax/output/CommonHTML/fonts/TeX/fontdata.js

```
Epoch 1/150
77/77 ———————————— 4s 4ms/step - accuracy: 0.6468 - loss: 21.7332
Epoch 2/150
77/77 ———————————— 0s 4ms/step - accuracy: 0.6555 - loss: 5.2476
Epoch 3/150
77/77 ———————————— 0s 4ms/step - accuracy: 0.5791 - loss: 1.1657
Epoch 4/150
77/77 ———————————— 0s 4ms/step - accuracy: 0.5059 - loss: 0.7988
Epoch 5/150
77/77 ———————————— 0s 4ms/step - accuracy: 0.5150 - loss: 0.7419
Epoch 6/150
77/77 ———————————— 0s 4ms/step - accuracy: 0.5162 - loss: 0.7146
Epoch 7/150
77/77 ———————————— 0s 4ms/step - accuracy: 0.5463 - loss: 0.6999
Epoch 8/150
77/77 ———————————— 0s 4ms/step - accuracy: 0.5662 - loss: 0.6928
Epoch 9/150
77/77 ———————————— 0s 4ms/step - accuracy: 0.5566 - loss: 0.6425
Epoch 10/150
77/77 ———————————— 0s 4ms/step - accuracy: 0.6431 - loss: 0.6510
Epoch 11/150
77/77 ———————————— 0s 4ms/step - accuracy: 0.6724 - loss: 0.6271
Epoch 12/150
77/77 ———————————— 0s 4ms/step - accuracy: 0.6391 - loss: 0.6401
Epoch 13/150
77/77 ———————————— 0s 4ms/step - accuracy: 0.6586 - loss: 0.6416
Epoch 14/150
77/77 ———————————— 0s 4ms/step - accuracy: 0.6830 - loss: 0.6176
Epoch 15/150
77/77 ———————————— 0s 4ms/step - accuracy: 0.6646 - loss: 0.6395
Epoch 16/150
77/77 ———————————— 0s 3ms/step - accuracy: 0.6753 - loss: 0.6169
Epoch 17/150
77/77 ———————————— 0s 4ms/step - accuracy: 0.6784 - loss: 0.6146
Epoch 18/150
77/77 ———————————— 0s 3ms/step - accuracy: 0.6714 - loss: 0.6074
Epoch 19/150
77/77 ———————————— 0s 4ms/step - accuracy: 0.6676 - loss: 0.6106
Epoch 20/150
77/77 ———————————— 0s 4ms/step - accuracy: 0.7023 - loss: 0.5975
Epoch 21/150
77/77 ———————————— 0s 4ms/step - accuracy: 0.7001 - loss: 0.5949
Epoch 22/150
77/77 ———————————— 0s 4ms/step - accuracy: 0.6794 - loss: 0.6001
Epoch 23/150
77/77 ———————————— 0s 3ms/step - accuracy: 0.6924 - loss: 0.5926
Epoch 24/150
77/77 ———————————— 0s 4ms/step - accuracy: 0.6862 - loss: 0.5902
Epoch 25/150
77/77 ———————————— 0s 3ms/step - accuracy: 0.6721 - loss: 0.6077
Epoch 26/150
77/77 ———————————— 0s 3ms/step - accuracy: 0.7119 - loss: 0.5821
Epoch 27/150
77/77 ———————————— 0s 4ms/step - accuracy: 0.6710 - loss: 0.6129
Epoch 28/150
77/77 ———————————— 0s 4ms/step - accuracy: 0.6770 - loss: 0.5973
Epoch 29/150
77/77 ———————————— 0s 4ms/step - accuracy: 0.7118 - loss: 0.5867
Epoch 30/150
77/77 ———————————— 0s 3ms/step - accuracy: 0.6869 - loss: 0.5994
Epoch 31/150
77/77 ———————————— 0s 3ms/step - accuracy: 0.6870 - loss: 0.5792
77/77 ———————————— 0s 3ms/step - accuracy: 0.7120 - loss: 0.5755
```

```
Epoch 33/150
77/77 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0.6815 - loss: 0.5847
Epoch 34/150
77/77 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.6843 - loss: 0.5847
Epoch 35/150
77/77 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.7145 - loss: 0.5714
Epoch 36/150
77/77 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.7012 - loss: 0.5772
Epoch 37/150
77/77 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0.6972 - loss: 0.5742
Epoch 38/150
77/77 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.7012 - loss: 0.5647
Epoch 39/150
77/77 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.7348 - loss: 0.5574
Epoch 40/150
77/77 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.7035 - loss: 0.5587
Epoch 41/150
77/77 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0.7048 - loss: 0.5723
Epoch 42/150
77/77 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0.7269 - loss: 0.5629
Epoch 43/150
77/77 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.7331 - loss: 0.5449
Epoch 44/150
77/77 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.6888 - loss: 0.5761
Epoch 45/150
77/77 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0.7000 - loss: 0.5688
Epoch 46/150
77/77 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0.7262 - loss: 0.5590
Epoch 47/150
77/77 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.6978 - loss: 0.5760
Epoch 48/150
77/77 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0.7245 - loss: 0.5323
Epoch 49/150
77/77 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.6914 - loss: 0.5793
Epoch 50/150
77/77 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.7267 - loss: 0.5571
Epoch 51/150
77/77 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0.7305 - loss: 0.5559
Epoch 52/150
77/77 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.7379 - loss: 0.5454
Epoch 53/150
77/77 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0.7337 - loss: 0.5421
Epoch 54/150
77/77 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0.7056 - loss: 0.5639
Epoch 55/150
77/77 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.7643 - loss: 0.5215
Epoch 56/150
77/77 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.7508 - loss: 0.5129
Epoch 57/150
77/77 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.7156 - loss: 0.5454
Epoch 58/150
77/77 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.7488 - loss: 0.5236
Epoch 59/150
77/77 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0.7246 - loss: 0.5442
Epoch 60/150
77/77 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0.7222 - loss: 0.5418
Epoch 61/150
77/77 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.7116 - loss: 0.5509
Epoch 62/150
77/77 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.7362 - loss: 0.5447
Epoch 63/150
77/77 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.7326 - loss: 0.5381
77/77 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0.7117 - loss: 0.5438
```

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```
Epoch 65/150
77/77 ———————————— 0s 4ms/step - accuracy: 0.7308 - loss: 0.5389
Epoch 66/150
77/77 ———————————— 0s 3ms/step - accuracy: 0.7297 - loss: 0.5349
Epoch 67/150
77/77 ———————————— 0s 4ms/step - accuracy: 0.7209 - loss: 0.5469
Epoch 68/150
77/77 ———————————— 0s 4ms/step - accuracy: 0.7211 - loss: 0.5548
Epoch 69/150
77/77 ———————————— 0s 3ms/step - accuracy: 0.7309 - loss: 0.5447
Epoch 70/150
77/77 ———————————— 0s 3ms/step - accuracy: 0.7345 - loss: 0.5384
Epoch 71/150
77/77 ———————————— 0s 3ms/step - accuracy: 0.7145 - loss: 0.5414
Epoch 72/150
77/77 ———————————— 0s 4ms/step - accuracy: 0.7591 - loss: 0.5026
Epoch 73/150
77/77 ———————————— 0s 3ms/step - accuracy: 0.7411 - loss: 0.5064
Epoch 74/150
77/77 ———————————— 0s 3ms/step - accuracy: 0.7658 - loss: 0.5100
Epoch 75/150
77/77 ———————————— 0s 3ms/step - accuracy: 0.7520 - loss: 0.5219
Epoch 76/150
77/77 ———————————— 0s 4ms/step - accuracy: 0.7341 - loss: 0.5386
Epoch 77/150
77/77 ———————————— 0s 3ms/step - accuracy: 0.7414 - loss: 0.5471
Epoch 78/150
77/77 ———————————— 0s 4ms/step - accuracy: 0.7455 - loss: 0.5008
Epoch 79/150
77/77 ———————————— 0s 4ms/step - accuracy: 0.7060 - loss: 0.5464
Epoch 80/150
77/77 ———————————— 0s 3ms/step - accuracy: 0.7351 - loss: 0.5249
Epoch 81/150
77/77 ———————————— 0s 4ms/step - accuracy: 0.7605 - loss: 0.5096
Epoch 82/150
77/77 ———————————— 0s 4ms/step - accuracy: 0.7338 - loss: 0.5098
Epoch 83/150
77/77 ———————————— 0s 3ms/step - accuracy: 0.7145 - loss: 0.5290
Epoch 84/150
77/77 ———————————— 0s 4ms/step - accuracy: 0.7497 - loss: 0.5219
Epoch 85/150
77/77 ———————————— 0s 4ms/step - accuracy: 0.7339 - loss: 0.5338
Epoch 86/150
77/77 ———————————— 0s 3ms/step - accuracy: 0.7453 - loss: 0.5120
Epoch 87/150
77/77 ———————————— 0s 3ms/step - accuracy: 0.7234 - loss: 0.5288
Epoch 88/150
77/77 ———————————— 0s 3ms/step - accuracy: 0.7059 - loss: 0.5384
Epoch 89/150
77/77 ———————————— 0s 3ms/step - accuracy: 0.7339 - loss: 0.5157
Epoch 90/150
77/77 ———————————— 0s 4ms/step - accuracy: 0.7505 - loss: 0.5047
Epoch 91/150
77/77 ———————————— 0s 2ms/step - accuracy: 0.7375 - loss: 0.5222
Epoch 92/150
77/77 ———————————— 0s 3ms/step - accuracy: 0.7322 - loss: 0.5202
Epoch 93/150
77/77 ———————————— 0s 3ms/step - accuracy: 0.7347 - loss: 0.5146
Epoch 94/150
77/77 ———————————— 0s 3ms/step - accuracy: 0.7242 - loss: 0.5300
Epoch 95/150
77/77 ———————————— 0s 2ms/step - accuracy: 0.7278 - loss: 0.5102
```

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```
77/77 ———————————— 0s 2ms/step - accuracy: 0.7499 - loss: 0.5115
```

```
Epoch 97/150
77/77 ──────────────── 0s 3ms/step - accuracy: 0.7510 - loss: 0.5091
Epoch 98/150
77/77 ──────────────── 0s 3ms/step - accuracy: 0.7349 - loss: 0.5323
Epoch 99/150
77/77 ──────────────── 0s 2ms/step - accuracy: 0.7291 - loss: 0.5206
Epoch 100/150
77/77 ──────────────── 0s 2ms/step - accuracy: 0.7314 - loss: 0.5226
Epoch 101/150
77/77 ──────────────── 0s 2ms/step - accuracy: 0.7785 - loss: 0.4969
Epoch 102/150
77/77 ──────────────── 0s 3ms/step - accuracy: 0.7637 - loss: 0.5088
Epoch 103/150
77/77 ──────────────── 0s 2ms/step - accuracy: 0.7877 - loss: 0.4591
Epoch 104/150
77/77 ──────────────── 0s 3ms/step - accuracy: 0.7385 - loss: 0.5037
Epoch 105/150
77/77 ──────────────── 0s 3ms/step - accuracy: 0.7713 - loss: 0.4905
Epoch 106/150
77/77 ──────────────── 0s 3ms/step - accuracy: 0.7537 - loss: 0.5025
Epoch 107/150
77/77 ──────────────── 0s 3ms/step - accuracy: 0.7586 - loss: 0.4847
Epoch 108/150
77/77 ──────────────── 0s 2ms/step - accuracy: 0.7518 - loss: 0.4995
Epoch 109/150
77/77 ──────────────── 0s 3ms/step - accuracy: 0.7453 - loss: 0.5077
Epoch 110/150
77/77 ──────────────── 0s 2ms/step - accuracy: 0.7560 - loss: 0.4853
Epoch 111/150
77/77 ──────────────── 0s 2ms/step - accuracy: 0.7390 - loss: 0.5166
Epoch 112/150
77/77 ──────────────── 0s 2ms/step - accuracy: 0.7568 - loss: 0.4954
Epoch 113/150
77/77 ──────────────── 0s 2ms/step - accuracy: 0.7669 - loss: 0.4833
Epoch 114/150
77/77 ──────────────── 0s 2ms/step - accuracy: 0.7529 - loss: 0.5036
Epoch 115/150
77/77 ──────────────── 0s 3ms/step - accuracy: 0.7393 - loss: 0.5260
Epoch 116/150
77/77 ──────────────── 0s 2ms/step - accuracy: 0.7406 - loss: 0.5268
Epoch 117/150
77/77 ──────────────── 0s 2ms/step - accuracy: 0.7581 - loss: 0.5079
Epoch 118/150
77/77 ──────────────── 0s 3ms/step - accuracy: 0.7523 - loss: 0.4952
Epoch 119/150
77/77 ──────────────── 0s 2ms/step - accuracy: 0.7328 - loss: 0.5176
Epoch 120/150
77/77 ──────────────── 0s 2ms/step - accuracy: 0.7750 - loss: 0.4830
Epoch 121/150
77/77 ──────────────── 0s 2ms/step - accuracy: 0.7677 - loss: 0.4994
Epoch 122/150
77/77 ──────────────── 0s 2ms/step - accuracy: 0.7308 - loss: 0.5176
Epoch 123/150
77/77 ──────────────── 0s 2ms/step - accuracy: 0.7381 - loss: 0.5047
Epoch 124/150
77/77 ──────────────── 0s 2ms/step - accuracy: 0.7906 - loss: 0.4820
Epoch 125/150
77/77 ──────────────── 0s 3ms/step - accuracy: 0.7330 - loss: 0.5131
Epoch 126/150
77/77 ──────────────── 0s 2ms/step - accuracy: 0.7370 - loss: 0.5156
Epoch 127/150
77/77 ──────────────── 0s 2ms/step - accuracy: 0.7605 - loss: 0.4950
77/77 ──────────────── 0s 2ms/step - accuracy: 0.7443 - loss: 0.5165
```

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```
Epoch 129/150
77/77 ───────────────────── 0s 2ms/step - accuracy: 0.7669 - loss: 0.4667
Epoch 130/150
77/77 ───────────────────── 0s 2ms/step - accuracy: 0.7288 - loss: 0.5314
Epoch 131/150
77/77 ───────────────────── 0s 2ms/step - accuracy: 0.7692 - loss: 0.5074
Epoch 132/150
77/77 ───────────────────── 0s 2ms/step - accuracy: 0.7366 - loss: 0.5371
Epoch 133/150
77/77 ───────────────────── 0s 2ms/step - accuracy: 0.7508 - loss: 0.5089
Epoch 134/150
77/77 ───────────────────── 0s 2ms/step - accuracy: 0.7649 - loss: 0.4798
Epoch 135/150
77/77 ───────────────────── 0s 2ms/step - accuracy: 0.7913 - loss: 0.4623
Epoch 136/150
77/77 ───────────────────── 0s 2ms/step - accuracy: 0.7850 - loss: 0.4554
Epoch 137/150
77/77 ───────────────────── 0s 2ms/step - accuracy: 0.7398 - loss: 0.5213
Epoch 138/150
77/77 ───────────────────── 0s 2ms/step - accuracy: 0.7478 - loss: 0.4984
Epoch 139/150
77/77 ───────────────────── 0s 2ms/step - accuracy: 0.7376 - loss: 0.5200
Epoch 140/150
77/77 ───────────────────── 0s 2ms/step - accuracy: 0.7743 - loss: 0.4825
Epoch 141/150
77/77 ───────────────────── 0s 2ms/step - accuracy: 0.7672 - loss: 0.4916
Epoch 142/150
77/77 ───────────────────── 0s 2ms/step - accuracy: 0.7785 - loss: 0.4945
Epoch 143/150
77/77 ───────────────────── 0s 3ms/step - accuracy: 0.7605 - loss: 0.4995
Epoch 144/150
77/77 ───────────────────── 0s 2ms/step - accuracy: 0.7617 - loss: 0.4835
Epoch 145/150
77/77 ───────────────────── 0s 2ms/step - accuracy: 0.7433 - loss: 0.5286
Epoch 146/150
77/77 ───────────────────── 0s 3ms/step - accuracy: 0.7285 - loss: 0.5219
Epoch 147/150
77/77 ───────────────────── 0s 3ms/step - accuracy: 0.7764 - loss: 0.4777
Epoch 148/150
77/77 ───────────────────── 0s 3ms/step - accuracy: 0.7576 - loss: 0.4950
Epoch 149/150
77/77 ───────────────────── 0s 3ms/step - accuracy: 0.7790 - loss: 0.4645
Epoch 150/150
77/77 ───────────────────── 0s 2ms/step - accuracy: 0.7916 - loss: 0.4651
```

Out[14]: `<keras.src.callbacks.history.History at 0x1b084b98280>`

In [15]:
```python
loss, accuracy = model.evaluate(x, y)
print(f"Model accuracy: {accuracy * 100:.2f}%")
```

```
24/24 ───────────────────── 0s 3ms/step - accuracy: 0.7443 - loss: 0.5034
Model accuracy: 76.43%
```

In [16]:
```python
predicted_probabilities = model.predict(x)
```

```
24/24 ───────────────────── 0s 3ms/step
```

In [18]:
```python
predicted_classes = (predicted_probabilities > 0.5).astype(int)
# Print the first 10 actual and predicted values
print("Actual values:", y[:10])
print("Predicted probabilities:", predicted_probabilities[:10])
print("Predicted classes:", predicted_classes[:10])
```

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```
Actual values: [1. 0. 1. 0. 1. 0. 1. 0. 1. 1.]
Predicted probabilities: [[0.83572793]
 [0.15752493]
 [0.9255555 ]
 [0.25144973]
 [0.7081789 ]
 [0.37806875]
 [0.25144973]
 [0.67908263]
 [0.81452835]
 [0.20310159]]
Predicted classes: [[1]
 [0]
 [1]
 [0]
 [1]
 [0]
 [0]
 [1]
 [1]
 [0]]
```

In [ ]: