untitled2

October 14, 2024

[3]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn.metrics import confusion_matrix, ConfusionMatrixDisplay
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense
from tensorflow.keras.optimizers import Adam
from tensorflow.keras.losses import MeanSquaredError

df = pd.read_csv('/content/breast-cancer.data')

print("Data types of each column:")
print(df.dtypes)

df = pd.get_dummies(df, drop_first=True)

print("Checking for NaN values in the dataset:")
print(df.isnull().sum())

df = df.apply(pd.to_numeric, errors='coerce')
df = df.dropna()

X = df.iloc[:, :-1].values
y = df.iloc[:, -1].values.reshape(-1, 1)

print("Feature matrix (X):")
print(X)

print("Target variable (y):")
print(y)

print("X shape:", X.shape)
print("y shape:", y.shape)

if X.size == 0 or y.size == 0:
    raise ValueError("X or y is empty after preprocessing.")
```

```
X = np.array(X, dtype=np.float32)
y = np.array(y, dtype=np.float32)

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3,␣
 ↪random_state=42)

print("Data types after train-test split:")
print(f"X_train dtype: {X_train.dtype}, y_train dtype: {y_train.dtype}")

model = Sequential()
model.add(Dense(15, input_dim=X_train.shape[1], activation='relu'))
model.add(Dense(1, activation='sigmoid'))

learning_rate = 0.001
model.compile(optimizer=Adam(learning_rate=learning_rate),␣
 ↪loss=MeanSquaredError())
batch_size = 20

history = model.fit(X_train, y_train, epochs=40, batch_size=batch_size,␣
 ↪validation_split=0.1)

plt.figure(figsize=(10, 6))
plt.plot(history.history['loss'], label='Training Loss', color='blue')
plt.plot(history.history['val_loss'], label='Validation Loss', color='orange')
plt.title('Training and Validation Loss vs Epochs')
plt.xlabel('Epochs')
plt.ylabel('Loss')
plt.legend()
plt.grid()
plt.show()

y_pred = model.predict(X_test)

cm = confusion_matrix(y_test, np.round(y_pred))
disp = ConfusionMatrixDisplay(confusion_matrix=cm)
disp.plot()
plt.show()

weights, biases = model.layers[0].get_weights()
print("Weights for Hidden Layer after training:")
print(weights)

print("Biases for Hidden Layer after training:")
print(biases)
```

```
Data types of each column:
```

```
no-recurrence-events    object
30-39                   object
premeno                 object
30-34                   object
0-2                     object
no                      object
3                        int64
left                    object
left_low                object
no.1                    object
dtype: object
Checking for NaN values in the dataset:
3                                          0
no-recurrence-events_recurrence-events     0
30-39_30-39                                0
30-39_40-49                                0
30-39_50-59                                0
30-39_60-69                                0
30-39_70-79                                0
premeno_lt40                               0
premeno_premeno                            0
30-34_10-14                                0
30-34_15-19                                0
30-34_20-24                                0
30-34_25-29                                0
30-34_30-34                                0
30-34_35-39                                0
30-34_40-44                                0
30-34_45-49                                0
30-34_5-9                                  0
30-34_50-54                                0
0-2_12-14                                  0
0-2_15-17                                  0
0-2_24-26                                  0
0-2_3-5                                    0
0-2_6-8                                    0
0-2_9-11                                   0
no_no                                      0
no_yes                                     0
left_right                                 0
left_low_central                           0
left_low_left_low                          0
left_low_left_up                           0
left_low_right_low                         0
left_low_right_up                          0
no.1_yes                                   0
dtype: int64
Feature matrix (X):
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[[2 False False … False False True]
 [2 False False … False False False]
 [2 False False … True False False]
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 [1 True False … True False False]
 [3 True False … False False False]
 [3 True False … False False False]]
Target variable (y):
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X shape: (285, 33)
y shape: (285, 1)
Data types after train-test split:
X_train dtype: float32, y_train dtype: float32
Epoch 1/40

/usr/local/lib/python3.10/dist-packages/keras/src/layers/core/dense.py:87:
UserWarning: Do not pass an `input_shape`/`input_dim` argument to a layer. When
using Sequential models, prefer using an `Input(shape)` object as the first
layer in the model instead.
  super().__init__(activity_regularizer=activity_regularizer, **kwargs)

9/9             1s 17ms/step - loss:
0.3813 - val_loss: 0.3835
Epoch 2/40
9/9             0s 5ms/step - loss:
0.3437 - val_loss: 0.3382
Epoch 3/40
9/9             0s 5ms/step - loss:
0.3168 - val_loss: 0.2952
Epoch 4/40
9/9             0s 4ms/step - loss:
0.2956 - val_loss: 0.2583
Epoch 5/40
9/9             0s 4ms/step - loss:
0.2731 - val_loss: 0.2262
Epoch 6/40
9/9             0s 5ms/step - loss:
0.2487 - val_loss: 0.2021
Epoch 7/40
9/9             0s 4ms/step - loss:
0.2436 - val_loss: 0.1811
Epoch 8/40
9/9             0s 4ms/step - loss:
0.2455 - val_loss: 0.1675
Epoch 9/40
9/9             0s 4ms/step - loss:
0.2158 - val_loss: 0.1554
Epoch 10/40
9/9             0s 4ms/step - loss:
0.2171 - val_loss: 0.1476
Epoch 11/40
9/9             0s 4ms/step - loss:
0.2140 - val_loss: 0.1418
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Epoch 12/40
9/9             0s 4ms/step - loss:
0.2010 - val_loss: 0.1369
Epoch 13/40
9/9             0s 5ms/step - loss:
0.2109 - val_loss: 0.1343
Epoch 14/40
9/9             0s 6ms/step - loss:
0.2091 - val_loss: 0.1315
Epoch 15/40
9/9             0s 6ms/step - loss:
0.1969 - val_loss: 0.1294
Epoch 16/40
9/9             0s 5ms/step - loss:
0.1758 - val_loss: 0.1273
Epoch 17/40
9/9             0s 4ms/step - loss:
0.2095 - val_loss: 0.1268
Epoch 18/40
9/9             0s 5ms/step - loss:
0.1817 - val_loss: 0.1251
Epoch 19/40
9/9             0s 4ms/step - loss:
0.1592 - val_loss: 0.1236
Epoch 20/40
9/9             0s 4ms/step - loss:
0.1756 - val_loss: 0.1239
Epoch 21/40
9/9             0s 4ms/step - loss:
0.1817 - val_loss: 0.1243
Epoch 22/40
9/9             0s 4ms/step - loss:
0.1628 - val_loss: 0.1230
Epoch 23/40
9/9             0s 4ms/step - loss:
0.1876 - val_loss: 0.1244
Epoch 24/40
9/9             0s 7ms/step - loss:
0.1740 - val_loss: 0.1248
Epoch 25/40
9/9             0s 8ms/step - loss:
0.1720 - val_loss: 0.1253
Epoch 26/40
9/9             0s 6ms/step - loss:
0.1699 - val_loss: 0.1247
Epoch 27/40
9/9             0s 5ms/step - loss:
0.1570 - val_loss: 0.1237
```

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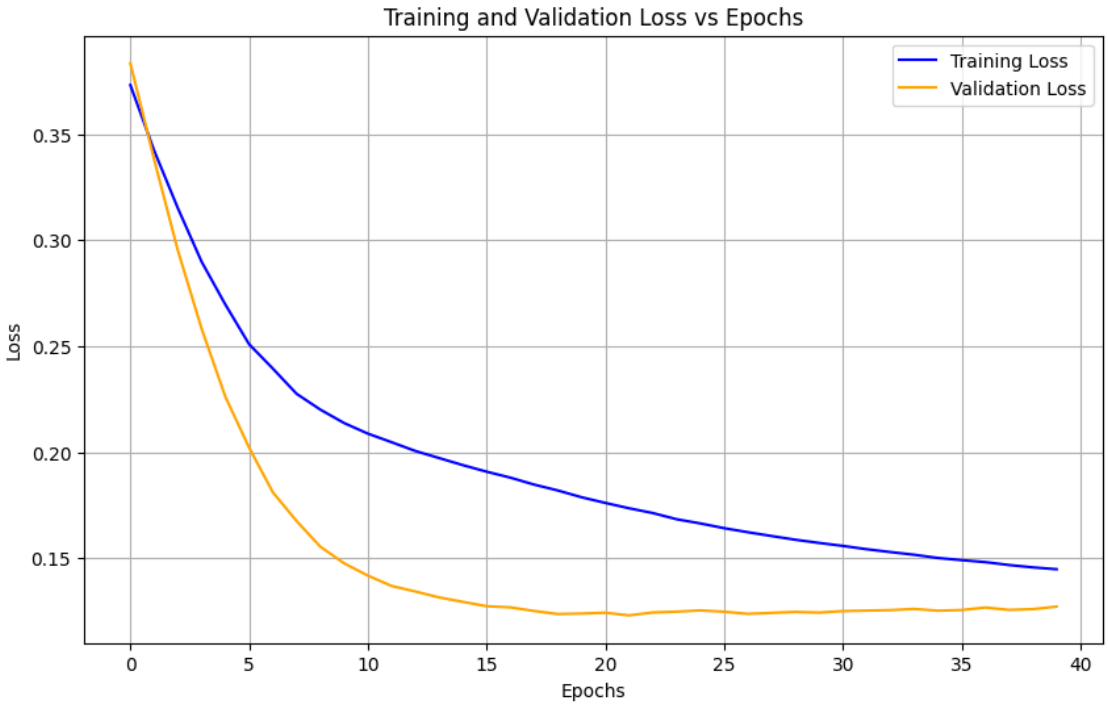
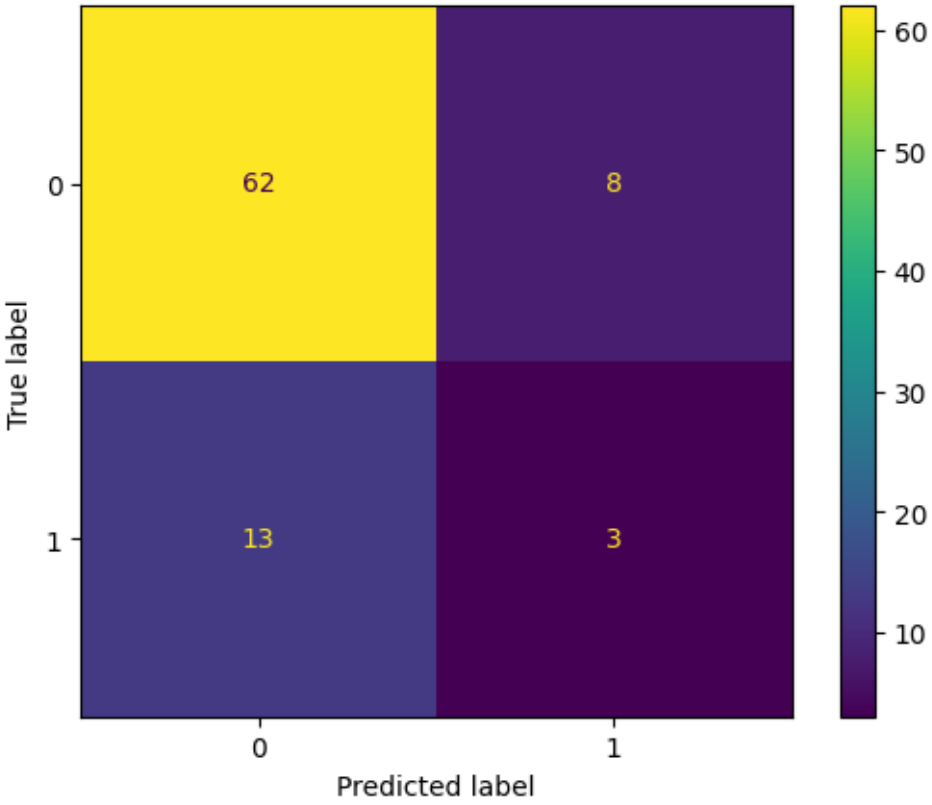
Epoch 28/40
9/9             0s 8ms/step - loss:
0.1605 - val_loss: 0.1242
Epoch 29/40
9/9             0s 6ms/step - loss:
0.1589 - val_loss: 0.1246
Epoch 30/40
9/9             0s 8ms/step - loss:
0.1517 - val_loss: 0.1243
Epoch 31/40
9/9             0s 6ms/step - loss:
0.1523 - val_loss: 0.1250
Epoch 32/40
9/9             0s 6ms/step - loss:
0.1634 - val_loss: 0.1253
Epoch 33/40
9/9             0s 8ms/step - loss:
0.1543 - val_loss: 0.1255
Epoch 34/40
9/9             0s 6ms/step - loss:
0.1524 - val_loss: 0.1261
Epoch 35/40
9/9             0s 6ms/step - loss:
0.1582 - val_loss: 0.1252
Epoch 36/40
9/9             0s 6ms/step - loss:
0.1549 - val_loss: 0.1255
Epoch 37/40
9/9             0s 9ms/step - loss:
0.1612 - val_loss: 0.1267
Epoch 38/40
9/9             0s 6ms/step - loss:
0.1525 - val_loss: 0.1256
Epoch 39/40
9/9             0s 7ms/step - loss:
0.1501 - val_loss: 0.1260
Epoch 40/40
9/9             0s 6ms/step - loss:
0.1436 - val_loss: 0.1271
```




```
3/3                 0s 14ms/step
```



```
Weights for Hidden Layer after training:
[[ 9.44672078e-02  1.93519011e-01  2.41250828e-01 -2.77994704e-02
   8.43580440e-03 -2.49010101e-01  2.05564514e-01  2.24679440e-01
  -1.19471096e-01 -2.63771527e-02  1.55332983e-02 -2.66227305e-01
   9.85795557e-02  2.67663330e-01  1.99167386e-01]
 [-1.76150262e-01 -2.08562881e-01 -2.27828085e-01 -2.06789181e-01
  -1.19457476e-01  2.51930133e-02  2.98283547e-01 -2.80458212e-01
  -3.13180268e-01 -1.12227172e-01  2.14477792e-01 -1.64669037e-01
  -3.60737890e-01  2.53302664e-01 -2.07081303e-01]
 [ 2.67173618e-01  4.34499932e-03  1.46835506e-01 -3.85347217e-01
  -3.90753560e-02  2.88771838e-01  2.38323554e-01  3.13478917e-01
  -2.64559910e-02 -1.67828217e-01 -9.31328163e-02  9.27257240e-02
   2.67071545e-01 -2.98565686e-01  2.71285981e-01]
 [ 8.62550735e-02 -1.12663299e-01  2.13996187e-01 -3.28243785e-02
   2.90292948e-01 -5.51857501e-02  1.10737965e-01 -7.70309120e-02
   2.32709199e-01 -3.12061161e-01 -3.99080142e-02 -2.22800240e-01
  -1.65134937e-01  9.35061425e-02 -1.16535969e-01]
 [-2.08867922e-01  1.31895214e-01  2.64299899e-01 -5.08779623e-02
   2.91555762e-01 -2.34862044e-01 -1.78404495e-01 -1.45943210e-01
  -3.04417461e-01 -1.26114815e-01  1.74152151e-01 -3.14534724e-01
   1.61984384e-01 -4.96383645e-02 -2.96173960e-01]
 [ 4.52202512e-03 -2.79191047e-01  3.84878904e-01 -1.25651106e-01
  -2.95418054e-01  1.97592780e-01 -4.16805856e-02  7.94301778e-02
  -2.12385774e-01  1.36333257e-01 -2.29138106e-01 -1.12411030e-01
   1.13514341e-01  5.82158901e-02 -2.47741178e-01]
 [-3.19819331e-01 -1.54331222e-01  1.52783051e-01  4.26150411e-01
   5.62217832e-02  1.18600383e-01 -3.32711995e-01  3.05073380e-01
   1.24647081e-01  1.38279617e-01  3.35600004e-02  3.25312577e-02
   2.57189304e-01  2.25553125e-01  1.92483604e-01]
 [-6.87379465e-02 -9.59368609e-03 -5.46844751e-02 -1.72562793e-01
  -2.36952871e-01  7.40701407e-02 -1.41046658e-01  2.53474534e-01
   6.75295740e-02  1.53966188e-01  2.68720657e-01  2.29654282e-01
   4.20266330e-01  9.68963280e-02  9.46878493e-02]
 [ 1.71238244e-01 -1.33362368e-01 -1.51242539e-01  1.70613617e-01
   1.22129425e-01  4.22944248e-01 -9.25375521e-02 -2.04879075e-01
  -2.11362973e-01 -2.52391070e-01 -3.05665545e-02  1.66937605e-01
   6.49209395e-02  4.37223427e-02  1.56534284e-01]
 [-2.05117509e-01  2.07819626e-01  2.30391845e-01  8.11479762e-02
  -3.09550554e-01  9.43600982e-02  9.47770532e-05  4.69999202e-02
   7.21466243e-02  3.64410952e-02  4.52317119e-01 -2.18179390e-01
   3.02591592e-01  4.77763377e-02 -6.86590299e-02]
 [-2.46571824e-01 -3.56973819e-02 -2.88161576e-01  4.34235930e-02
  -3.30506712e-01  1.28823370e-01  5.19303791e-02 -2.49513298e-01
  -4.41290811e-02  3.06709260e-01 -1.06814295e-01  2.56512552e-01
   4.01606768e-01 -9.38603431e-02 -3.33156705e-01]
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[ 1.37146533e-01  1.11668609e-01  3.44587117e-01  2.57198662e-01
 -3.34634483e-01  3.14173579e-01  3.10177617e-02 -1.30513934e-02
 -1.98567241e-01  3.95581126e-01 -3.62616256e-02 -1.90278903e-01
 -1.88051730e-01 -3.96723561e-02 -1.91265300e-01]
[-1.66140497e-01  5.62788844e-02  2.09275275e-01  4.16933537e-01
  1.30640164e-01 -9.17300582e-02  3.15252170e-02 -3.49538177e-01
  1.71953648e-01 -2.34315872e-01  7.15978742e-02  4.43654321e-02
 -1.81818947e-01  6.03257157e-02  2.34029844e-01]
[ 5.03317155e-02  7.53881782e-02  2.78722942e-01  7.61393681e-02
 -3.34960013e-03  1.97946548e-01 -1.14141144e-01  2.46324271e-01
 -2.65685588e-01 -2.47495383e-01 -5.35478666e-02 -1.78390473e-01
  2.41328120e-01  2.40645736e-01  1.22605510e-01]
[-7.12150559e-02 -1.14162929e-01 -2.39858881e-01 -4.07158323e-02
 -2.63648421e-01 -1.79862380e-01 -2.81609893e-01  6.92335665e-02
  6.15971535e-02  2.69546688e-01 -8.14160332e-03 -1.53598059e-02
 -1.74716651e-01 -2.52991289e-01 -2.26732016e-01]
[-1.33329287e-01 -9.18160155e-02 -2.58067437e-03 -7.40847662e-02
 -1.87403262e-01  5.56850247e-02  9.84488502e-02  3.31088841e-01
  2.90476698e-02 -3.37243557e-01  5.34963198e-02  1.16574988e-01
 -8.93123448e-02 -1.48288190e-01  1.17558040e-01]
[ 3.28035176e-01 -5.58807254e-02 -3.04759264e-01 -2.12293595e-01
  2.37983912e-01 -3.88363153e-01  1.28761113e-01 -9.95436907e-02
  2.60590523e-01  2.19722226e-01 -4.93505955e-01 -2.17443764e-01
 -8.12024325e-02  3.82360846e-01  1.13675401e-01]
[ 2.98373282e-01 -1.57423288e-01 -2.32800603e-01 -3.80966753e-01
 -1.05519466e-01  2.89180189e-01  7.20445067e-02 -2.82324106e-01
  7.75936395e-02 -1.75916478e-01 -3.64091575e-01 -1.63476188e-02
  3.42926905e-02  3.17503810e-01 -1.19412087e-01]
[-9.01468322e-02  4.62263077e-03 -1.50961563e-01  1.41102552e-01
 -2.98486859e-01  2.07515791e-01  4.04617995e-01 -1.95611656e-01
  7.06492215e-02 -2.18534023e-01 -2.91359872e-01  1.29759908e-02
  2.61361003e-01 -1.80057719e-01  2.25747585e-01]
[ 4.32063997e-01  3.79940808e-01 -3.93545717e-01  1.26210183e-01
  4.28746581e-01  1.57277390e-01  4.56041574e-01 -2.88967639e-01
 -2.47202858e-01 -9.36861336e-02 -4.74144340e-01  2.32525259e-01
  1.73595443e-01 -8.28714371e-02  2.50749320e-01]
[-3.09769422e-01 -1.51461899e-01 -3.39164913e-01  2.27548763e-01
 -1.79840654e-01  2.29939342e-01 -1.84427857e-01  2.36927763e-01
  5.66369258e-02  2.22289562e-01  9.64847729e-02  3.19701821e-01
  2.61634558e-01 -1.54611483e-01  7.47483596e-02]
[-1.43353507e-01  4.30818081e-01 -9.95764434e-02  1.30022794e-01
 -6.27820194e-02 -3.74793530e-01 -1.33272976e-01 -1.96683913e-01
 -2.00560093e-02 -8.26459229e-02 -3.62424701e-01 -2.16306478e-01
  3.11093122e-01  4.37589064e-02  3.87904674e-01]
[ 2.62727141e-01  3.07607263e-01 -2.49253344e-02  1.56403914e-01
 -5.41059449e-02 -2.77393609e-01 -4.57225507e-03  2.59658456e-01
 -2.76879430e-01 -8.95344540e-02  1.70836791e-01  3.69176865e-01
 -2.75992721e-01 -2.82408260e-02  3.21286082e-01]
```

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 [-2.25777641e-01  7.27022141e-02  2.13984847e-01 -2.22878650e-01
   5.09134173e-01 -8.22433159e-02  3.82476091e-01 -2.55925823e-02
  -2.37374306e-01 -3.72751951e-02 -1.77279770e-01  2.51736313e-01
   7.60613829e-02  1.95323274e-01  7.75808841e-02]
 [ 1.03462376e-01  4.01123285e-01 -6.06474169e-02 -2.60365665e-01
   7.46802241e-02 -4.23256725e-01 -3.54028136e-01 -4.27556098e-01
   3.17973584e-01  1.30807981e-01 -3.28278452e-01 -2.33419612e-01
  -2.10426271e-01 -1.24899372e-01 -9.52392071e-02]
 [-9.42549929e-02 -1.83943227e-01 -1.38182461e-01  4.64736894e-02
  -2.50381023e-01 -9.13640857e-02 -1.86512321e-01 -8.72261748e-02
   2.77013063e-01  1.51970372e-01  5.77381253e-01  1.04463488e-01
   4.55539534e-03  1.67118937e-01  5.95503412e-02]
 [ 3.06432426e-01  2.78137535e-01 -3.06775421e-01 -3.75238098e-02
  -5.70088923e-02  9.73637030e-02  1.95519999e-01  1.73599124e-01
   3.58659834e-01  2.08957478e-01 -9.88056809e-02 -2.46187404e-01
  -4.05983061e-01  1.30396590e-01  2.98690915e-01]
 [ 3.07971954e-01 -3.03212941e-01  1.23718426e-01  2.15102926e-01
  -2.81550914e-01  3.15214813e-01  5.46482243e-02  2.35191330e-01
   1.00246489e-01 -3.35021526e-01 -1.83661103e-01  1.41849279e-01
   1.79397076e-01 -3.63671631e-01  2.30261087e-01]
 [-2.55647212e-01 -2.62464397e-02  3.60445827e-01 -9.48761124e-03
  -3.39968860e-01  1.66442424e-01 -3.66563976e-01  1.76432561e-02
   1.88043267e-02 -4.39354628e-01  3.65521498e-02  2.43057068e-02
   1.69099867e-01 -3.07633057e-02 -2.37192288e-01]
 [ 1.26949832e-01 -1.83499098e-01 -2.79551178e-01  2.55749792e-01
   4.21140581e-01  3.46737593e-01  3.27891181e-03  3.38624477e-01
   1.77089453e-01  3.30036163e-01  2.59542465e-01  2.65772849e-01
  -1.16808482e-01  2.46470004e-01 -2.17955858e-01]
 [-5.51868603e-02 -2.07384333e-01 -1.95778877e-01  1.15488216e-01
   4.76691574e-02 -2.41553381e-01 -5.79910465e-02  2.92462438e-01
   2.00014547e-01  2.06427187e-01  3.32185961e-02 -1.76819742e-01
   3.12953204e-01 -2.10901201e-01  4.50010784e-03]
 [-2.18958169e-01  2.36133665e-01  6.12362958e-02  3.50262970e-02
   1.97215930e-01  4.61726964e-01 -1.60768822e-01 -1.54791340e-01
   2.12519214e-01  7.05272928e-02  1.00025505e-01 -2.65518308e-01
   1.61986187e-01 -2.27319509e-01 -1.28150597e-01]
 [ 1.01835988e-01  1.87180862e-01  4.28254277e-01  2.62774527e-01
  -1.68917179e-01  8.92021954e-02 -4.12030488e-01  1.69345096e-01
   8.07107016e-02 -1.85173109e-01 -9.44990888e-02  1.61065683e-01
  -1.37178198e-01  1.20085189e-02 -1.42209932e-01]]
Biases for Hidden Layer after training:
[-0.01432697 -0.06976659  0.11097985  0.12876424 -0.0301521   0.10083409
  0.11621467  0.09178078 -0.04460031  0.10849834  0.20240663 -0.03386266
  0.1685316  -0.10871898 -0.06453896]
```