Baseline Datasets

Load Datasets

In [1]:
```
import random
import numpy as np
import pandas as pd
from tensorflow.random import set_seed
random.seed(2024)
np.random.seed(2024)
set_seed(2024)

df_train = pd.read_csv("train.csv")
df_test = pd.read_csv("test.csv")
X_train = df_train.drop(columns = ["converter"])
Y_train = df_train.converter
X_test = df_test.drop(columns = ["converter"])
Y_test = df_test["converter"]
```

```
WARNING:tensorflow:From C:\Users\43115\anaconda3\envs\python_310\lib\site-packages
\keras\src\losses.py:2976: The name tf.losses.sparse_softmax_cross_entropy is depr
ecated. Please use tf.compat.v1.losses.sparse_softmax_cross_entropy instead.
```

Normalization

1. scale numerical columns
2. apply one-hot encoding to categorical columns

In [2]:
```
from sklearn.preprocessing import StandardScaler
from sklearn.preprocessing import OneHotEncoder


numerical_cols = X_train.select_dtypes(include=['float64', 'int64']).columns.tolist
categorical_cols = X_train.select_dtypes(include=['object']).columns.tolist()

# Initialize the StandardScaler and OneHotEncoder
scaler = StandardScaler()
encoder = OneHotEncoder(sparse=False)

# scale
X_train_scaled = scaler.fit_transform(X_train[numerical_cols])
X_test_scaled = scaler.transform(X_test[numerical_cols])

# encode
X_train_encoded = encoder.fit_transform(X_train[categorical_cols])
X_test_encoded = encoder.transform(X_test[categorical_cols])

# concatenate
```

```
X_train_preprocessed = np.concatenate([X_train_scaled, X_train_encoded], axis=1)
X_test_preprocessed = np.concatenate([X_test_scaled, X_test_encoded], axis=1)
```

```
C:\Users\43115\anaconda3\envs\python_310\lib\site-packages\sklearn\preprocessing\_
encoders.py:868: FutureWarning: `sparse` was renamed to `sparse_output` in version
1.2 and will be removed in 1.4. `sparse_output` is ignored unless you leave `spars
e` to its default value.
  warnings.warn(
```

Neural Network

In [3]:
```
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense

NNmodel = Sequential()
NNmodel.add(Dense(8, input_dim = len(X_train_preprocessed[0,:]), activation = "relu
NNmodel.add(Dense(1, activation = "sigmoid")) # binary
NNmodel.summary()
```

```
WARNING:tensorflow:From C:\Users\43115\anaconda3\envs\python_310\lib\site-packages
\keras\src\backend.py:873: The name tf.get_default_graph is deprecated. Please use
tf.compat.v1.get_default_graph instead.

Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 dense (Dense)               (None, 8)                 184

 dense_1 (Dense)             (None, 1)                 9

=================================================================
Total params: 193 (772.00 Byte)
Trainable params: 193 (772.00 Byte)
Non-trainable params: 0 (0.00 Byte)
_________________________________________________________________
```

In [4]:
```
NNmodel.compile(loss = "binary_crossentropy", optimizer = "adam", metrics = ["accur
history = NNmodel.fit(x = X_train_preprocessed, y = Y_train, epochs = 200, validati
```

```
WARNING:tensorflow:From C:\Users\43115\anaconda3\envs\python_310\lib\site-packages
\keras\src\optimizers\__init__.py:309: The name tf.train.Optimizer is deprecated.
Please use tf.compat.v1.train.Optimizer instead.

Epoch 1/200
WARNING:tensorflow:From C:\Users\43115\anaconda3\envs\python_310\lib\site-packages
\keras\src\utils\tf_utils.py:492: The name tf.ragged.RaggedTensorValue is deprecat
ed. Please use tf.compat.v1.ragged.RaggedTensorValue instead.

WARNING:tensorflow:From C:\Users\43115\anaconda3\envs\python_310\lib\site-packages
\keras\src\engine\base_layer_utils.py:384: The name tf.executing_eagerly_outside_f
unctions is deprecated. Please use tf.compat.v1.executing_eagerly_outside_function
s instead.

20/20 [==============================] - 1s 9ms/step - loss: 0.8490 - accuracy: 0.
3997 - val_loss: 0.8206 - val_accuracy: 0.4551
Epoch 2/200
20/20 [==============================] - 0s 2ms/step - loss: 0.7783 - accuracy: 0.
4543 - val_loss: 0.7597 - val_accuracy: 0.4808
Epoch 3/200
20/20 [==============================] - 0s 3ms/step - loss: 0.7223 - accuracy: 0.
5329 - val_loss: 0.7137 - val_accuracy: 0.5321
Epoch 4/200
20/20 [==============================] - 0s 3ms/step - loss: 0.6791 - accuracy: 0.
6228 - val_loss: 0.6750 - val_accuracy: 0.6154
Epoch 5/200
20/20 [==============================] - 0s 3ms/step - loss: 0.6423 - accuracy: 0.
6838 - val_loss: 0.6435 - val_accuracy: 0.6603
Epoch 6/200
20/20 [==============================] - 0s 3ms/step - loss: 0.6072 - accuracy: 0.
7319 - val_loss: 0.6161 - val_accuracy: 0.7115
Epoch 7/200
20/20 [==============================] - 0s 3ms/step - loss: 0.5752 - accuracy: 0.
7464 - val_loss: 0.5893 - val_accuracy: 0.7244
Epoch 8/200
20/20 [==============================] - 0s 2ms/step - loss: 0.5457 - accuracy: 0.
7673 - val_loss: 0.5672 - val_accuracy: 0.7500
Epoch 9/200
20/20 [==============================] - 0s 2ms/step - loss: 0.5208 - accuracy: 0.
7705 - val_loss: 0.5489 - val_accuracy: 0.7372
Epoch 10/200
20/20 [==============================] - 0s 2ms/step - loss: 0.5006 - accuracy: 0.
7753 - val_loss: 0.5335 - val_accuracy: 0.7500
Epoch 11/200
20/20 [==============================] - 0s 2ms/step - loss: 0.4843 - accuracy: 0.
7785 - val_loss: 0.5219 - val_accuracy: 0.7436
Epoch 12/200
20/20 [==============================] - 0s 2ms/step - loss: 0.4718 - accuracy: 0.
7769 - val_loss: 0.5128 - val_accuracy: 0.7436
Epoch 13/200
20/20 [==============================] - 0s 3ms/step - loss: 0.4623 - accuracy: 0.
7817 - val_loss: 0.5066 - val_accuracy: 0.7500
Epoch 14/200
20/20 [==============================] - 0s 2ms/step - loss: 0.4559 - accuracy: 0.
7817 - val_loss: 0.5006 - val_accuracy: 0.7500
Epoch 15/200
```

```
20/20 [==============================] - 0s 2ms/step - loss: 0.4497 - accuracy: 0.
7881 - val_loss: 0.4970 - val_accuracy: 0.7564
Epoch 16/200
20/20 [==============================] - 0s 2ms/step - loss: 0.4454 - accuracy: 0.
7913 - val_loss: 0.4933 - val_accuracy: 0.7564
Epoch 17/200
20/20 [==============================] - 0s 3ms/step - loss: 0.4416 - accuracy: 0.
7913 - val_loss: 0.4914 - val_accuracy: 0.7628
Epoch 18/200
20/20 [==============================] - 0s 2ms/step - loss: 0.4390 - accuracy: 0.
7929 - val_loss: 0.4898 - val_accuracy: 0.7500
Epoch 19/200
20/20 [==============================] - 0s 2ms/step - loss: 0.4363 - accuracy: 0.
7945 - val_loss: 0.4883 - val_accuracy: 0.7564
Epoch 20/200
20/20 [==============================] - 0s 2ms/step - loss: 0.4340 - accuracy: 0.
7961 - val_loss: 0.4866 - val_accuracy: 0.7500
Epoch 21/200
20/20 [==============================] - 0s 2ms/step - loss: 0.4326 - accuracy: 0.
7945 - val_loss: 0.4855 - val_accuracy: 0.7564
Epoch 22/200
20/20 [==============================] - 0s 2ms/step - loss: 0.4309 - accuracy: 0.
7978 - val_loss: 0.4842 - val_accuracy: 0.7564
Epoch 23/200
20/20 [==============================] - 0s 3ms/step - loss: 0.4296 - accuracy: 0.
7978 - val_loss: 0.4834 - val_accuracy: 0.7564
Epoch 24/200
20/20 [==============================] - 0s 2ms/step - loss: 0.4280 - accuracy: 0.
7994 - val_loss: 0.4826 - val_accuracy: 0.7564
Epoch 25/200
20/20 [==============================] - 0s 3ms/step - loss: 0.4267 - accuracy: 0.
7994 - val_loss: 0.4816 - val_accuracy: 0.7564
Epoch 26/200
20/20 [==============================] - 0s 3ms/step - loss: 0.4252 - accuracy: 0.
8010 - val_loss: 0.4808 - val_accuracy: 0.7564
Epoch 27/200
20/20 [==============================] - 0s 3ms/step - loss: 0.4253 - accuracy: 0.
8058 - val_loss: 0.4801 - val_accuracy: 0.7564
Epoch 28/200
20/20 [==============================] - 0s 3ms/step - loss: 0.4233 - accuracy: 0.
7994 - val_loss: 0.4801 - val_accuracy: 0.7500
Epoch 29/200
20/20 [==============================] - 0s 2ms/step - loss: 0.4218 - accuracy: 0.
8042 - val_loss: 0.4792 - val_accuracy: 0.7564
Epoch 30/200
20/20 [==============================] - 0s 2ms/step - loss: 0.4207 - accuracy: 0.
8074 - val_loss: 0.4790 - val_accuracy: 0.7628
Epoch 31/200
20/20 [==============================] - 0s 2ms/step - loss: 0.4198 - accuracy: 0.
8090 - val_loss: 0.4791 - val_accuracy: 0.7564
Epoch 32/200
20/20 [==============================] - 0s 2ms/step - loss: 0.4190 - accuracy: 0.
8106 - val_loss: 0.4790 - val_accuracy: 0.7564
Epoch 33/200
20/20 [==============================] - 0s 2ms/step - loss: 0.4185 - accuracy: 0.
8074 - val_loss: 0.4785 - val_accuracy: 0.7628
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Epoch 34/200
20/20 [==============================] - 0s 2ms/step - loss: 0.4170 - accuracy: 0.
8074 - val_loss: 0.4782 - val_accuracy: 0.7628
Epoch 35/200
20/20 [==============================] - 0s 2ms/step - loss: 0.4163 - accuracy: 0.
8122 - val_loss: 0.4779 - val_accuracy: 0.7628
Epoch 36/200
20/20 [==============================] - 0s 2ms/step - loss: 0.4152 - accuracy: 0.
8138 - val_loss: 0.4777 - val_accuracy: 0.7628
Epoch 37/200
20/20 [==============================] - 0s 2ms/step - loss: 0.4143 - accuracy: 0.
8154 - val_loss: 0.4774 - val_accuracy: 0.7628
Epoch 38/200
20/20 [==============================] - 0s 2ms/step - loss: 0.4135 - accuracy: 0.
8218 - val_loss: 0.4777 - val_accuracy: 0.7628
Epoch 39/200
20/20 [==============================] - 0s 2ms/step - loss: 0.4127 - accuracy: 0.
8202 - val_loss: 0.4769 - val_accuracy: 0.7628
Epoch 40/200
20/20 [==============================] - 0s 2ms/step - loss: 0.4119 - accuracy: 0.
8186 - val_loss: 0.4766 - val_accuracy: 0.7628
Epoch 41/200
20/20 [==============================] - 0s 2ms/step - loss: 0.4111 - accuracy: 0.
8186 - val_loss: 0.4760 - val_accuracy: 0.7628
Epoch 42/200
20/20 [==============================] - 0s 2ms/step - loss: 0.4101 - accuracy: 0.
8218 - val_loss: 0.4765 - val_accuracy: 0.7628
Epoch 43/200
20/20 [==============================] - 0s 2ms/step - loss: 0.4096 - accuracy: 0.
8186 - val_loss: 0.4767 - val_accuracy: 0.7628
Epoch 44/200
20/20 [==============================] - 0s 2ms/step - loss: 0.4087 - accuracy: 0.
8186 - val_loss: 0.4760 - val_accuracy: 0.7692
Epoch 45/200
20/20 [==============================] - 0s 2ms/step - loss: 0.4081 - accuracy: 0.
8202 - val_loss: 0.4763 - val_accuracy: 0.7692
Epoch 46/200
20/20 [==============================] - 0s 2ms/step - loss: 0.4072 - accuracy: 0.
8218 - val_loss: 0.4763 - val_accuracy: 0.7628
Epoch 47/200
20/20 [==============================] - 0s 2ms/step - loss: 0.4062 - accuracy: 0.
8202 - val_loss: 0.4763 - val_accuracy: 0.7692
Epoch 48/200
20/20 [==============================] - 0s 2ms/step - loss: 0.4057 - accuracy: 0.
8170 - val_loss: 0.4759 - val_accuracy: 0.7756
Epoch 49/200
20/20 [==============================] - 0s 2ms/step - loss: 0.4052 - accuracy: 0.
8186 - val_loss: 0.4755 - val_accuracy: 0.7692
Epoch 50/200
20/20 [==============================] - 0s 2ms/step - loss: 0.4046 - accuracy: 0.
8170 - val_loss: 0.4757 - val_accuracy: 0.7692
Epoch 51/200
20/20 [==============================] - 0s 2ms/step - loss: 0.4040 - accuracy: 0.
8186 - val_loss: 0.4766 - val_accuracy: 0.7692
Epoch 52/200
20/20 [==============================] - 0s 2ms/step - loss: 0.4031 - accuracy: 0.
```

```
8202 - val_loss: 0.4762 - val_accuracy: 0.7692
Epoch 53/200
20/20 [==============================] - 0s 2ms/step - loss: 0.4023 - accuracy: 0.
8186 - val_loss: 0.4760 - val_accuracy: 0.7628
Epoch 54/200
20/20 [==============================] - 0s 2ms/step - loss: 0.4017 - accuracy: 0.
8186 - val_loss: 0.4764 - val_accuracy: 0.7628
Epoch 55/200
20/20 [==============================] - 0s 2ms/step - loss: 0.4014 - accuracy: 0.
8202 - val_loss: 0.4757 - val_accuracy: 0.7628
Epoch 56/200
20/20 [==============================] - 0s 2ms/step - loss: 0.4004 - accuracy: 0.
8202 - val_loss: 0.4758 - val_accuracy: 0.7628
Epoch 57/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3999 - accuracy: 0.
8186 - val_loss: 0.4755 - val_accuracy: 0.7628
Epoch 58/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3996 - accuracy: 0.
8170 - val_loss: 0.4760 - val_accuracy: 0.7628
Epoch 59/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3992 - accuracy: 0.
8186 - val_loss: 0.4749 - val_accuracy: 0.7628
Epoch 60/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3986 - accuracy: 0.
8186 - val_loss: 0.4757 - val_accuracy: 0.7628
Epoch 61/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3979 - accuracy: 0.
8218 - val_loss: 0.4759 - val_accuracy: 0.7628
Epoch 62/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3973 - accuracy: 0.
8170 - val_loss: 0.4759 - val_accuracy: 0.7692
Epoch 63/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3965 - accuracy: 0.
8154 - val_loss: 0.4758 - val_accuracy: 0.7692
Epoch 64/200
20/20 [==============================] - 0s 3ms/step - loss: 0.3962 - accuracy: 0.
8186 - val_loss: 0.4756 - val_accuracy: 0.7692
Epoch 65/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3957 - accuracy: 0.
8186 - val_loss: 0.4764 - val_accuracy: 0.7756
Epoch 66/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3950 - accuracy: 0.
8202 - val_loss: 0.4764 - val_accuracy: 0.7692
Epoch 67/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3944 - accuracy: 0.
8202 - val_loss: 0.4769 - val_accuracy: 0.7692
Epoch 68/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3941 - accuracy: 0.
8202 - val_loss: 0.4773 - val_accuracy: 0.7692
Epoch 69/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3940 - accuracy: 0.
8202 - val_loss: 0.4772 - val_accuracy: 0.7756
Epoch 70/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3930 - accuracy: 0.
8202 - val_loss: 0.4770 - val_accuracy: 0.7692
Epoch 71/200
```

```
20/20 [==============================] - 0s 2ms/step - loss: 0.3926 - accuracy: 0.
8234 - val_loss: 0.4766 - val_accuracy: 0.7692
Epoch 72/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3918 - accuracy: 0.
8218 - val_loss: 0.4765 - val_accuracy: 0.7692
Epoch 73/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3912 - accuracy: 0.
8218 - val_loss: 0.4766 - val_accuracy: 0.7692
Epoch 74/200
20/20 [==============================] - 0s 3ms/step - loss: 0.3907 - accuracy: 0.
8250 - val_loss: 0.4769 - val_accuracy: 0.7692
Epoch 75/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3904 - accuracy: 0.
8250 - val_loss: 0.4772 - val_accuracy: 0.7756
Epoch 76/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3898 - accuracy: 0.
8218 - val_loss: 0.4766 - val_accuracy: 0.7756
Epoch 77/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3895 - accuracy: 0.
8250 - val_loss: 0.4764 - val_accuracy: 0.7692
Epoch 78/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3890 - accuracy: 0.
8234 - val_loss: 0.4767 - val_accuracy: 0.7628
Epoch 79/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3883 - accuracy: 0.
8250 - val_loss: 0.4767 - val_accuracy: 0.7756
Epoch 80/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3879 - accuracy: 0.
8250 - val_loss: 0.4776 - val_accuracy: 0.7756
Epoch 81/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3873 - accuracy: 0.
8234 - val_loss: 0.4772 - val_accuracy: 0.7692
Epoch 82/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3870 - accuracy: 0.
8234 - val_loss: 0.4777 - val_accuracy: 0.7692
Epoch 83/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3866 - accuracy: 0.
8234 - val_loss: 0.4774 - val_accuracy: 0.7692
Epoch 84/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3862 - accuracy: 0.
8234 - val_loss: 0.4775 - val_accuracy: 0.7692
Epoch 85/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3857 - accuracy: 0.
8250 - val_loss: 0.4775 - val_accuracy: 0.7692
Epoch 86/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3852 - accuracy: 0.
8234 - val_loss: 0.4780 - val_accuracy: 0.7692
Epoch 87/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3847 - accuracy: 0.
8218 - val_loss: 0.4779 - val_accuracy: 0.7692
Epoch 88/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3851 - accuracy: 0.
8218 - val_loss: 0.4779 - val_accuracy: 0.7692
Epoch 89/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3838 - accuracy: 0.
8250 - val_loss: 0.4779 - val_accuracy: 0.7692
```

```
Epoch 90/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3837 - accuracy: 0.
8234 - val_loss: 0.4784 - val_accuracy: 0.7692
Epoch 91/200
20/20 [==============================] - 0s 3ms/step - loss: 0.3828 - accuracy: 0.
8266 - val_loss: 0.4784 - val_accuracy: 0.7692
Epoch 92/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3824 - accuracy: 0.
8266 - val_loss: 0.4785 - val_accuracy: 0.7692
Epoch 93/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3823 - accuracy: 0.
8266 - val_loss: 0.4785 - val_accuracy: 0.7692
Epoch 94/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3819 - accuracy: 0.
8250 - val_loss: 0.4790 - val_accuracy: 0.7692
Epoch 95/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3815 - accuracy: 0.
8250 - val_loss: 0.4786 - val_accuracy: 0.7692
Epoch 96/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3811 - accuracy: 0.
8266 - val_loss: 0.4791 - val_accuracy: 0.7692
Epoch 97/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3807 - accuracy: 0.
8266 - val_loss: 0.4798 - val_accuracy: 0.7692
Epoch 98/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3805 - accuracy: 0.
8266 - val_loss: 0.4799 - val_accuracy: 0.7692
Epoch 99/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3800 - accuracy: 0.
8250 - val_loss: 0.4799 - val_accuracy: 0.7692
Epoch 100/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3798 - accuracy: 0.
8234 - val_loss: 0.4798 - val_accuracy: 0.7692
Epoch 101/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3799 - accuracy: 0.
8234 - val_loss: 0.4798 - val_accuracy: 0.7692
Epoch 102/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3791 - accuracy: 0.
8250 - val_loss: 0.4800 - val_accuracy: 0.7692
Epoch 103/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3786 - accuracy: 0.
8283 - val_loss: 0.4800 - val_accuracy: 0.7628
Epoch 104/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3785 - accuracy: 0.
8299 - val_loss: 0.4802 - val_accuracy: 0.7692
Epoch 105/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3784 - accuracy: 0.
8299 - val_loss: 0.4800 - val_accuracy: 0.7692
Epoch 106/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3778 - accuracy: 0.
8315 - val_loss: 0.4804 - val_accuracy: 0.7692
Epoch 107/200
20/20 [==============================] - 0s 3ms/step - loss: 0.3775 - accuracy: 0.
8315 - val_loss: 0.4799 - val_accuracy: 0.7692
Epoch 108/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3772 - accuracy: 0.
```

```
8283 - val_loss: 0.4807 - val_accuracy: 0.7692
Epoch 109/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3768 - accuracy: 0.
8299 - val_loss: 0.4805 - val_accuracy: 0.7692
Epoch 110/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3765 - accuracy: 0.
8315 - val_loss: 0.4813 - val_accuracy: 0.7756
Epoch 111/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3763 - accuracy: 0.
8315 - val_loss: 0.4806 - val_accuracy: 0.7692
Epoch 112/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3759 - accuracy: 0.
8315 - val_loss: 0.4818 - val_accuracy: 0.7692
Epoch 113/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3760 - accuracy: 0.
8331 - val_loss: 0.4824 - val_accuracy: 0.7756
Epoch 114/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3754 - accuracy: 0.
8299 - val_loss: 0.4821 - val_accuracy: 0.7756
Epoch 115/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3752 - accuracy: 0.
8331 - val_loss: 0.4821 - val_accuracy: 0.7692
Epoch 116/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3751 - accuracy: 0.
8299 - val_loss: 0.4824 - val_accuracy: 0.7692
Epoch 117/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3749 - accuracy: 0.
8331 - val_loss: 0.4831 - val_accuracy: 0.7692
Epoch 118/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3745 - accuracy: 0.
8299 - val_loss: 0.4828 - val_accuracy: 0.7628
Epoch 119/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3744 - accuracy: 0.
8299 - val_loss: 0.4832 - val_accuracy: 0.7500
Epoch 120/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3738 - accuracy: 0.
8299 - val_loss: 0.4833 - val_accuracy: 0.7692
Epoch 121/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3736 - accuracy: 0.
8347 - val_loss: 0.4829 - val_accuracy: 0.7692
Epoch 122/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3733 - accuracy: 0.
8331 - val_loss: 0.4835 - val_accuracy: 0.7692
Epoch 123/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3730 - accuracy: 0.
8363 - val_loss: 0.4836 - val_accuracy: 0.7692
Epoch 124/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3730 - accuracy: 0.
8315 - val_loss: 0.4835 - val_accuracy: 0.7692
Epoch 125/200
20/20 [==============================] - 0s 3ms/step - loss: 0.3724 - accuracy: 0.
8315 - val_loss: 0.4841 - val_accuracy: 0.7692
Epoch 126/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3726 - accuracy: 0.
8363 - val_loss: 0.4851 - val_accuracy: 0.7692
Epoch 127/200
```

```
20/20 [==============================] - 0s 2ms/step - loss: 0.3719 - accuracy: 0.
8331 - val_loss: 0.4849 - val_accuracy: 0.7692
Epoch 128/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3716 - accuracy: 0.
8347 - val_loss: 0.4853 - val_accuracy: 0.7692
Epoch 129/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3717 - accuracy: 0.
8315 - val_loss: 0.4852 - val_accuracy: 0.7628
Epoch 130/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3715 - accuracy: 0.
8363 - val_loss: 0.4852 - val_accuracy: 0.7692
Epoch 131/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3709 - accuracy: 0.
8331 - val_loss: 0.4844 - val_accuracy: 0.7628
Epoch 132/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3709 - accuracy: 0.
8331 - val_loss: 0.4858 - val_accuracy: 0.7628
Epoch 133/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3705 - accuracy: 0.
8331 - val_loss: 0.4856 - val_accuracy: 0.7692
Epoch 134/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3704 - accuracy: 0.
8363 - val_loss: 0.4849 - val_accuracy: 0.7692
Epoch 135/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3697 - accuracy: 0.
8347 - val_loss: 0.4861 - val_accuracy: 0.7628
Epoch 136/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3696 - accuracy: 0.
8363 - val_loss: 0.4864 - val_accuracy: 0.7692
Epoch 137/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3691 - accuracy: 0.
8363 - val_loss: 0.4863 - val_accuracy: 0.7628
Epoch 138/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3691 - accuracy: 0.
8347 - val_loss: 0.4873 - val_accuracy: 0.7628
Epoch 139/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3687 - accuracy: 0.
8363 - val_loss: 0.4867 - val_accuracy: 0.7692
Epoch 140/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3684 - accuracy: 0.
8363 - val_loss: 0.4869 - val_accuracy: 0.7628
Epoch 141/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3687 - accuracy: 0.
8363 - val_loss: 0.4866 - val_accuracy: 0.7628
Epoch 142/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3687 - accuracy: 0.
8379 - val_loss: 0.4876 - val_accuracy: 0.7628
Epoch 143/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3677 - accuracy: 0.
8363 - val_loss: 0.4878 - val_accuracy: 0.7692
Epoch 144/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3674 - accuracy: 0.
8363 - val_loss: 0.4877 - val_accuracy: 0.7628
Epoch 145/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3672 - accuracy: 0.
8363 - val_loss: 0.4882 - val_accuracy: 0.7692
```

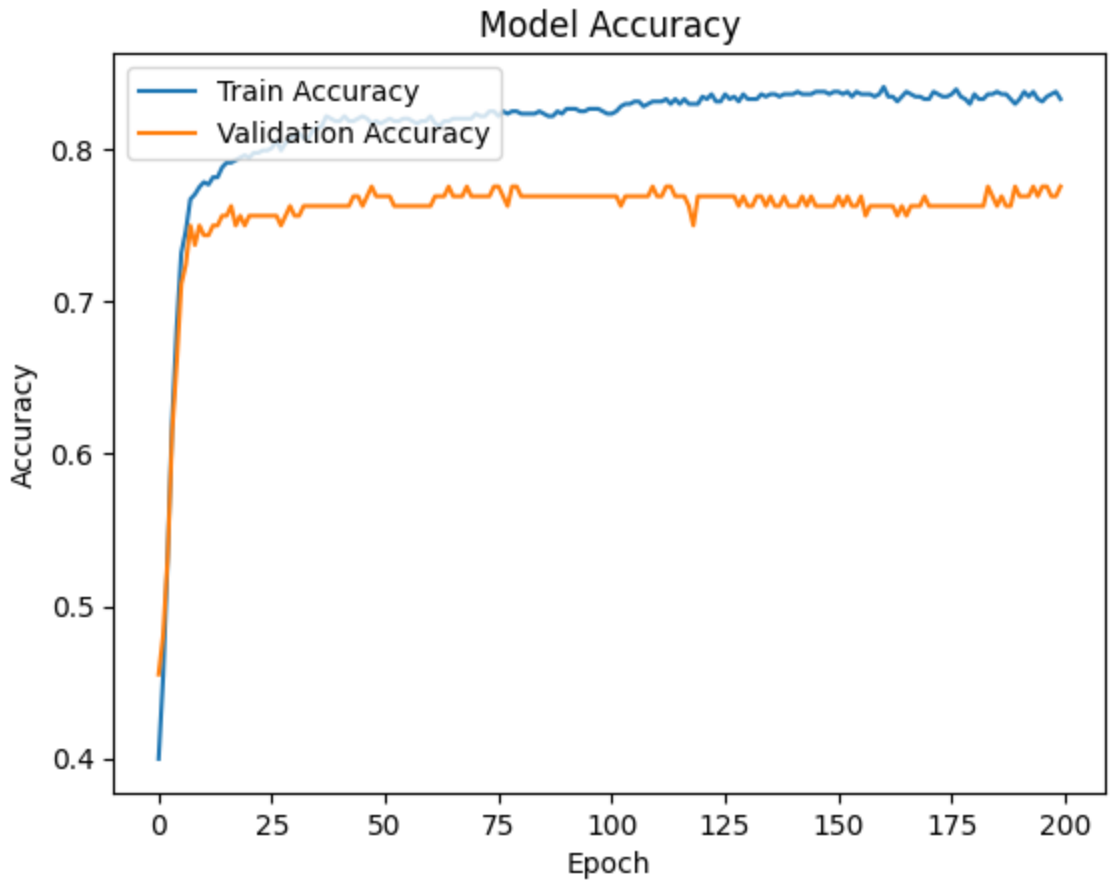
```
Epoch 146/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3669 - accuracy: 0.
8379 - val_loss: 0.4882 - val_accuracy: 0.7628
Epoch 147/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3671 - accuracy: 0.
8379 - val_loss: 0.4893 - val_accuracy: 0.7628
Epoch 148/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3665 - accuracy: 0.
8379 - val_loss: 0.4897 - val_accuracy: 0.7628
Epoch 149/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3663 - accuracy: 0.
8363 - val_loss: 0.4889 - val_accuracy: 0.7628
Epoch 150/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3660 - accuracy: 0.
8379 - val_loss: 0.4897 - val_accuracy: 0.7628
Epoch 151/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3659 - accuracy: 0.
8379 - val_loss: 0.4903 - val_accuracy: 0.7692
Epoch 152/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3654 - accuracy: 0.
8363 - val_loss: 0.4908 - val_accuracy: 0.7628
Epoch 153/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3651 - accuracy: 0.
8379 - val_loss: 0.4915 - val_accuracy: 0.7692
Epoch 154/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3650 - accuracy: 0.
8347 - val_loss: 0.4906 - val_accuracy: 0.7628
Epoch 155/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3646 - accuracy: 0.
8379 - val_loss: 0.4906 - val_accuracy: 0.7628
Epoch 156/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3645 - accuracy: 0.
8363 - val_loss: 0.4920 - val_accuracy: 0.7692
Epoch 157/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3642 - accuracy: 0.
8363 - val_loss: 0.4915 - val_accuracy: 0.7564
Epoch 158/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3637 - accuracy: 0.
8363 - val_loss: 0.4919 - val_accuracy: 0.7628
Epoch 159/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3642 - accuracy: 0.
8347 - val_loss: 0.4924 - val_accuracy: 0.7628
Epoch 160/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3636 - accuracy: 0.
8363 - val_loss: 0.4926 - val_accuracy: 0.7628
Epoch 161/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3642 - accuracy: 0.
8411 - val_loss: 0.4925 - val_accuracy: 0.7628
Epoch 162/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3626 - accuracy: 0.
8347 - val_loss: 0.4929 - val_accuracy: 0.7628
Epoch 163/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3628 - accuracy: 0.
8347 - val_loss: 0.4929 - val_accuracy: 0.7628
Epoch 164/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3630 - accuracy: 0.
```

```
8315 - val_loss: 0.4933 - val_accuracy: 0.7564
Epoch 165/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3621 - accuracy: 0.
8347 - val_loss: 0.4948 - val_accuracy: 0.7628
Epoch 166/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3622 - accuracy: 0.
8379 - val_loss: 0.4951 - val_accuracy: 0.7564
Epoch 167/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3622 - accuracy: 0.
8363 - val_loss: 0.4952 - val_accuracy: 0.7628
Epoch 168/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3617 - accuracy: 0.
8347 - val_loss: 0.4952 - val_accuracy: 0.7628
Epoch 169/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3614 - accuracy: 0.
8347 - val_loss: 0.4966 - val_accuracy: 0.7628
Epoch 170/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3616 - accuracy: 0.
8331 - val_loss: 0.4969 - val_accuracy: 0.7692
Epoch 171/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3608 - accuracy: 0.
8331 - val_loss: 0.4976 - val_accuracy: 0.7628
Epoch 172/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3608 - accuracy: 0.
8379 - val_loss: 0.4975 - val_accuracy: 0.7628
Epoch 173/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3605 - accuracy: 0.
8363 - val_loss: 0.4985 - val_accuracy: 0.7628
Epoch 174/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3602 - accuracy: 0.
8347 - val_loss: 0.4973 - val_accuracy: 0.7628
Epoch 175/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3603 - accuracy: 0.
8347 - val_loss: 0.4974 - val_accuracy: 0.7628
Epoch 176/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3602 - accuracy: 0.
8363 - val_loss: 0.4987 - val_accuracy: 0.7628
Epoch 177/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3595 - accuracy: 0.
8395 - val_loss: 0.4989 - val_accuracy: 0.7628
Epoch 178/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3596 - accuracy: 0.
8347 - val_loss: 0.4990 - val_accuracy: 0.7628
Epoch 179/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3594 - accuracy: 0.
8331 - val_loss: 0.5004 - val_accuracy: 0.7628
Epoch 180/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3596 - accuracy: 0.
8299 - val_loss: 0.5005 - val_accuracy: 0.7628
Epoch 181/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3591 - accuracy: 0.
8363 - val_loss: 0.5016 - val_accuracy: 0.7628
Epoch 182/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3588 - accuracy: 0.
8331 - val_loss: 0.5009 - val_accuracy: 0.7628
Epoch 183/200
```

```
20/20 [==============================] - 0s 2ms/step - loss: 0.3586 - accuracy: 0.
8331 - val_loss: 0.5014 - val_accuracy: 0.7628
Epoch 184/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3584 - accuracy: 0.
8363 - val_loss: 0.5016 - val_accuracy: 0.7756
Epoch 185/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3584 - accuracy: 0.
8363 - val_loss: 0.5025 - val_accuracy: 0.7692
Epoch 186/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3577 - accuracy: 0.
8379 - val_loss: 0.5025 - val_accuracy: 0.7628
Epoch 187/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3578 - accuracy: 0.
8363 - val_loss: 0.5026 - val_accuracy: 0.7692
Epoch 188/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3576 - accuracy: 0.
8363 - val_loss: 0.5034 - val_accuracy: 0.7628
Epoch 189/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3574 - accuracy: 0.
8331 - val_loss: 0.5041 - val_accuracy: 0.7628
Epoch 190/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3575 - accuracy: 0.
8299 - val_loss: 0.5039 - val_accuracy: 0.7756
Epoch 191/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3571 - accuracy: 0.
8331 - val_loss: 0.5044 - val_accuracy: 0.7692
Epoch 192/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3568 - accuracy: 0.
8379 - val_loss: 0.5051 - val_accuracy: 0.7692
Epoch 193/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3570 - accuracy: 0.
8347 - val_loss: 0.5049 - val_accuracy: 0.7692
Epoch 194/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3568 - accuracy: 0.
8379 - val_loss: 0.5048 - val_accuracy: 0.7756
Epoch 195/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3566 - accuracy: 0.
8331 - val_loss: 0.5050 - val_accuracy: 0.7692
Epoch 196/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3567 - accuracy: 0.
8315 - val_loss: 0.5058 - val_accuracy: 0.7756
Epoch 197/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3561 - accuracy: 0.
8347 - val_loss: 0.5058 - val_accuracy: 0.7756
Epoch 198/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3563 - accuracy: 0.
8363 - val_loss: 0.5055 - val_accuracy: 0.7692
Epoch 199/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3558 - accuracy: 0.
8379 - val_loss: 0.5064 - val_accuracy: 0.7692
Epoch 200/200
20/20 [==============================] - 0s 2ms/step - loss: 0.3557 - accuracy: 0.
8331 - val_loss: 0.5068 - val_accuracy: 0.7756
```

In [5]:
```
import matplotlib.pyplot as plt
plt.plot(history.history['accuracy'], label='Train Accuracy')
```

```
plt.plot(history.history['val_accuracy'], label='Validation Accuracy')
plt.title('Model Accuracy')
plt.ylabel('Accuracy')
plt.xlabel('Epoch')
plt.legend(loc='upper left')
plt.savefig('Graphs/NN1_accuracy.png')
plt.show()
plt.close()
```

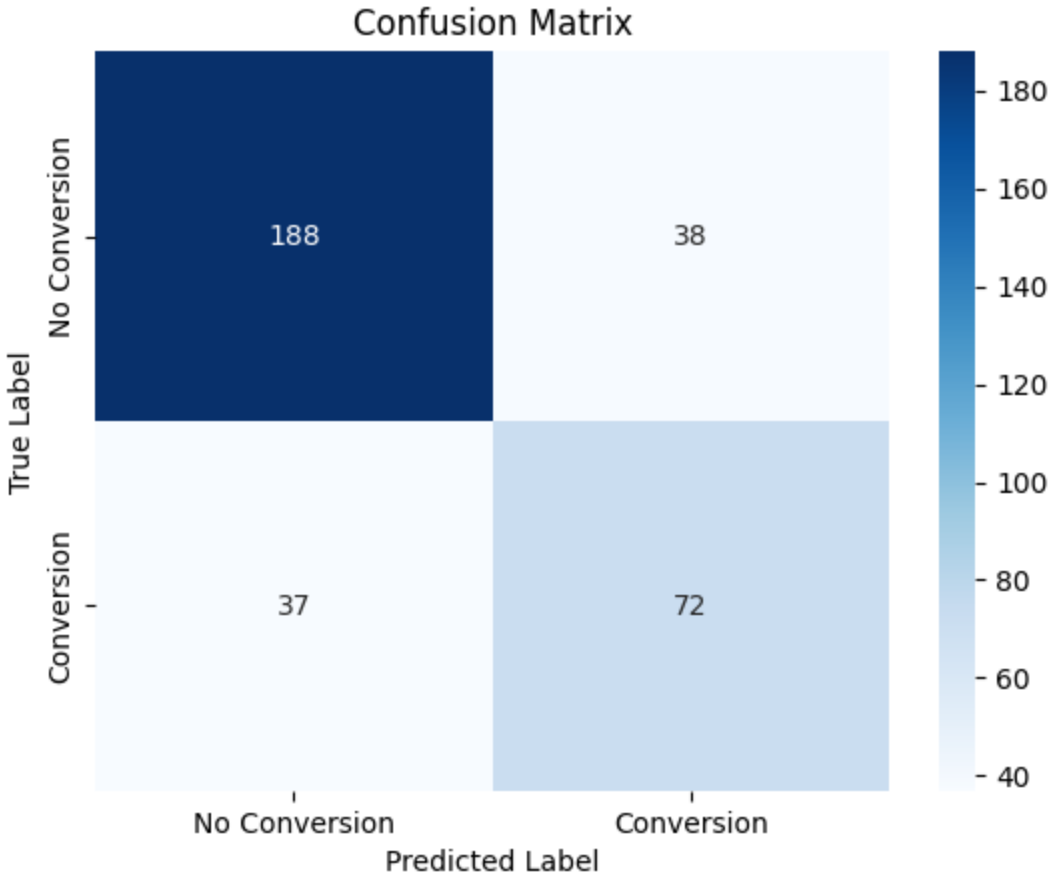


Test dataset

In [6]:
```
from sklearn.metrics import confusion_matrix
from sklearn.metrics import accuracy_score
import seaborn as sns

test_pred_prob = NNmodel.predict(X_test_preprocessed)
test_preds = (test_pred_prob > 0.5).astype(int)
accuracy = accuracy_score(Y_test, test_preds)
print(f'Test Accuracy: {accuracy * 100:.2f}%')
cm = confusion_matrix(Y_test, test_preds)
sns.heatmap(cm, annot=True, fmt='d', cmap='Blues', xticklabels=['No Conversion', 'C
plt.ylabel('True Label')
plt.xlabel('Predicted Label')
plt.title('Confusion Matrix')
plt.savefig('Graphs/NN1_cm1.png')
plt.show()
plt.close()
```

```
11/11 [==============================] - 0s 800us/step
Test Accuracy: 77.61%
```



Completer Dataset

Datasets

In [7]:
```
df_train = pd.read_csv("train_completer.csv")
df_test = pd.read_csv("test_completer.csv")
X_train = df_train.drop(columns = ["converter"])
Y_train = df_train.converter
X_test = df_test.drop(columns = ["converter"])
Y_test = df_test["converter"]
```

Normalization

In [8]:
```
numerical_cols = X_train.select_dtypes(include=['float64', 'int64']).columns.tolist
categorical_cols = X_train.select_dtypes(include=['object']).columns.tolist()

# Initialize the StandardScaler and OneHotEncoder
scaler = StandardScaler()
encoder = OneHotEncoder(sparse=False)

# scale
```

```
X_train_scaled = scaler.fit_transform(X_train[numerical_cols])
X_test_scaled = scaler.transform(X_test[numerical_cols])

# encode
X_train_encoded = encoder.fit_transform(X_train[categorical_cols])
X_test_encoded = encoder.transform(X_test[categorical_cols])

# concatenate
X_train_preprocessed = np.concatenate([X_train_scaled, X_train_encoded], axis=1)
X_test_preprocessed = np.concatenate([X_test_scaled, X_test_encoded], axis=1)
```

```
C:\Users\43115\anaconda3\envs\python_310\lib\site-packages\sklearn\preprocessing\_
encoders.py:868: FutureWarning: `sparse` was renamed to `sparse_output` in version
1.2 and will be removed in 1.4. `sparse_output` is ignored unless you leave `spars
e` to its default value.
  warnings.warn(
```

NN model

In [9]:
```
NNmodel = Sequential()
NNmodel.add(Dense(8, input_dim = len(X_train_preprocessed[0,:]), activation = "relu
NNmodel.add(Dense(1, activation = "sigmoid")) # binary
NNmodel.summary()
```

```
Model: "sequential_1"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 dense_2 (Dense)             (None, 8)                 184

 dense_3 (Dense)             (None, 1)                 9

=================================================================
Total params: 193 (772.00 Byte)
Trainable params: 193 (772.00 Byte)
Non-trainable params: 0 (0.00 Byte)
_________________________________________________________________
```

In [10]:
```
NNmodel.compile(loss = "binary_crossentropy", optimizer = "adam", metrics = ["accur
history = NNmodel.fit(x = X_train_preprocessed, y = Y_train, epochs = 200, validati
```

```
Epoch 1/200
5/5 [==============================] - 1s 31ms/step - loss: 0.6886 - accuracy: 0.5
232 - val_loss: 0.8398 - val_accuracy: 0.3684
Epoch 2/200
5/5 [==============================] - 0s 8ms/step - loss: 0.6725 - accuracy: 0.54
30 - val_loss: 0.8209 - val_accuracy: 0.3684
Epoch 3/200
5/5 [==============================] - 0s 8ms/step - loss: 0.6576 - accuracy: 0.56
95 - val_loss: 0.8035 - val_accuracy: 0.3684
Epoch 4/200
5/5 [==============================] - 0s 7ms/step - loss: 0.6453 - accuracy: 0.58
94 - val_loss: 0.7867 - val_accuracy: 0.4211
Epoch 5/200
5/5 [==============================] - 0s 7ms/step - loss: 0.6332 - accuracy: 0.60
93 - val_loss: 0.7714 - val_accuracy: 0.4211
Epoch 6/200
5/5 [==============================] - 0s 7ms/step - loss: 0.6223 - accuracy: 0.64
24 - val_loss: 0.7581 - val_accuracy: 0.4737
Epoch 7/200
5/5 [==============================] - 0s 7ms/step - loss: 0.6120 - accuracy: 0.66
89 - val_loss: 0.7458 - val_accuracy: 0.5263
Epoch 8/200
5/5 [==============================] - 0s 7ms/step - loss: 0.6032 - accuracy: 0.67
55 - val_loss: 0.7337 - val_accuracy: 0.5263
Epoch 9/200
5/5 [==============================] - 0s 7ms/step - loss: 0.5952 - accuracy: 0.68
21 - val_loss: 0.7221 - val_accuracy: 0.5263
Epoch 10/200
5/5 [==============================] - 0s 7ms/step - loss: 0.5874 - accuracy: 0.68
21 - val_loss: 0.7117 - val_accuracy: 0.5526
Epoch 11/200
5/5 [==============================] - 0s 7ms/step - loss: 0.5794 - accuracy: 0.68
87 - val_loss: 0.7024 - val_accuracy: 0.5789
Epoch 12/200
5/5 [==============================] - 0s 7ms/step - loss: 0.5721 - accuracy: 0.72
85 - val_loss: 0.6928 - val_accuracy: 0.6316
Epoch 13/200
5/5 [==============================] - 0s 7ms/step - loss: 0.5649 - accuracy: 0.74
17 - val_loss: 0.6841 - val_accuracy: 0.6316
Epoch 14/200
5/5 [==============================] - 0s 7ms/step - loss: 0.5581 - accuracy: 0.75
50 - val_loss: 0.6760 - val_accuracy: 0.6579
Epoch 15/200
5/5 [==============================] - 0s 7ms/step - loss: 0.5504 - accuracy: 0.76
16 - val_loss: 0.6680 - val_accuracy: 0.6842
Epoch 16/200
5/5 [==============================] - 0s 8ms/step - loss: 0.5434 - accuracy: 0.76
82 - val_loss: 0.6601 - val_accuracy: 0.7105
Epoch 17/200
5/5 [==============================] - 0s 7ms/step - loss: 0.5367 - accuracy: 0.78
15 - val_loss: 0.6520 - val_accuracy: 0.7105
Epoch 18/200
5/5 [==============================] - 0s 7ms/step - loss: 0.5299 - accuracy: 0.79
47 - val_loss: 0.6444 - val_accuracy: 0.7105
Epoch 19/200
5/5 [==============================] - 0s 7ms/step - loss: 0.5232 - accuracy: 0.80
```

```
79 - val_loss: 0.6362 - val_accuracy: 0.7105
Epoch 20/200
5/5 [==============================] - 0s 7ms/step - loss: 0.5166 - accuracy: 0.81
46 - val_loss: 0.6274 - val_accuracy: 0.7368
Epoch 21/200
5/5 [==============================] - 0s 7ms/step - loss: 0.5100 - accuracy: 0.80
79 - val_loss: 0.6189 - val_accuracy: 0.7368
Epoch 22/200
5/5 [==============================] - 0s 7ms/step - loss: 0.5033 - accuracy: 0.81
46 - val_loss: 0.6111 - val_accuracy: 0.7632
Epoch 23/200
5/5 [==============================] - 0s 7ms/step - loss: 0.4967 - accuracy: 0.80
79 - val_loss: 0.6030 - val_accuracy: 0.7632
Epoch 24/200
5/5 [==============================] - 0s 7ms/step - loss: 0.4902 - accuracy: 0.80
79 - val_loss: 0.5959 - val_accuracy: 0.7632
Epoch 25/200
5/5 [==============================] - 0s 7ms/step - loss: 0.4849 - accuracy: 0.82
12 - val_loss: 0.5886 - val_accuracy: 0.7895
Epoch 26/200
5/5 [==============================] - 0s 7ms/step - loss: 0.4777 - accuracy: 0.82
12 - val_loss: 0.5818 - val_accuracy: 0.7895
Epoch 27/200
5/5 [==============================] - 0s 7ms/step - loss: 0.4723 - accuracy: 0.82
12 - val_loss: 0.5741 - val_accuracy: 0.7895
Epoch 28/200
5/5 [==============================] - 0s 7ms/step - loss: 0.4659 - accuracy: 0.82
12 - val_loss: 0.5672 - val_accuracy: 0.7895
Epoch 29/200
5/5 [==============================] - 0s 8ms/step - loss: 0.4603 - accuracy: 0.82
78 - val_loss: 0.5606 - val_accuracy: 0.7895
Epoch 30/200
5/5 [==============================] - 0s 7ms/step - loss: 0.4550 - accuracy: 0.82
78 - val_loss: 0.5547 - val_accuracy: 0.7895
Epoch 31/200
5/5 [==============================] - 0s 7ms/step - loss: 0.4499 - accuracy: 0.82
78 - val_loss: 0.5493 - val_accuracy: 0.7895
Epoch 32/200
5/5 [==============================] - 0s 7ms/step - loss: 0.4449 - accuracy: 0.82
12 - val_loss: 0.5437 - val_accuracy: 0.7895
Epoch 33/200
5/5 [==============================] - 0s 7ms/step - loss: 0.4408 - accuracy: 0.82
12 - val_loss: 0.5382 - val_accuracy: 0.7895
Epoch 34/200
5/5 [==============================] - 0s 7ms/step - loss: 0.4365 - accuracy: 0.82
12 - val_loss: 0.5335 - val_accuracy: 0.7895
Epoch 35/200
5/5 [==============================] - 0s 7ms/step - loss: 0.4326 - accuracy: 0.82
12 - val_loss: 0.5292 - val_accuracy: 0.7895
Epoch 36/200
5/5 [==============================] - 0s 7ms/step - loss: 0.4289 - accuracy: 0.82
12 - val_loss: 0.5252 - val_accuracy: 0.7895
Epoch 37/200
5/5 [==============================] - 0s 7ms/step - loss: 0.4254 - accuracy: 0.82
78 - val_loss: 0.5219 - val_accuracy: 0.7895
Epoch 38/200
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5/5 [==============================] - 0s 8ms/step - loss: 0.4221 - accuracy: 0.82
12 - val_loss: 0.5183 - val_accuracy: 0.7895
Epoch 39/200
5/5 [==============================] - 0s 7ms/step - loss: 0.4191 - accuracy: 0.82
12 - val_loss: 0.5144 - val_accuracy: 0.7895
Epoch 40/200
5/5 [==============================] - 0s 7ms/step - loss: 0.4160 - accuracy: 0.82
78 - val_loss: 0.5109 - val_accuracy: 0.7895
Epoch 41/200
5/5 [==============================] - 0s 7ms/step - loss: 0.4132 - accuracy: 0.82
78 - val_loss: 0.5084 - val_accuracy: 0.8158
Epoch 42/200
5/5 [==============================] - 0s 7ms/step - loss: 0.4103 - accuracy: 0.82
78 - val_loss: 0.5054 - val_accuracy: 0.8158
Epoch 43/200
5/5 [==============================] - 0s 7ms/step - loss: 0.4077 - accuracy: 0.82
78 - val_loss: 0.5032 - val_accuracy: 0.8158
Epoch 44/200
5/5 [==============================] - 0s 7ms/step - loss: 0.4049 - accuracy: 0.82
78 - val_loss: 0.4999 - val_accuracy: 0.8158
Epoch 45/200
5/5 [==============================] - 0s 7ms/step - loss: 0.4027 - accuracy: 0.82
78 - val_loss: 0.4973 - val_accuracy: 0.8158
Epoch 46/200
5/5 [==============================] - 0s 7ms/step - loss: 0.4003 - accuracy: 0.82
12 - val_loss: 0.4947 - val_accuracy: 0.8158
Epoch 47/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3978 - accuracy: 0.82
12 - val_loss: 0.4921 - val_accuracy: 0.8158
Epoch 48/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3956 - accuracy: 0.82
78 - val_loss: 0.4901 - val_accuracy: 0.8158
Epoch 49/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3935 - accuracy: 0.84
11 - val_loss: 0.4884 - val_accuracy: 0.8158
Epoch 50/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3914 - accuracy: 0.84
11 - val_loss: 0.4871 - val_accuracy: 0.8158
Epoch 51/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3895 - accuracy: 0.84
11 - val_loss: 0.4857 - val_accuracy: 0.8158
Epoch 52/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3873 - accuracy: 0.84
11 - val_loss: 0.4840 - val_accuracy: 0.8158
Epoch 53/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3857 - accuracy: 0.84
11 - val_loss: 0.4828 - val_accuracy: 0.8158
Epoch 54/200
5/5 [==============================] - 0s 8ms/step - loss: 0.3835 - accuracy: 0.84
11 - val_loss: 0.4815 - val_accuracy: 0.8158
Epoch 55/200
5/5 [==============================] - 0s 8ms/step - loss: 0.3817 - accuracy: 0.84
11 - val_loss: 0.4807 - val_accuracy: 0.8158
Epoch 56/200
5/5 [==============================] - 0s 8ms/step - loss: 0.3799 - accuracy: 0.84
11 - val_loss: 0.4789 - val_accuracy: 0.8158
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Epoch 57/200
5/5 [==============================] - 0s 8ms/step - loss: 0.3781 - accuracy: 0.84
11 - val_loss: 0.4778 - val_accuracy: 0.8158
Epoch 58/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3762 - accuracy: 0.84
11 - val_loss: 0.4771 - val_accuracy: 0.8158
Epoch 59/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3744 - accuracy: 0.84
11 - val_loss: 0.4764 - val_accuracy: 0.8158
Epoch 60/200
5/5 [==============================] - 0s 8ms/step - loss: 0.3728 - accuracy: 0.84
11 - val_loss: 0.4765 - val_accuracy: 0.8158
Epoch 61/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3709 - accuracy: 0.84
11 - val_loss: 0.4753 - val_accuracy: 0.8158
Epoch 62/200
5/5 [==============================] - 0s 8ms/step - loss: 0.3692 - accuracy: 0.84
77 - val_loss: 0.4743 - val_accuracy: 0.8158
Epoch 63/200
5/5 [==============================] - 0s 8ms/step - loss: 0.3676 - accuracy: 0.84
77 - val_loss: 0.4737 - val_accuracy: 0.8158
Epoch 64/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3660 - accuracy: 0.84
77 - val_loss: 0.4727 - val_accuracy: 0.8158
Epoch 65/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3642 - accuracy: 0.84
77 - val_loss: 0.4728 - val_accuracy: 0.8158
Epoch 66/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3625 - accuracy: 0.85
43 - val_loss: 0.4721 - val_accuracy: 0.8158
Epoch 67/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3609 - accuracy: 0.85
43 - val_loss: 0.4718 - val_accuracy: 0.8158
Epoch 68/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3592 - accuracy: 0.85
43 - val_loss: 0.4706 - val_accuracy: 0.8158
Epoch 69/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3576 - accuracy: 0.85
43 - val_loss: 0.4703 - val_accuracy: 0.8158
Epoch 70/200
5/5 [==============================] - 0s 9ms/step - loss: 0.3562 - accuracy: 0.85
43 - val_loss: 0.4690 - val_accuracy: 0.8158
Epoch 71/200
5/5 [==============================] - 0s 8ms/step - loss: 0.3544 - accuracy: 0.85
43 - val_loss: 0.4691 - val_accuracy: 0.8158
Epoch 72/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3530 - accuracy: 0.86
09 - val_loss: 0.4699 - val_accuracy: 0.8158
Epoch 73/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3514 - accuracy: 0.86
09 - val_loss: 0.4696 - val_accuracy: 0.8158
Epoch 74/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3501 - accuracy: 0.86
09 - val_loss: 0.4680 - val_accuracy: 0.8158
Epoch 75/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3484 - accuracy: 0.86
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09 - val_loss: 0.4679 - val_accuracy: 0.8158
Epoch 76/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3469 - accuracy: 0.86
09 - val_loss: 0.4681 - val_accuracy: 0.8158
Epoch 77/200
5/5 [==============================] - 0s 8ms/step - loss: 0.3455 - accuracy: 0.86
09 - val_loss: 0.4678 - val_accuracy: 0.8158
Epoch 78/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3440 - accuracy: 0.86
09 - val_loss: 0.4680 - val_accuracy: 0.8158
Epoch 79/200
5/5 [==============================] - 0s 8ms/step - loss: 0.3427 - accuracy: 0.86
09 - val_loss: 0.4679 - val_accuracy: 0.8158
Epoch 80/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3413 - accuracy: 0.86
09 - val_loss: 0.4676 - val_accuracy: 0.8158
Epoch 81/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3401 - accuracy: 0.86
09 - val_loss: 0.4667 - val_accuracy: 0.8158
Epoch 82/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3386 - accuracy: 0.86
09 - val_loss: 0.4654 - val_accuracy: 0.8158
Epoch 83/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3372 - accuracy: 0.86
09 - val_loss: 0.4644 - val_accuracy: 0.8158
Epoch 84/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3361 - accuracy: 0.86
09 - val_loss: 0.4636 - val_accuracy: 0.8158
Epoch 85/200
5/5 [==============================] - 0s 8ms/step - loss: 0.3349 - accuracy: 0.86
09 - val_loss: 0.4627 - val_accuracy: 0.8158
Epoch 86/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3336 - accuracy: 0.86
09 - val_loss: 0.4624 - val_accuracy: 0.8158
Epoch 87/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3324 - accuracy: 0.86
09 - val_loss: 0.4620 - val_accuracy: 0.8158
Epoch 88/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3313 - accuracy: 0.86
09 - val_loss: 0.4621 - val_accuracy: 0.8158
Epoch 89/200
5/5 [==============================] - 0s 8ms/step - loss: 0.3301 - accuracy: 0.86
09 - val_loss: 0.4610 - val_accuracy: 0.8158
Epoch 90/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3290 - accuracy: 0.86
09 - val_loss: 0.4603 - val_accuracy: 0.8158
Epoch 91/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3279 - accuracy: 0.86
75 - val_loss: 0.4604 - val_accuracy: 0.8158
Epoch 92/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3266 - accuracy: 0.86
75 - val_loss: 0.4599 - val_accuracy: 0.8158
Epoch 93/200
5/5 [==============================] - 0s 8ms/step - loss: 0.3254 - accuracy: 0.87
42 - val_loss: 0.4593 - val_accuracy: 0.8158
Epoch 94/200
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5/5 [==============================] - 0s 7ms/step - loss: 0.3245 - accuracy: 0.87
42 - val_loss: 0.4592 - val_accuracy: 0.8158
Epoch 95/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3234 - accuracy: 0.88
08 - val_loss: 0.4587 - val_accuracy: 0.8158
Epoch 96/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3223 - accuracy: 0.88
08 - val_loss: 0.4575 - val_accuracy: 0.8158
Epoch 97/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3212 - accuracy: 0.88
08 - val_loss: 0.4571 - val_accuracy: 0.8158
Epoch 98/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3201 - accuracy: 0.88
74 - val_loss: 0.4560 - val_accuracy: 0.8158
Epoch 99/200
5/5 [==============================] - 0s 8ms/step - loss: 0.3193 - accuracy: 0.88
08 - val_loss: 0.4547 - val_accuracy: 0.8158
Epoch 100/200
5/5 [==============================] - 0s 8ms/step - loss: 0.3179 - accuracy: 0.88
08 - val_loss: 0.4544 - val_accuracy: 0.8158
Epoch 101/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3170 - accuracy: 0.88
08 - val_loss: 0.4539 - val_accuracy: 0.8158
Epoch 102/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3160 - accuracy: 0.88
08 - val_loss: 0.4531 - val_accuracy: 0.8158
Epoch 103/200
5/5 [==============================] - 0s 8ms/step - loss: 0.3148 - accuracy: 0.88
74 - val_loss: 0.4526 - val_accuracy: 0.8158
Epoch 104/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3137 - accuracy: 0.88
74 - val_loss: 0.4530 - val_accuracy: 0.8158
Epoch 105/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3128 - accuracy: 0.89
40 - val_loss: 0.4523 - val_accuracy: 0.8158
Epoch 106/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3118 - accuracy: 0.89
40 - val_loss: 0.4517 - val_accuracy: 0.8158
Epoch 107/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3107 - accuracy: 0.89
40 - val_loss: 0.4511 - val_accuracy: 0.8158
Epoch 108/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3098 - accuracy: 0.89
40 - val_loss: 0.4509 - val_accuracy: 0.8158
Epoch 109/200
5/5 [==============================] - 0s 8ms/step - loss: 0.3090 - accuracy: 0.89
40 - val_loss: 0.4492 - val_accuracy: 0.8158
Epoch 110/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3079 - accuracy: 0.89
40 - val_loss: 0.4486 - val_accuracy: 0.8158
Epoch 111/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3070 - accuracy: 0.89
40 - val_loss: 0.4472 - val_accuracy: 0.8158
Epoch 112/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3061 - accuracy: 0.89
40 - val_loss: 0.4462 - val_accuracy: 0.8158
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Epoch 113/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3050 - accuracy: 0.89
40 - val_loss: 0.4462 - val_accuracy: 0.8158
Epoch 114/200
5/5 [==============================] - 0s 8ms/step - loss: 0.3042 - accuracy: 0.89
40 - val_loss: 0.4463 - val_accuracy: 0.8158
Epoch 115/200
5/5 [==============================] - 0s 8ms/step - loss: 0.3033 - accuracy: 0.90
07 - val_loss: 0.4457 - val_accuracy: 0.8158
Epoch 116/200
5/5 [==============================] - 0s 8ms/step - loss: 0.3023 - accuracy: 0.90
73 - val_loss: 0.4454 - val_accuracy: 0.8158
Epoch 117/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3014 - accuracy: 0.90
73 - val_loss: 0.4447 - val_accuracy: 0.8158
Epoch 118/200
5/5 [==============================] - 0s 7ms/step - loss: 0.3005 - accuracy: 0.90
73 - val_loss: 0.4440 - val_accuracy: 0.8158
Epoch 119/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2997 - accuracy: 0.90
73 - val_loss: 0.4440 - val_accuracy: 0.8158
Epoch 120/200
5/5 [==============================] - 0s 8ms/step - loss: 0.2989 - accuracy: 0.90
73 - val_loss: 0.4428 - val_accuracy: 0.8158
Epoch 121/200
5/5 [==============================] - 0s 8ms/step - loss: 0.2979 - accuracy: 0.90
73 - val_loss: 0.4422 - val_accuracy: 0.8158
Epoch 122/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2970 - accuracy: 0.90
73 - val_loss: 0.4418 - val_accuracy: 0.8158
Epoch 123/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2963 - accuracy: 0.90
73 - val_loss: 0.4420 - val_accuracy: 0.8158
Epoch 124/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2954 - accuracy: 0.90
73 - val_loss: 0.4420 - val_accuracy: 0.8158
Epoch 125/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2946 - accuracy: 0.90
73 - val_loss: 0.4412 - val_accuracy: 0.8158
Epoch 126/200
5/5 [==============================] - 0s 8ms/step - loss: 0.2938 - accuracy: 0.90
73 - val_loss: 0.4406 - val_accuracy: 0.8158
Epoch 127/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2928 - accuracy: 0.90
73 - val_loss: 0.4399 - val_accuracy: 0.8158
Epoch 128/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2920 - accuracy: 0.90
73 - val_loss: 0.4391 - val_accuracy: 0.8158
Epoch 129/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2912 - accuracy: 0.90
73 - val_loss: 0.4383 - val_accuracy: 0.8158
Epoch 130/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2904 - accuracy: 0.90
73 - val_loss: 0.4383 - val_accuracy: 0.8158
Epoch 131/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2896 - accuracy: 0.90
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73 - val_loss: 0.4372 - val_accuracy: 0.8158
Epoch 132/200
5/5 [==============================] - 0s 9ms/step - loss: 0.2889 - accuracy: 0.90
73 - val_loss: 0.4375 - val_accuracy: 0.8158
Epoch 133/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2879 - accuracy: 0.90
73 - val_loss: 0.4365 - val_accuracy: 0.8158
Epoch 134/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2873 - accuracy: 0.90
73 - val_loss: 0.4358 - val_accuracy: 0.8158
Epoch 135/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2865 - accuracy: 0.90
73 - val_loss: 0.4360 - val_accuracy: 0.8158
Epoch 136/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2857 - accuracy: 0.90
73 - val_loss: 0.4355 - val_accuracy: 0.8158
Epoch 137/200
5/5 [==============================] - 0s 8ms/step - loss: 0.2850 - accuracy: 0.90
73 - val_loss: 0.4351 - val_accuracy: 0.8158
Epoch 138/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2844 - accuracy: 0.90
73 - val_loss: 0.4333 - val_accuracy: 0.8158
Epoch 139/200
5/5 [==============================] - 0s 8ms/step - loss: 0.2834 - accuracy: 0.90
73 - val_loss: 0.4328 - val_accuracy: 0.8158
Epoch 140/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2828 - accuracy: 0.90
73 - val_loss: 0.4317 - val_accuracy: 0.8158
Epoch 141/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2819 - accuracy: 0.90
73 - val_loss: 0.4314 - val_accuracy: 0.8158
Epoch 142/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2813 - accuracy: 0.90
73 - val_loss: 0.4317 - val_accuracy: 0.8158
Epoch 143/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2806 - accuracy: 0.90
73 - val_loss: 0.4316 - val_accuracy: 0.8158
Epoch 144/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2799 - accuracy: 0.90
73 - val_loss: 0.4311 - val_accuracy: 0.8158
Epoch 145/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2791 - accuracy: 0.90
73 - val_loss: 0.4304 - val_accuracy: 0.8158
Epoch 146/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2783 - accuracy: 0.90
73 - val_loss: 0.4300 - val_accuracy: 0.8158
Epoch 147/200
5/5 [==============================] - 0s 8ms/step - loss: 0.2777 - accuracy: 0.90
73 - val_loss: 0.4302 - val_accuracy: 0.8158
Epoch 148/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2770 - accuracy: 0.90
73 - val_loss: 0.4300 - val_accuracy: 0.8158
Epoch 149/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2762 - accuracy: 0.90
73 - val_loss: 0.4294 - val_accuracy: 0.8158
Epoch 150/200
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5/5 [==============================] - 0s 7ms/step - loss: 0.2756 - accuracy: 0.90
73 - val_loss: 0.4286 - val_accuracy: 0.8158
Epoch 151/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2750 - accuracy: 0.90
73 - val_loss: 0.4279 - val_accuracy: 0.8158
Epoch 152/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2743 - accuracy: 0.90
73 - val_loss: 0.4274 - val_accuracy: 0.8158
Epoch 153/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2736 - accuracy: 0.90
73 - val_loss: 0.4274 - val_accuracy: 0.8158
Epoch 154/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2730 - accuracy: 0.90
73 - val_loss: 0.4270 - val_accuracy: 0.8158
Epoch 155/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2724 - accuracy: 0.90
73 - val_loss: 0.4278 - val_accuracy: 0.8158
Epoch 156/200
5/5 [==============================] - 0s 8ms/step - loss: 0.2715 - accuracy: 0.90
73 - val_loss: 0.4278 - val_accuracy: 0.8158
Epoch 157/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2710 - accuracy: 0.90
73 - val_loss: 0.4274 - val_accuracy: 0.8158
Epoch 158/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2704 - accuracy: 0.90
73 - val_loss: 0.4273 - val_accuracy: 0.8158
Epoch 159/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2696 - accuracy: 0.90
73 - val_loss: 0.4271 - val_accuracy: 0.8158
Epoch 160/200
5/5 [==============================] - 0s 8ms/step - loss: 0.2691 - accuracy: 0.90
73 - val_loss: 0.4263 - val_accuracy: 0.8158
Epoch 161/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2683 - accuracy: 0.90
73 - val_loss: 0.4265 - val_accuracy: 0.8158
Epoch 162/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2677 - accuracy: 0.90
73 - val_loss: 0.4266 - val_accuracy: 0.8158
Epoch 163/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2671 - accuracy: 0.90
73 - val_loss: 0.4271 - val_accuracy: 0.8158
Epoch 164/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2665 - accuracy: 0.90
73 - val_loss: 0.4266 - val_accuracy: 0.8158
Epoch 165/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2658 - accuracy: 0.90
73 - val_loss: 0.4262 - val_accuracy: 0.8158
Epoch 166/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2653 - accuracy: 0.90
73 - val_loss: 0.4266 - val_accuracy: 0.8158
Epoch 167/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2647 - accuracy: 0.90
73 - val_loss: 0.4266 - val_accuracy: 0.8158
Epoch 168/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2639 - accuracy: 0.90
73 - val_loss: 0.4267 - val_accuracy: 0.8158
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Epoch 169/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2634 - accuracy: 0.90
73 - val_loss: 0.4259 - val_accuracy: 0.8158
Epoch 170/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2627 - accuracy: 0.90
73 - val_loss: 0.4259 - val_accuracy: 0.8158
Epoch 171/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2621 - accuracy: 0.90
73 - val_loss: 0.4261 - val_accuracy: 0.8158
Epoch 172/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2615 - accuracy: 0.90
73 - val_loss: 0.4258 - val_accuracy: 0.8158
Epoch 173/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2609 - accuracy: 0.90
73 - val_loss: 0.4255 - val_accuracy: 0.8158
Epoch 174/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2603 - accuracy: 0.90
73 - val_loss: 0.4251 - val_accuracy: 0.8158
Epoch 175/200
5/5 [==============================] - 0s 8ms/step - loss: 0.2597 - accuracy: 0.90
73 - val_loss: 0.4247 - val_accuracy: 0.8158
Epoch 176/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2592 - accuracy: 0.90
73 - val_loss: 0.4251 - val_accuracy: 0.8158
Epoch 177/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2585 - accuracy: 0.90
73 - val_loss: 0.4253 - val_accuracy: 0.8158
Epoch 178/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2580 - accuracy: 0.90
73 - val_loss: 0.4249 - val_accuracy: 0.8158
Epoch 179/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2573 - accuracy: 0.90
73 - val_loss: 0.4253 - val_accuracy: 0.8158
Epoch 180/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2569 - accuracy: 0.90
73 - val_loss: 0.4249 - val_accuracy: 0.8158
Epoch 181/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2562 - accuracy: 0.90
73 - val_loss: 0.4254 - val_accuracy: 0.8158
Epoch 182/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2557 - accuracy: 0.90
73 - val_loss: 0.4249 - val_accuracy: 0.8158
Epoch 183/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2551 - accuracy: 0.90
73 - val_loss: 0.4248 - val_accuracy: 0.8158
Epoch 184/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2545 - accuracy: 0.90
73 - val_loss: 0.4238 - val_accuracy: 0.8158
Epoch 185/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2540 - accuracy: 0.90
73 - val_loss: 0.4230 - val_accuracy: 0.8158
Epoch 186/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2533 - accuracy: 0.90
73 - val_loss: 0.4228 - val_accuracy: 0.8158
Epoch 187/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2529 - accuracy: 0.90
```
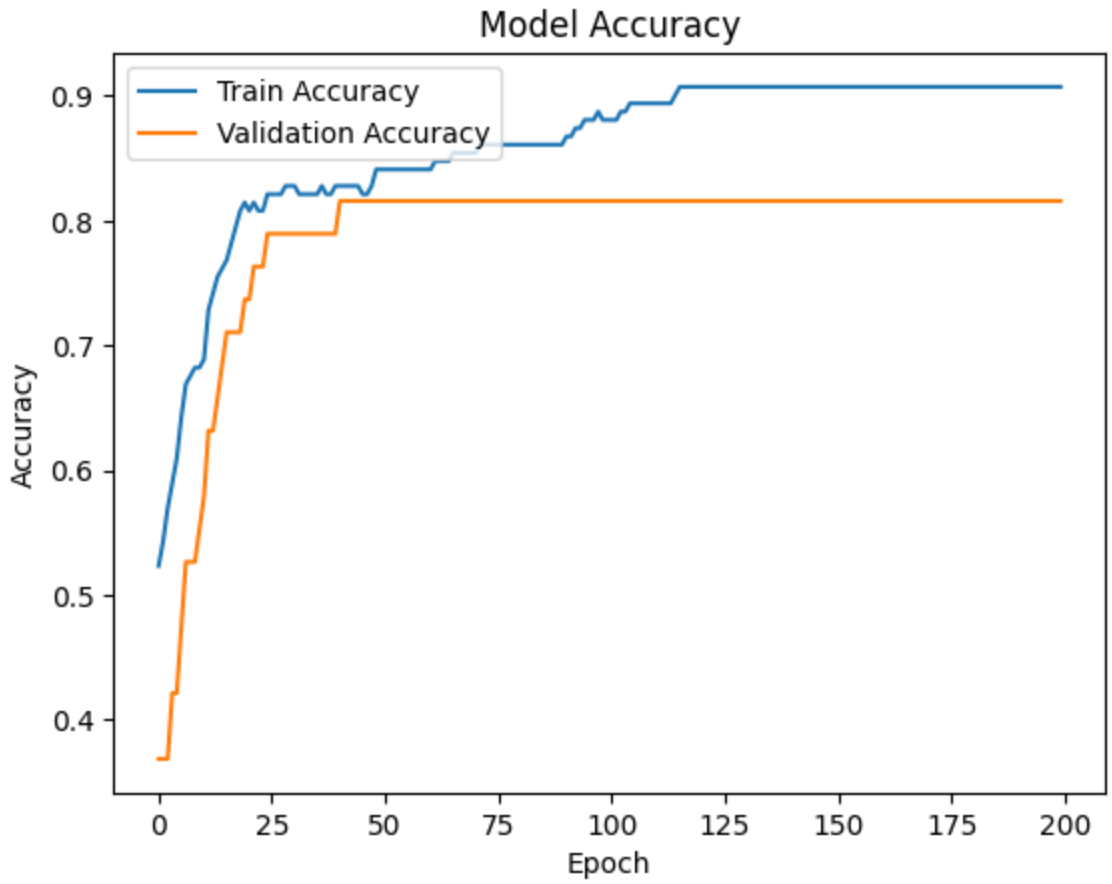

```
73 - val_loss: 0.4235 - val_accuracy: 0.8158
Epoch 188/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2522 - accuracy: 0.90
73 - val_loss: 0.4231 - val_accuracy: 0.8158
Epoch 189/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2516 - accuracy: 0.90
73 - val_loss: 0.4239 - val_accuracy: 0.8158
Epoch 190/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2513 - accuracy: 0.90
73 - val_loss: 0.4252 - val_accuracy: 0.8158
Epoch 191/200
5/5 [==============================] - 0s 9ms/step - loss: 0.2505 - accuracy: 0.90
73 - val_loss: 0.4247 - val_accuracy: 0.8158
Epoch 192/200
5/5 [==============================] - 0s 8ms/step - loss: 0.2501 - accuracy: 0.90
73 - val_loss: 0.4247 - val_accuracy: 0.8158
Epoch 193/200
5/5 [==============================] - 0s 8ms/step - loss: 0.2496 - accuracy: 0.90
73 - val_loss: 0.4256 - val_accuracy: 0.8158
Epoch 194/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2490 - accuracy: 0.90
73 - val_loss: 0.4256 - val_accuracy: 0.8158
Epoch 195/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2484 - accuracy: 0.90
73 - val_loss: 0.4258 - val_accuracy: 0.8158
Epoch 196/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2481 - accuracy: 0.90
73 - val_loss: 0.4249 - val_accuracy: 0.8158
Epoch 197/200
5/5 [==============================] - 0s 8ms/step - loss: 0.2475 - accuracy: 0.90
73 - val_loss: 0.4255 - val_accuracy: 0.8158
Epoch 198/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2468 - accuracy: 0.90
73 - val_loss: 0.4258 - val_accuracy: 0.8158
Epoch 199/200
5/5 [==============================] - 0s 8ms/step - loss: 0.2464 - accuracy: 0.90
73 - val_loss: 0.4257 - val_accuracy: 0.8158
Epoch 200/200
5/5 [==============================] - 0s 7ms/step - loss: 0.2458 - accuracy: 0.90
73 - val_loss: 0.4259 - val_accuracy: 0.8158
```

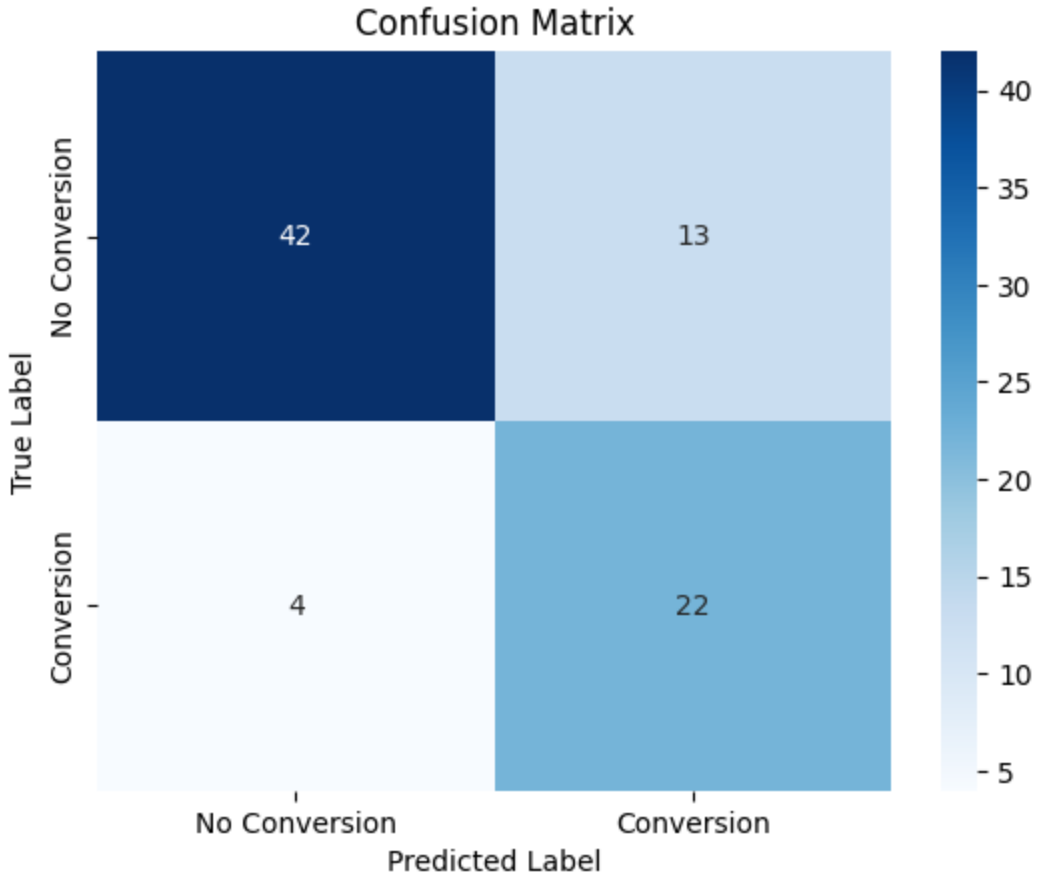
In [11]:

```
plt.plot(history.history['accuracy'], label='Train Accuracy')
plt.plot(history.history['val_accuracy'], label='Validation Accuracy')
plt.title('Model Accuracy')
plt.ylabel('Accuracy')
plt.xlabel('Epoch')
plt.legend(loc='upper left')
plt.savefig('Graphs/NN2_accuracy.png')
plt.show()
plt.close()
```



In [12]:
```
test_pred_prob = NNmodel.predict(X_test_preprocessed)
test_preds = (test_pred_prob > 0.5).astype(int)
accuracy = accuracy_score(Y_test, test_preds)
print(f'Test Accuracy: {accuracy * 100:.2f}%')
cm = confusion_matrix(Y_test, test_preds)
sns.heatmap(cm, annot=True, fmt='d', cmap='Blues', xticklabels=['No Conversion', 'C
plt.ylabel('True Label')
plt.xlabel('Predicted Label')
plt.title('Confusion Matrix')
plt.savefig('Graphs/NN2_cm2.png')
plt.show()
plt.close()
```

```
3/3 [==============================] - 0s 1ms/step
Test Accuracy: 79.01%
```


Confusion Matrix
No Conversion
Conversion
True Label
42
13
4
22
No Conversion
Conversion
Predicted Label
40
35
30
25
20
15
10
5

In [ ]: