In [ ]:

In [1]:
```
!pip install numpy
```

```
Requirement already satisfied: numpy in c:\users\pavan\appdata\roaming\pytho
n\python311\site-packages (1.25.1)
[notice] A new release of pip is available: 23.2 -> 24.3.1
[notice] To update, run: python.exe -m pip install --upgrade pip
```

In [2]:
```
!pip install pandas
```

```
Requirement already satisfied: pandas in c:\users\pavan\appdata\roaming\pyth
on\python311\site-packages (2.0.3)
Requirement already satisfied: python-dateutil>=2.8.2 in c:\users\pavan\anac
onda3\lib\site-packages (from pandas) (2.8.2)
Requirement already satisfied: pytz>=2020.1 in c:\users\pavan\anaconda3\lib
\site-packages (from pandas) (2023.3.post1)
Requirement already satisfied: tzdata>=2022.1 in c:\users\pavan\anaconda3\li
b\site-packages (from pandas) (2023.3)
Requirement already satisfied: numpy>=1.21.0 in c:\users\pavan\appdata\roami
ng\python\python311\site-packages (from pandas) (1.25.1)
Requirement already satisfied: six>=1.5 in c:\users\pavan\anaconda3\lib\site
-packages (from python-dateutil>=2.8.2->pandas) (1.16.0)
[notice] A new release of pip is available: 23.2 -> 24.3.1
[notice] To update, run: python.exe -m pip install --upgrade pip
```

In [3]:
```
!pip install matplotlib
```

```
Requirement already satisfied: matplotlib in c:\users\pavan\anaconda3\lib\si
te-packages (3.8.0)
Requirement already satisfied: contourpy>=1.0.1 in c:\users\pavan\anaconda3
\lib\site-packages (from matplotlib) (1.2.0)
Requirement already satisfied: cycler>=0.10 in c:\users\pavan\anaconda3\lib
\site-packages (from matplotlib) (0.11.0)
Requirement already satisfied: fonttools>=4.22.0 in c:\users\pavan\anaconda3
\lib\site-packages (from matplotlib) (4.25.0)
Requirement already satisfied: kiwisolver>=1.0.1 in c:\users\pavan\anaconda3
\lib\site-packages (from matplotlib) (1.4.4)
Requirement already satisfied: numpy<2,>=1.21 in c:\users\pavan\appdata\roam
ing\python\python311\site-packages (from matplotlib) (1.25.1)
Requirement already satisfied: packaging>=20.0 in c:\users\pavan\anaconda3\l
ib\site-packages (from matplotlib) (23.1)
Requirement already satisfied: pillow>=6.2.0 in c:\users\pavan\anaconda3\lib
\site-packages (from matplotlib) (10.2.0)
Requirement already satisfied: pyparsing>=2.3.1 in c:\users\pavan\anaconda3
\lib\site-packages (from matplotlib) (3.0.9)
Requirement already satisfied: python-dateutil>=2.7 in c:\users\pavan\anacon
da3\lib\site-packages (from matplotlib) (2.8.2)
Requirement already satisfied: six>=1.5 in c:\users\pavan\anaconda3\lib\site
-packages (from python-dateutil>=2.7->matplotlib) (1.16.0)
[notice] A new release of pip is available: 23.2 -> 24.3.1
[notice] To update, run: python.exe -m pip install --upgrade pip
```

In [4]:
```
!pip install scikit-learn
```

```
Requirement already satisfied: scikit-learn in c:\users\pavan\anaconda3\lib
\site-packages (1.2.2)
Requirement already satisfied: numpy>=1.17.3 in c:\users\pavan\appdata\roami
ng\python\python311\site-packages (from scikit-learn) (1.25.1)
Requirement already satisfied: scipy>=1.3.2 in c:\users\pavan\anaconda3\lib
\site-packages (from scikit-learn) (1.11.4)
Requirement already satisfied: joblib>=1.1.1 in c:\users\pavan\anaconda3\lib
\site-packages (from scikit-learn) (1.2.0)
Requirement already satisfied: threadpoolctl>=2.0.0 in c:\users\pavan\anacon
da3\lib\site-packages (from scikit-learn) (2.2.0)
[notice] A new release of pip is available: 23.2 -> 24.3.1
[notice] To update, run: python.exe -m pip install --upgrade pip
```

In [5]:
```
!pip install seaborn
```

```
Requirement already satisfied: seaborn in c:\users\pavan\anaconda3\lib\site-
packages (0.12.2)
Requirement already satisfied: numpy!=1.24.0,>=1.17 in c:\users\pavan\appdat
a\roaming\python\python311\site-packages (from seaborn) (1.25.1)
Requirement already satisfied: pandas>=0.25 in c:\users\pavan\appdata\roamin
g\python\python311\site-packages (from seaborn) (2.0.3)
Requirement already satisfied: matplotlib!=3.6.1,>=3.1 in c:\users\pavan\ana
conda3\lib\site-packages (from seaborn) (3.8.0)
Requirement already satisfied: contourpy>=1.0.1 in c:\users\pavan\anaconda3
\lib\site-packages (from matplotlib!=3.6.1,>=3.1->seaborn) (1.2.0)
Requirement already satisfied: cycler>=0.10 in c:\users\pavan\anaconda3\lib
\site-packages (from matplotlib!=3.6.1,>=3.1->seaborn) (0.11.0)
Requirement already satisfied: fonttools>=4.22.0 in c:\users\pavan\anaconda3
\lib\site-packages (from matplotlib!=3.6.1,>=3.1->seaborn) (4.25.0)
Requirement already satisfied: kiwisolver>=1.0.1 in c:\users\pavan\anaconda3
\lib\site-packages (from matplotlib!=3.6.1,>=3.1->seaborn) (1.4.4)
Requirement already satisfied: packaging>=20.0 in c:\users\pavan\anaconda3\l
ib\site-packages (from matplotlib!=3.6.1,>=3.1->seaborn) (23.1)
Requirement already satisfied: pillow>=6.2.0 in c:\users\pavan\anaconda3\lib
\site-packages (from matplotlib!=3.6.1,>=3.1->seaborn) (10.2.0)
Requirement already satisfied: pyparsing>=2.3.1 in c:\users\pavan\anaconda3
\lib\site-packages (from matplotlib!=3.6.1,>=3.1->seaborn) (3.0.9)
Requirement already satisfied: python-dateutil>=2.7 in c:\users\pavan\anacon
da3\lib\site-packages (from matplotlib!=3.6.1,>=3.1->seaborn) (2.8.2)
Requirement already satisfied: pytz>=2020.1 in c:\users\pavan\anaconda3\lib
\site-packages (from pandas>=0.25->seaborn) (2023.3.post1)
Requirement already satisfied: tzdata>=2022.1 in c:\users\pavan\anaconda3\li
b\site-packages (from pandas>=0.25->seaborn) (2023.3)
Requirement already satisfied: six>=1.5 in c:\users\pavan\anaconda3\lib\site
-packages (from python-dateutil>=2.7->matplotlib!=3.6.1,>=3.1->seaborn) (1.1
6.0)
[notice] A new release of pip is available: 23.2 -> 24.3.1
[notice] To update, run: python.exe -m pip install --upgrade pip
```

In [6]:
```
!pip install tensorflow
```

```
Requirement already satisfied: tensorflow in c:\users\pavan\anaconda3\lib\si
te-packages (2.17.0)
Requirement already satisfied: tensorflow-intel==2.17.0 in c:\users\pavan\an
aconda3\lib\site-packages (from tensorflow) (2.17.0)
Requirement already satisfied: absl-py>=1.0.0 in c:\users\pavan\anaconda3\li
b\site-packages (from tensorflow-intel==2.17.0->tensorflow) (2.1.0)
Requirement already satisfied: astunparse>=1.6.0 in c:\users\pavan\anaconda3
\lib\site-packages (from tensorflow-intel==2.17.0->tensorflow) (1.6.3)
Requirement already satisfied: flatbuffers>=24.3.25 in c:\users\pavan\anacon
da3\lib\site-packages (from tensorflow-intel==2.17.0->tensorflow) (24.3.25)
Requirement already satisfied: gast!=0.5.0,!=0.5.1,!=0.5.2,>=0.2.1 in c:\use
rs\pavan\anaconda3\lib\site-packages (from tensorflow-intel==2.17.0->tensorf
low) (0.6.0)
Requirement already satisfied: google-pasta>=0.1.1 in c:\users\pavan\anacond
a3\lib\site-packages (from tensorflow-intel==2.17.0->tensorflow) (0.2.0)
Requirement already satisfied: h5py>=3.10.0 in c:\users\pavan\anaconda3\lib
\site-packages (from tensorflow-intel==2.17.0->tensorflow) (3.12.1)
Requirement already satisfied: libclang>=13.0.0 in c:\users\pavan\anaconda3
\lib\site-packages (from tensorflow-intel==2.17.0->tensorflow) (18.1.1)
Requirement already satisfied: ml-dtypes<0.5.0,>=0.3.1 in c:\users\pavan\ana
conda3\lib\site-packages (from tensorflow-intel==2.17.0->tensorflow) (0.4.1)
Requirement already satisfied: opt-einsum>=2.3.2 in c:\users\pavan\anaconda3
\lib\site-packages (from tensorflow-intel==2.17.0->tensorflow) (3.4.0)
Requirement already satisfied: packaging in c:\users\pavan\anaconda3\lib\sit
e-packages (from tensorflow-intel==2.17.0->tensorflow) (23.1)
Requirement already satisfied: protobuf!=4.21.0,!=4.21.1,!=4.21.2,!=4.21.3,!
=4.21.4,!=4.21.5,<5.0.0dev,>=3.20.3 in c:\users\pavan\anaconda3\lib\site-pac
kages (from tensorflow-intel==2.17.0->tensorflow) (3.20.3)
Requirement already satisfied: requests<3,>=2.21.0 in c:\users\pavan\anacond
a3\lib\site-packages (from tensorflow-intel==2.17.0->tensorflow) (2.31.0)
Requirement already satisfied: setuptools in c:\users\pavan\anaconda3\lib\si
te-packages (from tensorflow-intel==2.17.0->tensorflow) (68.2.2)
Requirement already satisfied: six>=1.12.0 in c:\users\pavan\anaconda3\lib\s
ite-packages (from tensorflow-intel==2.17.0->tensorflow) (1.16.0)
Requirement already satisfied: termcolor>=1.1.0 in c:\users\pavan\anaconda3
\lib\site-packages (from tensorflow-intel==2.17.0->tensorflow) (2.4.0)
Requirement already satisfied: typing-extensions>=3.6.6 in c:\users\pavan\an
aconda3\lib\site-packages (from tensorflow-intel==2.17.0->tensorflow) (4.9.
0)
Requirement already satisfied: wrapt>=1.11.0 in c:\users\pavan\anaconda3\lib
\site-packages (from tensorflow-intel==2.17.0->tensorflow) (1.14.1)
Requirement already satisfied: grpcio<2.0,>=1.24.3 in c:\users\pavan\anacond
a3\lib\site-packages (from tensorflow-intel==2.17.0->tensorflow) (1.66.2)
Requirement already satisfied: tensorboard<2.18,>=2.17 in c:\users\pavan\ana
conda3\lib\site-packages (from tensorflow-intel==2.17.0->tensorflow) (2.17.
1)
Requirement already satisfied: keras>=3.2.0 in c:\users\pavan\anaconda3\lib
\site-packages (from tensorflow-intel==2.17.0->tensorflow) (3.6.0)
Requirement already satisfied: tensorflow-io-gcs-filesystem>=0.23.1 in c:\us
ers\pavan\anaconda3\lib\site-packages (from tensorflow-intel==2.17.0->tensor
flow) (0.31.0)
Requirement already satisfied: numpy<2.0.0,>=1.23.5 in c:\users\pavan\appdat
a\roaming\python\python311\site-packages (from tensorflow-intel==2.17.0->ten
sorflow) (1.25.1)
Requirement already satisfied: wheel<1.0,>=0.23.0 in c:\users\pavan\anaconda
3\lib\site-packages (from astunparse>=1.6.0->tensorflow-intel==2.17.0->tenso
```

```
rflow) (0.41.2)
Requirement already satisfied: rich in c:\users\pavan\anaconda3\lib\site-pac
kages (from keras>=3.2.0->tensorflow-intel==2.17.0->tensorflow) (13.3.5)
Requirement already satisfied: namex in c:\users\pavan\anaconda3\lib\site-pa
ckages (from keras>=3.2.0->tensorflow-intel==2.17.0->tensorflow) (0.0.8)
Requirement already satisfied: optree in c:\users\pavan\anaconda3\lib\site-p
ackages (from keras>=3.2.0->tensorflow-intel==2.17.0->tensorflow) (0.13.0)
Requirement already satisfied: charset-normalizer<4,>=2 in c:\users\pavan\an
aconda3\lib\site-packages (from requests<3,>=2.21.0->tensorflow-intel==2.17.
0->tensorflow) (2.0.4)
Requirement already satisfied: idna<4,>=2.5 in c:\users\pavan\anaconda3\lib
\site-packages (from requests<3,>=2.21.0->tensorflow-intel==2.17.0->tensorfl
ow) (3.4)
Requirement already satisfied: urllib3<3,>=1.21.1 in c:\users\pavan\anaconda
3\lib\site-packages (from requests<3,>=2.21.0->tensorflow-intel==2.17.0->ten
sorflow) (2.0.7)
Requirement already satisfied: certifi>=2017.4.17 in c:\users\pavan\anaconda
3\lib\site-packages (from requests<3,>=2.21.0->tensorflow-intel==2.17.0->ten
sorflow) (2024.8.30)
Requirement already satisfied: markdown>=2.6.8 in c:\users\pavan\anaconda3\l
ib\site-packages (from tensorboard<2.18,>=2.17->tensorflow-intel==2.17.0->te
nsorflow) (3.4.1)
Requirement already satisfied: tensorboard-data-server<0.8.0,>=0.7.0 in c:\u
sers\pavan\anaconda3\lib\site-packages (from tensorboard<2.18,>=2.17->tensor
flow-intel==2.17.0->tensorflow) (0.7.2)
Requirement already satisfied: werkzeug>=1.0.1 in c:\users\pavan\anaconda3\l
ib\site-packages (from tensorboard<2.18,>=2.17->tensorflow-intel==2.17.0->te
nsorflow) (2.2.3)
Requirement already satisfied: MarkupSafe>=2.1.1 in c:\users\pavan\anaconda3
\lib\site-packages (from werkzeug>=1.0.1->tensorboard<2.18,>=2.17->tensorflo
w-intel==2.17.0->tensorflow) (2.1.3)
Requirement already satisfied: markdown-it-py<3.0.0,>=2.2.0 in c:\users\pava
n\anaconda3\lib\site-packages (from rich->keras>=3.2.0->tensorflow-intel==2.
17.0->tensorflow) (2.2.0)
Requirement already satisfied: pygments<3.0.0,>=2.13.0 in c:\users\pavan\ana
conda3\lib\site-packages (from rich->keras>=3.2.0->tensorflow-intel==2.17.0-
>tensorflow) (2.15.1)
Requirement already satisfied: mdurl~=0.1 in c:\users\pavan\anaconda3\lib\si
te-packages (from markdown-it-py<3.0.0,>=2.2.0->rich->keras>=3.2.0->tensorfl
ow-intel==2.17.0->tensorflow) (0.1.0)
[notice] A new release of pip is available: 23.2 -> 24.3.1
[notice] To update, run: python.exe -m pip install --upgrade pip
```

In [ ]:

In [ ]:

In [ ]:

In [2]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
```

```
from sklearn.metrics import classification_report, confusion_matrix
import seaborn as sns
```

In [ ]:

In [3]:
```
import tensorflow as tf
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, Dropout
from tensorflow.keras.optimizers import Adam
```

In [ ]:

In [4]:
```
# Set random seed for reproducibility
np.random.seed(42)
tf.random.set_seed(42)
```

In [ ]:

In [5]:
```
# Set up GPU (if available)
physical_devices = tf.config.list_physical_devices('GPU')
if len(physical_devices) > 0:
    tf.config.experimental.set_memory_growth(physical_devices[0], True)
```

In [ ]:

In [6]:
```
# Load
data = pd.read_csv('diabetes.csv')
```

In [ ]:

In [7]:
```
# Prepare the data
X = data.drop('Outcome', axis=1)
y = data['Outcome']
```

In [ ]:

In [8]:
```
# Split the data into train and test sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, rar
```

In [ ]:

In [9]:
```
# Scale the features
scaler = StandardScaler()
X_train_scaled = scaler.fit_transform(X_train)
X_test_scaled = scaler.transform(X_test)
```

In [ ]:

In [14]:
```
# Create the model
model = Sequential([
    Dense(64, activation='relu', input_shape=(8,)),
```

```
    Dropout(0.2),
    Dense(32, activation='relu'),
    Dropout(0.2),
    Dense(16, activation='relu'),
    Dense(1, activation='sigmoid')
])
```

In [ ]:

In [38]:
```
# Compile the model
model.compile(optimizer=Adam(learning_rate=0.001), loss='binary_crossentropy

# Train the model
history = model.fit(
    X_train_scaled, y_train,
    epochs=100,
    batch_size=32,
    validation_split=0.2,
    verbose=1
)
```

```
Epoch 1/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 3s 18ms/step - accuracy: 0.8279 - loss: 0.3522 -
val_accuracy: 0.7317 - val_loss: 0.5429
Epoch 2/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.8374 - loss: 0.3456 - v
al_accuracy: 0.7236 - val_loss: 0.5459
Epoch 3/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.8235 - loss: 0.3507 - v
al_accuracy: 0.7154 - val_loss: 0.5399
Epoch 4/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 6ms/step - accuracy: 0.8370 - loss: 0.3206 - v
al_accuracy: 0.7236 - val_loss: 0.5373
Epoch 5/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.8363 - loss: 0.3475 - v
al_accuracy: 0.7154 - val_loss: 0.5420
Epoch 6/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 6ms/step - accuracy: 0.8475 - loss: 0.3125 - v
al_accuracy: 0.7154 - val_loss: 0.5428
Epoch 7/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 6ms/step - accuracy: 0.8492 - loss: 0.3202 - v
al_accuracy: 0.7236 - val_loss: 0.5414
Epoch 8/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 6ms/step - accuracy: 0.8493 - loss: 0.3289 - v
al_accuracy: 0.7154 - val_loss: 0.5442
Epoch 9/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - accuracy: 0.8538 - loss: 0.3239 - v
al_accuracy: 0.7154 - val_loss: 0.5471
Epoch 10/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 6ms/step - accuracy: 0.8527 - loss: 0.2985 - v
al_accuracy: 0.7073 - val_loss: 0.5526
Epoch 11/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 6ms/step - accuracy: 0.8294 - loss: 0.3436 - v
al_accuracy: 0.7154 - val_loss: 0.5547
Epoch 12/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - accuracy: 0.8364 - loss: 0.3303 - v
al_accuracy: 0.7073 - val_loss: 0.5570
Epoch 13/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - accuracy: 0.8687 - loss: 0.3211 - v
al_accuracy: 0.7073 - val_loss: 0.5564
Epoch 14/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.8465 - loss: 0.3254 - v
al_accuracy: 0.7154 - val_loss: 0.5535
Epoch 15/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 6ms/step - accuracy: 0.8306 - loss: 0.3675 - v
al_accuracy: 0.7317 - val_loss: 0.5473
Epoch 16/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 7ms/step - accuracy: 0.8206 - loss: 0.3398 - v
al_accuracy: 0.7236 - val_loss: 0.5450
Epoch 17/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 8ms/step - accuracy: 0.8410 - loss: 0.3220 - v
al_accuracy: 0.7317 - val_loss: 0.5534
Epoch 18/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.8295 - loss: 0.3078 - v
al_accuracy: 0.7317 - val_loss: 0.5600
Epoch 19/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - accuracy: 0.8340 - loss: 0.3467 - v
```

```
al_accuracy: 0.7317 - val_loss: 0.5630
Epoch 20/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 6ms/step - accuracy: 0.8258 - loss: 0.3248 - v
al_accuracy: 0.7236 - val_loss: 0.5725
Epoch 21/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 6ms/step - accuracy: 0.8660 - loss: 0.3239 - v
al_accuracy: 0.7154 - val_loss: 0.5642
Epoch 22/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 6ms/step - accuracy: 0.8630 - loss: 0.3287 - v
al_accuracy: 0.7154 - val_loss: 0.5638
Epoch 23/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - accuracy: 0.8532 - loss: 0.3079 - v
al_accuracy: 0.7317 - val_loss: 0.5647
Epoch 24/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 6ms/step - accuracy: 0.8478 - loss: 0.3216 - v
al_accuracy: 0.7236 - val_loss: 0.5674
Epoch 25/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 6ms/step - accuracy: 0.8429 - loss: 0.3007 - v
al_accuracy: 0.7317 - val_loss: 0.5710
Epoch 26/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - accuracy: 0.8316 - loss: 0.3497 - v
al_accuracy: 0.7236 - val_loss: 0.5790
Epoch 27/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 6ms/step - accuracy: 0.8663 - loss: 0.3155 - v
al_accuracy: 0.7236 - val_loss: 0.5896
Epoch 28/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 6ms/step - accuracy: 0.8569 - loss: 0.3150 - v
al_accuracy: 0.7236 - val_loss: 0.5931
Epoch 29/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.8344 - loss: 0.3331 - v
al_accuracy: 0.7154 - val_loss: 0.5905
Epoch 30/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.8546 - loss: 0.3337 - v
al_accuracy: 0.7317 - val_loss: 0.5742
Epoch 31/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0.8419 - loss: 0.3118 - v
al_accuracy: 0.7317 - val_loss: 0.5708
Epoch 32/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 6ms/step - accuracy: 0.8458 - loss: 0.3155 - v
al_accuracy: 0.7317 - val_loss: 0.5792
Epoch 33/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 6ms/step - accuracy: 0.8607 - loss: 0.3032 - v
al_accuracy: 0.7317 - val_loss: 0.5938
Epoch 34/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - accuracy: 0.8657 - loss: 0.2933 - v
al_accuracy: 0.7236 - val_loss: 0.6052
Epoch 35/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 6ms/step - accuracy: 0.8402 - loss: 0.3470 - v
al_accuracy: 0.7236 - val_loss: 0.6001
Epoch 36/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.8736 - loss: 0.3149 - v
al_accuracy: 0.7236 - val_loss: 0.5959
Epoch 37/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 7ms/step - accuracy: 0.8646 - loss: 0.2897 - v
al_accuracy: 0.7317 - val_loss: 0.5909
Epoch 38/100
```

```
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.8410 - loss: 0.3475 - v
al_accuracy: 0.7236 - val_loss: 0.5862
Epoch 39/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - accuracy: 0.8597 - loss: 0.2909 - v
al_accuracy: 0.7236 - val_loss: 0.5896
Epoch 40/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.8350 - loss: 0.3135 - v
al_accuracy: 0.7154 - val_loss: 0.5941
Epoch 41/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.8651 - loss: 0.2803 - v
al_accuracy: 0.7236 - val_loss: 0.5964
Epoch 42/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.8442 - loss: 0.3110 - v
al_accuracy: 0.7236 - val_loss: 0.5906
Epoch 43/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.8651 - loss: 0.2895 - v
al_accuracy: 0.7236 - val_loss: 0.5985
Epoch 44/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 6ms/step - accuracy: 0.8503 - loss: 0.2937 - v
al_accuracy: 0.7236 - val_loss: 0.6049
Epoch 45/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.8361 - loss: 0.3274 - v
al_accuracy: 0.7317 - val_loss: 0.6007
Epoch 46/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0.8691 - loss: 0.3094 - v
al_accuracy: 0.7317 - val_loss: 0.6012
Epoch 47/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 7ms/step - accuracy: 0.8525 - loss: 0.2912 - v
al_accuracy: 0.7317 - val_loss: 0.6002
Epoch 48/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 6ms/step - accuracy: 0.8523 - loss: 0.3078 - v
al_accuracy: 0.7317 - val_loss: 0.6072
Epoch 49/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - accuracy: 0.8589 - loss: 0.2982 - v
al_accuracy: 0.7317 - val_loss: 0.6250
Epoch 50/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - accuracy: 0.8767 - loss: 0.2825 - v
al_accuracy: 0.7317 - val_loss: 0.6278
Epoch 51/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 6ms/step - accuracy: 0.8560 - loss: 0.2915 - v
al_accuracy: 0.7317 - val_loss: 0.6330
Epoch 52/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - accuracy: 0.8835 - loss: 0.3036 - v
al_accuracy: 0.7317 - val_loss: 0.6239
Epoch 53/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 6ms/step - accuracy: 0.8854 - loss: 0.2604 - v
al_accuracy: 0.7317 - val_loss: 0.6219
Epoch 54/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 6ms/step - accuracy: 0.8809 - loss: 0.2770 - v
al_accuracy: 0.7317 - val_loss: 0.6394
Epoch 55/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - accuracy: 0.8713 - loss: 0.2903 - v
al_accuracy: 0.7317 - val_loss: 0.6420
Epoch 56/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.8589 - loss: 0.3098 - v
al_accuracy: 0.7236 - val_loss: 0.6511
```

```
Epoch 57/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - accuracy: 0.8701 - loss: 0.2733 - v
al_accuracy: 0.7317 - val_loss: 0.6542
Epoch 58/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - accuracy: 0.8730 - loss: 0.3092 - v
al_accuracy: 0.7317 - val_loss: 0.6467
Epoch 59/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - accuracy: 0.8544 - loss: 0.2838 - v
al_accuracy: 0.7317 - val_loss: 0.6423
Epoch 60/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - accuracy: 0.8479 - loss: 0.2951 - v
al_accuracy: 0.7317 - val_loss: 0.6399
Epoch 61/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - accuracy: 0.8761 - loss: 0.2845 - v
al_accuracy: 0.7317 - val_loss: 0.6395
Epoch 62/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 6ms/step - accuracy: 0.8895 - loss: 0.2693 - v
al_accuracy: 0.7236 - val_loss: 0.6404
Epoch 63/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.8645 - loss: 0.2867 - v
al_accuracy: 0.7236 - val_loss: 0.6426
Epoch 64/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 7ms/step - accuracy: 0.8738 - loss: 0.2758 - v
al_accuracy: 0.7236 - val_loss: 0.6508
Epoch 65/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.8478 - loss: 0.2913 - v
al_accuracy: 0.7236 - val_loss: 0.6542
Epoch 66/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - accuracy: 0.8832 - loss: 0.2609 - v
al_accuracy: 0.7317 - val_loss: 0.6589
Epoch 67/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - accuracy: 0.8599 - loss: 0.2896 - v
al_accuracy: 0.7398 - val_loss: 0.6634
Epoch 68/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.8677 - loss: 0.2948 - v
al_accuracy: 0.7236 - val_loss: 0.6706
Epoch 69/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - accuracy: 0.8775 - loss: 0.2911 - v
al_accuracy: 0.7236 - val_loss: 0.6608
Epoch 70/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - accuracy: 0.8537 - loss: 0.2895 - v
al_accuracy: 0.7154 - val_loss: 0.6541
Epoch 71/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 6ms/step - accuracy: 0.8825 - loss: 0.2807 - v
al_accuracy: 0.7236 - val_loss: 0.6578
Epoch 72/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.8801 - loss: 0.3042 - v
al_accuracy: 0.7236 - val_loss: 0.6512
Epoch 73/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0.8732 - loss: 0.2800 - v
al_accuracy: 0.7317 - val_loss: 0.6470
Epoch 74/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - accuracy: 0.8708 - loss: 0.2760 - v
al_accuracy: 0.7317 - val_loss: 0.6459
Epoch 75/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 6ms/step - accuracy: 0.8724 - loss: 0.2770 - v
```

```
al_accuracy: 0.7317 - val_loss: 0.6339
Epoch 76/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - accuracy: 0.8966 - loss: 0.2527 - v
al_accuracy: 0.7317 - val_loss: 0.6521
Epoch 77/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - accuracy: 0.8832 - loss: 0.2798 - v
al_accuracy: 0.7317 - val_loss: 0.6718
Epoch 78/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.8787 - loss: 0.2610 - v
al_accuracy: 0.7398 - val_loss: 0.6656
Epoch 79/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0.8784 - loss: 0.2556 - v
al_accuracy: 0.7398 - val_loss: 0.6669
Epoch 80/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0.8644 - loss: 0.2872 - v
al_accuracy: 0.7398 - val_loss: 0.6608
Epoch 81/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0.8881 - loss: 0.2853 - v
al_accuracy: 0.7236 - val_loss: 0.6567
Epoch 82/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - accuracy: 0.8782 - loss: 0.2907 - v
al_accuracy: 0.7317 - val_loss: 0.6555
Epoch 83/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 6ms/step - accuracy: 0.8664 - loss: 0.3019 - v
al_accuracy: 0.7236 - val_loss: 0.6426
Epoch 84/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - accuracy: 0.8850 - loss: 0.2701 - v
al_accuracy: 0.7317 - val_loss: 0.6514
Epoch 85/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - accuracy: 0.8706 - loss: 0.2893 - v
al_accuracy: 0.7236 - val_loss: 0.6549
Epoch 86/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 7ms/step - accuracy: 0.8708 - loss: 0.2898 - v
al_accuracy: 0.7236 - val_loss: 0.6577
Epoch 87/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 6ms/step - accuracy: 0.8798 - loss: 0.2674 - v
al_accuracy: 0.7236 - val_loss: 0.6667
Epoch 88/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 6ms/step - accuracy: 0.8651 - loss: 0.2654 - v
al_accuracy: 0.7317 - val_loss: 0.6664
Epoch 89/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 6ms/step - accuracy: 0.8763 - loss: 0.2559 - v
al_accuracy: 0.7317 - val_loss: 0.6729
Epoch 90/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - accuracy: 0.8883 - loss: 0.2506 - v
al_accuracy: 0.7317 - val_loss: 0.6778
Epoch 91/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.8809 - loss: 0.2498 - v
al_accuracy: 0.7317 - val_loss: 0.6764
Epoch 92/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.8625 - loss: 0.2704 - v
al_accuracy: 0.7317 - val_loss: 0.6618
Epoch 93/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.8705 - loss: 0.2933 - v
al_accuracy: 0.7317 - val_loss: 0.6490
Epoch 94/100
```

```
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.8953 - loss: 0.2472 - v
al_accuracy: 0.7317 - val_loss: 0.6556
Epoch 95/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.9119 - loss: 0.2223 - v
al_accuracy: 0.7236 - val_loss: 0.6705
Epoch 96/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - accuracy: 0.8965 - loss: 0.2711 - v
al_accuracy: 0.7317 - val_loss: 0.6678
Epoch 97/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - accuracy: 0.8811 - loss: 0.2548 - v
al_accuracy: 0.7236 - val_loss: 0.6816
Epoch 98/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 6ms/step - accuracy: 0.8937 - loss: 0.2609 - v
al_accuracy: 0.7236 - val_loss: 0.6851
Epoch 99/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - accuracy: 0.9041 - loss: 0.2474 - v
al_accuracy: 0.7236 - val_loss: 0.6804
Epoch 100/100
16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 8ms/step - accuracy: 0.8750 - loss: 0.2637 - v
al_accuracy: 0.7398 - val_loss: 0.6807
```

In [ ]:

In [16]:
```python
# Evaluate the model
test_loss, test_accuracy = model.evaluate(X_test_scaled, y_test)
print(f"Test accuracy: {test_accuracy:.4f}")
```

```
5/5 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.7372 - loss: 0.6336
Test accuracy: 0.7338
```

In [ ]:

In [17]:
```python
# Get predictions
predictions = model.predict(X_test_scaled)
predicted_classes = (predictions > 0.5).astype(int).flatten()
```

```
5/5 ━━━━━━━━━━━━━━━━━━━━ 0s 13ms/step
```

In [ ]:

In [18]:
```python
# Generate classification report
report = classification_report(y_test, predicted_classes)
print("Classification Report:")
print(report)
```

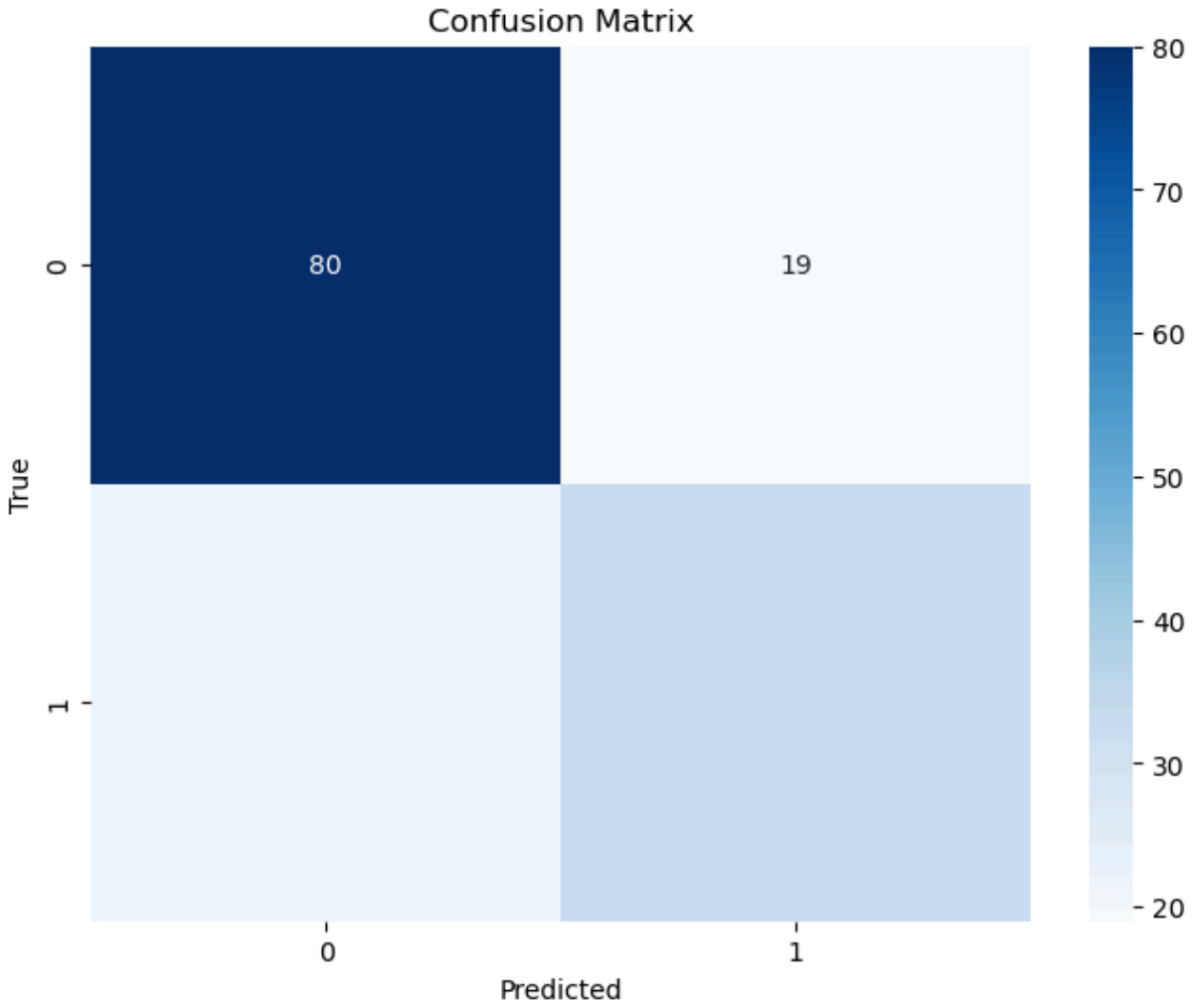
```
Classification Report:
              precision    recall  f1-score   support

           0       0.78      0.81      0.80        99
           1       0.63      0.60      0.62        55

    accuracy                           0.73       154
   macro avg       0.71      0.70      0.71       154
weighted avg       0.73      0.73      0.73       154
```

In [ ]:

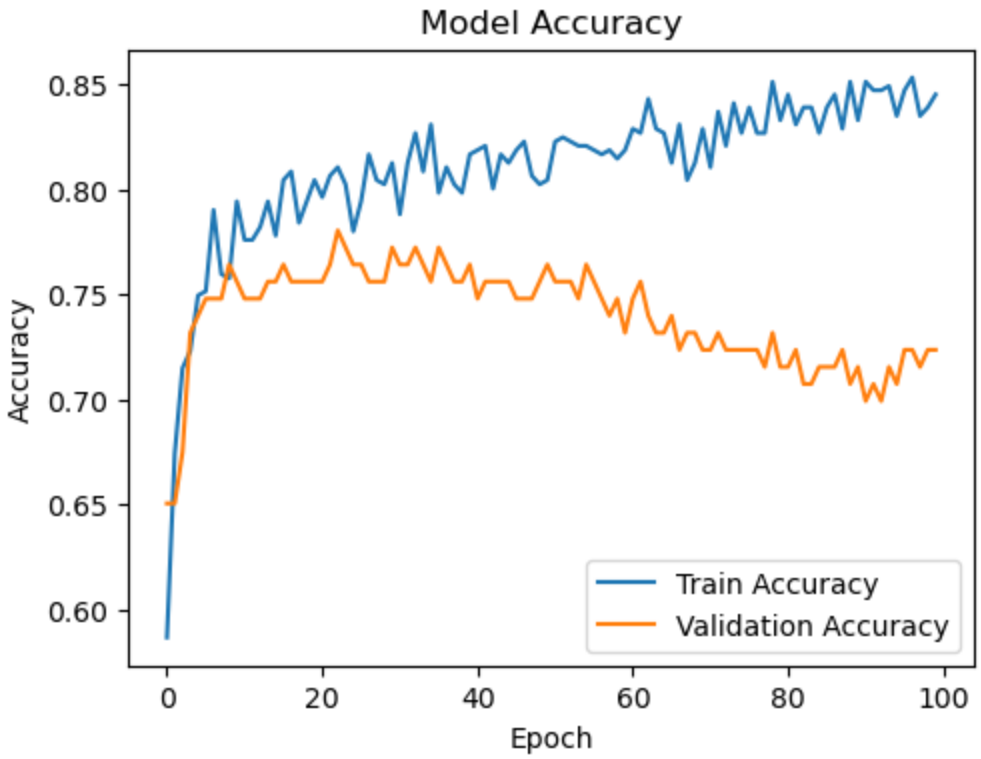
In [19]:
```
# Plot confusion matrix
cm = confusion_matrix(y_test, predicted_classes)
plt.figure(figsize=(8, 6))
sns.heatmap(cm, annot=True, fmt='d', cmap='Blues')
plt.title('Confusion Matrix')
plt.xlabel('Predicted')
plt.ylabel('True')
plt.show()
```



In [ ]:

In [20]:
```
# Plot training history
plt.figure(figsize=(12, 4))
plt.subplot(1, 2, 1)
plt.plot(history.history['accuracy'], label='Train Accuracy')
plt.plot(history.history['val_accuracy'], label='Validation Accuracy')
plt.title('Model Accuracy')
plt.xlabel('Epoch')
plt.ylabel('Accuracy')
plt.legend()
```

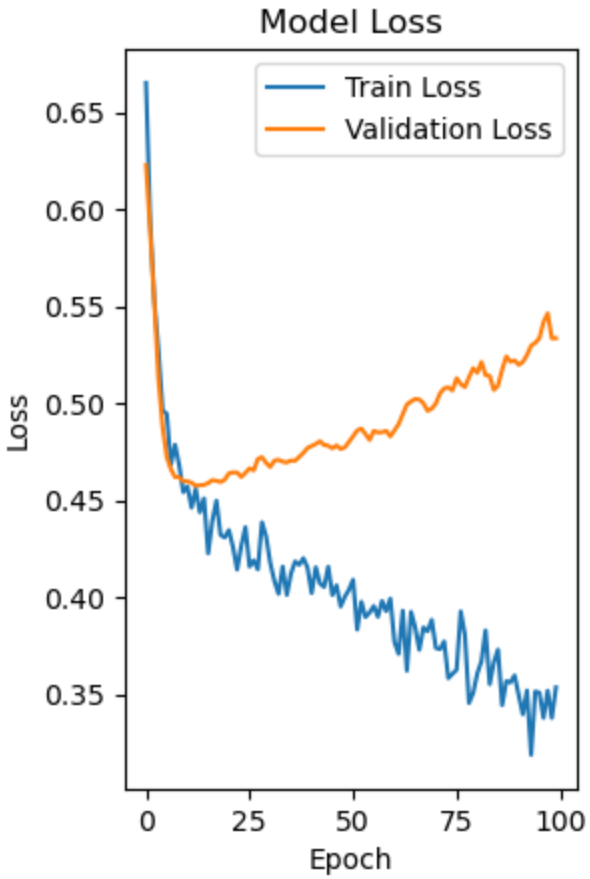
Out[20]: <matplotlib.legend.Legend at 0x244f37c4890>



In [ ]:

In [21]:
```
plt.subplot(1, 2, 2)
plt.plot(history.history['loss'], label='Train Loss')
plt.plot(history.history['val_loss'], label='Validation Loss')
plt.title('Model Loss')
plt.xlabel('Epoch')
plt.ylabel('Loss')
plt.legend()
```

Out[21]: <matplotlib.legend.Legend at 0x244f381bdd0>



In [ ]:

In [22]:
```
plt.tight_layout()
plt.show()
```

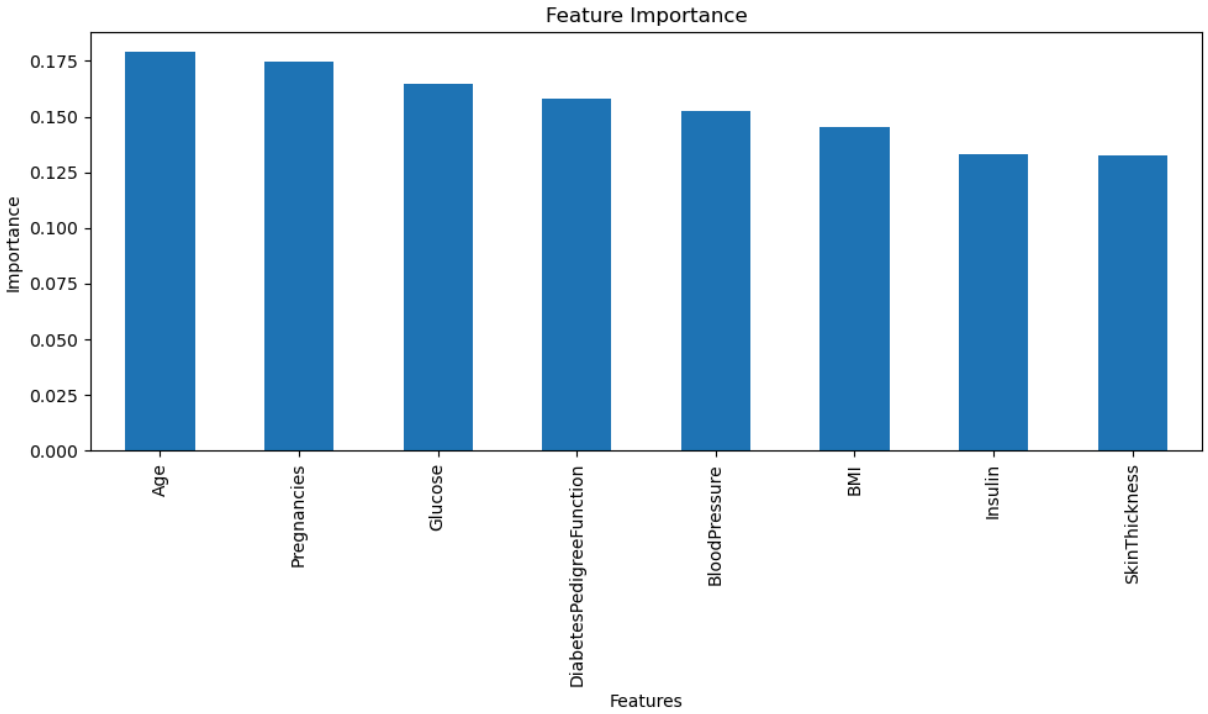
```
<Figure size 640x480 with 0 Axes>
```

In [ ]:

In [23]:
```
# Feature importance analysis
feature_importance = model.layers[0].get_weights()[0]
feature_importance = np.abs(feature_importance).mean(axis=1)
feature_importance = pd.Series(feature_importance, index=X.columns)
feature_importance = feature_importance.sort_values(ascending=False)
```

In [ ]:

In [24]:
```
plt.figure(figsize=(10, 6))
feature_importance.plot(kind='bar')
plt.title('Feature Importance')
plt.xlabel('Features')
plt.ylabel('Importance')
plt.tight_layout()
plt.show()
```



In [ ]:

In [33]:
```
# Modify the predict_diabetes function
def predict_diabetes(data):
    # Ensure data is a DataFrame with correct column names
    if not isinstance(data, pd.DataFrame):
        data = pd.DataFrame(data, columns=['Pregnancies', 'Glucose', 'BloodF
                                           'Insulin', 'BMI', 'DiabetesPedigr

    # Scale the data
    scaled_data = scaler.transform(data)

    # Make prediction
    prediction = model.predict(scaled_data)
    return prediction[0][0]
```

In [ ]:

In [34]:
```
sample_data = {
    "Pregnancies": 6,
    "Glucose": 148,
    "BloodPressure": 72,
    "SkinThickness": 35,
    "Insulin": 0,
    "BMI": 33.6,
    "DiabetesPedigreeFunction": 0.627,
    "Age": 50
}
```

In [ ]:

In [35]:
```
# Convert the dictionary to a pandas DataFrame
new_data = pd.DataFrame([sample_data])
```

In [ ]:

In [37]:
```
# Make prediction
risk = predict_diabetes(new_data)
print(f"Diabetes risk: {risk:.2f}")
```

```
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 34ms/step
Diabetes risk: 0.82
```

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