In [11]:

```python
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
import tensorflow as tf
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, Dropout, BatchNormalization
from tensorflow.keras.callbacks import EarlyStopping, ModelCheckpoint
from tensorflow.keras.metrics import AUC

# Загрузка данных
data = pd.read_csv('train_3.2.csv')

# Основной анализ данных
print(data.head())
print(data.describe())
print(data.isnull().sum())
print(data['defects'].value_counts())

# Корреляционная матрица
plt.figure(figsize=(12, 10))
sns.heatmap(data.corr(), annot=True, fmt=".2f")
plt.show()

# Предобработка данных
X = data.drop(['id', 'defects'], axis=1)
y = data['defects'].astype(np.float32)

# Разделение данных
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,

# Нормализация данных
scaler = StandardScaler()
X_train_scaled = scaler.fit_transform(X_train)
X_test_scaled = scaler.transform(X_test)

# Функция построения базовой модели
def build_model():
    model = Sequential([
        Dense(64, activation='relu', input_shape=(X_train_scaled.shape[1]
        Dense(32, activation='relu'),
        Dense(1, activation='sigmoid')
    ])
    model.compile(optimizer='adam', loss='binary_crossentropy', metrics=[
    return model

# Обучение модели
model = build_model()
history = model.fit(X_train_scaled, y_train, validation_data=(X_test_scal

# Построение модели с регуляризацией
def build_regularized_model():
    model = Sequential([
```

```
        Dense(64, activation='relu', input_shape=(X_train_scaled.shape[1]
        BatchNormalization(),
        Dropout(0.5),
        Dense(32, activation='relu'),
        BatchNormalization(),
        Dropout(0.5),
        Dense(1, activation='sigmoid')
    ])
    model.compile(optimizer='adam', loss='binary_crossentropy', metrics=[
    return model

# Коллбэки
early_stopping = EarlyStopping(monitor='val_auc', patience=10, mode='max'
model_checkpoint = ModelCheckpoint('best_model', monitor='val_auc', save_

# Обучение модели с регуляризацией
model_reg = build_regularized_model()
history_reg = model_reg.fit(X_train_scaled, y_train, validation_data=(X_t

# Загрузка и оценка лучшей модели
best_model = tf.keras.models.load_model('best_model')
_, test_auc = best_model.evaluate(X_test_scaled, y_test)
print(f'Test AUC: {test_auc}')

# Визуализация результатов
plt.plot(history.history['auc'], label='Training AUC (Base Model)')
plt.plot(history.history['val_auc'], label='Validation AUC (Base Model)')
plt.plot(history_reg.history['auc'], label='Training AUC (Regularized Mod
plt.plot(history_reg.history['val_auc'], label='Validation AUC (Regulariz
plt.title('Model AUC Performance')
plt.xlabel('Epochs')
plt.ylabel('AUC')
plt.legend()
plt.show()
```

```
   id   loc  v(g)  ev(g)  iv(g)     n       v     l      d      i  ...  \
0   0  22.0   3.0    1.0    2.0  60.0  278.63  0.06  19.56  14.25  ...
1   1  14.0   2.0    1.0    2.0  32.0  151.27  0.14   7.00  21.11  ...
2   2  11.0   2.0    1.0    2.0  45.0  197.65  0.11   8.05  22.76  ...
3   3   8.0   1.0    1.0    1.0  23.0   94.01  0.19   5.25  17.86  ...
4   4  11.0   2.0    1.0    2.0  17.0   60.94  0.18   5.63  12.44  ...

   lOCode  lOComment  lOBlank  locCodeAndComment  uniq_Op  uniq_Opnd  \
0      17          1        1                  0     16.0        9.0
1      11          0        1                  0     11.0       11.0
2       8          0        1                  0     12.0       11.0
3       4          0        2                  0      8.0        6.0
4       7          0        2                  0      7.0        6.0

   total_Op  total_Opnd  branchCount  defects
0      38.0        22.0          5.0    False
1      18.0        14.0          3.0    False
2      28.0        17.0          3.0    False
3      16.0         7.0          1.0     True
4      10.0        10.0          3.0    False

[5 rows x 23 columns]
```

```
                id            loc           v(g)          ev(g)  \
count  101763.000000  101763.000000  101763.000000  101763.000000
mean    50881.000000      37.347160       5.492684       2.845022
std     29376.592059      54.600401       7.900855       4.631262
min         0.000000       1.000000       1.000000       1.000000
25%     25440.500000      13.000000       2.000000       1.000000
50%     50881.000000      22.000000       3.000000       1.000000
75%     76321.500000      42.000000       6.000000       3.000000
max    101762.000000    3442.000000     404.000000     165.000000

              iv(g)             n             v             l  \
count  101763.000000  101763.000000  101763.000000  101763.000000
mean        3.498826      96.655995     538.280956       0.111634
std         5.534541     171.147191    1270.791601       0.100096
min         1.000000       0.000000       0.000000       0.000000
25%         1.000000      25.000000      97.670000       0.050000
50%         2.000000      51.000000     232.790000       0.090000
75%         4.000000     111.000000     560.250000       0.150000
max       402.000000    8441.000000   80843.080000       1.000000

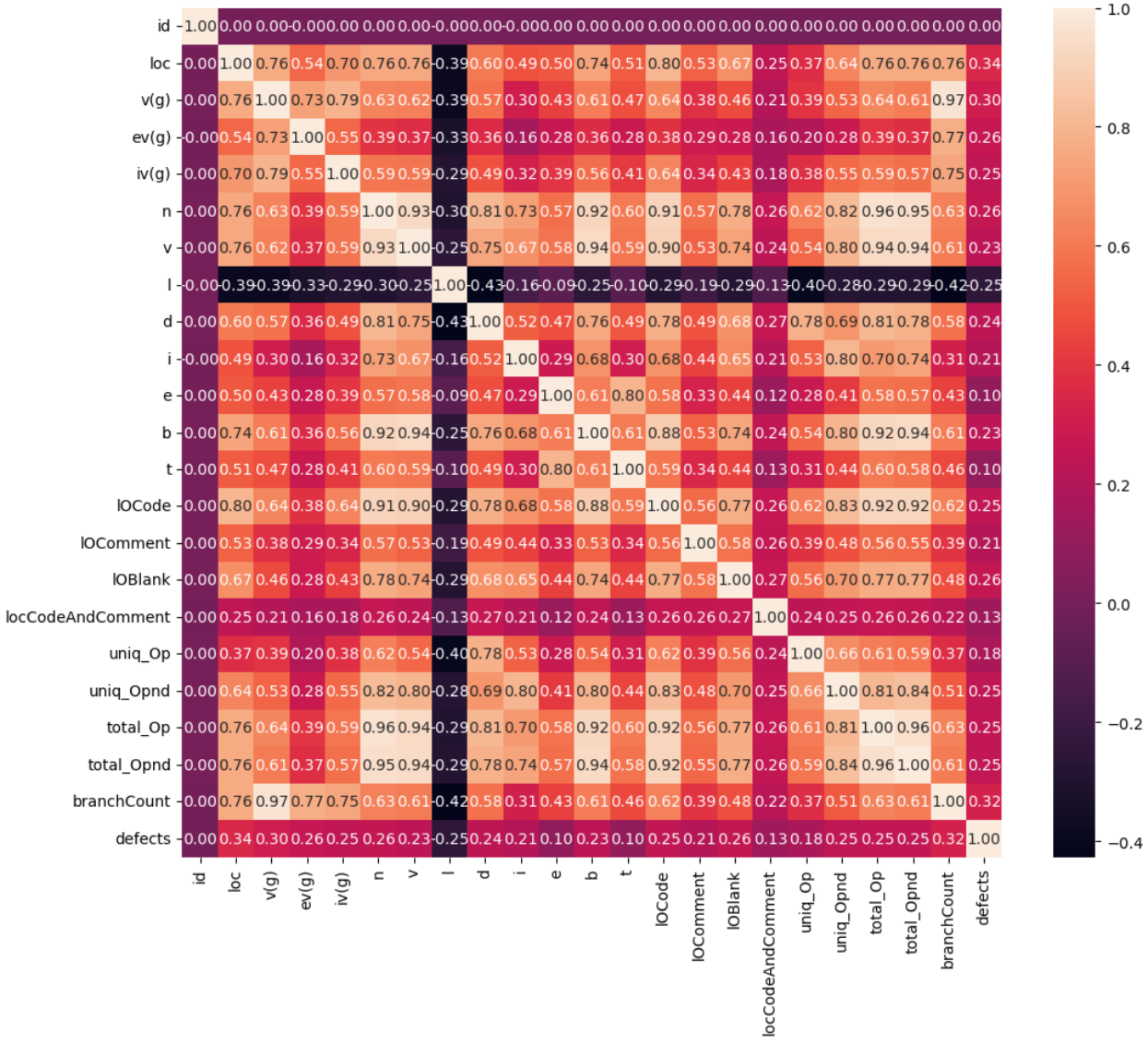
                 d             i  ...             t         lOCode  \
count  101763.000000  101763.000000  ...  101763.000000  101763.000000
mean       13.681881      27.573007  ...    1141.357982      22.802453
std        14.121306      22.856742  ...    9862.795472      38.541010
min         0.000000       0.000000  ...       0.000000       0.000000
25%         5.600000      15.560000  ...      31.380000       7.000000
50%         9.820000      23.360000  ...     125.400000      14.000000
75%        18.000000      34.340000  ...     565.920000      26.000000
max       418.200000     569.780000  ...  935923.390000    2824.000000

          lOComment        lOBlank  locCodeAndComment        uniq_Op  \
count  101763.000000  101763.000000      101763.000000  101763.000000
mean        1.773945       3.979865           0.196604      11.896131
std         5.902412       6.382358           0.998906       6.749549
min         0.000000       0.000000           0.000000       0.000000
25%         0.000000       1.000000           0.000000       8.000000
50%         0.000000       2.000000           0.000000      11.000000
75%         1.000000       5.000000           0.000000      16.000000
max       344.000000     219.000000          43.000000     410.000000

          uniq_Opnd       total_Op     total_Opnd    branchCount
count  101763.000000  101763.000000  101763.000000  101763.000000
mean       15.596671      57.628116      39.249698       9.839549
std        18.064261     104.537660      71.692309      14.412769
min         0.000000       0.000000       0.000000       1.000000
25%         7.000000      15.000000      10.000000       3.000000
50%        12.000000      30.000000      20.000000       5.000000
75%        20.000000      66.000000      45.000000      11.000000
max      1026.000000    5420.000000    3021.000000     503.000000

[8 rows x 22 columns]
id                  0
loc                 0
v(g)                0
ev(g)               0
iv(g)               0
n                   0
```

```
v                       0
l                       0
d                       0
i                       0
e                       0
b                       0
t                       0
lOCode                  0
lOComment               0
lOBlank                 0
locCodeAndComment       0
uniq_Op                 0
uniq_Opnd               0
total_Op                0
total_Opnd              0
branchCount             0
defects                 0
dtype: int64
False    78699
True     23064
Name: defects, dtype: int64
```




```
Epoch 1/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4400 -
auc: 0.7805 - val_loss: 0.4320 - val_auc: 0.7855
Epoch 2/100
```

```
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4328 -
auc: 0.7878 - val_loss: 0.4312 - val_auc: 0.7864
Epoch 3/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4319 -
auc: 0.7886 - val_loss: 0.4333 - val_auc: 0.7841
Epoch 4/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4314 -
auc: 0.7893 - val_loss: 0.4311 - val_auc: 0.7866
Epoch 5/100
2545/2545 [==============================] - 2s 966us/step - loss: 0.4309
- auc: 0.7901 - val_loss: 0.4313 - val_auc: 0.7870
Epoch 6/100
2545/2545 [==============================] - 3s 997us/step - loss: 0.4309
- auc: 0.7899 - val_loss: 0.4315 - val_auc: 0.7854
Epoch 7/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4306 -
auc: 0.7904 - val_loss: 0.4309 - val_auc: 0.7868
Epoch 8/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4301 -
auc: 0.7907 - val_loss: 0.4303 - val_auc: 0.7868
Epoch 9/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4301 -
auc: 0.7905 - val_loss: 0.4296 - val_auc: 0.7865
Epoch 10/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4295 -
auc: 0.7913 - val_loss: 0.4297 - val_auc: 0.7870
Epoch 11/100
2545/2545 [==============================] - 3s 990us/step - loss: 0.4296
- auc: 0.7911 - val_loss: 0.4312 - val_auc: 0.7869
Epoch 12/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4293 -
auc: 0.7915 - val_loss: 0.4303 - val_auc: 0.7861
Epoch 13/100
2545/2545 [==============================] - 3s 992us/step - loss: 0.4294
- auc: 0.7915 - val_loss: 0.4301 - val_auc: 0.7863
Epoch 14/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4289 -
auc: 0.7918 - val_loss: 0.4306 - val_auc: 0.7865
Epoch 15/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4287 -
auc: 0.7921 - val_loss: 0.4313 - val_auc: 0.7858
Epoch 16/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4284 -
auc: 0.7924 - val_loss: 0.4304 - val_auc: 0.7865
Epoch 17/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4284 -
auc: 0.7925 - val_loss: 0.4303 - val_auc: 0.7867
Epoch 18/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4283 -
auc: 0.7925 - val_loss: 0.4309 - val_auc: 0.7863
Epoch 19/100
2545/2545 [==============================] - 3s 997us/step - loss: 0.4280
- auc: 0.7928 - val_loss: 0.4319 - val_auc: 0.7859
Epoch 20/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4278 -
auc: 0.7932 - val_loss: 0.4307 - val_auc: 0.7862
Epoch 21/100
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2545/2545 [==============================] - 3s 987us/step - loss: 0.4277
- auc: 0.7931 - val_loss: 0.4317 - val_auc: 0.7863
Epoch 22/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4277 -
auc: 0.7931 - val_loss: 0.4319 - val_auc: 0.7852
Epoch 23/100
2545/2545 [==============================] - 2s 974us/step - loss: 0.4274
- auc: 0.7932 - val_loss: 0.4312 - val_auc: 0.7860
Epoch 24/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4273 -
auc: 0.7933 - val_loss: 0.4326 - val_auc: 0.7862
Epoch 25/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4270 -
auc: 0.7938 - val_loss: 0.4321 - val_auc: 0.7849
Epoch 26/100
2545/2545 [==============================] - 3s 994us/step - loss: 0.4269
- auc: 0.7941 - val_loss: 0.4315 - val_auc: 0.7860
Epoch 27/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4265 -
auc: 0.7945 - val_loss: 0.4322 - val_auc: 0.7867
Epoch 28/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4264 -
auc: 0.7943 - val_loss: 0.4326 - val_auc: 0.7861
Epoch 29/100
2545/2545 [==============================] - 3s 984us/step - loss: 0.4262
- auc: 0.7949 - val_loss: 0.4321 - val_auc: 0.7865
Epoch 30/100
2545/2545 [==============================] - 3s 1000us/step - loss: 0.4261
- auc: 0.7948 - val_loss: 0.4333 - val_auc: 0.7851
Epoch 31/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4257 -
auc: 0.7953 - val_loss: 0.4316 - val_auc: 0.7854
Epoch 32/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4254 -
auc: 0.7957 - val_loss: 0.4343 - val_auc: 0.7855
Epoch 33/100
2545/2545 [==============================] - 2s 959us/step - loss: 0.4256
- auc: 0.7953 - val_loss: 0.4319 - val_auc: 0.7856
Epoch 34/100
2545/2545 [==============================] - 3s 994us/step - loss: 0.4250
- auc: 0.7959 - val_loss: 0.4339 - val_auc: 0.7853
Epoch 35/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4247 -
auc: 0.7960 - val_loss: 0.4352 - val_auc: 0.7843
Epoch 36/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4248 -
auc: 0.7960 - val_loss: 0.4330 - val_auc: 0.7843
Epoch 37/100
2545/2545 [==============================] - 2s 963us/step - loss: 0.4246
- auc: 0.7965 - val_loss: 0.4348 - val_auc: 0.7838
Epoch 38/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4245 -
auc: 0.7966 - val_loss: 0.4337 - val_auc: 0.7852
Epoch 39/100
2545/2545 [==============================] - 2s 963us/step - loss: 0.4240
- auc: 0.7968 - val_loss: 0.4362 - val_auc: 0.7829
Epoch 40/100
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2545/2545 [==============================] - 3s 1ms/step - loss: 0.4240 -
auc: 0.7967 - val_loss: 0.4345 - val_auc: 0.7841
Epoch 41/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4238 -
auc: 0.7970 - val_loss: 0.4353 - val_auc: 0.7833
Epoch 42/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4237 -
auc: 0.7971 - val_loss: 0.4352 - val_auc: 0.7844
Epoch 43/100
2545/2545 [==============================] - 2s 980us/step - loss: 0.4235
- auc: 0.7972 - val_loss: 0.4345 - val_auc: 0.7845
Epoch 44/100
2545/2545 [==============================] - 3s 994us/step - loss: 0.4234
- auc: 0.7974 - val_loss: 0.4341 - val_auc: 0.7853
Epoch 45/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4232 -
auc: 0.7976 - val_loss: 0.4364 - val_auc: 0.7838
Epoch 46/100
2545/2545 [==============================] - 2s 981us/step - loss: 0.4229
- auc: 0.7979 - val_loss: 0.4363 - val_auc: 0.7835
Epoch 47/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4227 -
auc: 0.7980 - val_loss: 0.4371 - val_auc: 0.7826
Epoch 48/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4227 -
auc: 0.7985 - val_loss: 0.4358 - val_auc: 0.7840
Epoch 49/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4223 -
auc: 0.7986 - val_loss: 0.4368 - val_auc: 0.7818
Epoch 50/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4222 -
auc: 0.7985 - val_loss: 0.4360 - val_auc: 0.7826
Epoch 51/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4221 -
auc: 0.7991 - val_loss: 0.4374 - val_auc: 0.7836
Epoch 52/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4219 -
auc: 0.7988 - val_loss: 0.4382 - val_auc: 0.7833
Epoch 53/100
2545/2545 [==============================] - 3s 985us/step - loss: 0.4214
- auc: 0.7993 - val_loss: 0.4378 - val_auc: 0.7825
Epoch 54/100
2545/2545 [==============================] - 2s 973us/step - loss: 0.4216
- auc: 0.7992 - val_loss: 0.4388 - val_auc: 0.7816
Epoch 55/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4217 -
auc: 0.7992 - val_loss: 0.4376 - val_auc: 0.7831
Epoch 56/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4212 -
auc: 0.7995 - val_loss: 0.4392 - val_auc: 0.7827
Epoch 57/100
2545/2545 [==============================] - 2s 973us/step - loss: 0.4210
- auc: 0.7998 - val_loss: 0.4385 - val_auc: 0.7828
Epoch 58/100
2545/2545 [==============================] - 2s 964us/step - loss: 0.4206
- auc: 0.8001 - val_loss: 0.4382 - val_auc: 0.7823
Epoch 59/100
```

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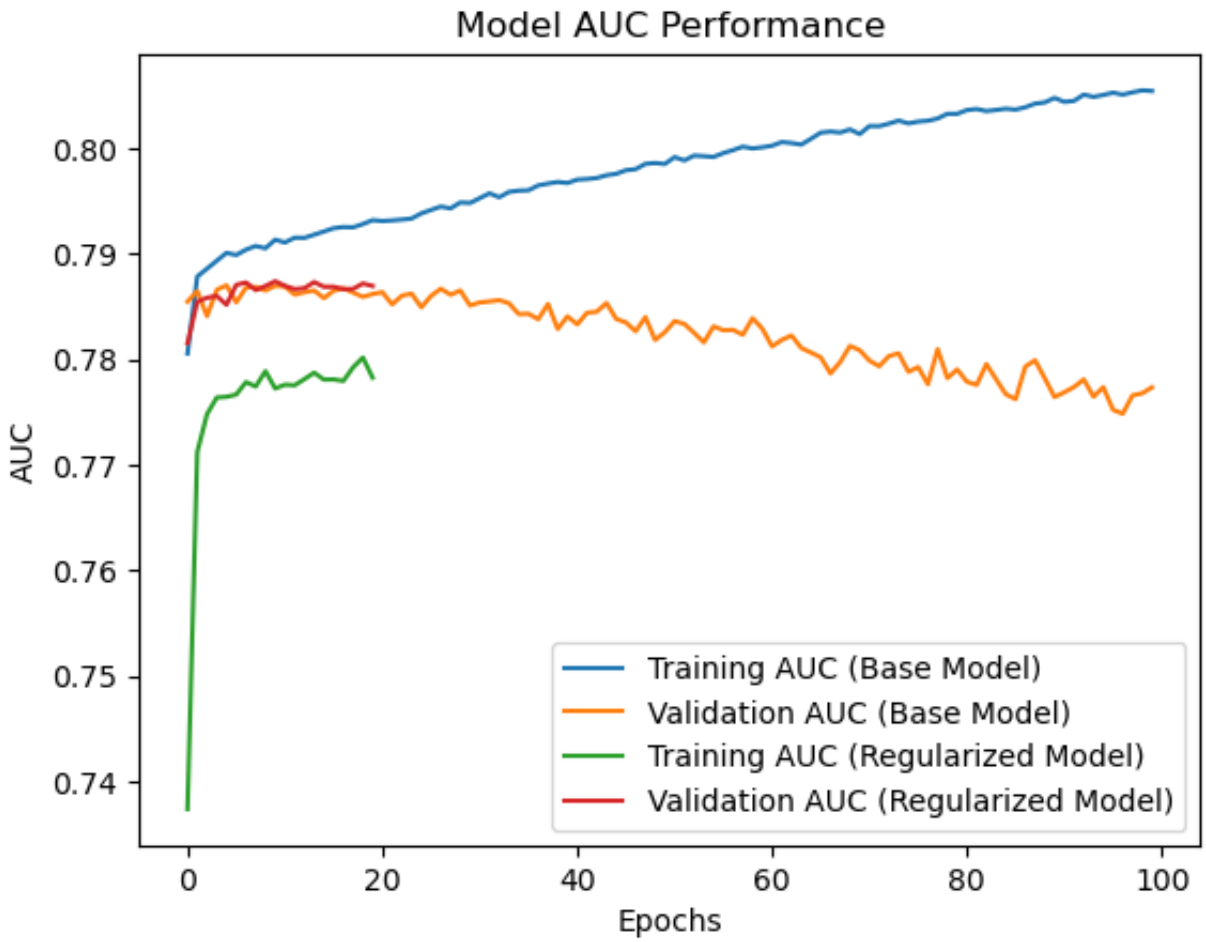
2545/2545 [==============================] - 2s 960us/step - loss: 0.4208
- auc: 0.8000 - val_loss: 0.4397 - val_auc: 0.7839
Epoch 60/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4207 -
auc: 0.8001 - val_loss: 0.4401 - val_auc: 0.7829
Epoch 61/100
2545/2545 [==============================] - 2s 963us/step - loss: 0.4205
- auc: 0.8002 - val_loss: 0.4399 - val_auc: 0.7812
Epoch 62/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4202 -
auc: 0.8006 - val_loss: 0.4422 - val_auc: 0.7818
Epoch 63/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4200 -
auc: 0.8005 - val_loss: 0.4411 - val_auc: 0.7822
Epoch 64/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4201 -
auc: 0.8003 - val_loss: 0.4426 - val_auc: 0.7811
Epoch 65/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4199 -
auc: 0.8009 - val_loss: 0.4410 - val_auc: 0.7806
Epoch 66/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4193 -
auc: 0.8015 - val_loss: 0.4426 - val_auc: 0.7802
Epoch 67/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4193 -
auc: 0.8016 - val_loss: 0.4427 - val_auc: 0.7787
Epoch 68/100
2545/2545 [==============================] - 2s 982us/step - loss: 0.4193
- auc: 0.8015 - val_loss: 0.4425 - val_auc: 0.7797
Epoch 69/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4191 -
auc: 0.8018 - val_loss: 0.4407 - val_auc: 0.7813
Epoch 70/100
2545/2545 [==============================] - 2s 972us/step - loss: 0.4193
- auc: 0.8013 - val_loss: 0.4398 - val_auc: 0.7809
Epoch 71/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4186 -
auc: 0.8021 - val_loss: 0.4404 - val_auc: 0.7799
Epoch 72/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4185 -
auc: 0.8021 - val_loss: 0.4445 - val_auc: 0.7793
Epoch 73/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4187 -
auc: 0.8023 - val_loss: 0.4417 - val_auc: 0.7803
Epoch 74/100
2545/2545 [==============================] - 3s 988us/step - loss: 0.4183
- auc: 0.8026 - val_loss: 0.4429 - val_auc: 0.7806
Epoch 75/100
2545/2545 [==============================] - 2s 973us/step - loss: 0.4183
- auc: 0.8023 - val_loss: 0.4437 - val_auc: 0.7788
Epoch 76/100
2545/2545 [==============================] - 2s 968us/step - loss: 0.4179
- auc: 0.8025 - val_loss: 0.4449 - val_auc: 0.7792
Epoch 77/100
2545/2545 [==============================] - 3s 991us/step - loss: 0.4180
- auc: 0.8026 - val_loss: 0.4454 - val_auc: 0.7776
Epoch 78/100
```

```
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4177 -
auc: 0.8028 - val_loss: 0.4440 - val_auc: 0.7810
Epoch 79/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4174 -
auc: 0.8033 - val_loss: 0.4457 - val_auc: 0.7782
Epoch 80/100
2545/2545 [==============================] - 3s 988us/step - loss: 0.4175
- auc: 0.8032 - val_loss: 0.4481 - val_auc: 0.7790
Epoch 81/100
2545/2545 [==============================] - 3s 995us/step - loss: 0.4170
- auc: 0.8036 - val_loss: 0.4479 - val_auc: 0.7779
Epoch 82/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4170 -
auc: 0.8037 - val_loss: 0.4447 - val_auc: 0.7776
Epoch 83/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4169 -
auc: 0.8035 - val_loss: 0.4478 - val_auc: 0.7795
Epoch 84/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4172 -
auc: 0.8036 - val_loss: 0.4458 - val_auc: 0.7781
Epoch 85/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4169 -
auc: 0.8037 - val_loss: 0.4487 - val_auc: 0.7767
Epoch 86/100
2545/2545 [==============================] - 3s 992us/step - loss: 0.4167
- auc: 0.8036 - val_loss: 0.4492 - val_auc: 0.7762
Epoch 87/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4168 -
auc: 0.8039 - val_loss: 0.4467 - val_auc: 0.7793
Epoch 88/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4164 -
auc: 0.8042 - val_loss: 0.4500 - val_auc: 0.7799
Epoch 89/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4160 -
auc: 0.8043 - val_loss: 0.4494 - val_auc: 0.7782
Epoch 90/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4157 -
auc: 0.8048 - val_loss: 0.4532 - val_auc: 0.7764
Epoch 91/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4161 -
auc: 0.8044 - val_loss: 0.4542 - val_auc: 0.7769
Epoch 92/100
2545/2545 [==============================] - 3s 983us/step - loss: 0.4158
- auc: 0.8045 - val_loss: 0.4498 - val_auc: 0.7774
Epoch 93/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4157 -
auc: 0.8051 - val_loss: 0.4478 - val_auc: 0.7781
Epoch 94/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4157 -
auc: 0.8049 - val_loss: 0.4522 - val_auc: 0.7764
Epoch 95/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4157 -
auc: 0.8050 - val_loss: 0.4536 - val_auc: 0.7773
Epoch 96/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4152 -
auc: 0.8053 - val_loss: 0.4493 - val_auc: 0.7752
Epoch 97/100
```

```
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4152 -
auc: 0.8051 - val_loss: 0.4492 - val_auc: 0.7748
Epoch 98/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4151 -
auc: 0.8053 - val_loss: 0.4535 - val_auc: 0.7766
Epoch 99/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4146 -
auc: 0.8055 - val_loss: 0.4554 - val_auc: 0.7768
Epoch 100/100
2545/2545 [==============================] - 2s 974us/step - loss: 0.4151
- auc: 0.8054 - val_loss: 0.4536 - val_auc: 0.7773
Epoch 1/100
2533/2545 [============================>.] - ETA: 0s - loss: 0.4886 - auc:
0.7372INFO:tensorflow:Assets written to: best_model/assets
INFO:tensorflow:Assets written to: best_model/assets
2545/2545 [==============================] - 7s 2ms/step - loss: 0.4885 -
auc: 0.7374 - val_loss: 0.4417 - val_auc: 0.7815
Epoch 2/100
2504/2545 [============================>.] - ETA: 0s - loss: 0.4471 - auc:
0.7713INFO:tensorflow:Assets written to: best_model/assets
INFO:tensorflow:Assets written to: best_model/assets
2545/2545 [==============================] - 5s 2ms/step - loss: 0.4474 -
auc: 0.7712 - val_loss: 0.4391 - val_auc: 0.7855
Epoch 3/100
2540/2545 [============================>.] - ETA: 0s - loss: 0.4447 - auc:
0.7747INFO:tensorflow:Assets written to: best_model/assets
INFO:tensorflow:Assets written to: best_model/assets
2545/2545 [==============================] - 5s 2ms/step - loss: 0.4447 -
auc: 0.7748 - val_loss: 0.4362 - val_auc: 0.7858
Epoch 4/100
2518/2545 [============================>.] - ETA: 0s - loss: 0.4430 - auc:
0.7765INFO:tensorflow:Assets written to: best_model/assets
INFO:tensorflow:Assets written to: best_model/assets
2545/2545 [==============================] - 5s 2ms/step - loss: 0.4432 -
auc: 0.7764 - val_loss: 0.4362 - val_auc: 0.7860
Epoch 5/100
2545/2545 [==============================] - 4s 1ms/step - loss: 0.4432 -
auc: 0.7764 - val_loss: 0.4339 - val_auc: 0.7852
Epoch 6/100
2538/2545 [============================>.] - ETA: 0s - loss: 0.4423 - auc:
0.7767INFO:tensorflow:Assets written to: best_model/assets
INFO:tensorflow:Assets written to: best_model/assets
2545/2545 [==============================] - 5s 2ms/step - loss: 0.4424 -
auc: 0.7766 - val_loss: 0.4341 - val_auc: 0.7870
Epoch 7/100
2527/2545 [============================>.] - ETA: 0s - loss: 0.4418 - auc:
0.7780INFO:tensorflow:Assets written to: best_model/assets
INFO:tensorflow:Assets written to: best_model/assets
```

```
2545/2545 [==============================] - 5s 2ms/step - loss: 0.4420 -
auc: 0.7778 - val_loss: 0.4331 - val_auc: 0.7873
Epoch 8/100
2545/2545 [==============================] - 4s 1ms/step - loss: 0.4425 -
auc: 0.7774 - val_loss: 0.4332 - val_auc: 0.7866
Epoch 9/100
2545/2545 [==============================] - 4s 2ms/step - loss: 0.4413 -
auc: 0.7789 - val_loss: 0.4329 - val_auc: 0.7869
Epoch 10/100
2523/2545 [============================>.] - ETA: 0s - loss: 0.4426 - auc:
0.7770INFO:tensorflow:Assets written to: best_model/assets
INFO:tensorflow:Assets written to: best_model/assets
2545/2545 [==============================] - 5s 2ms/step - loss: 0.4423 -
auc: 0.7772 - val_loss: 0.4315 - val_auc: 0.7874
Epoch 11/100
2545/2545 [==============================] - 4s 1ms/step - loss: 0.4421 -
auc: 0.7776 - val_loss: 0.4338 - val_auc: 0.7869
Epoch 12/100
2545/2545 [==============================] - 4s 2ms/step - loss: 0.4416 -
auc: 0.7775 - val_loss: 0.4333 - val_auc: 0.7866
Epoch 13/100
2545/2545 [==============================] - 4s 1ms/step - loss: 0.4415 -
auc: 0.7781 - val_loss: 0.4320 - val_auc: 0.7867
Epoch 14/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4412 -
auc: 0.7787 - val_loss: 0.4317 - val_auc: 0.7873
Epoch 15/100
2545/2545 [==============================] - 3s 1ms/step - loss: 0.4414 -
auc: 0.7781 - val_loss: 0.4333 - val_auc: 0.7869
Epoch 16/100
2545/2545 [==============================] - 4s 1ms/step - loss: 0.4412 -
auc: 0.7781 - val_loss: 0.4337 - val_auc: 0.7869
Epoch 17/100
2545/2545 [==============================] - 4s 1ms/step - loss: 0.4415 -
auc: 0.7779 - val_loss: 0.4322 - val_auc: 0.7866
Epoch 18/100
2545/2545 [==============================] - 4s 1ms/step - loss: 0.4408 -
auc: 0.7792 - val_loss: 0.4329 - val_auc: 0.7867
Epoch 19/100
2545/2545 [==============================] - 4s 1ms/step - loss: 0.4401 -
auc: 0.7802 - val_loss: 0.4350 - val_auc: 0.7872
Epoch 20/100
2545/2545 [==============================] - 4s 1ms/step - loss: 0.4410 -
auc: 0.7782 - val_loss: 0.4320 - val_auc: 0.7869
637/637 [==============================] - 1s 794us/step - loss: 0.4315 -
auc: 0.7874
Test AUC: 0.7873856425285339
```



In [12]:
```
best_model = tf.keras.models.load_model('best_model')
_, test_auc = best_model.evaluate(X_test_scaled, y_test)
print(f'Test AUC: {test_auc}')
```

```
637/637 [==============================] - 1s 841us/step - loss: 0.4315 -
auc: 0.7874
Test AUC: 0.7873856425285339
```

In [ ]: