Task:

Take this dataset for bank customer churn prediction: https://www.kaggle.com/barelydedicated/bank-customer-churn-modeling

1) Build a deep learning model to predict churn rate at bank.

2) Once model is built, print classification report and analyze precision, recall and f1-score

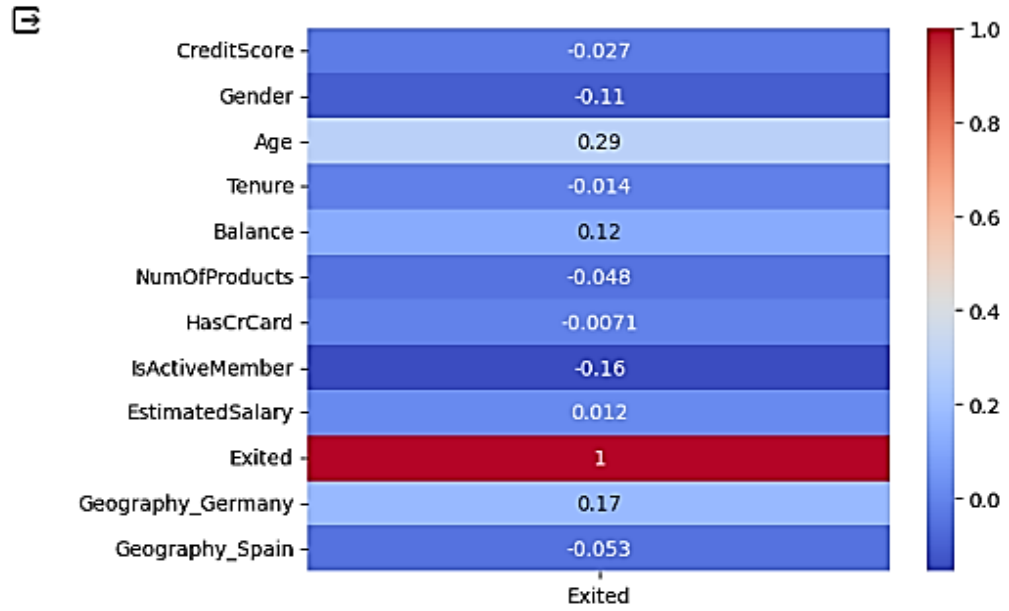
```
import pandas as pd
```

```
[115] data=pd.read_csv('/content/drive/MyDrive/AI Lab Semester 5/AI Lab 11/Churn_Modelling.csv')
```

```
[116] data
```

	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary	Exited
0	1	15634602	Hargrave	619	France	Female	42	2	0.00	1	1	1	101348.88	1
1	2	15647311	Hill	608	Spain	Female	41	1	83807.86	1	0	1	112542.58	0
2	3	15619304	Onio	502	France	Female	42	8	159660.80	3	1	0	113931.57	1
3	4	15701354	Boni	699	France	Female	39	1	0.00	2	0	0	93826.63	0
4	5	15737888	Mitchell	850	Spain	Female	43	2	125510.82	1	1	1	79084.10	0
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
9995	9996	15606229	Obijiaku	771	France	Male	39	5	0.00	2	1	0	96270.64	0
9996	9997	15569892	Johnstone	516	France	Male	35	10	57369.61	1	1	1	101699.77	0
9997	9998	15584532	Liu	709	France	Female	36	7	0.00	1	0	1	42085.58	1
9998	9999	15682355	Sabbatini	772	Germany	Male	42	3	75075.31	2	1	0	92888.52	1
9999	10000	15628319	Walker	792	France	Female	28	4	130142.79	1	1	0	38190.78	0

```
import seaborn as sns
correlation_matrix = data.corr()
sns.heatmap(correlation_matrix[['Exited']], annot=True, cmap='coolwarm')
plt.show()
```



Drop irrelevant columns

```
[117] data = data.drop(['RowNumber', 'CustomerId', 'Surname'], axis=1)
```

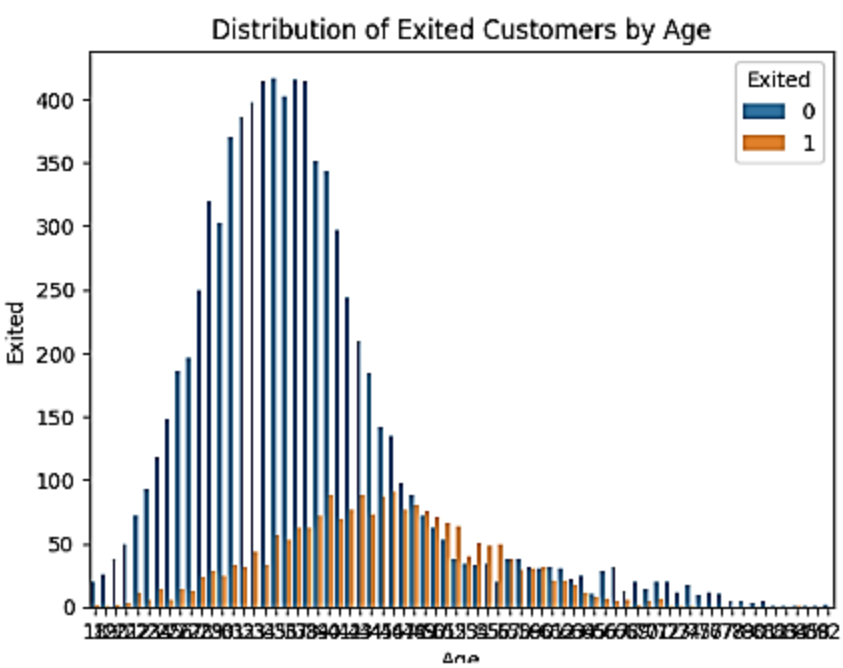
Encode categorical variables

```
[118] from sklearn.preprocessing import StandardScaler, LabelEncoder
```

```
[119] le = LabelEncoder()
      data['Gender'] = le.fit_transform(data['Gender'])
      data = pd.get_dummies(data, columns=['Geography'], drop_first=True)
```

```
[122] import matplotlib.pyplot as plt
      import seaborn as sns
```

```
[136] sns.countplot(x='Age', hue='Exited', data=data)
      plt.title('Distribution of Exited Customers by Age')
      plt.xlabel('Age')
      plt.ylabel('Exited')
      plt.show()
```

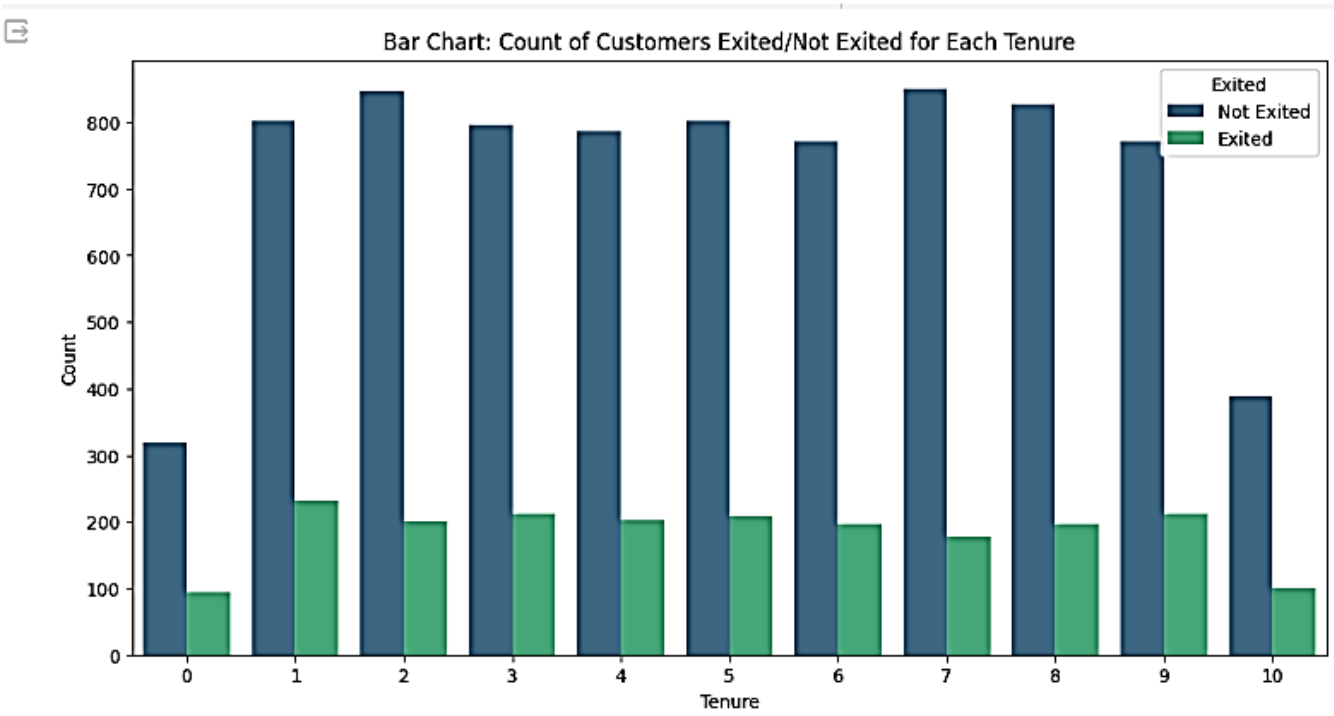


Split the data

```
[121] X = data['Tenure']
      y = data['Exited']
```

Bar chart

```
[123] plt.figure(figsize=(12, 6))
      sns.countplot(x='Tenure', hue='Exited', data=data, palette='viridis')
      plt.title('Bar Chart: Count of Customers Exited/Not Exited for Each Tenure')
      plt.xlabel('Tenure')
      plt.ylabel('Count')
      plt.legend(title='Exited', loc='upper right', labels=['Not Exited', 'Exited'])
      plt.show()
```




```
[120] from sklearn.model_selection import train_test_split
```

```
[124] X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3, random_state=10)
```

```
[126] from sklearn.metrics import classification_report
      from tensorflow.keras.models import Sequential
      from tensorflow.keras.layers import Dense
```

Model

```
[127] model = Sequential()
      model.add(Dense(64, input_dim=1, activation='relu'))
      model.add(Dense(32, activation='relu'))
      model.add(Dense(1, activation='sigmoid'))
```

```
[128] model.compile(loss='binary_crossentropy', optimizer='adam', metrics=['accuracy'])
```

```
[129] model.fit(X_train, y_train, epochs=10, batch_size=32, validation_split=0.2)
```

```
Epoch 1/10
175/175 [==============================] - 2s 4ms/step - loss: 0.5338 - accuracy: 0.7950 - val_loss: 0.5044 - val_accuracy: 0.8079
Epoch 2/10
175/175 [==============================] - 1s 4ms/step - loss: 0.5140 - accuracy: 0.7950 - val_loss: 0.4924 - val_accuracy: 0.8079
Epoch 3/10
175/175 [==============================] - 1s 3ms/step - loss: 0.5112 - accuracy: 0.7950 - val_loss: 0.4950 - val_accuracy: 0.8079
Epoch 4/10
175/175 [==============================] - 1s 3ms/step - loss: 0.5097 - accuracy: 0.7950 - val_loss: 0.4929 - val_accuracy: 0.8079
Epoch 5/10
175/175 [==============================] - 1s 3ms/step - loss: 0.5103 - accuracy: 0.7950 - val_loss: 0.4908 - val_accuracy: 0.8079
Epoch 6/10
175/175 [==============================] - 0s 3ms/step - loss: 0.5091 - accuracy: 0.7950 - val_loss: 0.4907 - val_accuracy: 0.8079
Epoch 7/10
175/175 [==============================] - 0s 3ms/step - loss: 0.5109 - accuracy: 0.7950 - val_loss: 0.4936 - val_accuracy: 0.8079
Epoch 8/10
175/175 [==============================] - 1s 3ms/step - loss: 0.5108 - accuracy: 0.7950 - val_loss: 0.4919 - val_accuracy: 0.8079
Epoch 9/10
175/175 [==============================] - 1s 3ms/step - loss: 0.5098 - accuracy: 0.7950 - val_loss: 0.4943 - val_accuracy: 0.8079
Epoch 10/10
175/175 [==============================] - 1s 4ms/step - loss: 0.5085 - accuracy: 0.7950 - val_loss: 0.4911 - val_accuracy: 0.8079
<keras.src.callbacks.History at 0x7875258795a0>
```

```
y_pred = model.predict(X_test)
y_pred = (y_pred > 0.5).astype(int)
print(classification_report(y_test, y_pred))
```

```
94/94 [==============================] - 0s 2ms/step
              precision    recall  f1-score   support

           0       0.79      1.00      0.88      2380
           1       0.00      0.00      0.00       620

    accuracy                           0.79      3000
   macro avg       0.40      0.50      0.44      3000
weighted avg       0.63      0.79      0.70      3000

/usr/local/lib/python3.10/dist-packages/sklearn/metrics/_classification.py:1344: Undefi
  _warn_prf(average, modifier, msg_start, len(result))
/usr/local/lib/python3.10/dist-packages/sklearn/metrics/_classification.py:1344: Undefi
  _warn_prf(average, modifier, msg_start, len(result))
/usr/local/lib/python3.10/dist-packages/sklearn/metrics/_classification.py:1344: Undefi
  _warn_prf(average, modifier, msg_start, len(result))
```

```
[131] accuracy=model.evaluate(X_test,y_pred)
      accuracy
```

```
94/94 [==============================] - 0s 3ms/step - loss: 0.2040 - accuracy: 1.0000
[0.20400972664356232, 1.0]
```