In [95]:
```
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.linear_model import LogisticRegression
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import accuracy_score, classification_report, confusion_matri
```

In [94]:
```
#made by yours truly, Mohamed Ehab
```

In [2]:
```
df = pd.read_csv("Bank Customer Churn Prediction.csv")
```

In [4]:
```
df.head()
```

Out[4]:

	customer_id	credit_score	country	gender	age	tenure	balance	products_number	credit_card
0	15634602	619	France	Female	42	2	0.00	1	1
1	15647311	608	Spain	Female	41	1	83807.86	1	0
2	15619304	502	France	Female	42	8	159660.80	3	1
3	15701354	699	France	Female	39	1	0.00	2	0
4	15737888	850	Spain	Female	43	2	125510.82	1	1

In [6]:
```
df = df.drop(columns=["customer_id"])
```

In [8]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10000 entries, 0 to 9999
Data columns (total 11 columns):
 #   Column            Non-Null Count  Dtype  
---  ------            --------------  -----  
 0   credit_score      10000 non-null  int64  
 1   country           10000 non-null  object 
 2   gender            10000 non-null  object 
 3   age               10000 non-null  int64  
 4   tenure            10000 non-null  int64  
 5   balance           10000 non-null  float64
 6   products_number   10000 non-null  int64  
 7   credit_card       10000 non-null  int64  
 8   active_member     10000 non-null  int64  
 9   estimated_salary  10000 non-null  float64
 10  churn             10000 non-null  int64  
dtypes: float64(2), int64(7), object(2)
memory usage: 859.5+ KB
```

In [15]:
```
print(df.isnull().sum())
print("\nduplicated: ",df.duplicated().sum())
```

```
credit_score        0
country             0
gender              0
age                 0
tenure              0
balance             0
products_number     0
credit_card         0
active_member       0
estimated_salary    0
churn               0
dtype: int64

duplicated:  0
```

In [20]:
```
df['country'].unique()
```

Out[20]:
```
array(['France', 'Spain', 'Germany'], dtype=object)
```

In [21]:
```
df['products_number'].unique()
```

Out[21]:
```
array([1, 3, 2, 4], dtype=int64)
```

In [26]:
```
df = pd.get_dummies(df, drop_first=True)
```

In [41]:
```
df.head()
```

Out[41]:

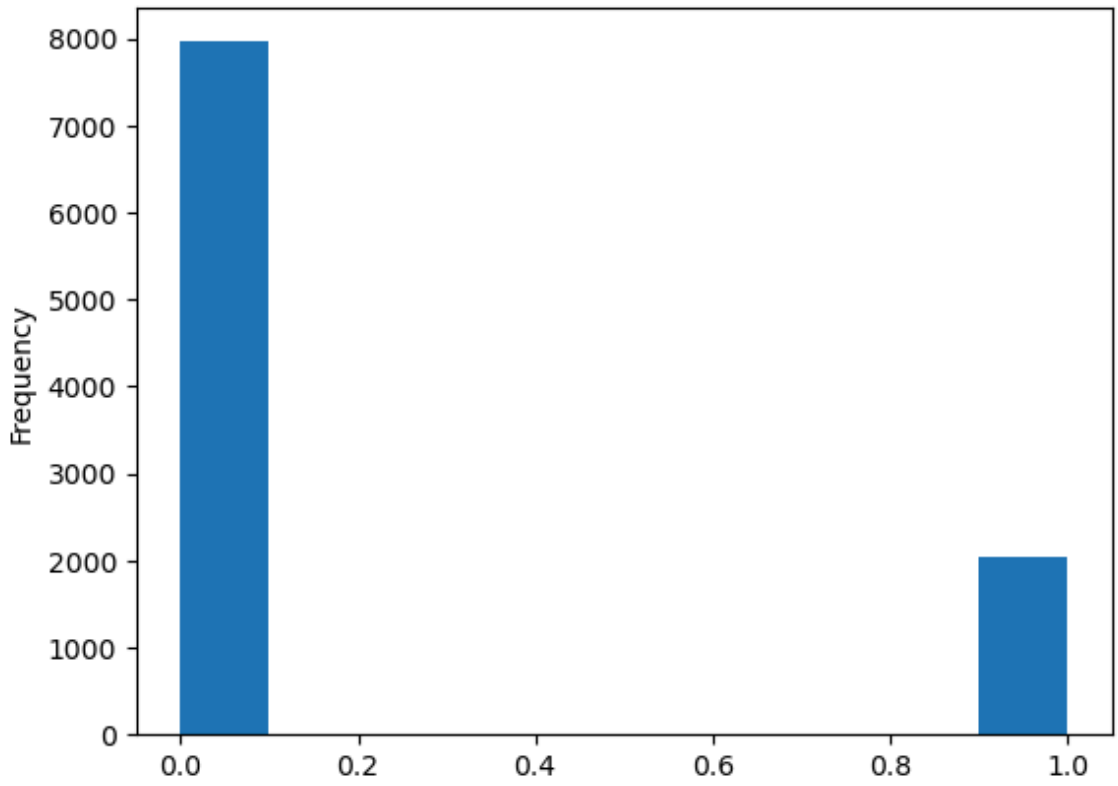
	credit_score	age	tenure	balance	products_number	credit_card	active_member	estimated_sala
0	619	42	2	0.00	1	1	1	101348.
1	608	41	1	83807.86	1	0	1	112542.
2	502	42	8	159660.80	3	1	0	113931.
3	699	39	1	0.00	2	0	0	93826.
4	850	43	2	125510.82	1	1	1	79084.

In [42]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10000 entries, 0 to 9999
Data columns (total 12 columns):
 #   Column            Non-Null Count  Dtype  
---  ------            --------------  -----  
 0   credit_score      10000 non-null  int64  
 1   age               10000 non-null  int64  
 2   tenure            10000 non-null  int64  
 3   balance           10000 non-null  float64
 4   products_number   10000 non-null  int64  
 5   credit_card       10000 non-null  int64  
 6   active_member     10000 non-null  int64  
 7   estimated_salary  10000 non-null  float64
 8   churn             10000 non-null  int64  
 9   country_Germany   10000 non-null  bool   
 10  country_Spain     10000 non-null  bool   
 11  gender_Male       10000 non-null  bool   
dtypes: bool(3), float64(2), int64(7)
memory usage: 732.6 KB
```

In [32]:
```
df.churn.plot.hist()
```

Out[32]: <Axes: ylabel='Frequency'>



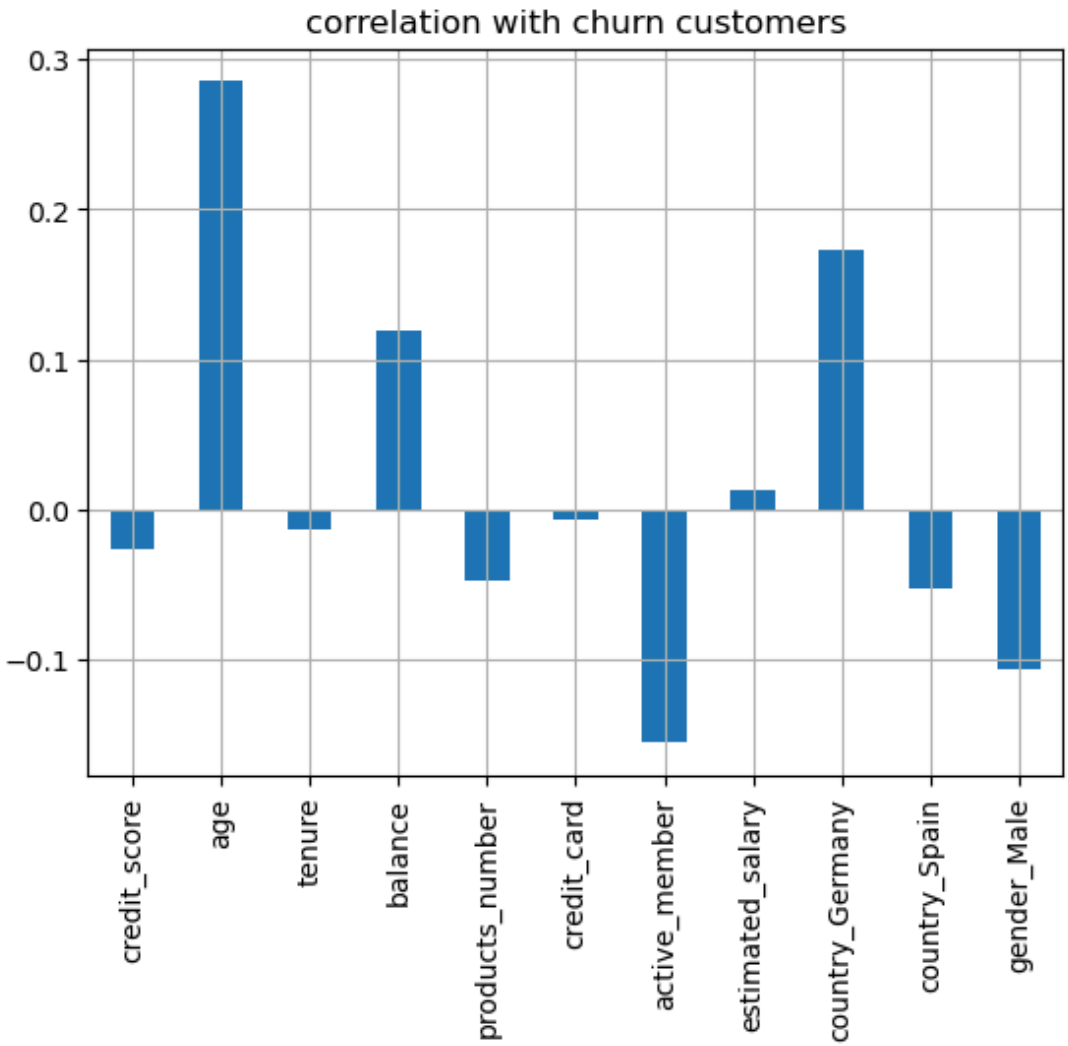
In [37]:
```
loyal = (df.churn==0).sum()
churned = (df.churn==1).sum()
print(f"{loyal} is still bank customers\n{churned} has left the bank.")
```

```
7963 is still bank customers
2037 has left the bank.
```

In [56]:
```
X = df.drop(columns='churn')
y = df['churn']
```

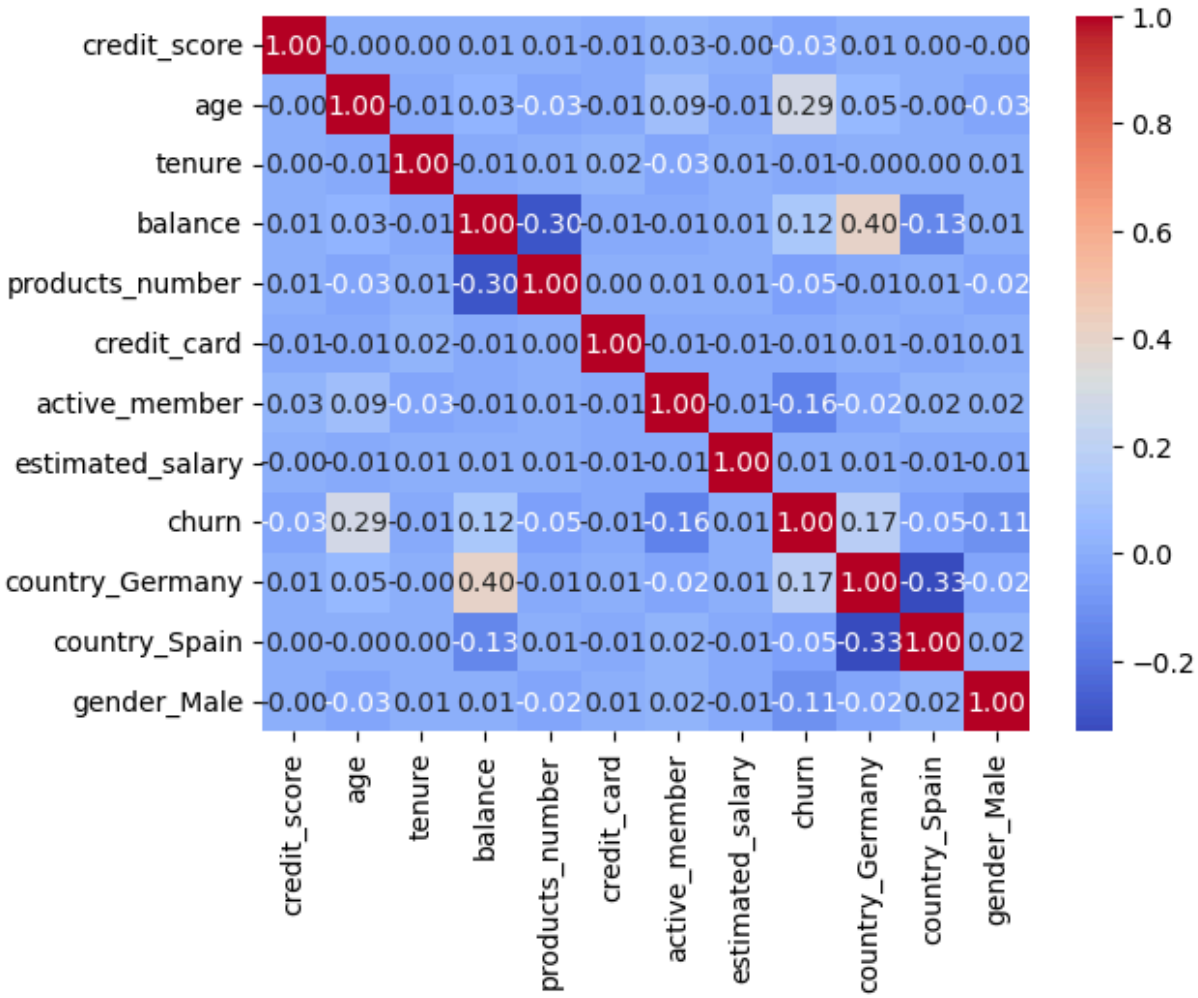
In [57]:
```
X.corrwith(df['churn']).plot.bar(title='correlation with churn customers', grid=Tr
```

Out[57]: <Axes: title={'center': 'correlation with churn customers'}>



In [51]:
```
sns.heatmap(df.corr(), annot=True, cmap="coolwarm", fmt='.2f')
```

Out[51]: <Axes: >



In [68]:
```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2)
```

In [71]:
```
scaler = StandardScaler()
X_train = scaler.fit_transform(X_train)
X_test = scaler.transform(X_test)
```

In [72]:
```
model = LogisticRegression()
model.fit(X_train, y_train)
```

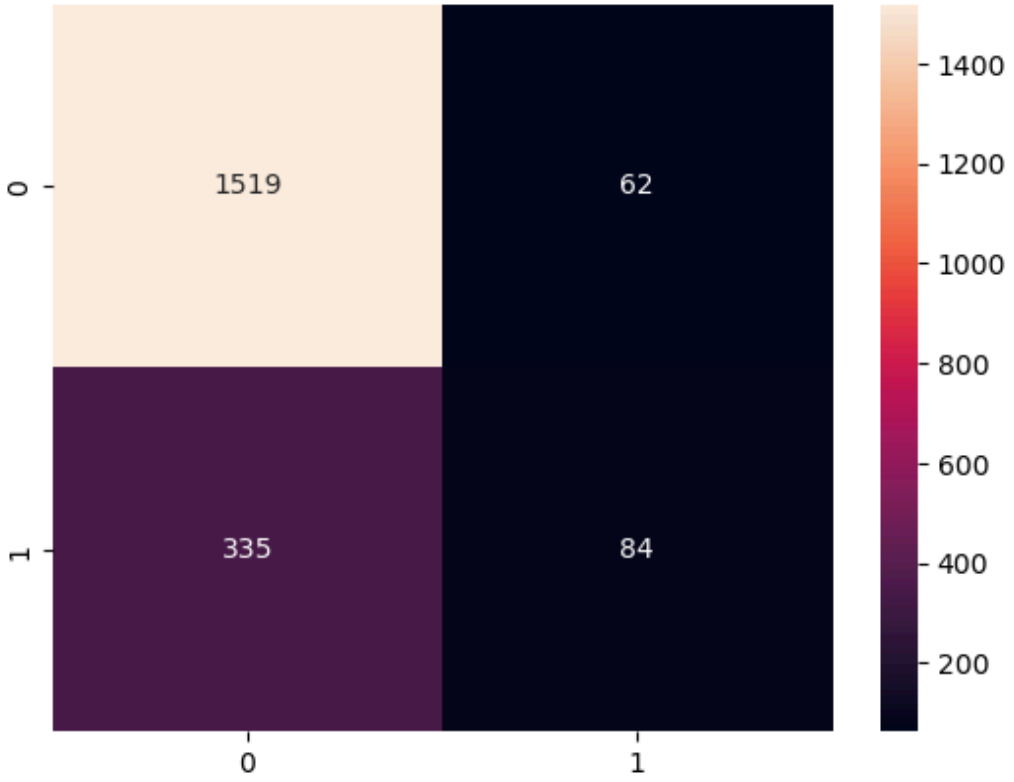
Out[72]:
```
▾ LogisticRegression
LogisticRegression()
```

In [73]:
```
y_pred = model.predict(X_test)
accuracy = accuracy_score(y_test, y_pred)
print("Accuracy: {:.2f}%".format(accuracy * 100))
```

```
Accuracy: 80.15%
```

In [93]:
```
sns.heatmap(confusion_matrix(y_test, y_pred), annot=True, fmt='.0f')
```

Out[93]: <Axes: >



In [83]:
```
print("\nClassification Report:\n", classification_report(y_test, y_pred))
```

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

           0       0.82      0.96      0.88      1581
           1       0.58      0.20      0.30       419

    accuracy                           0.80      2000
   macro avg       0.70      0.58      0.59      2000
weighted avg       0.77      0.80      0.76      2000
```

In [ ]:
```

```