In [8]:

```
# Importing dependencies

import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns

from sklearn.model_selection import train_test_split
from sklearn.ensemble import RandomForestClassifier
from sklearn import metrics
from sklearn.metrics import accuracy_score
from sklearn.metrics import classification_report

import warnings
warnings.filterwarnings('ignore')

data = pd.read_csv("heart.csv")

data.head(10)
```

Out[8]:

| | age | sex | cp | trestbps | chol | fbs | restecg | thalach | exang | oldpeak | slope | ca | thal | target |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 52 | 1 | 0 | 125 | 212 | 0 | 1 | 168 | 0 | 1.0 | 2 | 2 | 3 | 0 |
| **1** | 53 | 1 | 0 | 140 | 203 | 1 | 0 | 155 | 1 | 3.1 | 0 | 0 | 3 | 0 |
| **2** | 70 | 1 | 0 | 145 | 174 | 0 | 1 | 125 | 1 | 2.6 | 0 | 0 | 3 | 0 |
| **3** | 61 | 1 | 0 | 148 | 203 | 0 | 1 | 161 | 0 | 0.0 | 2 | 1 | 3 | 0 |
| **4** | 62 | 0 | 0 | 138 | 294 | 1 | 1 | 106 | 0 | 1.9 | 1 | 3 | 2 | 0 |
| **5** | 58 | 0 | 0 | 100 | 248 | 0 | 0 | 122 | 0 | 1.0 | 1 | 0 | 2 | 1 |
| **6** | 58 | 1 | 0 | 114 | 318 | 0 | 2 | 140 | 0 | 4.4 | 0 | 3 | 1 | 0 |
| **7** | 55 | 1 | 0 | 160 | 289 | 0 | 0 | 145 | 1 | 0.8 | 1 | 1 | 3 | 0 |
| **8** | 46 | 1 | 0 | 120 | 249 | 0 | 0 | 144 | 0 | 0.8 | 2 | 0 | 3 | 0 |
| **9** | 54 | 1 | 0 | 122 | 286 | 0 | 0 | 116 | 1 | 3.2 | 1 | 2 | 2 | 0 |

In [9]:

```
data.describe()
```

Out[9]:

| | age | sex | cp | trestbps | chol | fbs | restecg | thalach | exang | oldpe |
|---|---|---|---|---|---|---|---|---|---|---|
| **count** | 1025.000000 | 1025.000000 | 1025.000000 | 1025.000000 | 1025.00000 | 1025.000000 | 1025.000000 | 1025.000000 | 1025.000000 | 1025.0000 |
| **mean** | 54.434146 | 0.695610 | 0.942439 | 131.611707 | 246.00000 | 0.149268 | 0.529756 | 149.114146 | 0.336585 | 1.0715 |
| **std** | 9.072290 | 0.460373 | 1.029641 | 17.516718 | 51.59251 | 0.356527 | 0.527878 | 23.005724 | 0.472772 | 1.1750 |
| **min** | 29.000000 | 0.000000 | 0.000000 | 94.000000 | 126.00000 | 0.000000 | 0.000000 | 71.000000 | 0.000000 | 0.0000 |
| **25%** | 48.000000 | 0.000000 | 0.000000 | 120.000000 | 211.00000 | 0.000000 | 0.000000 | 132.000000 | 0.000000 | 0.0000 |
| **50%** | 56.000000 | 1.000000 | 1.000000 | 130.000000 | 240.00000 | 0.000000 | 1.000000 | 152.000000 | 0.000000 | 0.8000 |
| **75%** | 61.000000 | 1.000000 | 2.000000 | 140.000000 | 275.00000 | 0.000000 | 1.000000 | 166.000000 | 1.000000 | 1.8000 |
| **max** | 77.000000 | 1.000000 | 3.000000 | 200.000000 | 564.00000 | 1.000000 | 2.000000 | 202.000000 | 1.000000 | 6.2000 |

In [10]:

```
data.shape, data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1025 entries, 0 to 1024
Data columns (total 14 columns):
 #   Column    Non-Null Count  Dtype  
---  ------    --------------  -----  
 0   age       1025 non-null   int64  
 1   sex       1025 non-null   int64  
 2   cp        1025 non-null   int64  
 3   trestbps  1025 non-null   int64  
 4   chol      1025 non-null   int64  
 5   fbs       1025 non-null   int64  
 6   restecg   1025 non-null   int64  
 7   thalach   1025 non-null   int64  
 8   exang     1025 non-null   int64  
 9   oldpeak   1025 non-null   float64
 10  slope     1025 non-null   int64  
 11  ca        1025 non-null   int64  
 12  thal      1025 non-null   int64  
 13  target    1025 non-null   int64  
dtypes: float64(1), int64(13)
memory usage: 112.2 KB
```

Out[10]:

```
((1025, 14), None)
```

In [11]:

```
data['target'].value_counts()
```

Out[11]:

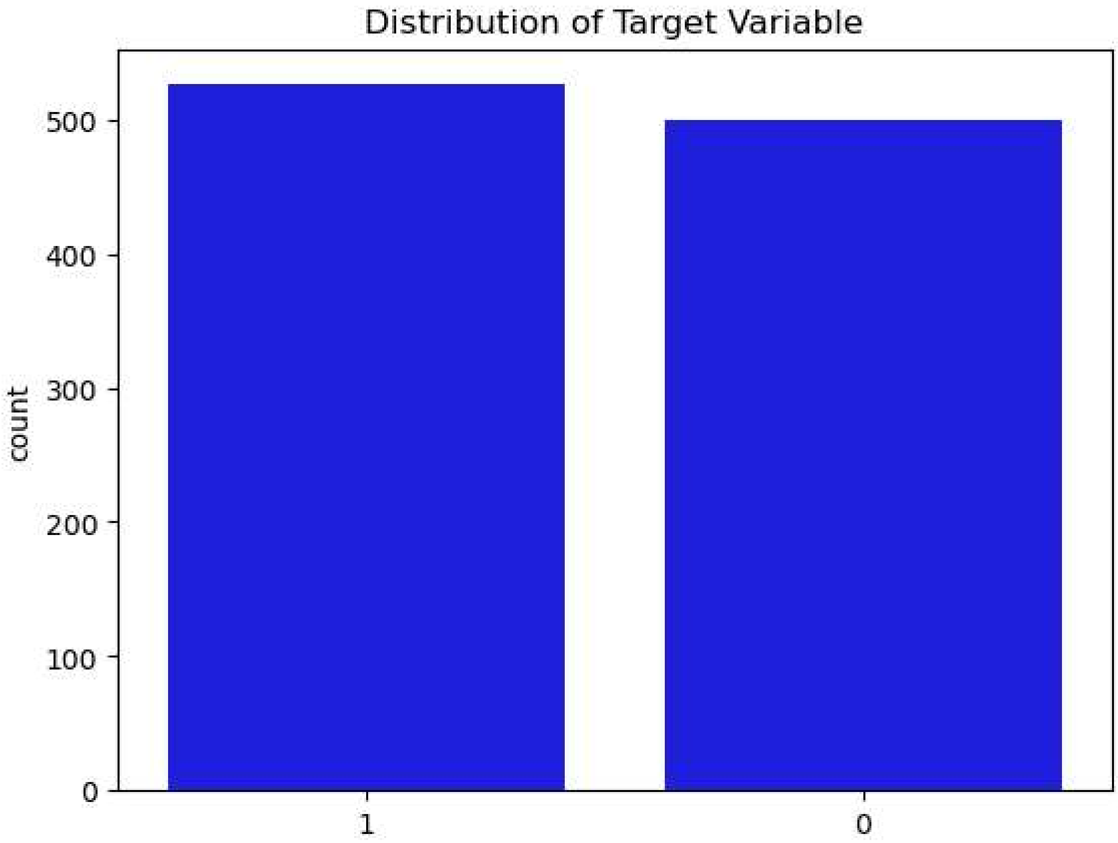
```
target
1    526
0    499
Name: count, dtype: int64
```

In [14]:

```
# More patient values w/ heart disease than there are without.
# Visualizing values.

x = ['1', '0']
y = data['target'].value_counts()

sns.barplot(x=x, y=y, color='blue')
plt.title('Distribution of Target Variable')
plt.show()
```

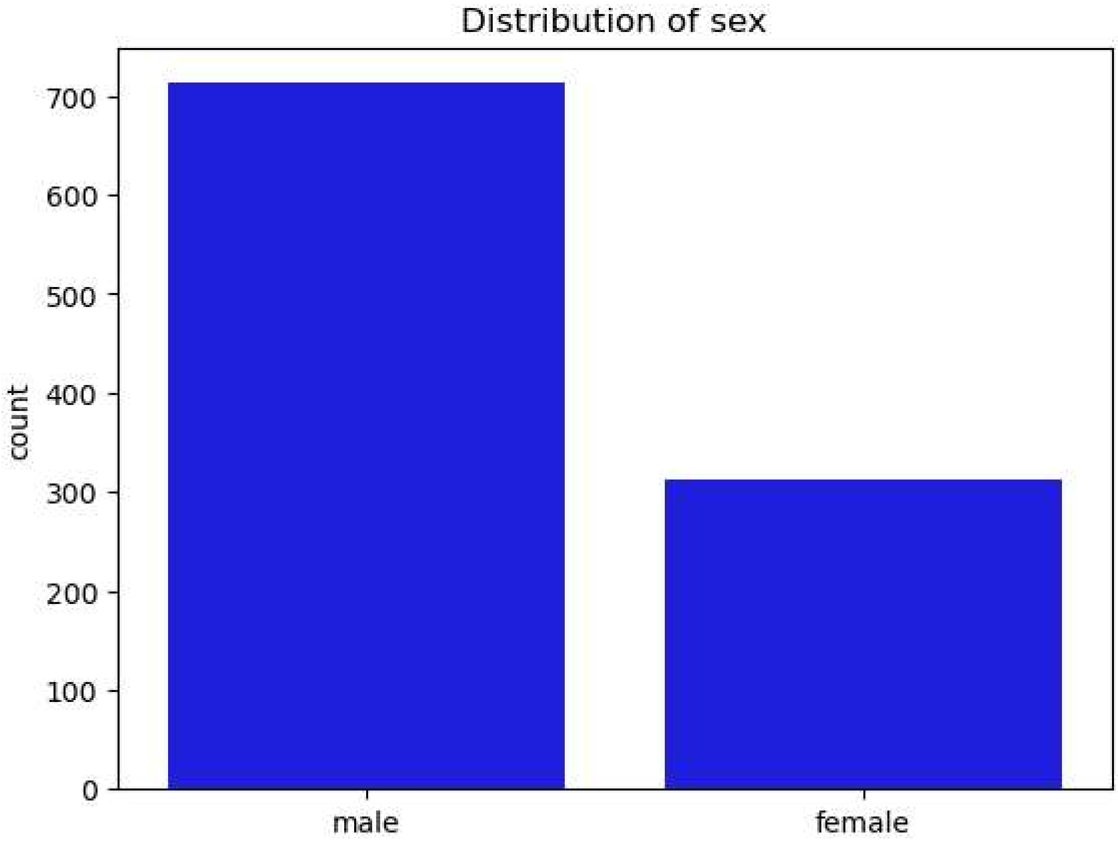


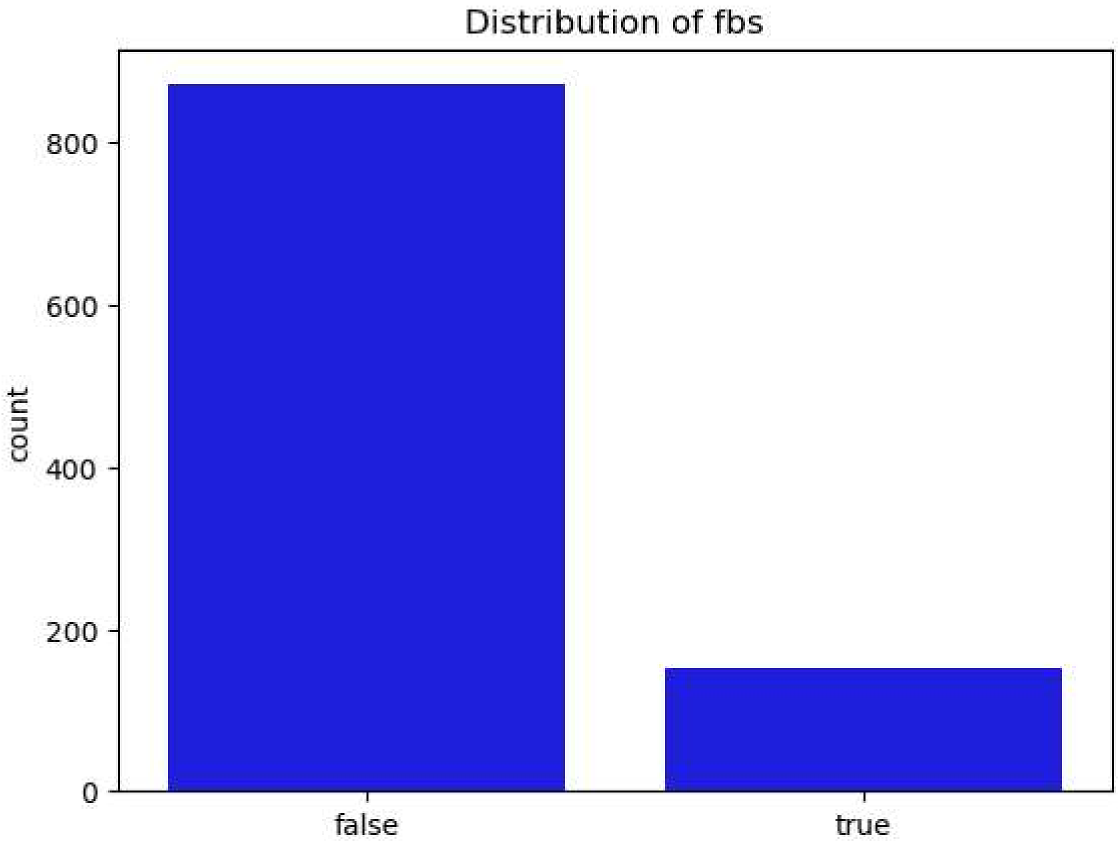
In [15]:

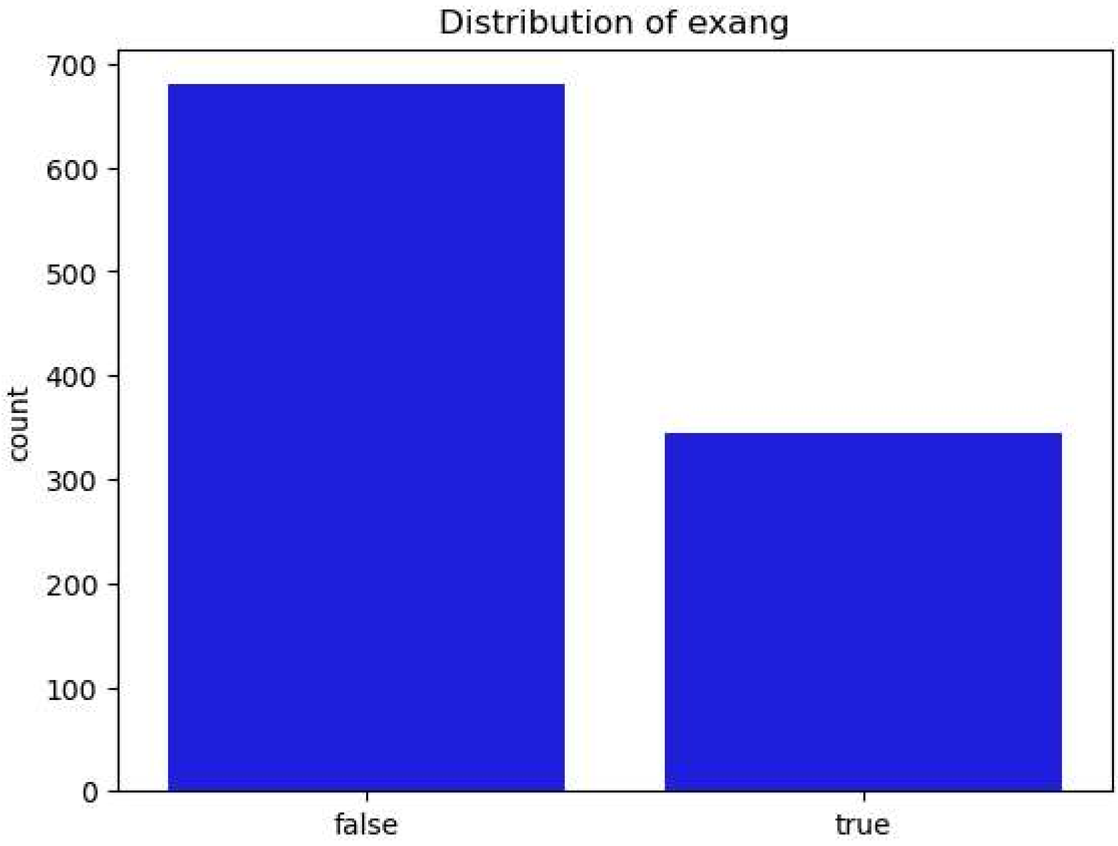
```python
def showBinaryFeatureValues(feature1, feature2, feature):
    x = [feature1, feature2]
    y = data[feature].value_counts()

    sns.barplot(x=x, y=y, color='blue')
    plt.title(f'Distribution of {feature}')
    plt.show()

showBinaryFeatureValues('male', 'female', 'sex')
showBinaryFeatureValues('false', 'true', 'fbs')
showBinaryFeatureValues('false', 'true', 'exang')
```




Distribution of fbs
count
800
600
400
200
0
false
true



In [58]:
```
# Data Preprocessing
# All of the values are already numerical so there is no need for any encoding.

X = data.drop(['target'], axis=1)
Y = data['target']

x_train, x_test, y_train, y_test = train_test_split(X, Y, test_size=0.2)
```

In [ ]:

```
# RandomForest Classification
rfc = RandomForestClassifier(n_estimators=10, max_depth=None, min_samples_split=2,
                             max_leaf_nodes=None, min_samples_leaf=1, max_samples=None, max_features=None)

rfc.fit(x_train, y_train)

predictions = rfc.predict(x_test)
```

In [62]:

```
print("Accuracy:",metrics.accuracy_score(y_test, predictions))
```

```
Accuracy: 0.975609756097561
```

In [63]:

```
# To make the search for the optimal # of trees, we can iterate through a list of range of values and return

def ListComp():
    return [x for x in range(1, 100)]

n_estimators = ListComp()

accuracies = []

for i in n_estimators:
    rfc = RandomForestClassifier(n_estimators=i, max_depth=None, min_samples_split=2, max_leaf_nodes=None, mi
    rfc.fit(x_train, y_train)
    predictions = rfc.predict(x_test)
    accuracies.append(metrics.accuracy_score(y_test, predictions))

#shows the maximum accuracy
max_acc = max(accuracies)
print(max_acc)

# Using sklearn's classification report to see the precision, recall, and f1 score for our model.
classification_report(y_test, predictions)
```

```
1.0
```

Out[63]:

```
'              precision    recall  f1-score   support\n\n           0       1.00      0.97      0.98
89\n           1       0.97      1.00      0.99       116\n\n    accuracy                           0.99
205\n   macro avg       0.99      0.98      0.99       205\nweighted avg       0.99      0.99      0.99
205\n'
```

In [ ]: