Importing the dataset

In [1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import warnings
warnings.simplefilter("ignore")
```

In [2]:
```
## Displaying the csv file
df=pd.read_csv("heart.csv")
df.head()
```

Out[2]:

	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal	targ
0	52	1	0	125	212	0	1	168	0	1.0	2	2	3	
1	53	1	0	140	203	1	0	155	1	3.1	0	0	3	
2	70	1	0	145	174	0	1	125	1	2.6	0	0	3	
3	61	1	0	148	203	0	1	161	0	0.0	2	1	3	
4	62	0	0	138	294	1	1	106	0	1.9	1	3	2	

In [3]:
```
df.info()
```

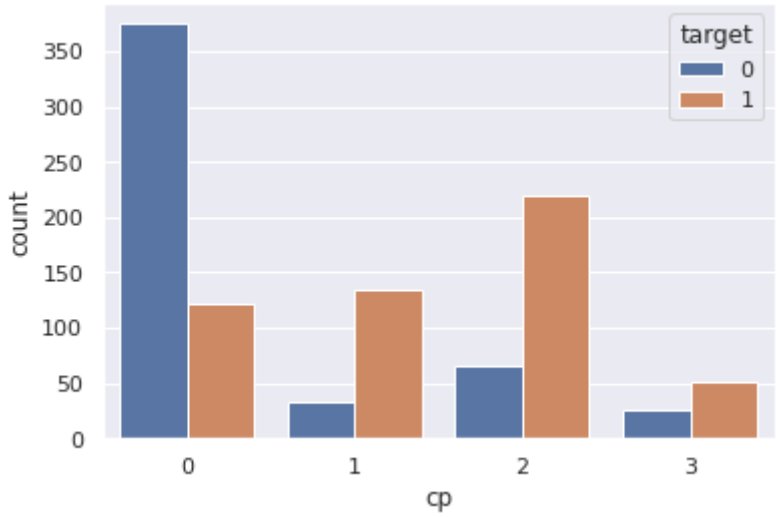
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1025 entries, 0 to 1024
Data columns (total 14 columns):
 #   Column    Non-Null Count  Dtype  
---  ------    --------------  -----  
 0   age       1025 non-null   int64  
 1   sex       1025 non-null   int64  
 2   cp        1025 non-null   int64  
 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
```

In [5]:
```
sns.set_theme(color_codes=True)
```

Data Visualization

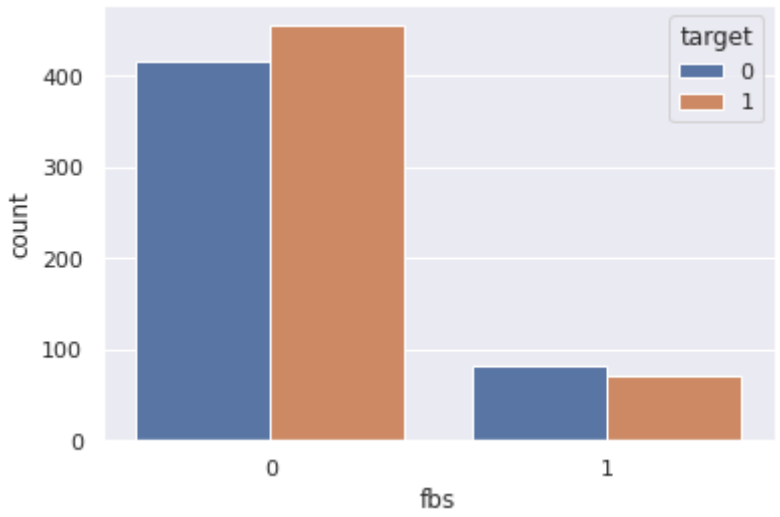
In [6]:
```
sns.countplot(data=df,x="cp",hue="target")
```

Out[6]: <AxesSubplot:xlabel='cp', ylabel='count'>



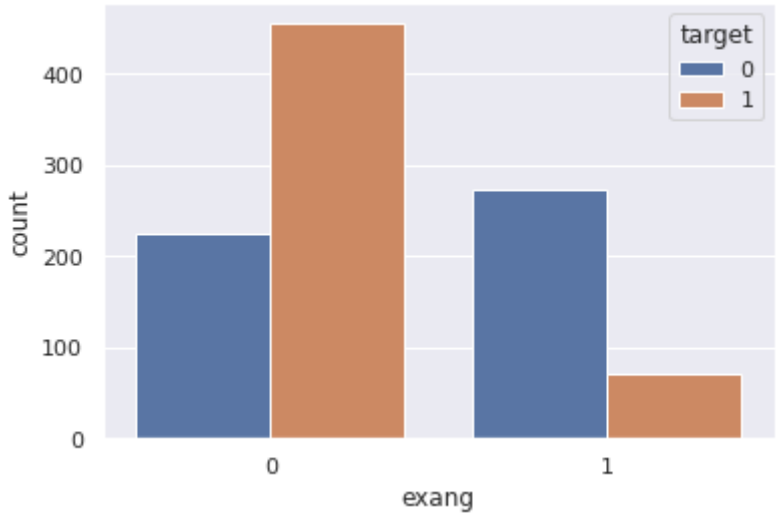
In [9]:
```
sns.countplot(data=df,x="fbs",hue="target")
```

Out[9]: <AxesSubplot:xlabel='fbs', ylabel='count'>



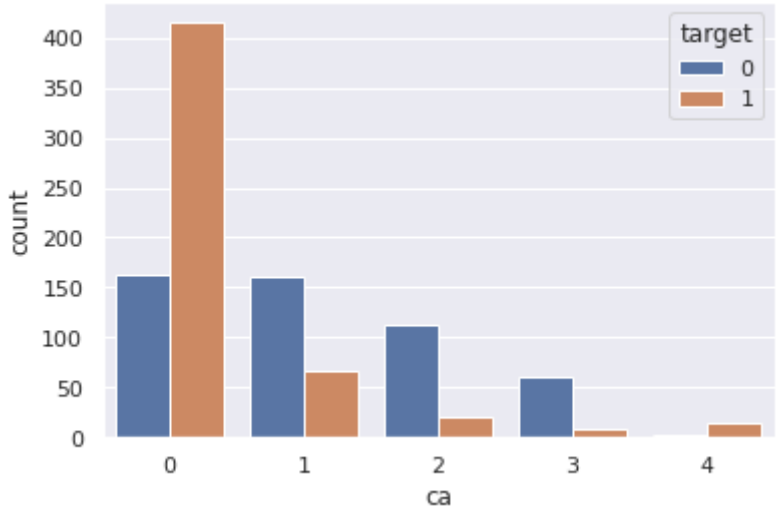
In [10]:
```
sns.countplot(data=df,x="exang",hue="target")
```

Out[10]: <AxesSubplot:xlabel='exang', ylabel='count'>



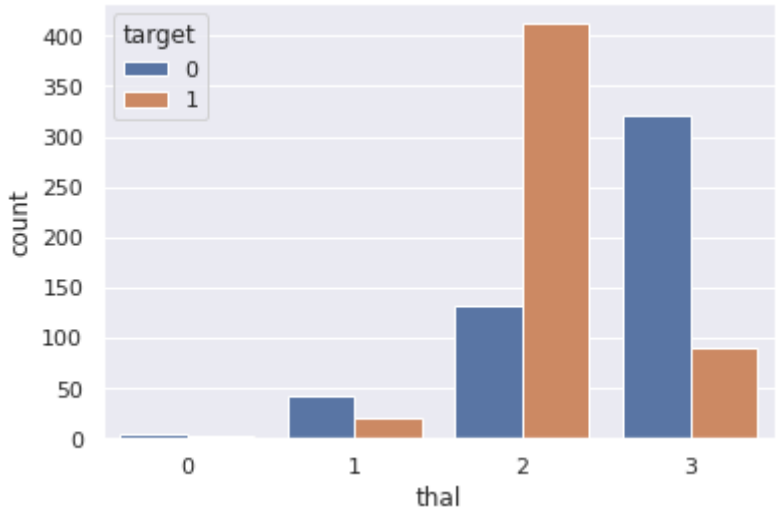
In [11]:
```
sns.countplot(data=df,x="ca",hue="target")
```

Out[11]: <AxesSubplot:xlabel='ca', ylabel='count'>



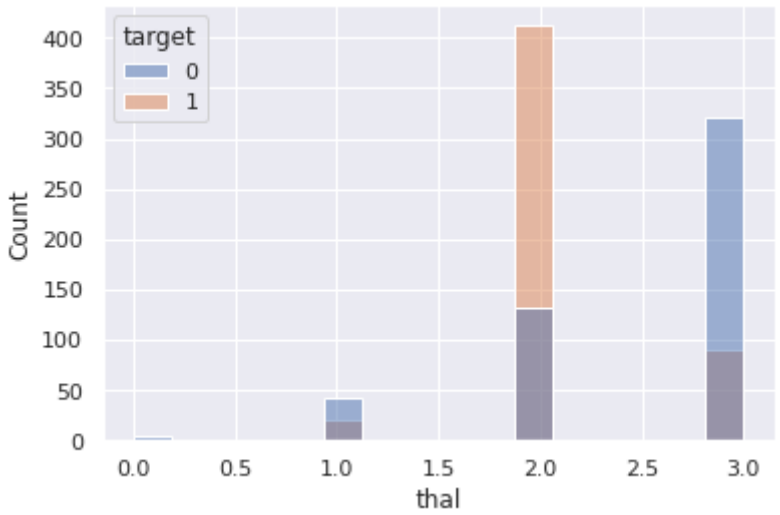
In [12]:
```
sns.countplot(data=df,x="thal",hue="target")
```

Out[12]: <AxesSubplot:xlabel='thal', ylabel='count'>



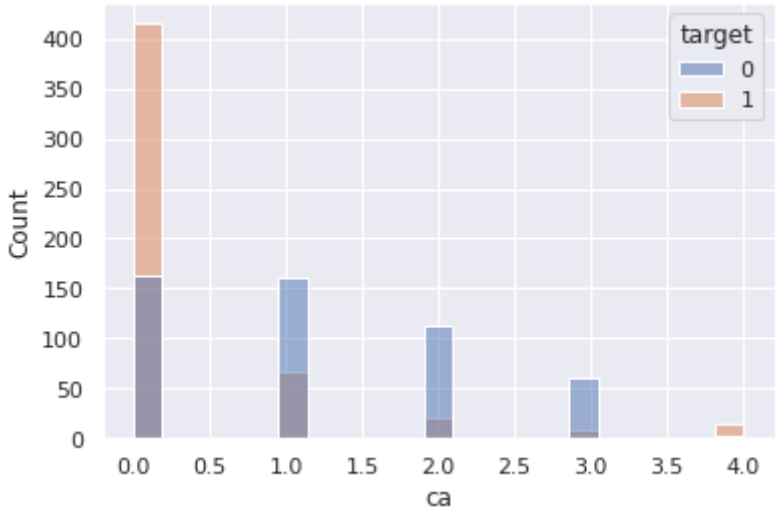
In [13]:
```
sns.histplot(data=df,x="thal",hue="target")
```

Out[13]: <AxesSubplot:xlabel='thal', ylabel='Count'>



In [14]:
```
sns.histplot(data=df,x="ca",hue="target")
```

Out[14]:
```
<AxesSubplot:xlabel='ca', ylabel='Count'>
```



Data precprocessing

In [15]:
```
df.isnull().sum()
```

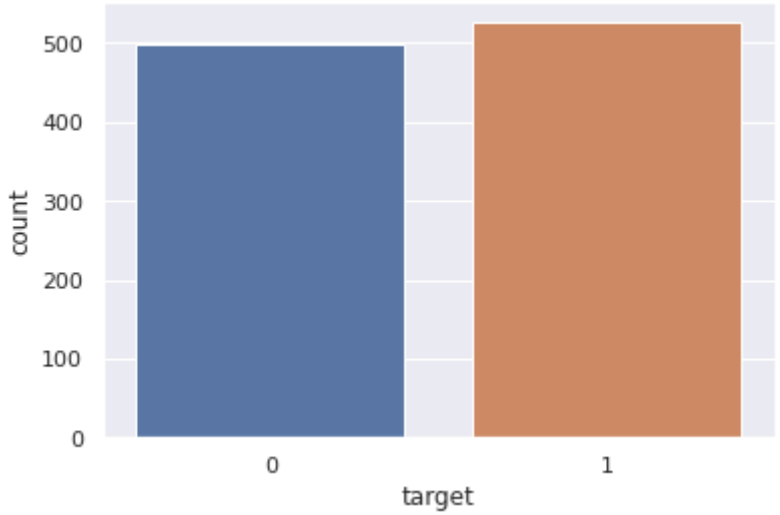
Out[15]:
```
age         0
sex         0
cp          0
trestbps    0
chol        0
fbs         0
restecg     0
thalach     0
exang       0
oldpeak     0
slope       0
ca          0
thal        0
target      0
dtype: int64
```

- We can infer that the dataset does not contain any NAN Values

Checking if the class label is balanced or not

In [18]:
```
sns.countplot(x=df['target'])
print (df.target.value_counts())
```

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



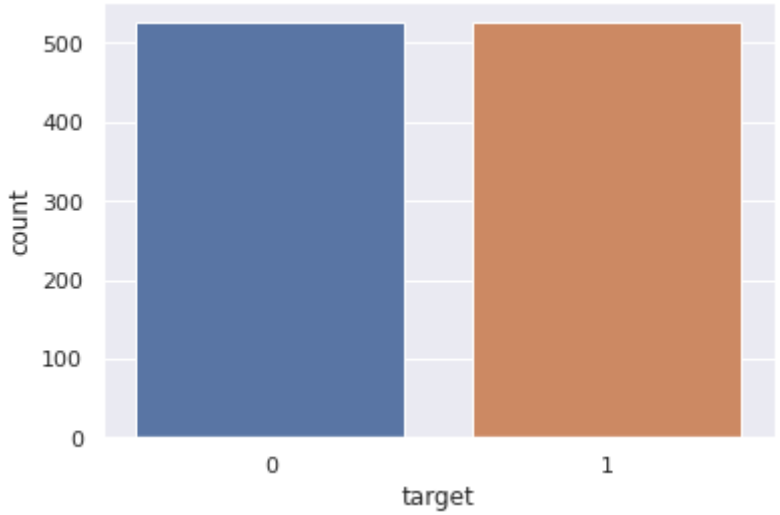
- We can infer that the class label is not balanced

Balancing the class label

In [24]:
```
from sklearn.utils import resample
df_majority=df[(df['target']==1)]
df_minority=df[(df['target']==0)]
df_minority_upsampled=resample(df_minority,n_samples=526,random_state
df2=pd.concat([df_majority,df_minority_upsampled])
```

In [26]:
```
sns.countplot(x=df2['target'])
print (df2.target.value_counts())
```

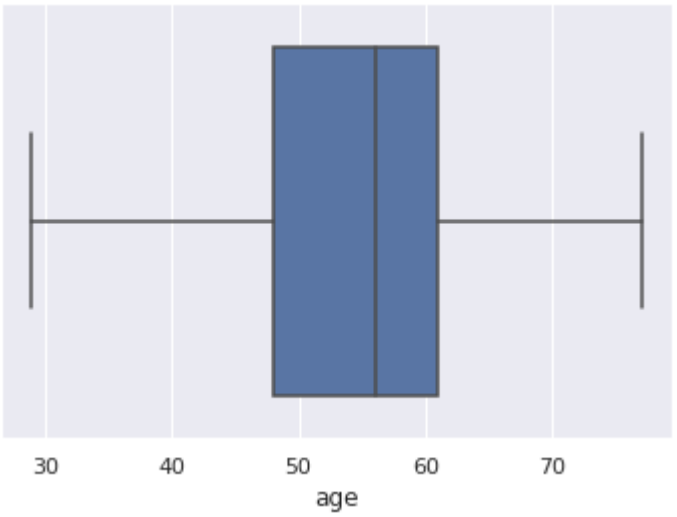
```
1    526
0    526
Name: target, dtype: int64
```



Checking for the impurities

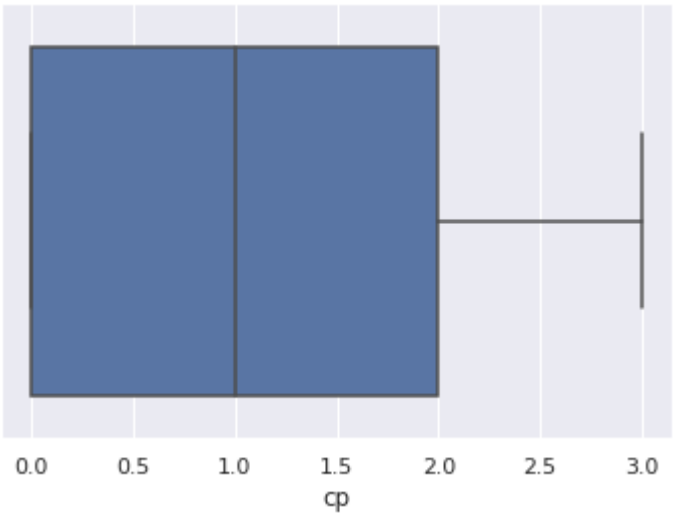
In [27]:
```
sns.boxplot(x=df["age"])
```

Out[27]: <AxesSubplot:xlabel='age'>



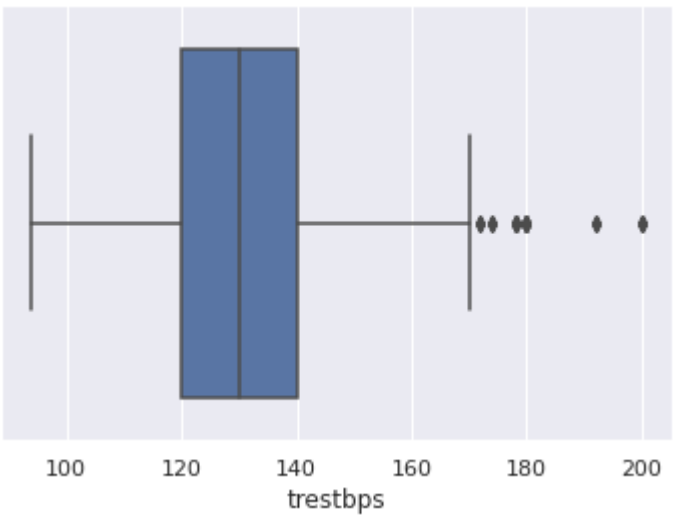
In [28]:
```
sns.boxplot(x=df["cp"])
```

Out[28]: <AxesSubplot:xlabel='cp'>



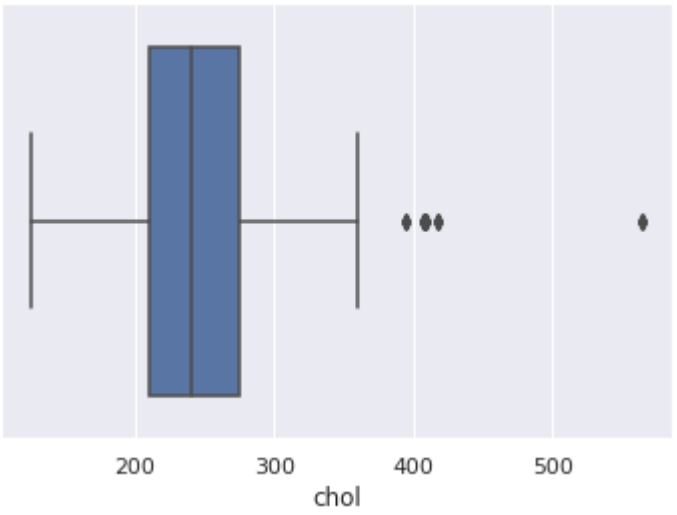
In [29]:
```
sns.boxplot(x=df["trestbps"])
```

Out[29]: <AxesSubplot:xlabel='trestbps'>



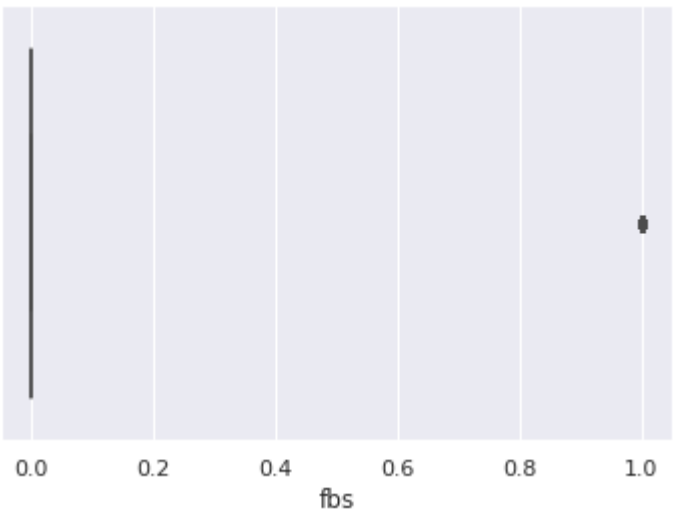
In [30]:
```
sns.boxplot(x=df["chol"])
```

Out[30]: <AxesSubplot:xlabel='chol'>



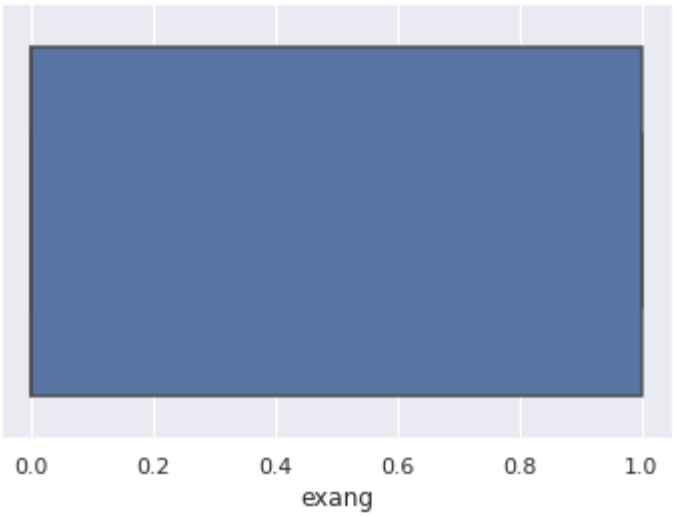
In [31]:
```
sns.boxplot(x=df["fbs"])
```

Out[31]: <AxesSubplot:xlabel='fbs'>



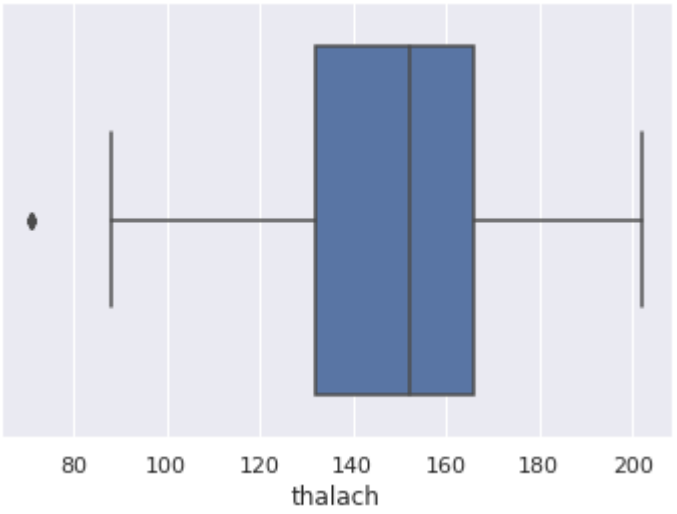
In [32]:
```
sns.boxplot(x=df["exang"])
```

Out[32]: <AxesSubplot:xlabel='exang'>



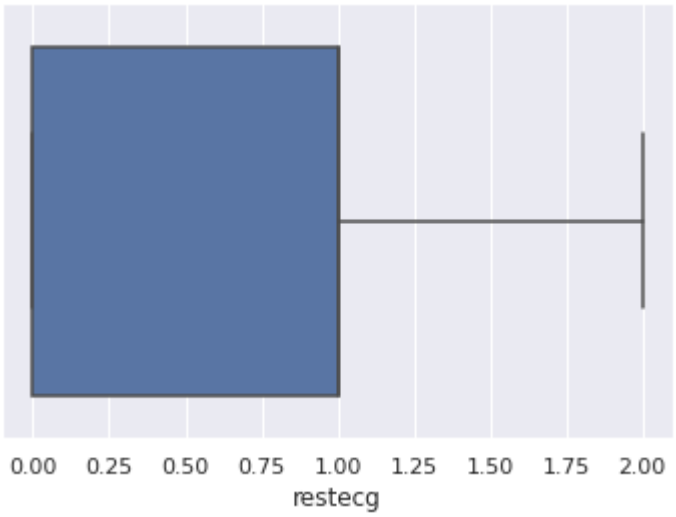
In [33]:
```
sns.boxplot(x=df["thalach"])
```

Out[33]: <AxesSubplot:xlabel='thalach'>



In [34]:
```
sns.boxplot(x=df["restecg"])
```

Out[34]: <AxesSubplot:xlabel='restecg'>



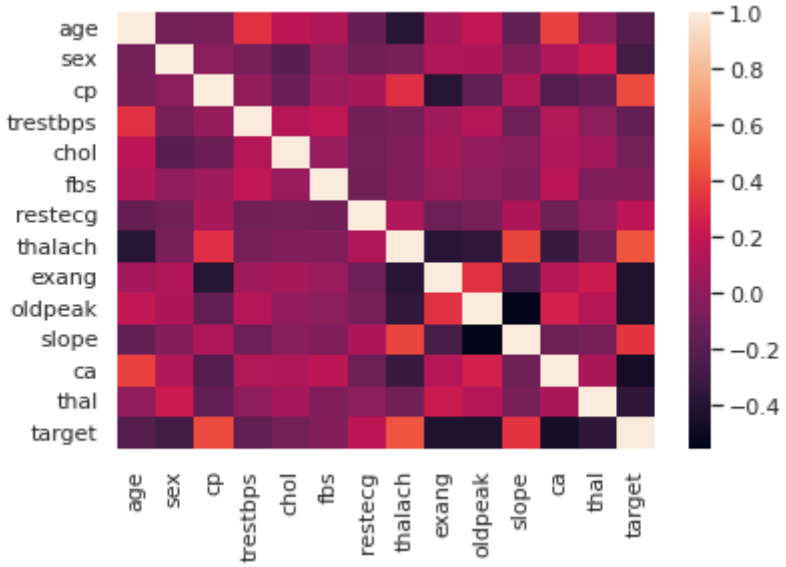
Removing the outlier using Z-Score moethod

In [35]:
```
import scipy.stats as stats
z = np.abs(stats.zscore(df2))
data_clean = df2[(z<3).all(axis = 1)]
data_clean.shape
```

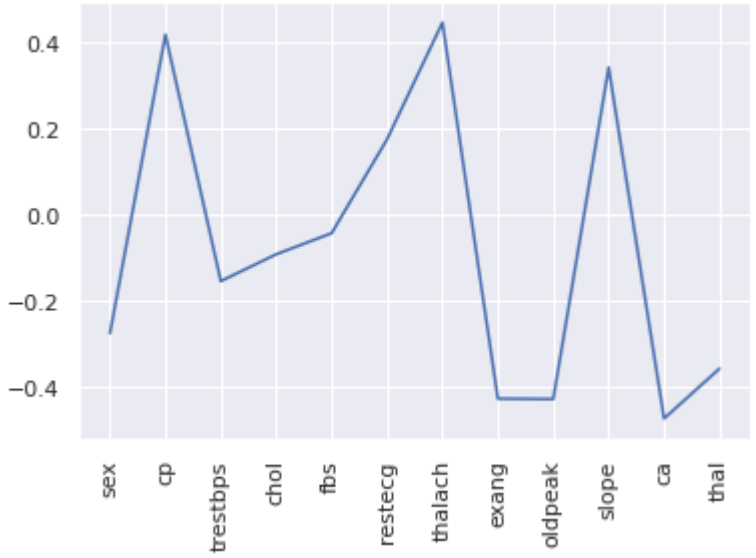
Out[35]: (989, 14)

In [36]:
```
sns.heatmap(data_clean.corr(),fmt='.2g')
```

Out[36]: <AxesSubplot:>



In [37]:
```
corr = data_clean[data_clean.columns[1:]].corr()['target'][:-1]
plt.plot(corr)
plt.xticks(rotation=90)
plt.show()
```



Separating the target variable

In [38]:
```
x=data_clean.drop("target",axis=1)
y=data_clean["target"]
```

Implementing ML Algorithm

In [48]:
```
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score,confusion_matrix
```

In [41]:
```
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.2,ranc
```

Logistic Regression

In [42]:
```
from sklearn.linear_model import LogisticRegression
```

In [43]:
```
model=LogisticRegression()
```

In [45]:
```
model.fit(x_train,y_train)
```

Out[45]:
```
LogisticRegression()
```

In [46]:
```
y_pred_logistic=model.predict(x_test)
```

In [47]:
```
y_pred_logistic
```

Out[47]:
```
array([1, 1, 1, 1, 0, 1, 1, 1, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 1,
       1, 1,
       1, 1, 1, 1, 0, 1, 0, 0, 0, 1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 1,
       0, 0,
       1, 1, 0, 0, 1, 1, 0, 1, 0, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0,
       1, 1,
       1, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 1, 1, 1, 0, 0, 0, 1, 1,
       1, 1,
       1, 1, 0, 0, 1, 0, 0, 1, 1, 1, 1, 1, 1, 0, 0, 1, 1, 0, 0, 0,
       0, 0,
       1, 0, 0, 1, 1, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 1, 0,
       0, 1,
       0, 0, 0, 1, 1, 0, 1, 1, 0, 1, 1, 1, 0, 1, 0, 1, 0, 1, 1, 0,
       0, 1,
       0, 1, 0, 1, 0, 1, 1, 0, 0, 1, 1, 0, 1, 0, 1, 1, 0, 0, 0, 1,
       0, 1,
       0, 1, 1, 0, 0, 1, 1, 1, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 1, 0,
       1, 1])
```

In [49]:
```
accuracy_logistic=accuracy_score(y_test,y_pred_logistic)*100
print(f"The accuracy of logistic regression is: {accuracy_logistic}%"
```

```
The accuracy of logistic regression is: 86.86868686868688%
```

KNN Algorithm

In [50]:
```
from sklearn.neighbors import KNeighborsClassifier
classifier= KNeighborsClassifier(n_neighbors=5, metric='minkowski', p
classifier.fit(x_train, y_train)
y_pred_knn= classifier.predict(x_test)
y_pred_knn
```

Out[50]:
```
array([0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 1, 0, 1, 0, 0, 0, 1, 1,
       0, 1,
       1, 1, 1, 0, 1, 0, 0, 0, 0, 1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 1,
       0, 0,
       1, 1, 0, 0, 0, 1, 0, 1, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0,
       1, 1,
       1, 0, 1, 1, 1, 0, 1, 0, 0, 0, 0, 1, 1, 1, 1, 1, 0, 1, 0, 1,
       0, 0,
       1, 0, 0, 0, 0, 1, 0, 0, 1, 0, 1, 1, 0, 0, 0, 1, 1, 0, 0, 0,
       0, 0,
       0, 0, 0, 1, 1, 0, 1, 0, 0, 0, 1, 0, 0, 0, 1, 0, 1, 1, 1, 0,
       0, 1,
       0, 1, 0, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 0, 1, 0, 0, 1, 0,
       0, 0,
       0, 1, 0, 1, 0, 1, 0, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 1, 0, 1,
       0, 0,
       0, 1, 1, 0, 0, 1, 0, 1, 0, 0, 1, 0, 1, 1, 0, 0, 0, 0, 1, 0,
       1, 0])
```

In [51]:
```
accuracy_knn=accuracy_score(y_test,y_pred_knn)*100
print(f"The accuracy of KNN is: {accuracy_knn}%")
```

```
The accuracy of KNN is: 79.7979797979798%
```

Random Forest Algorithm

In [53]:
```
from sklearn.ensemble import RandomForestClassifier
classifierrandom=RandomForestClassifier(n_estimators=10,criterion="er
classifierrandom.fit(x_train,y_train)
```

Out[53]:
```
RandomForestClassifier(criterion='entropy', n_estimators=10)
```

In [54]:
```
y_pred_random= classifierrandom.predict(x_test)
y_pred_random
```

Out[54]:
```
array([1, 1, 1, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 1, 1, 0, 0, 1, 1,
1, 1,
       1, 1, 1, 0, 0, 1, 0, 0, 0, 1, 0, 1, 0, 1, 1, 0, 0, 0, 1, 1,
0, 0,
       1, 1, 0, 0, 1, 1, 0, 1, 0, 1, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0,
1, 1,
       1, 0, 1, 1, 1, 0, 0, 1, 0, 0, 1, 1, 1, 1, 1, 0, 0, 0, 1, 1,
0, 1,
       0, 0, 0, 0, 1, 0, 0, 1, 1, 0, 1, 1, 1, 0, 0, 1, 1, 0, 0, 0,
0, 0,
       1, 0, 0, 1, 1, 0, 1, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 1, 1, 0,
0, 1,
       1, 1, 0, 1, 1, 0, 1, 1, 0, 1, 1, 1, 0, 1, 0, 1, 0, 0, 1, 0,
0, 1,
       0, 1, 0, 1, 0, 1, 0, 0, 0, 1, 1, 0, 1, 0, 0, 1, 0, 0, 0, 1,
0, 0,
       0, 1, 1, 0, 0, 0, 0, 1, 0, 0, 1, 0, 1, 1, 0, 0, 0, 0, 1, 0,
1, 0])
```

In [55]:
```
accuracy_random=accuracy_score(y_test,y_pred_random)*100
print(f"The accuracy of Random forest algorithm is: {accuracy_random}
```

```
The accuracy of Random forest algorithm is: 98.48484848484848%
```

Ada Boost

In [56]:
```
from sklearn.ensemble import AdaBoostClassifier
```

In [57]:
```
# Create adaboost classifer object
abc = AdaBoostClassifier(n_estimators=50,learning_rate=1)
# Train Adaboost Classifer
model1 = abc.fit(x_train, y_train)
```

In [58]:
```
y_pred_abc=model1.predict(x_test)
```

In [59]:
```
y_pred_abc
```

Out[59]:
```
array([1, 1, 1, 1, 1, 1, 0, 1, 1, 0, 1, 0, 0, 1, 1, 1, 0, 0, 1, 1,
       1, 1,
       1, 1, 1, 0, 0, 1, 0, 0, 0, 1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 1,
       0, 0,
       1, 1, 0, 0, 1, 1, 0, 1, 0, 1, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0,
       1, 1,
       1, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 1, 1, 1, 0, 0, 0, 0, 1,
       1, 1,
       1, 1, 0, 0, 1, 0, 0, 1, 1, 0, 1, 1, 1, 0, 0, 1, 1, 0, 0, 0,
       0, 0,
       1, 0, 0, 1, 1, 0, 1, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 1, 1, 0,
       1, 1,
       0, 0, 0, 1, 1, 0, 1, 1, 0, 1, 1, 1, 0, 1, 0, 1, 0, 0, 1, 0,
       0, 1,
       0, 1, 0, 1, 0, 1, 0, 0, 0, 1, 1, 0, 1, 0, 1, 1, 0, 0, 0, 1,
       0, 0,
       0, 1, 1, 0, 0, 1, 0, 1, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 1, 0,
       1, 0])
```

In [60]:
```
accuracy_abc=accuracy_score(y_test,y_pred_abc)*100
print(f"The accuracy of Ada Boost algorithm is: {accuracy_abc}%")
```

```
The accuracy of Ada Boost algorithm is: 89.8989898989899%
```

Conclusion

- The accuracy of logistic regression is: 86.86%
- The accuracy of KNN is: 79.79%
- The accuracy of Random forest algorithm is: 98.48%
- The accuracy of Ada Boost algorithm is: 89.89%

In [ ]:
```

```