In [27]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
data = pd.read_csv("heart_disease_data.csv")
data
```

Out[27]:

	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal	ta
0	63	1	3	145	233	1	0	150	0	2.3	0	0	1	
1	37	1	2	130	250	0	1	187	0	3.5	0	0	2	
2	41	0	1	130	204	0	0	172	0	1.4	2	0	2	
3	56	1	1	120	236	0	1	178	0	0.8	2	0	2	
4	57	0	0	120	354	0	1	163	1	0.6	2	0	2	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	
298	57	0	0	140	241	0	1	123	1	0.2	1	0	3	
299	45	1	3	110	264	0	1	132	0	1.2	1	0	3	
300	68	1	0	144	193	1	1	141	0	3.4	1	2	3	
301	57	1	0	130	131	0	1	115	1	1.2	1	1	3	
302	57	0	1	130	236	0	0	174	0	0.0	1	1	2	

303 rows × 14 columns

In [29]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
data = pd.read_csv("heart_disease_data.csv")
data.shape
```

Out[29]:
```
(303, 14)
```

In [30]:
```
data.duplicated().sum()
```

Out[30]:
```
1
```

In [31]:
```
data.isnull().sum()
```

Out[31]:
```
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
```

In [32]:
```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 303 entries, 0 to 302
Data columns (total 14 columns):
 #   Column    Non-Null Count  Dtype  
---  ------    --------------  -----  
 0   age       303 non-null    int64  
 1   sex       303 non-null    int64  
 2   cp        303 non-null    int64  
 3   trestbps  303 non-null    int64  
 4   chol      303 non-null    int64  
 5   fbs       303 non-null    int64  
 6   restecg   303 non-null    int64  
 7   thalach   303 non-null    int64  
 8   exang     303 non-null    int64  
 9   oldpeak   303 non-null    float64
 10  slope     303 non-null    int64  
 11  ca        303 non-null    int64  
 12  thal      303 non-null    int64  
 13  target    303 non-null    int64  
dtypes: float64(1), int64(13)
memory usage: 33.3 KB
```

In [33]:
```
data.describe()
```

Out[33]:

	age	sex	cp	trestbps	chol	fbs	restecg
count	303.000000	303.000000	303.000000	303.000000	303.000000	303.000000	303.000000
mean	54.366337	0.683168	0.966997	131.623762	246.264026	0.148515	0.528053
std	9.082101	0.466011	1.032052	17.538143	51.830751	0.356198	0.525860
min	29.000000	0.000000	0.000000	94.000000	126.000000	0.000000	0.000000
25%	47.500000	0.000000	0.000000	120.000000	211.000000	0.000000	0.000000
50%	55.000000	1.000000	1.000000	130.000000	240.000000	0.000000	1.000000
75%	61.000000	1.000000	2.000000	140.000000	274.500000	0.000000	1.000000
max	77.000000	1.000000	3.000000	200.000000	564.000000	1.000000	2.000000

In [34]:
```
from sklearn import preprocessing
le = preprocessing.LabelEncoder()
data["age"]=le.fit_transform(data["age"])
```

In [35]:
```
data
```

Out[35]:

	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal	ta
0	29	1	3	145	233	1	0	150	0	2.3	0	0	1	
1	3	1	2	130	250	0	1	187	0	3.5	0	0	2	
2	7	0	1	130	204	0	0	172	0	1.4	2	0	2	
3	22	1	1	120	236	0	1	178	0	0.8	2	0	2	
4	23	0	0	120	354	0	1	163	1	0.6	2	0	2	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	
298	23	0	0	140	241	0	1	123	1	0.2	1	0	3	
299	11	1	3	110	264	0	1	132	0	1.2	1	0	3	
300	34	1	0	144	193	1	1	141	0	3.4	1	2	3	
301	23	1	0	130	131	0	1	115	1	1.2	1	1	3	
302	23	0	1	130	236	0	0	174	0	0.0	1	1	2	

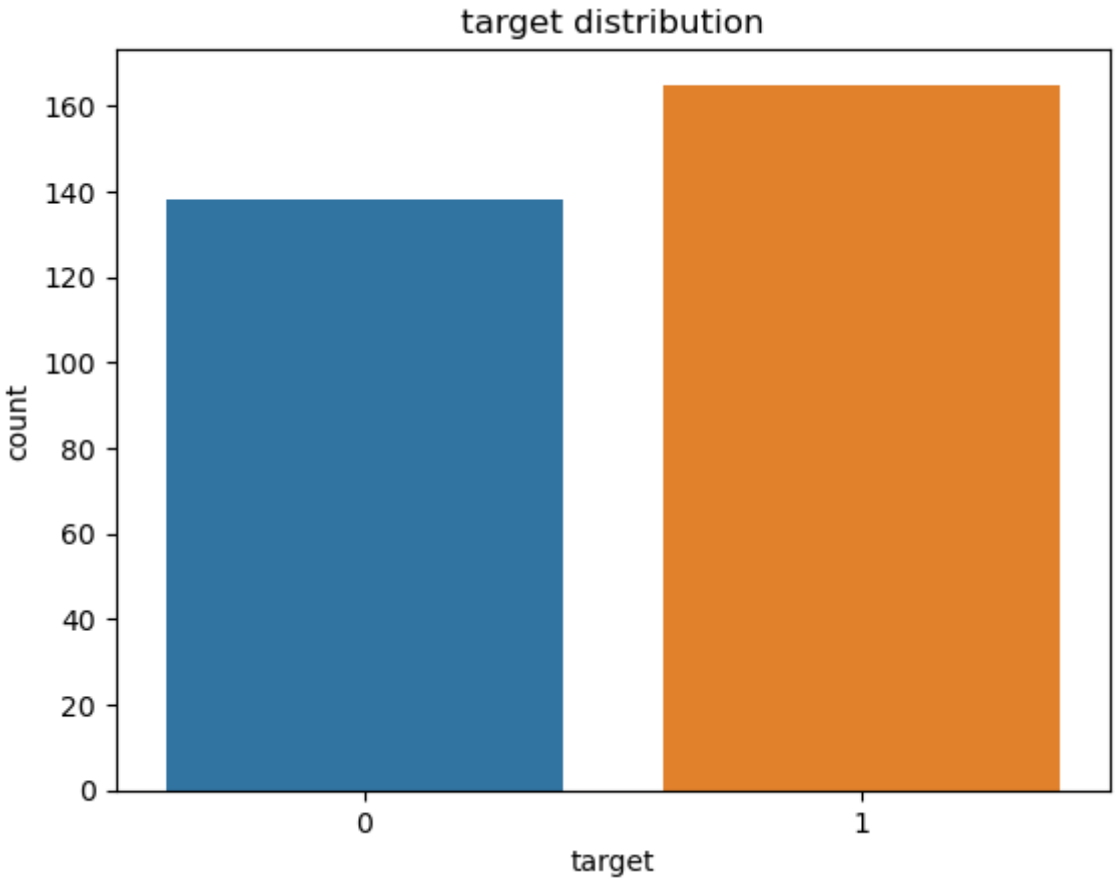
303 rows × 14 columns

In [36]:
```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 303 entries, 0 to 302
Data columns (total 14 columns):
 #   Column    Non-Null Count  Dtype  
---  ------    --------------  -----  
 0   age       303 non-null    int64  
 1   sex       303 non-null    int64  
 2   cp        303 non-null    int64  
 3   trestbps  303 non-null    int64  
 4   chol      303 non-null    int64  
 5   fbs       303 non-null    int64  
 6   restecg   303 non-null    int64  
 7   thalach   303 non-null    int64  
 8   exang     303 non-null    int64  
 9   oldpeak   303 non-null    float64
 10  slope     303 non-null    int64  
 11  ca        303 non-null    int64  
 12  thal      303 non-null    int64  
 13  target    303 non-null    int64  
dtypes: float64(1), int64(13)
memory usage: 33.3 KB
```

In [37]:
```
#distribution of Target Variable
import matplotlib.pyplot as plt
sns.countplot(x="target", data=data)
plt.title("target distribution")
```

Out[37]:
```
Text(0.5, 1.0, 'target distribution')
```



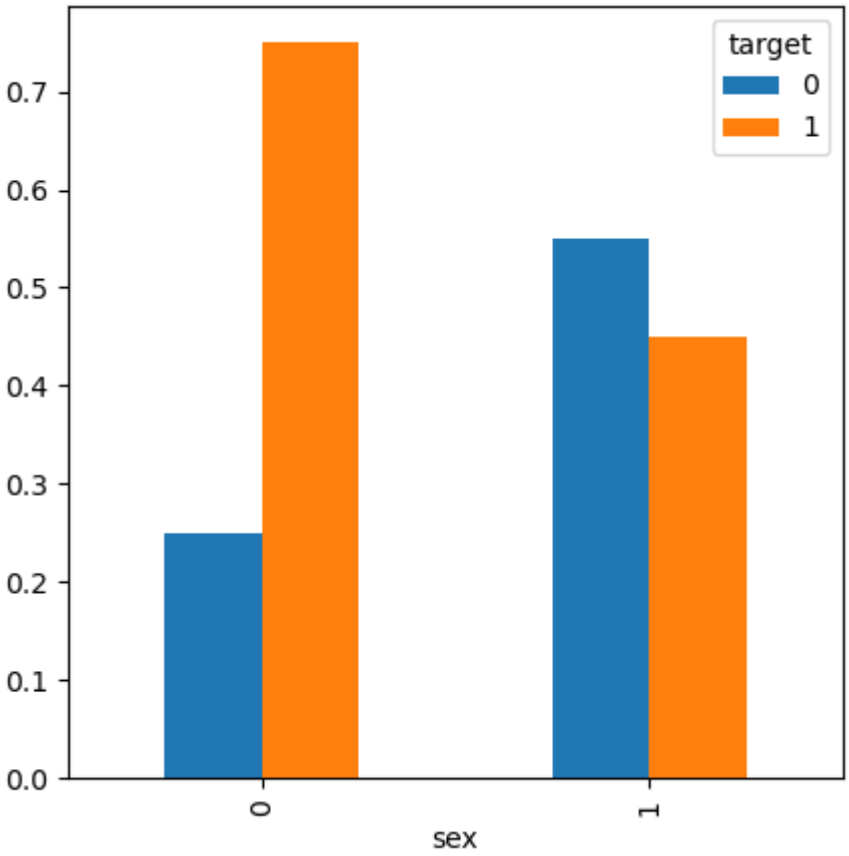
In [38]:
```
data["target"].value_counts()
```

Out[38]:
```
1    165
0    138
Name: target, dtype: int64
```

In [39]:
```
#function for plotting
def plot(col, data=data):
  return data.groupby(col)["target"].value_counts(normalize=True).unstack()
```

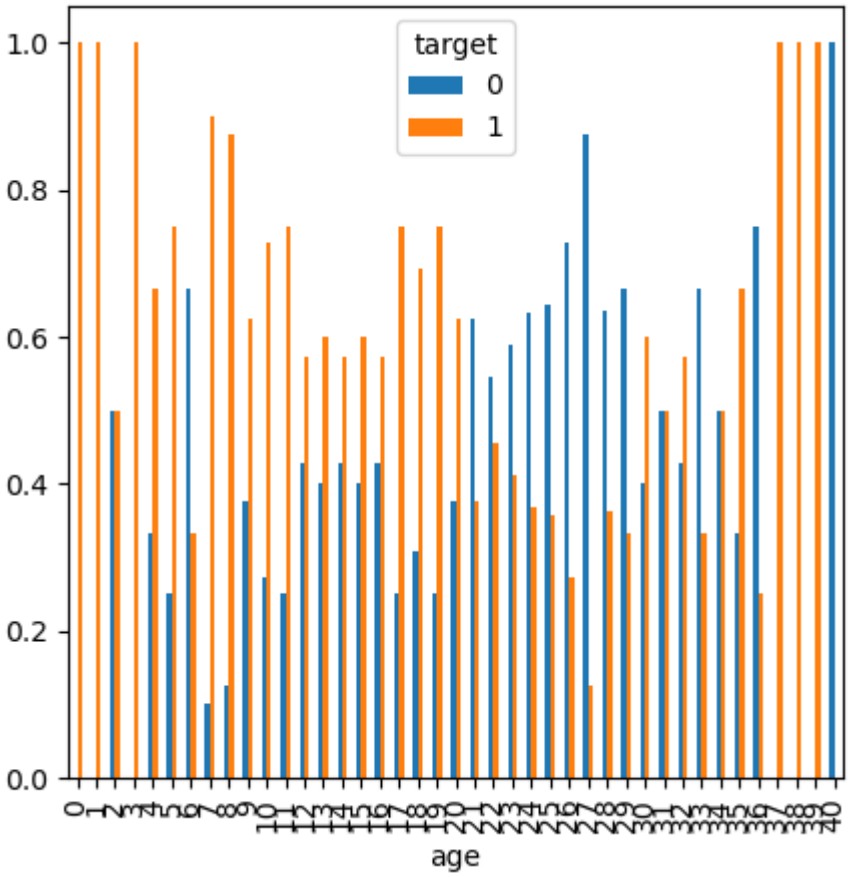
In [40]:
```
plot("sex")
```

Out[40]:
```
<AxesSubplot:xlabel='sex'>
```



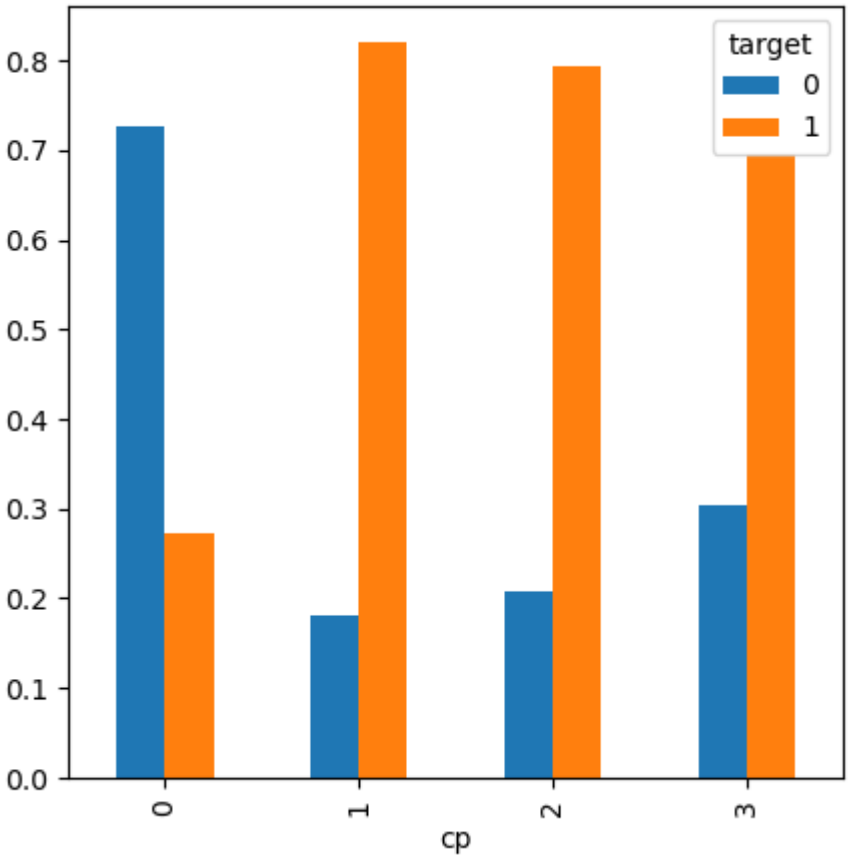
In [41]:
```
plot("age")
```

Out[41]: <AxesSubplot:xlabel='age'>



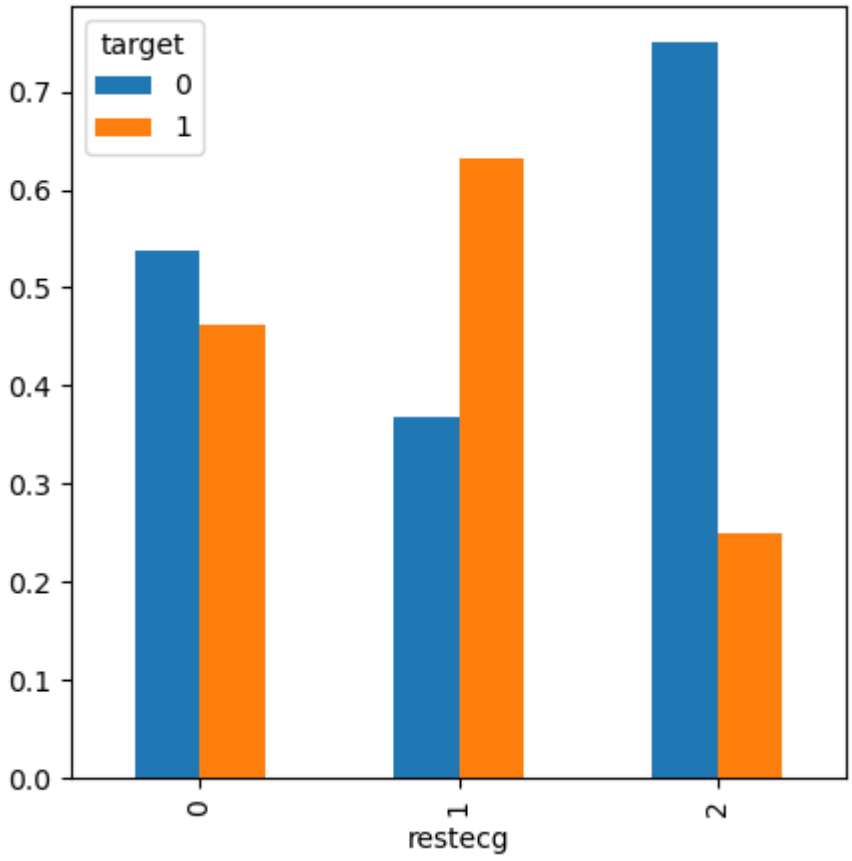
In [42]:
```
plot("cp")
```

Out[42]:
```
<AxesSubplot:xlabel='cp'>
```



In [43]:
```
plot("restecg")
```

Out[43]:
```
<AxesSubplot:xlabel='restecg'>
```



In [44]:
```
df_new=data.drop(columns=["sex","age","cp"])
df_new
```

Out[44]:

	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal	target
0	145	233	1	0	150	0	2.3	0	0	1	1
1	130	250	0	1	187	0	3.5	0	0	2	1
2	130	204	0	0	172	0	1.4	2	0	2	1
3	120	236	0	1	178	0	0.8	2	0	2	1
4	120	354	0	1	163	1	0.6	2	0	2	1
...	...	...	...	...	...	...	...	...	...	...	...
298	140	241	0	1	123	1	0.2	1	0	3	0
299	110	264	0	1	132	0	1.2	1	0	3	0
300	144	193	1	1	141	0	3.4	1	2	3	0
301	130	131	0	1	115	1	1.2	1	1	3	0
302	130	236	0	0	174	0	0.0	1	1	2	0

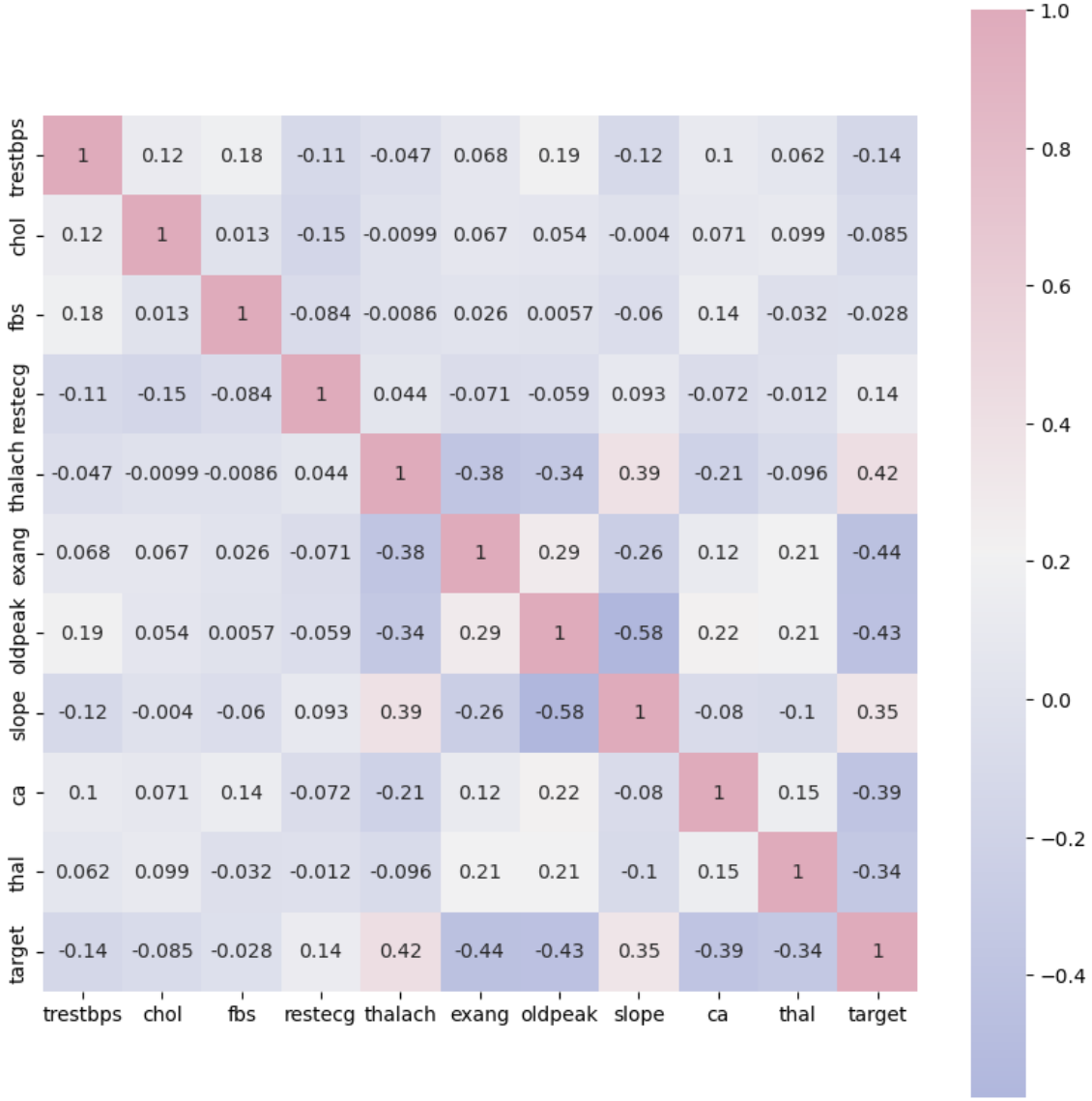
303 rows × 11 columns

In [45]:
```
#Finding correlation
cn=df_new.corr()
cn
```

Out[45]:

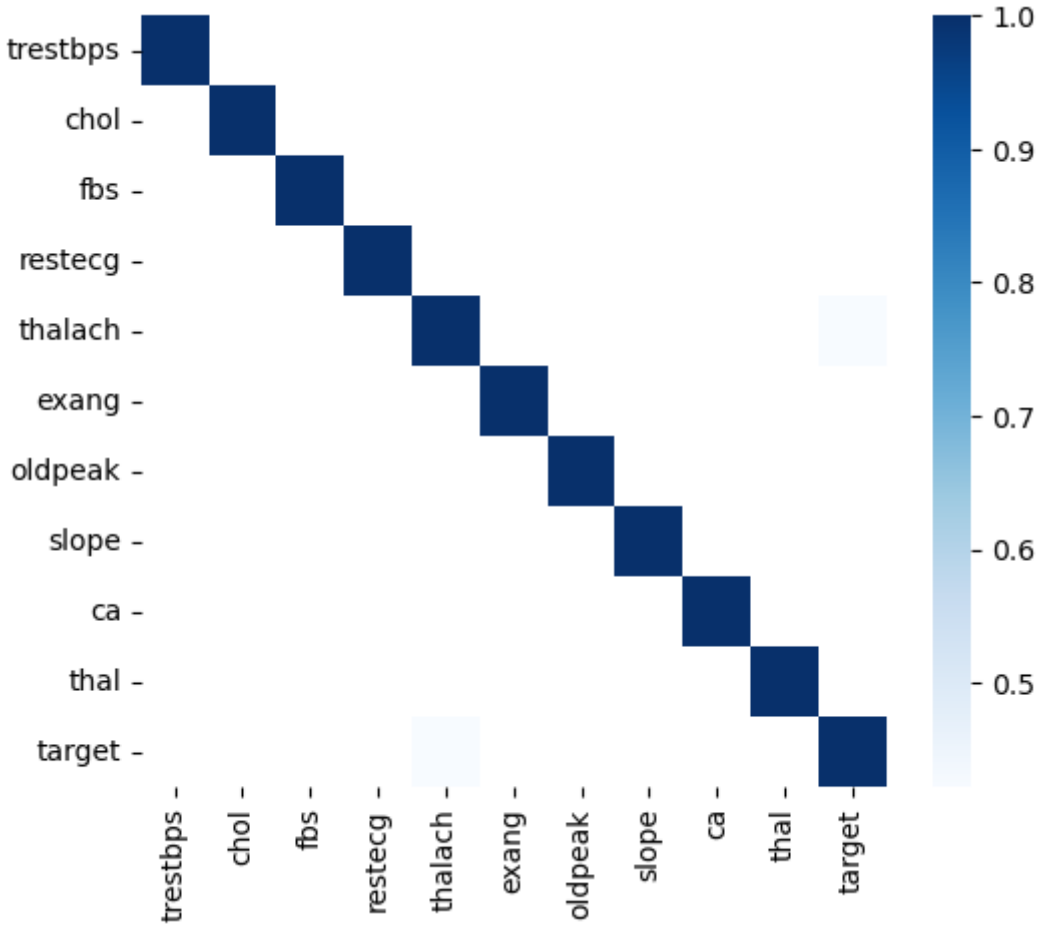
	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope
trestbps	1.000000	0.123174	0.177531	-0.114103	-0.046698	0.067616	0.193216	-0.121475
chol	0.123174	1.000000	0.013294	-0.151040	-0.009940	0.067023	0.053952	-0.004038
fbs	0.177531	0.013294	1.000000	-0.084189	-0.008567	0.025665	0.005747	-0.059894
restecg	-0.114103	-0.151040	-0.084189	1.000000	0.044123	-0.070733	-0.058770	0.093045
thalach	-0.046698	-0.009940	-0.008567	0.044123	1.000000	-0.378812	-0.344187	0.386784
exang	0.067616	0.067023	0.025665	-0.070733	-0.378812	1.000000	0.288223	-0.257748
oldpeak	0.193216	0.053952	0.005747	-0.058770	-0.344187	0.288223	1.000000	-0.577537
slope	-0.121475	-0.004038	-0.059894	0.093045	0.386784	-0.257748	-0.577537	1.000000
ca	0.101389	0.070511	0.137979	-0.072042	-0.213177	0.115739	0.222682	-0.080155
thal	0.062210	0.098803	-0.032019	-0.011981	-0.096439	0.206754	0.210244	-0.104764
target	-0.144931	-0.085239	-0.028046	0.137230	0.421741	-0.436757	-0.430696	0.345877

In [46]:
```
#correlation
cmap = sns.diverging_palette(260,-10, s=50, l=75, n=6, as_cmap=True)
plt.subplots(figsize=(10,10))
sns.heatmap(cn,cmap=cmap,annot=True,square=True)
plt.show()
```



In [47]:
```
df = cn[cn>=.40]
plt.figure(figsize=(6,5))
sns.heatmap(df, cmap="Blues")
```

Out[47]: <AxesSubplot:>



In [48]:
```
df_new["choltrestbps"]=df_new["chol"]*df_new["trestbps"]
df_new
```

Out[48]:

	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal	target	choltrestb
0	145	233	1	0	150	0	2.3	0	0	1	1	33
1	130	250	0	1	187	0	3.5	0	0	2	1	32
2	130	204	0	0	172	0	1.4	2	0	2	1	26
3	120	236	0	1	178	0	0.8	2	0	2	1	28
4	120	354	0	1	163	1	0.6	2	0	2	1	42
...	...	...	...	...	...	...	...	...	...	...	...	
298	140	241	0	1	123	1	0.2	1	0	3	0	33
299	110	264	0	1	132	0	1.2	1	0	3	0	29
300	144	193	1	1	141	0	3.4	1	2	3	0	27
301	130	131	0	1	115	1	1.2	1	1	3	0	17
302	130	236	0	0	174	0	0.0	1	1	2	0	30

303 rows × 12 columns

In [52]:
```
x = df_new.drop("target", axis = 1)
y = df_new["target"]
```

In [62]:
```
from imblearn.over_sampling import ADASYN
adasyn = ADASYN(random_state=42)
x,y = adasyn.fit_resample(x,y)
```

```
---------------------------------------------------------------------------
-
ModuleNotFoundError                       Traceback (most recent call las
t)
~\AppData\Local\Temp\ipykernel_436\2895492658.py in <module>
----> 1 from imblearn.over_sampling import ADASYN
      2 adasyn = ADASYN(random_state=42)
      3 x,y = adasyn.fit_resample(x,y)

ModuleNotFoundError: No module named 'imblearn'
```

In [54]:
```
len(x)
```

Out[54]:
```
303
```

In [55]:
```
#splitting data for training and testing
from sklearn.model_selection import train_test_split
xtrain, xtest, ytrain, ytest=train_test_split(x,y,test_size=0.25, random_st
```

In [56]:
```
#fitting training data to the model
from sklearn.linear_model import LogisticRegression
lr_model=LogisticRegression(random_state=0)
lr_model.fit(xtrain, ytrain)
```

Out[56]:
```
LogisticRegression(random_state=0)
```

In [57]:
```
#predicting result using testing data
y_pred = lr_model.predict(xtest)
y_pred
```

Out[57]:
```
array([0, 1, 1, 0, 0, 1, 0, 0, 0, 0, 1, 1, 0, 1, 1, 1, 0, 1, 0, 1, 1, 1,
       0, 0, 1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 1, 1, 0, 1, 0, 0, 1, 1, 0, 0,
       0, 1, 1, 1, 0, 1, 1, 0, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 0, 0, 1], dtype=int64)
```

In [58]:
```
#model accuracy
from sklearn.metrics import classification_report, accuracy_score,f1_score
lr_cr=classification_report(ytest,y_pred)
print(lr_cr)
```

```
              precision    recall  f1-score   support

           0       0.81      0.67      0.73        33
           1       0.78      0.88      0.83        43

    accuracy                           0.79        76
   macro avg       0.80      0.78      0.78        76
weighted avg       0.79      0.79      0.79        76
```

In [59]:
```
#Decission Tree
from sklearn.tree import DecisionTreeClassifier
dt_model = DecisionTreeClassifier(criterion = "entropy", random_state=0)
dt_model.fit(xtrain,ytrain)
```

Out[59]:
```
DecisionTreeClassifier(criterion='entropy', random_state=0)
```

In [60]:
```
y_dt_pred = dt_model.predict(xtest)
y_dt_pred
```

Out[60]:
```
array([0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 1, 1, 0, 1, 1, 0, 1, 1, 1,
       0, 0, 1, 0, 0, 1, 1, 0, 1, 0, 1, 0, 1, 1, 0, 1, 0, 0, 1, 0, 1, 0,
       0, 1, 1, 0, 0, 0, 1, 1, 1, 1, 1, 1, 1, 0, 1, 0, 1, 1, 0, 1, 1, 1,
       0, 0, 1, 1, 1, 1, 1, 0, 0, 1], dtype=int64)
```

In [61]:
```
#model accuracy
dt_cr = classification_report(ytest,y_dt_pred)
print(dt_cr)
```

```
              precision    recall  f1-score   support

           0       0.69      0.73      0.71        33
           1       0.78      0.74      0.76        43

    accuracy                           0.74        76
   macro avg       0.73      0.74      0.73        76
weighted avg       0.74      0.74      0.74        76
```