Heart Failure Prediction

In [51]:

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

In [54]:

```
heartdf = pd.read_csv('heart.csv')
```

Structure of our data

In [55]:

```
heartdf.head()
```

Out[55]:

	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal	target
0	63	1	3	145	233	1	0	150	0	2.3	0	0	1	1
1	37	1	2	130	250	0	1	187	0	3.5	0	0	2	1
2	41	0	1	130	204	0	0	172	0	1.4	2	0	2	1
3	56	1	1	120	236	0	1	178	0	0.8	2	0	2	1
4	57	0	0	120	354	0	1	163	1	0.6	2	0	2	1

In [56]:

```
heartdf.describe()
```

Out[56]:

	age	sex	cp	trestbps	chol	fbs	restecg	
count	303.000000	303.000000	303.000000	303.000000	303.000000	303.000000	303.000000	30
mean	54.366337	0.683168	0.966997	131.623762	246.264026	0.148515	0.528053	14
std	9.082101	0.466011	1.032052	17.538143	51.830751	0.356198	0.525860	2
min	29.000000	0.000000	0.000000	94.000000	126.000000	0.000000	0.000000	7
25%	47.500000	0.000000	0.000000	120.000000	211.000000	0.000000	0.000000	13
50%	55.000000	1.000000	1.000000	130.000000	240.000000	0.000000	1.000000	15
75%	61.000000	1.000000	2.000000	140.000000	274.500000	0.000000	1.000000	16
max	77.000000	1.000000	3.000000	200.000000	564.000000	1.000000	2.000000	20

In [57]:

```
heartdf.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
```

Data Visualizations

1. Correlation Matrix

In [67]:

```
fig = plt.figure(figsize=[16, 9])
plt.style.use('seaborn-darkgrid')
sns.heatmap(hfp.corr(), annot=True, mask=np.triu(hfp.corr()), cmap='coolwarm')
```

Out[67]:

<AxesSubplot:>

In [59]:

```
##By this Heat map - we have the correlation values between columns.

##We don't have any redundant columns,ie.we dont have highly correlated columns, which can
##All the columns are lying between low positive correlation to low negative correlation.
##Most of the columns have negative correlation(column value increase will decrease the tar
```

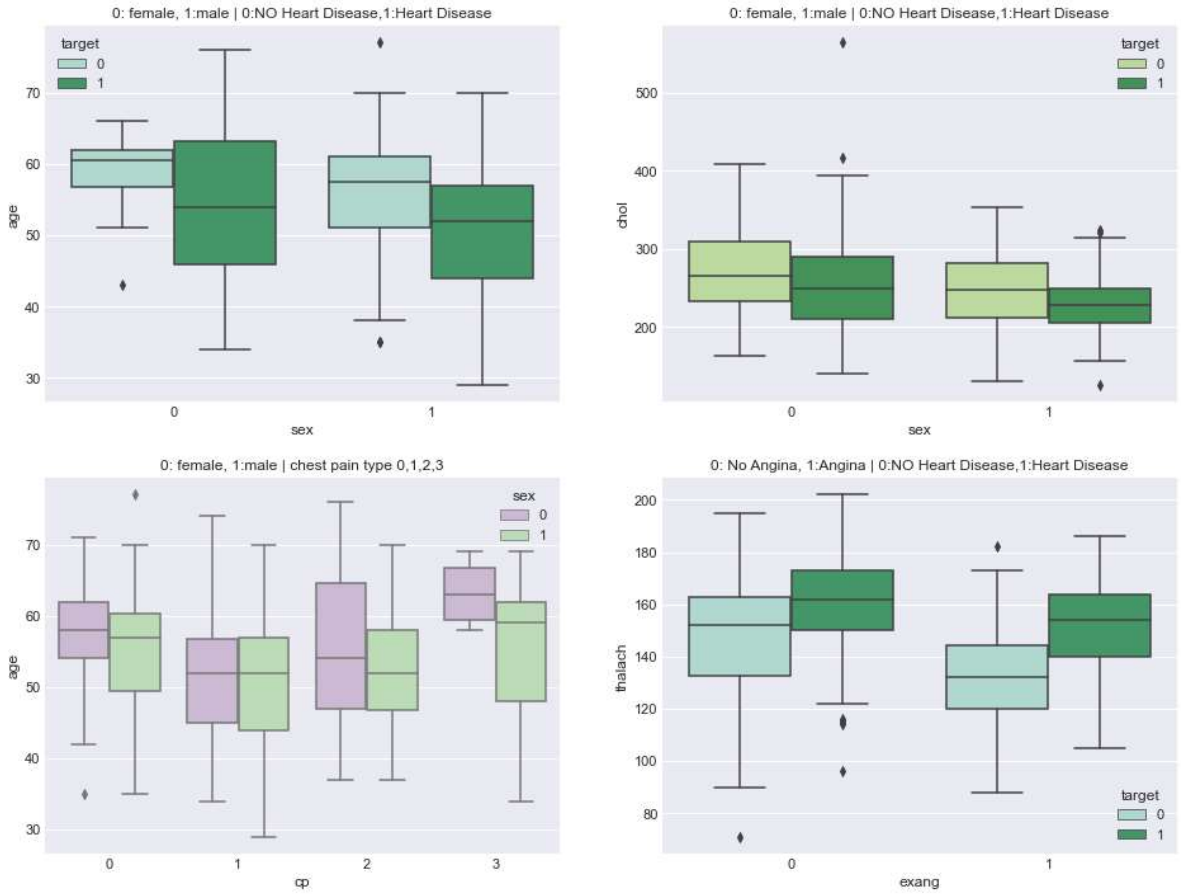
2. Box Whisker Plot

In [60]:

```
#BOX WHISKER PLOT-
#This is for looking outliers in the columns.
#This gives a five number summary[min,25,median,75,max] among the data values in a column.
#used to compare available data among two to three features.

fig,ax=plt.subplots(figsize=(16,12))
plt.subplot(221)
b1=sns.boxplot(x="sex",y="age",hue="target",data=heartdf,palette="BuGn")
b1.set_title("0: female, 1:male | 0:NO Heart Disease,1:Heart Disease")


plt.subplot(222)
b2=sns.boxplot(x="sex",y="chol",hue="target",data=heartdf,palette="YlGn")
b2.set_title("0: female, 1:male | 0:NO Heart Disease,1:Heart Disease")


plt.subplot(223)
b3=sns.boxplot(x="cp",y="age",hue="sex",data=heartdf,palette="PRGn")
b3.set_title("0: female, 1:male | chest pain type 0,1,2,3")


plt.subplot(224)
b4=sns.boxplot(x="exang",y="thalach",hue="target",data=heartdf,palette="BuGn")
b4.set_title("0: No Angina, 1:Angina | 0:NO Heart Disease,1:Heart Disease")
```

Out[60]:

```
Text(0.5, 1.0, '0: No Angina, 1:Angina | 0:NO Heart Disease,1:Heart Diseas
e')
```



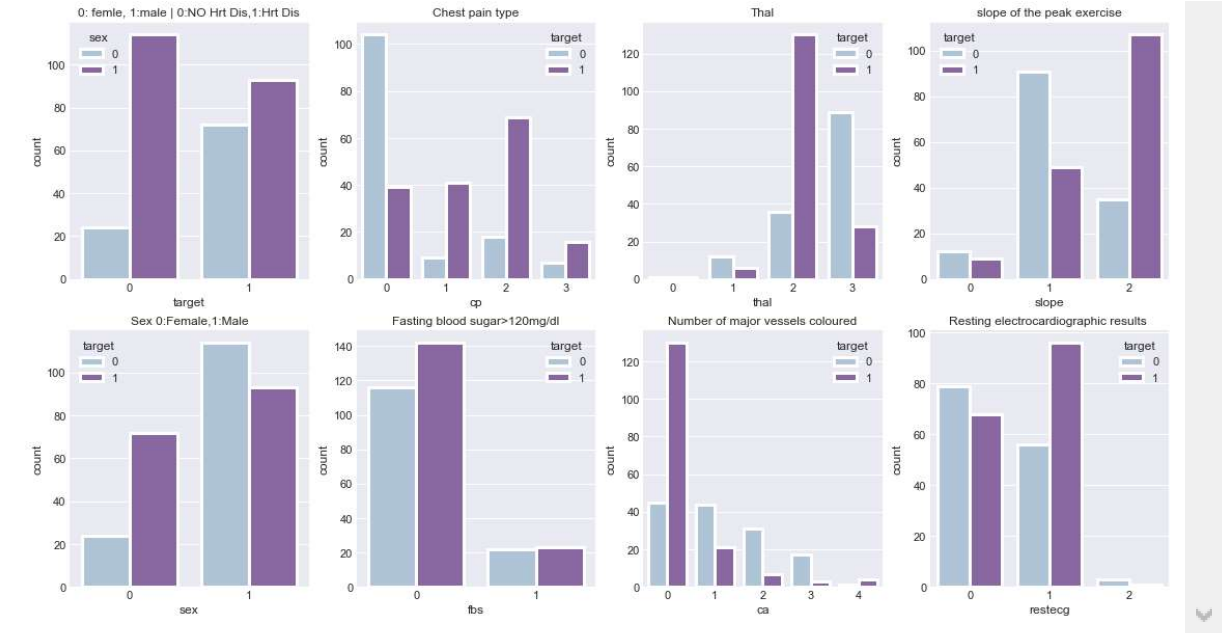
3. Count Plot

In [61]:

```
#COUNT PLOT-
#This is used to show the counts of the variables
#This can be used to depict 2 -3 variables.

fig,ax=plt.subplots(figsize=(19,10))

plt.subplot(241)
s1=sns.countplot(x='target',data=heartdf,hue='sex',palette='BuPu',linewidth=3)
s1.set_title('0: femle, 1:male | 0:NO Hrt Dis,1:Hrt Dis')

plt.subplot(242)
s2=sns.countplot(x='cp',data=heartdf,hue='target',palette='BuPu',linewidth=3)
s2.set_title('Chest pain type')

plt.subplot(243)
s3=sns.countplot(x='thal',data=heartdf,hue='target',palette='BuPu',linewidth=3)
s3.set_title('Thal')


plt.subplot(244)
s4=sns.countplot(x='slope',data=heartdf,hue='target',palette='BuPu',linewidth=3)
s4.set_title('slope of the peak exercise')

plt.subplot(245)
s5=sns.countplot(x='sex',data=heartdf,hue='target',palette='BuPu',linewidth=3)
s5.set_title('Sex 0:Female,1:Male')

plt.subplot(246)
s6=sns.countplot(x='fbs',data=heartdf,hue='target',palette="BuPu",linewidth=3)
s6.set_title('Fasting blood sugar>120mg/dl')

plt.subplot(247)
s7=sns.countplot(x='ca',data=heartdf,hue='target',palette='BuPu',linewidth=3)
s7.set_title('Number of major vessels coloured')

plt.subplot(248)
s8=sns.countplot(x='restecg',data=heartdf,hue='target',palette='BuPu',linewidth=3)
s8.set_title('Resting electrocardiographic results ')
```

Out[61]:

```
Text(0.5, 1.0, 'Resting electrocardiographic results ')
```


0: femle, 1:male | 0:NO Hrt Dis,1:Hrt Dis
sex
target
Chest pain type
cp
Thal
thal
slope of the peak exercise
slope
Sex 0:Female,1:Male
sex
Fasting blood sugar>120mg/dl
fbs
Number of major vessels coloured
ca
Resting electrocardiographic results
restecg
count

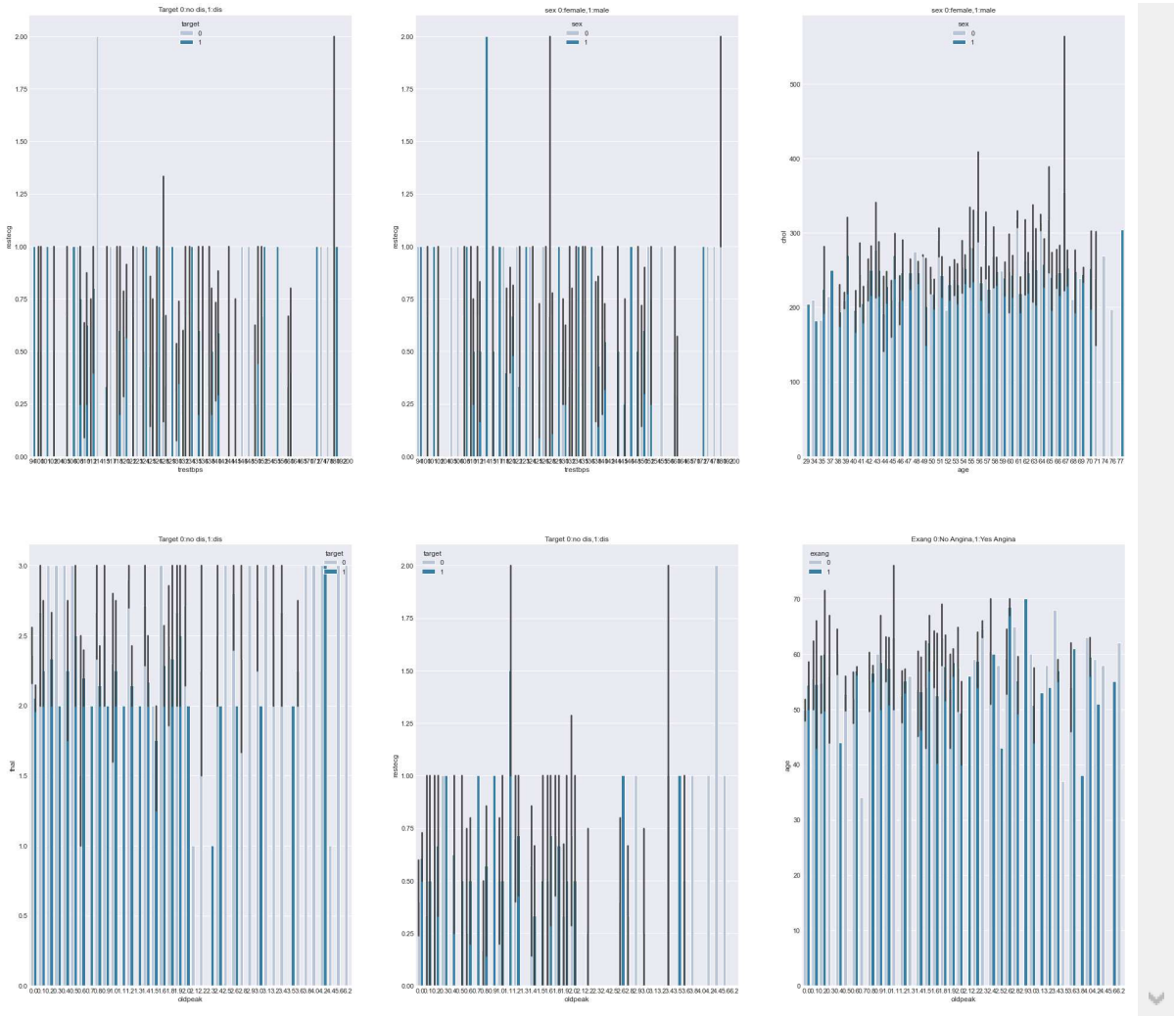
4. Bar Plot

In [62]:

```
#BAR PLOT-
#This helps in finding the relationship between categorical and discrete variables.
#This also can be used to know relation between two continuos variable with binary data

fig,ax=plt.subplots(figsize=(33,30))
plt.subplot(231)
bx_1 = sns.barplot(x="trestbps", y="restecg", hue="target", data=heartdf,palette="PuBu")
bx_1.set_title("Target 0:no dis,1:dis")

plt.subplot(232)
bx_2 = sns.barplot(x="trestbps", y="restecg", hue="sex", data=heartdf,palette="PuBu")
bx_2.set_title("sex 0:female,1:male")

plt.subplot(233)
bx_3 = sns.barplot(x="age", y="chol", hue="sex", data=heartdf,palette="PuBu")
bx_3.set_title("sex 0:female,1:male")

plt.subplot(234)
bx_4 = sns.barplot(x="oldpeak", y="thal", hue="target", data=heartdf,palette="PuBu")
bx_4.set_title("Target 0:no dis,1:dis")

plt.subplot(235)
bx_5 = sns.barplot(x="oldpeak", y="restecg", hue="target", data=heartdf,palette="PuBu")
bx_5.set_title("Target 0:no dis,1:dis")

plt.subplot(616)
bx_6 = sns.barplot(x="oldpeak", y="age", hue="exang", data=heartdf,palette="PuBu")
bx_6.set_title("Exang 0:No Angina,1:Yes Angina")
```

Out[62]:

```
Text(0.5, 1.0, 'Exang 0:No Angina,1:Yes Angina')
```



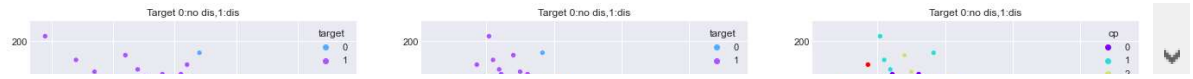
5. Scatter Plot

In [64]:

```
#SCATTER PLOT
#It is used to find the relationship between 2 variables.
#It helps to find outliers and correaltion between features.
fig,ax=plt.subplots(figsize=(23,16))
plt.subplot(231)
sp_1 = sns.scatterplot(x="age", y="thalach",hue="target",data=heartdf,palette="cool")
sp_1.set_title("Target 0:no dis,1:dis")
plt.subplot(232)
sp_2 = sns.scatterplot(x="chol", y="thalach",hue="target",data=heartdf,palette="cool")
sp_2.set_title("Target 0:no dis,1:dis")
plt.subplot(233)
sp_3 = sns.scatterplot(x="chol", y="thalach",hue="cp",data=heartdf,palette="rainbow")
sp_3.set_title("Target 0:no dis,1:dis")
plt.subplot(234)
sp_3 = sns.scatterplot(x="oldpeak", y="thalach",hue="target",data=heartdf,palette="spring")
sp_3.set_title("Target 0:no dis,1:dis")
plt.subplot(235)
sp_3 = sns.scatterplot(x="ca", y="trestbps",hue="sex",data=heartdf,palette="cool")
sp_3.set_title("Target 0:no dis,1:dis")
plt.xticks([0,1, 2, 3, 4])
plt.subplot(236)
sp_3 = sns.scatterplot(x="ca", y="trestbps",hue="target",data=heartdf,palette="cool")
sp_3.set_title("Target 0:no dis,1:dis")
plt.xticks([0,1, 2, 3, 4])
```

Out[64]:

```
([<matplotlib.axis.XTick at 0x2ad6ed8ae50>,
  <matplotlib.axis.XTick at 0x2ad6ed8ae20>,
  <matplotlib.axis.XTick at 0x2ad6edb3400>,
  <matplotlib.axis.XTick at 0x2ad6edc43d0>,
  <matplotlib.axis.XTick at 0x2ad6edc48e0>],
 [Text(0, 0, ''),
  Text(0, 0, ''),
  Text(0, 0, ''),
  Text(0, 0, ''),
  Text(0, 0, '')])
```



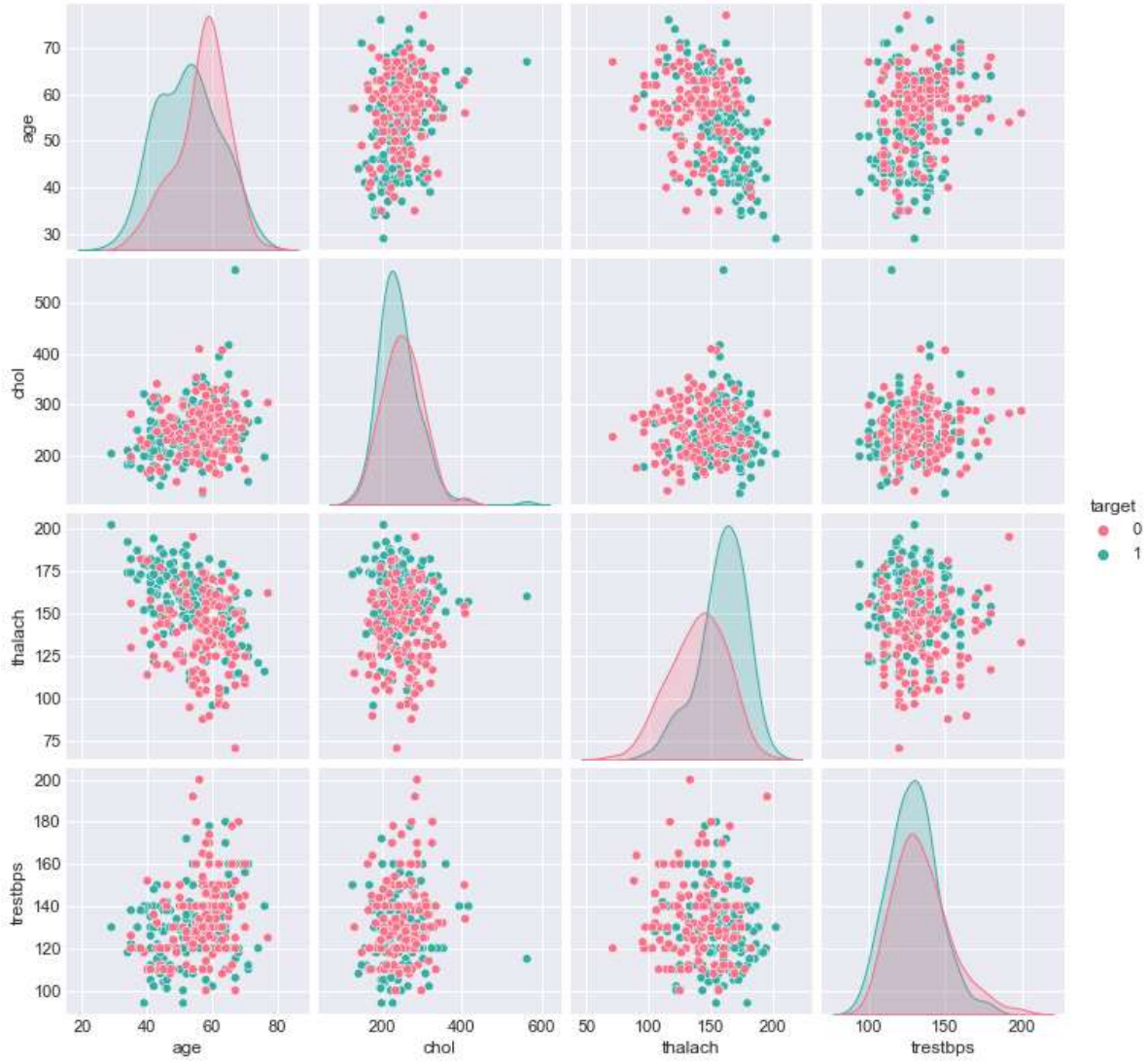
6. Pair Plot

In [65]:

```
#Pair Plot
#This can be drawn to find the relationship of multiple features with respect to each other
sns.pairplot(heartdf,hue="target",vars=["age","chol","thalach","trestbps"],palette="husl")
```

Out[65]:

```
<seaborn.axisgrid.PairGrid at 0x2ad623e69d0>
```

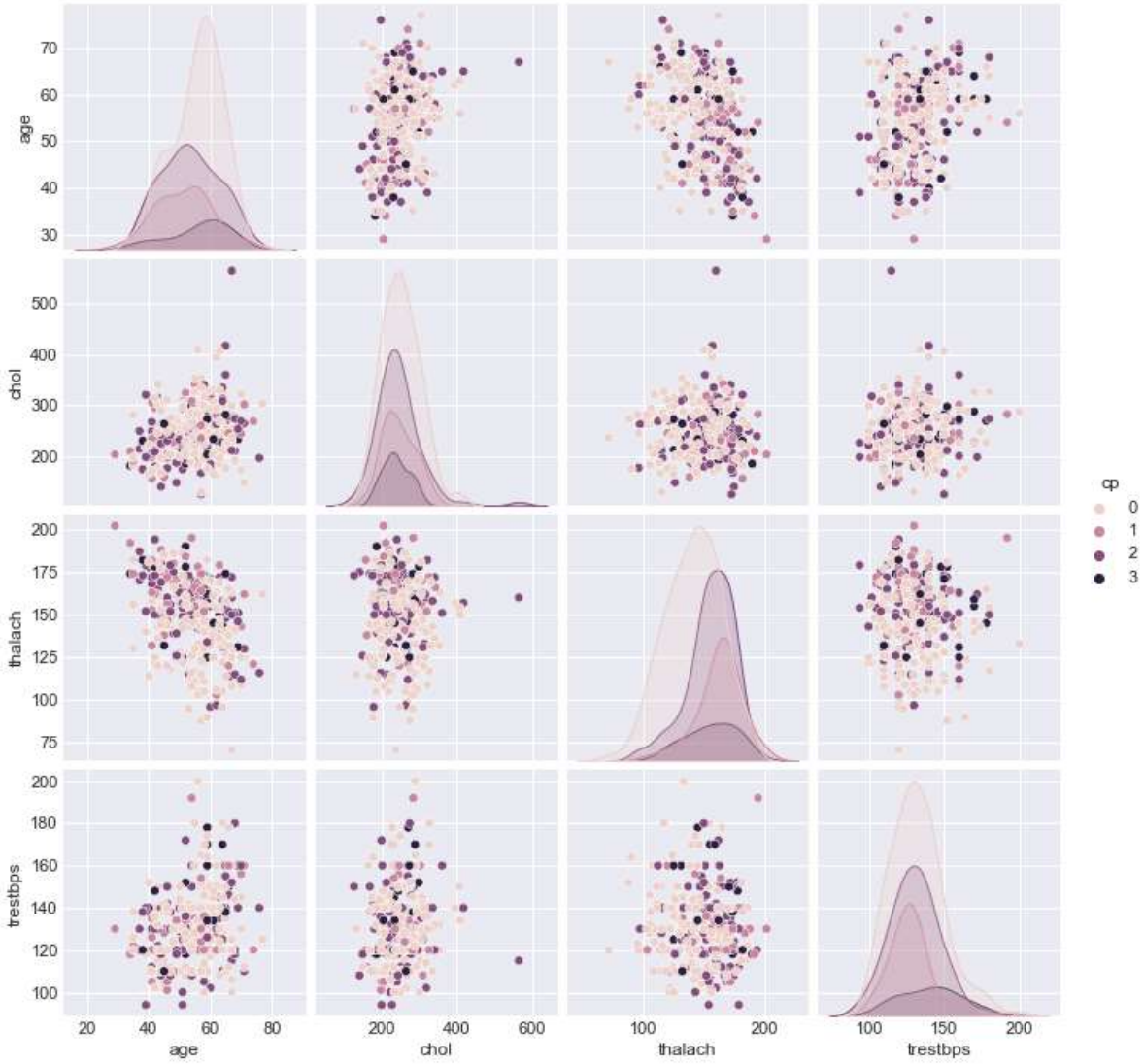


In [66]:

```
sns.pairplot(heartdf,hue="cp",vars=["age","chol","thalach","trestbps"])
```

Out[66]:

```
<seaborn.axisgrid.PairGrid at 0x2ad6f96a550>
```

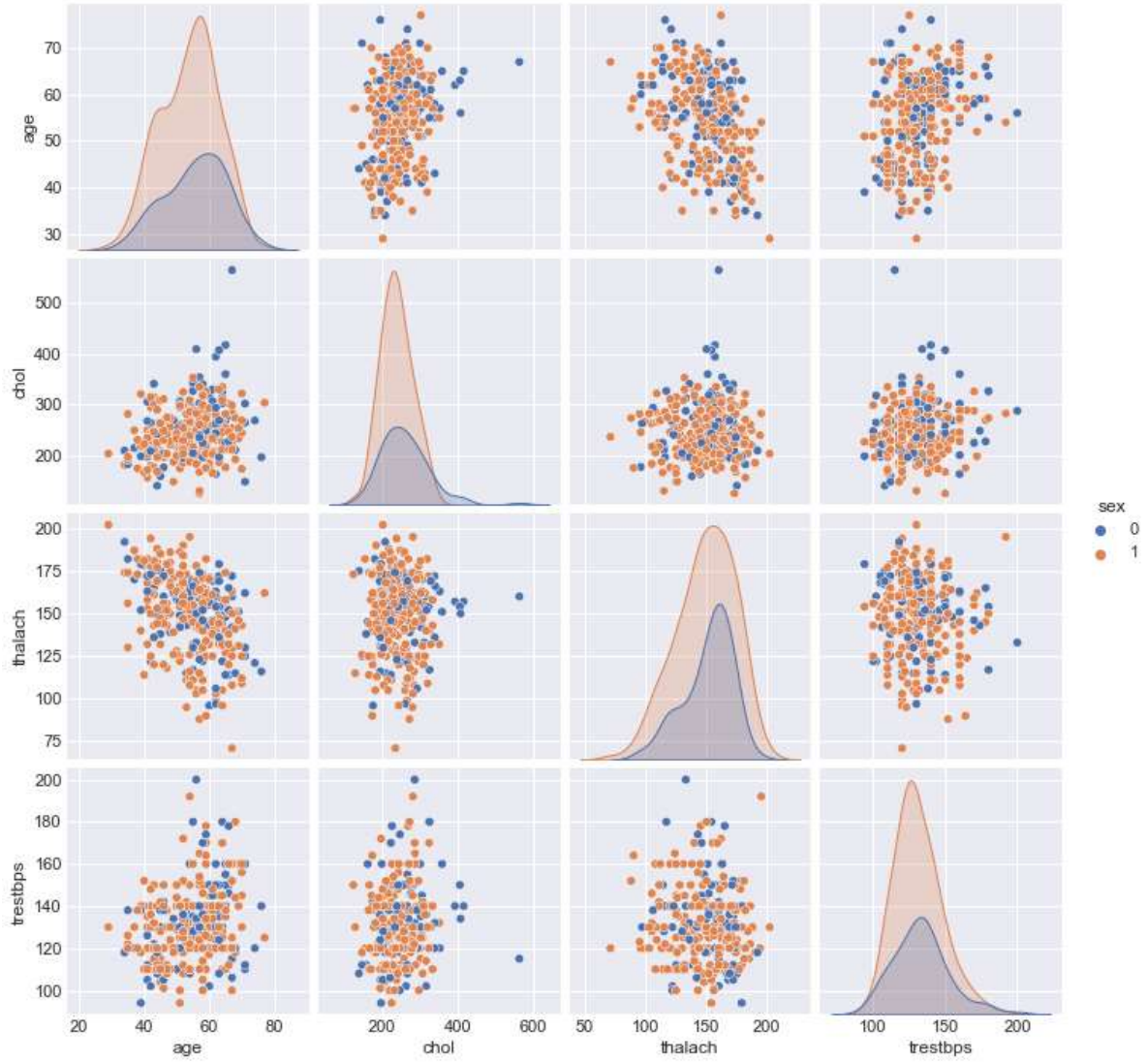


In [68]:

```
sns.pairplot(heartdf,hue="sex",vars=["age","chol","thalach","trestbps"])
```

Out[68]:

```
<seaborn.axisgrid.PairGrid at 0x2ad6f96adc0>
```

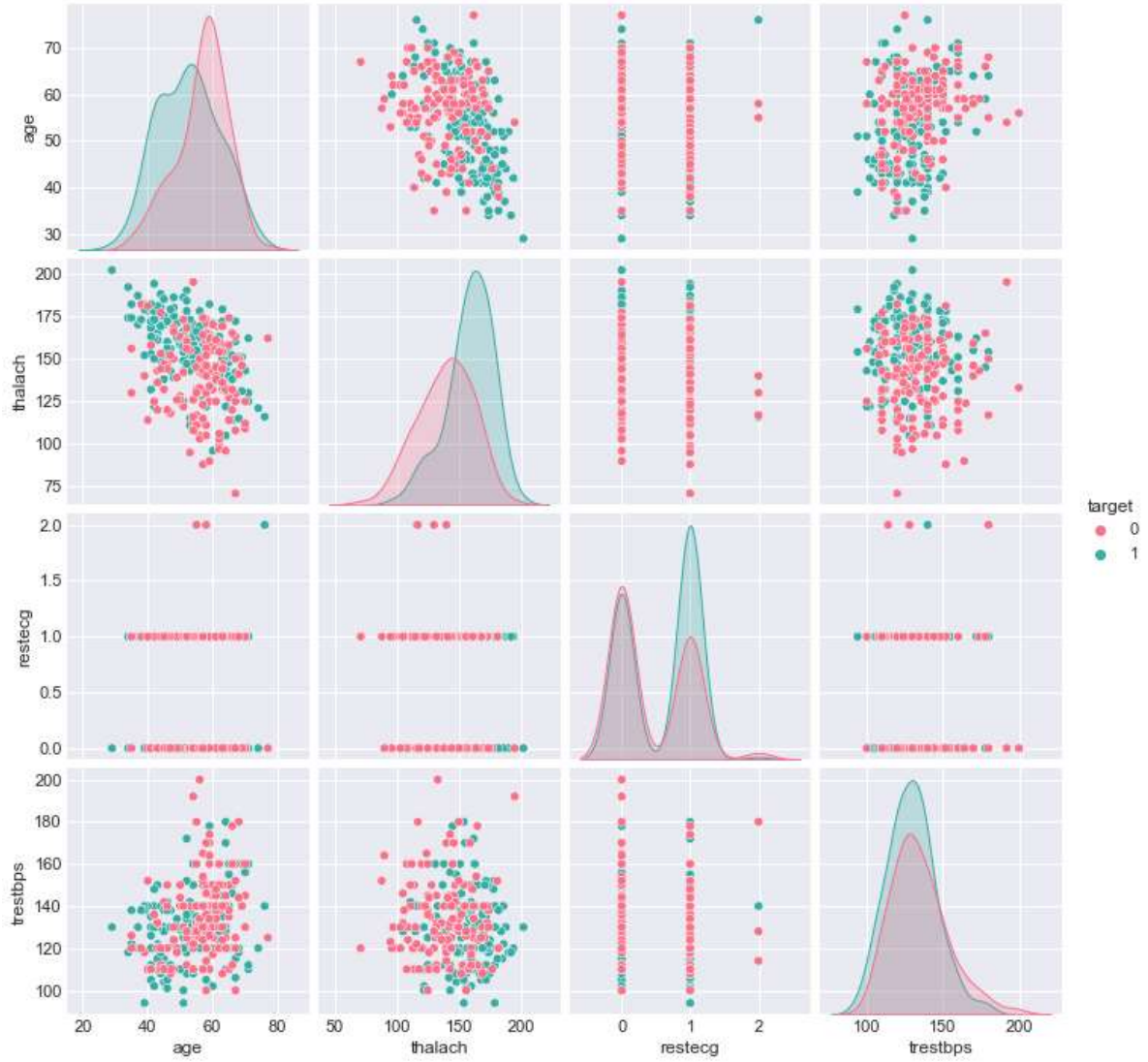


In [69]:

```
sns.pairplot(heartdf,hue="target",vars=["age","thalach","restecg","trestbps"],palette="husl
```

Out[69]:

```
<seaborn.axisgrid.PairGrid at 0x2ad731aca30>
```



7. Joint Plot

In [70]:

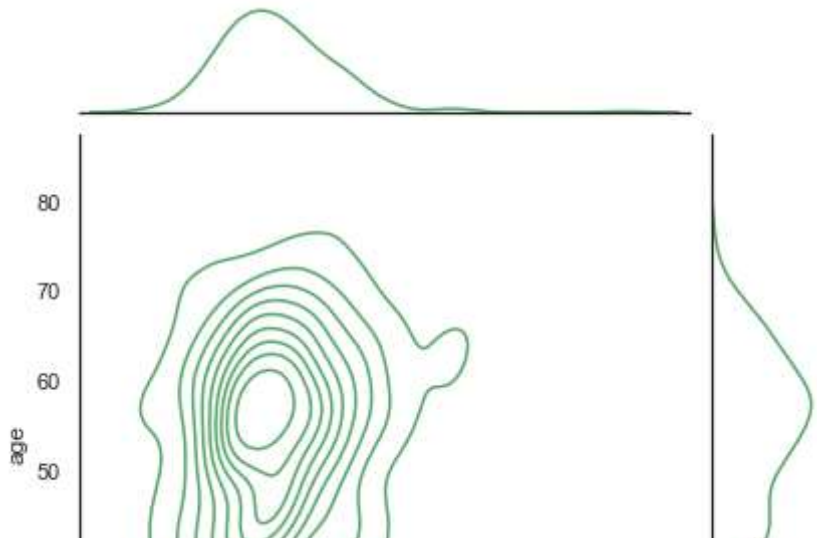
```
#JOINTPLOT
#This is drawn between two features.
```

In [71]:

```
sns.set(style="white")
sns.jointplot(x="chol",y="age",kind="kde",color="g",data=heartdf)


sns.set(style="white")
sns.jointplot(x="thalach",y="cp",kind="hex",color="g",data=heartdf)

sns.set(style="white")
sns.jointplot(x="trestbps",y="ca",kind="hex",color="g",data=heartdf)


sns.set(style="white")
sns.jointplot(x="oldpeak",y="thal",kind="kde",color="g",data=heartdf)


sns.set(style="white")
sns.jointplot(x="ca",y="thal",kind="kde",color="g",data=heartdf)


sns.set(style="white")
sns.jointplot(x="ca",y="cp",kind="kde",color="g",data=heartdf)
```

Out[71]:

```
<seaborn.axisgrid.JointGrid at 0x2ad73ce6d00>
```



8. Cat Plot

In [72]:

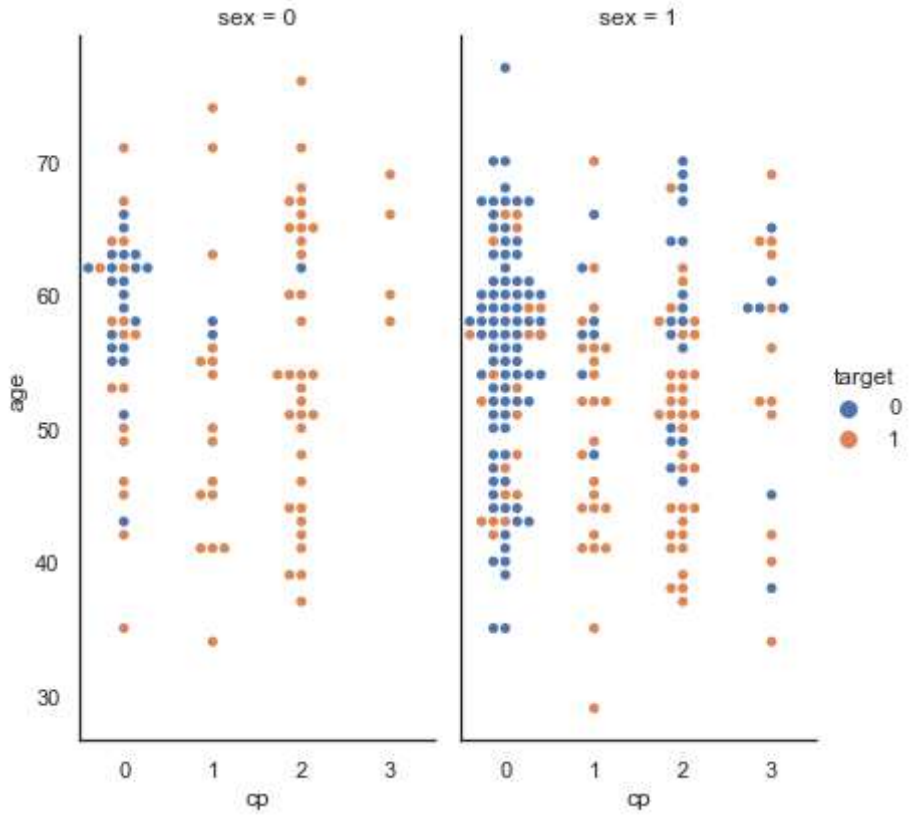
```
#CAT PLOT
#This plot combines facetgrid and swarmplot.
```

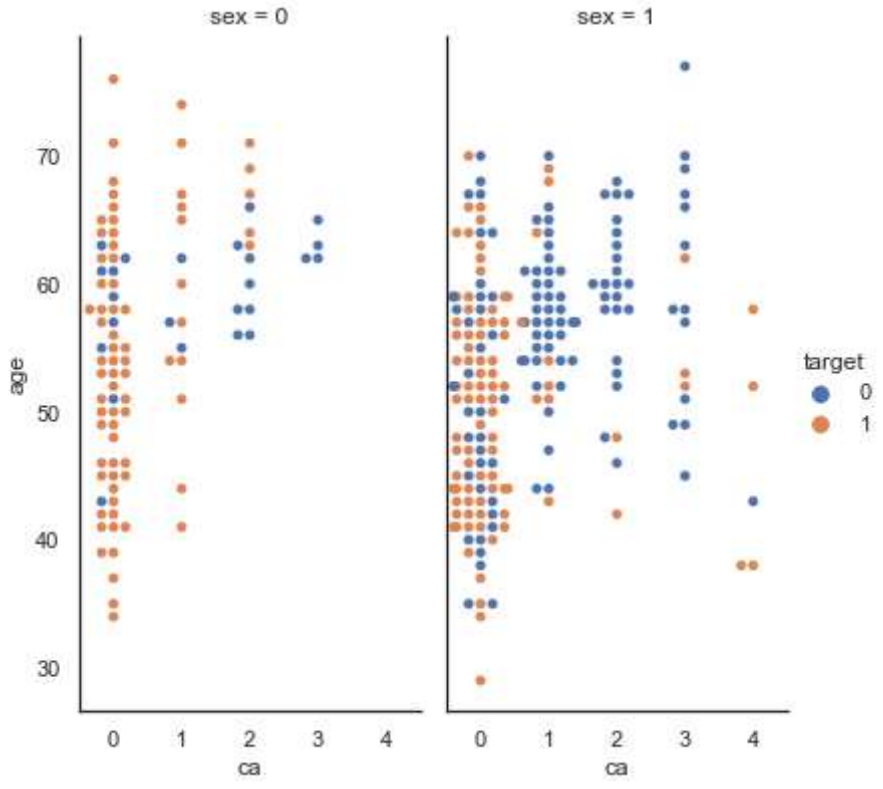
In [73]:

```
sns.catplot(x="cp", y="age",hue="target", col="sex",data=heartdf, kind="swarm",height=5.7,
sns.catplot(x="ca", y="age",hue="target", col="sex",data=heartdf, kind="swarm",height=5.5,
```

Out[73]:

```
<seaborn.axisgrid.FacetGrid at 0x2ad6ecd71c0>
```





In [ ]: