МОСКОВСКИЙ ГОСУДАРСТВЕННЫЙ ТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ
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Кафедра «Систем обработки информации и управления»

Рубежный контроль №1

по курсу «Методы машинного обучения»

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группа ИУ5-21М

Москва - 2020

РК1 ММО Сефербеков М.С

age - age in years (возраст)

sex - (1 = male; 0 = female) (пол)

cp - chest pain type (тип боли в груди)

trestbps - resting blood pressure (in mm Hg on admission to the hospital) (кровяное давление в состоянии покоя)

chol - serum cholestoral in mg/dl (давление холестерина в сыворотке крови)

fbs - (fasting blood sugar > 120 mg/dl) (1 = true; 0 = false) (уровень сахара в крови натощак)

restecg - resting electrocardiographic results (электрокардиографические результаты покоя)

thalach - maximum heart rate achieved (максимальная частота сердечных сокращений)

exang - exercise induced angina (1 = yes; 0 = no) (стенокардия, вызванная физической нагрузкой)

oldpeak - ST depression induced by exercise relative to rest (понижение ST-сегмента на электрокардиограмме, вызванное физ. упражнениями по сравнению с состоянием покоя)

slope - the slope of the peak exercise ST segment (элевация сегмента ST)

ca - number of major vessels (0-3) colored by flourosopy (количество крупных сосудов (0-3), окрашенных по цвету)

thal - 3 = normal; 6 = fixed defect; 7 = reversable defect (результат талиевого стресс-теста)

target - 1 or 0 (целевой признак: наличие или отсутствие сердечного заболевания)

In [2]:
```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn.datasets import load_diabetes
%matplotlib inline
sns.set(style="ticks")
```

In [3]:
```
data = pd.read_csv('heart.csv')
```

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

Out[4]:

	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 [5]:
```
data.shape
```

Out[5]:
```
(303, 14)
```

In [6]:
```
data.columns
```

Out[6]:
```
Index(['age', 'sex', 'cp', 'trestbps', 'chol', 'fbs', 'restecg', 'thalach',
       'exang', 'oldpeak', 'slope', 'ca', 'thal', 'target'],
      dtype='object')
```

In [7]:
```
data.dtypes
```

Out[7]:
```
age           int64
sex           int64
cp            int64
trestbps      int64
chol          int64
fbs           int64
restecg       int64
thalach       int64
exang         int64
oldpeak     float64
slope         int64
ca            int64
thal          int64
target        int64
dtype: object
```

In [8]:
```
for col in data.columns:
    # Количество пустых значений - все значения заполнены
    temp_null_count = data[data[col].isnull()].shape[0]
    print('{} - {}'.format(col, temp_null_count))
```

```
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
```

In [9]:
```
data = data.fillna(0)
```

In [10]:
```
data.describe()
```

Out[10]:

	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal	
count	303.000000	303.000000	303.000000	303.000000	303.000000	303.000000	303.000000	303.000000	303.000000	303.000000	303.000000	303.000000	303.000000	303
mean	54.366337	0.683168	0.966997	131.623762	246.264026	0.148515	0.528053	149.646865	0.326733	1.039604	1.399340	0.729373	2.313531	0
std	9.082101	0.466011	1.032052	17.538143	51.830751	0.356198	0.525860	22.905161	0.469794	1.161075	0.616226	1.022606	0.612277	0
min	29.000000	0.000000	0.000000	94.000000	126.000000	0.000000	0.000000	71.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0
25%	47.500000	0.000000	0.000000	120.000000	211.000000	0.000000	0.000000	133.500000	0.000000	0.000000	1.000000	0.000000	2.000000	0
50%	55.000000	1.000000	1.000000	130.000000	240.000000	0.000000	1.000000	153.000000	0.000000	0.800000	1.000000	0.000000	2.000000	1
75%	61.000000	1.000000	2.000000	140.000000	274.500000	0.000000	1.000000	166.000000	1.000000	1.600000	2.000000	1.000000	3.000000	1
max	77.000000	1.000000	3.000000	200.000000	564.000000	1.000000	2.000000	202.000000	1.000000	6.200000	2.000000	4.000000	3.000000	1

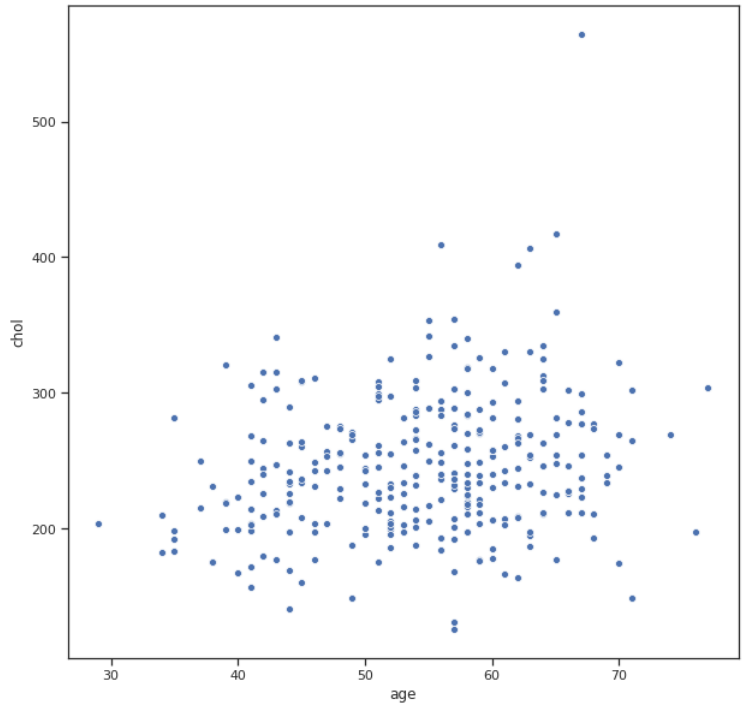
In [ ]:
```
```

In [11]:
```
# Определим уникальные значения для целевого признака
data['target'].unique()
```

Out[11]:
```
array([1, 0])
```

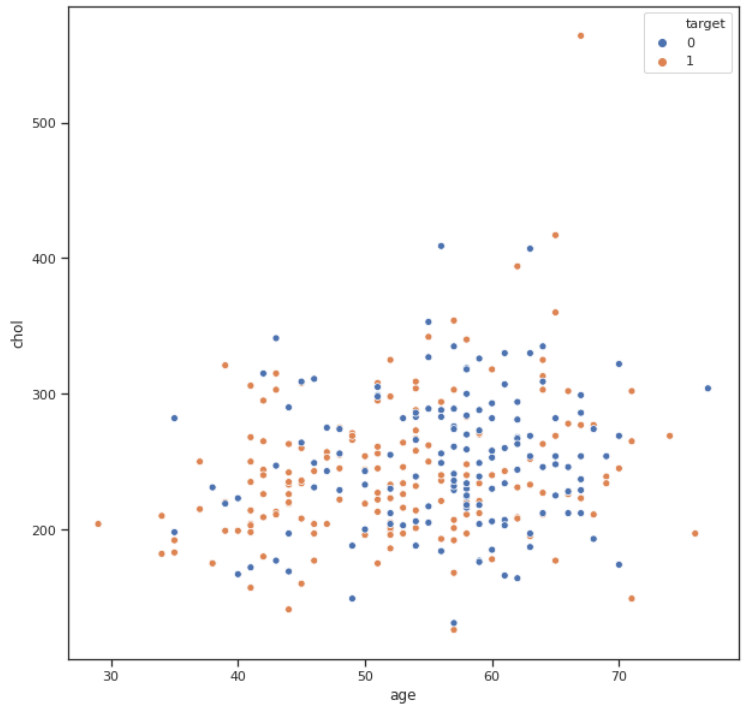
In [12]:
```
#диаграмма рассеивания
fig, ax = plt.subplots(figsize=(10,10))
sns.scatterplot(ax=ax, x='age', y='chol', data=data)
```

Out[12]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f8a21324760>
```



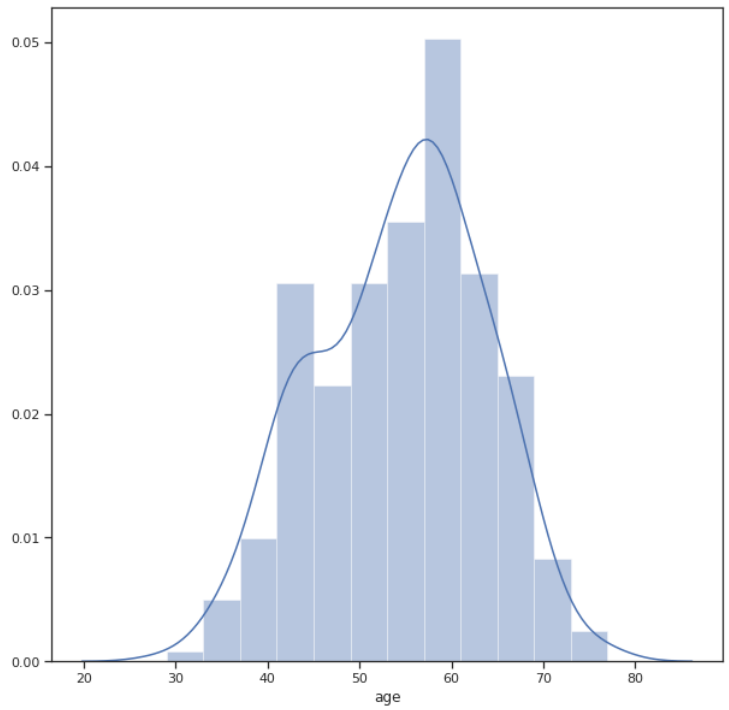
In [13]:
```
fig, ax = plt.subplots(figsize=(10,10))

sns.scatterplot(ax=ax, x='age', y='chol', data=data,hue='target')
```

Out[13]: <matplotlib.axes._subplots.AxesSubplot at 0x7f8a1f2b12e0>



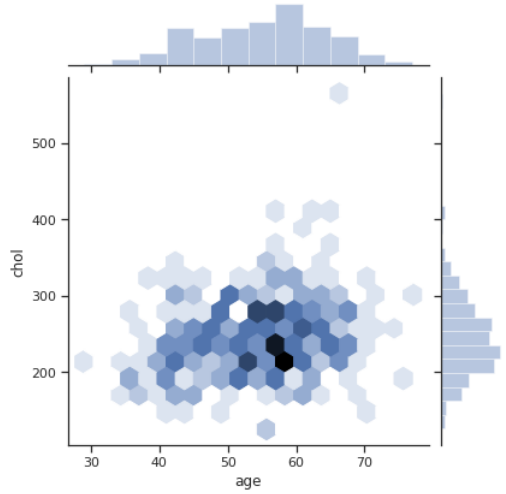
In [14]:
```
fig, ax = plt.subplots(figsize=(10,10))
sns.distplot(data['age'])
```

Out[14]: <matplotlib.axes._subplots.AxesSubplot at 0x7f8a1f214070>



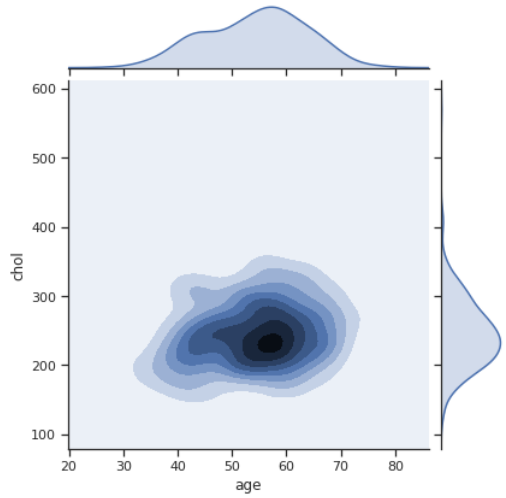
In [15]:
```
sns.jointplot(x='age', y='chol', data=data,kind="hex")
```

Out[15]: <seaborn.axisgrid.JointGrid at 0x7f8a1f18f700>



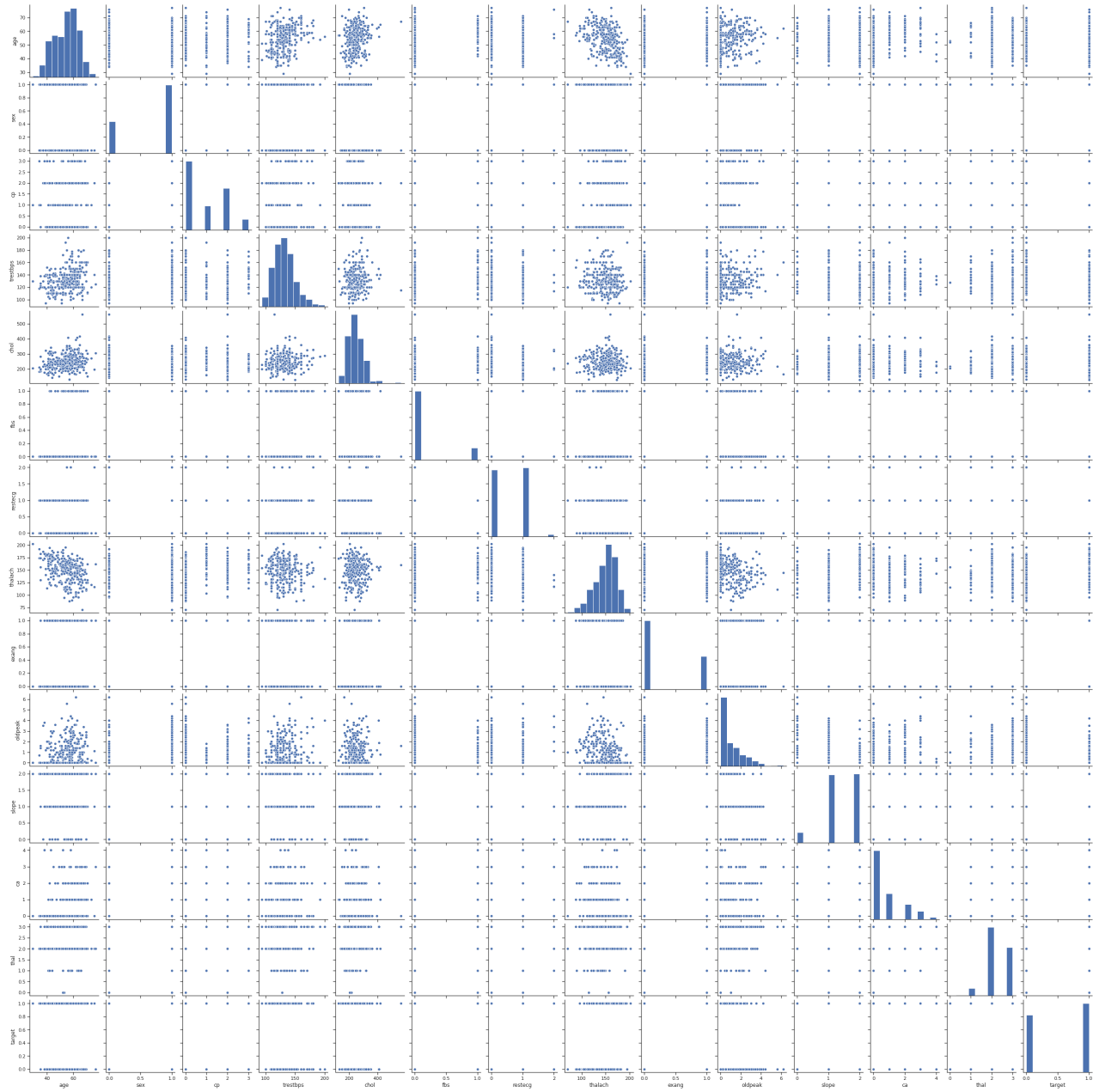
In [16]:
```
sns.jointplot(x='age', y='chol', data=data,kind="kde")
```

Out[16]: <seaborn.axisgrid.JointGrid at 0x7f8a1ee5fca0>



In [17]:
```
sns.pairplot(data)
```

Out[17]:
```
<seaborn.axisgrid.PairGrid at 0x7f8a1edd2130>
```



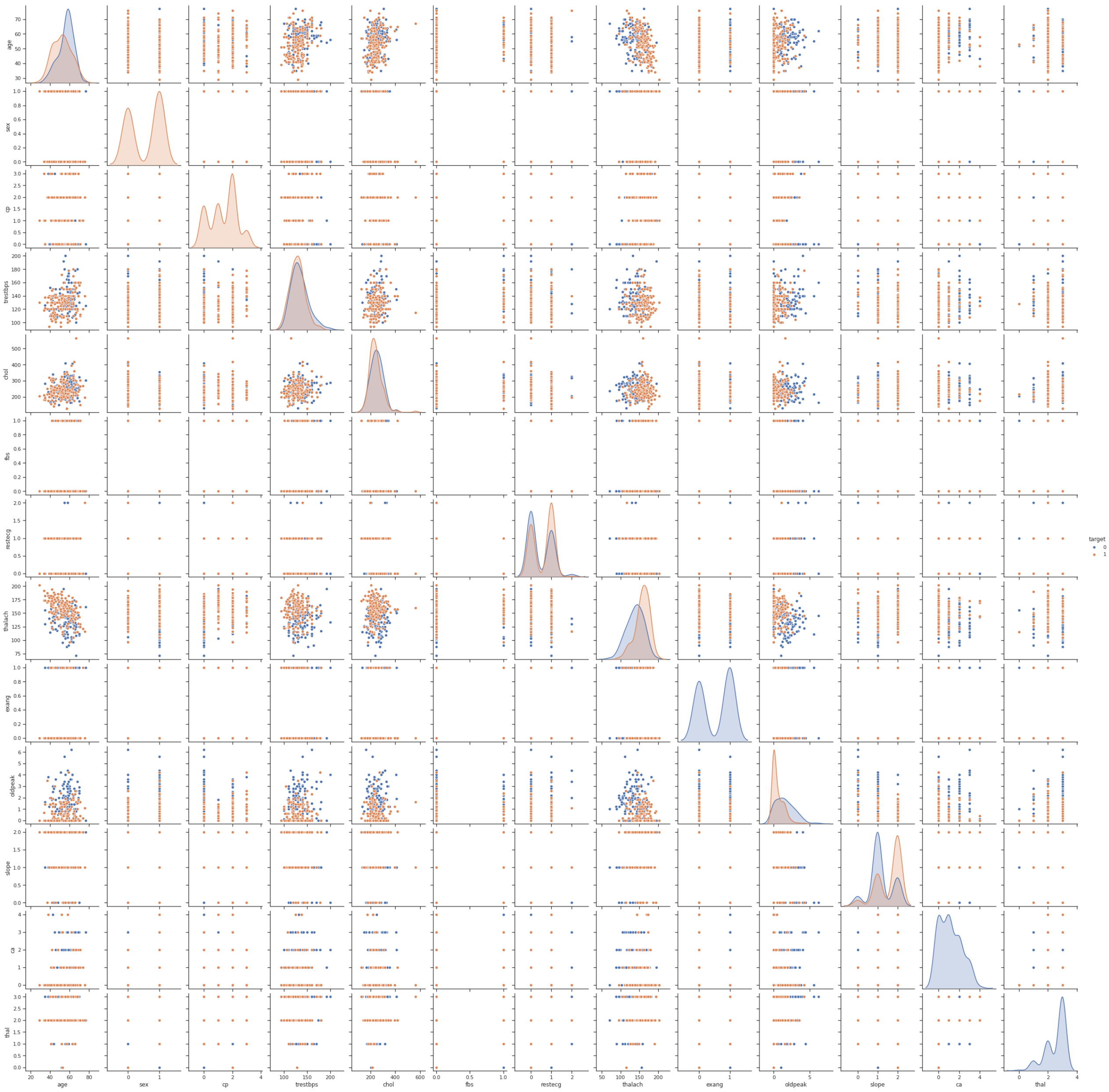
In [18]:

```
sns.pairplot(data,hue='target')
```

```
/home/sef/anaconda3/envs/ml/lib/python3.8/site-packages/seaborn/distributions.py:369: UserWarning: Default bandwidth for data is 0; skipp
ing density estimation.
  warnings.warn(msg, UserWarning)
/home/sef/anaconda3/envs/ml/lib/python3.8/site-packages/seaborn/distributions.py:369: UserWarning: Default bandwidth for data is 0; skipp
ing density estimation.
  warnings.warn(msg, UserWarning)
/home/sef/anaconda3/envs/ml/lib/python3.8/site-packages/seaborn/distributions.py:369: UserWarning: Default bandwidth for data is 0; skipp
ing density estimation.
  warnings.warn(msg, UserWarning)
/home/sef/anaconda3/envs/ml/lib/python3.8/site-packages/seaborn/distributions.py:369: UserWarning: Default bandwidth for data is 0; skipp
ing density estimation.
  warnings.warn(msg, UserWarning)
/home/sef/anaconda3/envs/ml/lib/python3.8/site-packages/seaborn/distributions.py:369: UserWarning: Default bandwidth for data is 0; skipp
ing density estimation.
  warnings.warn(msg, UserWarning)
/home/sef/anaconda3/envs/ml/lib/python3.8/site-packages/seaborn/distributions.py:369: UserWarning: Default bandwidth for data is 0; skipp
ing density estimation.
  warnings.warn(msg, UserWarning)
/home/sef/anaconda3/envs/ml/lib/python3.8/site-packages/seaborn/distributions.py:369: UserWarning: Default bandwidth for data is 0; skipp
ing density estimation.
  warnings.warn(msg, UserWarning)
```

Out[18]:

```
<seaborn.axisgrid.PairGrid at 0x7f8a19de25e0>
```



In [19]:
```
data.corr()
```

Out[19]:

	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal	target
age	1.000000	-0.098447	-0.068653	0.279351	0.213678	0.121308	-0.116211	-0.398522	0.096801	0.210013	-0.168814	0.276326	0.068001	-0.225439
sex	-0.098447	1.000000	-0.049353	-0.056769	-0.197912	0.045032	-0.058196	-0.044020	0.141664	0.096093	-0.030711	0.118261	0.210041	-0.280937
cp	-0.068653	-0.049353	1.000000	0.047608	-0.076904	0.094444	0.044421	0.295762	-0.394280	-0.149230	0.119717	-0.181053	-0.161736	0.433798
trestbps	0.279351	-0.056769	0.047608	1.000000	0.123174	0.177531	-0.114103	-0.046698	0.067616	0.193216	-0.121475	0.101389	0.062210	-0.144931
chol	0.213678	-0.197912	-0.076904	0.123174	1.000000	0.013294	-0.151040	-0.009940	0.067023	0.053952	-0.004038	0.070511	0.098803	-0.085239
fbs	0.121308	0.045032	0.094444	0.177531	0.013294	1.000000	-0.084189	-0.008567	0.025665	0.005747	-0.059894	0.137979	-0.032019	-0.028046
restecg	-0.116211	-0.058196	0.044421	-0.114103	-0.151040	-0.084189	1.000000	0.044123	-0.070733	-0.058770	0.093045	-0.072042	-0.011981	0.137230
thalach	-0.398522	-0.044020	0.295762	-0.046698	-0.009940	-0.008567	0.044123	1.000000	-0.378812	-0.344187	0.386784	-0.213177	-0.096439	0.421741
exang	0.096801	0.141664	-0.394280	0.067616	0.067023	0.025665	-0.070733	-0.378812	1.000000	0.288223	-0.257748	0.115739	0.206754	-0.436757
oldpeak	0.210013	0.096093	-0.149230	0.193216	0.053952	0.005747	-0.058770	-0.344187	0.288223	1.000000	-0.577537	0.222682	0.210244	-0.430696
slope	-0.168814	-0.030711	0.119717	-0.121475	-0.004038	-0.059894	0.093045	0.386784	-0.257748	-0.577537	1.000000	-0.080155	-0.104764	0.345877
ca	0.276326	0.118261	-0.181053	0.101389	0.070511	0.137979	-0.072042	-0.213177	0.115739	0.222682	-0.080155	1.000000	0.151832	-0.391724
thal	0.068001	0.210041	-0.161736	0.062210	0.098803	-0.032019	-0.011981	-0.096439	0.206754	0.210244	-0.104764	0.151832	1.000000	-0.344029
target	-0.225439	-0.280937	0.433798	-0.144931	-0.085239	-0.028046	0.137230	0.421741	-0.436757	-0.430696	0.345877	-0.391724	-0.344029	1.000000

In [20]:
```
data.corr(method='pearson')
```

Out[20]:

	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal	target
age	1.000000	-0.098447	-0.068653	0.279351	0.213678	0.121308	-0.116211	-0.398522	0.096801	0.210013	-0.168814	0.276326	0.068001	-0.225439
sex	-0.098447	1.000000	-0.049353	-0.056769	-0.197912	0.045032	-0.058196	-0.044020	0.141664	0.096093	-0.030711	0.118261	0.210041	-0.280937
cp	-0.068653	-0.049353	1.000000	0.047608	-0.076904	0.094444	0.044421	0.295762	-0.394280	-0.149230	0.119717	-0.181053	-0.161736	0.433798
trestbps	0.279351	-0.056769	0.047608	1.000000	0.123174	0.177531	-0.114103	-0.046698	0.067616	0.193216	-0.121475	0.101389	0.062210	-0.144931
chol	0.213678	-0.197912	-0.076904	0.123174	1.000000	0.013294	-0.151040	-0.009940	0.067023	0.053952	-0.004038	0.070511	0.098803	-0.085239
fbs	0.121308	0.045032	0.094444	0.177531	0.013294	1.000000	-0.084189	-0.008567	0.025665	0.005747	-0.059894	0.137979	-0.032019	-0.028046
restecg	-0.116211	-0.058196	0.044421	-0.114103	-0.151040	-0.084189	1.000000	0.044123	-0.070733	-0.058770	0.093045	-0.072042	-0.011981	0.137230
thalach	-0.398522	-0.044020	0.295762	-0.046698	-0.009940	-0.008567	0.044123	1.000000	-0.378812	-0.344187	0.386784	-0.213177	-0.096439	0.421741
exang	0.096801	0.141664	-0.394280	0.067616	0.067023	0.025665	-0.070733	-0.378812	1.000000	0.288223	-0.257748	0.115739	0.206754	-0.436757
oldpeak	0.210013	0.096093	-0.149230	0.193216	0.053952	0.005747	-0.058770	-0.344187	0.288223	1.000000	-0.577537	0.222682	0.210244	-0.430696
slope	-0.168814	-0.030711	0.119717	-0.121475	-0.004038	-0.059894	0.093045	0.386784	-0.257748	-0.577537	1.000000	-0.080155	-0.104764	0.345877
ca	0.276326	0.118261	-0.181053	0.101389	0.070511	0.137979	-0.072042	-0.213177	0.115739	0.222682	-0.080155	1.000000	0.151832	-0.391724
thal	0.068001	0.210041	-0.161736	0.062210	0.098803	-0.032019	-0.011981	-0.096439	0.206754	0.210244	-0.104764	0.151832	1.000000	-0.344029
target	-0.225439	-0.280937	0.433798	-0.144931	-0.085239	-0.028046	0.137230	0.421741	-0.436757	-0.430696	0.345877	-0.391724	-0.344029	1.000000

In [21]:
```
data.corr(method='kendall')
```

Out[21]:

	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal	target
age	1.000000	-0.082272	-0.071577	0.201071	0.135062	0.094595	-0.109349	-0.280009	0.074427	0.193269	-0.147713	0.273255	0.070722	-0.197857
sex	-0.082272	1.000000	-0.057955	-0.044438	-0.124104	0.045032	-0.048085	-0.032817	0.141664	0.086437	-0.024333	0.112199	0.244164	-0.280937
cp	-0.071577	-0.057955	1.000000	0.027548	-0.069899	0.083862	0.060839	0.246160	-0.390708	-0.125081	0.145796	-0.189400	-0.188999	0.430506
trestbps	0.201071	-0.044438	0.027548	1.000000	0.086474	0.127574	-0.105147	-0.027760	0.044419	0.109103	-0.070360	0.070387	0.049028	-0.102064
chol	0.135062	-0.124104	-0.069899	0.086474	1.000000	0.015140	-0.132664	-0.031437	0.075044	0.035176	-0.010039	0.088549	0.066255	-0.099131
fbs	0.094595	0.045032	0.083862	0.127574	0.015140	1.000000	-0.080996	-0.011749	0.025665	0.024342	-0.044546	0.126434	-0.006559	-0.028046
restecg	-0.109349	-0.048085	0.060839	-0.105147	-0.132664	-0.080996	1.000000	0.072481	-0.076913	-0.066262	0.110042	-0.091541	-0.010692	0.147678
thalach	-0.280009	-0.032817	0.246160	-0.027760	-0.031437	-0.011749	0.072481	1.000000	-0.329965	-0.306843	0.349702	-0.198407	-0.130239	0.352609
exang	0.074427	0.141664	-0.390708	0.044419	0.075044	0.025665	-0.076913	-0.329965	1.000000	0.255042	-0.267046	0.152294	0.240555	-0.436757
oldpeak	0.193269	0.086437	-0.125081	0.109103	0.035176	0.024342	-0.066262	-0.306843	0.255042	1.000000	-0.508539	0.183166	0.213656	-0.361731
slope	-0.147713	-0.024333	0.145796	-0.070360	-0.010039	-0.044546	0.110042	0.349702	-0.267046	-0.508539	1.000000	-0.092013	-0.147382	0.361406
ca	0.273255	0.112199	-0.189400	0.070387	0.088549	0.126434	-0.091541	-0.198407	0.152294	0.183166	-0.092013	1.000000	0.173361	-0.430124
thal	0.070722	0.244164	-0.188999	0.049028	0.066255	-0.006559	-0.010692	-0.130239	0.240555	0.213656	-0.147382	0.173361	1.000000	-0.392595
target	-0.197857	-0.280937	0.430506	-0.102064	-0.099131	-0.028046	0.147678	0.352609	-0.436757	-0.361731	0.361406	-0.430124	-0.392595	1.000000

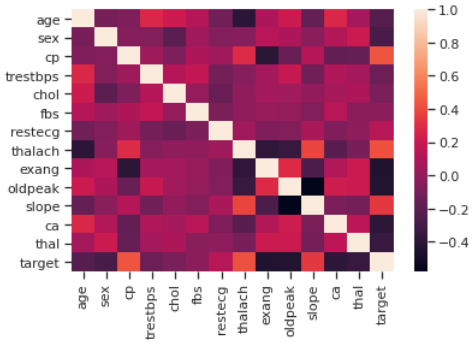
In [22]:
```
data.corr(method='spearman')
```

Out[22]:

	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal	target
age	1.000000	-0.099131	-0.087494	0.285617	0.195786	0.113978	-0.132769	-0.398052	0.089679	0.268291	-0.184048	0.340955	0.087254	-0.238400
sex	-0.099131	1.000000	-0.062041	-0.052941	-0.151342	0.045032	-0.048389	-0.039868	0.141664	0.100715	-0.025010	0.119368	0.250821	-0.280937
cp	-0.087494	-0.062041	1.000000	0.035413	-0.091721	0.089775	0.065640	0.324013	-0.418256	-0.161449	0.159478	-0.216006	-0.207840	0.460860
trestbps	0.285617	-0.052941	0.035413	1.000000	0.126562	0.151984	-0.125841	-0.040407	0.052918	0.154267	-0.086570	0.090140	0.059673	-0.121593
chol	0.195786	-0.151342	-0.091721	0.126562	1.000000	0.018463	-0.161933	-0.046766	0.091514	0.045260	-0.012551	0.111981	0.083628	-0.120888
fbs	0.113978	0.045032	0.089775	0.151984	0.018463	1.000000	-0.081508	-0.014273	0.025665	0.028363	-0.045786	0.134513	-0.006737	-0.028046
restecg	-0.132769	-0.048389	0.065640	-0.125841	-0.161933	-0.081508	1.000000	0.087863	-0.077399	-0.077372	0.113661	-0.097862	-0.010982	0.148612
thalach	-0.398052	-0.039868	0.324013	-0.040407	-0.046766	-0.014273	0.087863	1.000000	-0.400860	-0.433241	0.436968	-0.257347	-0.160581	0.428370
exang	0.089679	0.141664	-0.418256	0.052918	0.091514	0.025665	-0.077399	-0.400860	1.000000	0.297173	-0.274475	0.162025	0.247113	-0.436757
oldpeak	0.268291	0.100715	-0.161449	0.154267	0.045260	0.028363	-0.077372	-0.433241	0.297173	1.000000	-0.594847	0.224895	0.255026	-0.421487
slope	-0.184048	-0.025010	0.159478	-0.086570	-0.012551	-0.045786	0.113661	0.436968	-0.274475	-0.594847	1.000000	-0.099901	-0.154886	0.371460
ca	0.340955	0.119368	-0.216006	0.090140	0.111981	0.134513	-0.097862	-0.257347	0.162025	0.224895	-0.099901	1.000000	0.189103	-0.457607
thal	0.087254	0.250821	-0.207840	0.059673	0.083628	-0.006737	-0.010982	-0.160581	0.247113	0.255026	-0.154886	0.189103	1.000000	-0.403299
target	-0.238400	-0.280937	0.460860	-0.121593	-0.120888	-0.028046	0.148612	0.428370	-0.436757	-0.421487	0.371460	-0.457607	-0.403299	1.000000

In [23]:
```
sns.heatmap(data.corr())
```

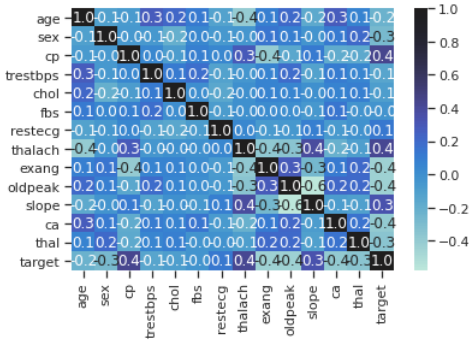
Out[23]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f8a0e7ad850>
```



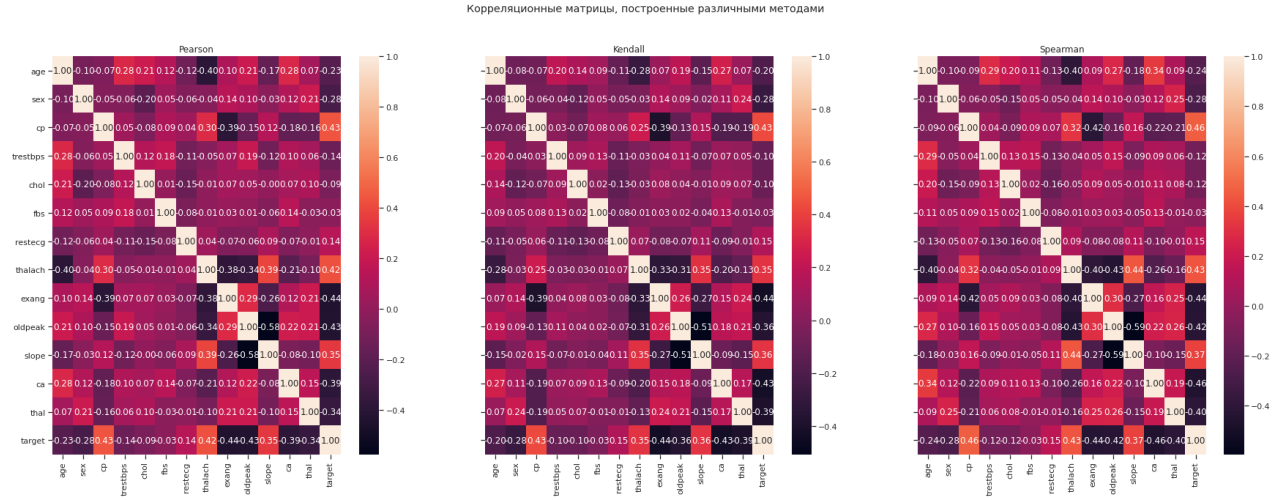
target корреллирует в основном с cp, thalach

In [24]:
```
sns.heatmap(data.corr(), annot=True, fmt='.1f',center=1)
```

Out[24]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f8a0e96e0d0>
```



In [25]:
```
fig, ax = plt.subplots(1, 3, sharex='col', sharey='row', figsize=(30,10))
sns.heatmap(data.corr(method='pearson'), ax=ax[0], annot=True, fmt='.2f')
sns.heatmap(data.corr(method='kendall'), ax=ax[1], annot=True, fmt='.2f')
sns.heatmap(data.corr(method='spearman'), ax=ax[2], annot=True, fmt='.2f')
fig.suptitle('Корреляционные матрицы, построенные различными методами')
ax[0].title.set_text('Pearson')
ax[1].title.set_text('Kendall')
ax[2].title.set_text('Spearman')
```



In [ ]:
```
```