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Кафедра «Системы обработки информации и управления»

Курс «Технологии машинного обучения»

Отчет по лабораторной работе №1

Разведочный анализ данных. Исследование и визуализация данных

Группа: ИУ5-62Б

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Цель лабораторной работы: изучение различных методов визуализация данных.

Описание задания

Выбрать набор данных (датасет).
Создать ноутбук, который содержит следующие разделы:
1. Текстовое описание выбранного набора данных.
2. Основные характеристики датасета.
3. Визуальное исследование датасета.
4. Информация о корреляции признаков.

Текст программы и примеры выполнения

```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
%matplotlib inline
sns.set(style="ticks")
from sklearn.datasets import *
sklearn_data = load_breast_cancer()
# Возможные значения целевого признака
sklearn_data['target_names']
```

```
Out[3]: array(['malignant', 'benign'], dtype='<U9')
```

```
data = pd.DataFrame(data=np.c_[sklearn_data['data'],
      sklearn_data['target']],
      columns=np.append(sklearn_data['feature_names'], ['target']))
# Первые 5 строк датасета
data.head()
```

	mean radius	mean texture	mean perimeter	mean area	mean smoothness	mean compactness	mean concavity	mean concave points	mean symmetry	mean fractal dimension	...	worst texture	worst perimeter	worst area	worst smoothness	cc
0	17.99	10.38	122.80	1001.0	0.11840	0.27760	0.3001	0.14710	0.2419	0.07871	...	17.33	184.60	2019.0	0.1622	
1	20.57	17.77	132.90	1326.0	0.08474	0.07864	0.0869	0.07017	0.1812	0.05667	...	23.41	158.80	1956.0	0.1238	
2	19.69	21.25	130.00	1203.0	0.10960	0.15990	0.1974	0.12790	0.2069	0.05999	...	25.53	152.50	1709.0	0.1444	
3	11.42	20.38	77.58	386.1	0.14250	0.28390	0.2414	0.10520	0.2597	0.09744	...	26.50	98.87	567.7	0.2098	
4	20.29	14.34	135.10	1297.0	0.10030	0.13280	0.1980	0.10430	0.1809	0.05883	...	16.67	152.20	1575.0	0.1374	

5 rows × 31 columns

```
# Размер датасета - 569 строк, 31 колонка
data.shape
```

```
Out[6]: (569, 31)
```

```
# Список колонок
```

```
data.columns
```

```
Out[7]: Index(['mean radius', 'mean texture', 'mean perimeter', 'mean area',
                'mean smoothness', 'mean compactness', 'mean concavity',
                'mean concave points', 'mean symmetry', 'mean fractal dimension',
                'radius error', 'texture error', 'perimeter error', 'area error',
                'smoothness error', 'compactness error', 'concavity error',
                'concave points error', 'symmetry error', 'fractal dimension error',
                'worst radius', 'worst texture', 'worst perimeter', 'worst area',
                'worst smoothness', 'worst compactness', 'worst concavity',
                'worst concave points', 'worst symmetry', 'worst fractal dimension',
                'target'],
               dtype='object')
```

```
# Список колонок с типами данных
data.dtypes
```

```
Out[8]: mean radius               float64
        mean texture              float64
        mean perimeter            float64
        mean area                 float64
        mean smoothness           float64
        mean compactness          float64
        mean concavity            float64
        mean concave points       float64
        mean symmetry             float64
        mean fractal dimension    float64
        radius error              float64
        texture error             float64
        perimeter error           float64
        area error                float64
        smoothness error          float64
        compactness error         float64
        concavity error           float64
        concave points error      float64
        symmetry error            float64
        fractal dimension error   float64
        worst radius              float64
        worst texture             float64
        worst perimeter           float64
        worst area                float64
        worst smoothness          float64
        worst compactness         float64
        worst concavity           float64
        worst concave points      float64
        worst symmetry            float64
        worst fractal dimension   float64
        target                    float64
        dtype: object
```

```
# Наличие пустых значений
data.isnull().sum()
```

```
Out[9]: mean radius                0
        mean texture               0
        mean perimeter             0
        mean area                  0
        mean smoothness            0
        mean compactness           0
        mean concavity             0
        mean concave points        0
        mean symmetry              0
        mean fractal dimension     0
        radius error               0
        texture error              0
        perimeter error            0
        area error                 0
        smoothness error           0
        compactness error          0
        concavity error            0
        concave points error       0
        symmetry error             0
        fractal dimension error    0
        worst radius               0
        worst texture              0
        worst perimeter            0
        worst area                 0
        worst smoothness           0
        worst compactness          0
        worst concavity            0
        worst concave points       0
        worst symmetry             0
        worst fractal dimension    0
        target                     0
        dtype: int64
```

```
# Основные статистические характеристики набора
data.describe()
```

	mean radius	mean texture	mean perimeter	mean area	mean smoothness	mean compactness	mean concavity	mean concave points	mean symmetry	mean fractal dimension	...	worst texture	peri
count	569.000000	569.000000	569.000000	569.000000	569.000000	569.000000	569.000000	569.000000	569.000000	569.000000	...	569.000000	569.00
mean	14.127292	19.289649	91.969033	654.889104	0.096360	0.104341	0.088799	0.048919	0.181162	0.062798	...	25.677223	107.26
std	3.524049	4.301036	24.298981	351.914129	0.014064	0.052813	0.079720	0.038803	0.027414	0.007060	...	6.146258	33.60
min	6.981000	9.710000	43.790000	143.500000	0.052630	0.019380	0.000000	0.000000	0.106000	0.049960	...	12.020000	50.41
25%	11.700000	16.170000	75.170000	420.300000	0.086370	0.064920	0.029560	0.020310	0.161900	0.057700	...	21.080000	84.11
50%	13.370000	18.840000	86.240000	551.100000	0.095870	0.092630	0.061540	0.033500	0.179200	0.061540	...	25.410000	97.66
75%	15.780000	21.800000	104.100000	782.700000	0.105300	0.130400	0.130700	0.074000	0.195700	0.066120	...	29.720000	125.40
max	28.110000	39.280000	188.500000	2501.000000	0.163400	0.345400	0.426800	0.201200	0.304000	0.097440	...	49.540000	251.20

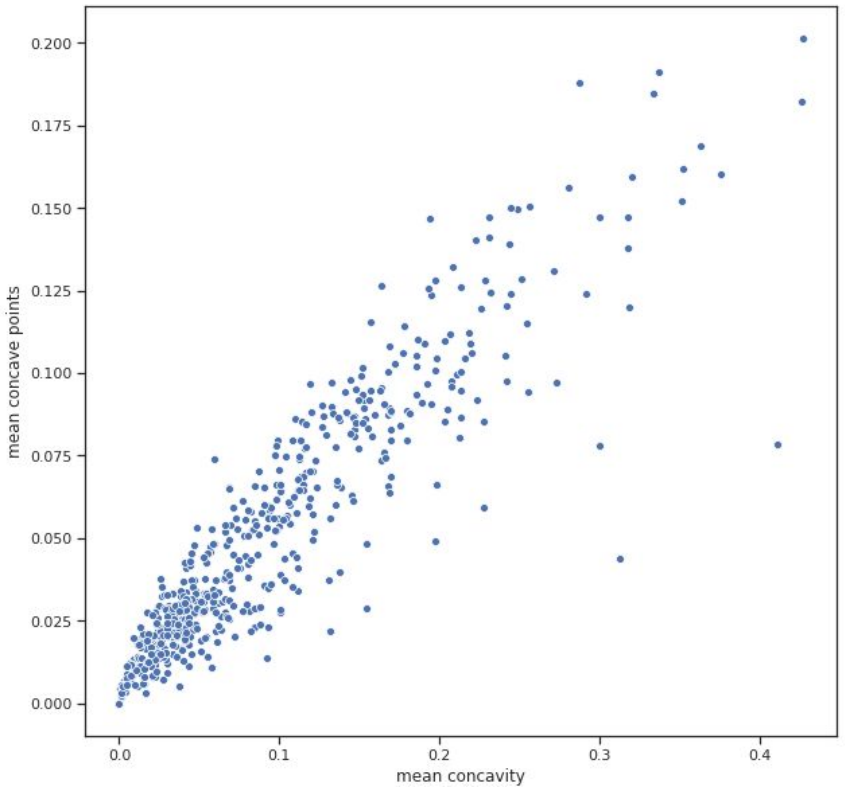
8 rows × 31 columns

```
# Уникальные значения для целевого признака
data['target'].unique()
```

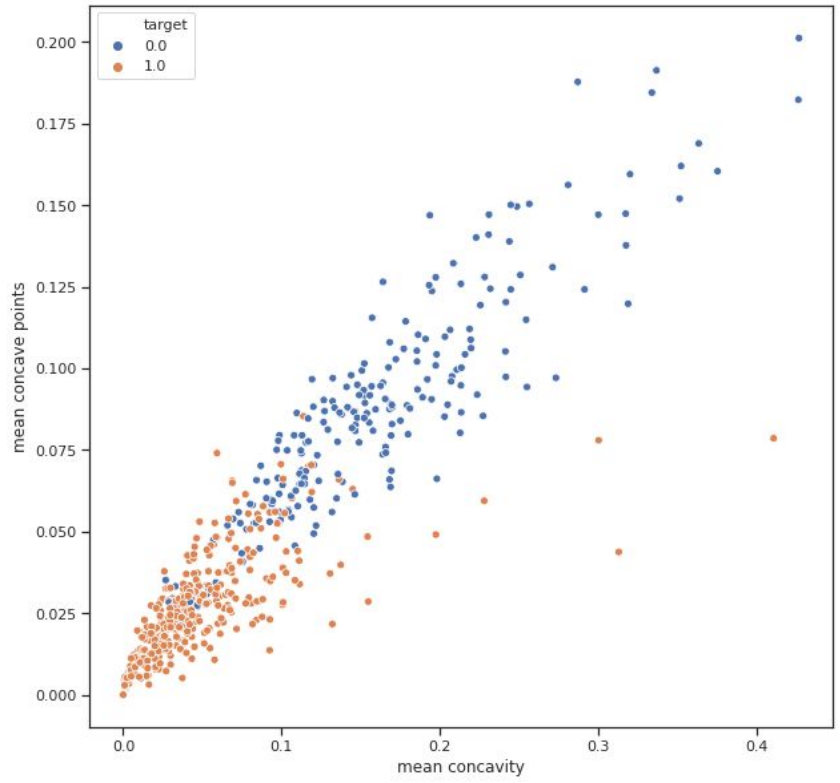
```
Out[11]: array([0., 1.])
```

```
# Зависимость количества вогнутых частей контура от вогнутости
fig, ax = plt.subplots(figsize=(10,10))
sns.scatterplot(ax=ax, x='mean concavity', y='mean concave points',
```

```
        data=data)
```

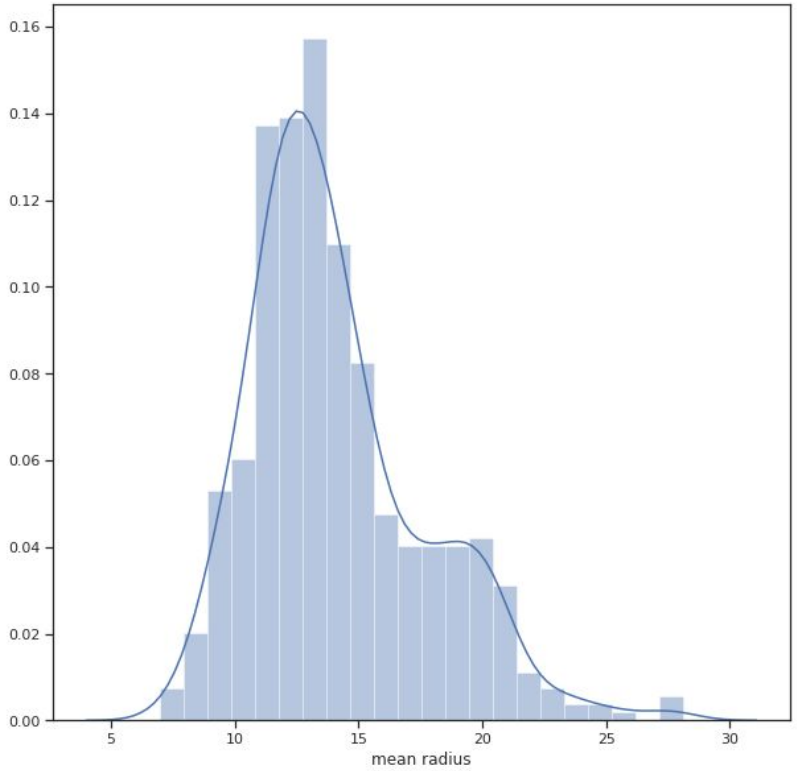



```
fig, ax = plt.subplots(figsize=(10,10))
sns.scatterplot(ax=ax, x='mean concavity', y='mean concave points',
        data=data, hue='target')
```

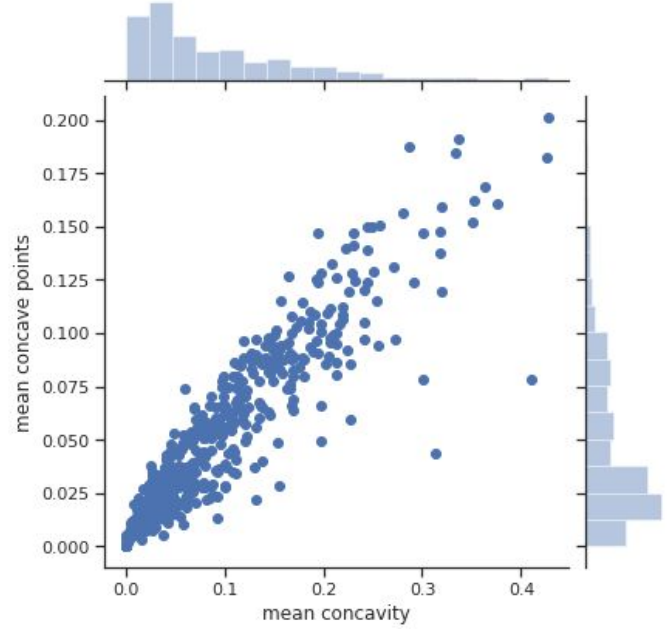



```
# Распределение среднего значения радиуса
```

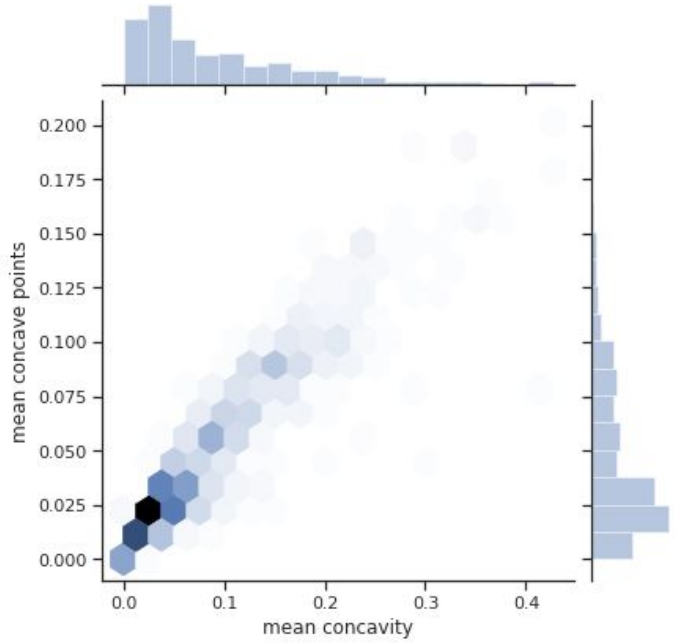
```
fig, ax = plt.subplots(figsize=(10,10))
sns.distplot(data['mean radius'])
```



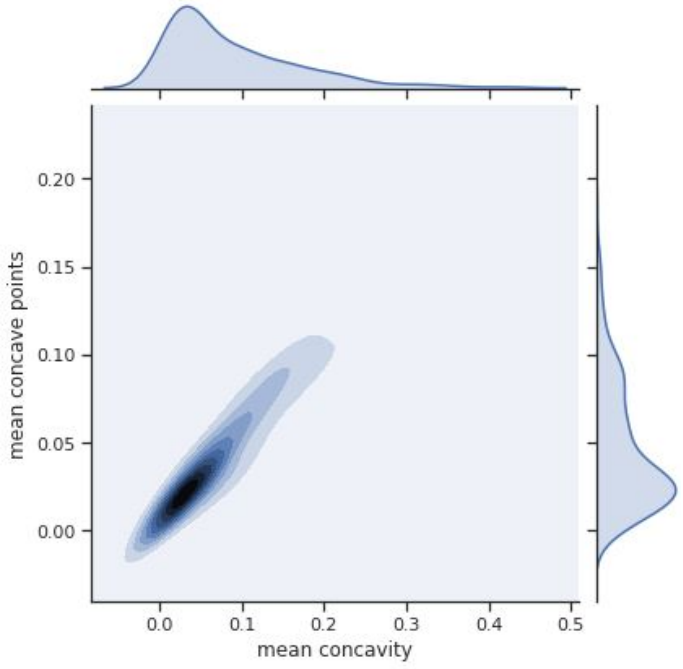

```
sns.jointplot(x='mean concavity', y='mean concave points', data=data)
```



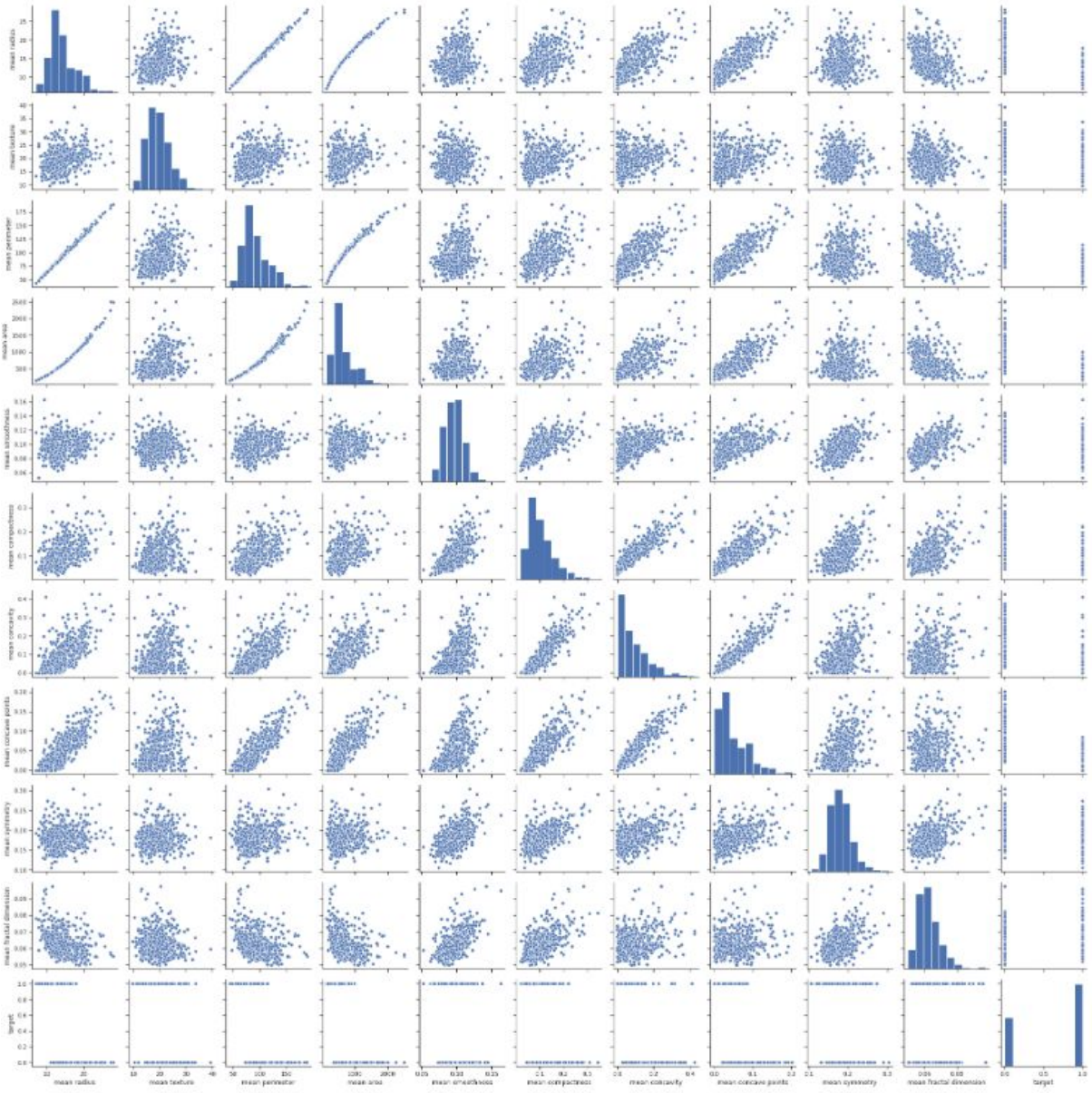

```
sns.jointplot(x='mean concavity', y='mean concave points', data=data,
      kind='hex')
```



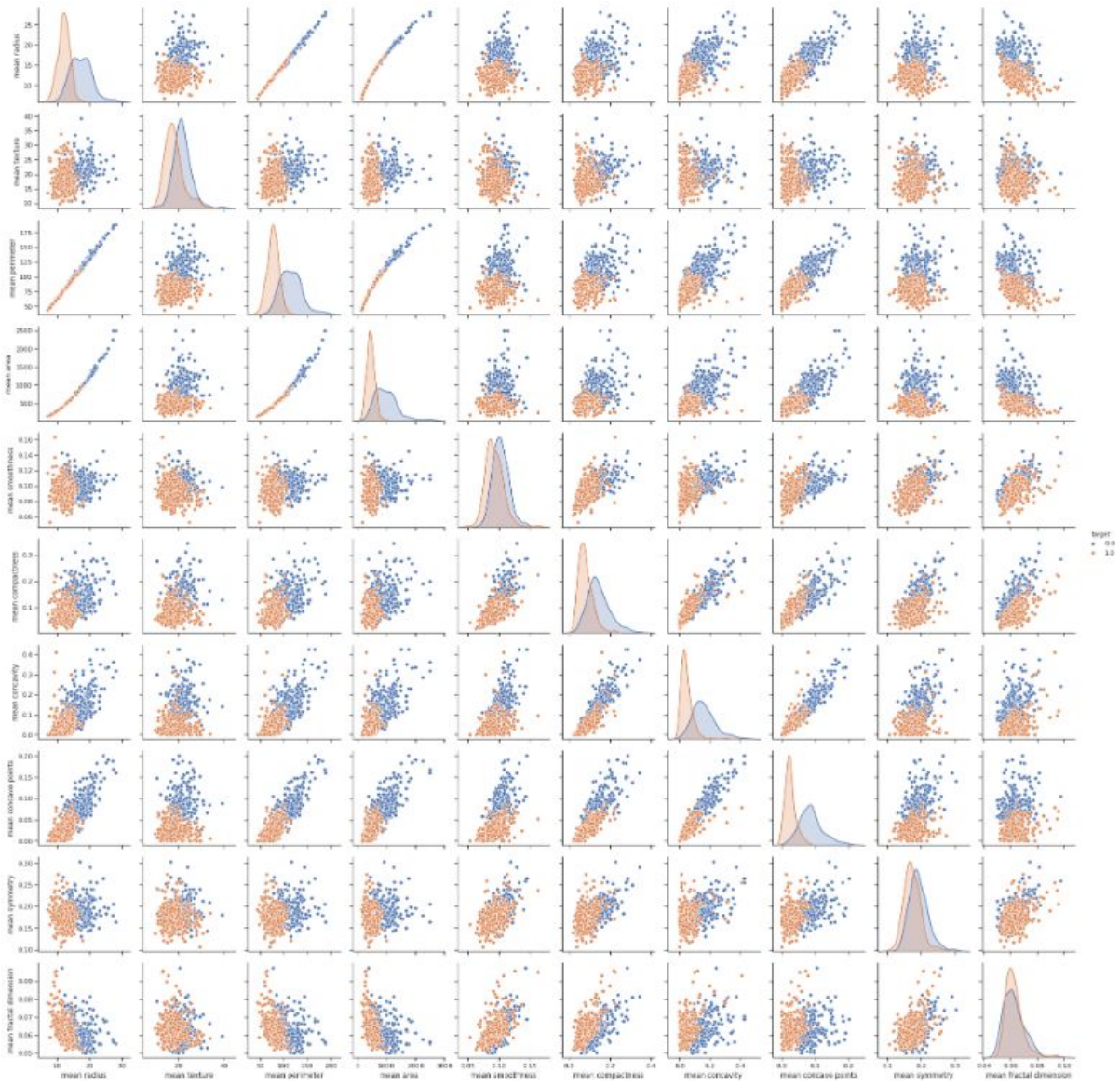

```
sns.jointplot(x='mean concavity', y='mean concave points', data=data,
      kind='kde')
```



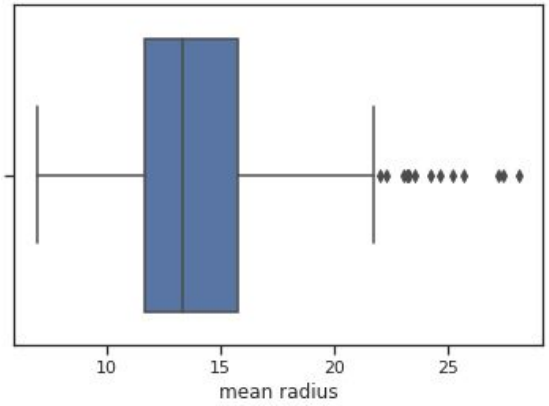

```
data1 = data[['mean radius', 'mean texture', 'mean perimeter', 'mean
      area', 'mean smoothness', 'mean compactness', 'mean concavity',
      'mean concave points', 'mean symmetry', 'mean fractal dimension',
      'target']]
sns.pairplot(data1)
```



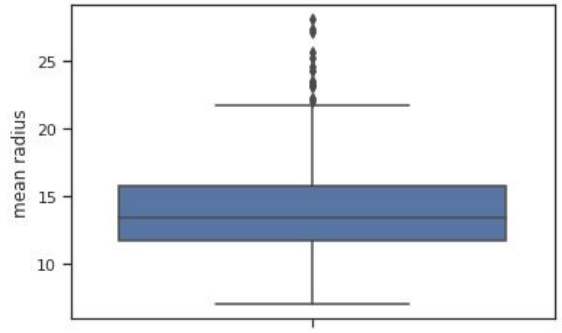

```
sns.pairplot(data1, hue='target')
```



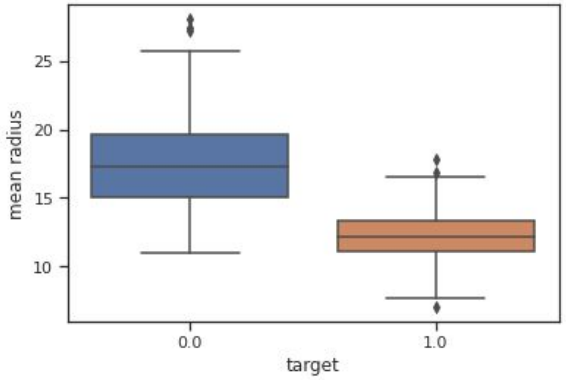

```
# По горизонтали
sns.boxplot(x=data['mean radius'])
```



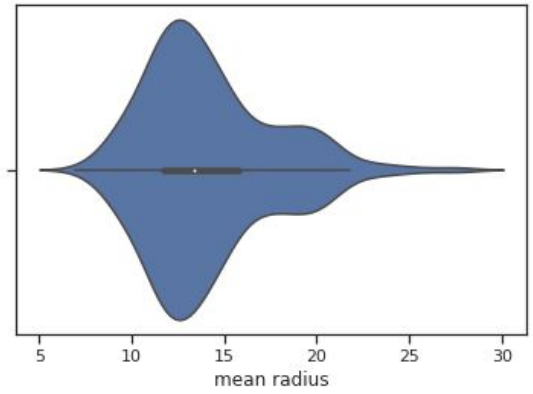

```
# По вертикали
sns.boxplot(y=data['mean radius'])
```



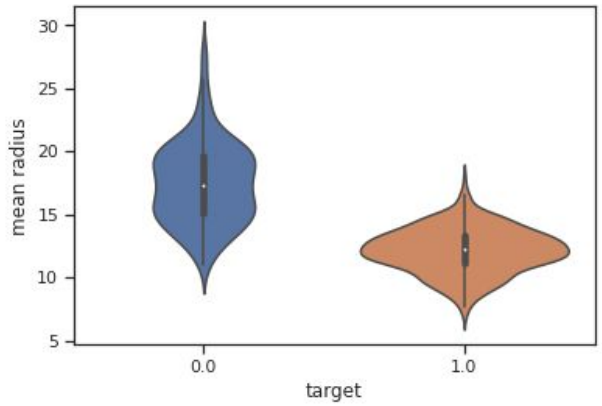

```
# Распределение параметра mean radius,
сгруппированное по target
sns.boxplot(x=data['target'], y=data['mean radius'])
```




```
sns.violinplot(x=data['mean radius'])
```




```
# Распределение параметра mean radius
сгруппированные по target.
sns.violinplot(x='target', y='mean radius', data=data)
```




```
data.corr(method='pearson')
```

	mean radius	mean texture	mean perimeter	mean area	mean smoothness	mean compactness	mean concavity	mean concave points	mean symmetry	mean fractal dimension	...	worst texture	worst perimeter
mean radius	1.000000	0.323782	0.997855	0.987357	0.170581	0.506124	0.676764	0.822529	0.147741	-0.311631	...	0.297008	0.965137
mean texture	0.323782	1.000000	0.329533	0.321086	-0.023389	0.236702	0.302418	0.293464	0.071401	-0.076437	...	0.912045	0.358040
mean perimeter	0.997855	0.329533	1.000000	0.986507	0.207278	0.556936	0.716136	0.850977	0.183027	-0.261477	...	0.303038	0.970387
mean area	0.987357	0.321086	0.986507	1.000000	0.177028	0.498502	0.685983	0.823269	0.151293	-0.283110	...	0.287489	0.959120
mean smoothness	0.170581	-0.023389	0.207278	0.177028	1.000000	0.659123	0.521984	0.553695	0.557775	0.584792	...	0.036072	0.238853
mean compactness	0.506124	0.236702	0.556936	0.498502	0.659123	1.000000	0.883121	0.831135	0.602641	0.565369	...	0.248133	0.590210
mean concavity	0.676764	0.302418	0.716136	0.685983	0.521984	0.883121	1.000000	0.921391	0.500667	0.336783	...	0.299879	0.729565
mean concave points	0.822529	0.293464	0.850977	0.823269	0.553695	0.831135	0.921391	1.000000	0.462497	0.166917	...	0.292752	0.855923
mean symmetry	0.147741	0.071401	0.183027	0.151293	0.557775	0.602641	0.500667	0.462497	1.000000	0.479921	...	0.090651	0.219169
mean fractal dimension	-0.311631	-0.076437	-0.261477	-0.283110	0.584792	0.565369	0.336783	0.166917	0.479921	1.000000	...	-0.051269	-0.205151
radius error	0.679090	0.275869	0.691765	0.732562	0.301467	0.497473	0.631925	0.698050	0.303379	0.000111	...	0.194799	0.719684
texture error	-0.097317	0.386358	-0.086761	-0.066280	0.068406	0.046205	0.076218	0.021480	0.128053	0.164174	...	0.409003	-0.102242
perimeter error	0.674172	0.281673	0.693135	0.726628	0.296092	0.548905	0.660391	0.710650	0.313893	0.039830	...	0.200371	0.721031
area error	0.735864	0.259845	0.744983	0.800086	0.246552	0.455653	0.617427	0.690299	0.223970	-0.090170	...	0.196497	0.761213
smoothness error	-0.222600	0.006614	-0.202694	-0.166777	0.332375	0.135299	0.098564	0.027653	0.187321	0.401964	...	-0.074743	-0.217304
compactness error	0.206000	0.191975	0.250744	0.212583	0.318943	0.738722	0.670279	0.490424	0.421659	0.559837	...	0.143003	0.260516
concavity error	0.194204	0.143293	0.228082	0.207660	0.248396	0.570517	0.691270	0.439167	0.342627	0.446630	...	0.100241	0.226680
concave points error	0.376169	0.163851	0.407217	0.372320	0.380676	0.642262	0.683260	0.615634	0.393298	0.341198	...	0.086741	0.394999
symmetry error	-0.104321	0.009127	-0.081629	-0.072497	0.200774	0.229977	0.178009	0.095351	0.449137	0.345007	...	-0.077473	-0.103753
fractal dimension error	-0.042641	0.054458	-0.005523	-0.019887	0.283607	0.507318	0.449301	0.257584	0.331786	0.688132	...	-0.003195	-0.001000
worst radius	0.969539	0.352573	0.969476	0.962746	0.213120	0.535315	0.688236	0.830318	0.185728	-0.253691	...	0.359921	0.993708
worst texture	0.297008	0.912045	0.303038	0.287489	0.036072	0.248133	0.299879	0.292752	0.090651	-0.051269	...	1.000000	0.365098
worst perimeter	0.965137	0.358040	0.970387	0.959120	0.238853	0.590210	0.729565	0.855923	0.219169	-0.205151	...	0.365098	1.000000
worst area	0.941082	0.343546	0.941550	0.959213	0.206718	0.509604	0.675987	0.809630	0.177193	-0.231854	...	0.345842	0.977578
worst smoothness	0.119616	0.077503	0.150549	0.123523	0.805324	0.565541	0.448822	0.452753	0.426675	0.504942	...	0.225429	0.236775
worst compactness	0.413463	0.277830	0.455774	0.390410	0.472468	0.865809	0.754968	0.667454	0.473200	0.458798	...	0.360832	0.529408
worst concavity	0.526911	0.301025	0.563879	0.512606	0.434926	0.816275	0.884103	0.752399	0.433721	0.346234	...	0.368366	0.618344
worst concave points	0.744214	0.295316	0.771241	0.722017	0.503053	0.815573	0.861323	0.910155	0.430297	0.175325	...	0.359755	0.816322
worst symmetry	0.163953	0.105008	0.189115	0.143570	0.394309	0.510223	0.409464	0.375744	0.699826	0.334019	...	0.233027	0.269493
worst fractal dimension	0.007066	0.119205	0.051019	0.003738	0.499316	0.687382	0.514930	0.368661	0.438413	0.767297	...	0.219122	0.138957
target	-0.730029	-0.415185	-0.742636	-0.708984	-0.358560	-0.596534	-0.696360	-0.776614	-0.330499	0.012838	...	-0.456903	-0.782914

31 rows × 31 columns

```
data.corr(method='kendall')
```

	mean radius	mean texture	mean perimeter	mean area	mean smoothness	mean compactness	mean concavity	mean concave points	mean symmetry	mean fractal dimension	...	worst texture	worst perimeter
mean radius	1.000000	0.229159	0.963320	0.985565	0.099549	0.340020	0.465087	0.566917	0.081502	-0.246220	...	0.210302	0.862763
mean texture	0.229159	1.000000	0.234353	0.230829	0.017135	0.184220	0.236079	0.209629	0.075493	-0.039255	...	0.741293	0.254406
mean perimeter	0.963320	0.234353	1.000000	0.956965	0.122434	0.375540	0.497587	0.596716	0.101781	-0.214661	...	0.216032	0.881245
mean area	0.985565	0.230829	0.956965	1.000000	0.092541	0.333534	0.461843	0.561760	0.076963	-0.252131	...	0.212051	0.863409
mean smoothness	0.099549	0.017135	0.122434	0.092541	1.000000	0.491072	0.364105	0.398511	0.381515	0.417070	...	0.041361	0.152343
mean compactness	0.340020	0.184220	0.375540	0.333534	0.491072	1.000000	0.719194	0.653022	0.392366	0.345923	...	0.174449	0.412628
mean concavity	0.465087	0.236079	0.497587	0.461843	0.364105	0.719194	1.000000	0.775266	0.311354	0.173476	...	0.227797	0.531750
mean concave points	0.566917	0.209629	0.596716	0.561760	0.398511	0.653022	0.775266	1.000000	0.291970	0.094885	...	0.200509	0.620728
mean symmetry	0.081502	0.075493	0.101781	0.076963	0.381515	0.392366	0.311354	0.291970	1.000000	0.297681	...	0.081521	0.129378
mean fractal dimension	-0.246220	-0.039255	-0.214661	-0.252131	0.417070	0.345923	0.173476	0.094885	0.297681	1.000000	...	-0.031406	-0.174835
radius error	0.384712	0.247098	0.393716	0.387101	0.223561	0.351001	0.405383	0.454104	0.225514	0.002996	...	0.191005	0.425010
texture error	-0.095861	0.309294	-0.091170	-0.094179	0.061806	0.032274	0.035346	0.005238	0.095181	0.105633	...	0.348027	-0.094206
perimeter error	0.398999	0.264142	0.414246	0.400951	0.220743	0.409292	0.459626	0.490678	0.237409	0.038443	...	0.205631	0.455179
area error	0.549079	0.270659	0.557127	0.552309	0.196414	0.372483	0.460080	0.532389	0.191490	-0.081134	...	0.221482	0.585220
smoothness error	-0.226065	0.024484	-0.215165	-0.226658	0.230123	0.084992	0.048788	0.012047	0.136064	0.276804	...	-0.024264	-0.211233
compactness error	0.181153	0.180535	0.211562	0.177378	0.274218	0.619218	0.559088	0.427162	0.307858	0.333806	...	0.142983	0.237664
concavity error	0.255945	0.197820	0.283680	0.254040	0.247024	0.570663	0.678378	0.497183	0.256674	0.232522	...	0.158908	0.305778
concave points error	0.286742	0.162570	0.310856	0.283280	0.305479	0.537138	0.581517	0.568956	0.263132	0.196318	...	0.105170	0.316127
symmetry error	-0.168407	0.007114	-0.158856	-0.169859	0.101045	0.066251	0.015244	-0.019819	0.262925	0.214262	...	-0.070404	-0.171452
fractal dimension error	-0.005832	0.099663	0.021156	-0.008733	0.286167	0.437206	0.351399	0.254332	0.281801	0.498389	...	0.055635	0.042561
worst radius	0.882063	0.246993	0.886941	0.883811	0.136219	0.372046	0.492914	0.590400	0.111969	-0.208569	...	0.250127	0.939026
worst texture	0.210302	0.741293	0.216032	0.212051	0.041361	0.174449	0.227797	0.200509	0.081521	-0.031406	...	1.000000	0.257984
worst perimeter	0.862763	0.254406	0.881245	0.863409	0.152343	0.412628	0.531750	0.620728	0.129378	-0.174835	...	0.257984	1.000000
worst area	0.882035	0.248096	0.885246	0.885906	0.128881	0.363980	0.488281	0.583169	0.104677	-0.215901	...	0.251341	0.931692
worst smoothness	0.082284	0.069336	0.102428	0.077793	0.608475	0.412274	0.338902	0.339906	0.291003	0.348018	...	0.148002	0.158814
worst compactness	0.332970	0.199777	0.365026	0.328257	0.335814	0.724842	0.654070	0.557303	0.308333	0.274333	...	0.234597	0.426479
worst concavity	0.421100	0.235242	0.449549	0.418822	0.300847	0.647942	0.787870	0.635728	0.275028	0.162783	...	0.266734	0.507132
worst concave points	0.532569	0.217743	0.559819	0.528375	0.349195	0.633090	0.734047	0.783933	0.276077	0.092549	...	0.247731	0.615378
worst symmetry	0.114141	0.081482	0.130283	0.112032	0.270602	0.312991	0.263490	0.240447	0.520061	0.204803	...	0.154258	0.186325
worst fractal dimension	0.024103	0.078289	0.053103	0.020265	0.357792	0.498231	0.377455	0.285028	0.281841	0.566543	...	0.130159	0.113309
target	-0.599082	-0.377644	-0.611775	-0.599992	-0.304033	-0.497971	-0.599449	-0.635873	-0.271924	0.021173	...	-0.389654	-0.650879

31 rows × 31 columns

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data.corr(method='spearman')
```

	mean radius	mean texture	mean perimeter	mean area	mean smoothness	mean compactness	mean concavity	mean concave points	mean symmetry	mean fractal dimension	...	worst texture	worst perimeter
mean radius	1.000000	0.340956	0.997802	0.999602	0.148510	0.497578	0.645728	0.759702	0.120242	-0.349931	...	0.314911	0.971555
mean texture	0.340956	1.000000	0.348142	0.344145	0.024649	0.266499	0.342646	0.306891	0.110130	-0.059303	...	0.909218	0.375273
mean perimeter	0.997802	0.348142	1.000000	0.997068	0.182923	0.543925	0.681958	0.788629	0.150049	-0.304891	...	0.323109	0.978980
mean area	0.999602	0.344145	0.997068	1.000000	0.138053	0.488988	0.642557	0.755165	0.113928	-0.358425	...	0.318178	0.971822
mean smoothness	0.148510	0.024649	0.182923	0.138053	1.000000	0.678806	0.518511	0.565172	0.542228	0.588465	...	0.060645	0.226345
mean compactness	0.497578	0.266499	0.543925	0.488988	0.678806	1.000000	0.896518	0.848295	0.552203	0.499195	...	0.255305	0.592254
mean concavity	0.645728	0.342646	0.681958	0.642557	0.518511	0.896518	1.000000	0.927352	0.446793	0.258174	...	0.335866	0.722424
mean concave points	0.759702	0.306891	0.788629	0.755165	0.565172	0.848295	0.927352	1.000000	0.423767	0.142659	...	0.300562	0.813960
mean symmetry	0.120242	0.110130	0.150049	0.113928	0.542228	0.552203	0.446793	0.423767	1.000000	0.428467	...	0.118890	0.190526
mean fractal dimension	-0.349931	-0.059303	-0.304891	-0.358425	0.588465	0.499195	0.258174	0.142659	0.428467	1.000000	...	-0.047791	-0.247456
radius error	0.550247	0.363621	0.560326	0.553388	0.334282	0.506582	0.575277	0.635054	0.337912	0.001477	...	0.283581	0.592509
texture error	-0.144499	0.450720	-0.137578	-0.142469	0.091283	0.047766	0.051318	0.008710	0.139124	0.157103	...	0.496551	-0.142855
perimeter error	0.565520	0.386813	0.582789	0.568237	0.331360	0.583520	0.646199	0.679841	0.354888	0.055309	...	0.302553	0.626896
area error	0.738077	0.395139	0.745824	0.741518	0.296059	0.539511	0.644344	0.726982	0.288322	-0.120333	...	0.327857	0.768336
smoothness error	-0.326385	0.037048	-0.311147	-0.327431	0.338692	0.127381	0.070321	0.016798	0.206106	0.401530	...	-0.036290	-0.308749
compactness error	0.264904	0.263591	0.308620	0.260362	0.392455	0.817875	0.761230	0.608388	0.435714	0.481139	...	0.209979	0.344865
concavity error	0.364555	0.287188	0.402277	0.362308	0.354730	0.772283	0.858306	0.674668	0.367637	0.344007	...	0.235945	0.432895
concave points error	0.410576	0.238610	0.441996	0.406468	0.438826	0.732425	0.774656	0.758438	0.382736	0.286393	...	0.157304	0.448363
symmetry error	-0.241376	0.008945	-0.228187	-0.243507	0.150740	0.098388	0.022753	-0.028353	0.384123	0.314165	...	-0.104702	-0.246712
fractal dimension error	-0.008411	0.147605	0.032429	-0.012688	0.413429	0.621121	0.513593	0.378374	0.402630	0.683800	...	0.083174	0.063012
worst radius	0.978604	0.366547	0.981244	0.979258	0.203453	0.542626	0.682316	0.787411	0.164552	-0.294540	...	0.371230	0.993548
worst texture	0.314911	0.909218	0.323109	0.318178	0.060645	0.255305	0.335866	0.300562	0.118890	-0.047791	...	1.000000	0.381022
worst perimeter	0.971555	0.375273	0.978980	0.971822	0.226345	0.592254	0.722424	0.813960	0.190526	-0.247456	...	0.381022	1.000000
worst area	0.978863	0.368335	0.980864	0.980264	0.191735	0.531590	0.676628	0.780395	0.154462	-0.304927	...	0.372376	0.992433
worst smoothness	0.125789	0.101401	0.156611	0.119712	0.796085	0.578902	0.488775	0.490035	0.424230	0.493474	...	0.217799	0.241172
worst compactness	0.491357	0.290917	0.534565	0.485813	0.481384	0.901029	0.849985	0.758309	0.440828	0.403653	...	0.342319	0.613070
worst concavity	0.596043	0.339725	0.632106	0.593736	0.429107	0.837921	0.938543	0.827281	0.394481	0.242611	...	0.387009	0.700572
worst concave points	0.727265	0.319235	0.757526	0.723390	0.498868	0.825473	0.904938	0.937075	0.397477	0.139152	...	0.365309	0.812983
worst symmetry	0.174698	0.120693	0.199007	0.170860	0.393579	0.450333	0.383667	0.355477	0.710359	0.295046	...	0.226816	0.281383
worst fractal dimension	0.044564	0.116144	0.088961	0.038758	0.511457	0.688986	0.541838	0.421110	0.410069	0.760771	...	0.193191	0.179003
target	-0.732785	-0.461971	-0.748496	-0.734122	-0.371892	-0.609288	-0.733308	-0.777877	-0.332567	0.025903	...	-0.476720	-0.796319

31 rows × 31 columns

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sns.heatmap(data.corr())
```

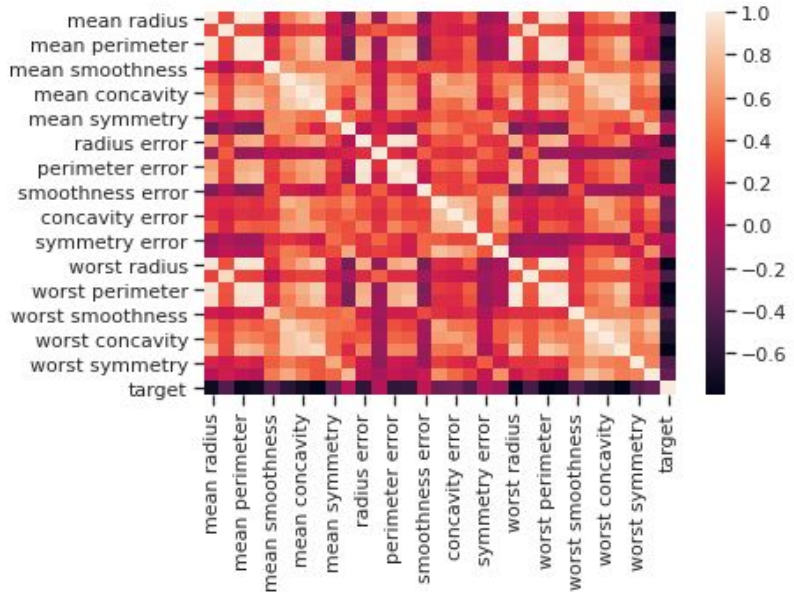
mean radius
mean perimeter
mean smoothness
mean concavity
mean symmetry
radius error
perimeter error
smoothness error
concavity error
symmetry error
worst radius
worst perimeter
worst smoothness
worst concavity
worst symmetry
target
1.0
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6