ncer-pridection-logistic-regration

September 29, 2024

0.0.1 Importing the dependencies libraries

[3]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.preprocessing import LabelEncoder
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import accuracy_score
```

0.0.2 Data collection & processing

[4]:
```
#load the deta set
data=pd.read_csv("breast-cancer.csv")
data
```

[4]:

	id	diagnosis	radius_mean	texture_mean	perimeter_mean	area_mean	\
0	842302	M	17.99	10.38	122.80	1001.0	
1	842517	M	20.57	17.77	132.90	1326.0	
2	84300903	M	19.69	21.25	130.00	1203.0	
3	84348301	M	11.42	20.38	77.58	386.1	
4	84358402	M	20.29	14.34	135.10	1297.0	
..	…	…	…	…	…	…	
564	926424	M	21.56	22.39	142.00	1479.0	
565	926682	M	20.13	28.25	131.20	1261.0	
566	926954	M	16.60	28.08	108.30	858.1	
567	927241	M	20.60	29.33	140.10	1265.0	
568	92751	B	7.76	24.54	47.92	181.0	

	smoothness_mean	compactness_mean	concavity_mean	concave points_mean	\
0	0.11840	0.27760	0.30010	0.14710	
1	0.08474	0.07864	0.08690	0.07017	
2	0.10960	0.15990	0.19740	0.12790	
3	0.14250	0.28390	0.24140	0.10520	
4	0.10030	0.13280	0.19800	0.10430	
..	…	…	…	…	
564	0.11100	0.11590	0.24390	0.13890	

```
565          0.09780           0.10340         0.14400              0.09791
566          0.08455           0.10230         0.09251              0.05302
567          0.11780           0.27700         0.35140              0.15200
568          0.05263           0.04362         0.00000              0.00000

     …  radius_worst  texture_worst  perimeter_worst  area_worst  \
0    …        25.380          17.33           184.60      2019.0
1    …        24.990          23.41           158.80      1956.0
2    …        23.570          25.53           152.50      1709.0
3    …        14.910          26.50            98.87       567.7
4    …        22.540          16.67           152.20      1575.0
..   …           …              …                …          …
564  …        25.450          26.40           166.10      2027.0
565  …        23.690          38.25           155.00      1731.0
566  …        18.980          34.12           126.70      1124.0
567  …        25.740          39.42           184.60      1821.0
568  …         9.456          30.37            59.16       268.6

     smoothness_worst  compactness_worst  concavity_worst  \
0             0.16220            0.66560           0.7119
1             0.12380            0.18660           0.2416
2             0.14440            0.42450           0.4504
3             0.20980            0.86630           0.6869
4             0.13740            0.20500           0.4000
..                …                  …                …
564           0.14100            0.21130           0.4107
565           0.11660            0.19220           0.3215
566           0.11390            0.30940           0.3403
567           0.16500            0.86810           0.9387
568           0.08996            0.06444           0.0000

     concave points_worst  symmetry_worst  fractal_dimension_worst
0                  0.2654          0.4601                  0.11890
1                  0.1860          0.2750                  0.08902
2                  0.2430          0.3613                  0.08758
3                  0.2575          0.6638                  0.17300
4                  0.1625          0.2364                  0.07678
..                    …               …                        …
564                0.2216          0.2060                  0.07115
565                0.1628          0.2572                  0.06637
566                0.1418          0.2218                  0.07820
567                0.2650          0.4087                  0.12400
568                0.0000          0.2871                  0.07039

[569 rows x 32 columns]
```

[5]:
```
#print the first 5 rows of the dataset
data.head()
```

[5]:

	id	diagnosis	radius_mean	texture_mean	perimeter_mean	area_mean	\
0	842302	M	17.99	10.38	122.80	1001.0	
1	842517	M	20.57	17.77	132.90	1326.0	
2	84300903	M	19.69	21.25	130.00	1203.0	
3	84348301	M	11.42	20.38	77.58	386.1	
4	84358402	M	20.29	14.34	135.10	1297.0	

	smoothness_mean	compactness_mean	concavity_mean	concave points_mean	\
0	0.11840	0.27760	0.3001	0.14710	
1	0.08474	0.07864	0.0869	0.07017	
2	0.10960	0.15990	0.1974	0.12790	
3	0.14250	0.28390	0.2414	0.10520	
4	0.10030	0.13280	0.1980	0.10430	

	…	radius_worst	texture_worst	perimeter_worst	area_worst	\
0	…	25.38	17.33	184.60	2019.0	
1	…	24.99	23.41	158.80	1956.0	
2	…	23.57	25.53	152.50	1709.0	
3	…	14.91	26.50	98.87	567.7	
4	…	22.54	16.67	152.20	1575.0	

	smoothness_worst	compactness_worst	concavity_worst	concave points_worst	\
0	0.1622	0.6656	0.7119	0.2654	
1	0.1238	0.1866	0.2416	0.1860	
2	0.1444	0.4245	0.4504	0.2430	
3	0.2098	0.8663	0.6869	0.2575	
4	0.1374	0.2050	0.4000	0.1625	

	symmetry_worst	fractal_dimension_worst
0	0.4601	0.11890
1	0.2750	0.08902
2	0.3613	0.08758
3	0.6638	0.17300
4	0.2364	0.07678

[5 rows x 32 columns]

[6]:
```
# Check the distribution of the diagnosis column
data['diagnosis'].value_counts()
```

[6]:
```
B    357
M    212
Name: diagnosis, dtype: int64
```

[7]:
```
# Initialize the LabelEncoder
label_encoder = LabelEncoder()
```

[8]:
```
# Encode the diagnosis labels (B = 0, M = 1)
data['diagnosis']=label_encoder.fit_transform(data['diagnosis'])
```

[9]:
```
# Create a new column 'label' for encoded diagnosis
data['label'] = data.diagnosis
```

[10]:
```
# Check the distribution of the new label column
data['label'].value_counts()
```

[10]:
```
0    357
1    212
Name: label, dtype: int64
```

1 —> M 0 —> B

[11]:
```
# Check the shape of the dataset
data.shape
```

[11]:
```
(569, 33)
```

[12]:
```
# Get some information about the dataset
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 569 entries, 0 to 568
Data columns (total 33 columns):
 #   Column                   Non-Null Count  Dtype
---  ------                   --------------  -----
 0   id                       569 non-null    int64
 1   diagnosis                569 non-null    int32
 2   radius_mean              569 non-null    float64
 3   texture_mean             569 non-null    float64
 4   perimeter_mean           569 non-null    float64
 5   area_mean                569 non-null    float64
 6   smoothness_mean          569 non-null    float64
 7   compactness_mean         569 non-null    float64
 8   concavity_mean           569 non-null    float64
 9   concave points_mean      569 non-null    float64
 10  symmetry_mean            569 non-null    float64
 11  fractal_dimension_mean   569 non-null    float64
 12  radius_se                569 non-null    float64
 13  texture_se               569 non-null    float64
 14  perimeter_se             569 non-null    float64
 15  area_se                  569 non-null    float64
 16  smoothness_se            569 non-null    float64
```

```
 17  compactness_se           569 non-null    float64
 18  concavity_se             569 non-null    float64
 19  concave points_se        569 non-null    float64
 20  symmetry_se              569 non-null    float64
 21  fractal_dimension_se     569 non-null    float64
 22  radius_worst             569 non-null    float64
 23  texture_worst            569 non-null    float64
 24  perimeter_worst          569 non-null    float64
 25  area_worst               569 non-null    float64
 26  smoothness_worst         569 non-null    float64
 27  compactness_worst        569 non-null    float64
 28  concavity_worst          569 non-null    float64
 29  concave points_worst     569 non-null    float64
 30  symmetry_worst           569 non-null    float64
 31  fractal_dimension_worst  569 non-null    float64
 32  label                    569 non-null    int32
dtypes: float64(30), int32(2), int64(1)
memory usage: 142.4 KB
```

[13]:
```
# Check for missing values in the dataset
data.isnull().sum()
```

[13]:
```
id                         0
diagnosis                  0
radius_mean                0
texture_mean               0
perimeter_mean             0
area_mean                  0
smoothness_mean            0
compactness_mean           0
concavity_mean             0
concave points_mean        0
symmetry_mean              0
fractal_dimension_mean     0
radius_se                  0
texture_se                 0
perimeter_se               0
area_se                    0
smoothness_se              0
compactness_se             0
concavity_se               0
concave points_se          0
symmetry_se                0
fractal_dimension_se       0
radius_worst               0
texture_worst              0
perimeter_worst            0
```

```
area_worst                0
smoothness_worst          0
compactness_worst         0
concavity_worst           0
concave points_worst      0
symmetry_worst            0
fractal_dimension_worst   0
label                     0
dtype: int64
```

[14]:
```
# Drop unnecessary columns
data = data.drop(columns=['id','diagnosis'])  # Drop a single column
```

[15]:
```
# Statistical measures about the data
data.describe()
```

[15]:

	radius_mean	texture_mean	perimeter_mean	area_mean	\
count	569.000000	569.000000	569.000000	569.000000	
mean	14.127292	19.289649	91.969033	654.889104	
std	3.524049	4.301036	24.298981	351.914129	
min	6.981000	9.710000	43.790000	143.500000	
25%	11.700000	16.170000	75.170000	420.300000	
50%	13.370000	18.840000	86.240000	551.100000	
75%	15.780000	21.800000	104.100000	782.700000	
max	28.110000	39.280000	188.500000	2501.000000	

	smoothness_mean	compactness_mean	concavity_mean	concave points_mean	\
count	569.000000	569.000000	569.000000	569.000000	
mean	0.096360	0.104341	0.088799	0.048919	
std	0.014064	0.052813	0.079720	0.038803	
min	0.052630	0.019380	0.000000	0.000000	
25%	0.086370	0.064920	0.029560	0.020310	
50%	0.095870	0.092630	0.061540	0.033500	
75%	0.105300	0.130400	0.130700	0.074000	
max	0.163400	0.345400	0.426800	0.201200	

	symmetry_mean	fractal_dimension_mean	…	texture_worst	\
count	569.000000	569.000000	…	569.000000	
mean	0.181162	0.062798	…	25.677223	
std	0.027414	0.007060	…	6.146258	
min	0.106000	0.049960	…	12.020000	
25%	0.161900	0.057700	…	21.080000	
50%	0.179200	0.061540	…	25.410000	
75%	0.195700	0.066120	…	29.720000	
max	0.304000	0.097440	…	49.540000	

	perimeter_worst	area_worst	smoothness_worst	compactness_worst	\

```
count       569.000000   569.000000        569.000000         569.000000
mean        107.261213   880.583128          0.132369           0.254265
std          33.602542   569.356993          0.022832           0.157336
min          50.410000   185.200000          0.071170           0.027290
25%          84.110000   515.300000          0.116600           0.147200
50%          97.660000   686.500000          0.131300           0.211900
75%         125.400000  1084.000000          0.146000           0.339100
max         251.200000  4254.000000          0.222600           1.058000

       concavity_worst  concave points_worst  symmetry_worst  \
count       569.000000            569.000000      569.000000
mean          0.272188              0.114606        0.290076
std           0.208624              0.065732        0.061867
min           0.000000              0.000000        0.156500
25%           0.114500              0.064930        0.250400
50%           0.226700              0.099930        0.282200
75%           0.382900              0.161400        0.317900
max           1.252000              0.291000        0.663800

       fractal_dimension_worst       label
count               569.000000  569.000000
mean                  0.083946    0.372583
std                   0.018061    0.483918
min                   0.055040    0.000000
25%                   0.071460    0.000000
50%                   0.080040    0.000000
75%                   0.092080    1.000000
max                   0.207500    1.000000

[8 rows x 31 columns]
```

[16]:
```
# Group data by label and get the mean of each feature
data.groupby('label').mean()
```

[16]:
```
       radius_mean  texture_mean  perimeter_mean   area_mean  smoothness_mean  \
label
0        12.146524     17.914762       78.075406  462.790196         0.092478
1        17.462830     21.604906      115.365377  978.376415         0.102898

       compactness_mean  concavity_mean  concave points_mean  symmetry_mean  \
label
0              0.080085        0.046058             0.025717       0.174186
1              0.145188        0.160775             0.087990       0.192909

       fractal_dimension_mean  …  radius_worst  texture_worst  \
label                          …
0                    0.062867  …     13.379801      23.515070
```

```
1                    0.062680  …     21.134811      29.318208

       perimeter_worst   area_worst  smoothness_worst  compactness_worst  \
label
0            87.005938   558.899440          0.124959           0.182673
1           141.370330  1422.286321          0.144845           0.374824

       concavity_worst  concave points_worst  symmetry_worst  \
label
0             0.166238              0.074444        0.270246
1             0.450606              0.182237        0.323468

       fractal_dimension_worst
label
0                     0.079442
1                     0.091530

[2 rows x 30 columns]
```

seprating the feature and target

[17]:
```
# Separating the features and target variable
x = data.drop(columns='label',axis = 1)#Features
y=data['label']# Target variable
```

[18]:
```
# Check the feature and target variable shapes
x,y
```

[18]:
```
(     radius_mean  texture_mean  perimeter_mean  area_mean  smoothness_mean  \
 0          17.99         10.38          122.80     1001.0          0.11840
 1          20.57         17.77          132.90     1326.0          0.08474
 2          19.69         21.25          130.00     1203.0          0.10960
 3          11.42         20.38           77.58      386.1          0.14250
 4          20.29         14.34          135.10     1297.0          0.10030
 ..           …             …              …          …               …
 564        21.56         22.39          142.00     1479.0          0.11100
 565        20.13         28.25          131.20     1261.0          0.09780
 566        16.60         28.08          108.30      858.1          0.08455
 567        20.60         29.33          140.10     1265.0          0.11780
 568         7.76         24.54           47.92      181.0          0.05263

      compactness_mean  concavity_mean  concave points_mean  symmetry_mean  \
 0             0.27760         0.30010              0.14710         0.2419
 1             0.07864         0.08690              0.07017         0.1812
 2             0.15990         0.19740              0.12790         0.2069
 3             0.28390         0.24140              0.10520         0.2597
 4             0.13280         0.19800              0.10430         0.1809
```

```
..                …              …                    …             …
564           0.11590         0.24390              0.13890         0.1726
565           0.10340         0.14400              0.09791         0.1752
566           0.10230         0.09251              0.05302         0.1590
567           0.27700         0.35140              0.15200         0.2397
568           0.04362         0.00000              0.00000         0.1587

     fractal_dimension_mean  …  radius_worst  texture_worst  \
0                   0.07871  …        25.380          17.33
1                   0.05667  …        24.990          23.41
2                   0.05999  …        23.570          25.53
3                   0.09744  …        14.910          26.50
4                   0.05883  …        22.540          16.67
..                      …  …           …             …
564                 0.05623  …        25.450          26.40
565                 0.05533  …        23.690          38.25
566                 0.05648  …        18.980          34.12
567                 0.07016  …        25.740          39.42
568                 0.05884  …         9.456          30.37

     perimeter_worst  area_worst  smoothness_worst  compactness_worst  \
0             184.60      2019.0           0.16220            0.66560
1             158.80      1956.0           0.12380            0.18660
2             152.50      1709.0           0.14440            0.42450
3              98.87       567.7           0.20980            0.86630
4             152.20      1575.0           0.13740            0.20500
..               …          …                 …                 …
564           166.10      2027.0           0.14100            0.21130
565           155.00      1731.0           0.11660            0.19220
566           126.70      1124.0           0.11390            0.30940
567           184.60      1821.0           0.16500            0.86810
568            59.16       268.6           0.08996            0.06444

     concavity_worst  concave points_worst  symmetry_worst  \
0             0.7119                0.2654          0.4601
1             0.2416                0.1860          0.2750
2             0.4504                0.2430          0.3613
3             0.6869                0.2575          0.6638
4             0.4000                0.1625          0.2364
..               …                   …              …
564           0.4107                0.2216          0.2060
565           0.3215                0.1628          0.2572
566           0.3403                0.1418          0.2218
567           0.9387                0.2650          0.4087
568           0.0000                0.0000          0.2871

     fractal_dimension_worst
```

```
0                    0.11890
1                    0.08902
2                    0.08758
3                    0.17300
4                    0.07678
..                       ...
564                  0.07115
565                  0.06637
566                  0.07820
567                  0.12400
568                  0.07039

[569 rows x 30 columns],
0      1
1      1
2      1
3      1
4      1
      ..
564    1
565    1
566    1
567    1
568    0
Name: label, Length: 569, dtype: int32)
```

spliting the data into traning data & Testing data

[19]:
```
# Splitting the data into training and testing sets
x_train, x_test, y_train, y_test = train_test_split(x, y, test_size=0.2,␣
 ↪random_state=2)
```

[20]:
```
# Check the shapes of the split data
x.shape,x_test.shape,x_train.shape
```

[20]:
```
((569, 30), (114, 30), (455, 30))
```

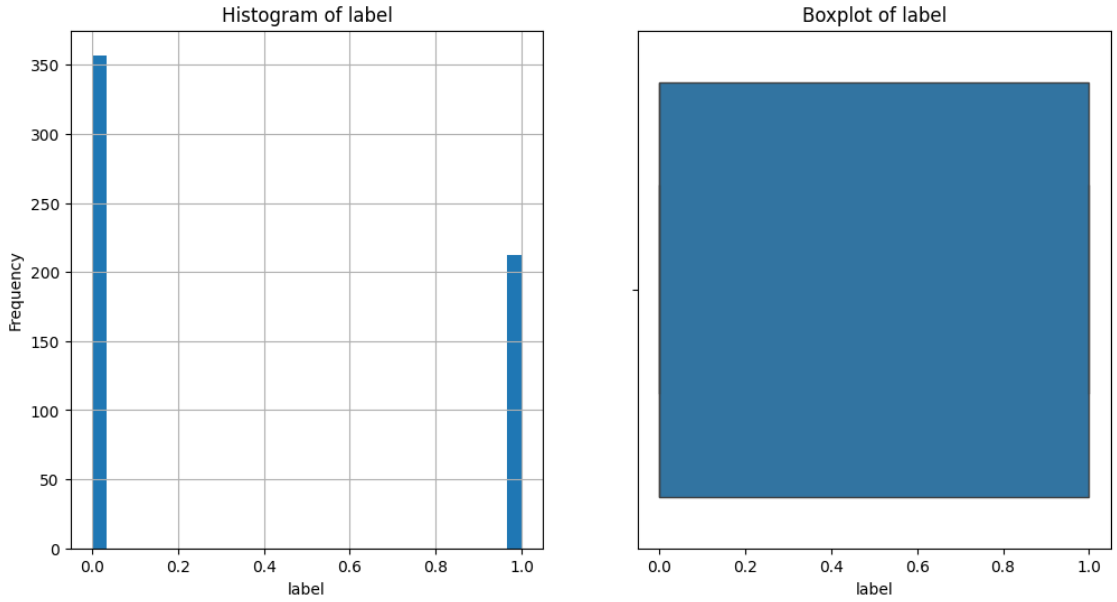
0.0.3 visualization

[21]:
```
#check the median of data
data.median()
```

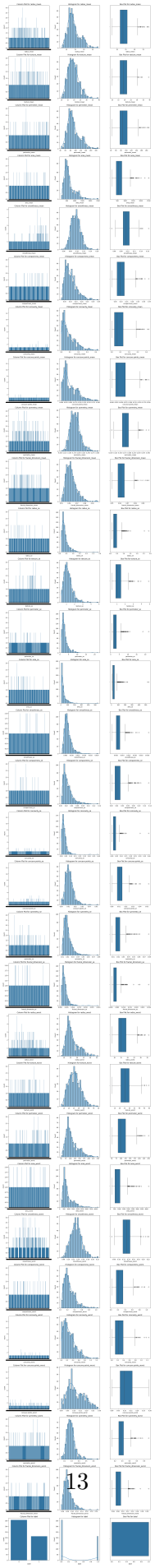
[21]:
```
radius_mean                 13.370000
texture_mean                18.840000
perimeter_mean              86.240000
area_mean                  551.100000
smoothness_mean              0.095870
```

```
compactness_mean             0.092630
concavity_mean               0.061540
concave points_mean          0.033500
symmetry_mean                0.179200
fractal_dimension_mean       0.061540
radius_se                    0.324200
texture_se                   1.108000
perimeter_se                 2.287000
area_se                     24.530000
smoothness_se                0.006380
compactness_se               0.020450
concavity_se                 0.025890
concave points_se            0.010930
symmetry_se                  0.018730
fractal_dimension_se         0.003187
radius_worst                14.970000
texture_worst               25.410000
perimeter_worst             97.660000
area_worst                 686.500000
smoothness_worst             0.131300
compactness_worst            0.211900
concavity_worst              0.226700
concave points_worst         0.099930
symmetry_worst               0.282200
fractal_dimension_worst      0.080040
label                        0.000000
dtype: float64
```

[22]:
```
plt.figure(figsize=(12, 6))
plt.subplot(1, 2, 1)
data['label'].hist(bins=30)
plt.title('Histogram of label')
plt.xlabel('label')
plt.ylabel('Frequency')


# Boxplot of 'LB'
plt.subplot(1, 2, 2)
sns.boxplot(x=data['label'])
plt.title('Boxplot of label')
plt.show()
```



[23]:
```
# Set the number of rows and columns for subplots
num_cols = len(data.columns)
fig, axes = plt.subplots(num_cols, 3, figsize=(15, 5 * num_cols))

for i, column in enumerate(data.columns):
    # Column Plot
    sns.countplot(x=column, data=data, ax=axes[i, 0])
    axes[i, 0].set_title(f'Column Plot for {column}')

    # Histogram
    sns.histplot(data[column], bins=30, kde=True, ax=axes[i, 1])
    axes[i, 1].set_title(f'Histogram for {column}')
# Box Plot
    sns.boxplot(x=data[column], ax=axes[i, 2])
    axes[i, 2].set_title(f'Box Plot for {column}')

# Adjust layout
plt.tight_layout()
plt.show()
```



[24]:
```
correlation=data.corr(numeric_only=True)
correlation
```

[24]:

	radius_mean	texture_mean	perimeter_mean	area_mean	\
radius_mean	1.000000	0.323782	0.997855	0.987357	
texture_mean	0.323782	1.000000	0.329533	0.321086	
perimeter_mean	0.997855	0.329533	1.000000	0.986507	
area_mean	0.987357	0.321086	0.986507	1.000000	
smoothness_mean	0.170581	-0.023389	0.207278	0.177028	
compactness_mean	0.506124	0.236702	0.556936	0.498502	
concavity_mean	0.676764	0.302418	0.716136	0.685983	
concave points_mean	0.822529	0.293464	0.850977	0.823269	
symmetry_mean	0.147741	0.071401	0.183027	0.151293	
fractal_dimension_mean	-0.311631	-0.076437	-0.261477	-0.283110	
radius_se	0.679090	0.275869	0.691765	0.732562	
texture_se	-0.097317	0.386358	-0.086761	-0.066280	
perimeter_se	0.674172	0.281673	0.693135	0.726628	
area_se	0.735864	0.259845	0.744983	0.800086	
smoothness_se	-0.222600	0.006614	-0.202694	-0.166777	
compactness_se	0.206000	0.191975	0.250744	0.212583	
concavity_se	0.194204	0.143293	0.228082	0.207660	
concave points_se	0.376169	0.163851	0.407217	0.372320	
symmetry_se	-0.104321	0.009127	-0.081629	-0.072497	
fractal_dimension_se	-0.042641	0.054458	-0.005523	-0.019887	
radius_worst	0.969539	0.352573	0.969476	0.962746	
texture_worst	0.297008	0.912045	0.303038	0.287489	
perimeter_worst	0.965137	0.358040	0.970387	0.959120	
area_worst	0.941082	0.343546	0.941550	0.959213	
smoothness_worst	0.119616	0.077503	0.150549	0.123523	
compactness_worst	0.413463	0.277830	0.455774	0.390410	
concavity_worst	0.526911	0.301025	0.563879	0.512606	
concave points_worst	0.744214	0.295316	0.771241	0.722017	
symmetry_worst	0.163953	0.105008	0.189115	0.143570	
fractal_dimension_worst	0.007066	0.119205	0.051019	0.003738	
label	0.730029	0.415185	0.742636	0.708984	

	smoothness_mean	compactness_mean	concavity_mean	\
radius_mean	0.170581	0.506124	0.676764	
texture_mean	-0.023389	0.236702	0.302418	
perimeter_mean	0.207278	0.556936	0.716136	
area_mean	0.177028	0.498502	0.685983	
smoothness_mean	1.000000	0.659123	0.521984	
compactness_mean	0.659123	1.000000	0.883121	
concavity_mean	0.521984	0.883121	1.000000	
concave points_mean	0.553695	0.831135	0.921391	

symmetry_mean	0.557775	0.602641	0.500667
fractal_dimension_mean	0.584792	0.565369	0.336783
radius_se	0.301467	0.497473	0.631925
texture_se	0.068406	0.046205	0.076218
perimeter_se	0.296092	0.548905	0.660391
area_se	0.246552	0.455653	0.617427
smoothness_se	0.332375	0.135299	0.098564
compactness_se	0.318943	0.738722	0.670279
concavity_se	0.248396	0.570517	0.691270
concave points_se	0.380676	0.642262	0.683260
symmetry_se	0.200774	0.229977	0.178009
fractal_dimension_se	0.283607	0.507318	0.449301
radius_worst	0.213120	0.535315	0.688236
texture_worst	0.036072	0.248133	0.299879
perimeter_worst	0.238853	0.590210	0.729565
area_worst	0.206718	0.509604	0.675987
smoothness_worst	0.805324	0.565541	0.448822
compactness_worst	0.472468	0.865809	0.754968
concavity_worst	0.434926	0.816275	0.884103
concave points_worst	0.503053	0.815573	0.861323
symmetry_worst	0.394309	0.510223	0.409464
fractal_dimension_worst	0.499316	0.687382	0.514930
label	0.358560	0.596534	0.696360

	concave points_mean	symmetry_mean	\
radius_mean	0.822529	0.147741	
texture_mean	0.293464	0.071401	
perimeter_mean	0.850977	0.183027	
area_mean	0.823269	0.151293	
smoothness_mean	0.553695	0.557775	
compactness_mean	0.831135	0.602641	
concavity_mean	0.921391	0.500667	
concave points_mean	1.000000	0.462497	
symmetry_mean	0.462497	1.000000	
fractal_dimension_mean	0.166917	0.479921	
radius_se	0.698050	0.303379	
texture_se	0.021480	0.128053	
perimeter_se	0.710650	0.313893	
area_se	0.690299	0.223970	
smoothness_se	0.027653	0.187321	
compactness_se	0.490424	0.421659	
concavity_se	0.439167	0.342627	
concave points_se	0.615634	0.393298	
symmetry_se	0.095351	0.449137	
fractal_dimension_se	0.257584	0.331786	
radius_worst	0.830318	0.185728	
texture_worst	0.292752	0.090651	

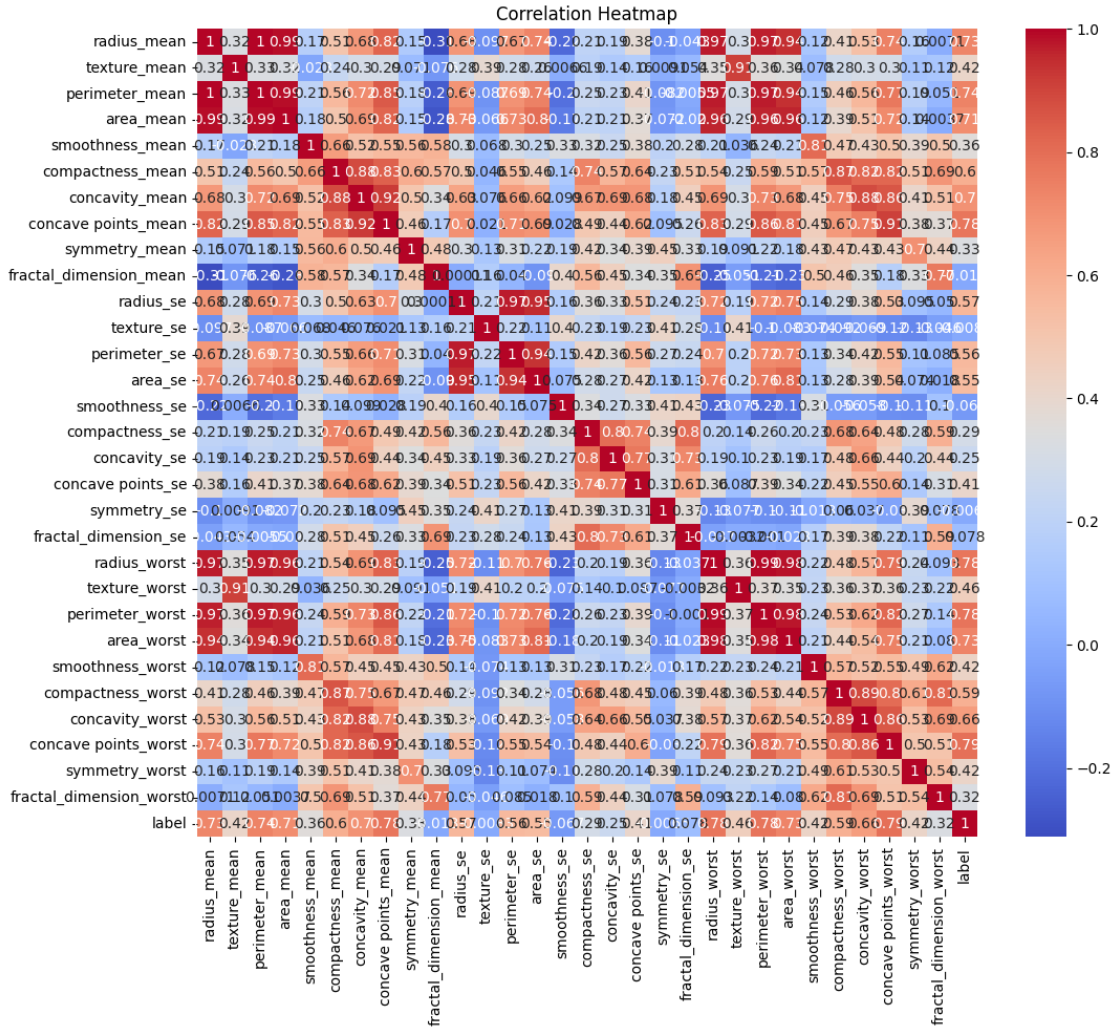
```
perimeter_worst                  0.855923       0.219169
area_worst                       0.809630       0.177193
smoothness_worst                 0.452753       0.426675
compactness_worst                0.667454       0.473200
concavity_worst                  0.752399       0.433721
concave points_worst             0.910155       0.430297
symmetry_worst                   0.375744       0.699826
fractal_dimension_worst          0.368661       0.438413
label                            0.776614       0.330499

                         fractal_dimension_mean  …  texture_worst  \
radius_mean                           -0.311631  …       0.297008
texture_mean                          -0.076437  …       0.912045
perimeter_mean                        -0.261477  …       0.303038
area_mean                             -0.283110  …       0.287489
smoothness_mean                        0.584792  …       0.036072
compactness_mean                       0.565369  …       0.248133
concavity_mean                         0.336783  …       0.299879
concave points_mean                    0.166917  …       0.292752
symmetry_mean                          0.479921  …       0.090651
fractal_dimension_mean                 1.000000  …      -0.051269
radius_se                              0.000111  …       0.194799
texture_se                             0.164174  …       0.409003
perimeter_se                           0.039830  …       0.200371
area_se                               -0.090170  …       0.196497
smoothness_se                          0.401964  …      -0.074743
compactness_se                         0.559837  …       0.143003
concavity_se                           0.446630  …       0.100241
concave points_se                      0.341198  …       0.086741
symmetry_se                            0.345007  …      -0.077473
fractal_dimension_se                   0.688132  …      -0.003195
radius_worst                          -0.253691  …       0.359921
texture_worst                         -0.051269  …       1.000000
perimeter_worst                       -0.205151  …       0.365098
area_worst                            -0.231854  …       0.345842
smoothness_worst                       0.504942  …       0.225429
compactness_worst                      0.458798  …       0.360832
concavity_worst                        0.346234  …       0.368366
concave points_worst                   0.175325  …       0.359755
symmetry_worst                         0.334019  …       0.233027
fractal_dimension_worst                0.767297  …       0.219122
label                                 -0.012838  …       0.456903

                         perimeter_worst  area_worst  smoothness_worst  \
radius_mean                     0.965137    0.941082          0.119616
texture_mean                    0.358040    0.343546          0.077503
perimeter_mean                  0.970387    0.941550          0.150549
```

```
area_mean                  0.959120    0.959213          0.123523
smoothness_mean            0.238853    0.206718          0.805324
compactness_mean           0.590210    0.509604          0.565541
concavity_mean             0.729565    0.675987          0.448822
concave points_mean        0.855923    0.809630          0.452753
symmetry_mean              0.219169    0.177193          0.426675
fractal_dimension_mean    -0.205151   -0.231854          0.504942
radius_se                  0.719684    0.751548          0.141919
texture_se                -0.102242   -0.083195         -0.073658
perimeter_se               0.721031    0.730713          0.130054
area_se                    0.761213    0.811408          0.125389
smoothness_se             -0.217304   -0.182195          0.314457
compactness_se             0.260516    0.199371          0.227394
concavity_se               0.226680    0.188353          0.168481
concave points_se          0.394999    0.342271          0.215351
symmetry_se               -0.103753   -0.110343         -0.012662
fractal_dimension_se      -0.001000   -0.022736          0.170568
radius_worst               0.993708    0.984015          0.216574
texture_worst              0.365098    0.345842          0.225429
perimeter_worst            1.000000    0.977578          0.236775
area_worst                 0.977578    1.000000          0.209145
smoothness_worst           0.236775    0.209145          1.000000
compactness_worst          0.529408    0.438296          0.568187
concavity_worst            0.618344    0.543331          0.518523
concave points_worst       0.816322    0.747419          0.547691
symmetry_worst             0.269493    0.209146          0.493838
fractal_dimension_worst    0.138957    0.079647          0.617624
label                      0.782914    0.733825          0.421465

                         compactness_worst  concavity_worst  \
radius_mean                       0.413463         0.526911
texture_mean                      0.277830         0.301025
perimeter_mean                    0.455774         0.563879
area_mean                         0.390410         0.512606
smoothness_mean                   0.472468         0.434926
compactness_mean                  0.865809         0.816275
concavity_mean                    0.754968         0.884103
concave points_mean               0.667454         0.752399
symmetry_mean                     0.473200         0.433721
fractal_dimension_mean            0.458798         0.346234
radius_se                         0.287103         0.380585
texture_se                       -0.092439        -0.068956
perimeter_se                      0.341919         0.418899
area_se                           0.283257         0.385100
smoothness_se                    -0.055558        -0.058298
compactness_se                    0.678780         0.639147
concavity_se                      0.484858         0.662564
```

```
concave points_se                0.452888        0.549592
symmetry_se                      0.060255        0.037119
fractal_dimension_se             0.390159        0.379975
radius_worst                     0.475820        0.573975
texture_worst                    0.360832        0.368366
perimeter_worst                  0.529408        0.618344
area_worst                       0.438296        0.543331
smoothness_worst                 0.568187        0.518523
compactness_worst                1.000000        0.892261
concavity_worst                  0.892261        1.000000
concave points_worst             0.801080        0.855434
symmetry_worst                   0.614441        0.532520
fractal_dimension_worst          0.810455        0.686511
label                            0.590998        0.659610

                         concave points_worst  symmetry_worst  \
radius_mean                          0.744214        0.163953
texture_mean                         0.295316        0.105008
perimeter_mean                       0.771241        0.189115
area_mean                            0.722017        0.143570
smoothness_mean                      0.503053        0.394309
compactness_mean                     0.815573        0.510223
concavity_mean                       0.861323        0.409464
concave points_mean                  0.910155        0.375744
symmetry_mean                        0.430297        0.699826
fractal_dimension_mean               0.175325        0.334019
radius_se                            0.531062        0.094543
texture_se                          -0.119638       -0.128215
perimeter_se                         0.554897        0.109930
area_se                              0.538166        0.074126
smoothness_se                       -0.102007       -0.107342
compactness_se                       0.483208        0.277878
concavity_se                         0.440472        0.197788
concave points_se                    0.602450        0.143116
symmetry_se                         -0.030413        0.389402
fractal_dimension_se                 0.215204        0.111094
radius_worst                         0.787424        0.243529
texture_worst                        0.359755        0.233027
perimeter_worst                      0.816322        0.269493
area_worst                           0.747419        0.209146
smoothness_worst                     0.547691        0.493838
compactness_worst                    0.801080        0.614441
concavity_worst                      0.855434        0.532520
concave points_worst                 1.000000        0.502528
symmetry_worst                       0.502528        1.000000
fractal_dimension_worst              0.511114        0.537848
label                                0.793566        0.416294
```

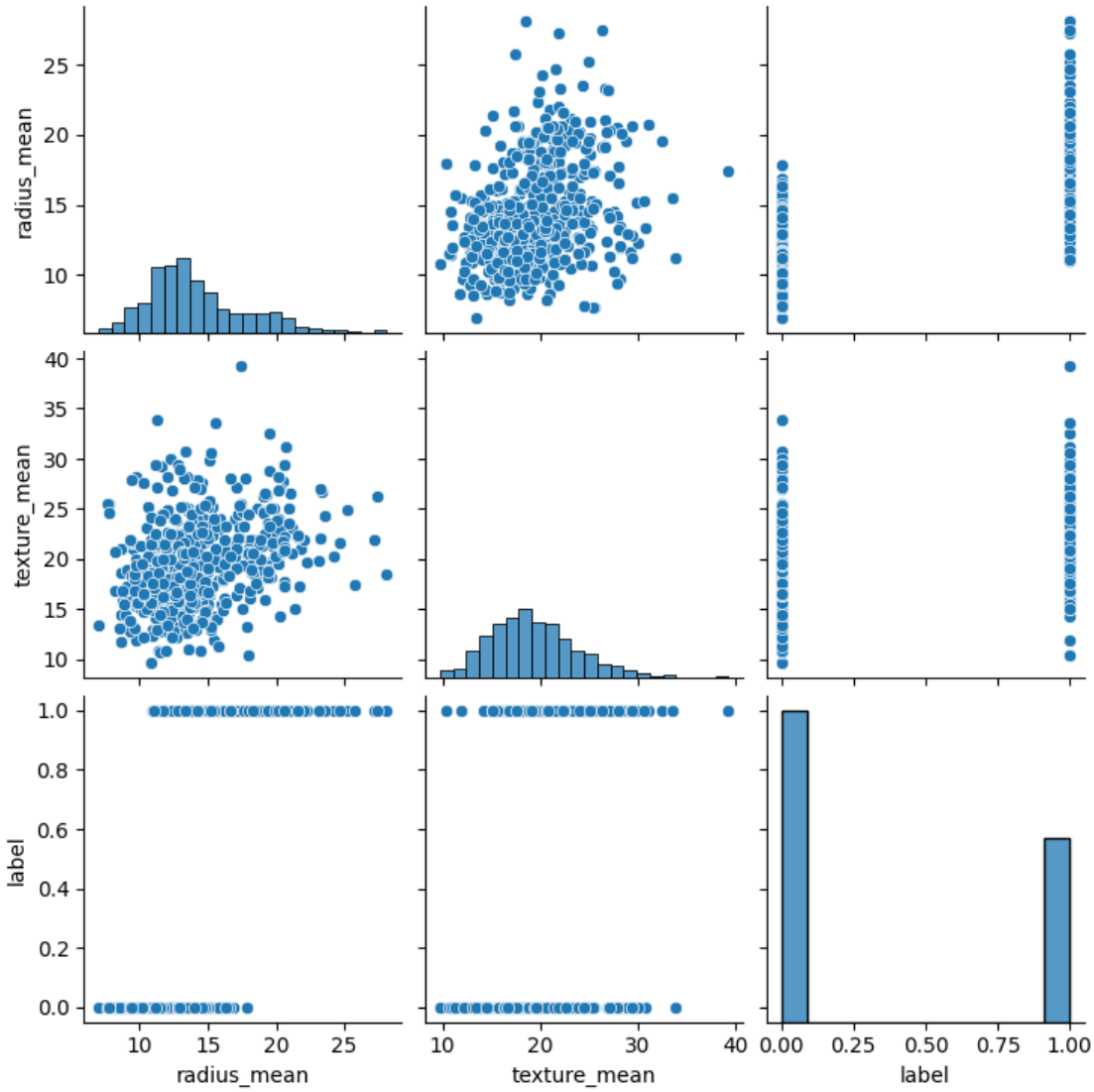
```
                         fractal_dimension_worst     label
radius_mean                             0.007066  0.730029
texture_mean                            0.119205  0.415185
perimeter_mean                          0.051019  0.742636
area_mean                               0.003738  0.708984
smoothness_mean                         0.499316  0.358560
compactness_mean                        0.687382  0.596534
concavity_mean                          0.514930  0.696360
concave points_mean                     0.368661  0.776614
symmetry_mean                           0.438413  0.330499
fractal_dimension_mean                  0.767297 -0.012838
radius_se                               0.049559  0.567134
texture_se                             -0.045655 -0.008303
perimeter_se                            0.085433  0.556141
area_se                                 0.017539  0.548236
smoothness_se                           0.101480 -0.067016
compactness_se                          0.590973  0.292999
concavity_se                            0.439329  0.253730
concave points_se                       0.310655  0.408042
symmetry_se                             0.078079 -0.006522
fractal_dimension_se                    0.591328  0.077972
radius_worst                            0.093492  0.776454
texture_worst                           0.219122  0.456903
perimeter_worst                         0.138957  0.782914
area_worst                              0.079647  0.733825
smoothness_worst                        0.617624  0.421465
compactness_worst                       0.810455  0.590998
concavity_worst                         0.686511  0.659610
concave points_worst                    0.511114  0.793566
symmetry_worst                          0.537848  0.416294
fractal_dimension_worst                 1.000000  0.323872
label                                   0.323872  1.000000

[31 rows x 31 columns]
```

[25]:
```
# Correlation Heatmap
plt.figure(figsize=(12, 10))
corr = data.corr()
sns.heatmap(corr, annot=True, cmap='coolwarm')
plt.title('Correlation Heatmap')
plt.show()
```



[38]:
```
sns.pairplot(data[['radius_mean', 'texture_mean', 'label']])
```

[38]: <seaborn.axisgrid.PairGrid at 0x217150ab710>



[36]:
```
data.head(1)
```

[36]:

	radius_mean	texture_mean	perimeter_mean	area_mean	smoothness_mean	\
0	17.99	10.38	122.8	1001.0	0.1184	

	compactness_mean	concavity_mean	concave points_mean	symmetry_mean	\
0	0.2776	0.3001	0.1471	0.2419	

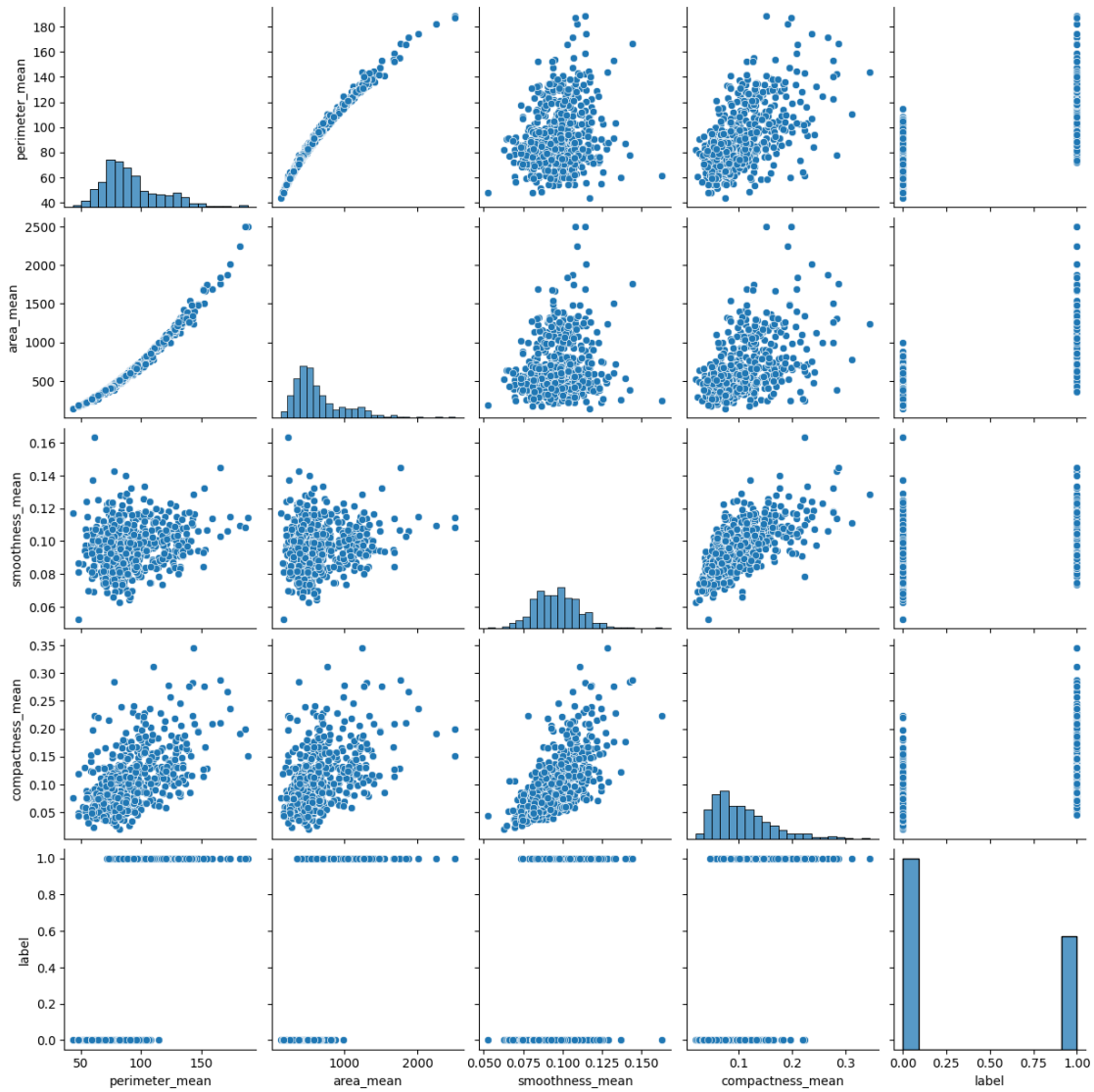
	fractal_dimension_mean	…	texture_worst	perimeter_worst	area_worst	\
0	0.07871	…	17.33	184.6	2019.0	

	smoothness_worst	compactness_worst	concavity_worst	concave points_worst	\
0	0.1622	0.6656	0.7119	0.2654	

```
   symmetry_worst  fractal_dimension_worst  label
0          0.4601                   0.1189      1

[1 rows x 31 columns]
```

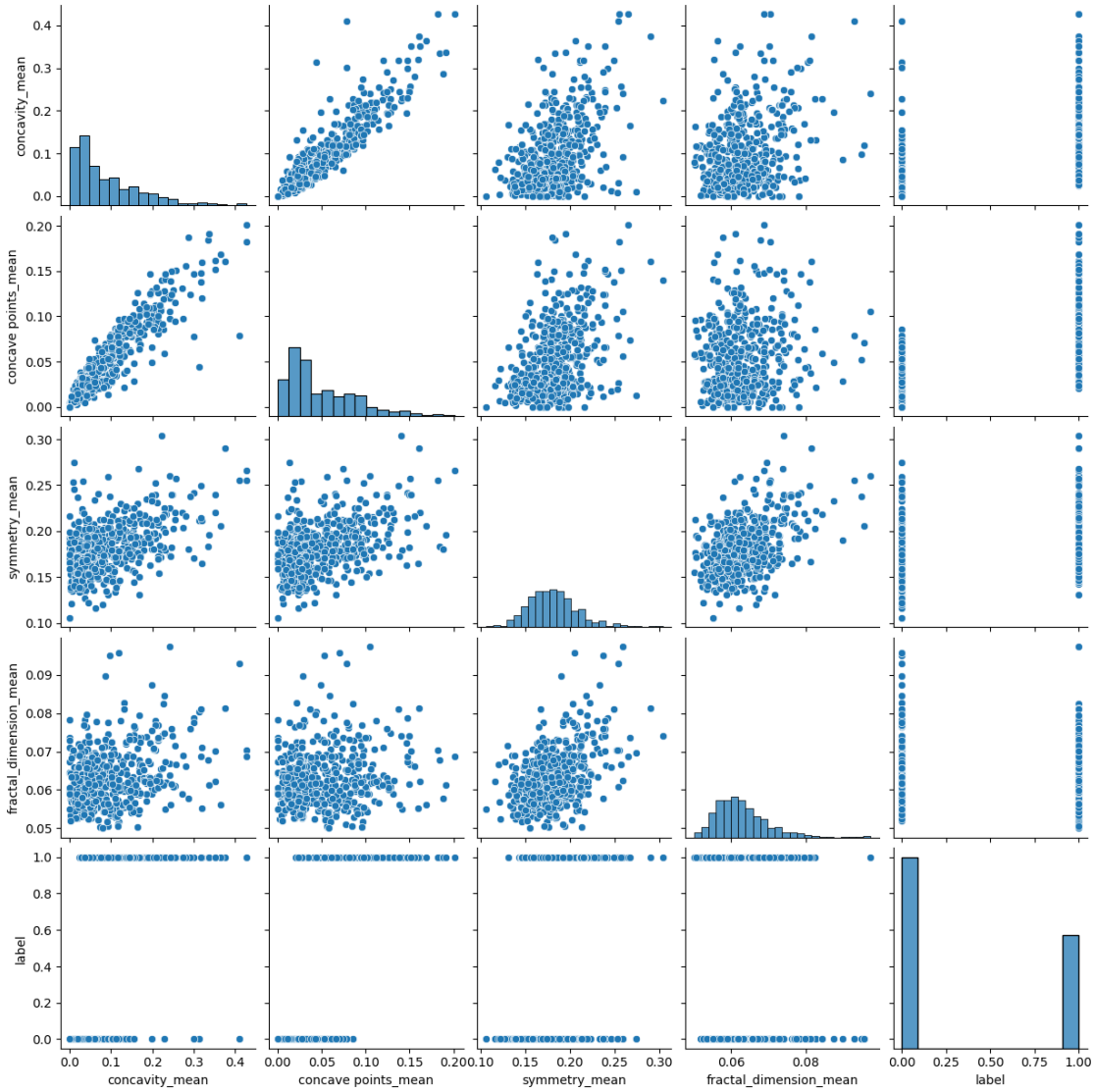
[39]:
```
sns.pairplot(data[['perimeter_mean',␣
↪'area_mean','smoothness_mean','compactness_mean','label']])
```

[39]:
```
<seaborn.axisgrid.PairGrid at 0x2171525cda0>
```



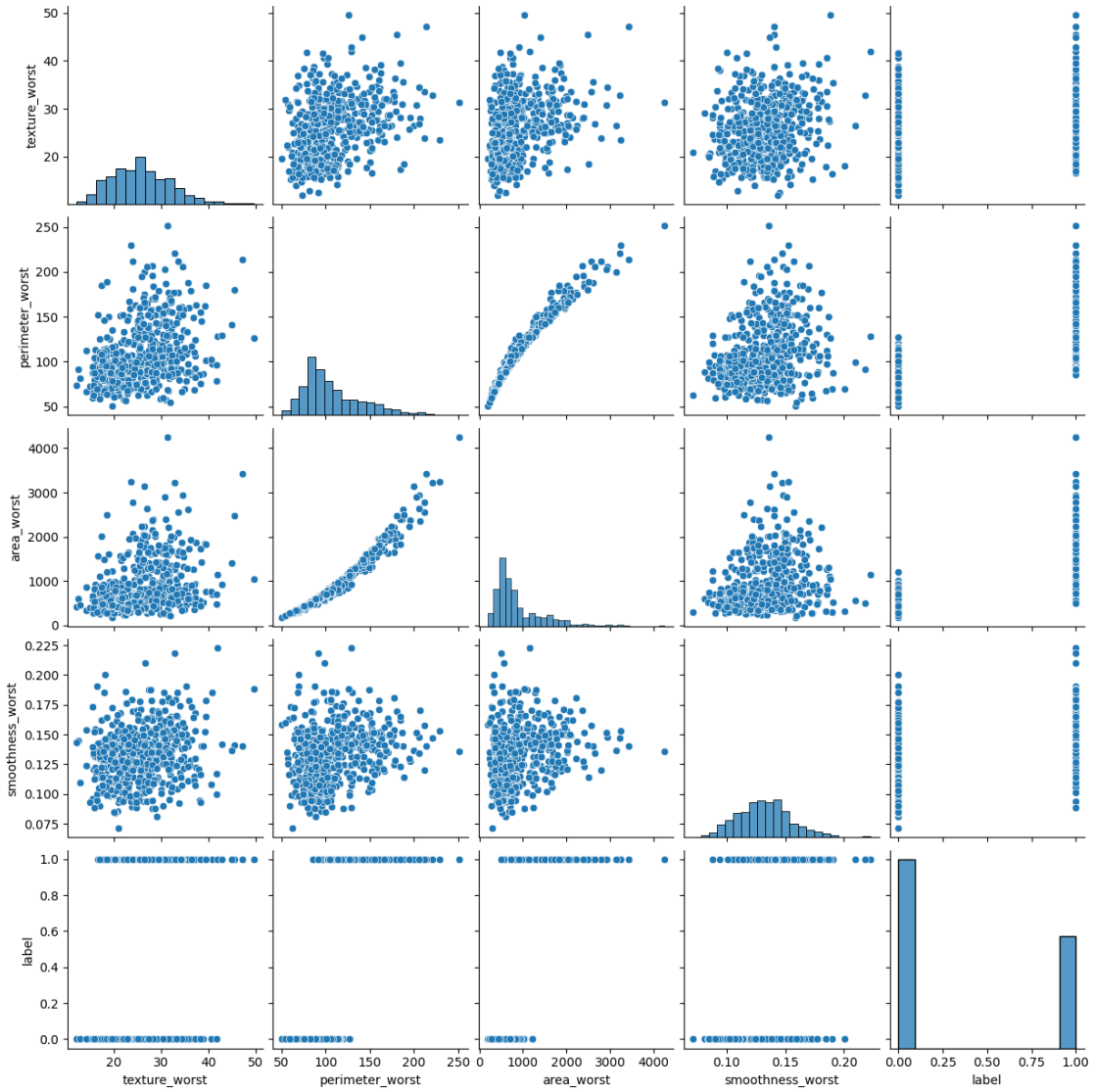
[40]:
```
sns.pairplot(data[['concavity_mean', 'concave␣
↪points_mean','symmetry_mean','fractal_dimension_mean','label']])
```

[40]: <seaborn.axisgrid.PairGrid at 0x217268c7020>



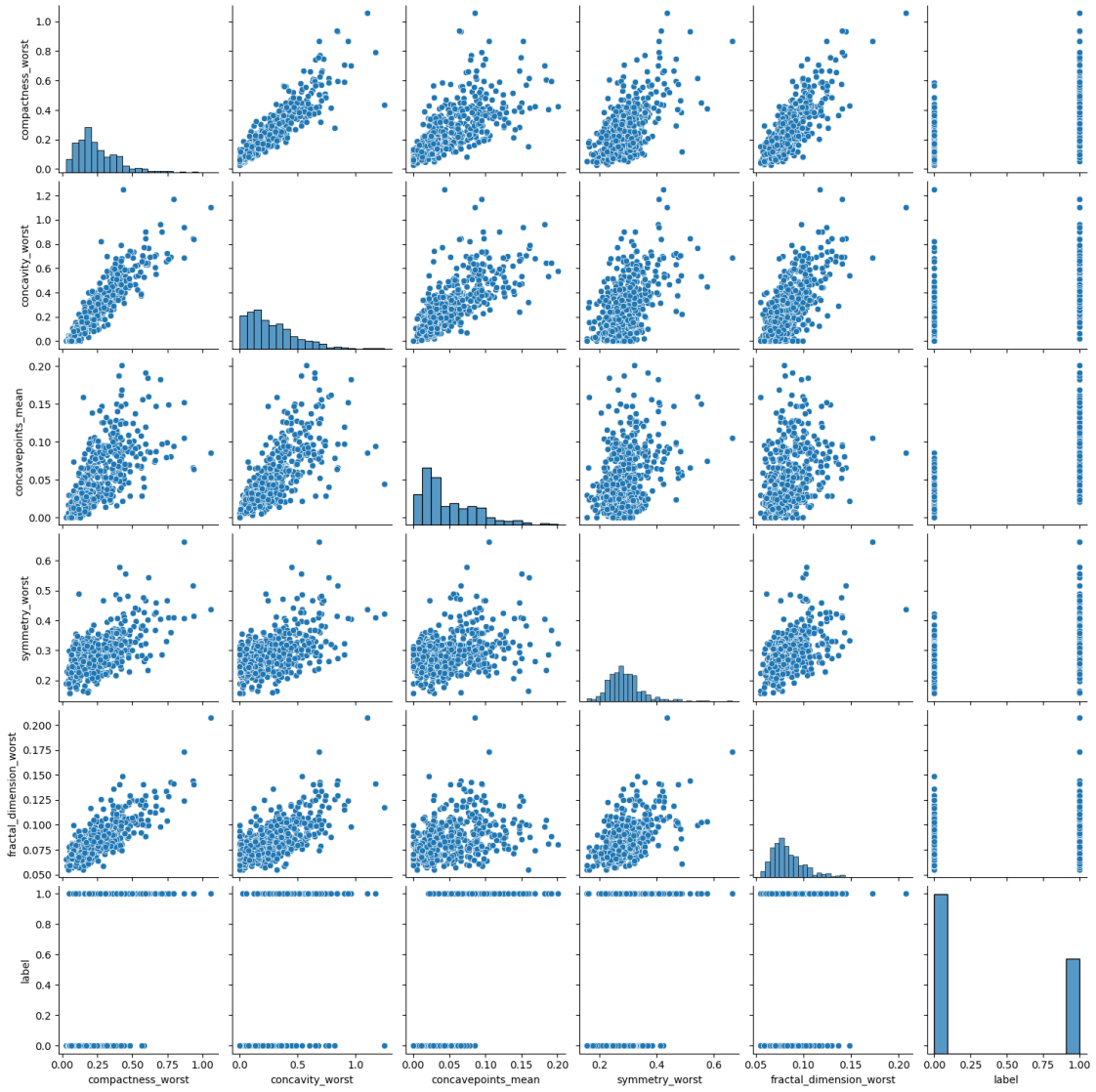
[41]:
```
sns.pairplot(data[['texture_worst',␣
 ↪'perimeter_worst','area_worst','smoothness_worst','label']])
```

[41]: <seaborn.axisgrid.PairGrid at 0x217248e6510>



[46]:
```
sns.pairplot(data[['compactness_worst',␣
↪'concavity_worst','concavepoints_mean','symmetry_worst','fractal_dimension_worst','label']])
```

[46]: <seaborn.axisgrid.PairGrid at 0x2172a5d01d0>



[44]:
```
data = data.rename(columns={
    'concave points_mean': 'concavepoints_mean'})
```

[45]:
```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 569 entries, 0 to 568
Data columns (total 31 columns):
 #   Column                  Non-Null Count  Dtype
---  ------                  --------------  -----
 0   radius_mean             569 non-null    float64
 1   texture_mean            569 non-null    float64
 2   perimeter_mean          569 non-null    float64
```

```
 3   area_mean                569 non-null    float64
 4   smoothness_mean          569 non-null    float64
 5   compactness_mean         569 non-null    float64
 6   concavity_mean           569 non-null    float64
 7   concavepoints_mean       569 non-null    float64
 8   symmetry_mean            569 non-null    float64
 9   fractal_dimension_mean   569 non-null    float64
 10  radius_se                569 non-null    float64
 11  texture_se               569 non-null    float64
 12  perimeter_se             569 non-null    float64
 13  area_se                  569 non-null    float64
 14  smoothness_se            569 non-null    float64
 15  compactness_se           569 non-null    float64
 16  concavity_se             569 non-null    float64
 17  concave points_se        569 non-null    float64
 18  symmetry_se              569 non-null    float64
 19  fractal_dimension_se     569 non-null    float64
 20  radius_worst             569 non-null    float64
 21  texture_worst            569 non-null    float64
 22  perimeter_worst          569 non-null    float64
 23  area_worst               569 non-null    float64
 24  smoothness_worst         569 non-null    float64
 25  compactness_worst        569 non-null    float64
 26  concavity_worst          569 non-null    float64
 27  concave points_worst     569 non-null    float64
 28  symmetry_worst           569 non-null    float64
 29  fractal_dimension_worst  569 non-null    float64
 30  label                    569 non-null    int32
dtypes: float64(30), int32(1)
memory usage: 135.7 KB
```

0.0.4 Model trainning

Logestic regration

[27]:
```
# Model training
# Logistic Regression
model = LogisticRegression(max_iter=569)
# Fit the model using the training data
model.fit(x_train, y_train)
```

```
C:\Users\binit\AppData\Roaming\Python\Python312\site-
packages\sklearn\linear_model\_logistic.py:469: ConvergenceWarning: lbfgs failed
to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
```

```
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-
regression
  n_iter_i = _check_optimize_result(
```

[27]:
```
LogisticRegression(max_iter=569)
```

Training the LogisticRegression model using trainning data

model Evaluation

Accuracy Score

[28]:
```
# accuracy  on tranning data
x_train_predictions = model.predict(x_train)
training_data_accuracy = accuracy_score(y_train,x_train_predictions)
```

[29]:
```
training_data_accuracy
```

[29]:
```
0.9560439560439561
```

[30]:
```
# accuracy  on test  data
x_test_predictions = model.predict(x_test)
test_data_accuracy = accuracy_score(y_test,x_test_predictions)
```

[31]:
```
test_data_accuracy
```

[31]:
```
0.9385964912280702
```

Building a predict System

[32]:
```
input_data = (18.25,19.98,119.6,1040,0.09463,0.109,0.1127,0.074,0.1794,0.
↪05742,0.4467,0.7732,3.18,53.91,0.004314,0.01382,0.02254,0.01039,0.01369,0.
↪002179,22.88,27.66,153.2,1606,0.1442,0.2576,0.3784,0.1932,0.3063,0.08368
)
#change the input data to numpy array
input_data=np.asarray(input_data)
#reshape the numpy array
input_data=input_data.reshape(1,-1)
```

[33]:
```
# Make a prediction
prediction = model.predict(input_data)
```

```
C:\Users\binit\AppData\Roaming\Python\Python312\site-
packages\sklearn\base.py:493: UserWarning: X does not have valid feature names,
but LogisticRegression was fitted with feature names
  warnings.warn(
```

[34]:
```
prediction
```

[34]:
```
array([1])
```

[35]:
```
# Output the prediction result
if(prediction[0]==0):
    print('Benign')#Benign
else:
    print('Malignant')#Malignant
```

```
Malignant
```