```
import numpy as np
import pandas as pd
import matplotlib as plt
from sklearn.datasets import load_breast_cancer
```

```
breast=load_breast_cancer()
breast_data=breast.data
print(breast_data)
print(breast_data.shape)
```

```
[[1.799e+01 1.038e+01 1.228e+02 ... 2.654e-01 4.601e-01 1.189e-01]
 [2.057e+01 1.777e+01 1.329e+02 ... 1.860e-01 2.750e-01 8.902e-02]
 [1.969e+01 2.125e+01 1.300e+02 ... 2.430e-01 3.613e-01 8.758e-02]
 ...
 [1.660e+01 2.808e+01 1.083e+02 ... 1.418e-01 2.218e-01 7.820e-02]
 [2.060e+01 2.933e+01 1.401e+02 ... 2.650e-01 4.087e-01 1.240e-01]
 [7.760e+00 2.454e+01 4.792e+01 ... 0.000e+00 2.871e-01 7.039e-02]]
(569, 30)
```

```
breast_labels=breast.target
print(breast_labels)
print(breast_labels.shape)
```

```
[0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
 1 0 0 0 0 0 0 0 0 1 0 1 1 1 1 1 0 0 1 0 0 1 1 1 1 0 1 0 0 1 1 1 1 0 1 0 0
 1 0 1 0 0 1 1 1 0 0 1 0 0 0 1 1 1 0 1 1 0 0 1 1 1 0 0 1 1 1 1 0 1 1 0 1 1
 1 1 1 1 1 1 0 0 0 1 0 0 1 1 1 0 0 1 0 1 0 0 1 0 0 1 1 0 1 1 0 1 1 1 1 0 1
 1 1 1 1 1 1 1 1 0 1 1 1 1 0 0 1 0 1 1 0 0 1 1 0 0 1 1 1 1 0 1 1 0 0 0 1 0
 1 0 1 1 1 0 1 1 0 0 1 0 0 0 0 1 0 0 0 1 0 1 0 1 1 0 1 0 0 0 0 1 1 0 0 1 1
 1 0 1 1 1 1 1 0 0 1 1 0 1 1 0 0 1 0 1 1 1 1 0 1 1 1 1 1 0 1 0 0 0 0 0 0 0
 0 0 0 0 0 0 0 1 1 1 1 1 1 0 1 0 1 1 0 1 1 0 1 0 0 1 1 1 1 1 1 1 1 1 1 1 1
 1 0 1 1 0 1 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0 1 1 1 0 1 0 1 1 1 1 0 0 0 1 1
 1 1 0 1 0 1 0 1 1 1 0 1 1 1 1 1 1 1 0 0 0 1 1 1 1 1 1 1 1 1 1 1 0 0 1 0 0
 0 1 0 0 1 1 1 1 1 0 1 1 1 1 1 0 1 1 1 0 1 1 0 0 1 1 1 1 1 1 0 1 1 1 1 1 1
 1 0 1 1 1 1 1 0 1 1 0 1 1 1 1 1 1 1 1 1 1 1 1 0 1 0 0 1 0 1 1 1 1 1 0 1 1
 0 1 0 1 1 0 1 0 1 1 1 1 1 1 1 1 0 0 1 1 1 1 1 1 0 1 1 1 1 1 1 1 1 1 1 0 1
 1 1 1 1 1 1 0 1 0 1 1 0 1 1 1 1 1 0 0 1 0 1 0 1 1 1 1 1 0 1 1 0 1 0 1 0 0
 1 1 1 0 1 1 1 1 1 1 1 1 1 1 1 0 1 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
 1 1 1 1 1 1 1 0 0 0 0 0 0 1]
(569,)
```

```
#reshape thedataset by adding label to it
labels=np.reshape(breast_labels,(569,1))
final_breast_data = np.concatenate([breast_data,labels],axis=1)
print(final_breast_data.shape)
```

```
(569, 31)
```

```
breast_dataset= pd.DataFrame(final_breast_data)
print(breast_dataset.head())
```

```
       0      1       2       3        4        5       6        7       8  \
0  17.99  10.38  122.80  1001.0  0.11840  0.27760  0.3001  0.14710  0.2419
1  20.57  17.77  132.90  1326.0  0.08474  0.07864  0.0869  0.07017  0.1812
```

```
2  19.69  21.25  130.00  1203.0  0.10960  0.15990  0.1974  0.12790  0.2069
3  11.42  20.38   77.58   386.1  0.14250  0.28390  0.2414  0.10520  0.2597
4  20.29  14.34  135.10  1297.0  0.10030  0.13280  0.1980  0.10430  0.1809

         9  ...     21      22      23      24      25      26      27  \
0  0.07871  ...  17.33  184.60  2019.0  0.1622  0.6656  0.7119  0.2654
1  0.05667  ...  23.41  158.80  1956.0  0.1238  0.1866  0.2416  0.1860
2  0.05999  ...  25.53  152.50  1709.0  0.1444  0.4245  0.4504  0.2430
3  0.09744  ...  26.50   98.87   567.7  0.2098  0.8663  0.6869  0.2575
4  0.05883  ...  16.67  152.20  1575.0  0.1374  0.2050  0.4000  0.1625

       28       29   30
0  0.4601  0.11890  0.0
1  0.2750  0.08902  0.0
2  0.3613  0.08758  0.0
3  0.6638  0.17300  0.0
4  0.2364  0.07678  0.0

[5 rows x 31 columns]
```

```
#print the features that are there in  the breast cancer dataset
features=breast.feature_names
print(features)
```

```
['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']
```

```
#here the label field is missing so add to it
features_label = np.append(features,'label')
```

```
#embed the column names to dataframe
breast_dataset.columns=features_label
breast_dataset.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	worst compactness	worst concavity	worst concave points	worst symmetry	wo frac dimens
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	0.6656	0.7119	0.2654	0.4601	0.11
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	0.1866	0.2416	0.1860	0.2750	0.08
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	0.4245	0.4504	0.2430	0.3613	0.08
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	0.8663	0.6869	0.2575	0.6638	0.17
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	0.2050	0.4000	0.1625	0.2364	0.07

5 rows × 31 columns

```
#replace target values
breast_dataset['label'].replace(0,'Benign',inplace=True)
breast_dataset['label'].replace(1,'Malignant',inplace=True)
breast_dataset.tail()
```

	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	worst compactness	worst concavity	worst concave points	worst symmetry	fr dime
564	21.56	22.39	142.00	1479.0	0.11100	0.11590	0.24390	0.13890	0.1726	0.05623	...	26.40	166.10	2027.0	0.14100	0.21130	0.4107	0.2216	0.2060	0.
565	20.13	28.25	131.20	1261.0	0.09780	0.10340	0.14400	0.09791	0.1752	0.05533	...	38.25	155.00	1731.0	0.11660	0.19220	0.3215	0.1628	0.2572	0.
566	16.60	28.08	108.30	858.1	0.08455	0.10230	0.09251	0.05302	0.1590	0.05648	...	34.12	126.70	1124.0	0.11390	0.30940	0.3403	0.1418	0.2218	0.
567	20.60	29.33	140.10	1265.0	0.11780	0.27700	0.35140	0.15200	0.2397	0.07016	...	39.42	184.60	1821.0	0.16500	0.86810	0.9387	0.2650	0.4087	0.
568	7.76	24.54	47.92	181.0	0.05263	0.04362	0.00000	0.00000	0.1587	0.05884	...	30.37	59.16	268.6	0.08996	0.06444	0.0000	0.0000	0.2871	0.

5 rows × 31 columns

Start coding or generate with AI.

```
#standardizing
from sklearn.preprocessing import StandardScaler
x=breast_dataset.loc[:, features].values
x=StandardScaler().fit_transform(x)#normalizing feature
print(x.shape)
```

```
(569, 30)
```

```
np.mean(x),np.std(x)
```

```
(-6.118909323768877e-16, 1.0)
```

```
#convertnormalized features into tabular form
feat_cols=['feature'+str(i) for i in range(x.shape[1])]
```

```
normalised_breast=pd.DataFrame(x,columns=feat_cols)
print(normalised_breast)
```

```
     feature0  feature1  feature2  feature3  feature4  feature5  feature6  \
0    1.097064 -2.073335  1.269934  0.984375  1.568466  3.283515  2.652874   
1    1.829821 -0.353632  1.685955  1.908708 -0.826962 -0.487072 -0.023846   
2    1.579888  0.456187  1.566503  1.558884  0.942210  1.052926  1.363478   
3   -0.768909  0.253732 -0.592687 -0.764464  3.283553  3.402909  1.915897   
4    1.750297 -1.151816  1.776573  1.826229  0.280372  0.539340  1.371011   
..        ...       ...       ...       ...       ...       ...       ...   
564  2.110995  0.721473  2.060786  2.343856  1.041842  0.219060  1.947285   
565  1.704854  2.085134  1.615931  1.723842  0.102458 -0.017833  0.693043   
566  0.702284  2.045574  0.672676  0.577953 -0.840484 -0.038680  0.046588   
567  1.838341  2.336457  1.982524  1.735218  1.525767  3.272144  3.296944   
568 -1.808401  1.221792 -1.814389 -1.347789 -3.112085 -1.150752 -1.114873   

     feature7  feature8  feature9  ...  feature20  feature21  feature22  \
0    2.532475  2.217515  2.255747  ...   1.886690  -1.359293   2.303601
1    0.548144  0.001392 -0.868652  ...   1.805927  -0.369203   1.535126
2    2.037231  0.939685 -0.398008  ...   1.511870  -0.023974   1.347475
3    1.451707  2.867383  4.910919  ...  -0.281464   0.133984  -0.249939
4    1.428493 -0.009560 -0.562450  ...   1.298575  -1.466770   1.338539
..        ...       ...       ...  ...        ...        ...        ...
564  2.320965 -0.312589 -0.931027  ...   1.901185   0.117700   1.752563
565  1.263669 -0.217664 -1.058611  ...   1.536720   2.047399   1.421940
566  0.105777 -0.809117 -0.895587  ...   0.561361   1.374854   0.579001
567  2.658866  2.137194  1.043695  ...   1.961239   2.237926   2.303601
568 -1.261820 -0.820070 -0.561032  ...  -1.410893   0.764190  -1.432735

     feature23  feature24  feature25  feature26  feature27  feature28  \
0     2.001237   1.307686   2.616665   2.109526   2.296076   2.750622
1     1.890489  -0.375612  -0.430444  -0.146749   1.087084  -0.243890
2     1.456285   0.527407   1.082932   0.854974   1.955000   1.152255
3    -0.550021   3.394275   3.893397   1.989588   2.175786   6.046041
4     1.220724   0.220556  -0.313395   0.613179   0.729259  -0.868353
..         ...        ...        ...        ...        ...        ...
564   2.015301   0.378365  -0.273318   0.664512   1.629151  -1.360158
565   1.494959  -0.691230  -0.394820   0.236573   0.733827  -0.531855
566   0.427906  -0.809587   0.350735   0.326767   0.414069  -1.104549
567   1.653171   1.430427   3.904848   3.197605   2.289985   1.919083
568  -1.075813  -1.859019  -1.207552  -1.305831  -1.745063  -0.048138

     feature29
0     1.937015
1     0.281190
2     0.201391
3     4.935010
4    -0.397100
..         ...
564  -0.709091
565  -0.973978
566  -0.318409
567   2.219635
568  -0.751207

[569 rows x 30 columns]
```

```
normalised_breast.tail()
```

	feature0	feature1	feature2	feature3	feature4	feature5	feature6	feature7	feature8	feature9	...	feature20	feature21	feature22	feature23	feature24	feature25	feature26	feature27
564	2.110995	0.721473	2.060786	2.343856	1.041842	0.219060	1.947285	2.320965	-0.312589	-0.931027	...	1.901185	0.117700	1.752563	2.015301	0.378365	-0.273318	0.664512	1.629151
565	1.704854	2.085134	1.615931	1.723842	0.102458	-0.017833	0.693043	1.263669	-0.217664	-1.058611	...	1.536720	2.047399	1.421940	1.494959	-0.691230	-0.394820	0.236573	0.733827
566	0.702284	2.045574	0.672676	0.577953	-0.840484	-0.038680	0.046588	0.105777	-0.809117	-0.895587	...	0.561361	1.374854	0.579001	0.427906	-0.809587	0.350735	0.326767	0.414069
567	1.838341	2.336457	1.982524	1.735218	1.525767	3.272144	3.296944	2.658866	2.137194	1.043695	...	1.961239	2.237926	2.303601	1.653171	1.430427	3.904848	3.197605	2.289985
568	-1.808401	1.221792	-1.814389	-1.347789	-3.112085	-1.150752	-1.114873	-1.261820	-0.820070	-0.561032	...	-1.410893	0.764190	-1.432735	-1.075813	-1.859019	-1.207552	-1.305831	-1.745063

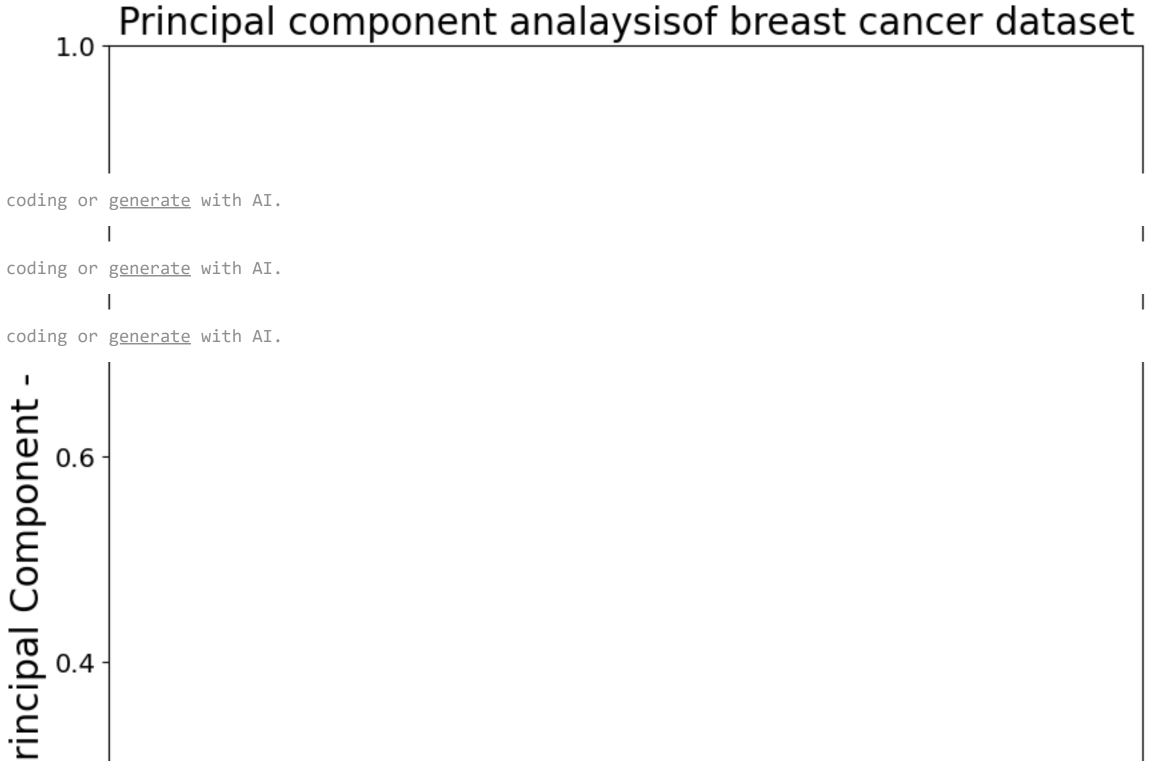
5 rows × 30 columns

```
#projecting thirty-dimensional breast cancer data to two dimnesion
from sklearn.decomposition import PCA
pca_breast= PCA(n_components=2)
principalComponents_breast =pca_breast.fit_transform(x)

principal_breast_Df= pd.DataFrame(data= principalComponents_breast,columns= ['principal component 1','principal component 2'])
principal_breast_Df.tail()
```

	principal component 1	principal component 2
564	6.439315	-3.576817
565	3.793382	-3.584048
566	1.256179	-1.902297
567	10.374794	1.672010
568	-5.475243	-0.670637

```
#plot PCA
import matplotlib.pyplot as plt
plt.figure()
plt.figure(figsize=(10,10))
plt.xticks(fontsize=12)
plt.yticks(fontsize=14)
plt.xlabel('Principal Component - 1',fontsize=20)
plt.ylabel('Principal Component - 2',fontsize=20)
plt.title("Principal component analaysisof breast cancer dataset",fontsize=20)
targets=['Benign','Malignant']
colors=['r','g']
for target, color in zip(targets,colors):
  indicesToKeep = breast_dataset['label']== target
  plt.scatter(principal_breast_Df.loc[indicesToKeep,'Principal Component 1'],principal_breast_Df.loc[indicesToKeep,'Princiapl Component 2'],c=color,s=5)
  plt.legend(targets,prop={'size':15})
  plt.show()
```

```
---------------------------------------------------------------------------
KeyError                                  Traceback (most recent call last)
/usr/local/lib/python3.10/dist-packages/pandas/core/indexes/base.py in get_loc(self, key, method, tolerance)
   3801             try:
-> 3802                 return self._engine.get_loc(casted_key)
   3803             except KeyError as err:

                              10 frames
pandas/_libs/hashtable_class_helper.pxi in pandas._libs.hashtable.PyObjectHashTable.get_item()

pandas/_libs/hashtable_class_helper.pxi in pandas._libs.hashtable.PyObjectHashTable.get_item()

KeyError: 'Principal Component 1'

The above exception was the direct cause of the following exception:

KeyError                                  Traceback (most recent call last)
/usr/local/lib/python3.10/dist-packages/pandas/core/indexes/base.py in get_loc(self, key, method, tolerance)
   3802                 return self._engine.get_loc(casted_key)
   3803             except KeyError as err:
-> 3804                 raise KeyError(key) from err
   3805             except TypeError:
   3806                 # If we have a listlike key, _check_indexing_error will raise

KeyError: 'Principal Component 1'

<Figure size 640x480 with 0 Axes>
```



Start coding or generate with AI.

Start coding or generate with AI.

Start coding or generate with AI.