Importing the Dependencies

```
import numpy as np
import pandas as pd
import sklearn.datasets
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import accuracy_score
```

Data Collection & Processing

```
# loading the data from sklearn
breast_cancer_dataset = sklearn.datasets.load_breast_cancer()
print(breast_cancer_dataset)
```

```
{'data': array([[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]]), 'target': array([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, 1, 0, 1, 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, 1, 0, 0, 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, 1, 0, 1, 1, 1, 0, 1, 0, 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, 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, 1, 0, 0, 0, 0, 0, 0, 1]), 'frame': None, 'target_names': array(['malignant', 'benign'], dtype='<
       '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'], dtype='<U23'), 'filename': 'breast_cancer.csv', 'data_module': 'sklearn.datasets.da
```

```
# loading the data to a data frame
data_frame = pd.DataFrame(breast_cancer_dataset.data, columns = breast_cancer_dataset.feature_names)
# print the first 5 rows of the dataframe
data_frame.head()
```

1 to 5 of 5 entries Filter

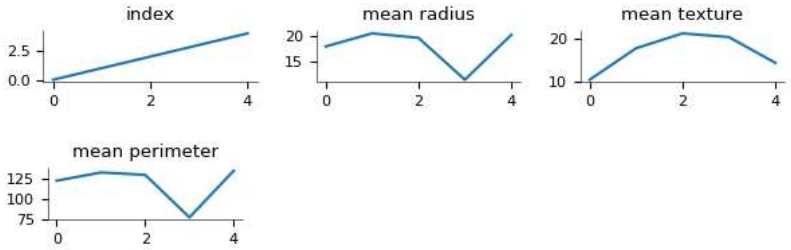
index	mean radius	mean texture	mean perimeter	mean area	mean smoothness	mean compactness	mean concavity
0	17.99	10.38	122.8	1001.0	0.1184	0.2776	0.3001
1	20.57	17.77	132.9	1326.0	0.08474	0.07864	0.0869
2	19.69	21.25	130.0	1203.0	0.1096	0.1599	0.1974
3	11.42	20.38	77.58	386.1	0.1425	0.2839	0.2414
4	20.29	14.34	135.1	1297.0	0.1003	0.1328	0.198

Show 25 per page

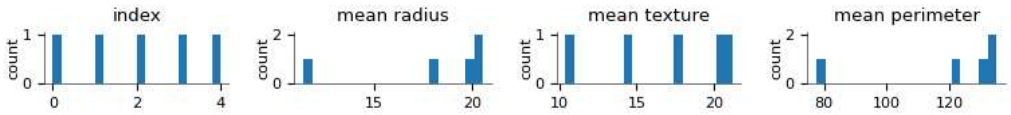
Like what you see? Visit the data table notebook to learn more about interactive tables.

```
Warning: Total number of columns (30) exceeds max_columns (20) limiting to first (20) columns.
```

Values



Distributions



2-d distributions


```
# adding the 'target' column to the data frame
data_frame['label'] = breast_cancer_dataset.target
# print last 5 rows of the dataframe
data_frame.tail()
```

1 to 5 of 5 entries Filter

index	mean radius	mean texture	mean perimeter	mean area	mean smoothness	mean compactness	mean concavity
564	21.56	22.39	142.0	1479.0	0.111	0.1159	0.2439
565	20.13	28.25	131.2	1261.0	0.0978	0.1034	0.144
566	16.6	28.08	108.3	858.1	0.08455	0.1023	0.09251
567	20.6	29.33	140.1	1265.0	0.1178	0.277	0.3514
568	7.76	24.54	47.92	181.0	0.05263	0.04362	0.0

Show 25 per page

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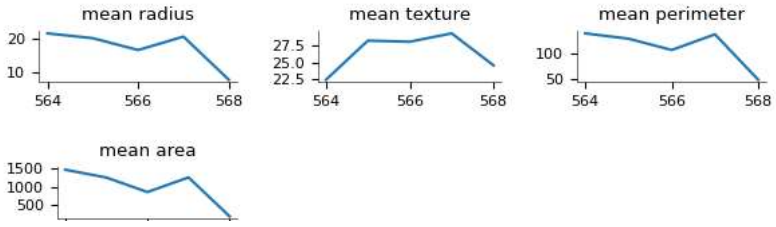
Values




```
# number of rows and columns in the dataset
data_frame.shape
# getting some information about the data
data_frame.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 569 entries, 0 to 568
Data columns (total 31 columns):
 #   Column                   Non-Null Count  Dtype  
---  ------                   --------------  -----  
 0   mean radius              569 non-null    float64
 1   mean texture             569 non-null    float64
 2   mean perimeter           569 non-null    float64
 3   mean area                569 non-null    float64
 4   mean smoothness          569 non-null    float64
 5   mean compactness         569 non-null    float64
 6   mean concavity           569 non-null    float64
 7   mean concave points      569 non-null    float64
 8   mean symmetry            569 non-null    float64
 9   mean fractal dimension   569 non-null    float64
 10  radius error             569 non-null    float64
 11  texture error            569 non-null    float64
 12  perimeter error          569 non-null    float64
 13  area error               569 non-null    float64
 14  smoothness error         569 non-null    float64
 15  compactness error        569 non-null    float64
 16  concavity error          569 non-null    float64
 17  concave points error     569 non-null    float64
 18  symmetry error           569 non-null    float64
 19  fractal dimension error  569 non-null    float64
 20  worst radius             569 non-null    float64
 21  worst texture            569 non-null    float64
 22  worst perimeter          569 non-null    float64
 23  worst area               569 non-null    float64
 24  worst smoothness         569 non-null    float64
 25  worst compactness        569 non-null    float64
 26  worst concavity          569 non-null    float64
 27  worst concave points     569 non-null    float64
 28  worst symmetry           569 non-null    float64
 29  worst fractal dimension  569 non-null    float64
 30  label                    569 non-null    int64  
dtypes: float64(30), int64(1)
memory usage: 137.9 KB
```

```
# checking for missing values
data_frame.isnull().sum()
```

```
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
label                     0
dtype: int64
```

```
# statistical measures about the data
data_frame.describe()
```

	mean radius	mean texture	mean perimeter	mean area	mean smoothness	mean compactness	mean concavity	mean concave points
count	569.000000	569.000000	569.000000	569.000000	569.000000	569.000000	569.000000	569.000000
mean	14.127292	19.289649	91.969033	654.889104	0.096360	0.104341	0.088799	0.048919
std	3.524049	4.301036	24.298981	351.914129	0.014064	0.052813	0.079720	0.038803
min	6.981000	9.710000	43.790000	143.500000	0.052630	0.019380	0.000000	0.000000
25%	11.700000	16.170000	75.170000	420.300000	0.086370	0.064920	0.029560	0.020310
50%	13.370000	18.840000	86.240000	551.100000	0.095870	0.092630	0.061540	0.033500
75%	15.780000	21.800000	104.100000	782.700000	0.105300	0.130400	0.130700	0.074000
max	28.110000	39.280000	188.500000	2501.000000	0.163400	0.345400	0.426800	0.201200

8 rows × 31 columns

```
# checking the distribution of Target Varibale
data_frame['label'].value_counts()
```

```
1    357
0    212
Name: label, dtype: int64
```

1 --> Benign

0 --> Malignant

```
data_frame.groupby('label').mean()
```

Separating the features and target

```
X = data_frame.drop(columns='label', axis=1)
Y = data_frame['label']
print(X)
print(Y)
```

```
     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

          worst perimeter  worst area  worst smoothness  worst compactness  \
     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

          worst concavity  worst concave points  worst symmetry  \
     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

          worst fractal dimension
     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      0
     1      0
     2      0
     3      0
     4      0
           ..
     564    0
     565    0
     566    0
     567    0
     568    1
     Name: label, Length: 569, dtype: int64
```

Splitting the data into training data & Testing data

```
X_train, X_test, Y_train, Y_test = train_test_split(X, Y, test_size=0.2, random_state=2)
print(X.shape, X_train.shape, X_test.shape)
```

```
     (569, 30) (455, 30) (114, 30)
```

Model Training

Logistic Regression

```
model = LogisticRegression()
```

```
model = LogisticRegression()
# training the Logistic Regression model using Training data
model.fit(X_train, Y_train)
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/linear_model/_logistic.py:458: ConvergenceWarning: lbfg
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(
```

▾ LogisticRegression

LogisticRegression()

Model Evaluation

Accuracy Score

```
# accuracy on training data
X_train_prediction = model.predict(X_train)
training_data_accuracy = accuracy_score(Y_train, X_train_prediction)
print('Accuracy on training data = ', training_data_accuracy)
# accuracy on test data
X_test_prediction = model.predict(X_test)
test_data_accuracy = accuracy_score(Y_test, X_test_prediction)
print('Accuracy on test data = ', test_data_accuracy)
```

```
Accuracy on training data =  0.9472527472527472
Accuracy on test data =  0.9298245614035088
```

Building a Predictive System

```
input_data = (13.54,14.36,87.46,566.3,0.09779,0.08129,0.06664,0.04781,0.1885,0.05766,0.2699,0.7886,2.058,23.56,0.008462,0.0146,0.02387,0.0131

# change the input data to a numpy array
input_data_as_numpy_array = np.asarray(input_data)

# reshape the numpy array as we are predicting for one datapoint
input_data_reshaped = input_data_as_numpy_array.reshape(1,-1)

prediction = model.predict(input_data_reshaped)
print(prediction)

if (prediction[0] == 0):
  print('The Breast cancer is Malignant')

else:
  print('The Breast Cancer is Benign')
```

```
[1]
The Breast Cancer is Benign
/usr/local/lib/python3.10/dist-packages/sklearn/base.py:439: UserWarning: X does not have valid feature names, but LogisticRegression wa
  warnings.warn(
```

✓ 0s completed at 12:22 PM