

Sp25 CS 477/577: Python for Machine Learning

Homework 1: Python for basic data processing

This homework aims to practice basic Python programming skills using the breast cancer wisconsin dataset.

Tasks:

Task 1: Explore the dataset. 40 points

Task 2: Data search. 15 points

Task 3: Study the 'area' feature. 15 points

Task 4: Count data samples. 10 points

Task 5: Define a function. 20 points

Dataset

- Number of data samples/rows: 569
- Each data sample has 30 numeric features/attributes. All features of a data sample form a 'feature vector' (each row).
- The first 10 features were directly calculated using mean features of all nuclei in an H&E image (Fig. 1).
- Only the first 10 features of each data sample will be used in this assignment.
- Each data sample is associated with one class label: 0 or 1
 - : 212 Malignant (0)
 - : 357 Benign (1)
- Get more details at:
https://scikit-learn.org/stable/modules/generated/sklearn.datasets.load_breast_cancer.html#sklearn.datasets.load_breast_cancer

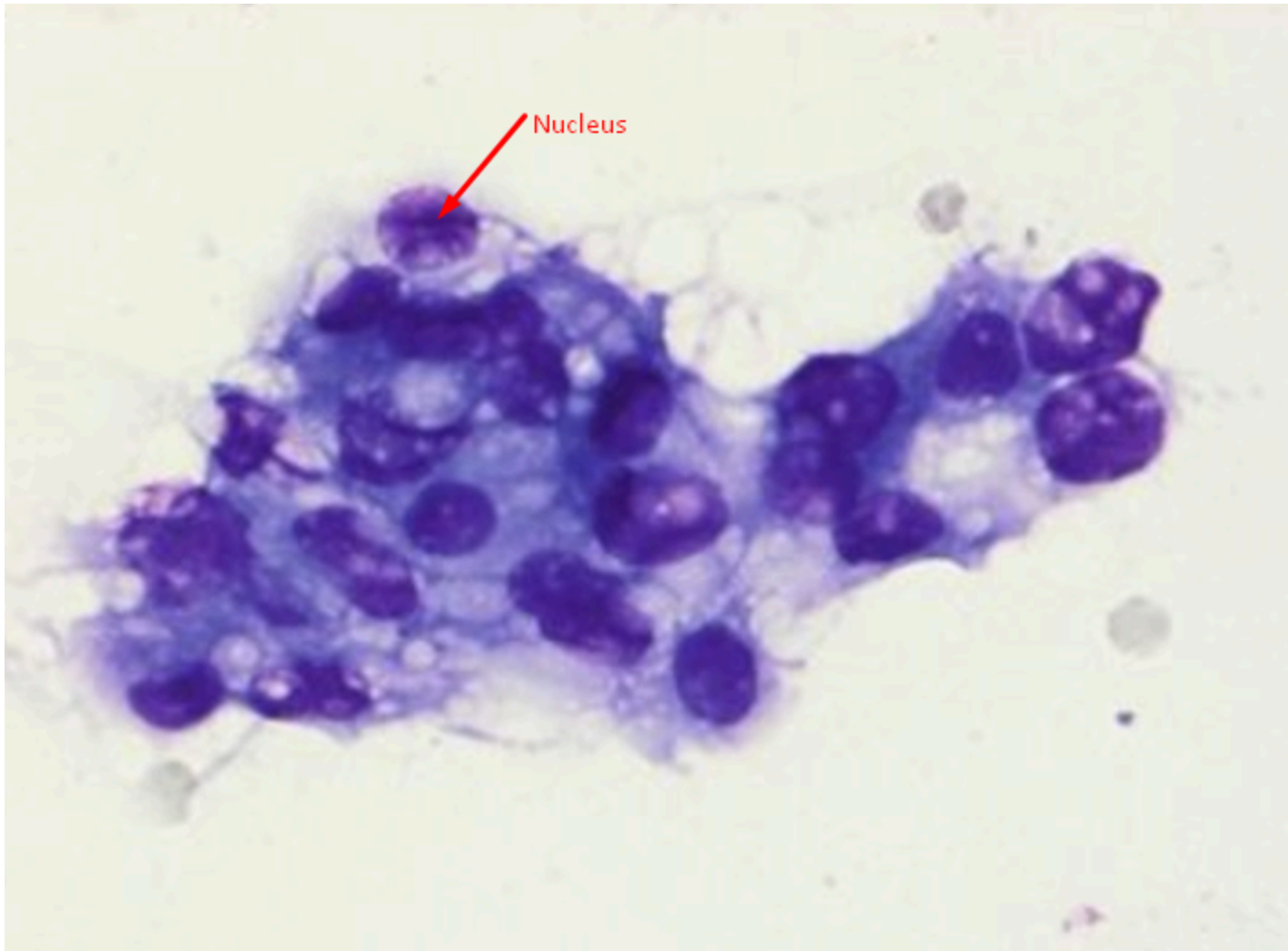


Fig. 1. Cell nuclei in a breast histopathology image

Fine Needle Aspiration (FNA) biopsy: <https://www.cancer.org/cancer/breast-cancer/screening-tests-and-early-detection/breast-biopsy/fine-needle-aspiration-biopsy-of-the-breast.html>

H&E stain: https://en.wikipedia.org/wiki/H%26E_stain

```
In [18]: import sklearn.datasets as ds  
import numpy as np
```

```
In [19]: #load dataset  
breast_ds = ds.load_breast_cancer()  
print('Data fields in breast_ds: \n', dir(breast_ds))  
print('\n Dataset description:\n', breast_ds['DESCR'])
```

Data fields in breast_ds:

```
['DESCR', 'data', 'data_module', 'feature_names', 'filename', 'frame', 'target', 'target_names']
```

Dataset description:

```
.. _breast_cancer_dataset:
```

Breast cancer wisconsin (diagnostic) dataset

****Data Set Characteristics:****

:Number of Instances: 569

:Number of Attributes: 30 numeric, predictive attributes and the class

:Attribute Information:

- radius (mean of distances from center to points on the perimeter)
- texture (standard deviation of gray-scale values)
- perimeter
- area
- smoothness (local variation in radius lengths)
- compactness ($\text{perimeter}^2 / \text{area} - 1.0$)
- concavity (severity of concave portions of the contour)
- concave points (number of concave portions of the contour)
- symmetry
- fractal dimension ("coastline approximation" - 1)

The mean, standard error, and "worst" or largest (mean of the three worst/largest values) of these features were computed for each image, resulting in 30 features. For instance, field 0 is Mean Radius, field 10 is Radius SE, field 20 is Worst Radius.

- class:
 - WDBC-Malignant
 - WDBC-Benign

:Summary Statistics:

	Min	Max
radius (mean):	6.981	28.11

texture (mean):	9.71	39.28
perimeter (mean):	43.79	188.5
area (mean):	143.5	2501.0
smoothness (mean):	0.053	0.163
compactness (mean):	0.019	0.345
concavity (mean):	0.0	0.427
concave points (mean):	0.0	0.201
symmetry (mean):	0.106	0.304
fractal dimension (mean):	0.05	0.097
radius (standard error):	0.112	2.873
texture (standard error):	0.36	4.885
perimeter (standard error):	0.757	21.98
area (standard error):	6.802	542.2
smoothness (standard error):	0.002	0.031
compactness (standard error):	0.002	0.135
concavity (standard error):	0.0	0.396
concave points (standard error):	0.0	0.053
symmetry (standard error):	0.008	0.079
fractal dimension (standard error):	0.001	0.03
radius (worst):	7.93	36.04
texture (worst):	12.02	49.54
perimeter (worst):	50.41	251.2
area (worst):	185.2	4254.0
smoothness (worst):	0.071	0.223
compactness (worst):	0.027	1.058
concavity (worst):	0.0	1.252
concave points (worst):	0.0	0.291
symmetry (worst):	0.156	0.664
fractal dimension (worst):	0.055	0.208
=====	=====	=====

:Missing Attribute Values: None

:Class Distribution: 212 – Malignant, 357 – Benign

:Creator: Dr. William H. Wolberg, W. Nick Street, Olvi L. Mangasarian

:Donor: Nick Street

:Date: November, 1995

This is a copy of UCI ML Breast Cancer Wisconsin (Diagnostic) datasets.

<https://goo.gl/U2Uwz2>

Features are computed from a digitized image of a fine needle aspirate (FNA) of a breast mass. They describe characteristics of the cell nuclei present in the image.

Separating plane described above was obtained using Multisurface Method-Tree (MSM-T) [K. P. Bennett, "Decision Tree Construction Via Linear Programming." Proceedings of the 4th Midwest Artificial Intelligence and Cognitive Science Society, pp. 97-101, 1992], a classification method which uses linear programming to construct a decision tree. Relevant features were selected using an exhaustive search in the space of 1-4 features and 1-3 separating planes.

The actual linear program used to obtain the separating plane in the 3-dimensional space is that described in: [K. P. Bennett and O. L. Mangasarian: "Robust Linear Programming Discrimination of Two Linearly Inseparable Sets", Optimization Methods and Software 1, 1992, 23-34].

This database is also available through the UW CS ftp server:

```
ftp ftp.cs.wisc.edu
cd math-prog/cpo-dataset/machine-learn/WDBC/
```

.. dropdown:: References

- W.N. Street, W.H. Wolberg and O.L. Mangasarian. Nuclear feature extraction for breast tumor diagnosis. IS&T/SPIE 1993 International Symposium on Electronic Imaging: Science and Technology, volume 1905, pages 861-870, San Jose, CA, 1993.
- O.L. Mangasarian, W.N. Street and W.H. Wolberg. Breast cancer diagnosis and prognosis via linear programming. Operations Research, 43(4), pages 570-577, July-August 1995.
- W.H. Wolberg, W.N. Street, and O.L. Mangasarian. Machine learning techniques to diagnose breast cancer from fine-needle aspirates. Cancer Letters 77 (1994) 163-171.

```
In [20]: # we will use the first 10 features in this assignment.
ftrs = breast_ds.data[:, :10] # feature vectors: use the first 10 features; one row is one feature vector
```

```
tgts = breast_ds.target # class labels

print('Size of feature vectors: ', ftrs.shape)
print('Size of targets: ', tgts.shape)
print('Target labels:\n', tgts)
```

Size of feature vectors: (569, 10)

Size of targets: (569,)

Target labels:

[illegible]

Task 1: Explore the dataset. 40 points

```
In [21]: #Task 1.1 check the data type of 'ftrs' and 'tgts', and print it out. 5 points
```

```
print(type(ftrs))
print(type(tgts))
```

```
<class 'numpy.ndarray'>
```

```
<class 'numpy.ndarray'>
```

```
In [22]: #Task 1.2 print out the the features and class label of the 10th data samples. 5 points
```

#each row is one data sample

Features

```
print(ftrs[9])
```

```
# Labels
print(tgts[9])
```

```
[1.246e+01 2.404e+01 8.397e+01 4.759e+02 1.186e-01 2.396e-01 2.273e-01
 8.543e-02 2.030e-01 8.243e-02]
0
```

In [23]: *#Task 1.3 count and print out the number of malignant samples (class label: 0). 5 points*

```
# traditional
malignant_count = 0
for i in tgts:
    if i == 0:
        malignant_count+=1
print(malignant_count)

# using numpy library for numpy.ndarray
count = np.sum(tgts == 0)
print(count)
```

```
212
212
```

In [24]: *#Task 1.4 count and print out the number of benign samples (class label: 1). 5 points*

```
benign_count = np.sum(tgts == 1)
print(benign_count)

# Alternatively, malignant is known from above: 212. Number of Instances: 569
print(569-212)
```

```
357
357
```

In [25]: *#Task 1.5 calculate the average (mean) of feature vectors of benign samples: 5 values*

```
benign_type = ftrs[tgts == 1]
b_mean = np.mean(benign_type, axis=0)
print('Mean:', b_mean)
```

```
Mean: [1.21465238e+01 1.79147619e+01 7.80754062e+01 4.62790196e+02
 9.24776471e-02 8.00846218e-02 4.60576210e-02 2.57174062e-02
 1.74185994e-01 6.28673950e-02]
```



```
In [26]: #Task 1.6 calculate the average (mean) of feature vectors of malignant samples: 5 values
malignant_type = ftrs[tgts == 0]
m_mean = np.mean(malignant_type, axis=0)
print('Mean:', m_mean)
```

```
Mean: [1.74628302e+01 2.16049057e+01 1.15365377e+02 9.78376415e+02
1.02898491e-01 1.45187783e-01 1.60774717e-01 8.79900000e-02
1.92908962e-01 6.26800943e-02]
```

```
In [27]: #Task 1.7 plot the mean feature vectors (m_mean, b_mean) using matplotlib. 10 points
from matplotlib import pyplot as plt
```

Task 2: Data search. 15 points.

Let the user input an index (0 to 568) of a data sample, and print out the feature vector and the corresponding class label of that sample.

- Require multiple searches in one run
- **Extra 5 points for dealing with abnormal input, e.g., out-of-range index

```
In [28]: # tip: use the input() function and while loop
while True:
    try:
        index = int(input("Enter an index (0 to 568) of a data sample (or -1 to exit): "))
        if index == -1:
            break
        if index < 0 or index > 568:
            print("Index out of range. Please enter an index (0 to 568).")
        else:
            print("Feature vector: ", ftrs[index])
            print("Class label: ", tgts[index])
    except ValueError:
        print("Invalid input. Please enter an index (0 to 568).")
```

Task 3. Study the 'area' (index = 3) feature. 15 points

```
In [29]: #Task 3.1: Calculate and print out the mean, min and max values
# of the feature 'area (index 3)' for all benign samples.
```

```
benign_area = benign_type[:, 3]
mean_area = np.mean(benign_area)
min_area = np.min(benign_area)
max_area = np.max(benign_area)

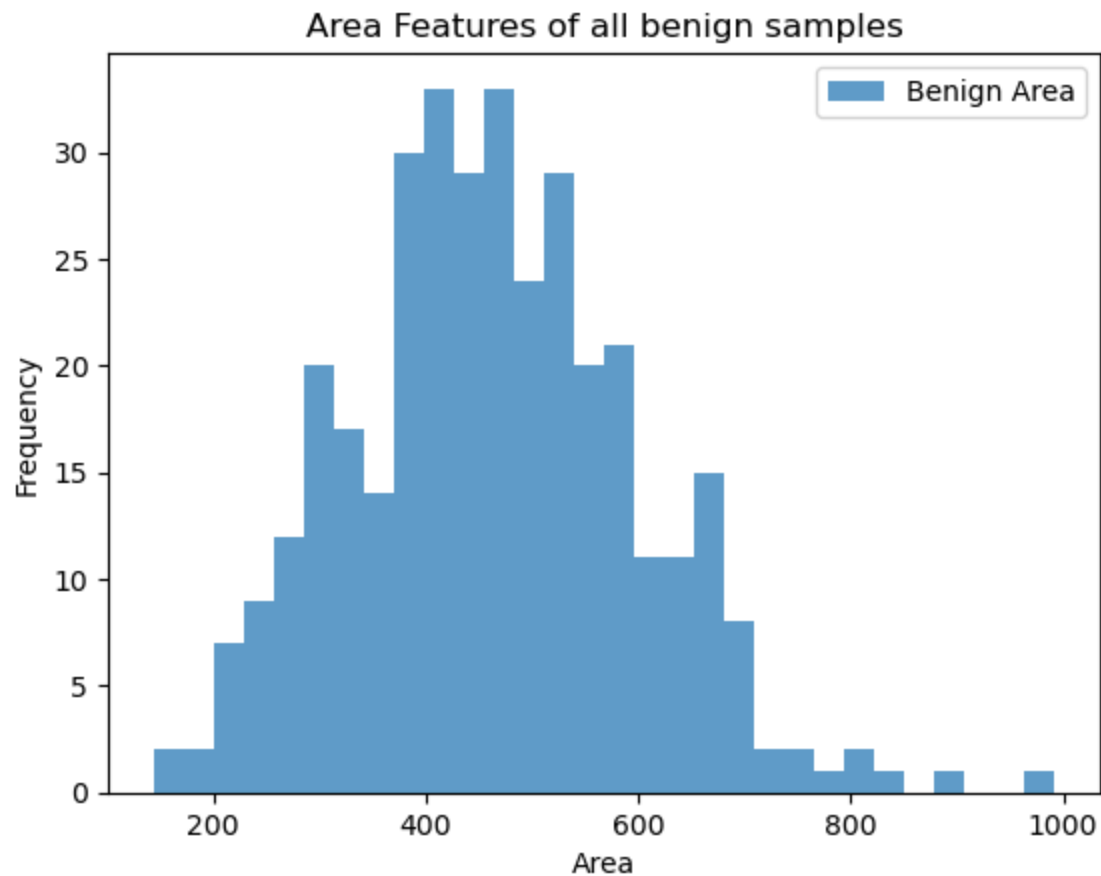
print('Mean area:', mean_area)
print('Min area:', min_area)
print('Max area:', max_area)

# plot the area features of all benign samples
plt.hist(benign_area, bins=30, alpha=0.7, label='Benign Area')
plt.xlabel('Area')
plt.ylabel('Frequency')
plt.title('Area Features of all benign samples')
plt.legend()
plt.show()
```

Mean area: 462.7901960784313

Min area: 143.5

Max area: 992.1



```
In [30]: #Task 3.2: Calculate and print out the mean, min and max values
# of the feature 'area (index 3)' for all malignant samples.

malignant_area = malignant_type[:, 3]
mean_area = np.mean(malignant_area)
min_area = np.min(malignant_area)
max_area = np.max(malignant_area)

print('Mean area:', mean_area)
print('Min area:', min_area)
print('Max area:', max_area)

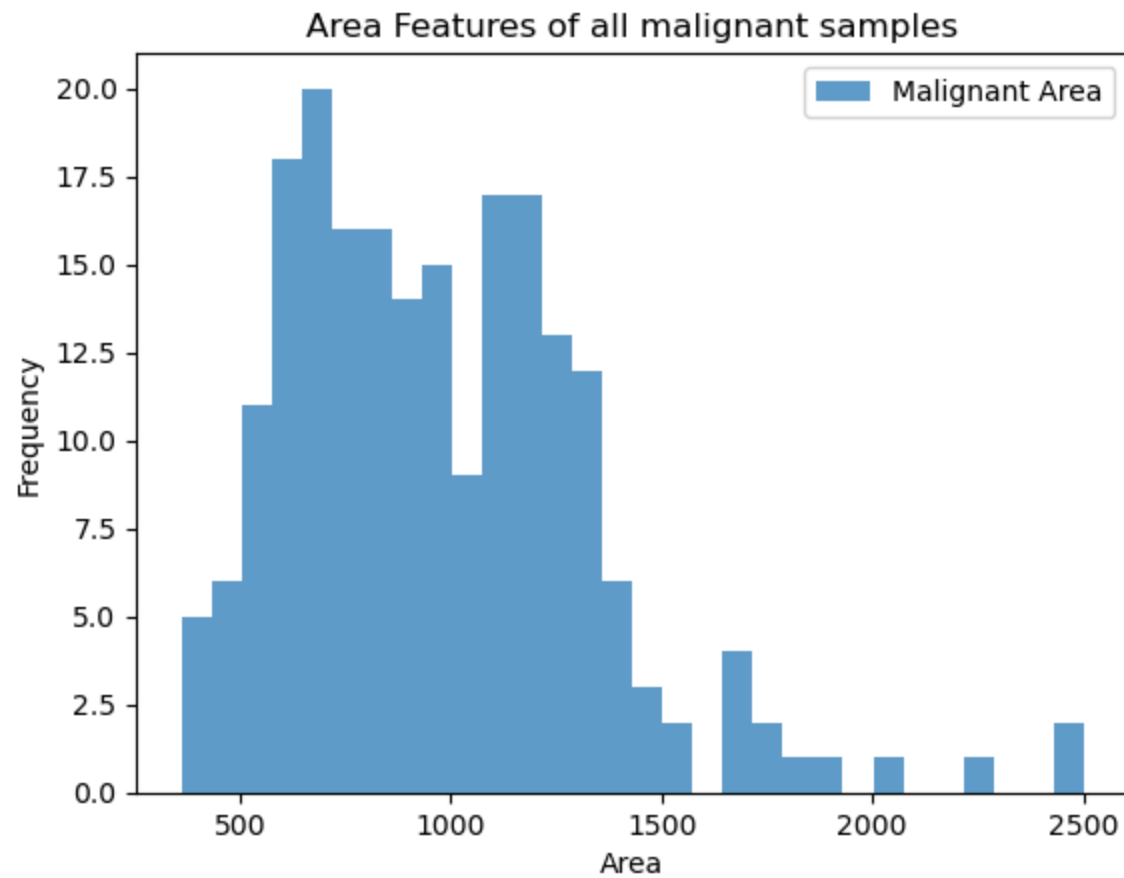
# plot the area features of all malignant samples
plt.hist(malignant_area, bins=30, alpha=0.7, label='Malignant Area')
```

```
plt.xlabel('Area')
plt.ylabel('Frequency')
plt.title('Area Features of all malignant samples')
plt.legend()
plt.show()
```

Mean area: 978.3764150943397

Min area: 361.6

Max area: 2501.0



Task 3.3: What observations can you get from the results of Tasks 3.1 and 3.2?

Response:

Task 4: Count data samples. 10 points

```
In [31]: # Task 4.1 Count the number of malignant samples that have 'area (index 3)' value less than 600. 10 points
malignant600 = np.sum(malignant_area < 600)
print(malignant600)
```

31

```
In [32]: # Task 4.2 Count the number of benign samples that have 'area (index 3)' values less than 600. 10 points
benign600 = np.sum(benign_area < 600)
print(benign600)
```

304

Task 5: Define a function. 20 points

Define a function that calculates and returns the Euclidean distance between any two given data samples

```
In [33]: # Task 5.1
def Eclidean(a, b):
    """
        inputs:a, b: feature vectors of two patients

        return: d: the distance
    """
    d = np.linalg.norm(a - b)
    return d

# test
print('two malignant samples:', Eclidean(ftrs[1], ftrs[2])) # two malignant samples
print('two benign samples:', Eclidean(ftrs[19], ftrs[20])) # two benign samples
print('between two mean vectors:', Eclidean(b_mean, m_mean)) # between means
```

```
two malignant samples: 123.08662898837753
two benign samples: 46.35812850705252
between two mean vectors: 516.9734937120693
```

```
In [34]: # Task 5.2 calculate and print out the Eclidean distance between
# every feature vector (ftrs[i]) and the mean feature vector of malignant samples (m_mean)
```

```
for i in range(len(ftrs)):
    distance = Eclidean(ftrs[i], m_mean)
    print(f"Distance between feature vector {i} and mean malignant vector: {distance}")
```

Distance between feature vector 0 and mean malignant vector: 26.33286841188874
Distance between feature vector 1 and mean malignant vector: 348.100547954307
Distance between feature vector 2 and mean malignant vector: 225.11112082189712
Distance between feature vector 3 and mean malignant vector: 593.5125407983936
Distance between feature vector 4 and mean malignant vector: 319.32932515401563
Distance between feature vector 5 and mean malignant vector: 502.40778179535
Distance between feature vector 6 and mean malignant vector: 61.795325836513186
Distance between feature vector 7 and mean malignant vector: 401.2846200083299
Distance between feature vector 8 and mean malignant vector: 459.4439860471249
Distance between feature vector 9 and mean malignant vector: 503.48703014490815
Distance between feature vector 10 and mean malignant vector: 181.0332464755555
Distance between feature vector 11 and mean malignant vector: 197.76883065979666
Distance between feature vector 12 and mean malignant vector: 145.6684522159039
Distance between feature vector 13 and mean malignant vector: 196.04450674669724
Distance between feature vector 14 and mean malignant vector: 400.6866907488999
Distance between feature vector 15 and mean malignant vector: 320.1876522604738
Distance between feature vector 16 and mean malignant vector: 294.6161712899466
Distance between feature vector 17 and mean malignant vector: 179.73066216538615
Distance between feature vector 18 and mean malignant vector: 282.0138745004371
Distance between feature vector 19 and mean malignant vector: 413.10237695597965
Distance between feature vector 20 and mean malignant vector: 459.3986357986808
Distance between feature vector 21 and mean malignant vector: 706.726381566751
Distance between feature vector 22 and mean malignant vector: 274.3848730362856
Distance between feature vector 23 and mean malignant vector: 426.2017365311438
Distance between feature vector 24 and mean malignant vector: 73.97606494559071
Distance between feature vector 25 and mean malignant vector: 65.88638397603917
Distance between feature vector 26 and mean malignant vector: 334.0717584016947
Distance between feature vector 27 and mean malignant vector: 115.83316744985136
Distance between feature vector 28 and mean malignant vector: 246.3546411922511
Distance between feature vector 29 and mean malignant vector: 24.184880491289793
Distance between feature vector 30 and mean malignant vector: 110.09086873547199
Distance between feature vector 31 and mean malignant vector: 539.1149593138027
Distance between feature vector 32 and mean malignant vector: 79.15495353921617
Distance between feature vector 33 and mean malignant vector: 184.1240715500901
Distance between feature vector 34 and mean malignant vector: 171.42636000463608
Distance between feature vector 35 and mean malignant vector: 109.0060656347418
Distance between feature vector 36 and mean malignant vector: 346.07460671194207
Distance between feature vector 37 and mean malignant vector: 455.78773691015635
Distance between feature vector 38 and mean malignant vector: 280.3124855035749
Distance between feature vector 39 and mean malignant vector: 420.0624745033168
Distance between feature vector 40 and mean malignant vector: 416.4199389573172
Distance between feature vector 41 and mean malignant vector: 608.8648211528222

Distance between feature vector 42 and mean malignant vector: 126.33865143090208
Distance between feature vector 43 and mean malignant vector: 434.10552387464344
Distance between feature vector 44 and mean malignant vector: 447.8992474060053
Distance between feature vector 45 and mean malignant vector: 98.06773690071056
Distance between feature vector 46 and mean malignant vector: 779.1509766177085
Distance between feature vector 47 and mean malignant vector: 444.7787209421317
Distance between feature vector 48 and mean malignant vector: 530.4648914839066
Distance between feature vector 49 and mean malignant vector: 418.36475441634684
Distance between feature vector 50 and mean malignant vector: 552.0044298453313
Distance between feature vector 51 and mean malignant vector: 407.60210529462614
Distance between feature vector 52 and mean malignant vector: 542.2670373148247
Distance between feature vector 53 and mean malignant vector: 54.928128713072034
Distance between feature vector 54 and mean malignant vector: 266.20370699082633
Distance between feature vector 55 and mean malignant vector: 570.9633365114181
Distance between feature vector 56 and mean malignant vector: 173.95437401617775
Distance between feature vector 57 and mean malignant vector: 322.0982991050606
Distance between feature vector 58 and mean malignant vector: 452.3912651548184
Distance between feature vector 59 and mean malignant vector: 756.4577613174755
Distance between feature vector 60 and mean malignant vector: 668.4844525142494
Distance between feature vector 61 and mean malignant vector: 759.0599564000124
Distance between feature vector 62 and mean malignant vector: 333.2313758885394
Distance between feature vector 63 and mean malignant vector: 719.7608498461
Distance between feature vector 64 and mean malignant vector: 480.51774356550777
Distance between feature vector 65 and mean malignant vector: 310.6167890241415
Distance between feature vector 66 and mean malignant vector: 711.1716127545313
Distance between feature vector 67 and mean malignant vector: 585.9362924903929
Distance between feature vector 68 and mean malignant vector: 730.1330557435878
Distance between feature vector 69 and mean malignant vector: 477.1395687551554
Distance between feature vector 70 and mean malignant vector: 151.85452113429386
Distance between feature vector 71 and mean malignant vector: 736.635282836788
Distance between feature vector 72 and mean malignant vector: 49.07765062573198
Distance between feature vector 73 and mean malignant vector: 395.1239087680631
Distance between feature vector 74 and mean malignant vector: 508.81568826007975
Distance between feature vector 75 and mean malignant vector: 161.08876206176845
Distance between feature vector 76 and mean malignant vector: 420.228373193496
Distance between feature vector 77 and mean malignant vector: 28.575209293036508
Distance between feature vector 78 and mean malignant vector: 268.1493343244469
Distance between feature vector 79 and mean malignant vector: 473.20777675943646
Distance between feature vector 80 and mean malignant vector: 578.4028226585929
Distance between feature vector 81 and mean malignant vector: 459.33944898130517
Distance between feature vector 82 and mean malignant vector: 901.4126923063918
Distance between feature vector 83 and mean malignant vector: 154.31617914211452

Distance between feature vector 84 and mean malignant vector: 536.51452853716
Distance between feature vector 85 and mean malignant vector: 96.84790559142846
Distance between feature vector 86 and mean malignant vector: 330.86439526561276
Distance between feature vector 87 and mean malignant vector: 97.90668591429404
Distance between feature vector 88 and mean malignant vector: 513.5363054036027
Distance between feature vector 89 and mean malignant vector: 327.13806479916445
Distance between feature vector 90 and mean malignant vector: 316.3826570165137
Distance between feature vector 91 and mean malignant vector: 250.64705534828622
Distance between feature vector 92 and mean malignant vector: 427.8494391274009
Distance between feature vector 93 and mean malignant vector: 424.28459659229327
Distance between feature vector 94 and mean malignant vector: 273.2084595194698
Distance between feature vector 95 and mean malignant vector: 286.14832960223805
Distance between feature vector 96 and mean malignant vector: 528.6534187855679
Distance between feature vector 97 and mean malignant vector: 685.9918502553204
Distance between feature vector 98 and mean malignant vector: 567.3598971789111
Distance between feature vector 99 and mean malignant vector: 336.54390095705315
Distance between feature vector 100 and mean malignant vector: 396.65123596167456
Distance between feature vector 101 and mean malignant vector: 838.0443901325493
Distance between feature vector 102 and mean malignant vector: 521.1024535809685
Distance between feature vector 103 and mean malignant vector: 682.062979869247
Distance between feature vector 104 and mean malignant vector: 644.1061387791233
Distance between feature vector 105 and mean malignant vector: 449.12171745705854
Distance between feature vector 106 and mean malignant vector: 567.3415452848034
Distance between feature vector 107 and mean malignant vector: 513.0009063012709
Distance between feature vector 108 and mean malignant vector: 531.9677567453571
Distance between feature vector 109 and mean malignant vector: 583.486890417219
Distance between feature vector 110 and mean malignant vector: 690.2622106632627
Distance between feature vector 111 and mean malignant vector: 499.10704879576195
Distance between feature vector 112 and mean malignant vector: 348.93754185539615
Distance between feature vector 113 and mean malignant vector: 645.9077886973453
Distance between feature vector 114 and mean malignant vector: 749.9159736355675
Distance between feature vector 115 and mean malignant vector: 541.1999709642598
Distance between feature vector 116 and mean malignant vector: 735.4323446438849
Distance between feature vector 117 and mean malignant vector: 296.4011951700786
Distance between feature vector 118 and mean malignant vector: 196.02643615496012
Distance between feature vector 119 and mean malignant vector: 4.157554880384549
Distance between feature vector 120 and mean malignant vector: 576.742570820695
Distance between feature vector 121 and mean malignant vector: 98.91702205290912
Distance between feature vector 122 and mean malignant vector: 784.3035028668614
Distance between feature vector 123 and mean malignant vector: 338.5166901579703
Distance between feature vector 124 and mean malignant vector: 425.9347316962329
Distance between feature vector 125 and mean malignant vector: 390.6470117301695

Distance between feature vector 126 and mean malignant vector: 406.7443149552021
Distance between feature vector 127 and mean malignant vector: 159.85580959416959
Distance between feature vector 128 and mean malignant vector: 304.3400001205328
Distance between feature vector 129 and mean malignant vector: 214.19350587547373
Distance between feature vector 130 and mean malignant vector: 523.9271916530114
Distance between feature vector 131 and mean malignant vector: 229.9014898020938
Distance between feature vector 132 and mean malignant vector: 168.83044300576884
Distance between feature vector 133 and mean malignant vector: 217.23096087353966
Distance between feature vector 134 and mean malignant vector: 96.75000646302132
Distance between feature vector 135 and mean malignant vector: 473.2979503381949
Distance between feature vector 136 and mean malignant vector: 556.3150149145716
Distance between feature vector 137 and mean malignant vector: 580.1857105539394
Distance between feature vector 138 and mean malignant vector: 300.8842633048096
Distance between feature vector 139 and mean malignant vector: 595.17519601239
Distance between feature vector 140 and mean malignant vector: 692.1066200702954
Distance between feature vector 141 and mean malignant vector: 165.7383794652634
Distance between feature vector 142 and mean malignant vector: 581.920089776351
Distance between feature vector 143 and mean malignant vector: 467.304794349295
Distance between feature vector 144 and mean malignant vector: 624.9258015842759
Distance between feature vector 145 and mean malignant vector: 546.9194849163026
Distance between feature vector 146 and mean malignant vector: 547.6382738397688
Distance between feature vector 147 and mean malignant vector: 289.4323450452123
Distance between feature vector 148 and mean malignant vector: 339.0267264040428
Distance between feature vector 149 and mean malignant vector: 394.35372273557647
Distance between feature vector 150 and mean malignant vector: 460.1029680272141
Distance between feature vector 151 and mean malignant vector: 777.0172632869445
Distance between feature vector 152 and mean malignant vector: 680.2083496783409
Distance between feature vector 153 and mean malignant vector: 598.2278094291946
Distance between feature vector 154 and mean malignant vector: 440.5686165973266
Distance between feature vector 155 and mean malignant vector: 519.4418827070984
Distance between feature vector 156 and mean malignant vector: 14.843636181632586
Distance between feature vector 157 and mean malignant vector: 98.44864336017697
Distance between feature vector 158 and mean malignant vector: 531.2768263844604
Distance between feature vector 159 and mean malignant vector: 613.4510198962145
Distance between feature vector 160 and mean malignant vector: 559.9857679256761
Distance between feature vector 161 and mean malignant vector: 179.05593696940412
Distance between feature vector 162 and mean malignant vector: 236.15693094687967
Distance between feature vector 163 and mean malignant vector: 515.1280929556177
Distance between feature vector 164 and mean malignant vector: 708.6003706813999
Distance between feature vector 165 and mean malignant vector: 288.8770197744973
Distance between feature vector 166 and mean malignant vector: 622.6719866642201
Distance between feature vector 167 and mean malignant vector: 92.32116899603885

Distance between feature vector 168 and mean malignant vector: 6.980974413136859
Distance between feature vector 169 and mean malignant vector: 293.14997282387696
Distance between feature vector 170 and mean malignant vector: 515.6791541385904
Distance between feature vector 171 and mean malignant vector: 414.0548909051305
Distance between feature vector 172 and mean malignant vector: 242.02225244263525
Distance between feature vector 173 and mean malignant vector: 607.4300287809883
Distance between feature vector 174 and mean malignant vector: 630.6661719988838
Distance between feature vector 175 and mean malignant vector: 753.7299776663776
Distance between feature vector 176 and mean malignant vector: 677.9313714251776
Distance between feature vector 177 and mean malignant vector: 145.6139320890012
Distance between feature vector 178 and mean malignant vector: 453.22788993418595
Distance between feature vector 179 and mean malignant vector: 470.9117196290401
Distance between feature vector 180 and mean malignant vector: 1273.410912657245
Distance between feature vector 181 and mean malignant vector: 333.80154635800335
Distance between feature vector 182 and mean malignant vector: 212.26094057703503
Distance between feature vector 183 and mean malignant vector: 577.9630778352914
Distance between feature vector 184 and mean malignant vector: 268.29105188292027
Distance between feature vector 185 and mean malignant vector: 662.9611481189444
Distance between feature vector 186 and mean malignant vector: 62.78579487039438
Distance between feature vector 187 and mean malignant vector: 559.6045017332978
Distance between feature vector 188 and mean malignant vector: 550.9825065576069
Distance between feature vector 189 and mean malignant vector: 516.0289462865203
Distance between feature vector 190 and mean malignant vector: 369.09145095628645
Distance between feature vector 191 and mean malignant vector: 472.1787646662126
Distance between feature vector 192 and mean malignant vector: 692.4868323617773
Distance between feature vector 193 and mean malignant vector: 502.19709736993997
Distance between feature vector 194 and mean malignant vector: 307.356204188982
Distance between feature vector 195 and mean malignant vector: 463.19429086141713
Distance between feature vector 196 and mean malignant vector: 390.279162819955
Distance between feature vector 197 and mean malignant vector: 45.673794040330776
Distance between feature vector 198 and mean malignant vector: 170.0680604081999
Distance between feature vector 199 and mean malignant vector: 336.3412484286526
Distance between feature vector 200 and mean malignant vector: 518.7157680483197
Distance between feature vector 201 and mean malignant vector: 26.87526167341295
Distance between feature vector 202 and mean malignant vector: 708.0055170808301
Distance between feature vector 203 and mean malignant vector: 381.3437443925046
Distance between feature vector 204 and mean malignant vector: 497.69227501244467
Distance between feature vector 205 and mean malignant vector: 262.35800550469077
Distance between feature vector 206 and mean malignant vector: 685.042833058915
Distance between feature vector 207 and mean malignant vector: 74.3063976537016
Distance between feature vector 208 and mean malignant vector: 449.8923318426801
Distance between feature vector 209 and mean malignant vector: 253.618998459326

Distance between feature vector 210 and mean malignant vector: 312.23883506072144
Distance between feature vector 211 and mean malignant vector: 551.8526962703027
Distance between feature vector 212 and mean malignant vector: 1522.4217488498825
Distance between feature vector 213 and mean malignant vector: 30.645153486509116
Distance between feature vector 214 and mean malignant vector: 368.38507878506203
Distance between feature vector 215 and mean malignant vector: 400.2647486643791
Distance between feature vector 216 and mean malignant vector: 547.5379357569011
Distance between feature vector 217 and mean malignant vector: 659.1526877901401
Distance between feature vector 218 and mean malignant vector: 252.0424091475823
Distance between feature vector 219 and mean malignant vector: 245.19922928916608
Distance between feature vector 220 and mean malignant vector: 410.50244821863504
Distance between feature vector 221 and mean malignant vector: 418.0242383519309
Distance between feature vector 222 and mean malignant vector: 667.2233357642924
Distance between feature vector 223 and mean malignant vector: 217.46240523368564
Distance between feature vector 224 and mean malignant vector: 433.11873994892704
Distance between feature vector 225 and mean malignant vector: 338.06249341994436
Distance between feature vector 226 and mean malignant vector: 650.6720087267126
Distance between feature vector 227 and mean malignant vector: 294.4953902105258
Distance between feature vector 228 and mean malignant vector: 483.2053190495274
Distance between feature vector 229 and mean malignant vector: 476.152234322044
Distance between feature vector 230 and mean malignant vector: 83.43882137387364
Distance between feature vector 231 and mean malignant vector: 584.3637441080398
Distance between feature vector 232 and mean malignant vector: 593.4118300517566
Distance between feature vector 233 and mean malignant vector: 341.2250516281538
Distance between feature vector 234 and mean malignant vector: 701.0174096064815
Distance between feature vector 235 and mean malignant vector: 375.863480286991
Distance between feature vector 236 and mean malignant vector: 692.7187379313435
Distance between feature vector 237 and mean malignant vector: 328.0852711541561
Distance between feature vector 238 and mean malignant vector: 355.2796046910315
Distance between feature vector 239 and mean malignant vector: 60.451522677699735
Distance between feature vector 240 and mean malignant vector: 404.10948140427166
Distance between feature vector 241 and mean malignant vector: 503.2886496187305
Distance between feature vector 242 and mean malignant vector: 590.4741774394598
Distance between feature vector 243 and mean malignant vector: 389.32549017204195
Distance between feature vector 244 and mean malignant vector: 177.17752878123915
Distance between feature vector 245 and mean malignant vector: 642.5608685839536
Distance between feature vector 246 and mean malignant vector: 437.93255162797794
Distance between feature vector 247 and mean malignant vector: 467.25007638644115
Distance between feature vector 248 and mean malignant vector: 633.1968273354867
Distance between feature vector 249 and mean malignant vector: 573.6490080393168
Distance between feature vector 250 and mean malignant vector: 386.3616904703078
Distance between feature vector 251 and mean malignant vector: 572.5650918536302

Distance between feature vector 252 and mean malignant vector: 228.15779984991968
Distance between feature vector 253 and mean malignant vector: 50.43582045290224
Distance between feature vector 254 and mean malignant vector: 190.97239716896922
Distance between feature vector 255 and mean malignant vector: 376.7813550965451
Distance between feature vector 256 and mean malignant vector: 229.4710107067249
Distance between feature vector 257 and mean malignant vector: 265.39951767308486
Distance between feature vector 258 and mean malignant vector: 204.9557986572122
Distance between feature vector 259 and mean malignant vector: 234.0811363760446
Distance between feature vector 260 and mean malignant vector: 310.18074307063097
Distance between feature vector 261 and mean malignant vector: 45.51010566720717
Distance between feature vector 262 and mean malignant vector: 30.596728862867714
Distance between feature vector 263 and mean malignant vector: 220.3319729880288
Distance between feature vector 264 and mean malignant vector: 50.22076037444197
Distance between feature vector 265 and mean malignant vector: 441.20726848828673
Distance between feature vector 266 and mean malignant vector: 633.6972560747151
Distance between feature vector 267 and mean malignant vector: 418.3463797637548
Distance between feature vector 268 and mean malignant vector: 467.39566883934657
Distance between feature vector 269 and mean malignant vector: 635.1716999224998
Distance between feature vector 270 and mean malignant vector: 346.7313256302704
Distance between feature vector 271 and mean malignant vector: 592.0443047972866
Distance between feature vector 272 and mean malignant vector: 513.6355953836176
Distance between feature vector 273 and mean malignant vector: 690.6490608703897
Distance between feature vector 274 and mean malignant vector: 20.730391294836206
Distance between feature vector 275 and mean malignant vector: 544.2327218531777
Distance between feature vector 276 and mean malignant vector: 583.4858120659801
Distance between feature vector 277 and mean malignant vector: 123.76548220466269
Distance between feature vector 278 and mean malignant vector: 407.1554423079812
Distance between feature vector 279 and mean malignant vector: 391.93439598626264
Distance between feature vector 280 and mean malignant vector: 160.0778258324161
Distance between feature vector 281 and mean malignant vector: 552.690535077791
Distance between feature vector 282 and mean malignant vector: 167.0896765867847
Distance between feature vector 283 and mean malignant vector: 173.4282406666978
Distance between feature vector 284 and mean malignant vector: 462.89526023344484
Distance between feature vector 285 and mean malignant vector: 490.69970059690695
Distance between feature vector 286 and mean malignant vector: 538.7119316454726
Distance between feature vector 287 and mean malignant vector: 463.78656839719815
Distance between feature vector 288 and mean malignant vector: 585.7938706157981
Distance between feature vector 289 and mean malignant vector: 584.014259458208
Distance between feature vector 290 and mean malignant vector: 327.966479068962
Distance between feature vector 291 and mean malignant vector: 291.67485060442783
Distance between feature vector 292 and mean malignant vector: 465.84785072124726
Distance between feature vector 293 and mean malignant vector: 547.1722994290927

Distance between feature vector 294 and mean malignant vector: 487.5207526628805
Distance between feature vector 295 and mean malignant vector: 396.72226075037725
Distance between feature vector 296 and mean malignant vector: 616.5164340217664
Distance between feature vector 297 and mean malignant vector: 548.8036034459582
Distance between feature vector 298 and mean malignant vector: 346.151547330758
Distance between feature vector 299 and mean malignant vector: 646.0399157329279
Distance between feature vector 300 and mean malignant vector: 239.06609346331788
Distance between feature vector 301 and mean malignant vector: 508.3059657557142
Distance between feature vector 302 and mean malignant vector: 269.340777300826
Distance between feature vector 303 and mean malignant vector: 645.9449063379259
Distance between feature vector 304 and mean malignant vector: 576.8327888996238
Distance between feature vector 305 and mean malignant vector: 562.7200181060437
Distance between feature vector 306 and mean malignant vector: 442.2436927908391
Distance between feature vector 307 and mean malignant vector: 734.5346066653676
Distance between feature vector 308 and mean malignant vector: 413.35807299977665
Distance between feature vector 309 and mean malignant vector: 449.05445484099664
Distance between feature vector 310 and mean malignant vector: 561.2139184324546
Distance between feature vector 311 and mean malignant vector: 314.3648420534074
Distance between feature vector 312 and mean malignant vector: 475.52292560211714
Distance between feature vector 313 and mean malignant vector: 570.931465330686
Distance between feature vector 314 and mean malignant vector: 759.7094639700479
Distance between feature vector 315 and mean malignant vector: 498.13938876569705
Distance between feature vector 316 and mean malignant vector: 518.4611573003048
Distance between feature vector 317 and mean malignant vector: 48.82037918111184
Distance between feature vector 318 and mean malignant vector: 736.0097866759983
Distance between feature vector 319 and mean malignant vector: 502.46974352237635
Distance between feature vector 320 and mean malignant vector: 656.0595401167627
Distance between feature vector 321 and mean malignant vector: 296.0607134501791
Distance between feature vector 322 and mean malignant vector: 474.7880274965254
Distance between feature vector 323 and mean malignant vector: 286.3752944182239
Distance between feature vector 324 and mean malignant vector: 521.8809705682046
Distance between feature vector 325 and mean malignant vector: 489.70868563774934
Distance between feature vector 326 and mean malignant vector: 362.8826566111417
Distance between feature vector 327 and mean malignant vector: 533.8635315353898
Distance between feature vector 328 and mean malignant vector: 164.90060204969487
Distance between feature vector 329 and mean malignant vector: 151.78536555664837
Distance between feature vector 330 and mean malignant vector: 185.52898512589047
Distance between feature vector 331 and mean malignant vector: 465.42677774626713
Distance between feature vector 332 and mean malignant vector: 592.7049402838107
Distance between feature vector 333 and mean malignant vector: 590.0904518708874
Distance between feature vector 334 and mean malignant vector: 515.373929915076
Distance between feature vector 335 and mean malignant vector: 59.88707864872644

Distance between feature vector 336 and mean malignant vector: 465.20975059360853
Distance between feature vector 337 and mean malignant vector: 113.88078317265463
Distance between feature vector 338 and mean malignant vector: 669.5717317152753
Distance between feature vector 339 and mean malignant vector: 769.6783319982512
Distance between feature vector 340 and mean malignant vector: 337.8948783829421
Distance between feature vector 341 and mean malignant vector: 700.0016817356252
Distance between feature vector 342 and mean malignant vector: 606.1369100710359
Distance between feature vector 343 and mean malignant vector: 216.12428986444274
Distance between feature vector 344 and mean malignant vector: 559.59559395671
Distance between feature vector 345 and mean malignant vector: 658.6895613646652
Distance between feature vector 346 and mean malignant vector: 534.5139070637239
Distance between feature vector 347 and mean malignant vector: 310.44161630178445
Distance between feature vector 348 and mean malignant vector: 577.289780207844
Distance between feature vector 349 and mean malignant vector: 553.0603500265589
Distance between feature vector 350 and mean malignant vector: 558.9801001436708
Distance between feature vector 351 and mean malignant vector: 219.9514491319944
Distance between feature vector 352 and mean malignant vector: 1033.3413328650552
Distance between feature vector 353 and mean malignant vector: 262.39517843337603
Distance between feature vector 354 and mean malignant vector: 595.4949709521587
Distance between feature vector 355 and mean malignant vector: 493.74142044388117
Distance between feature vector 356 and mean malignant vector: 467.38862559391083
Distance between feature vector 357 and mean malignant vector: 385.6665253206667
Distance between feature vector 358 and mean malignant vector: 739.7783626654251
Distance between feature vector 359 and mean malignant vector: 702.0310343458751
Distance between feature vector 360 and mean malignant vector: 487.84029283962997
Distance between feature vector 361 and mean malignant vector: 433.3448916850318
Distance between feature vector 362 and mean malignant vector: 482.97023019398347
Distance between feature vector 363 and mean malignant vector: 140.5924526706125
Distance between feature vector 364 and mean malignant vector: 427.06820363888664
Distance between feature vector 365 and mean malignant vector: 315.17730868758616
Distance between feature vector 366 and mean malignant vector: 256.3481446638115
Distance between feature vector 367 and mean malignant vector: 521.3339057895085
Distance between feature vector 368 and mean malignant vector: 568.2302006421561
Distance between feature vector 369 and mean malignant vector: 504.64931969510536
Distance between feature vector 370 and mean malignant vector: 138.13793162521185
Distance between feature vector 371 and mean malignant vector: 267.30597920614497
Distance between feature vector 372 and mean malignant vector: 408.5182663266883
Distance between feature vector 373 and mean malignant vector: 357.1922275110862
Distance between feature vector 374 and mean malignant vector: 400.28015369062194
Distance between feature vector 375 and mean malignant vector: 190.1776821148014
Distance between feature vector 376 and mean malignant vector: 641.7099684788448
Distance between feature vector 377 and mean malignant vector: 417.3901560233805

Distance between feature vector 378 and mean malignant vector: 398.76858786685693
Distance between feature vector 379 and mean malignant vector: 618.2484045623443
Distance between feature vector 380 and mean malignant vector: 593.6740437198894
Distance between feature vector 381 and mean malignant vector: 607.3939660700578
Distance between feature vector 382 and mean malignant vector: 531.8670681036799
Distance between feature vector 383 and mean malignant vector: 516.6861224756717
Distance between feature vector 384 and mean malignant vector: 437.6680905837161
Distance between feature vector 385 and mean malignant vector: 314.42281327900247
Distance between feature vector 386 and mean malignant vector: 517.7520411898607
Distance between feature vector 387 and mean malignant vector: 382.7851913938624
Distance between feature vector 388 and mean malignant vector: 587.9419207030622
Distance between feature vector 389 and mean malignant vector: 196.1089152382246
Distance between feature vector 390 and mean malignant vector: 658.7540755582625
Distance between feature vector 391 and mean malignant vector: 746.5655372448779
Distance between feature vector 392 and mean malignant vector: 234.04985384447133
Distance between feature vector 393 and mean malignant vector: 429.62642551876195
Distance between feature vector 394 and mean malignant vector: 533.5227759100371
Distance between feature vector 395 and mean malignant vector: 370.2058996233054
Distance between feature vector 396 and mean malignant vector: 421.18721413330377
Distance between feature vector 397 and mean malignant vector: 471.22718151242435
Distance between feature vector 398 and mean malignant vector: 601.9374119786102
Distance between feature vector 399 and mean malignant vector: 547.9925994941632
Distance between feature vector 400 and mean malignant vector: 18.063841038897515
Distance between feature vector 401 and mean malignant vector: 537.2456403942705
Distance between feature vector 402 and mean malignant vector: 454.28259878633787
Distance between feature vector 403 and mean malignant vector: 471.92833119533753
Distance between feature vector 404 and mean malignant vector: 510.69327121611843
Distance between feature vector 405 and mean malignant vector: 610.0789348790698
Distance between feature vector 406 and mean malignant vector: 178.85147122459412
Distance between feature vector 407 and mean malignant vector: 465.05299410026583
Distance between feature vector 408 and mean malignant vector: 13.587419698575843
Distance between feature vector 409 and mean malignant vector: 513.64715168032
Distance between feature vector 410 and mean malignant vector: 580.209033898727
Distance between feature vector 411 and mean malignant vector: 606.8590968228193
Distance between feature vector 412 and mean malignant vector: 711.7983256725302
Distance between feature vector 413 and mean malignant vector: 285.24576259712524
Distance between feature vector 414 and mean malignant vector: 259.6879167112839
Distance between feature vector 415 and mean malignant vector: 545.9980076581647
Distance between feature vector 416 and mean malignant vector: 709.4175283395596
Distance between feature vector 417 and mean malignant vector: 175.73086278822
Distance between feature vector 418 and mean malignant vector: 484.7202635156911
Distance between feature vector 419 and mean malignant vector: 599.7565547720625

Distance between feature vector 420 and mean malignant vector: 570.2006482345347
Distance between feature vector 421 and mean malignant vector: 322.83414037087346
Distance between feature vector 422 and mean malignant vector: 571.6284116797801
Distance between feature vector 423 and mean malignant vector: 403.9335075439193
Distance between feature vector 424 and mean malignant vector: 690.7940109555041
Distance between feature vector 425 and mean malignant vector: 673.1427946342461
Distance between feature vector 426 and mean malignant vector: 646.6230295347732
Distance between feature vector 427 and mean malignant vector: 620.2635768892385
Distance between feature vector 428 and mean malignant vector: 599.0156139325691
Distance between feature vector 429 and mean malignant vector: 478.353715519859
Distance between feature vector 430 and mean malignant vector: 293.68883868332136
Distance between feature vector 431 and mean malignant vector: 511.7403837302575
Distance between feature vector 432 and mean malignant vector: 272.26982715569676
Distance between feature vector 433 and mean malignant vector: 131.8946901451594
Distance between feature vector 434 and mean malignant vector: 305.41041535533185
Distance between feature vector 435 and mean malignant vector: 379.6725573064559
Distance between feature vector 436 and mean malignant vector: 470.34124163595504
Distance between feature vector 437 and mean malignant vector: 368.12567701413474
Distance between feature vector 438 and mean malignant vector: 386.7203878010816
Distance between feature vector 439 and mean malignant vector: 372.83195443502234
Distance between feature vector 440 and mean malignant vector: 608.493713815734
Distance between feature vector 441 and mean malignant vector: 49.81177432961034
Distance between feature vector 442 and mean malignant vector: 393.46397661830315
Distance between feature vector 443 and mean malignant vector: 639.3677920315403
Distance between feature vector 444 and mean malignant vector: 12.75145491406782
Distance between feature vector 445 and mean malignant vector: 538.4396941245059
Distance between feature vector 446 and mean malignant vector: 7.449788806355008
Distance between feature vector 447 and mean malignant vector: 304.23838464785933
Distance between feature vector 448 and mean malignant vector: 319.39671835211124
Distance between feature vector 449 and mean malignant vector: 406.27794025711654
Distance between feature vector 450 and mean malignant vector: 547.7622311892268
Distance between feature vector 451 and mean malignant vector: 213.01874627682105
Distance between feature vector 452 and mean malignant vector: 537.333133904131
Distance between feature vector 453 and mean malignant vector: 334.96732813370386
Distance between feature vector 454 and mean malignant vector: 486.76269397032627
Distance between feature vector 455 and mean malignant vector: 422.29353353851764
Distance between feature vector 456 and mean malignant vector: 564.8126187639332
Distance between feature vector 457 and mean malignant vector: 441.6202005059622
Distance between feature vector 458 and mean malignant vector: 459.3810208870455
Distance between feature vector 459 and mean malignant vector: 689.644028026552
Distance between feature vector 460 and mean malignant vector: 47.981877079072035
Distance between feature vector 461 and mean malignant vector: 1524.3427247989175

Distance between feature vector 462 and mean malignant vector: 333.1371309607959
Distance between feature vector 463 and mean malignant vector: 567.2352033789396
Distance between feature vector 464 and mean malignant vector: 442.2042707725279
Distance between feature vector 465 and mean malignant vector: 436.4306490307174
Distance between feature vector 466 and mean malignant vector: 442.4752748696429
Distance between feature vector 467 and mean malignant vector: 694.256378747368
Distance between feature vector 468 and mean malignant vector: 4.5520998796835235
Distance between feature vector 469 and mean malignant vector: 570.9492322019396
Distance between feature vector 470 and mean malignant vector: 691.4297077815289
Distance between feature vector 471 and mean malignant vector: 529.9461299543177
Distance between feature vector 472 and mean malignant vector: 292.1768835677335
Distance between feature vector 473 and mean malignant vector: 514.4721970655986
Distance between feature vector 474 and mean malignant vector: 621.169209114664
Distance between feature vector 475 and mean malignant vector: 472.6527859831343
Distance between feature vector 476 and mean malignant vector: 360.72397875460445
Distance between feature vector 477 and mean malignant vector: 379.9439653349717
Distance between feature vector 478 and mean malignant vector: 575.0408894860069
Distance between feature vector 479 and mean malignant vector: 162.68967443420908
Distance between feature vector 480 and mean malignant vector: 524.4277347494283
Distance between feature vector 481 and mean malignant vector: 376.4442854529166
Distance between feature vector 482 and mean malignant vector: 433.06980146853147
Distance between feature vector 483 and mean malignant vector: 408.24751769086924
Distance between feature vector 484 and mean malignant vector: 231.75425095161742
Distance between feature vector 485 and mean malignant vector: 502.78085960181414
Distance between feature vector 486 and mean malignant vector: 313.1408258788029
Distance between feature vector 487 and mean malignant vector: 189.08383758653108
Distance between feature vector 488 and mean malignant vector: 559.356004360756
Distance between feature vector 489 and mean malignant vector: 121.0696329292918
Distance between feature vector 490 and mean malignant vector: 513.2524958817653
Distance between feature vector 491 and mean malignant vector: 16.10092616915867
Distance between feature vector 492 and mean malignant vector: 28.808200567875467
Distance between feature vector 493 and mean malignant vector: 502.5081861210939
Distance between feature vector 494 and mean malignant vector: 440.8118203803244
Distance between feature vector 495 and mean malignant vector: 298.11287543990846
Distance between feature vector 496 and mean malignant vector: 493.89396268845314
Distance between feature vector 497 and mean malignant vector: 499.54166014935817
Distance between feature vector 498 and mean malignant vector: 89.91856703613391
Distance between feature vector 499 and mean malignant vector: 342.37392251558873
Distance between feature vector 500 and mean malignant vector: 289.50587243516236
Distance between feature vector 501 and mean malignant vector: 383.1976431710316
Distance between feature vector 502 and mean malignant vector: 503.285967344242
Distance between feature vector 503 and mean malignant vector: 704.6065565456391

Distance between feature vector 504 and mean malignant vector: 731.7606842769329
Distance between feature vector 505 and mean malignant vector: 707.8275926637793
Distance between feature vector 506 and mean malignant vector: 526.5299028317593
Distance between feature vector 507 and mean malignant vector: 613.5145010430045
Distance between feature vector 508 and mean malignant vector: 159.0486384506192
Distance between feature vector 509 and mean malignant vector: 247.3661812723144
Distance between feature vector 510 and mean malignant vector: 553.8281415853422
Distance between feature vector 511 and mean malignant vector: 298.4873633967937
Distance between feature vector 512 and mean malignant vector: 422.54340520081905
Distance between feature vector 513 and mean malignant vector: 320.38211648110087
Distance between feature vector 514 and mean malignant vector: 277.090733610207
Distance between feature vector 515 and mean malignant vector: 588.7595778217602
Distance between feature vector 516 and mean malignant vector: 73.83587239785989
Distance between feature vector 517 and mean malignant vector: 236.12545665801153
Distance between feature vector 518 and mean malignant vector: 486.29356851897205
Distance between feature vector 519 and mean malignant vector: 485.73662265896576
Distance between feature vector 520 and mean malignant vector: 722.7905836204707
Distance between feature vector 521 and mean malignant vector: 864.1089692480529
Distance between feature vector 522 and mean malignant vector: 591.9541126608711
Distance between feature vector 523 and mean malignant vector: 408.2739786302732
Distance between feature vector 524 and mean malignant vector: 687.242306366067
Distance between feature vector 525 and mean malignant vector: 759.6163956325736
Distance between feature vector 526 and mean malignant vector: 428.2162461392476
Distance between feature vector 527 and mean malignant vector: 511.2867875676797
Distance between feature vector 528 and mean malignant vector: 385.1010966486163
Distance between feature vector 529 and mean malignant vector: 534.5856012162959
Distance between feature vector 530 and mean malignant vector: 556.9213300192263
Distance between feature vector 531 and mean malignant vector: 563.640724190925
Distance between feature vector 532 and mean malignant vector: 403.8732829863704
Distance between feature vector 533 and mean malignant vector: 321.22146434887327
Distance between feature vector 534 and mean malignant vector: 614.442905416504
Distance between feature vector 535 and mean malignant vector: 330.40143911950526
Distance between feature vector 536 and mean malignant vector: 349.26059993174056
Distance between feature vector 537 and mean malignant vector: 573.3402466809849
Distance between feature vector 538 and mean malignant vector: 802.479356475296
Distance between feature vector 539 and mean malignant vector: 810.8196449261031
Distance between feature vector 540 and mean malignant vector: 576.9898403863778
Distance between feature vector 541 and mean malignant vector: 322.6013752112218
Distance between feature vector 542 and mean malignant vector: 310.50036624876583
Distance between feature vector 543 and mean malignant vector: 441.0990660826864
Distance between feature vector 544 and mean malignant vector: 394.4252369387906
Distance between feature vector 545 and mean malignant vector: 406.1763355945137

```
Distance between feature vector 546 and mean malignant vector: 655.4507140977108
Distance between feature vector 547 and mean malignant vector: 659.4965258161253
Distance between feature vector 548 and mean malignant vector: 694.8499603293326
Distance between feature vector 549 and mean malignant vector: 618.5661281060075
Distance between feature vector 550 and mean malignant vector: 619.685685984634
Distance between feature vector 551 and mean malignant vector: 601.6124754648717
Distance between feature vector 552 and mean malignant vector: 471.7927463549814
Distance between feature vector 553 and mean malignant vector: 716.6420489347938
Distance between feature vector 554 and mean malignant vector: 465.31880289423754
Distance between feature vector 555 and mean malignant vector: 658.9196999638029
Distance between feature vector 556 and mean malignant vector: 668.6395219669812
Distance between feature vector 557 and mean malignant vector: 709.3722079136661
Distance between feature vector 558 and mean malignant vector: 321.8509243003371
Distance between feature vector 559 and mean malignant vector: 576.3610754505775
Distance between feature vector 560 and mean malignant vector: 378.79266400158707
Distance between feature vector 561 and mean malignant vector: 594.143978908158
Distance between feature vector 562 and mean malignant vector: 261.9148746223375
Distance between feature vector 563 and mean malignant vector: 369.69061714136126
Distance between feature vector 564 and mean malignant vector: 501.3489712163999
Distance between feature vector 565 and mean malignant vector: 283.15737605146904
Distance between feature vector 566 and mean malignant vector: 120.66074819536671
Distance between feature vector 567 and mean malignant vector: 287.8097638641115
Distance between feature vector 568 and mean malignant vector: 800.287969162893
```

In []: