FCM

Question 1:

Iteration 1:

Centroid 1 (2.405172413793103 , 6.155172413793102)
Centroid 2 (4.855263157894737 , 6.894736842105264)
Distances from Centroid 1:
1 6 2.405172413793103 6.155172413793102 Distance 1.4137142534782317
2 5 2.405172413793103 6.155172413793102 Distance 1.2241682851991846
3 8 2.405172413793103 6.155172413793102 Distance 1.9383520526835913
4 4 2.405172413793103 6.155172413793102 Distance 2.6810899207041348
5 7 2.405172413793103 6.155172413793102 Distance 2.7288942545574177
6 9 2.405172413793103 6.155172413793102 Distance 4.584302495450957
Distances from Centroid 2:
1 6 4.855263157894737 6.894736842105264 Distance 3.95772763505032
2 5 4.855263157894737 6.894736842105264 Distance 3.426741221869847
3 8 4.855263157894737 6.894736842105264 Distance 2.1595388473563046
4 4 4.855263157894737 6.894736842105264 Distance 3.01843940709328
5 7 4.855263157894737 6.894736842105264 Distance 0.1789667172202026
6 9 4.855263157894737 6.894736842105264 Distance 2.3963629528228916
Membership 1
[0.7368091691548573, 0.7367894852956092, 0.526987882311674, 0.5295945039482335, 0.06154583006449497, 0.34328574697924463]
Membership2
[0.26319083084514266, 0.2632105147043909, 0.473012117688326, 0.4704054960517666, 0.938454169935505, 0.6567142530207554]

Iteration 2

Centroid 1 (2.440942571495239 , 5.8917946091991125)
Centroid 2 (4.618892076533485 , 7.113220842070102)
Distances from Centroid 1:
1 6 2.440942571495239 5.8917946091991125 Distance 1.444999619704339
2 5 2.440942571495239 5.8917946091991125 Distance 0.9948507306894998
3 8 2.440942571495239 5.8917946091991125 Distance 2.1810720249841085
4 4 2.440942571495239 5.8917946091991125 Distance 2.4514377228007858
5 7 2.440942571495239 5.8917946091991125 Distance 2.7887083229670235
6 9 2.440942571495239 5.8917946091991125 Distance 4.7252333837386935
Distances from Centroid 2:
1 6 4.618892076533485 7.113220842070102 Distance 3.7862435876229763
2 5 4.618892076533485 7.113220842070102 Distance 3.3651594369196443
3 8 4.618892076533485 7.113220842070102 Distance 1.8458572074788882
4 4 4.618892076533485 7.113220842070102 Distance 3.1741410513547756
5 7 4.618892076533485 7.113220842070102 Distance 0.3975703817036952
6 9 4.618892076533485 7.113220842070102 Distance 2.338246070682178
Membership 1
[0.7237751023159558, 0.7718237590177373, 0.45837835753321743, 0.5642336866629757, 0.12477577090820796, 0.33103318071077886]
Membership2
[0.27622489768404423, 0.22817624098226272, 0.5416216424667827, 0.4357663133370244, 0.875224229091792, 0.6689668192892211]

Iteration 3

Centroid 1 (2.455687722285259 , 5.736129064701775)
Centroid 2 (4.566895956842182 , 7.240135114342755)
Distances from Centroid 1:
1 6 2.455687722285259 5.736129064701775 Distance 1.4794102254977168

2 5 2.455687722285259 5.736129064701775 Distance 0.865758222681273
3 8 2.455687722285259 5.736129064701775 Distance 2.328387310427342
4 4 2.455687722285259 5.736129064701775 Distance 2.3235844164572006
5 7 2.455687722285259 5.736129064701775 Distance 2.840932013903463
6 9 2.455687722285259 5.736129064701775 Distance 4.818194994418965
Distances from Centroid 2:
1 6 4.566895956842182 7.240135114342755 Distance 3.7763318006715227
2 5 4.566895956842182 7.240135114342755 Distance 3.4069282621981007
3 8 4.566895956842182 7.240135114342755 Distance 1.7414240104073662
4 4 4.566895956842182 7.240135114342755 Distance 3.289353520842804
5 7 4.566895956842182 7.240135114342755 Distance 0.49522114791278565
6 9 4.566895956842182 7.240135114342755 Distance 2.269561987319287
Membership 1
[0.718515441181953, 0.7973738008287975, 0.4278881434852868, 0.5860306238171383, 0.1484407711195071, 0.3202087759451769]
Membership2
[0.28148455881804696, 0.2026261991712025, 0.5721118565147132, 0.41396937618286156, 0.8515592288804928, 0.6797912240548232]
Previous [0, 0, 1, 0, 1, 1]
Now [0, 0, 1, 0, 1, 1]
The Final Membership1 and Membership2 Values are [0.718515441181953, 0.7973738008287975, 0.4278881434852868, 0.5860306238171383, 0.1484407711195071, 0.3202087759451769]
[0.28148455881804696, 0.2026261991712025, 0.5721118565147132, 0.41396937618286156, 0.8515592288804928, 0.6797912240548232]

After 3 iteration the the points are classified in correct clusters.
Point 1 in Cluster 1
Point 2 in Cluster 1
Point 3 in Cluster 2
Point 4 in Cluster 1
Point 5 in Cluster 2
Point 6 in Cluster 2

Question 2:

	Alcohol	Malic acid	...	Proline	Class Label
0	14.23	1.71	...	1065	0
1	13.20	1.78	...	1050	0
2	13.16	2.36	...	1185	0
3	14.37	1.95	...	1480	0
4	13.24	2.59	...	735	0

The **full columns** are ['Alcohol', 'Malic acid', 'Ash', 'Alcalinity of ash', 'Magnesium', 'Total phenols', 'Flavanoids', 'Nonflavanoid phenols', 'Proanthocyanins', 'Color intensity', 'Hue', 'OD280/OD315 of diluted wines', 'Proline', 'Class Label']
The Features are ['Alcohol', 'Malic acid', 'Ash', 'Alcalinity of ash', 'Magnesium', 'Total phenols', 'Flavanoids', 'Nonflavanoid phenols', 'Proanthocyanins', 'Color intensity', 'Hue', 'OD280/OD315 of diluted wines', 'Proline']
The Class Labels are [0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 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, 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, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2]

The **dataframe** is
Alcohol Malic acid Ash ... Hue OD280/OD315 of diluted wines Proline

0	14.23	1.71	2.43	...	1.04		3.43	1065
1	13.20	1.78	2.14	...	1.05		3.40	1050
2	13.16	2.36	2.67	...	1.03		3.17	1185
3	14.37	1.95	2.50	...	0.86		3.45	1480
4	13.24	2.59	2.87	...	1.04		2.93	735
..	...	...	...	...	...	...	...	
173	13.71	5.65	2.45	...	0.64		1.74	740
174	13.40	3.91	2.48	...	0.70		1.56	750
175	13.27	4.28	2.26	...	0.59		1.56	835
176	13.17	2.59	2.37	...	0.60		1.62	840
177	14.13	4.10	2.74	...	0.61		1.60	560

Cluster Centers:

```
[[1.30142623e+01 2.43098361e+00 2.35508197e+00 1.98295082e+01
  9.99016393e+01 2.24967213e+00 1.99163934e+00 3.76721311e-01
  1.57327869e+00 5.37967213e+00 9.42459016e-01 2.54508197e+00
  7.36704918e+02]
 [1.29900000e+01 2.41142857e+00 2.39061224e+00 1.93224490e+01
  1.01714286e+02 2.30693878e+00 2.04979592e+00 3.60408163e-01
  1.63836735e+00 5.15244898e+00 9.43673469e-01 2.58142857e+00
  7.65530612e+02]
 [1.29960294e+01 2.19735294e+00 2.35941176e+00 1.93191176e+01
  9.81764706e+01 2.32735294e+00 2.04823529e+00 3.49558824e-01
  1.55985294e+00 4.70161765e+00 9.80882353e-01 2.68602941e+00
  7.42602941e+02]]
```

Partition matrix:

```
[[1.65115065e-02 8.84580753e-01 9.89077405e-02]
 [2.16536115e-02 8.39780963e-01 1.38565425e-01]
 [1.06255640e-04 9.99459399e-01 4.34345328e-04]
 [1.99058472e-02 9.29858958e-01 5.02351949e-02]
 [2.72282845e-04 5.69927587e-05 9.99670724e-01]
 [1.56235112e-02 9.43614559e-01 4.07619294e-02]
 [1.09066344e-03 9.95336941e-01 3.57239599e-03]
 [1.32201759e-03 9.94383024e-01 4.29495819e-03]
 [2.36661313e-02 8.21501061e-01 1.54832808e-01]
 [2.36433188e-02 8.21605772e-01 1.54750909e-01]
 [2.44715369e-02 9.15666761e-01 5.98617018e-02]
 [7.64320848e-04 9.96686965e-01 2.54871443e-03]
 [2.56573611e-03 9.89451568e-01 7.98269620e-03]
 [1.20856729e-03 9.93376418e-01 5.41501472e-03]
 [3.04469327e-02 8.97681203e-01 7.18718641e-02]
 [1.94885875e-03 9.91878582e-01 6.17255948e-03]
 [7.91409094e-04 9.96567649e-01 2.64094192e-03]
 [2.66079020e-03 9.84658692e-01 1.26805181e-02]
 [5.31468526e-02 8.34121612e-01 1.12731535e-01]
 [2.25662233e-02 2.57687186e-02 9.51665058e-01]
 [3.50512599e-03 1.49949694e-03 9.94995377e-01]
 [1.10829680e-03 4.01259456e-04 9.98490444e-01]
 [2.77852558e-02 7.81584552e-01 1.90630192e-01]
 [3.66235815e-02 6.85947414e-01 2.77429004e-01]
 [2.24040009e-02 2.54474755e-02 9.52148524e-01]
 [1.72728175e-02 1.57503935e-02 9.66976789e-01]
 [4.89750011e-05 9.99755890e-01 1.95134957e-04]
 [9.27201903e-04 9.96009116e-01 3.06368247e-03]
 [4.96257654e-02 1.65828634e-01 7.84545601e-01]
```

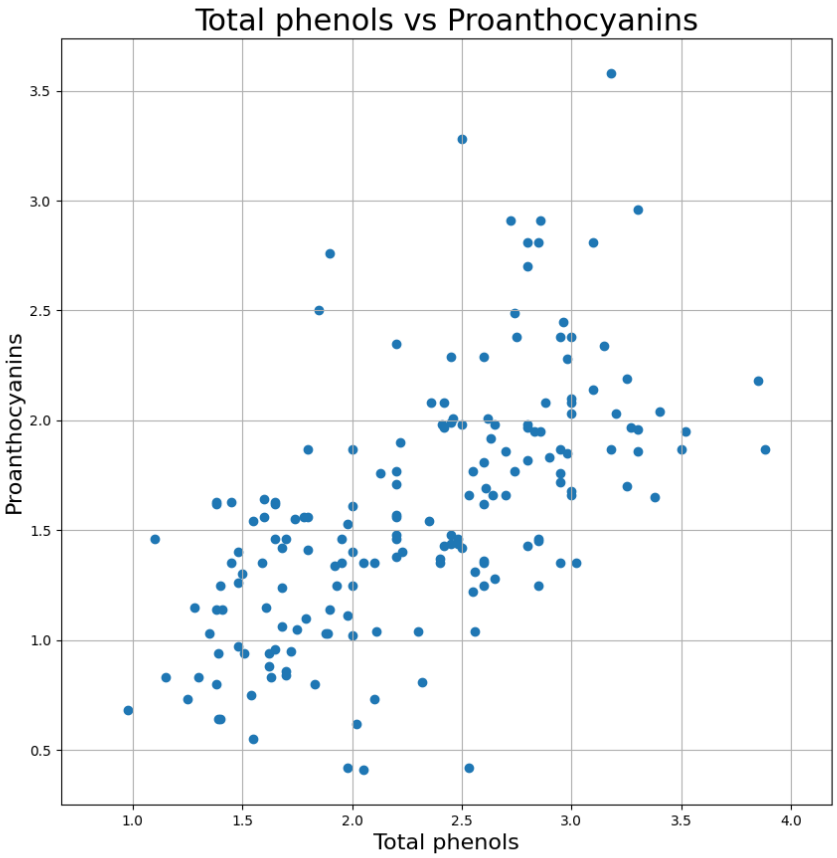
[2.78607911e-02 7.81208397e-01 1.90930811e-01]
[9.05785232e-04 9.96099614e-01 2.99460062e-03]
[2.52603916e-02 9.13252691e-01 6.14869178e-02]
[4.64682159e-02 5.46830470e-01 4.06701314e-01]
[1.30295360e-04 9.99395392e-01 4.74313068e-04]
[7.93966008e-03 9.49532860e-01 4.25274803e-02]
[5.09383064e-02 1.83967402e-01 7.65094291e-01]
[3.72715439e-02 7.23465645e-02 8.90381892e-01]
[6.02479739e-03 9.62846986e-01 3.11282168e-02]
[3.43782887e-02 7.11722563e-01 2.53899148e-01]
[1.51321251e-03 4.75746727e-04 9.98011041e-01]
[5.68306828e-03 3.04489939e-03 9.91272032e-01]
[2.80248106e-02 7.80317420e-01 1.91657770e-01]
[7.94099623e-03 9.49552185e-01 4.25068191e-02]
[2.50417742e-02 2.02166196e-03 9.72936564e-01]
[3.92663104e-02 8.22510400e-02 8.78482650e-01]
[1.15932037e-02 9.22756731e-01 6.56500653e-02]
[1.61516701e-02 8.86812647e-01 9.70356827e-02]
[4.81453531e-02 5.17467191e-01 4.34387456e-01]
[1.78700008e-02 8.72481428e-01 1.09648571e-01]
[2.85149907e-04 9.98726689e-01 9.88160641e-04]
[1.19429342e-03 9.93452977e-01 5.35272970e-03]
[3.99088099e-04 9.98232461e-01 1.36845064e-03]
[6.48427241e-05 9.99673290e-01 2.61867050e-04]
[6.78854085e-03 9.73737312e-01 1.94741474e-02]
[1.79782994e-02 8.71788815e-01 1.10232886e-01]
[3.79789955e-03 9.77523292e-01 1.86788084e-02]
[5.20961967e-02 4.30045585e-01 5.17858219e-01]
[4.80301319e-04 9.97887204e-01 1.63249448e-03]
[8.94880889e-04 9.96145586e-01 2.95953325e-03]
[9.73429512e-01 9.86483664e-04 2.55840038e-02]
[2.52570479e-02 2.03727518e-03 9.72705677e-01]
[9.99866203e-01 8.00891923e-06 1.25787812e-04]
[2.27405874e-01 6.80995239e-03 7.65784174e-01]
[9.97341691e-01 1.87037423e-04 2.47127184e-03]
[9.74343771e-01 2.37438720e-03 2.32818423e-02]
[2.84319426e-02 2.20680467e-03 9.69361253e-01]
[9.90918402e-01 3.91700094e-04 8.68989782e-03]
[9.84936877e-01 6.10851567e-04 1.44522712e-02]
[9.40486035e-05 2.49305299e-05 9.99881021e-01]
[9.77606121e-03 1.62122235e-03 9.88602716e-01]
[3.29675601e-02 5.48157127e-02 9.12216727e-01]
[9.95302521e-01 3.46908190e-04 4.35057052e-03]
[9.99746660e-01 1.33362086e-05 2.40003464e-04]
[4.91686129e-02 5.16149998e-01 4.34681389e-01]
[3.97166320e-02 8.43346016e-02 8.75948766e-01]
[9.98472715e-01 1.02994139e-04 1.42429082e-03]
[9.90257477e-01 7.79899088e-04 8.96262431e-03]
[9.91142124e-01 3.82897382e-04 8.47497898e-03]
[2.04679106e-03 5.53910971e-04 9.97399298e-01]
[9.99919745e-01 4.44963864e-06 7.58053106e-05]
[9.28332518e-01 8.48703394e-03 6.31804485e-02]
[2.84210281e-03 4.14681128e-04 9.96743216e-01]
[2.37334166e-01 7.16012370e-03 7.55505711e-01]
[9.80733096e-01 7.45493015e-04 1.85214114e-02]
[9.74387669e-01 9.45091740e-04 2.46672395e-02]

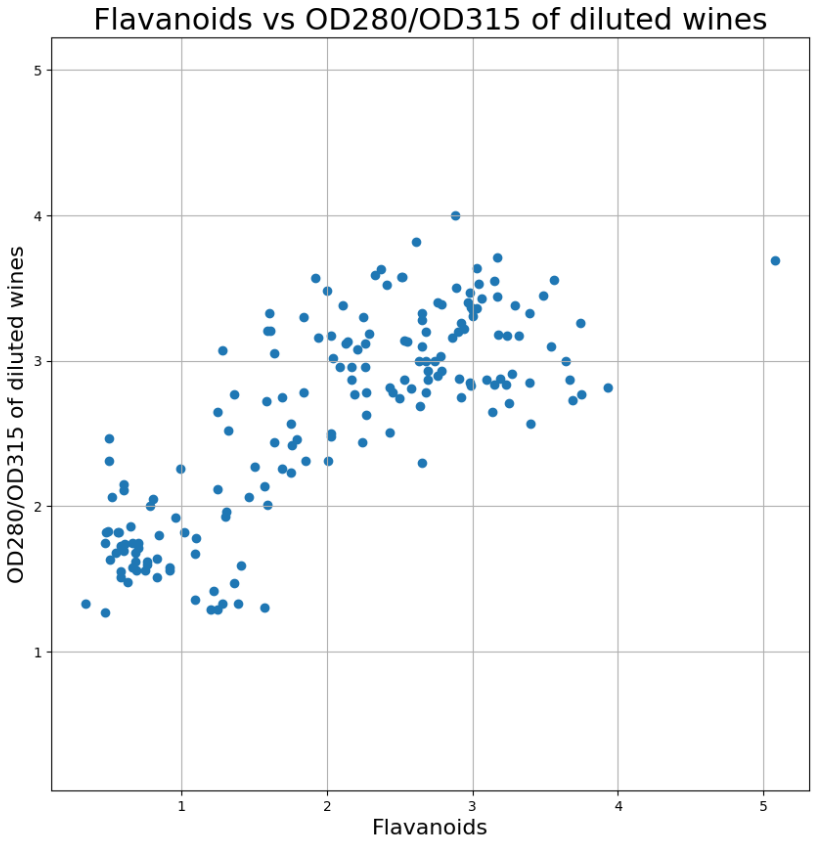
[9.99892953e-01 6.40870934e-06 1.00638113e-04]
[9.95646613e-01 1.95725911e-04 4.15766071e-03]
[8.27005582e-01 4.27536337e-03 1.68719055e-01]
[2.88172166e-02 2.31734540e-03 9.68865438e-01]
[2.82195918e-01 7.73908407e-03 7.10064998e-01]
[9.98843379e-01 5.80308534e-05 1.09859044e-03]
[9.99905298e-01 5.69123302e-06 8.90109830e-05]
[9.94996800e-01 2.26556019e-04 4.77664419e-03]
[9.36266082e-01 7.29619365e-03 5.64377241e-02]
[9.69462582e-01 2.93087113e-03 2.76065465e-02]
[5.76545609e-02 2.66033059e-01 6.76312380e-01]
[2.65194157e-01 7.73980802e-03 7.27066035e-01]
[9.98399738e-01 1.08294516e-04 1.49196738e-03]
[7.35470071e-02 4.06117633e-03 9.22391817e-01]
[9.94423077e-01 4.19233765e-04 5.15768920e-03]
[2.85380078e-03 3.89614427e-04 9.96756585e-01]
[8.27185005e-01 4.26506609e-03 1.68549928e-01]
[9.99430341e-01 3.64456690e-05 5.33213280e-04]
[9.96407261e-01 2.59079199e-04 3.33366020e-03]
[4.28998571e-02 2.97589571e-03 9.54124247e-01]
[9.52213855e-01 5.07368021e-03 4.27124646e-02]
[9.85301185e-01 5.94791758e-04 1.41040231e-02]
[9.97582360e-01 1.14644331e-04 2.30299533e-03]
[9.50348518e-01 5.32004912e-03 4.43314330e-02]
[2.60782438e-02 2.09675639e-03 9.71825000e-01]
[8.21945791e-01 4.35349184e-03 1.73700717e-01]
[9.58234637e-01 4.29609039e-03 3.74692725e-02]
[4.26225089e-01 7.62151307e-03 5.66153398e-01]
[9.99140768e-01 5.62964823e-05 8.02935032e-04]
[9.87788152e-01 1.00758748e-03 1.12042606e-02]
[9.94595446e-01 4.04813310e-04 4.99974042e-03]
[9.95495774e-01 2.03003284e-04 4.30122274e-03]
[9.68781413e-01 2.99611500e-03 2.82224723e-02]
[9.82287363e-01 1.54274326e-03 1.61698935e-02]
[8.14569887e-01 4.48216081e-03 1.80947952e-01]
[2.65309073e-01 7.12656958e-03 7.27564357e-01]
[9.98382009e-01 8.90143370e-05 1.52897626e-03]
[9.79214655e-01 1.85306245e-03 1.89322823e-02]
[9.85940210e-01 1.18360125e-03 1.28761886e-02]
[9.85764070e-01 1.19991211e-03 1.30360182e-02]
[9.85142424e-01 1.26123452e-03 1.35963413e-02]
[9.73198858e-01 2.51298979e-03 2.42881524e-02]
[9.99904336e-01 5.22198743e-06 9.04422560e-05]
[9.67906590e-01 3.11740626e-03 2.89760038e-02]
[6.93580044e-01 6.19924773e-03 3.00220708e-01]
[2.24578662e-01 7.00852805e-03 7.68412810e-01]
[9.54388690e-01 1.53797450e-03 4.40733358e-02]
[8.37697282e-01 4.06170914e-03 1.58241009e-01]
[4.94684793e-01 7.49992345e-03 4.97815284e-01]
[1.13602798e-01 5.15811521e-03 8.81239086e-01]
[1.01269258e-02 1.06566674e-03 9.88807407e-01]
[1.42224023e-03 2.29496936e-04 9.98348263e-01]
[9.80755223e-01 7.39952237e-04 1.85048246e-02]
[6.92574271e-01 6.11886080e-03 3.01306869e-01]
[5.96022633e-01 6.94904672e-03 3.97028320e-01]
[4.98757911e-01 7.46658425e-03 4.93775505e-01]

[2.86091291e-03 1.20607655e-03 9.95933011e-01]
[9.74192908e-01 9.51094625e-04 2.48559970e-02]
[8.90653325e-01 3.05499830e-03 1.06291677e-01]
[2.65831596e-02 3.52708267e-02 9.38146014e-01]
[1.62009698e-02 1.46859994e-02 9.69113031e-01]
[9.96102157e-01 2.81784405e-04 3.61605810e-03]
[2.70115101e-01 7.26287772e-03 7.22622021e-01]
[1.10330351e-01 5.00457053e-03 8.84665079e-01]
[8.82979263e-01 3.26472009e-03 1.13756017e-01]
[9.87592719e-01 5.39834609e-04 1.18674465e-02]
[9.97925262e-01 1.03329216e-04 1.97140885e-03]
[9.96736464e-01 2.23745861e-04 3.03978969e-03]
[3.36910451e-02 2.47693078e-03 9.63832024e-01]
[1.58662894e-01 5.90278468e-03 8.35434322e-01]
[6.29744226e-04 1.10516512e-04 9.99259739e-01]
[9.99099785e-01 4.49352996e-05 8.55279636e-04]
[3.74716094e-02 7.24304216e-02 8.90097969e-01]
[7.13021115e-02 3.95369713e-03 9.24744191e-01]
[3.10588357e-01 7.48043365e-03 6.81931209e-01]
[9.74298606e-01 9.51810920e-04 2.47495829e-02]
[2.49919177e-02 2.02303467e-03 9.72985048e-01]
[7.67691430e-01 5.17296255e-03 2.27135607e-01]
[3.30293662e-02 2.43758603e-03 9.64533048e-01]
[3.54853816e-01 7.61365910e-03 6.37532525e-01]
[9.74294033e-01 9.52099371e-04 2.47538673e-02]
[9.94138501e-03 1.05650657e-03 9.89002108e-01]
[2.08087039e-02 1.83287430e-03 9.77358422e-01]
[7.38960230e-05 1.95396495e-05 9.99906564e-01]
[2.23915132e-01 6.84101621e-03 7.69243852e-01]
[9.86145898e-01 5.54195865e-04 1.32999061e-02]
[9.99768458e-01 1.23507675e-05 2.19191112e-04]
[7.24262797e-02 4.00130986e-03 9.23572410e-01]
[7.05410865e-05 1.58326089e-05 9.99913626e-01]
[6.06605638e-05 1.60184899e-05 9.99923321e-01]
[1.87972911e-02 1.84704149e-02 9.62732294e-01]
[2.07656357e-02 2.20020803e-02 9.57232284e-01]
[8.37725684e-01 4.06837897e-03 1.58205937e-01]]

mean= 69.26966292134834
Std dev= 0.4529358285560963
Accuracy = 69.1

Cluster center vectors:
[[1.25153089e+01 2.45241598e+00 2.29352392e+00 2.07871399e+01
9.24393729e+01 2.07144355e+00 1.77616884e+00 3.87541101e-01
1.45139139e+00 4.11771586e+00 9.43228884e-01 2.48982035e+00
4.58912067e+02]
[1.38094553e+01 1.88251244e+00 2.44454146e+00 1.69345534e+01
1.05360680e+02 2.86612868e+00 3.02368604e+00 2.88487923e-01
1.90076327e+00 5.78858172e+00 1.07893244e+00 3.07681054e+00
1.21413585e+03]
[1.29763182e+01 2.52614838e+00 2.39416690e+00 1.97120680e+01
1.03891724e+02 2.14286775e+00 1.63149358e+00 3.87460992e-01
1.52672643e+00 5.65438483e+00 8.89566958e-01 2.40323328e+00
7.41402603e+02]]


Total phenols vs Proanthocyanins
Proanthocyanins
Total phenols
0.5
1.0
1.5
2.0
2.5
3.0
3.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0


Flavanoids vs OD280/OD315 of diluted wines
OD280/OD315 of diluted wines
Flavanoids
1
2
3
4
5
1
2
3
4
5