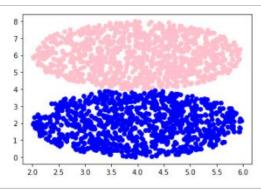
Two Circles Dataset

```
0 01
Final Cluster Means: {0: array([4.0555265 , 5.95997305]), 1: array([3.99267175, 1.97062519])}
Final Cluser Sizes [1000 1000]
Final Number of iterations: 3
Final distance between new and old means: 3.1883239666729e-05
```



Iris Dataset:

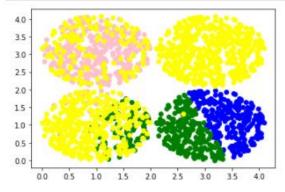
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0 1 1 1 1 2 2 1 0 2 1 0 0 1 1 0 2 0 2 2 2 1 1 2 2 0 0 1 1 1 0 0 0 2 2 1 0
                   \begin{smallmatrix} 0 & 0 & 0 & 1 & 0 & 1 & 2 & 1 & 2 & 2 & 2 & 1 & 1 & 2 & 0 & 1 & 0 & 0 & 2 & 1 & 1 & 2 & 1 & 1 & 2 & 2 & 2 & 0 & 0 & 2 & 0 & 0 & 1 \\ \end{smallmatrix}
                   \begin{smallmatrix} 0 & 1 & 0 & 1 & 0 & 2 & 1 & 2 & 1 & 1 & 0 & 2 & 1 & 0 & 0 & 1 & 0 & 1 & 2 & 0 & 2 & 2 & 0 & 0 & 0 & 0 & 1 & 2 & 1 & 2 & 2 & 1 & 1 & 1 & 0 & 1 & 2 \\ \end{smallmatrix}
                  Final Cluster Means: \{0: array([5.006, 3.418, 1.464, 0.244]), 1: array([5.9016129, 2.7483871, 4.39354839, 1.43387097]), 2: array([6.85, 3.07368421, 5.74210526, 2.07105263])\}
                  2: array([6.85
                  2: array([6.85 , 3.073684
Final Cluser Sizes [78 96 60]
                  Final Number of iterations: 5
                  Final distance between new and old means: 0.0
In [730]: H for x in classes[0]:
                       plt.scatter(x[0],x[1], color='pink')
                  for y in classes[1]:
                       plt.scatter(y[0],y[1], color='blue')
z in classes[2]:
                       plt.scatter(z[0],z[1], color='green')
                  plt.show()
                   4.0
                   3.5
                   3.0
                   2.5
                                                                     7.5
                           4.5
                                  5.0
                                         5.5
                                                6.0
                                                       6.5
                                                              7.0
```

fourCircles dataset:

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 1 2 2 1 2 2 1 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 1 2 1 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2
 1 1 2 2 2 2 2 1 1 1 2 1 1 2 1 2 2 2 2 1 2 1 1 2 1 2 1 2 1 1 1 1 2 1 2 1 2 1 1 1 1
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 2 2 2 1 2 1 1 2 2 1 2 2 2 1 2 1 2 1 2 2 1 1 2 2 2 1 1 2 2 2 1 2 1 2 1 1 1 1 2 1
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791]), 3: array([1.94046257, 2.29812915])}
Final Cluser Sizes [ 374 259 327 1040]
Final Number of iterations: 20
Final distance between new and old means: 0.24632426314129602
```

```
plt.scatter(z[0],z[1], color='green')
for m in classes[3]:
    plt.scatter(m[0],m[1], color='yellow')
plt.show()
```



T48K Dataset:

_ _ _

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[202032230222301213102013103232021302
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3 0 1 0 1 2 2 2 2 2 2 1 3 3 3 2 0 1 3 3 2 3 2 0 2 1 1 3 2 2 1 2 2 2 2 1 0
2 2 1 1 0 2 0 3 3 1 3 0 3 0 0 2 2 0 0 2 1 2 0 0 0 1 3 3 0 0 1 2 1 2 3 2 1
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2 3 2 3 0 1 2 2 2 2 1 2 3 2 3 2 3 2 0 2 3 1 1 3 1 3 2 2 0 1 2 2 0 0 2 2 2
1\; 2\; 1\; 2\; 1\; 1\; 0\; 1\; 2\; 2\; 0\; 0\; 2\; 2\; 1\; 0\; 2\; 1\; 0\; 3\; 1\; 2\; 0\; 0\; 0\; 2\; 0\; 0\; 2\; 3\; 3\; 0\; 2\; 1\; 2\; 2\; 0
2 2 2 2 2 0 1 2 0 3 2 2 0 3 3 1 0 0 0 1 1 2 3 3 0 0 2 2 3 1 2 2 2 1 2 2 2
0 3 3 2 3 3 0 0 1 2 3 0 2 2 2 2 0 0 3 2 0 2 3 0 3 1 2 3 1 3 2 1 2 2 0 2 3
2 2 2 2 0 2 2 2 1 0 1 0 1 1 1 1 3 2 2 3 1 0 0 1 0 0 0 2 3 3 1 2 1 3 2 1 1 2
1 3 2 1 3 2 3 2 2 2 3 1 0 3 3 3 1 0 2 3 1 3 0 2 0 1 3 1 0 1 1 2 0 2 2 2 1
0 1 0 2 3 2 1 3 0 0 3 2 1 2 1 3 1 1 1 0 1 2 2 3 3 2 2 3 3 0 0 2 0 1 2 1 2
0 3 2 2 2 3 3 1 1 1 3 2 0 2 0 1 3 0 2 0 0 2 1 3 3 2 3 0 0 1 0 1 1 2 1 3 2
\begin{smallmatrix} 3 & 2 & 1 & 2 & 0 & 0 & 3 & 3 & 1 & 2 & 2 & 1 & 3 & 2 & 1 & 1 & 2 & 2 & 3 & 1 & 2 & 2 & 1 & 2 & 2 & 0 & 2 & 1 & 2 & 2 & 0 & 0 & 3 & 2 & 2 & 0 & 1 \\ \end{smallmatrix}
1 1 2 1 0 0 2 0 2 0 0 2 2 1 0 2 2 0 0 2 2 0 1 3 1 3 1 1 2 2 3 2 2 2 2 0 2
```

1 2 1 2 1 1 2 2 3	1 2 0 2 2 2 1 0 2 2 0 1 2 2 1 2 0 1 2 1 1 1 2 3 2 1 2 0
	3 3 3 2 3 1 0 2 2 0 0 2 1 2 1 0 1 3 1 2 2 2 1 1 3 2 1 2
231002310	2 2 0 0 3 0 2 2 3 3 1 0 0 2 2 1 1 0 0 2 1 0 1 2 1 0 1 2
3 2 0 3 2 1 2 1	3 0 1 1 2 3 3 3 2 2 2 1 2 3 1 1 2 3 3 3 0 2 0 2 2 2 0 2
130003032	2 0 2 3 3 1 3 0 1 0 2 3 1 3 0 0 2 3 1 3 3 1 0 3 3 2 0 2
	1 2 0 2 2 0 3 0 1 2 1 0 0 0 2 1 3 3 2 1 1 3 2 2 2 2 1 2
	2 1 3 1 2 0 0 2 1 0 3 1 0 1 3 2 1 2 2 3 3 3 2 0 0 1 0 0
	2 1 2 3 1 0 3 0 3 2 2 3 0 2 0 3 1 2 1 2 2 2 3 3 2 2 3 1
3 2 3 0 2 0 1 0 2	2 2 1 2 2 1 1 2 3 0 3 3 0 2 3 1 1 1 1 2 0 2 2 2 0 1 1 2 2
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1 2 0 1 2 3 2 2 1	. 2 1 1 3 1 3 2 0 3 0 1 0 3 1 3 1 1 2 2 0 2 2 2 3 2 3 3 0
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2 2 2 0 2 1 1 2 0	0 3 3 2 0 0 2 0 0 1 2 2 3 1 0 2 1 0 2 3 1 2 2 3 3 3 1 2
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1 2 0 0 2 1 2 1 2	2 0 2 2 3 3 0 2 1 2 2 1 1 1 2 0 2 2 0 1 2 0 0 2 3 3 0 3
312101312	2 0 3 2 2 2 1 2 2 2 1 1 2 1 1 2 3 2 2 3 2 1 2 1
210032322	0 2 1 1 1 2 1 2 2 1 3 0 1 0 1 1 3 1 2 0 2 2 2 0 0 3 1 2
2 2 2 0 2 2 2 2 0	2 2 2 2 0 1 3 3 0 1 1 2 3 2 1 3 2 1 2 0 1 3 2 1 0 2 0 3
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313203123	0 2 3 2 2 1 0 1 3 1 3 0 0 0 2 2 3 2 3 1 2 1 2 2 0 2 0 3
210032322	0211121221301011312022200312
2 2 2 0 2 2 2 2 6	2 2 2 2 0 1 3 3 0 1 1 2 3 2 1 3 2 1 2 0 1 3 2 1 0 2 0 3
2 2 2 0 2 2 2 2 6 2 1 2 2 2 1 3 2 2	2 2 2 2 0 1 3 3 0 1 1 2 3 2 1 3 2 1 2 0 1 3 2 1 0 2 0 3 3 2 2 1 1 1 0 3 2 2 3 2 2 2 2 1 0 1 0 3 2 0 2 1 1 0 1 2
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2 2 2 0 2 2 2 2 0 2 1 2 2 2 1 3 2 2 3 1 3 2 0 3 1 2 3 1 1 2 1 3 2 3 2 0	2 2 2 2 0 1 3 3 0 1 1 2 3 2 1 3 2 1 2 0 1 3 2 1 0 2 0 3 3 2 2 1 1 1 0 3 2 2 3 2 2 2 2 1 0 1 0 3 2 0 2 1 1 0 1 2 0 2 3 2 2 1 0 1 3 1 3 0 0 0 0 2 2 3 2 3 1 2 1 2 2 0 2 0 3 0 2 3 2 2 2 1 0 1 3 1 2 0 2 0 2 2 3 2 3 1 2 1 2 2 2 2 2 2 3 2
2 2 2 0 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	2 2 2 2 0 1 3 3 0 1 1 2 3 2 1 3 2 1 2 0 1 3 2 1 0 2 0 3 3 2 2 1 1 1 0 3 2 2 3 2 2 2 2 1 0 1 0 3 2 0 2 1 1 0 1 2 0 2 3 2 2 1 0 1 3 1 3 0 0 0 2 2 3 2 3 1 2 1 2 2 0 2 0 3 0 2 2 3 2 2 2 1 0 2 2 3 2 2 2 1 3 2 3 1 2 0 2 1 2 2 3 2 2 1 1 2 1 3 3 2 1 2 1 1 2 2 2 2 0 1 2 1 3 1 2 1 3 1 2 2
2 2 2 0 2 2 2 2 2 6 2 1 2 2 2 1 3 2 2 3 1 3 2 0 3 1 2 3 1 1 2 1 3 2 3 2 6 2 1 0 2 0 1 0 3 3 2 2 3 2 0 2 1 2 1	2 2 2 2 0 1 3 3 0 1 1 2 3 2 1 3 2 1 2 0 1 3 2 1 0 2 0 3 3 2 2 1 1 1 0 3 2 2 3 2 2 2 2 1 0 1 0 3 2 0 2 1 1 0 1 2 0 2 3 2 2 1 0 1 3 1 3 0 0 0 2 2 3 2 3 1 2 1 2 2 0 2 0 3 0 2 2 3 2 2 2 1 0 2 2 3 2 2 2 2 1 3 2 3 1 2 0 2 1 2 2 3 2 2 1 1 2 1 3 3 2 1 2 1 1 2 2 2 2 0 1 2 1 3 1 2 1 3 1 2 2 2 0 1 2 0 1 2 1 3 0 0 0 2 1 2 0 1 3 2 2 1 1 2 0 2 2 2 1
2 2 2 0 2 2 2 2 2 6 2 1 2 2 2 1 3 2 2 3 1 3 2 0 3 1 2 3 1 1 2 1 3 2 3 2 6 2 1 0 2 0 1 0 3 3 2 2 3 2 0 2 1 2 1	2 2 2 2 0 1 3 3 0 1 1 2 3 2 1 3 2 1 2 0 1 3 2 1 0 2 0 3 3 2 2 1 1 1 0 3 2 2 3 2 2 2 2 1 0 1 0 3 2 0 2 1 1 0 1 2 0 2 3 2 2 1 0 1 3 1 3 0 0 0 2 2 3 2 3 1 2 1 2 2 0 2 0 3 0 2 2 3 2 2 2 1 0 2 2 3 2 2 2 1 3 2 3 1 2 0 2 1 2 2 3 2 2 1 1 2 1 3 3 2 1 2 1 1 2 2 2 2 0 1 2 1 3 1 2 1 3 1 2 2
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        11001302]
                1 1 0 0 1 3 0 2]
               1 1 0 0 1 3 0 2]
Final Cluster Means: {0: array([348.42970321, 240.20278214]), 1: array([530.11869335, 145.17573738]), 2: array([144.6002 0078, 151.10377496]), 3: array([343.16832606, 99.47555746])}
Final Cluser Sizes [1601 1930 2885 1584]
Final Number of iterations: 20
Final Mumber of iterations: 20
Final distance between new and old means: 0.030752574656318386
In [782]: M for x in classes[0]:
               plt.scatter(y[0],y[1], color='pink')
for y in classes[1]:
   plt.scatter(y[0],y[1], color='blue')
               for z in classes[2]:
               plt.scatter(z[0],z[1], color='green')
for m in classes[3]:
   plt.scatter(m[0],m[1], color='yellow')
               plt.show()
                300
                250
                200
                150
                100
```

Two Ellipses Dataset:

200 300

```
Final Cluster Assignments: [1011110000000011101100100001010001
01010010010000001100000111011101100101
010110110110001100000111101010011011101
100101000001110110010001111100000010
10001100100011000000001000110011110100
010101110101101100100111011111110000
01101001000011111110011100110000000110
1010100010110001010001010011100000110
10100001000000000111101000101111100001
001100000100100101010000101010000000111
01100000101111000111000101010100100001
11010111111001000111011110101110000100
111000011011011011010000110101010000
110101100101110111011110101001101011010
01010010010000000000010010111001100100
100010100000011100110010101100001000
00101100100010101010110110110101011101
0010000001000111010111110101000010001
0011000101010101010000111110000011100111000
1001010101001001010011110101110111010100
1000110001000001101011001100000001110
11010100101111001011110101001001111111
011110000010101111110001010001111000
110100100111111111000001111000011010101
010100101111011111111110101010101110000
10110110000111110101001011100001001001101
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0111100000101011111110001010001111000
110100100110111111100000111100011010101
10110110000111110101001011100001001101
111011110101000100110001010111011100101
000101110111100101110100000100001111
1\;1\;1\;1\;1\;1\;1\;1\;0\;1\;0\;1\;1\;0\;1\;0\;0\;1\;0\;0\;1\;1\;0\;0\;1\;1\;0\;1\;0\;1\;0\;0\;0
1010101111001101111000111001100110000
10111111101110001001001010111110011111
000101110010111000001000010111011011
1010000001100100001100000101111111001
11110010101110011011100000000101111101
1 1 1 1 0 1 0 0 1 1 1 1 1 0 0 1 0 1 1 1 0 0 0 0 0 0 0 0 1 0 0 1 1 1 1 0 1 0 0 0
001111111101110111111001110011001001
011011110001000001000011010101010000100
10111110101011110011100010001010100000
1000111000101000000010100001110010000
11101100010011111000011110001000011110
110111110110101011001000010110110100110
110110101111011100001111101111110011000
010010000011100001011010100010111011
0000011100110011001100100110101010001110010
0 1]
Final Cluster Means: {0: array([2.72539423, 4.55012085]), 1: array([5.25784102, 4.63778627])}
Final Cluser Sizes [1016 984]
Final Number of iterations: 8
Final distance between new and old means: 0.0003777915134484859
```

plt.show()

