# Introduction to Artificial Intelligence

## HW3 - Clustering

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# سوال اول

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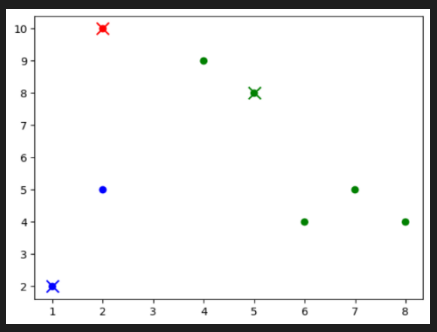
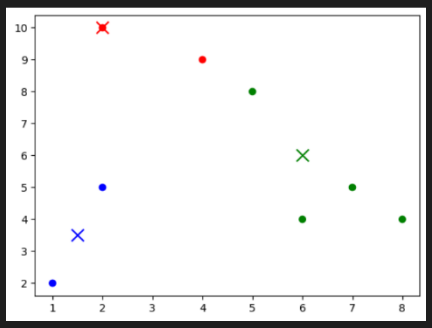
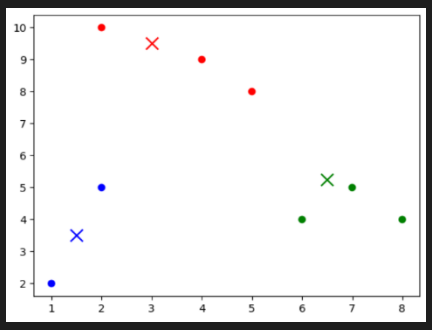
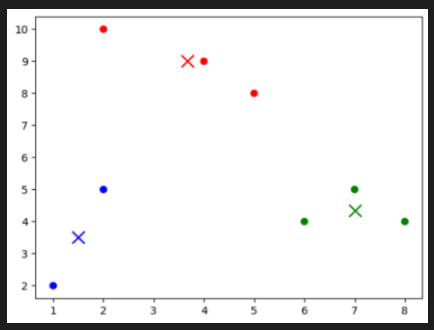
centroids: {'a': array([ 2, 10]), 'b': array([5, 8]), 'c': array([1, 2])}
////////////////////////////////////////////////////////////////////////////////////////////////////
epoch = 1
distance of point1 from centroids: {'a': 0.0, 'b': 3.61, 'c': 8.06}
distance of point2 from centroids: {'a': 5.0, 'b': 4.24, 'c': 3.16}
distance of point3 from centroids: {'a': 8.49, 'b': 5.0, 'c': 7.28}
distance of point4 from centroids: {'a': 3.61, 'b': 0.0, 'c': 7.21}
distance of point5 from centroids: {'a': 7.07, 'b': 3.61, 'c': 6.71}
distance of point6 from centroids: {'a': 7.21, 'b': 4.12, 'c': 5.39}
distance of point7 from centroids: {'a': 8.06, 'b': 7.21, 'c': 0.0}
distance of point8 from centroids: {'a': 2.24, 'b': 1.41, 'c': 7.62}
----------------------------------------------------------------------------------------------------
clusters: {'a': [1], 'b': [3, 4, 5, 6, 8], 'c': [2, 7]}
new centroids: {'a': array([ 2., 10.]), 'b': array([6., 6.]), 'c': array([1.5, 3.5])}
////////////////////////////////////////////////////////////////////////////////////////////////////
epoch = 2
distance of point1 from centroids: {'a': 0.0, 'b': 5.66, 'c': 6.52}
distance of point2 from centroids: {'a': 5.0, 'b': 4.12, 'c': 1.58}
distance of point3 from centroids: {'a': 8.49, 'b': 2.83, 'c': 6.52}
distance of point4 from centroids: {'a': 3.61, 'b': 2.24, 'c': 5.7}
distance of point5 from centroids: {'a': 7.07, 'b': 1.41, 'c': 5.7}
distance of point6 from centroids: {'a': 7.21, 'b': 2.0, 'c': 4.53}
distance of point7 from centroids: {'a': 8.06, 'b': 6.4, 'c': 1.58}
distance of point8 from centroids: {'a': 2.24, 'b': 3.61, 'c': 6.04}
----------------------------------------------------------------------------------------------------
clusters: {'a': [1, 8], 'b': [3, 4, 5, 6], 'c': [2, 7]}
new centroids: {'a': array([3. , 9.5]), 'b': array([6.5 , 5.25]), 'c': array([1.5, 3.5])}
////////////////////////////////////////////////////////////////////////////////////////////////////
epoch = 3
distance of point1 from centroids: {'a': 1.12, 'b': 6.54, 'c': 6.52}
distance of point2 from centroids: {'a': 4.61, 'b': 4.51, 'c': 1.58}
distance of point3 from centroids: {'a': 7.43, 'b': 1.95, 'c': 6.52}
distance of point4 from centroids: {'a': 2.5, 'b': 3.13, 'c': 5.7}
distance of point5 from centroids: {'a': 6.02, 'b': 0.56, 'c': 5.7}
distance of point6 from centroids: {'a': 6.26, 'b': 1.35, 'c': 4.53}
distance of point7 from centroids: {'a': 7.76, 'b': 6.39, 'c': 1.58}
distance of point8 from centroids: {'a': 1.12, 'b': 4.51, 'c': 6.04}
----------------------------------------------------------------------------------------------------
clusters: {'a': [1, 4, 8], 'b': [3, 5, 6], 'c': [2, 7]}
new centroids: {'a': array([3.67, 9.  ]), 'b': array([7.  , 4.33]), 'c': array([1.5, 3.5])}
////////////////////////////////////////////////////////////////////////////////////////////////////
epoch = 4
distance of point1 from centroids: {'a': 1.95, 'b': 7.56, 'c': 6.52}
distance of point2 from centroids: {'a': 4.33, 'b': 5.04, 'c': 1.58}
distance of point3 from centroids: {'a': 6.61, 'b': 1.05, 'c': 6.52}
distance of point4 from centroids: {'a': 1.66, 'b': 4.18, 'c': 5.7}
distance of point5 from centroids: {'a': 5.2, 'b': 0.67, 'c': 5.7}
distance of point6 from centroids: {'a': 5.52, 'b': 1.05, 'c': 4.53}
distance of point7 from centroids: {'a': 7.49, 'b': 6.44, 'c': 1.58}
distance of point8 from centroids: {'a': 0.33, 'b': 5.55, 'c': 6.04}
----------------------------------------------------------------------------------------------------
clusters: {'a': [1, 4, 8], 'b': [3, 5, 6], 'c': [2, 7]}
new centroids: {'a': array([3.67, 9.  ]), 'b': array([7.  , 4.33]), 'c': array([1.5, 3.5])}
```



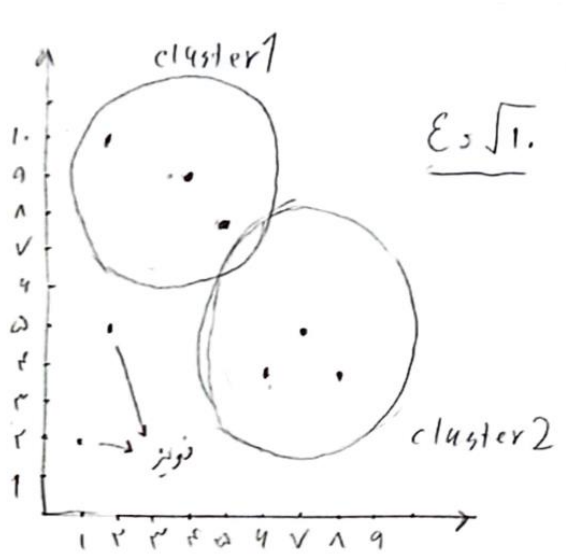


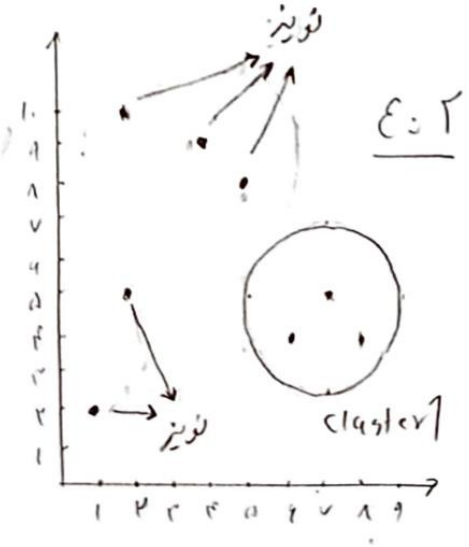




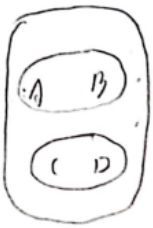
سه تا iteration کافی است تا الگوریتم همگرا شود

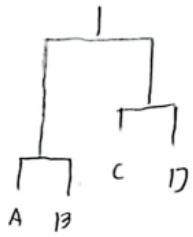
## سوال دوم




## سوال سوم




- فاصله A, B برابر ۱ است پس با هم گروه می شوند
- فاصله C, D برابر ۱ است پس با هم گروه می شوند
- فاصله B, C برابر ۳ است پس گروه A,B با گروه C,D با یکدیگر گروه می شوند