

Machine Learning Programming #3

Kirtan Patel

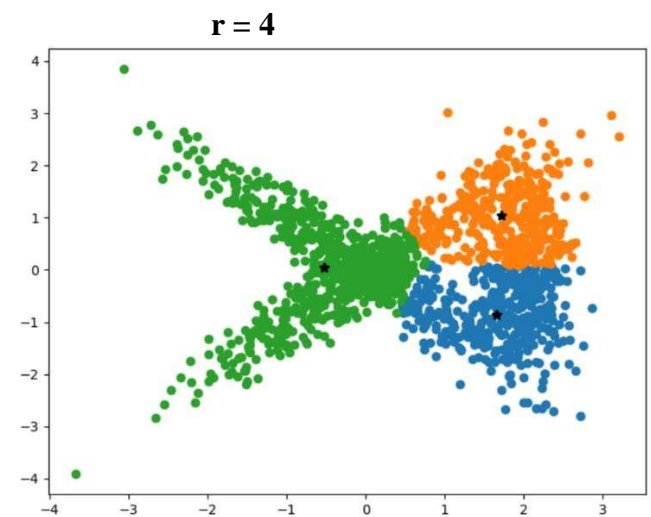
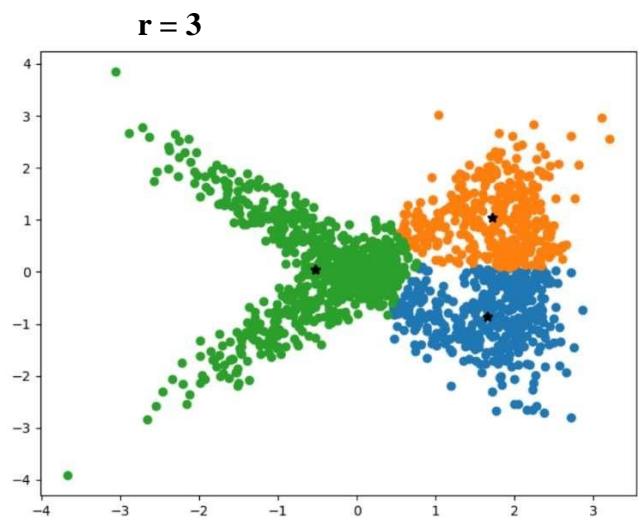
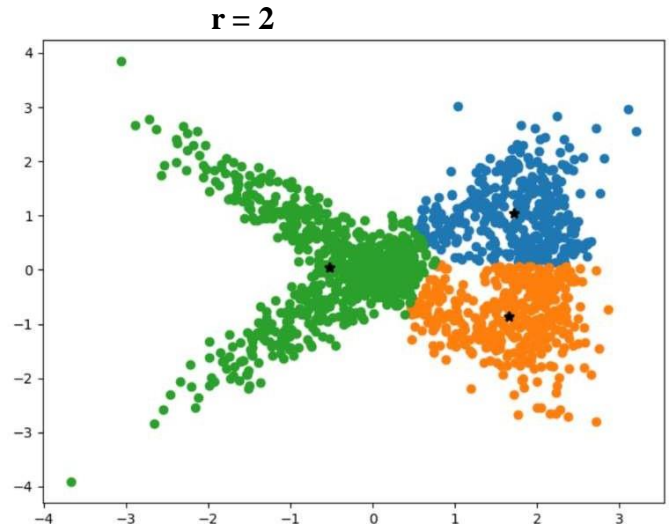
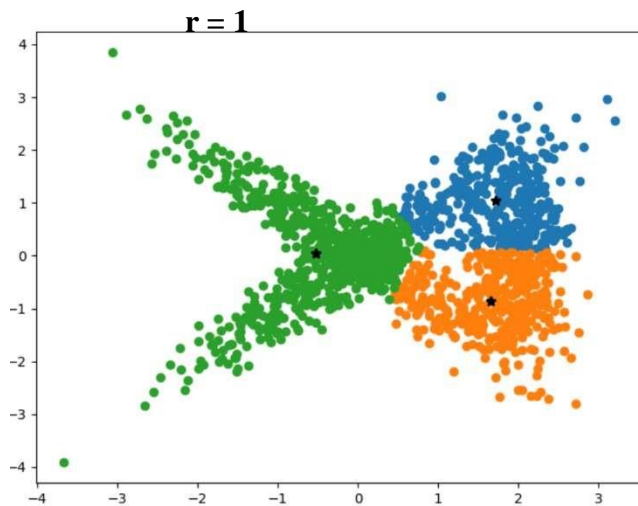
PSU ID: 973582669

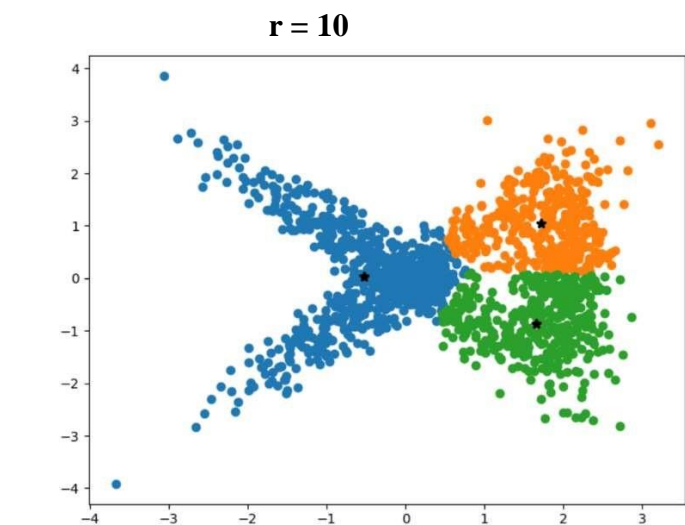
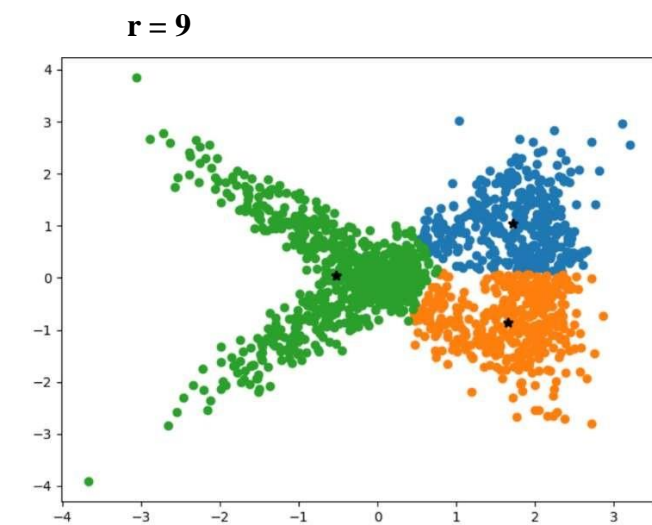
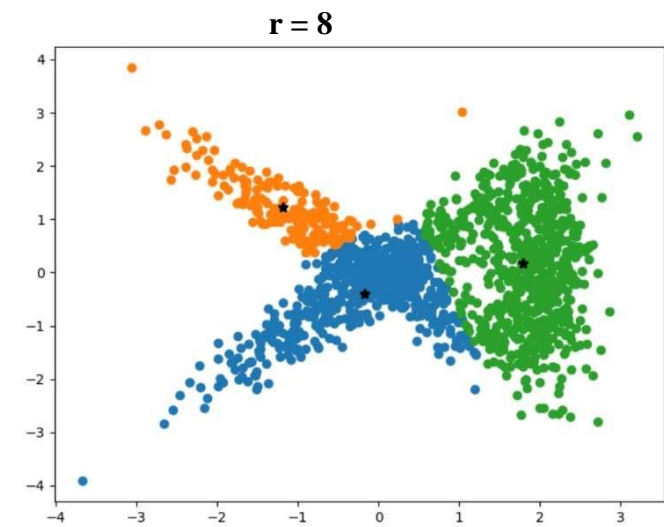
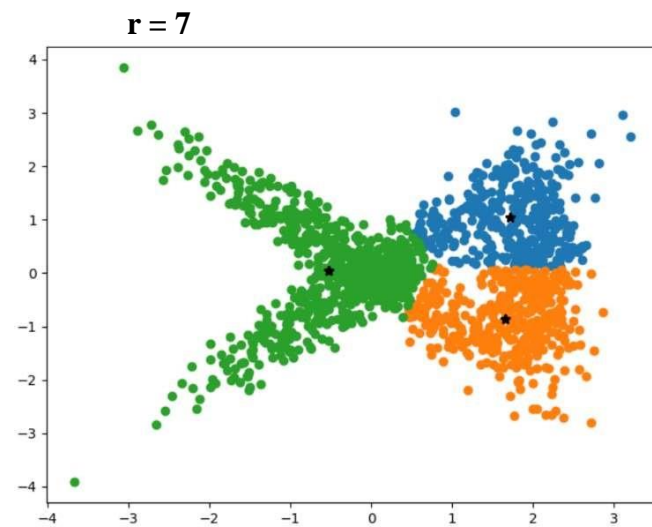
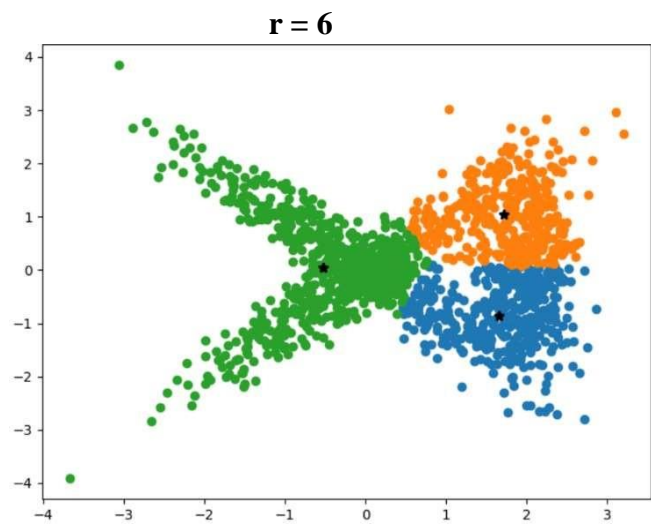
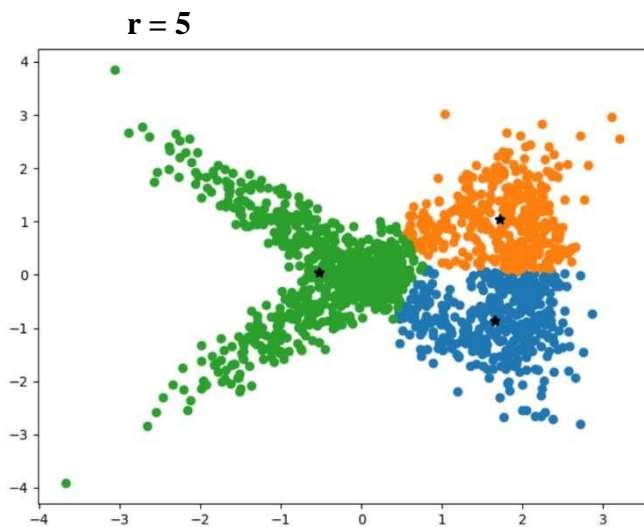
Algorithm #2 Fuzzy C Means

This is the algorithm of Fuzzy C Means. Centroid Update formula and membership values update formulas are used as explained in lecture. The fuzzifier (m) value is 1:1. Just like K Means this algorithm is ran for ' r ' number of times (here $r=10$) for each ' c ' value. Centroids are initiated and membership grades of each data point with respect to ' c ' clusters. The data points are placed in the clusters based on membership grades and then centroids are updated, and weights are recalculated. We repeat this this until centroids

Observations:

1. Number of clusters $c = 3$





Errors in C=3

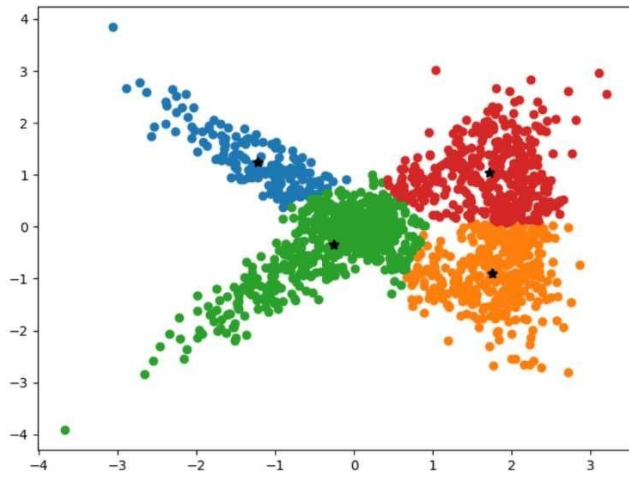
errors = [1536.7930378165074, 1761.954945566016, 1536.7930376966212, 1536.7930381566835, 1536.7930377399628, 1761.9549452097563, 1536.7930378759484, 1536.7930378605581, 1761.9549451802668, 1536.7930381834724]

min error when r = 3

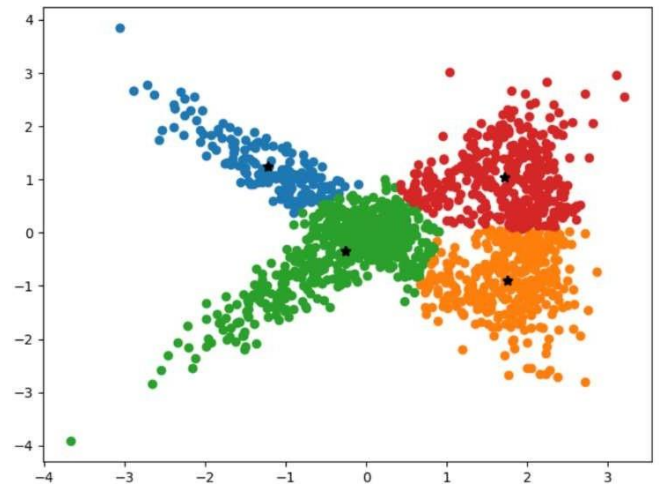
error = 1536.7930376966212

2) Number of clusters $c = 4$

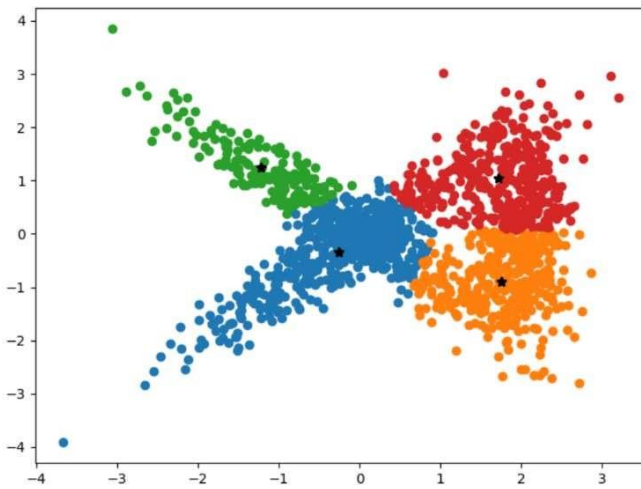
$r = 1$



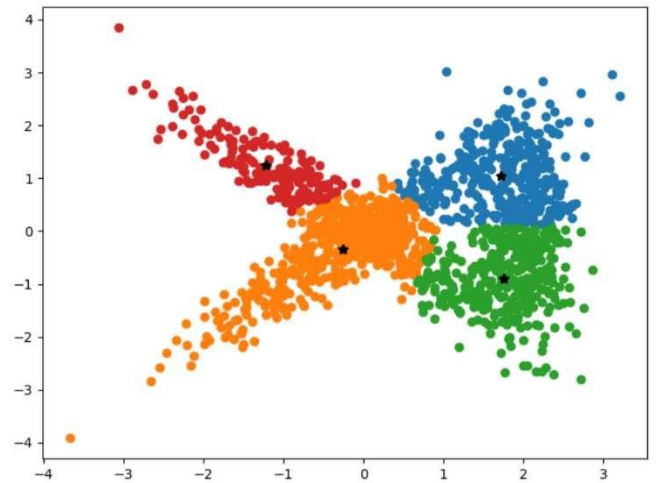
$r = 2$



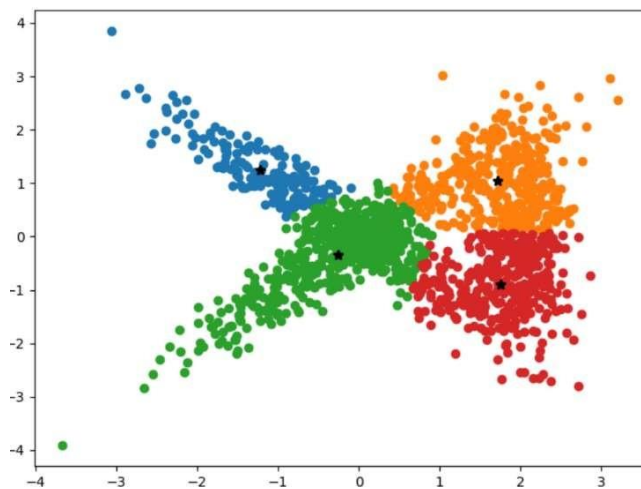
$r = 3$



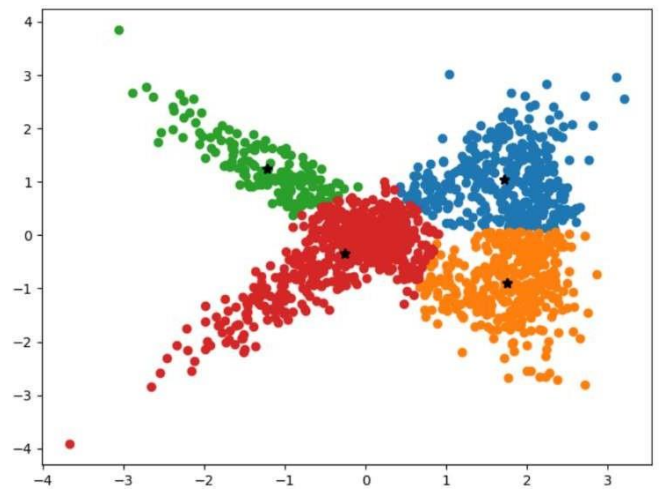
$r = 4$



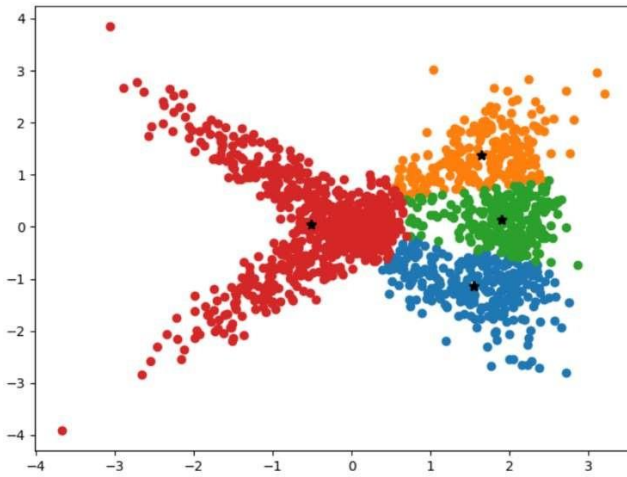
$r = 5$



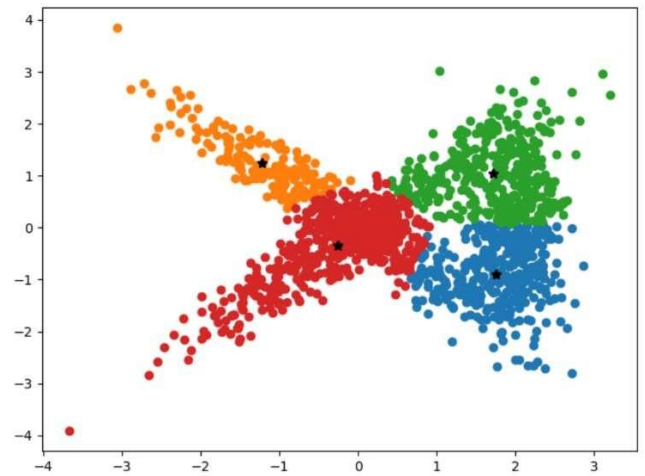
$r = 6$



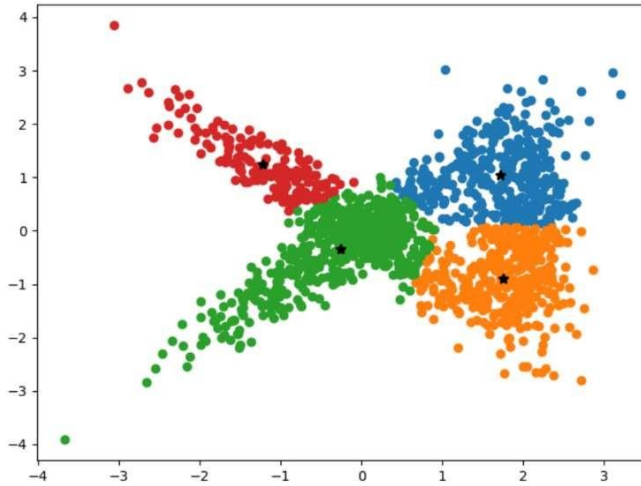
r = 7



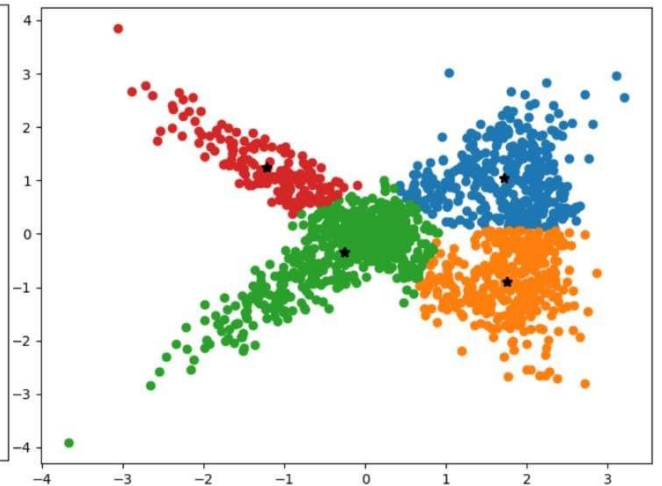
r=8



r = 9



r =10



Errors in C=4

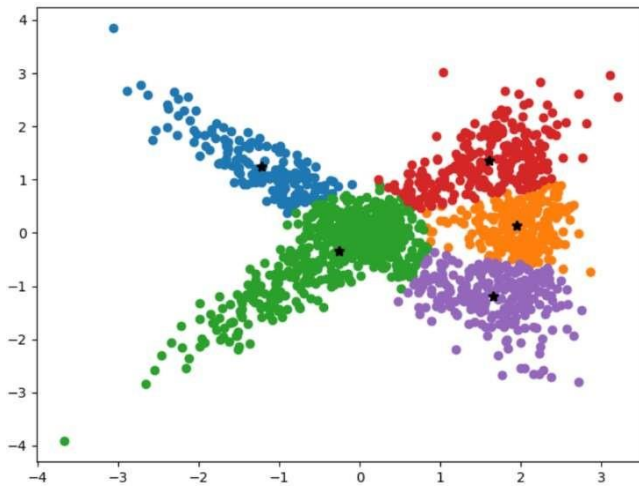
```
errors = [1100.4321186307259, 1420.261029066004, 1100.4321185081299, 1100.4321187610237, 1100.432118445531, 1100.43211870758  
34, 1100.4321184606108, 1100.432118594667, 1392.1300154707108, 1100.4321186121697]
```

```
min error when r = 5
```

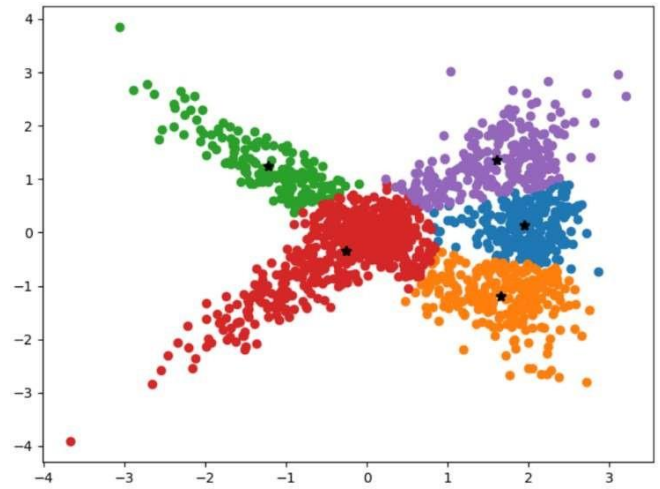
```
error = 1100.432118445531
```

3) Number of Clusters $c = 5$

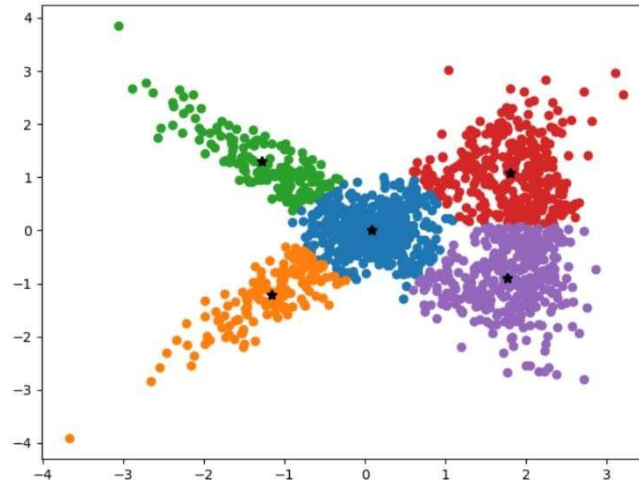
$r = 1$



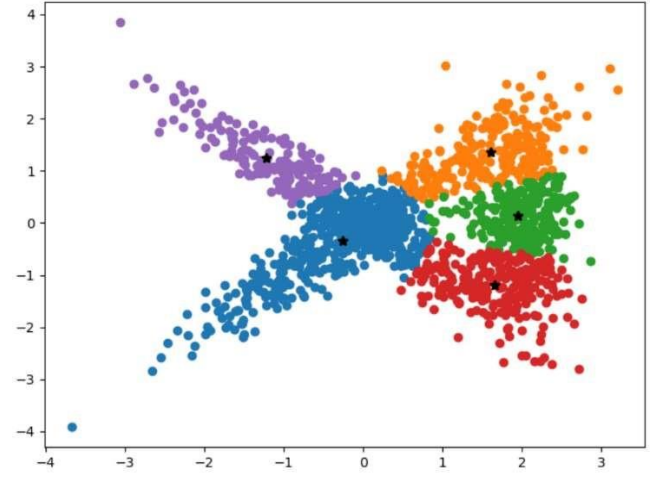
$r = 2$



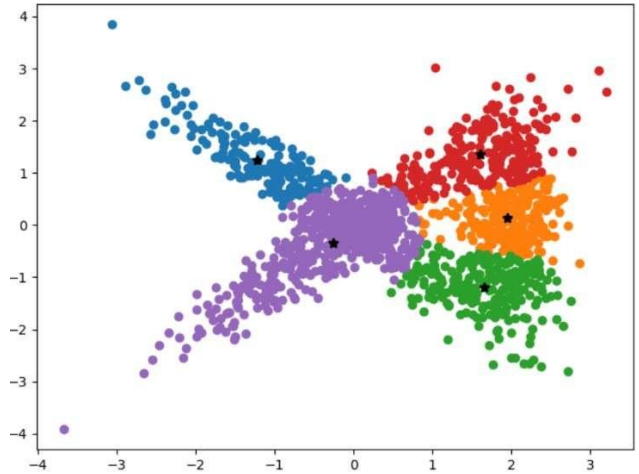
$r = 3$



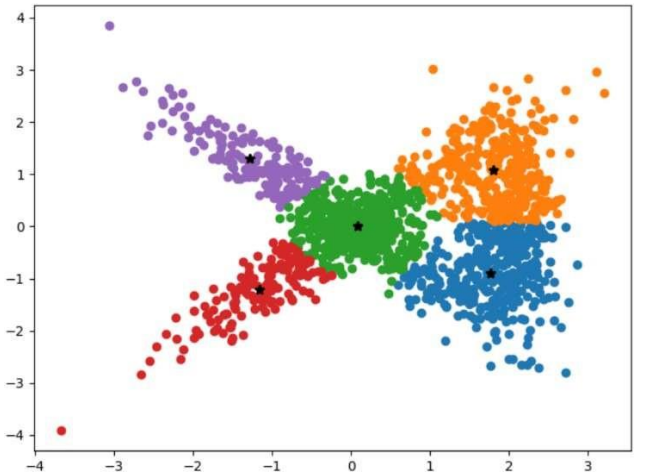
$r = 4$

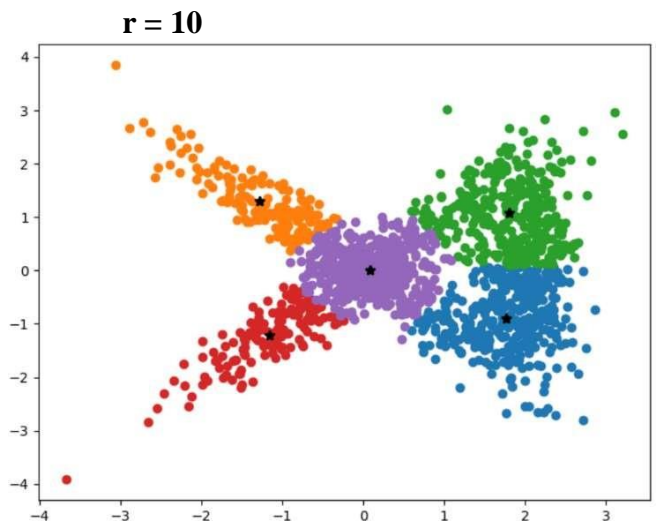
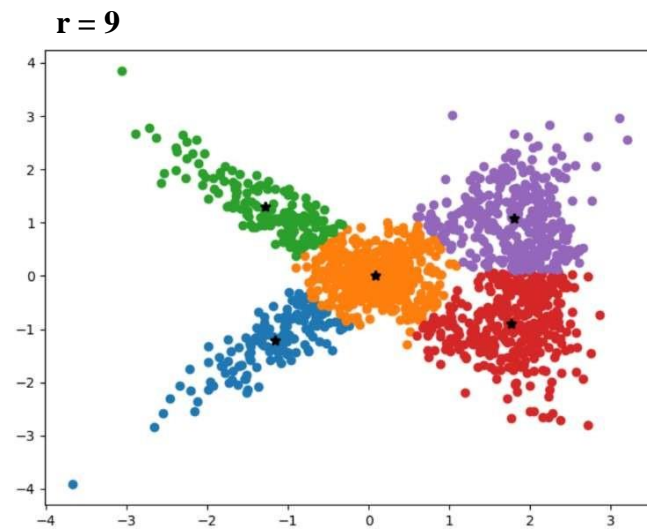
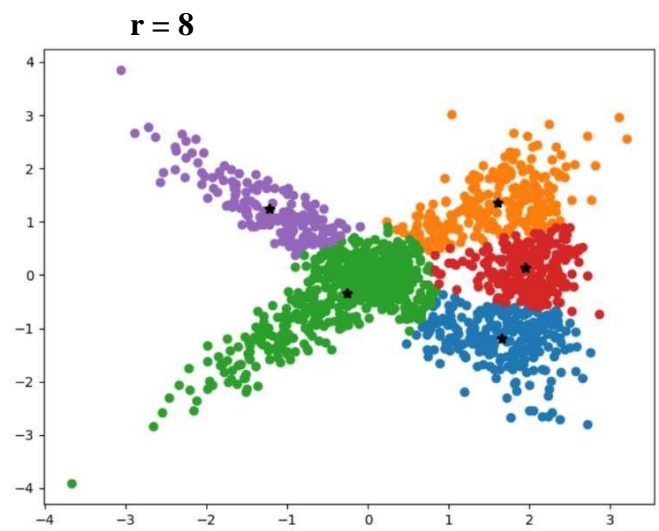
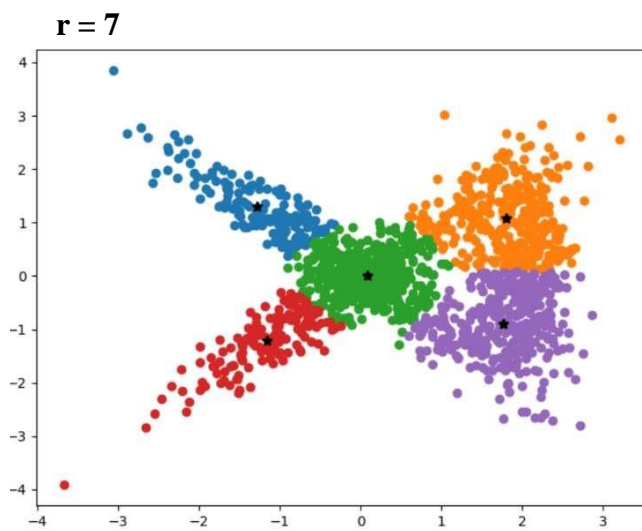


$r = 5$



$r = 6$





Errors in c=5

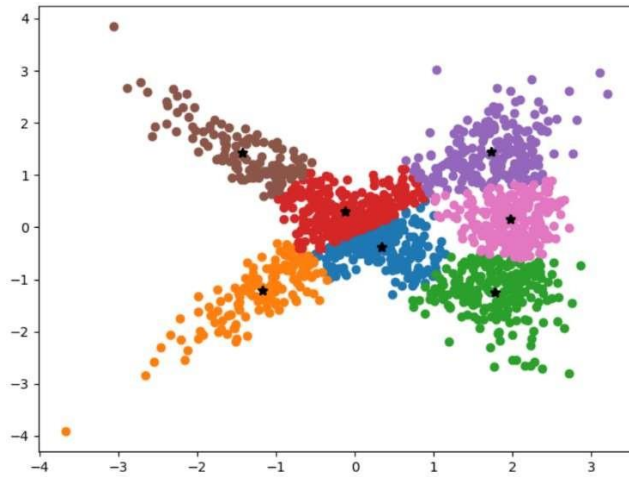
```
errors = [770.8956870683069, 956.1808537841066, 770.8956870089579, 770.8956871529006, 770.8956871407554, 770.8956868957421,
770.8956871835402, 770.8956871326384, 770.8956869924932, 770.8956870966763]
```

```
min error when r = 6
```

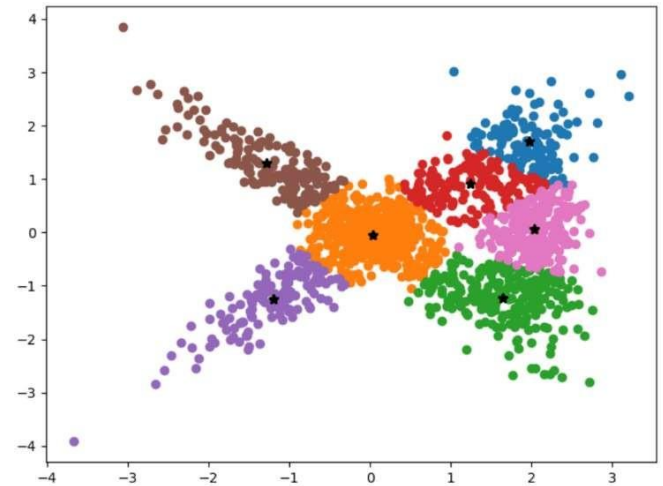
```
error = 770.8956868957421
```

4) Number of Clusters $c = 7$

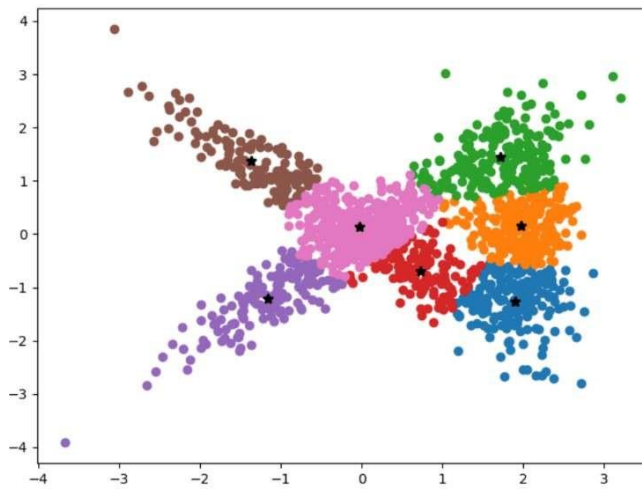
$r = 1$



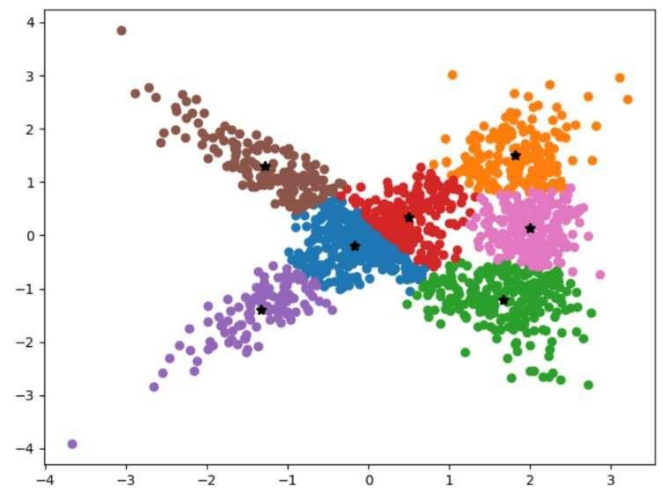
$r = 2$



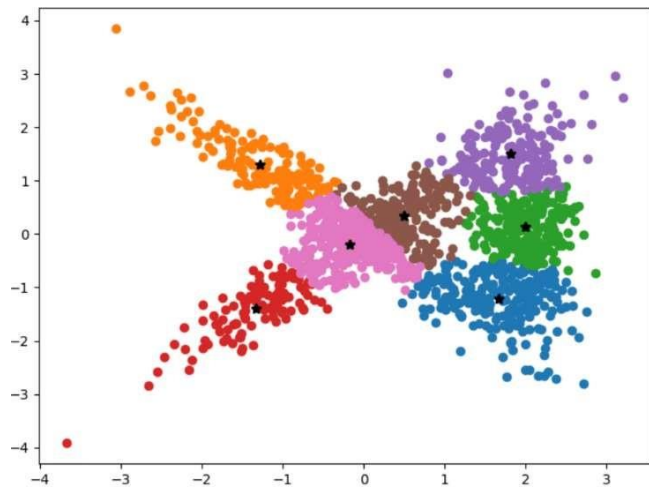
$r=3$



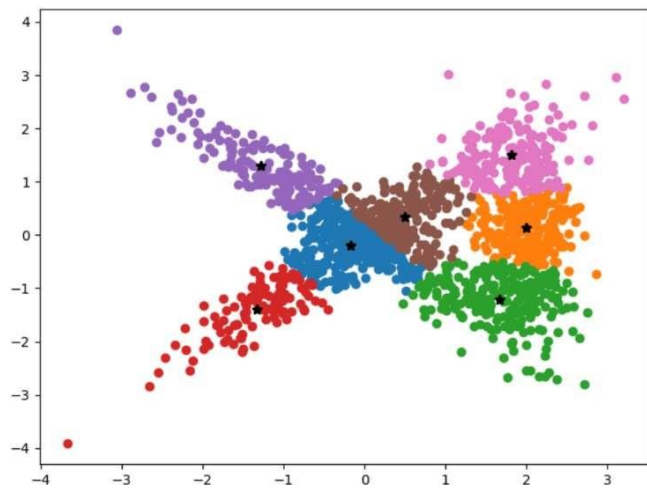
$r=4$



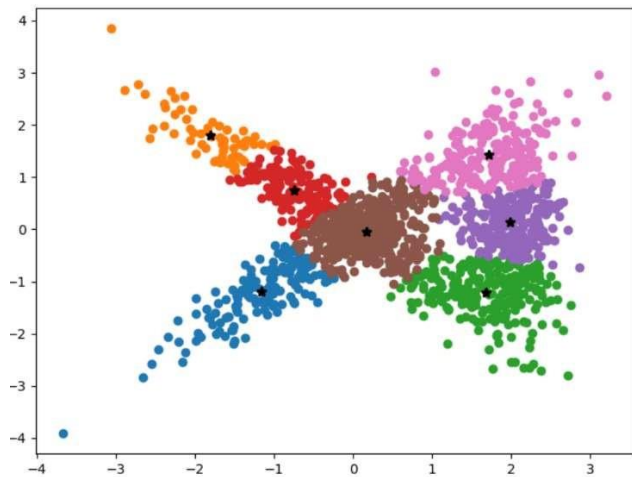
$r = 5$



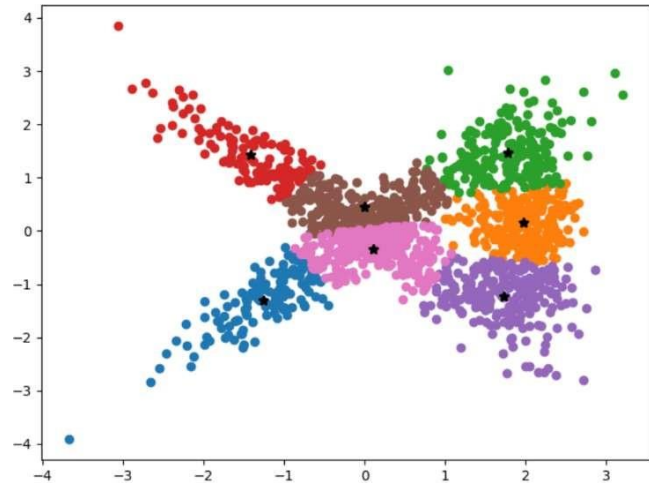
$r = 6$



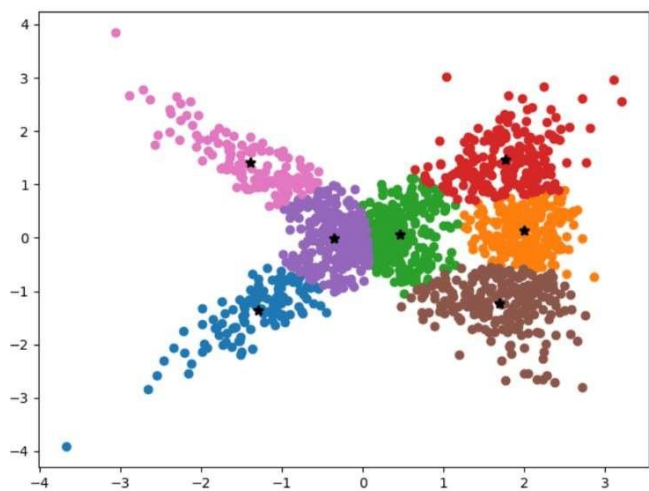
$r = 7$



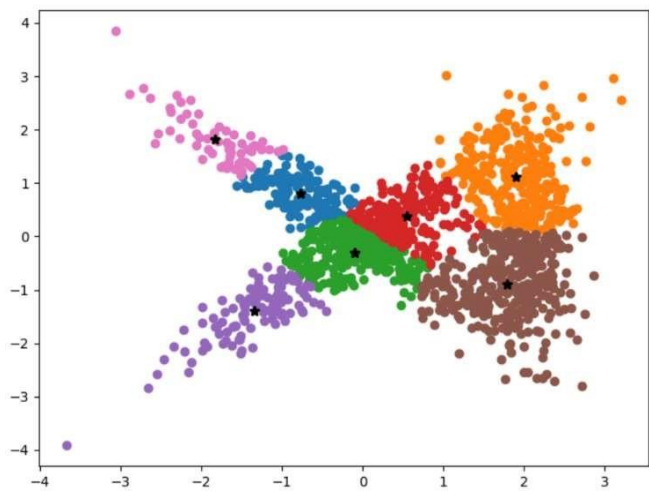
$r = 8$



$r = 9$



$r = 10$



Errors in C=7

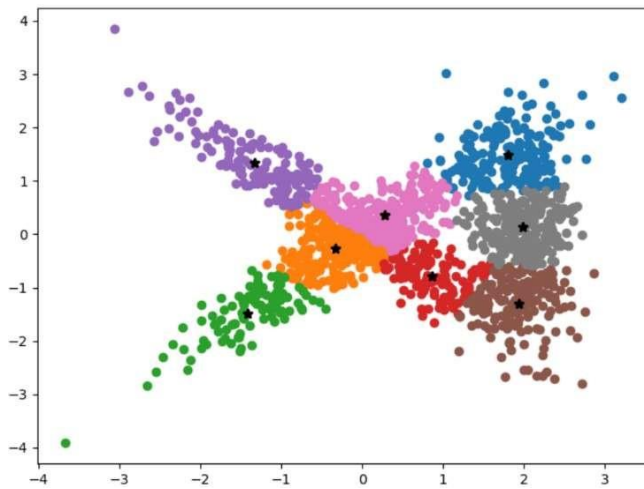
errors = [550.9846698133414, 550.9524769889592, 558.4164766903707, 553.2044505827336, 557.8079348547052, 550.845152524605, 51.1130464588143, 550.5475771636505, 551.8154147836933, 551.1217923007888]

min error when $r = 8$

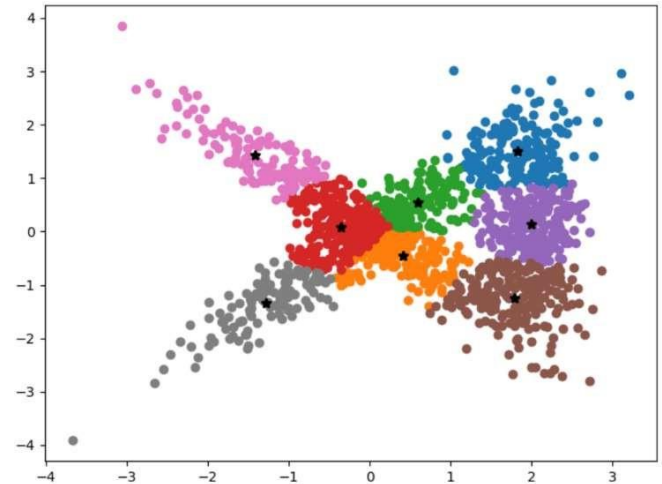
error = 550.5475771636505

5) Number of clusters $c = 8$

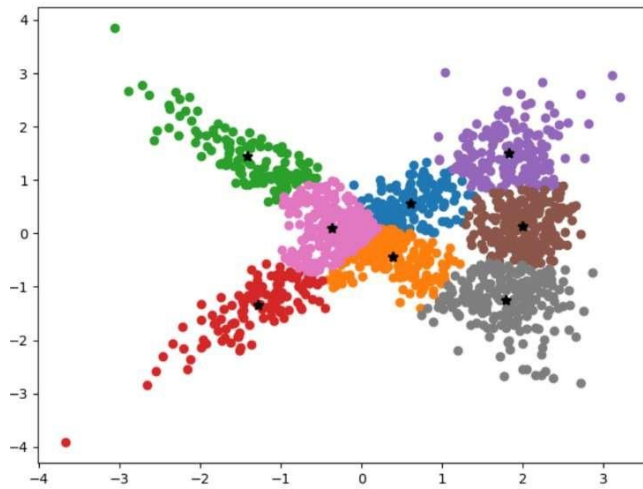
$r = 1$



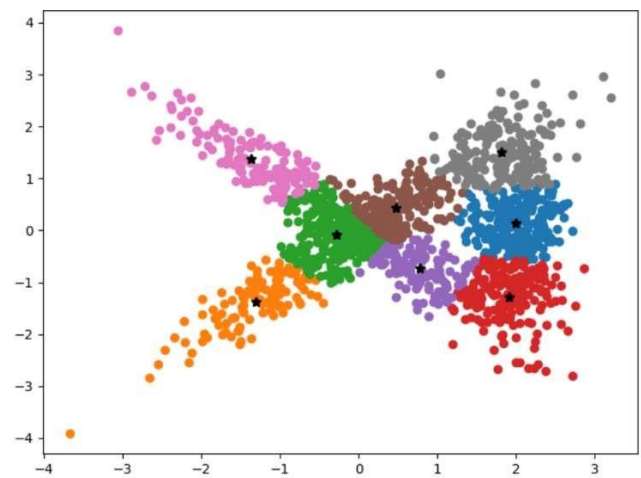
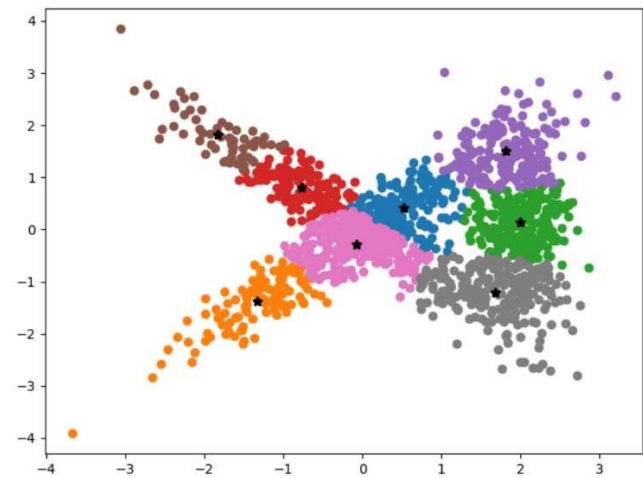
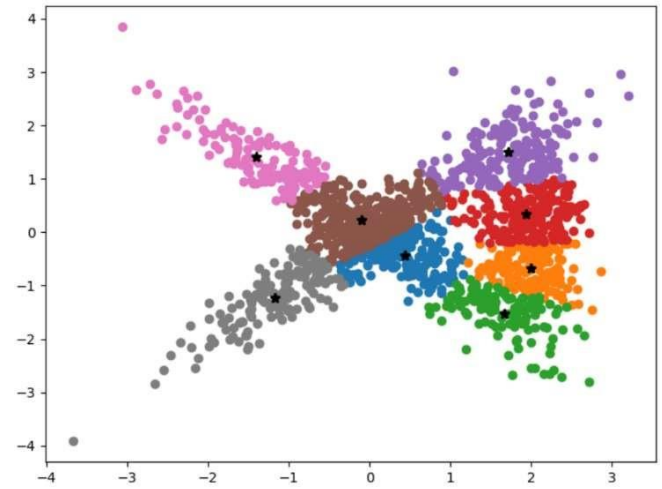
$r = 2$

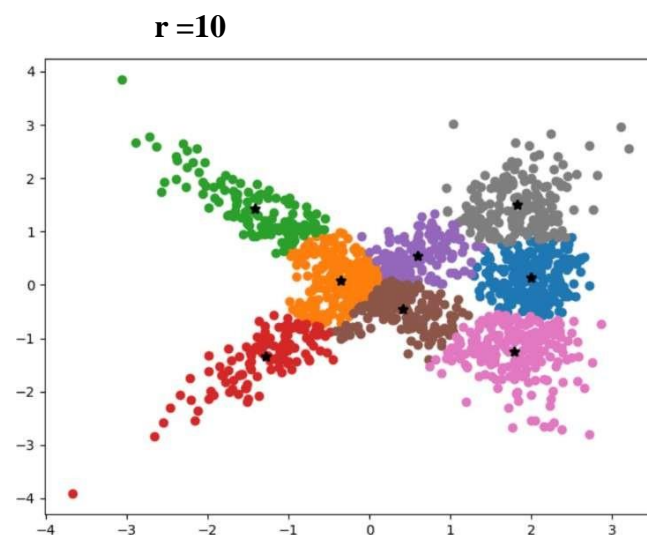
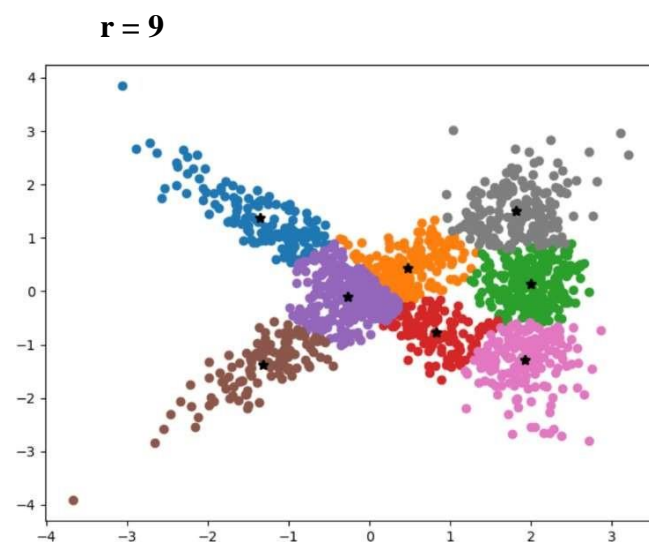
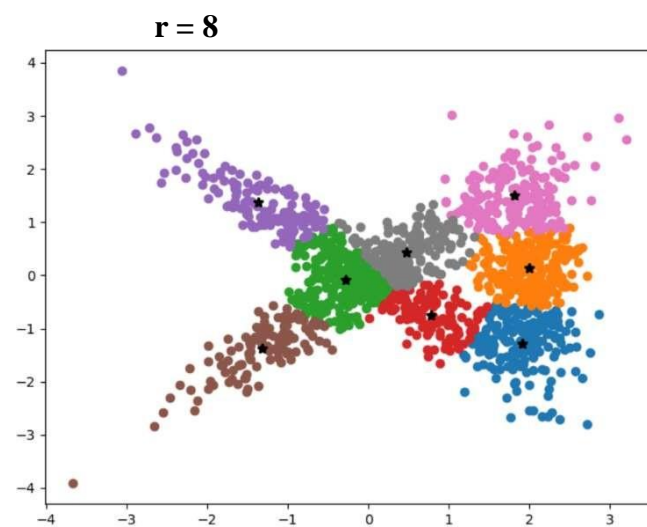
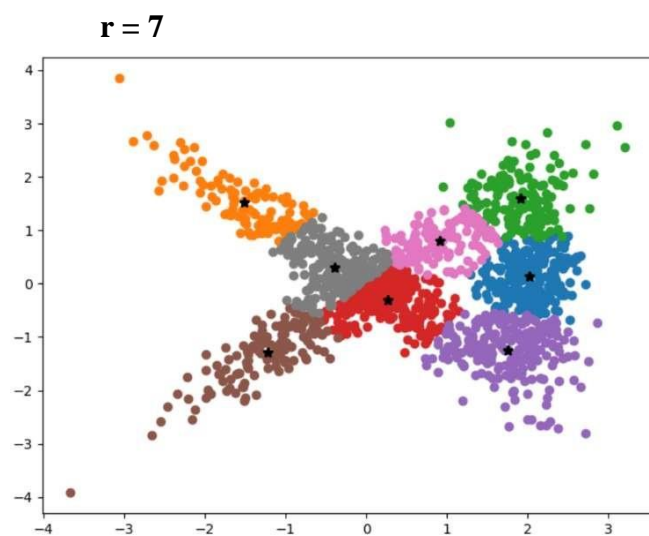


$r = 3$



$r = 4$





Errors in C=8

errors = [476.9350113728769, 477.4175614145857, 484.26139755026924, 476.81968328089755, 484.2426007929738, 476.817400052354, 511.9807782006153, 477.2638643538113, 484.27846518482977, 476.8388542682783]

min error when r = 6

error = 476.817400052354

For different number of clusters 'c' ($c = 3$ to 8). And for each 'c' value it is ran for 'r' (10) times. Below table shows selected models sum-square-error for each 'c' value and 'r' value at which that model occurred.

| C Value | Minimum Sum-Square Error | Model occurred at 'r' |
|----------------|---------------------------------|------------------------------|
| $C = 3$ | 1536.793 | 10 |
| $C = 4$ | 1100.432 | 5 |
| $C = 5$ | 770.895 | 6 |
| $C = 6$ | 624.607 | 8 |
| $C = 7$ | 550.547 | 9 |
| $C = 8$ | 476.817 | 5 |