

Assignment 5

Computational Intelligence, SS2020

Team Members		
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1 Classification - 2 dimensional feature

1.1 EM algorithm

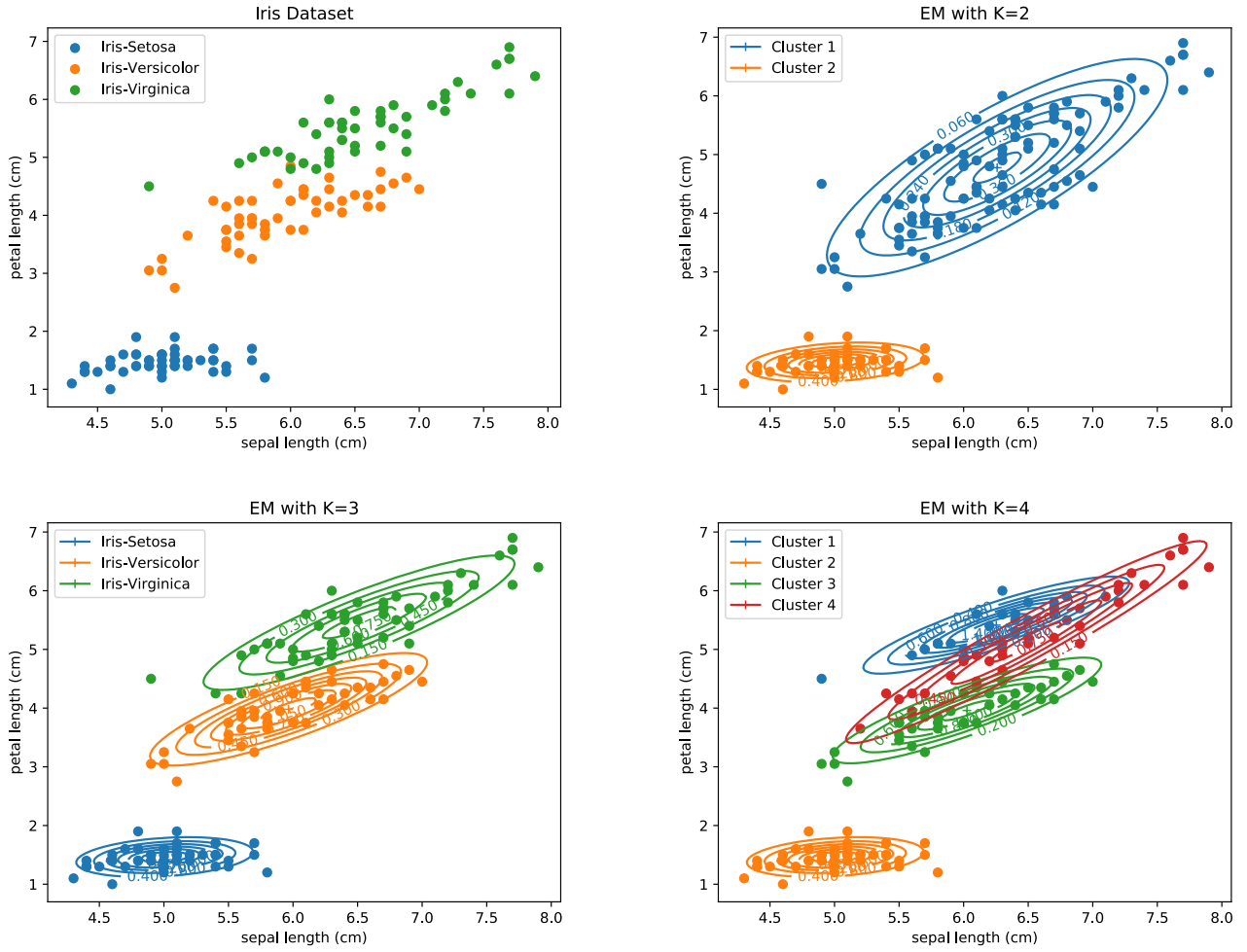


Figure 1: Results of EM classification with $K = 2 \dots 4$ components.

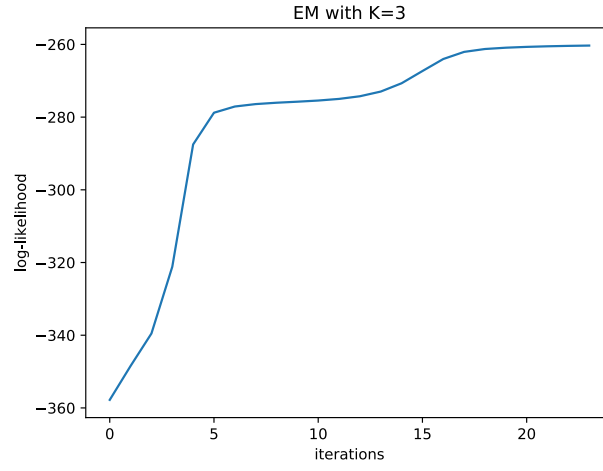


Figure 2: Log-likelihood function over iterations for $K = 3$ components.

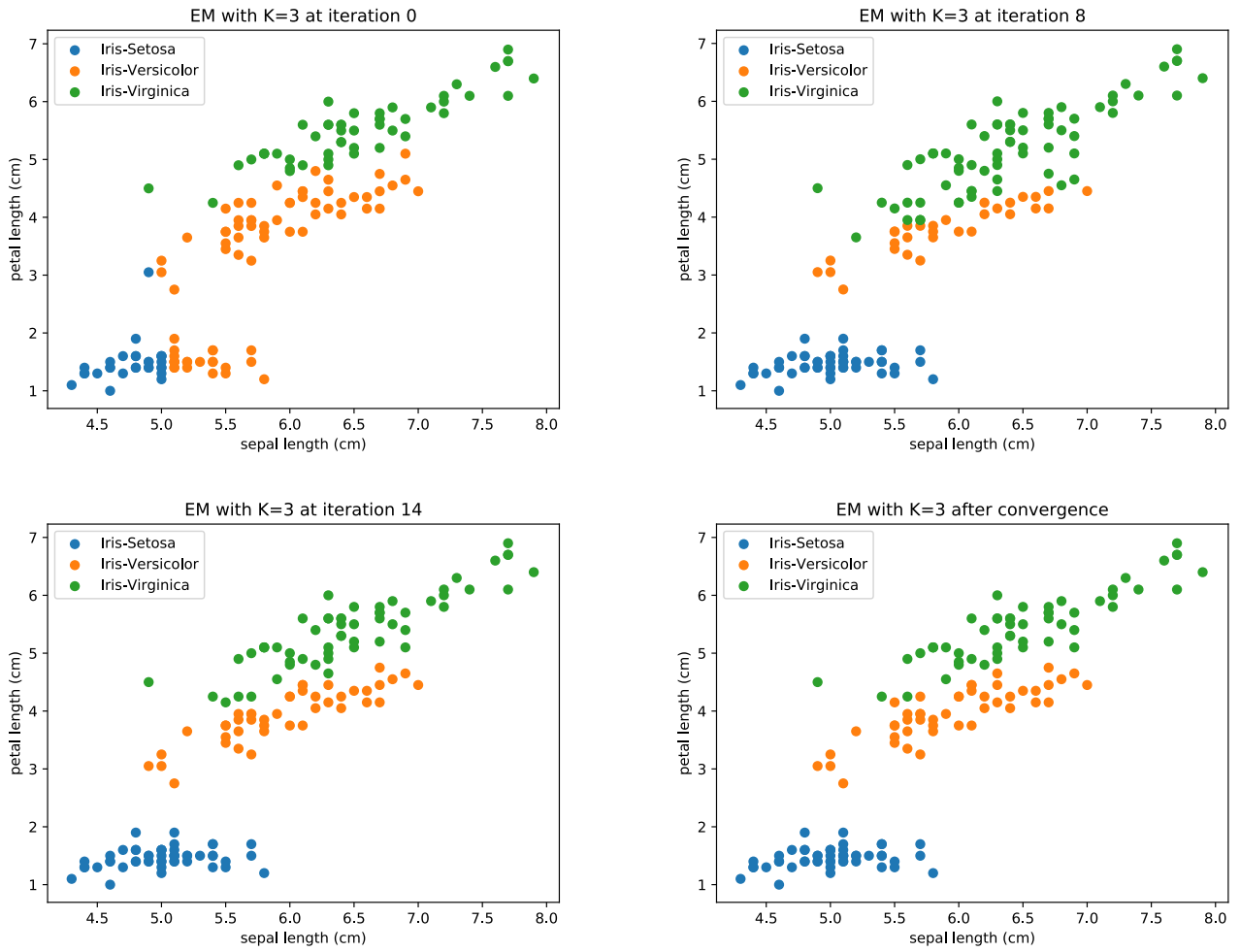


Figure 3: Results of soft-classification done in E-step.

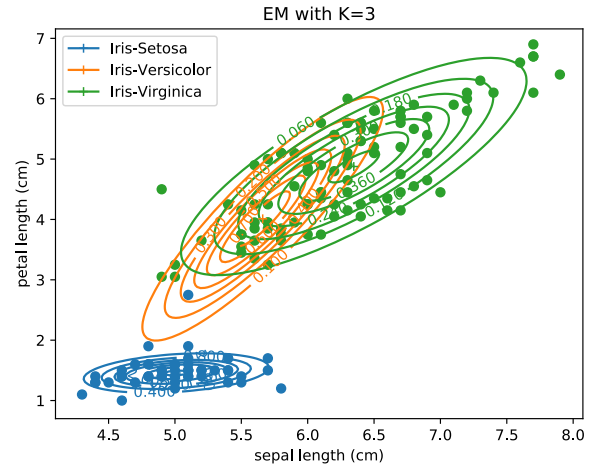
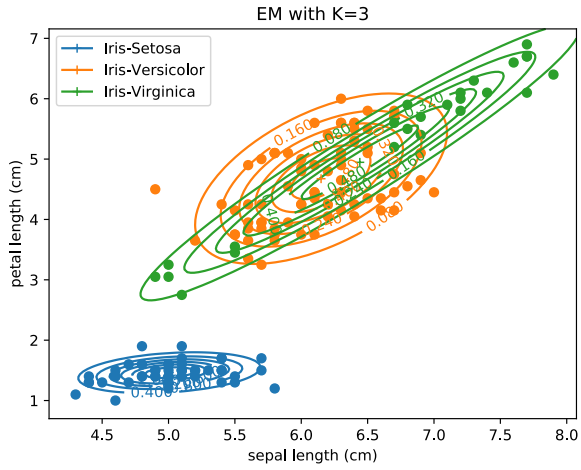
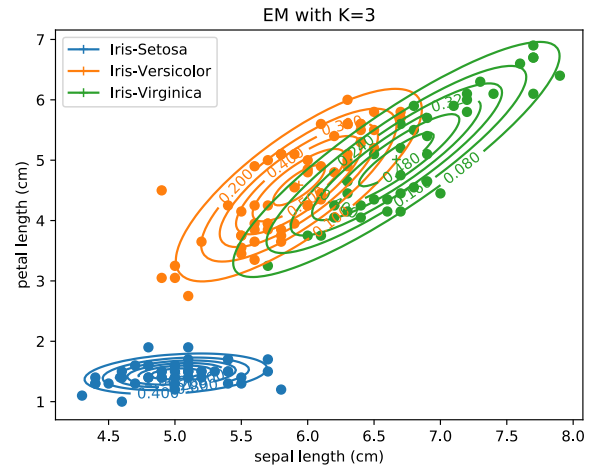
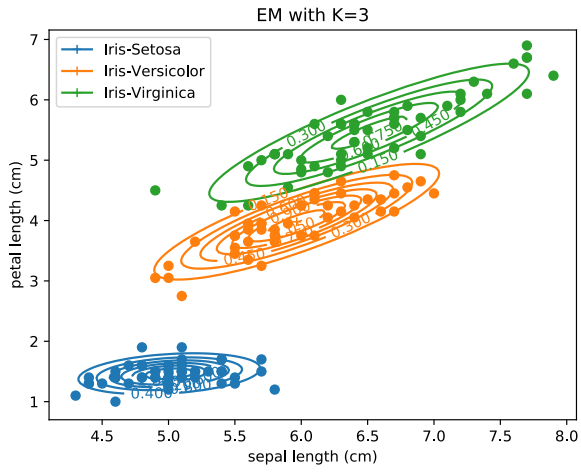


Figure 4: Results of EM classification for several random `mean0` starting samples.

1.2 K-means algorithm

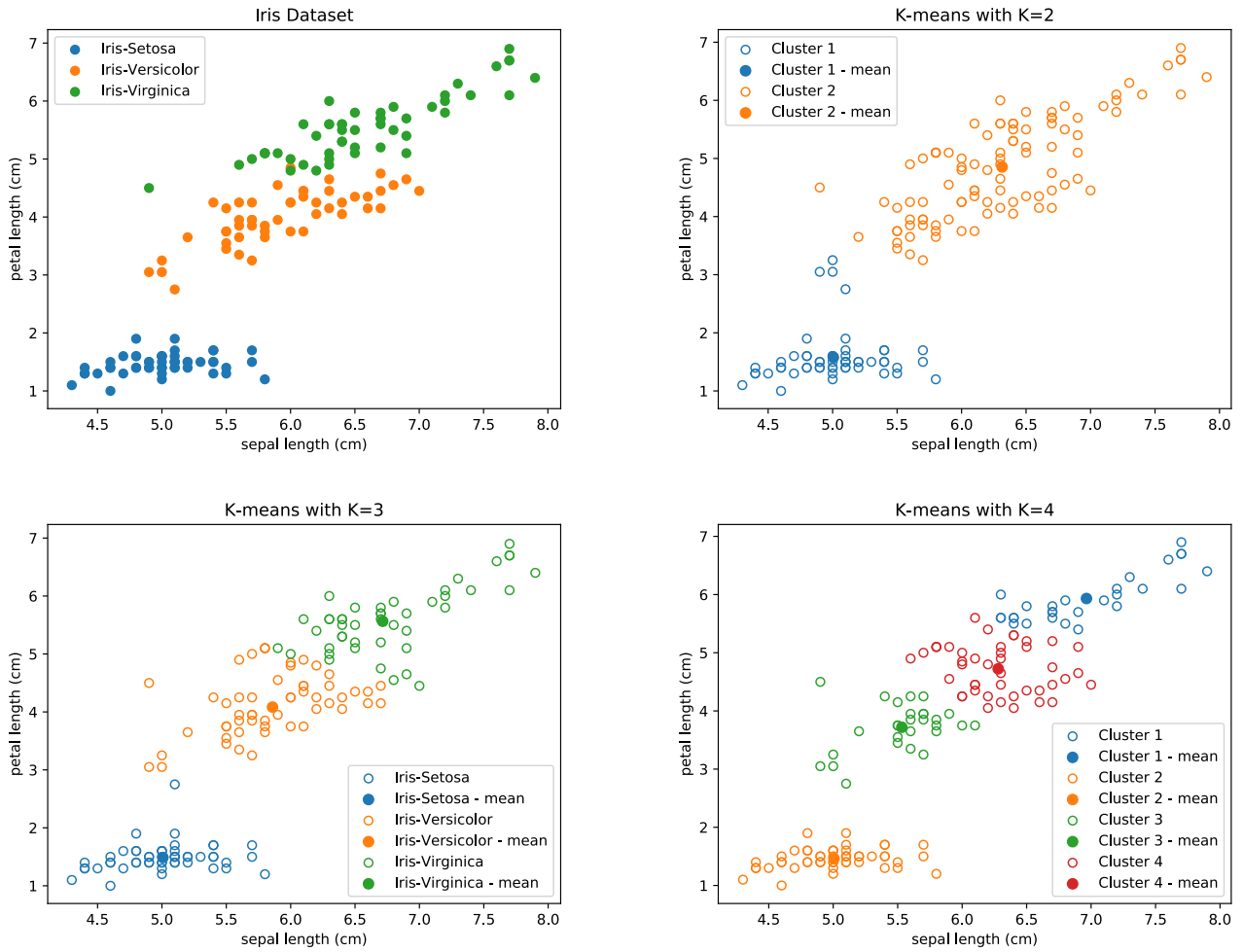


Figure 5: Results of K-means classification with $K = 2 \dots 4$ components.

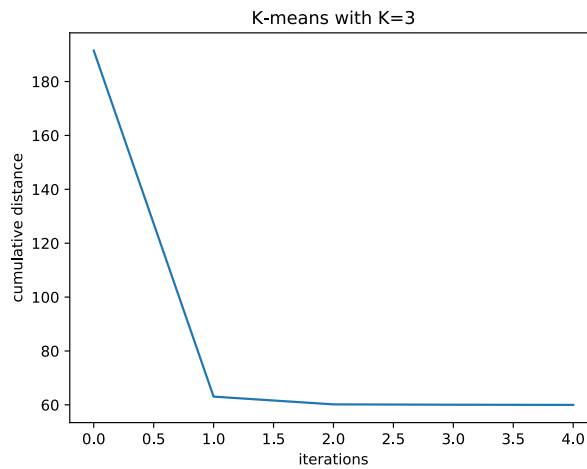


Figure 6: Cumulative distance function over iterations for $K = 3$ components.

The classification using K-means algorithm is also good. But in comparison to the EM-algorithm outliers are more often misclassified. The additional 4th cluster adds another classification area which can be clearly distinguished from all others, since all datapoints are spherically gathered around the mean value. The cumulative distance quickly converges after one iteration.

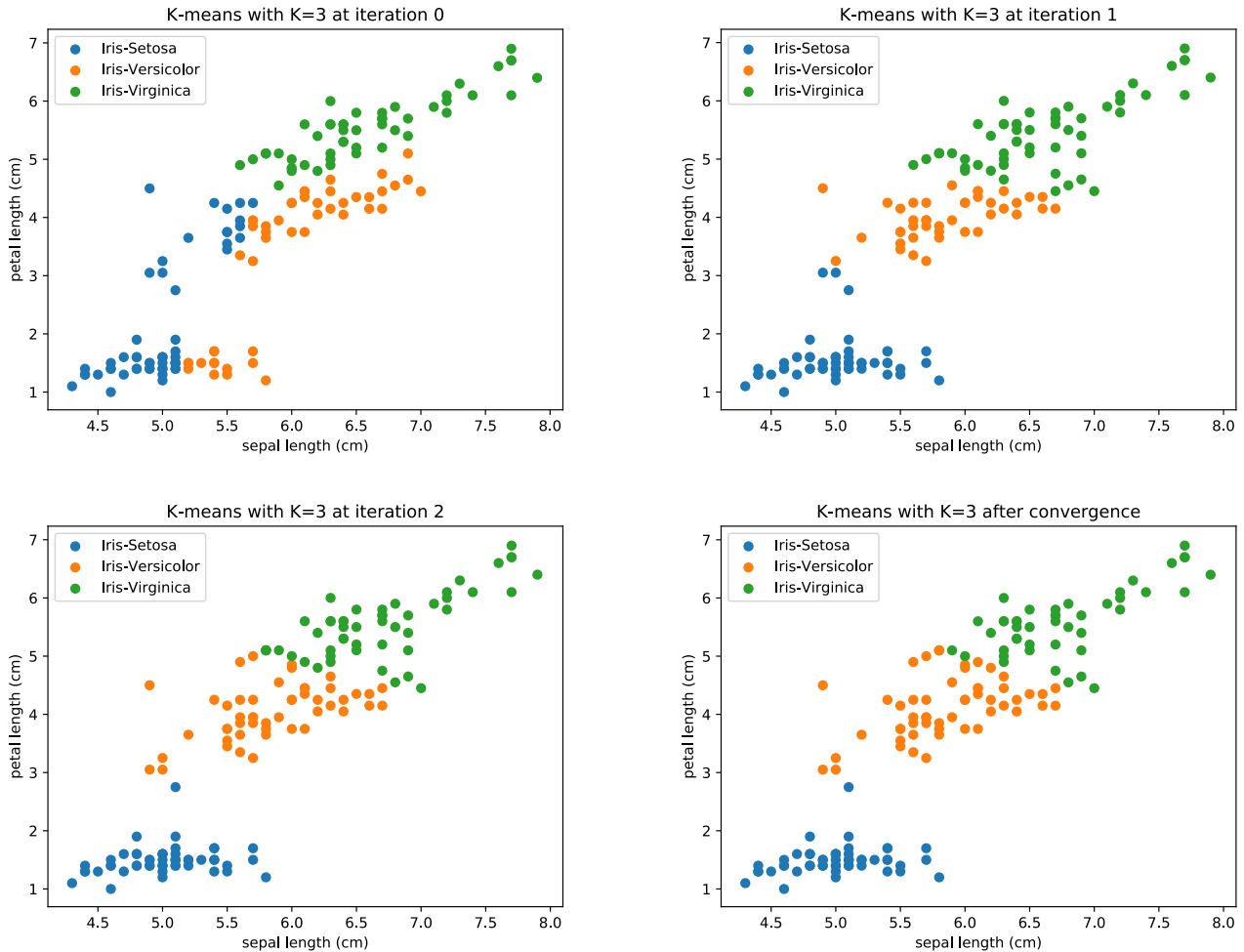


Figure 7: Results of hard-classification during optimisation.

The classification results are getting better with more iterations. This makes sense, since the start mean values are randomly initialized and new calculated for each iteration.

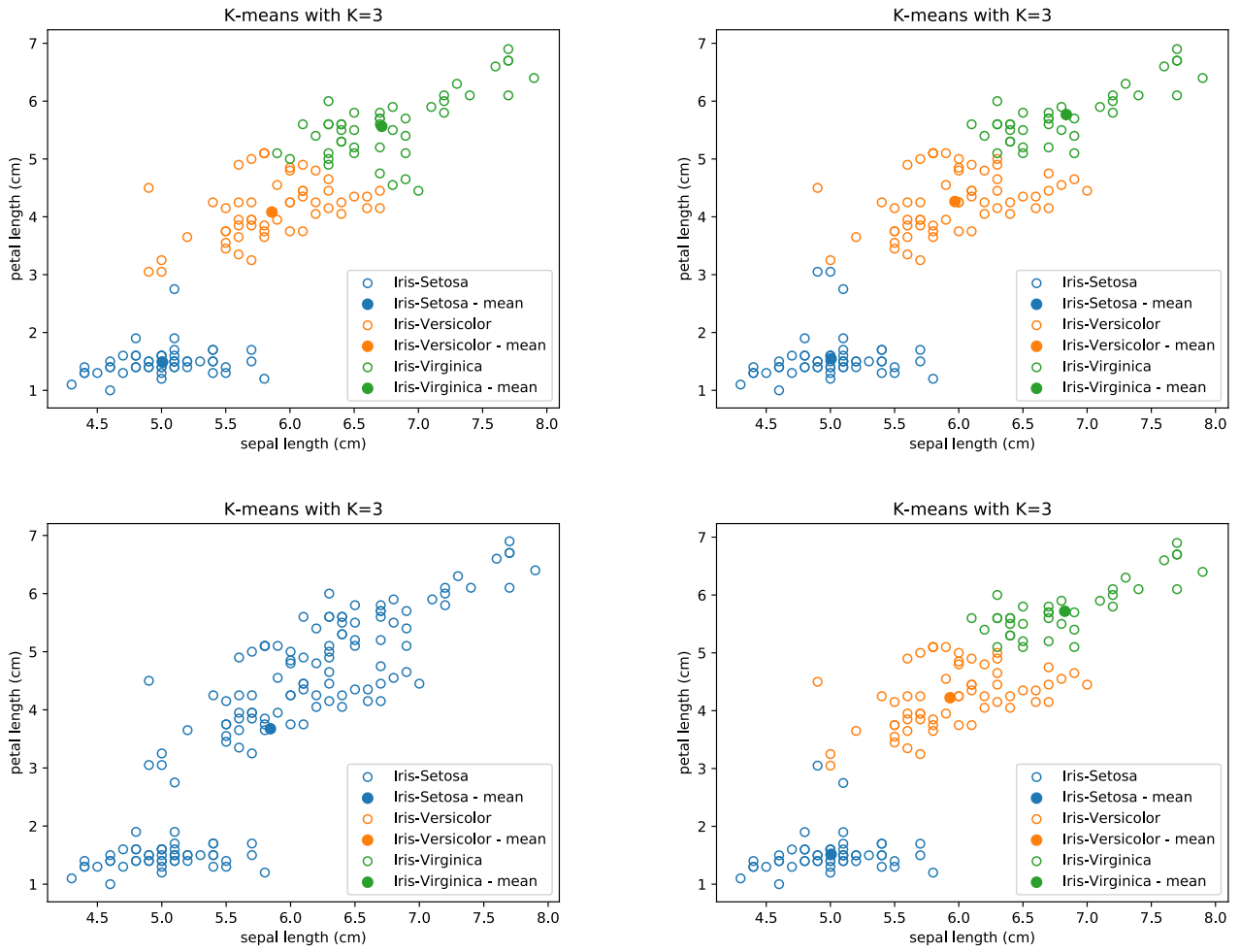


Figure 8: Results of K-means classification for several random `center0` starting samples.

Figure 8 supports our assumption that the algorithm is prone to misclassify outliers. The algorithm also seems to have problems with not clearly separated clusters because a lot data samples were misclassified at the border of "Iris-Versicolor" and "Iris-Virginica".

2 Classification - 4 dimensional feature

2.1 EM algorithm

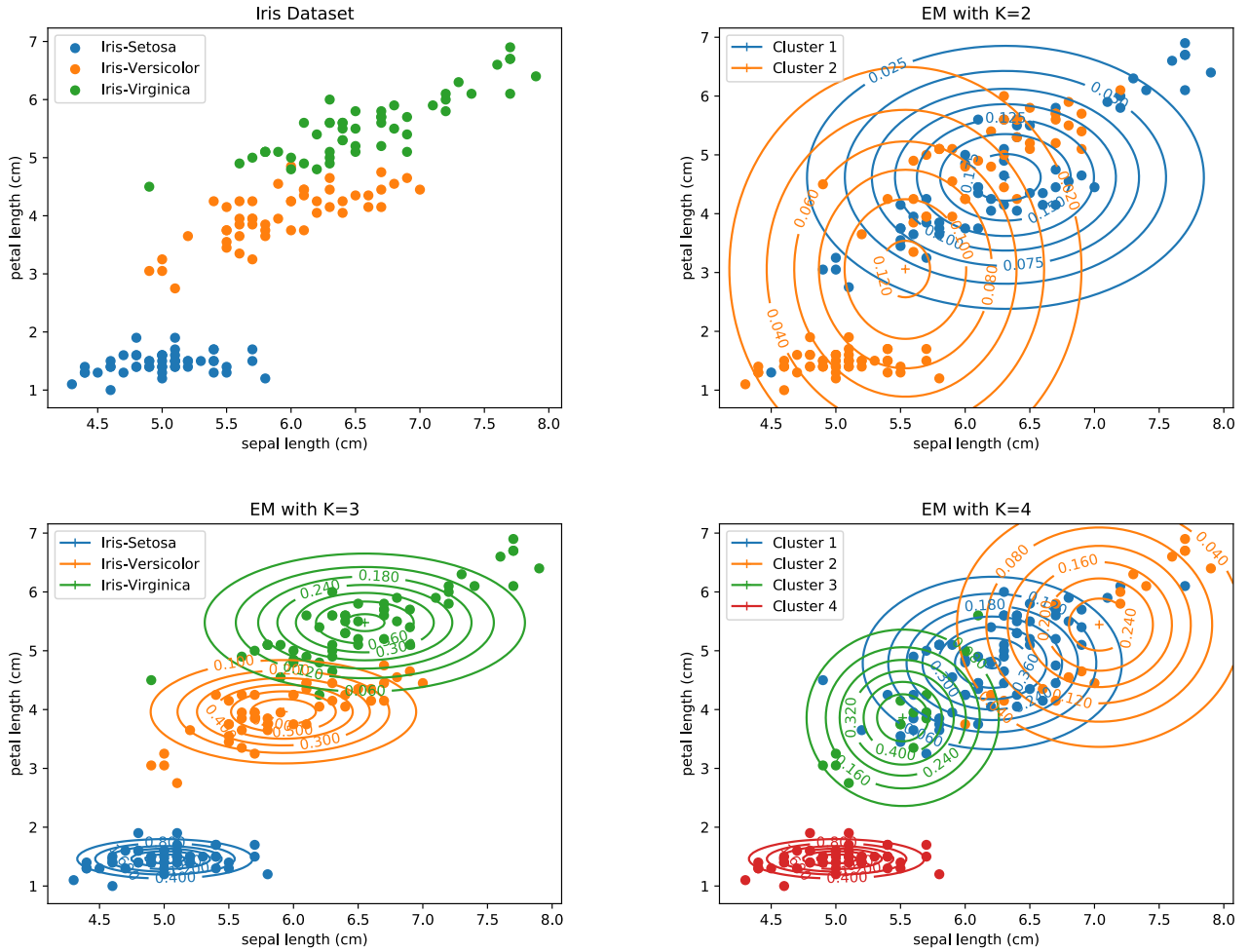


Figure 9: Results of EM classification with $K = 2 \dots 4$ components.

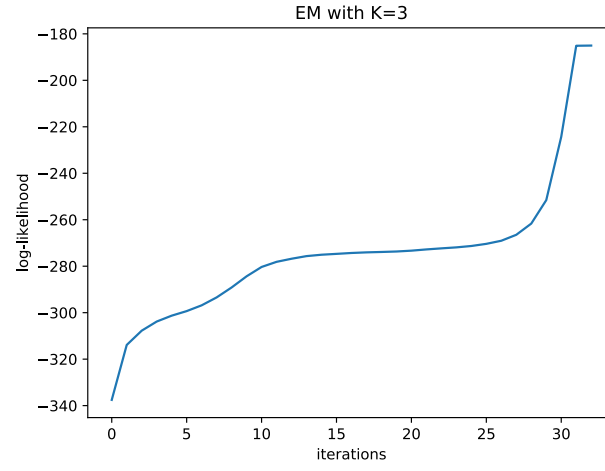


Figure 10: Log-likelihood function over iterations for $K = 3$ components.

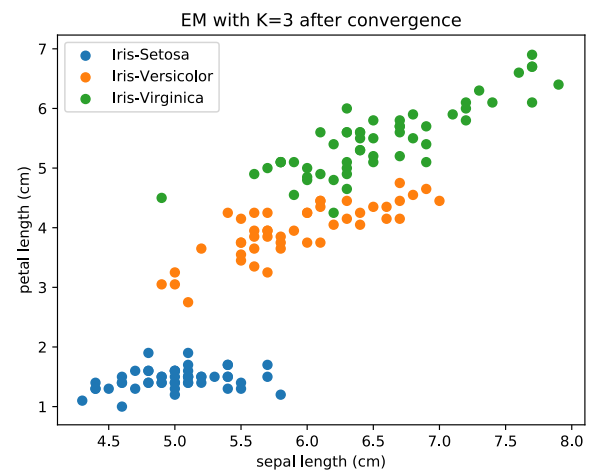
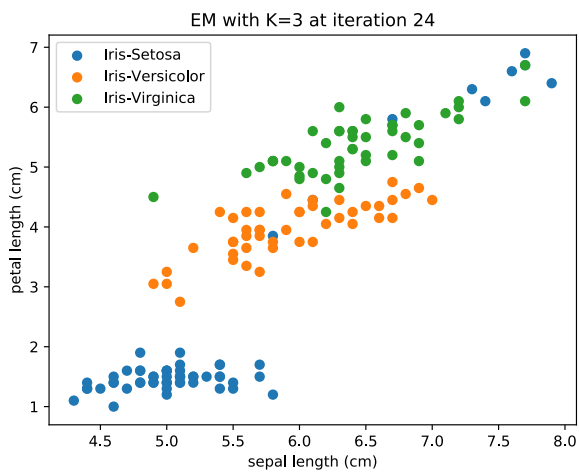
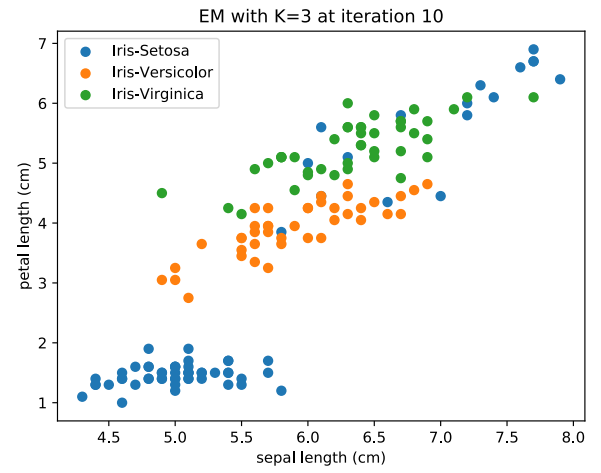
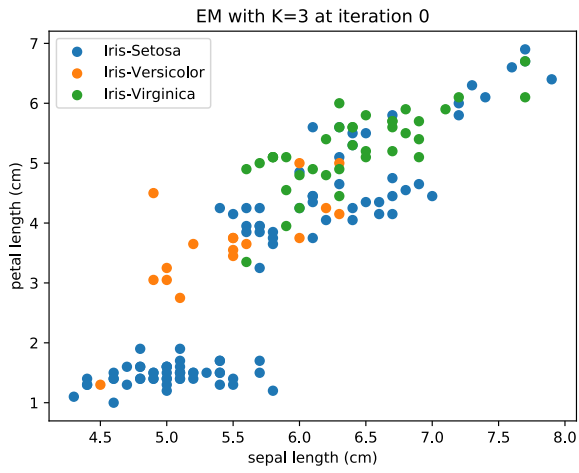


Figure 11: Results of soft-classification done in E-step.

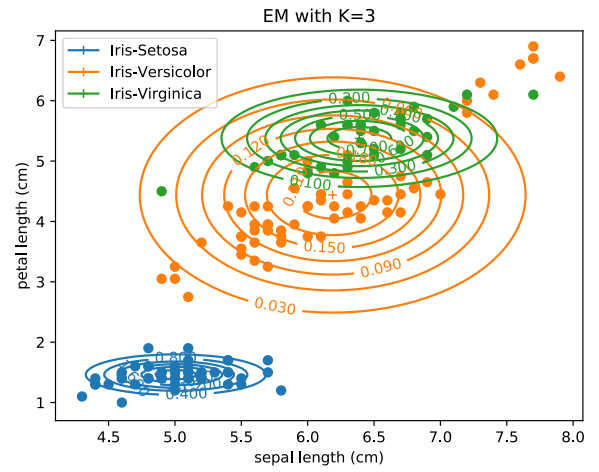
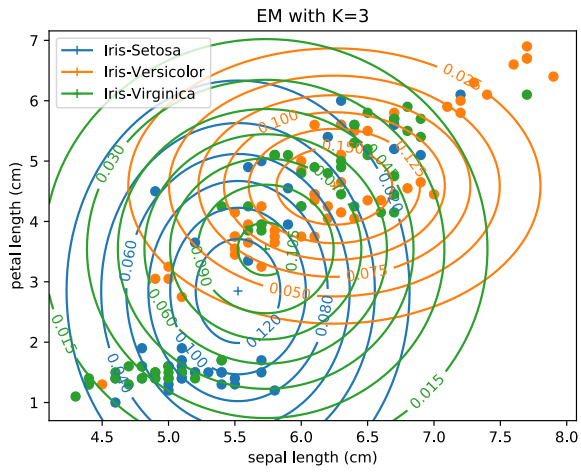
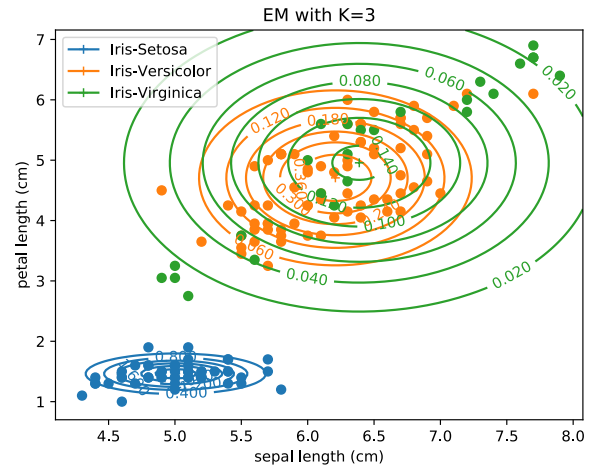
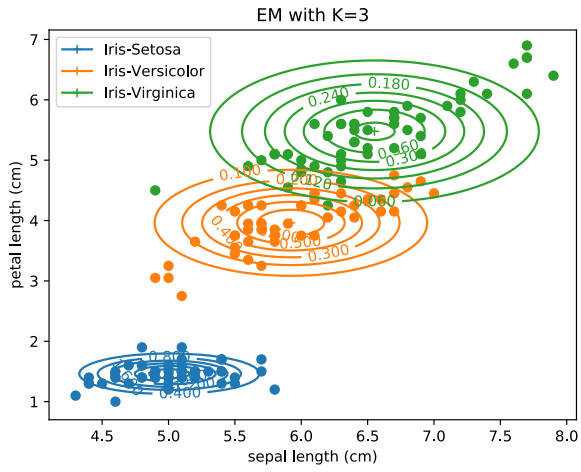
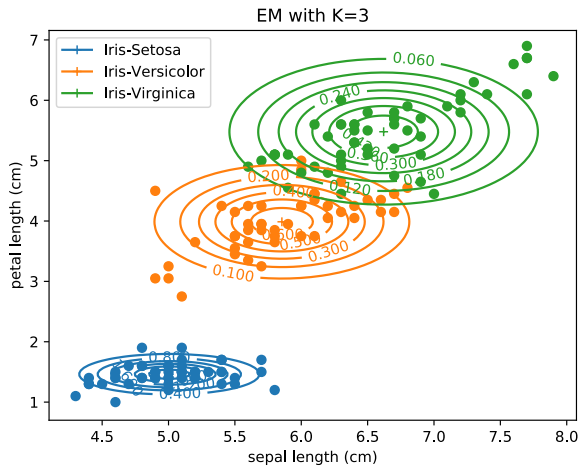
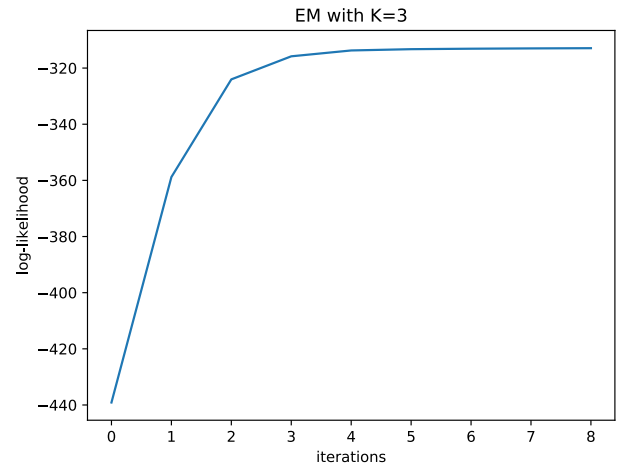


Figure 12: Results of EM classification for several random `mean0` starting samples.

2.2 EM algorithm with diagonal covariance matrices



(a) Results of classification



(b) Log-likelihood

Figure 13: Results of EM classification with diagonal covariance matrices.

2.3 K-means algorithm

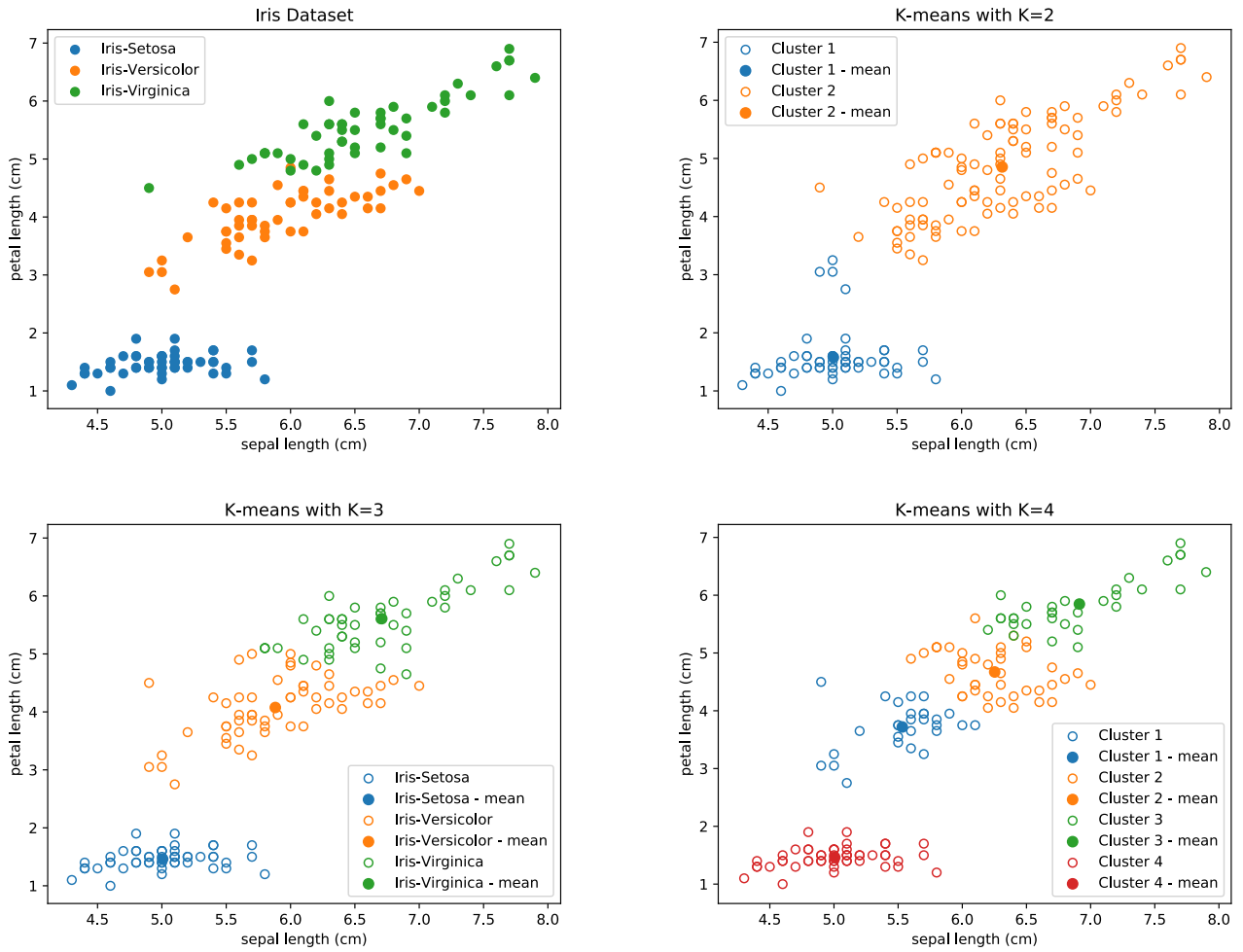


Figure 14: Results of K-means classification with $K = 2 \dots 4$ components.

Using four features the K-mean algorithms becomes less prone to outliers.