Lab 2: Support Vector Machines

DD2421 Machine Learning

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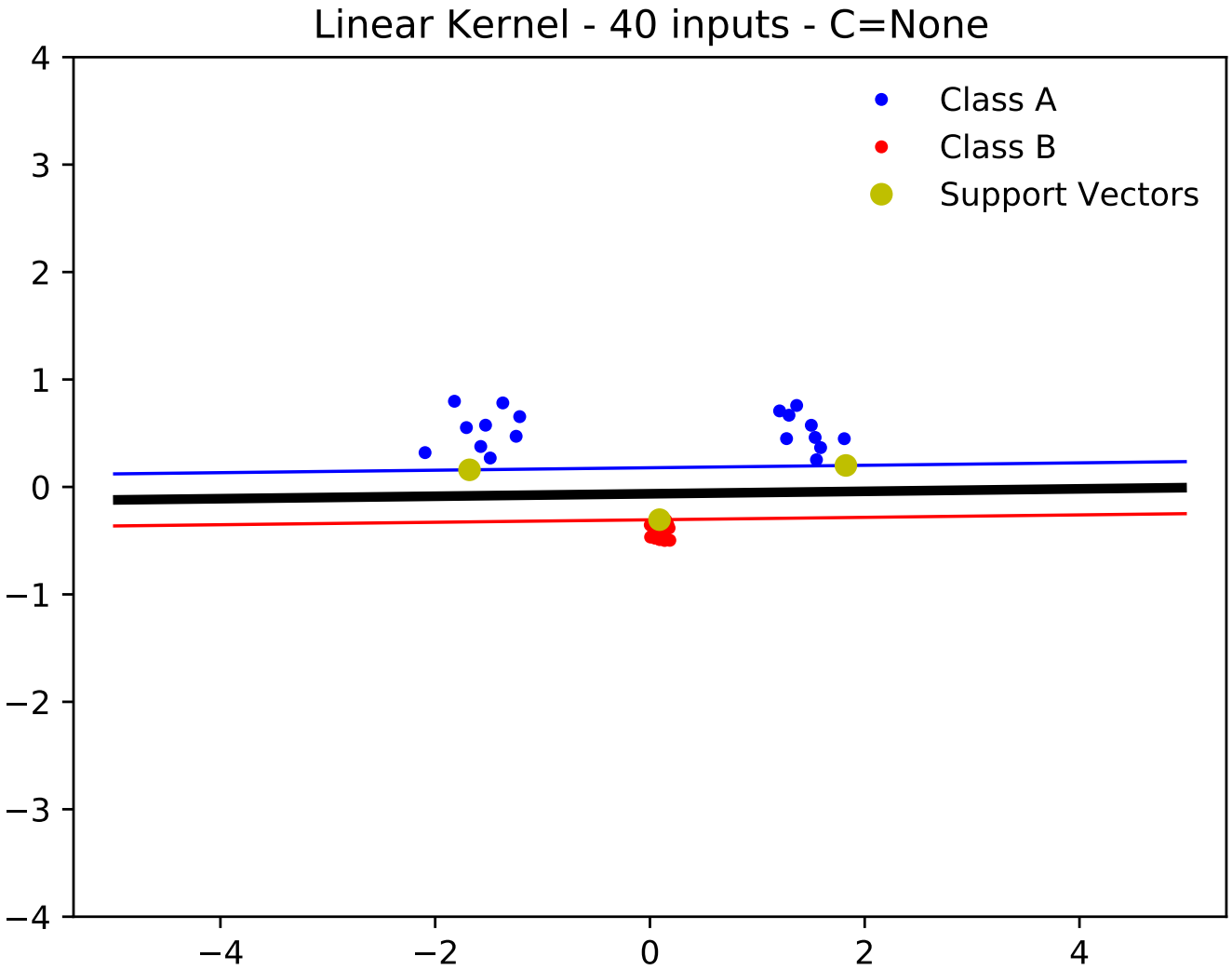
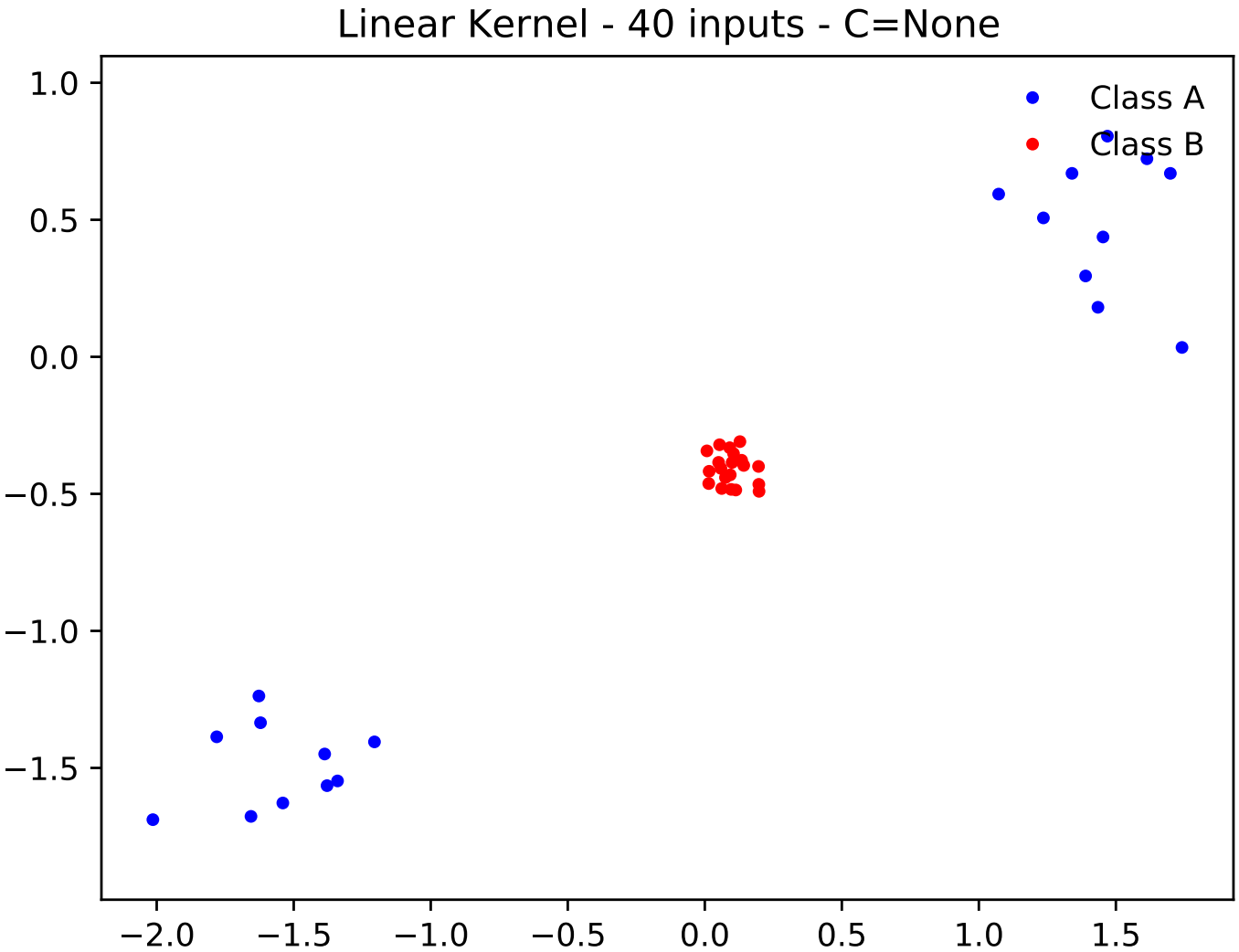
Objectives

- use the mathematical formulation of the optimization task
- formulate the indicator function and explain how it relates to the outcome of the classification
- predict and explain the outcome of using different kernels
- explain the effect of the C-value when using slack variables

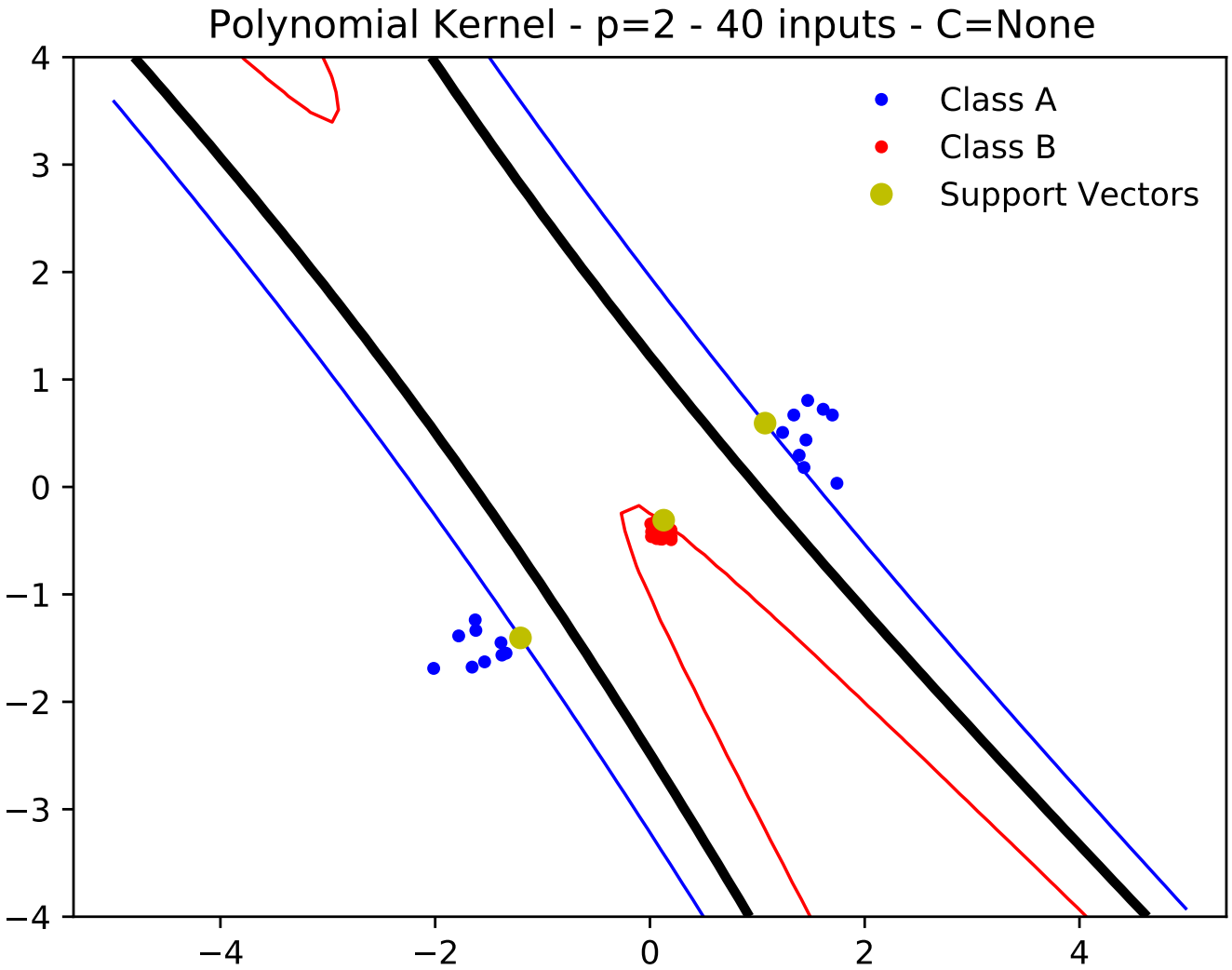
Linear Kernel



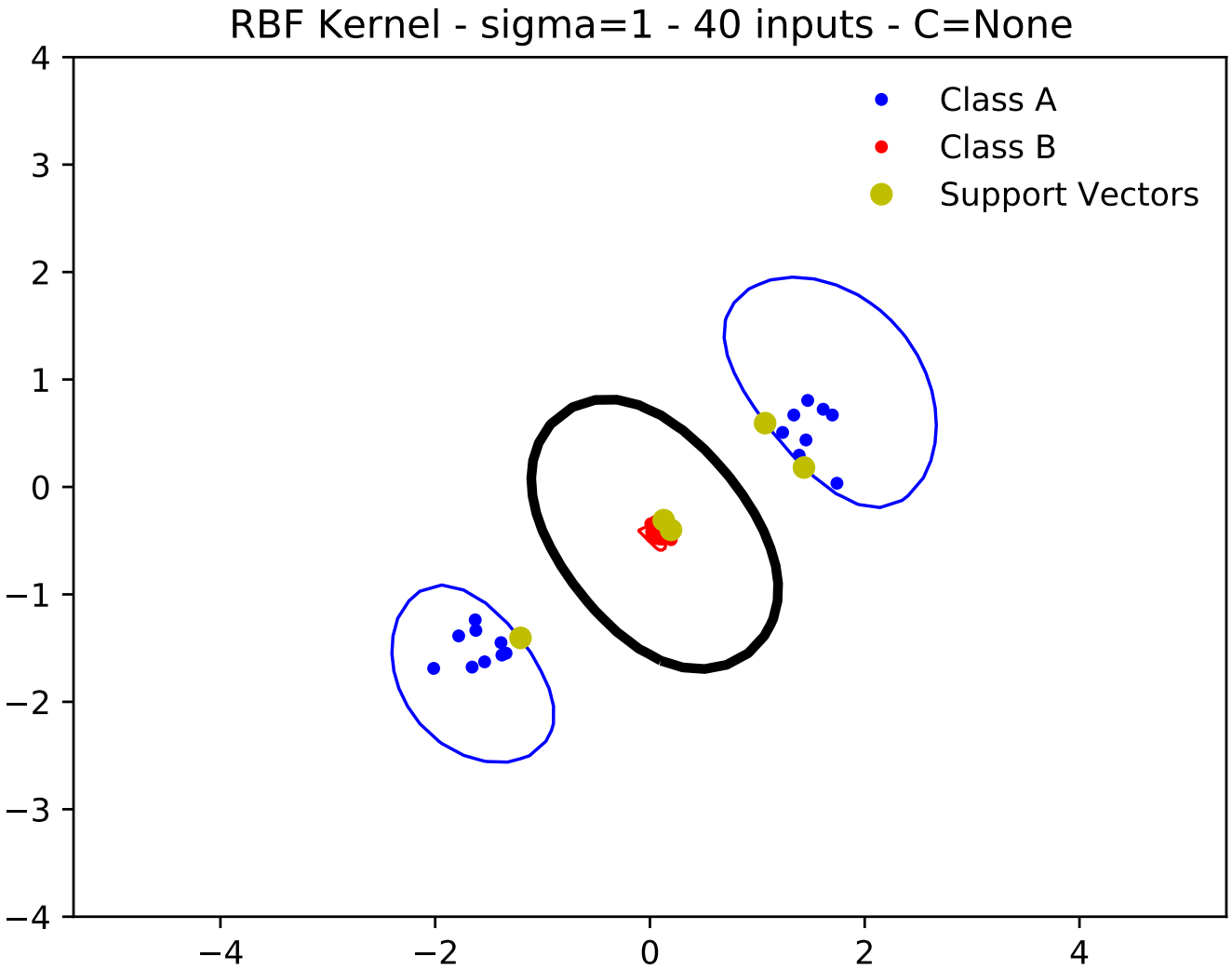
Linear Kernel - Assignment 1



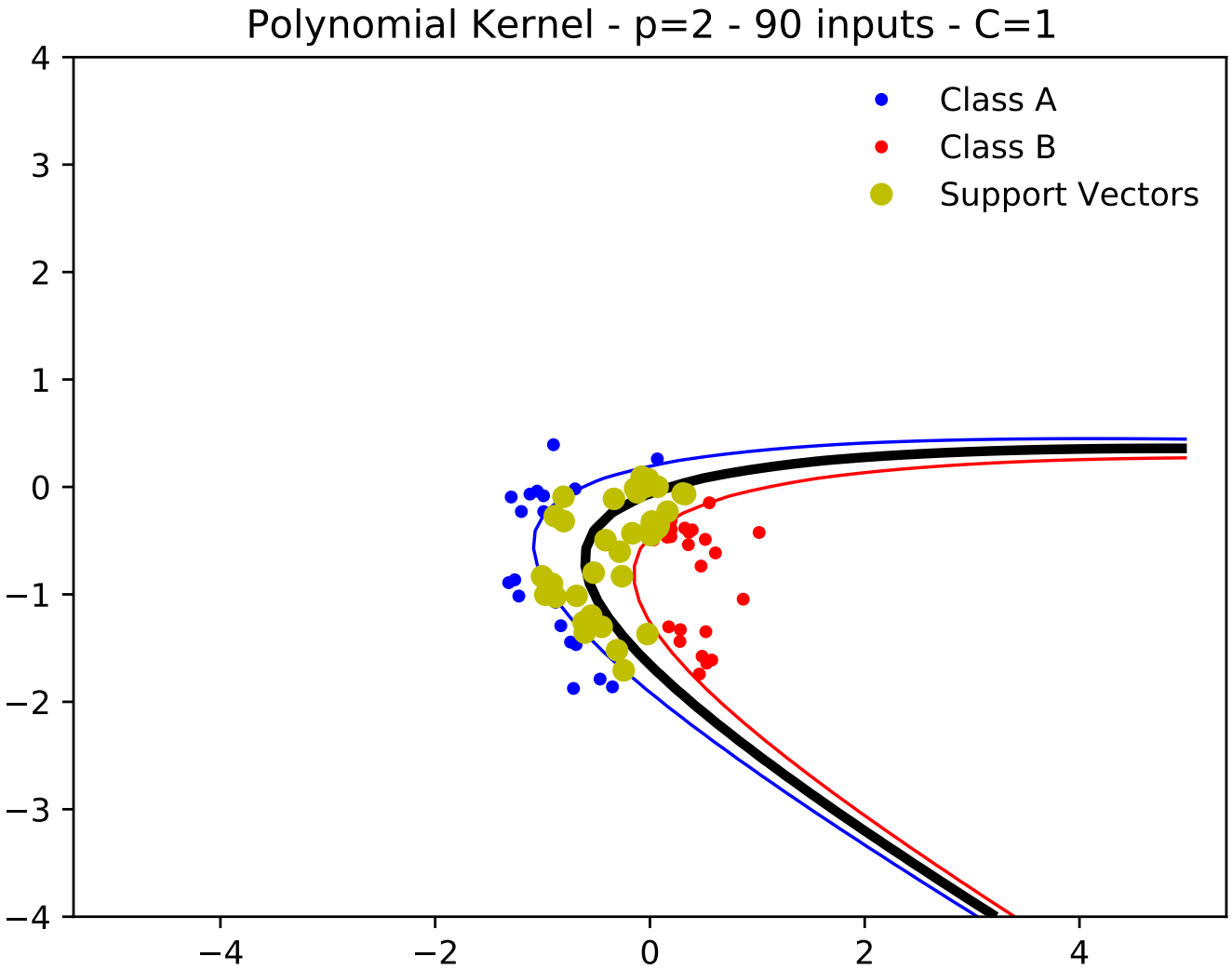
Polynomial Kernel - Assignment 2



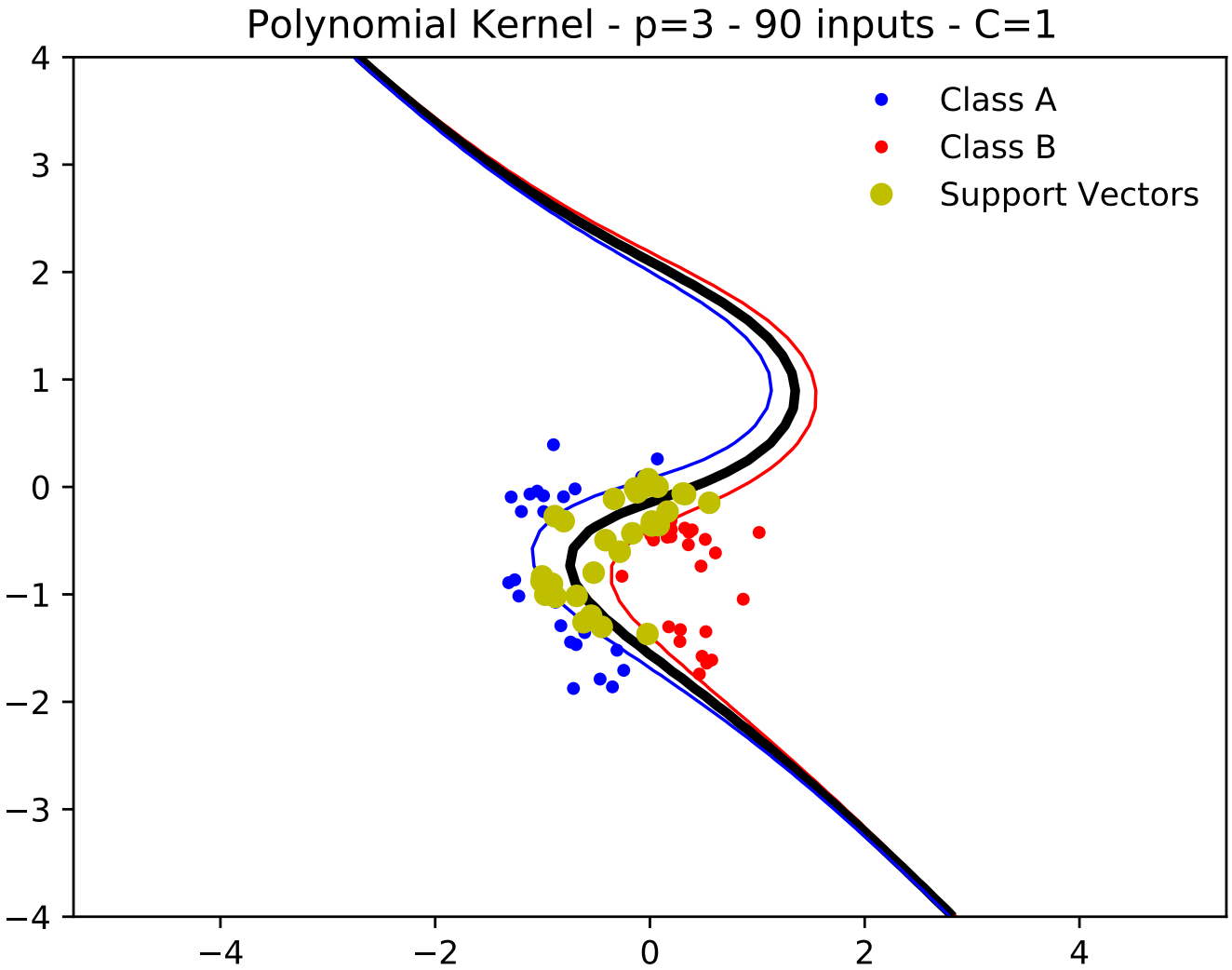
RBF Kernel - Assignment 2



Influence of p - Polynomial Kernel - Assignment 3



Influence of p - Polynomial Kernel - Assignment 3



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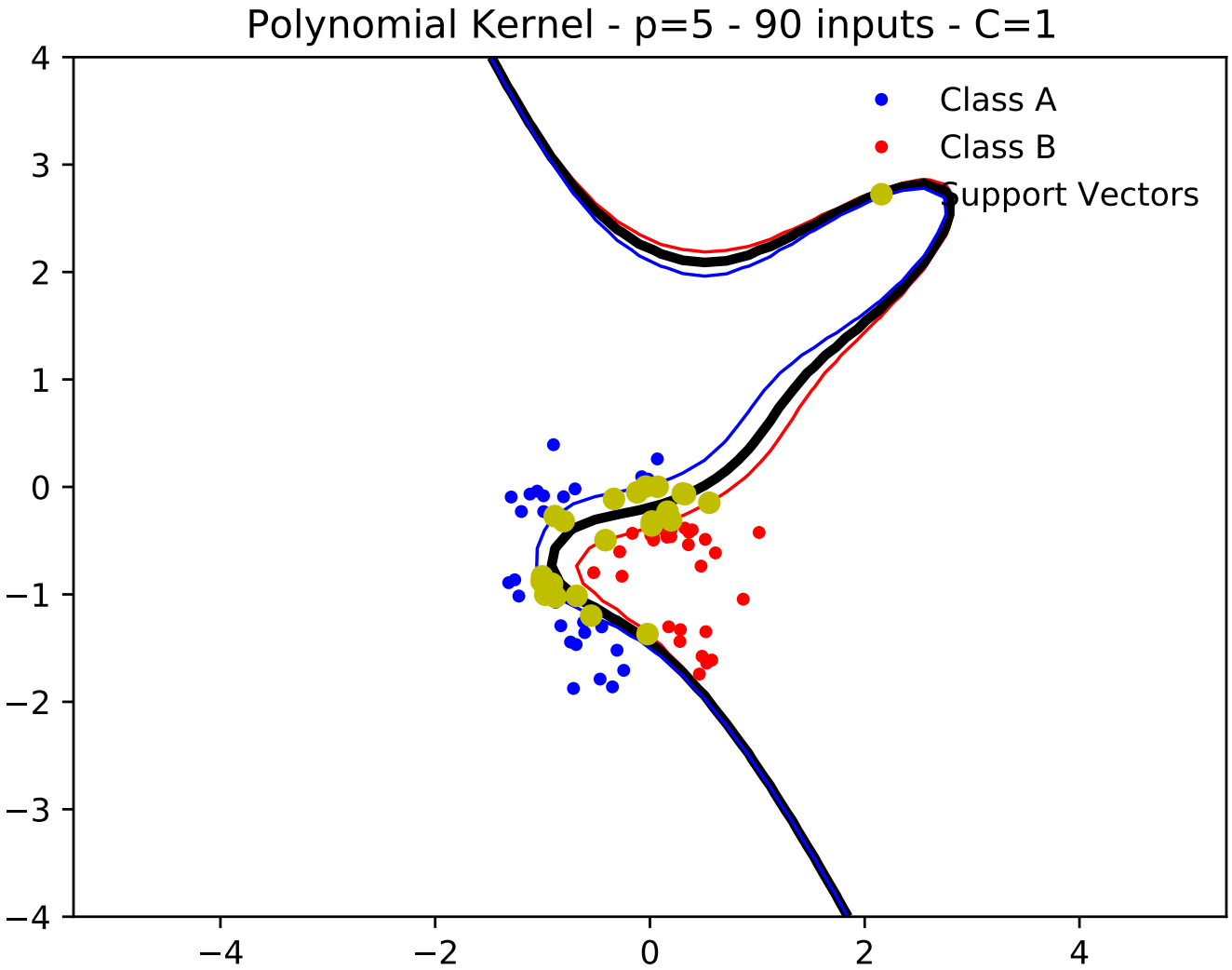
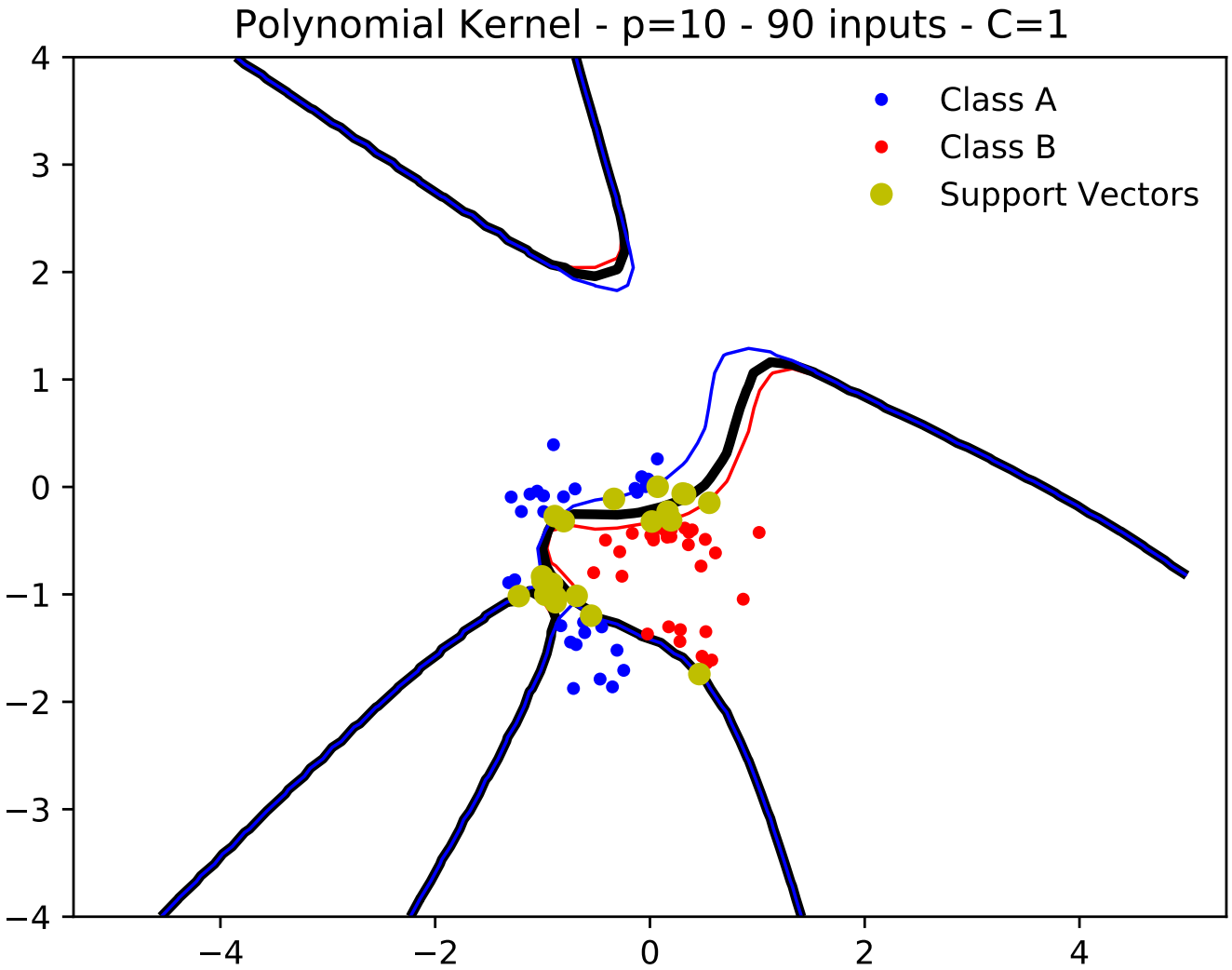


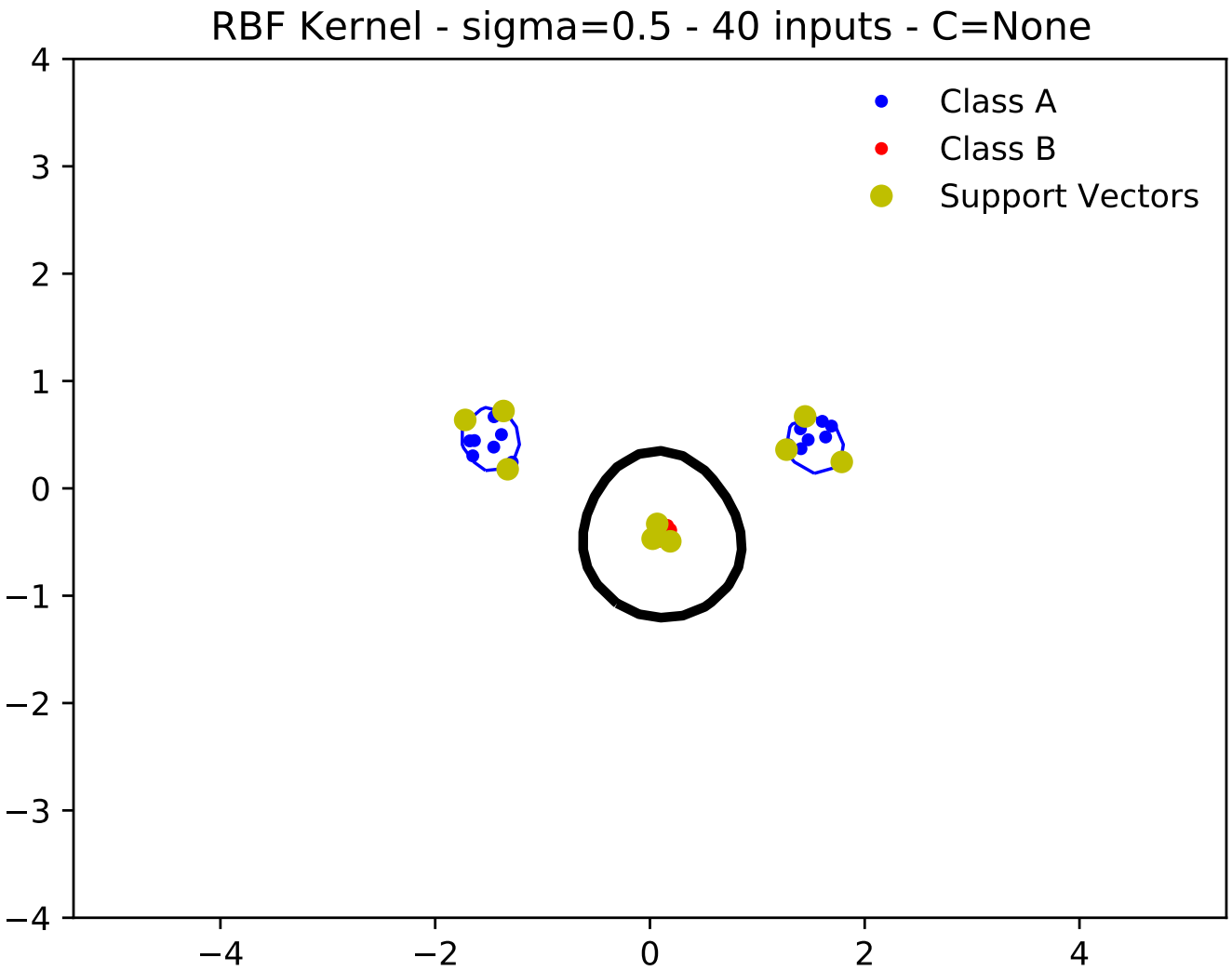
Influence of p - Polynomial Kernel - Assignment 3



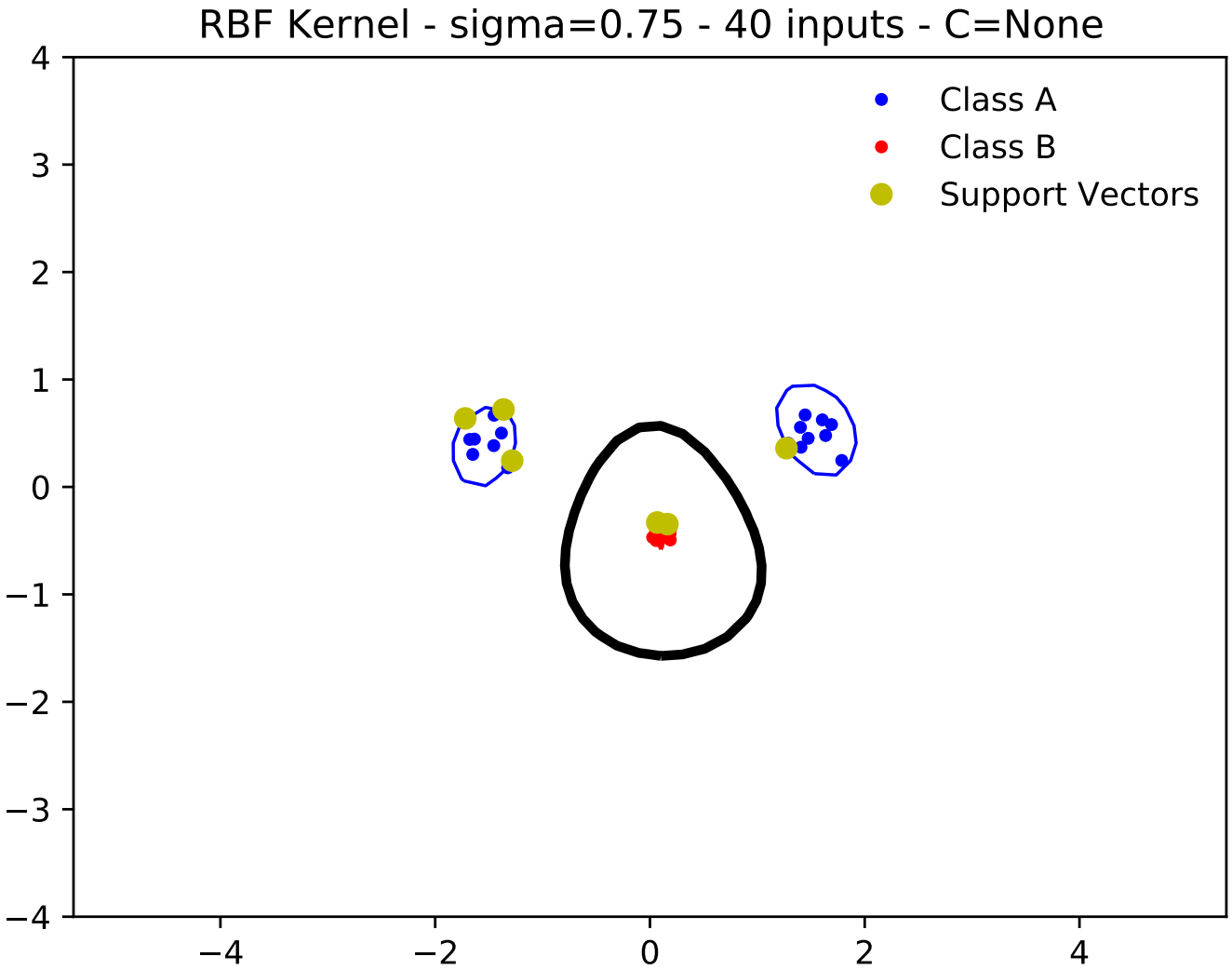
Influence of p - Polynomial Kernel - Assignment 3

- As p increases, we are adding dimensions to the feature space
- The complexity of the decision boundary increases, thus increasing the variance and decreasing bias

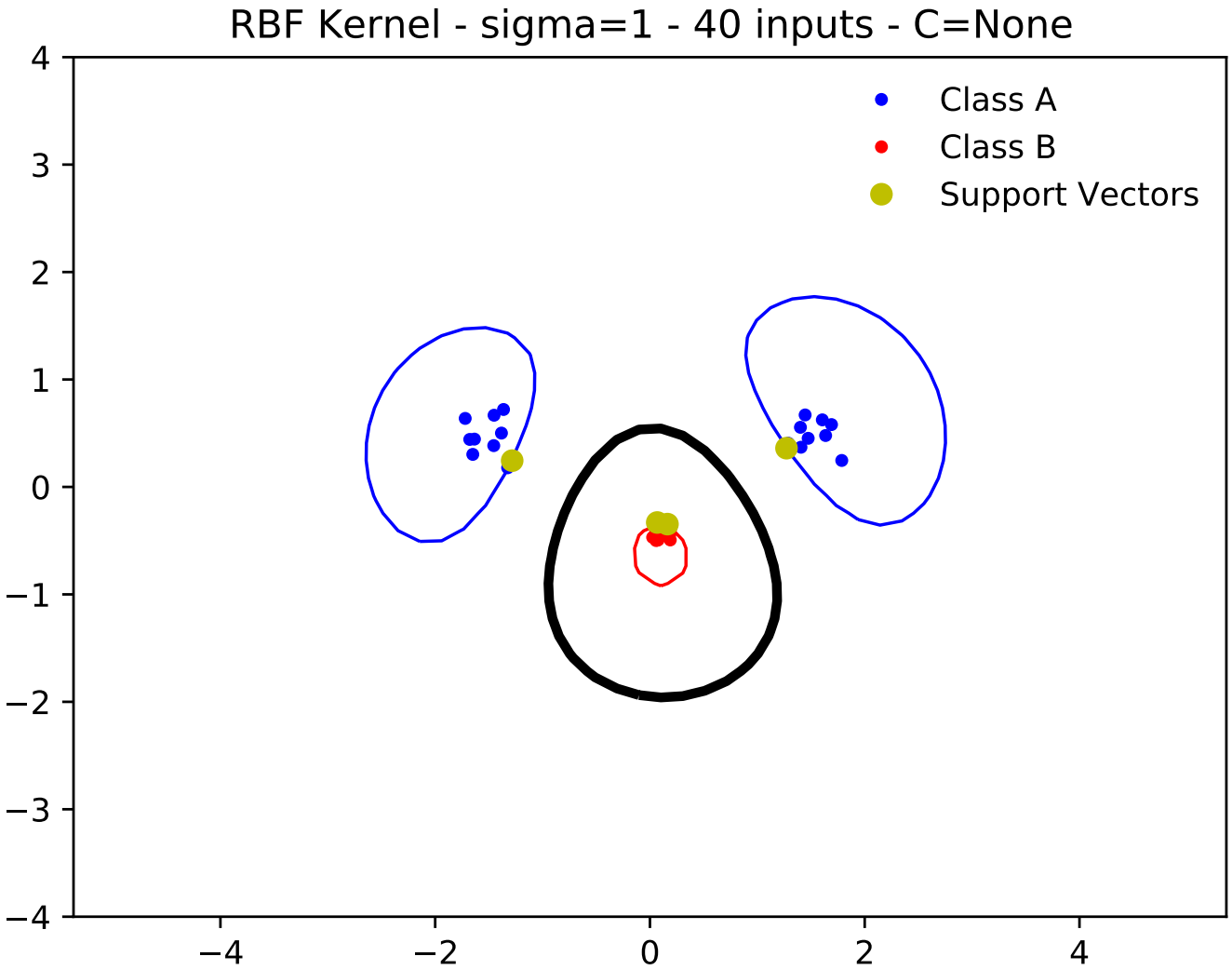
Influence of σ - RBF Kernel - Assignment 3



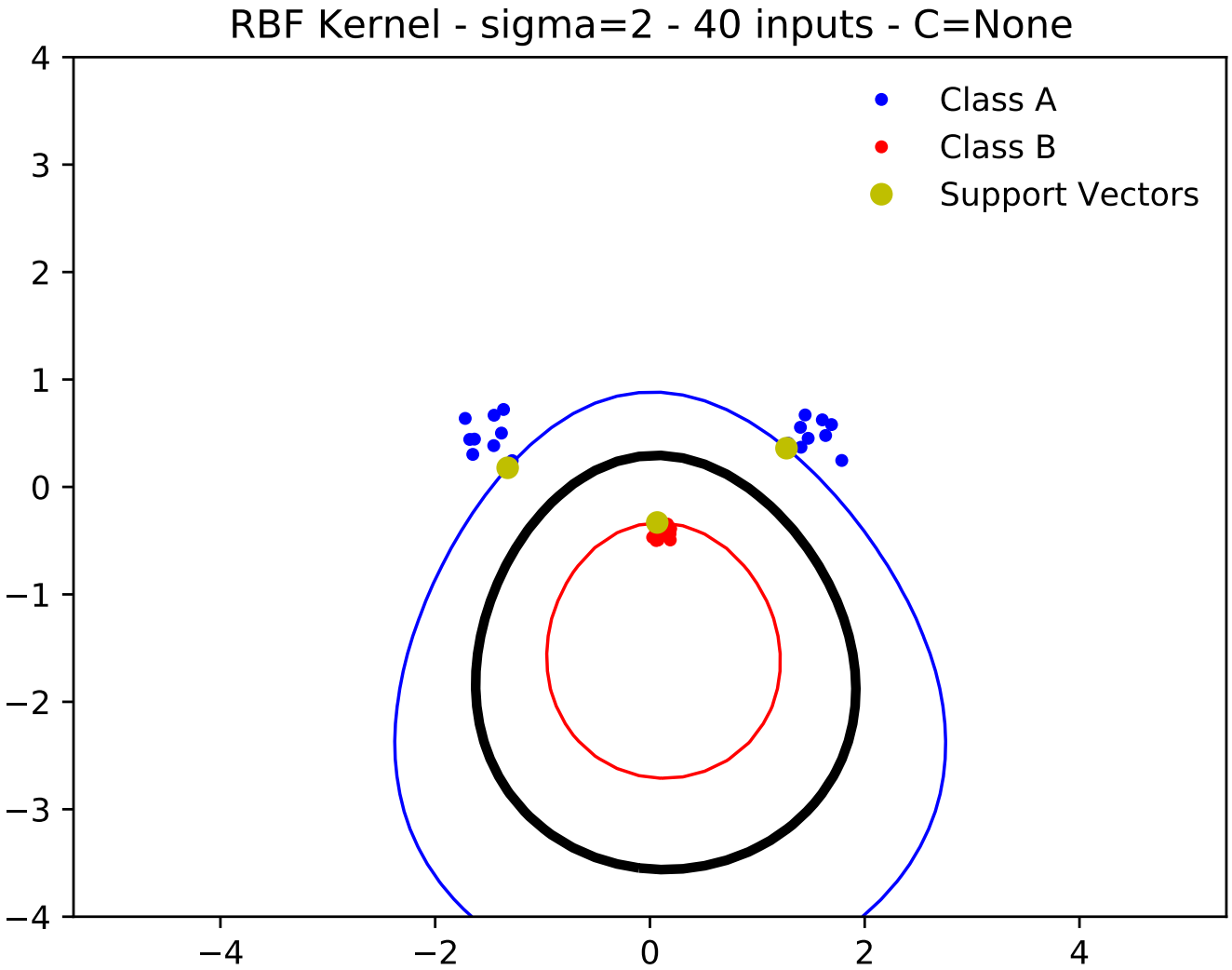
Influence of σ - RBF Kernel - Assignment 3



Influence of σ - RBF Kernel - Assignment 3



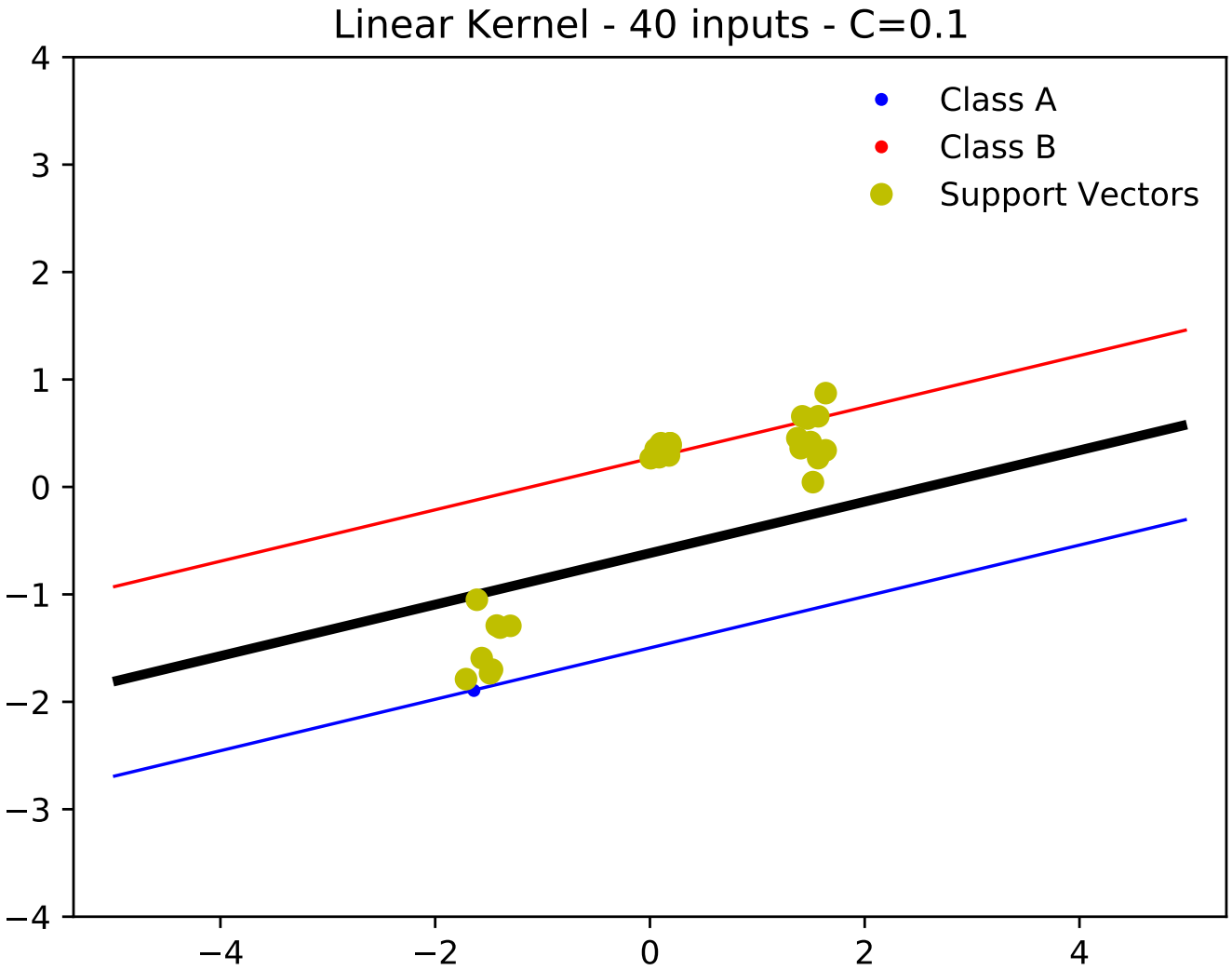
Influence of σ - RBF Kernel - Assignment 3



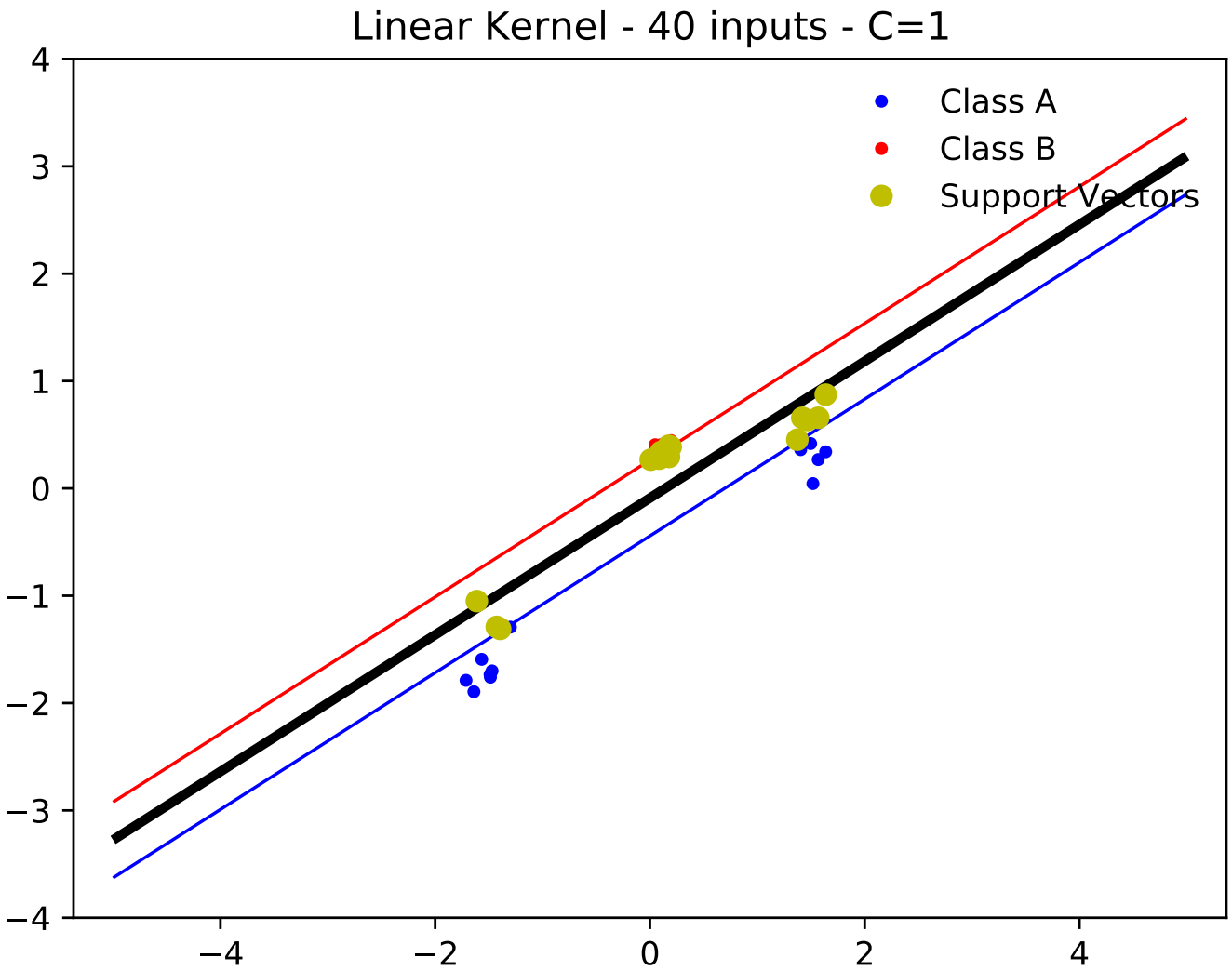
Influence of σ - RBF Kernel - Assignment 3

- As σ increases, we are increasing the smoothness of the boundary
- As the complexity decreases, so does variance, increasing the bias

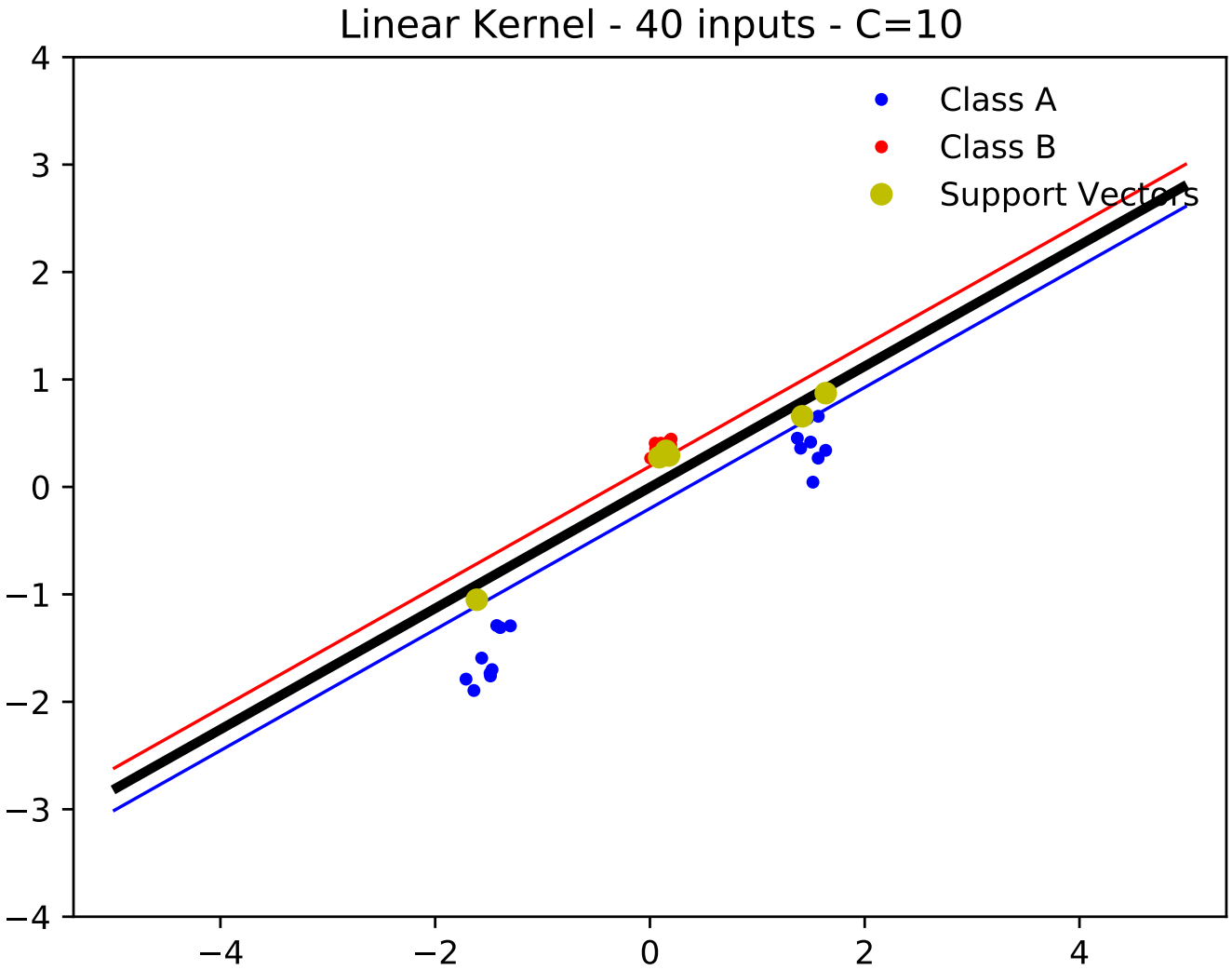
Influence of C - Linear Kernel - Assignment 4



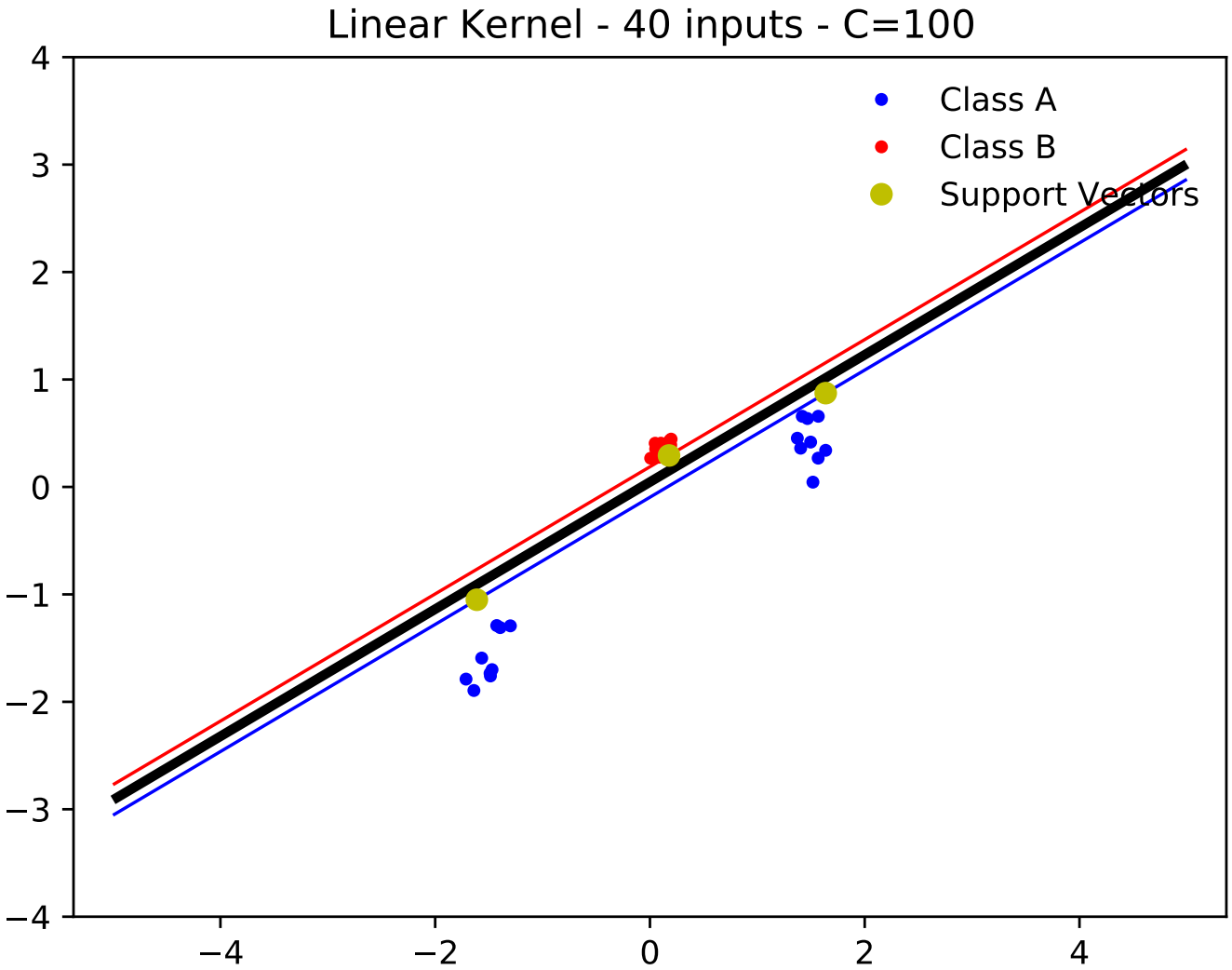
Influence of C - Linear Kernel - Assignment 4



Influence of C - Linear Kernel - Assignment 4



Influence of C - Linear Kernel - Assignment 4



Influence of C - Linear Kernel - Assignment 4

- As we increase C, we are decreasing the tolerance for error, thus also decreasing the margins
- As we decrease C, margins become larger and include more data points as we tolerate more error
- Very high values of C might lead to overfitting, while very low values can lead to underfitting, even in linearly separable data

Assignment 5

- The number of support vectors should not be very high, as that would represent overfitting
- If a model shows a very high number of support vectors, it can be an indication to increase slack and/or try a simpler model
- The same rationale applies vice-versa