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Exercise 11

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Problem 1. (*Kernel Methods Numerical Simulation*) In this exercise, various SVM algorithms are applied to the dataset `NL2classPub.txt`. The dataset is automatically labeled with -1 and 1.

- a) Apply linear SVM algorithm to the dataset. Find supporting vectors and the separating hyperplane. Compare the results with linear discriminant analysis.
- b) Apply Kernel SVM algorithm to the dataset. Use Gaussian kernel.
- c) Apply Kernel SVM algorithm to the dataset. Use Polynomial kernel of degree 2.
- d) Apply Kernel SVM algorithm to the dataset. Use Polynomial kernel of degree 3.
- e) Apply Kernel SVM algorithm to the dataset. Use Polynomial kernel of degree 4.

Problem 2. (*Polynomial Kernel*)

Suppose that a Kernel is given by $K(\mathbf{x}, \mathbf{z}) = (\mathbf{x}^T \mathbf{z} + c)^d$ where $\mathbf{x}, \mathbf{z} \in \mathbb{R}^p$, $c \in \mathbb{R}$, $d \in \mathbb{N}$, $d \geq 2$. Suppose that the feature space is of dimension $\binom{p+d}{d}$ and it contains all monomials of degree less than or equal to d . Determine $\phi(x)$.