Machnine Learning (PDEEC0049)

Homework 3

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November 24, 2014

1 Problem 1

2 Problem 2

3 Problem 3

Following the calculation below, we ensure that the there is no difference in solutions obtained with two kernels provided in the problem

Machine Learning 24/11/2014

HW3

(3) from SVM

We know that for dual rep.

$$\operatorname{argmax}_{\lambda} \sum_{n=1}^{N} \lambda_n - \frac{1}{2} \sum_{ij} \lambda_i \lambda_j y_i y_j x_i^T x_j$$

from the dual Lagrangian form:

$$\sum_{n=1}^{N} \lambda_n - \frac{1}{2} \sum_{n=1}^{N} \sum_{m=1}^{M} \lambda_n \lambda_m y_n y_m x_m^T x_n$$

$$0 < \lambda_n \leq C$$

$$\sum_{n=1}^{N} \lambda_n y_n = 0$$

for $K_1(x_1 : x_2)$ this will be

$$\sum_{n=1}^{N} \lambda_n - \frac{1}{2} \sum_{n=1}^{N} \sum_{m=1}^{M} \lambda_n \lambda_m y_n y_m K_1(x_1 : x_2) \; -($$

$$0 < \lambda_n \leq C$$

$$\sum_{n=1}^{N} \lambda_n y_n = 0$$

for $K_2(x_1 : x_2) = 1 + K_1(x_1 : x_2)$ this will be

$$\sum_{n=1}^{N} \lambda_n - \frac{1}{2} \sum_{n=1}^{N} \sum_{m=1}^{M} \lambda_n \lambda_m y_n y_m K_2(x_1 :$$

$$\Rightarrow \sum_{n=1}^{N} \lambda_n - \frac{1}{2} \sum_{n=1}^{N} \sum_{m=1}^{M} \lambda_n \lambda_m y_n y_m (1 + K_1(x_1 :$$

$$\Rightarrow \sum_{n=1}^{N} \lambda_n - \frac{1}{2}\sum_{n=1}^{N}\sum_{m=1}^{M} y_n y_m \lambda_n \lambda_m - \frac{1}{2}\sum_{n=1}^{N}\sum_{m=1}^{N} y_n y_m \lambda_n \lambda_m K_1(x$$

$$0 \le \lambda_n \le 1$$

$$\sum_{n=1}^{N} \lambda_n y_n = 0 \qquad \text{— (2)}$$

The only difference in (1) & (2) is $\Rightarrow$

$$(1) - (2) = -\frac{1}{2}\sum_{n=1}^{N}\sum_{m=1}^{N} y_n y_m \lambda_n \lambda_m \qquad \text{— (3)}$$

As the common constraint is $\sum_{n=1}^{N} y_n \lambda_n = 0$

from that the term at (3) becomes zero.

Hence there is no diff. & Sol^n are essentially equal.

4 Problem 4

Please run the testDAG to view the plots.

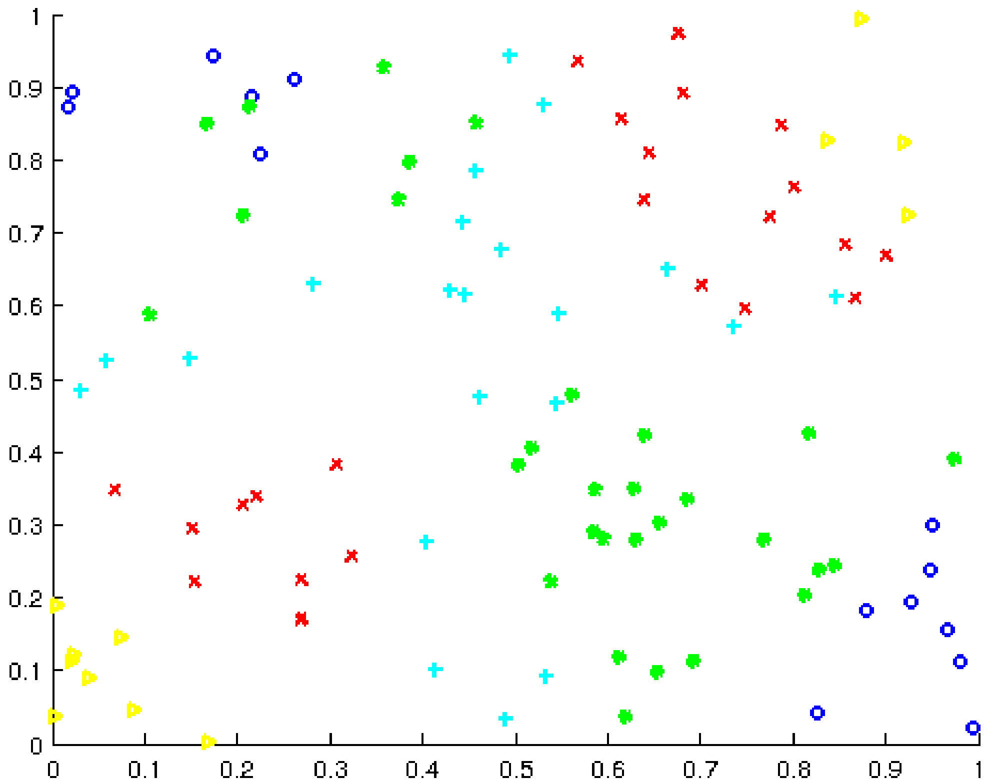

Figure 1: training set

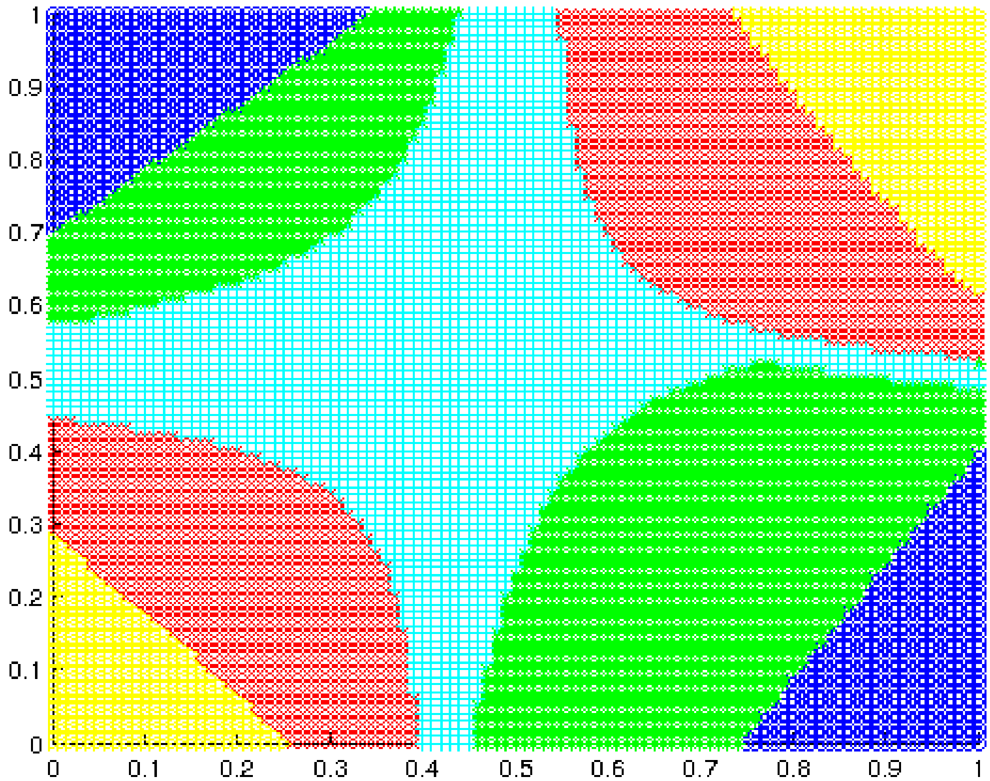

Figure 2: From the libsvm function svmtrain

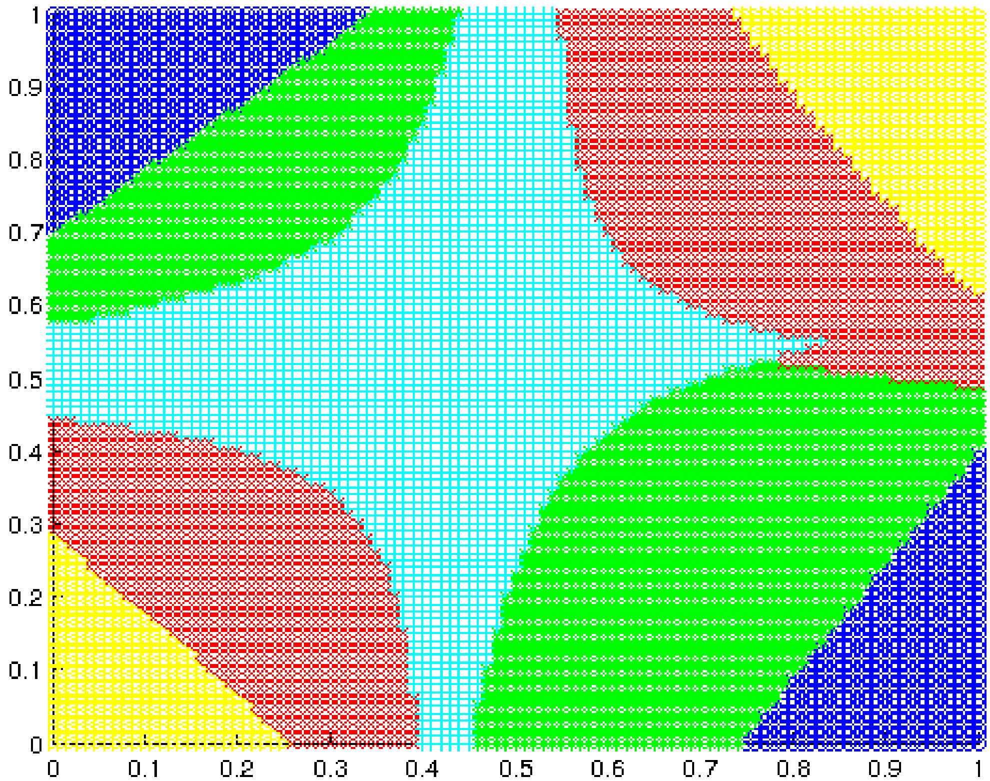

Figure 3: from the SVM DAG function basicsvmtrain and basicsvmpredict