# Exercises for module
# Technical Neural Networks (MA-INF 4204), WS22/23

# Assignments Sheet 10, due: Monday 9.01.2023

19.12.2022

| Group | Name | 60 | 61 | 62 | 63 | 8x8 | 65 | 66 | $\sum$ Sheet 10 |
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## Assignment 60 (3 Points)
Explain how the inequality is used within support vector machines to guarantee that all patterns are separated correctly by the hyperplane.
$y_i(\langle \vec{\mathbf{w}}, \vec{\mathbf{x}}_i \rangle + b) \geq 1.0$

## Assignment 61 (3 Points)
Calculate the extrema (maxima and the minima) of the following function
$f(x, y, z) = x + y - z$
with the constraints
$x^2 + y^2 + z^2 = q$, with $q = \frac{3}{100}$.

Use the method of Lagrange Multipliers.

## Assignment 62 (2 Points)
Describe and use a way to check if the found extrema from assignment 61 are a minimum or a maximum.

## Assignment 63 (3 Points)
The function $\theta$ maps points $(x_1, x_2)$ from the 2-dimensional space $\mathcal{G}$ onto points $(z_1, z_2, z_3)$ in a 3-dimensional feature space $\mathcal{F}$.
$\theta(x_1, x_2) = \left( z_1 = x_1, z_2 = x_2, z_3 = (x_1 + x_2)^2 \right)$

Create a *decision function* $f(x_1, x_2)$ that is using a hyperplane $H(z_1, z_2, z_3)$ in feature-space $\mathcal{F}$, to implement the Boolean function XOR $(x_1, x_2)$.

## Assignment $2^6$ (4 Points)

Derive the Dual Form $D(\alpha)$ of the SVM optimization problem.

Start with the primal form $L(\vec{\mathbf{W}}, b, \vec{\alpha})$ set the derivatives to zero, and insert the results into the primal form.

(You can use literature to solve this task, if you cite it in a correct scientific way).

## Assignment 65 (2 Points)

Explain the terms: **Cross Validation** and **Grid Search** in connection with Support Vector Machines.

You are explicitly encouraged to use literature to solve this task.

## Programming assignment PA-G (10 Points, Due: Monday 9.01.2023 )

Use *Support Vector Machines, SVM* for the task of binary classification, and test the capabilities of these SVMs using training data sets and testing data sets.

You should use a freely available SVM implementation.

Take the implementation (operating system, interface) that you are familiar with, and that is most suited for your experience.

Make yourself familiar with the usage of this software and especially the parameters and options. Tell us which implementation you have used, and motivate your choice.

To practice, train the SVM with the data points `PA-G-train-t1.txt` using one of the SVM implementations, and test the classification on the respective test set `PA-G-test-t1.txt`.

Visualize the result, and answer the following questions:

What kernel showed to be most appropriate for this data?

What are the support vectors for this data?

What parameters were necessary to adjust? Name, and explain the parameters, and discuss their role.

Do the above steps for at least two of the data sets

with training data `PA-G-train-t1.txt` to `PA-G-train-t6.txt`

and the test data `PA-G-test-t1.txt` to `PA-G-test-t6.txt`.

## Assignment 66 (2 Points)

*Have a Merry Christmas !*

    *and a*

*Happy, Healthy, Successful and Peaceful New Year 2023!*