Optimization – Laboratory 1
Function aproximation

The Matlab files corresponding to this lab are available on the course' website. The data set is chosen based on the number assigned in the column **P1** the current status.

Consider the following functions:

1. $f(\mathbf{x}, k) = x_1 k^{x_3} e^{-x_4 k} + x_2$
2. $f(\mathbf{x}, k) = \frac{x_1}{1+e^{-\frac{k-x_2}{x_3}}} + x_4$
3. $f(\mathbf{x}, k) = x_1 e^{-x_3 k} + x_2$

where **x** are the unknown parameters, and the measured data and the corresponding time instants are given in the electronic appendix. The first index in the name of each data file indicates which function should be considered. For instance, $trace1_{25}$ contains the 25th data set for the first function.

Requirements:

- Determine the unknown parameters **x** of the function. To define the optimization problem, we use e.g., the squared error, i.e., the function to be minimized is

$$e_{se}(\mathbf{x}, \hat{\mathbf{x}}) = \sum_{i=1}^{m} (f(\mathbf{x}, k_i) - f(\hat{\mathbf{x}}, k_i))^2$$

  Hint: Use Matlab's *fminunc* or *fminsearch* functions. *fminunc* is a trust-region/line-search based method, while *fminsearch* uses the Nelder-Mead method. They are local optimization methods and require defining the *objective function* and an *initial point* around which to search for a solution.

- Plot the data and the approximation in MATLAB.