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Exercise Sheet 4

Presentation during exercises in calendar week 23

In this exercise we want to solve different classes of optimization problems using the python module scipy. Follow the online tutorial and make use of the provided jupyter notebook: `https://docs.scipy.org/doc/scipy/reference/tutorial/optimize.html`

Exercise 4.1 – Linear Optimization Problem (LP) Solve the following LP using Linear Programming:

`https://docs.scipy.org/doc/scipy-0.15.1/reference/generated/scipy.optimize.linprog.html`

$$\begin{aligned} \min_x F &= -4x[0] + 2x[1] \\ \text{subject to:} & \\ -5x[0] + 1x[1] &<= 6 \\ x[0] + 5x[1] &<= 7 \\ x[1] &>= -3 \\ -inf <= x[0] &<= inf \end{aligned} \tag{1}$$

Exercise 4.2 – Quadratic Optimization Problem (QP)

Solve the following QP using the Sequential Least SQuares Programming (SLSQP) solver of scipy-optimize:

$$\begin{aligned} \min_x F &= x[1]^2 + 4x[2]^2 - 32x[2] + 64 \\ \text{subject to:} & \\ x[1] + x[2] &<= 7 \\ -x[1] + 2x[2] &<= 4 \\ x[1] &>= 0 \\ x[2] &>= 0 \\ x[2] &<= 4 \end{aligned} \tag{2}$$

by first transforming it into Matrix notation:

$$\begin{aligned} \min_x F &= (1/2) * x.T * H * x + c * x + c0 \\ \text{subject to:} & \\ Ax &<= b \end{aligned} \tag{3}$$

What is the solution with and without constraints? Compute the Jacobian of F and the Constraints and hand it to the solver. Use the timeit method and show how the computation time changes for the four cases:

- With constraints and with Jacobian
- With constraints and without Jacobian
- Without constraints and with Jacobian
- Without constraints and without Jacobian