Norwegian University of Science
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TMA4180
Optimization I
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Exercise set 8

1 Let

$$f(x) = x_1^4 + 2x_2^4 + x_1x_2 + x_1 - x_2 + 2.$$

Starting at the point $x_0 = (0, 0)$ compute explicitly one step for the trust region method with the model function $m(p) = f(x_0) + g^Tp + \frac{1}{2}p^TBp$, where $g = \nabla f(x_0)$, $B = \nabla^2 f(x_0)$, and the trust region radius $\Delta = 1$.

2 Let

$$f(x) = \frac{1}{2}x_1^2 + x_2^2,$$

let $x_0 = (1, 1)$, and define the model function $m(p) = f(x_0) + g^Tp + \frac{1}{2}p^TBp$ with $g = \nabla f(x_0)$ and $B = \nabla^2 f(x_0)$.

a) Compute explicitly the next step p in the trust region method using values of $\Delta = 2$ and $\Delta = 5/6$.

b) Compute for all $\Delta > 0$ the next step in the dogleg method.

3 Find (and simplify, if possible) the dual of the linear programme

$$\min c^Tx \qquad \text{subject to } Ax \geq b,\ x \geq 0.$$

4 Find the dual of the linear optimisation problem

$$5x_1 + 3x_2 + 4x_3 \to \min \qquad \text{subject to } \begin{cases} x_1 + x_2 + x_3 = 1, \\ x_i \geq 0, \quad i = 1, 2, 3, \end{cases}$$

and compute its (i.e., the *dual's*) solution.