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Übungen zu **Numerik (für Geowissenschaftler)**
Blatt 2

Ü1 (*Vector norms*) Sketch the sets

$$B_r = \{x \in \mathbb{R}^2 | \quad ||x||_r = (|x_1|^r + |x_2|^r)^{\frac{1}{r}} \leq 1\}$$

for

a) $r = 2$

b) $r = 1$

c) $r = 10$

d) $r = \frac{1}{2}$

Ü2 (*Modeling*) Discretize the differential equation $u''(t) = g(t), t \in (0,1)$, with $u(0) = u^0$, $u(1) = u^1$, for the parameter $h = \frac{1}{8}$.
How does the resulting linear system look like?[1]

Ü333 (*Linear equations*) The polynomial $h(t) = at^3 + bt^2 + ct + d, \ t \in \mathbb{R}$, should obey the following conditions:

$$\begin{aligned} h(0) &= 1 \\ h'(0) &= 0 \\ h(1) &= 0 \\ h'(1) &= 0 \end{aligned}$$

What are the coefficients a, b, c and d?
Sketch the graph of the solution h.

Ü4 (*Programming, matlab*) The `matlab`-function `hilb(n)` returns the *Hilbert-matrix* H with dimensions $n \times n$. Define the (solution-)vector $x =$ `ones(n,1)`, i.e. $x_i = 1, i = 1, ..., n$.
Now, try so solve for this exact solution x, by setting the right hand side b as $b := Hx$.
Use `matlab` to solve the linear system $H\hat{x} = b$.
What ist the difference between x and $\hat{x}$?

[1] $g(t), x^0, u^1$ are given!