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Fachbereich Mathematik und Statistik
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Optimierung
1. Programm

Implement the Armijo stepsize algorithm from the lecture using Matlab. For that purpose, write a function

```
t = armijo(fhandle, x0, d, t0, alpha, beta)
```

in a file `armijo.m`. The function returns the stepsize `t` that satisfies the Armijo condition. As input arguments the function accepts a function handle `fhandle`, initial point `x0`, descent direction `d`, initial stepsize `t0` and parameters `alpha` and `beta` as given in the lecture.

Implement the general descent method (Algorithmus 3.4) with direction $d_k := -\frac{\nabla f(x_k)}{\|\nabla f(x_k)\|}$ using the Armijo stepsize strategy. Write a file `gradmethod.m` for the function

```
X = gradmethod(fhandle, x0, epsilon, t0, alpha, beta)
```

with initial point `x0`, tolerance `epsilon` for the termination condition $\|\nabla f(x_k)\| < \epsilon$, and parameters `t0`, `alpha` and `beta` for the Armijo rule.

The program should return a matrix `X = [x0; x1; x2; ...]` containing the iteration history.

Test your program by using the following functions and parameters:

1. The function $f(x) = \cos(x)/x$ with $x \in [2\pi, 6\pi]$, `epsilon=1.0e-3`, `t0=1`, `alpha=1.0e-2` and `beta=0.5`. Consider two different initial points `x0`: `x0=12` and `x0=14`. Explain the results.
2. The Rosenbrock function $f(x) = 100(x_2 - x_1^2)^2 + (1 - x_1)^2$, $x = (x_1, x_2)^T \in \mathbb{R}^2$, with `x0 =[1;-0,5]`, `epsilon=1.0e-2`, `t0=1`, `alpha=1.0e-2` and `beta=0.5`. Comment the result.

To this end, write function files `cosinus.m` and `rosenbrock.m` which accept an input argument `x` and return the function and gradient values in `x`.

Finally, write a file `main.m` where you set the parameters and input functions and call the descent algorithm.