Optimization for Engineers

1. Lab Exercise

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Assignment 1: Bisection Line Search - 5 Credits

Complete the template **bisectionLineSearch.m**,
for minimizing $\phi(t) = f(x_k + td_k)$ in the interval $[t_l, t_r] := [0, 1]$.

a) Input: f, x_k, d_k; choose $\varepsilon > 0$.

b) Calculate $\phi_l \leftarrow f(x_k)$, $\phi_r \leftarrow f(x_k + d_k)$.

c) While $|t_l - t_r| > \varepsilon$ do

i) If $\phi_l \leq \phi_r$ set $t_r \leftarrow \frac{t_l + t_r}{2}$ and $\phi_r \leftarrow f(x_k + t_r d_k)$.

ii) Else set $t_l \leftarrow \frac{t_l + t_r}{2}$ and $\phi_l \leftarrow f(x_k + t_l d_k)$.

d) If $\phi_l \leq \phi_r$ return $t_* \leftarrow t_l$, else return $t_* \leftarrow t_r$.

Hints:

a) In Matlab use **=** instead of $\leftarrow$ to overwrite a variable.

b) Use **getValue(f_handle,x_k)** to get the function value at point x_k.

c) Use **abs(x)** the get the absolute value of x.

d) Test the algorithm with the command **sheet01Script(1);**
(autocomplete with tab key).

e) Do not set any input arguments, this is done by the **sheet01Script**.

Assignment 2: Backtracking Line Search - 5 Credits

Complete the template **backtrackingLineSearch.m**,
for minimizing $\phi(t) = f(x_k + td_k)$ in the interval $(0, 1]$.

a) Input: f, x_k, d_k; choose $\sigma, \beta \in (0, 1)$.

b) Set $t_j \leftarrow 1$. If $\nabla f(x_k)^\top d_k < 0$ is wrong, throw an error.

c) While $f(x_k + t_j d_k) > f(x_k) + t_j \sigma \nabla f(x_k)^\top d_k$ do

i) $t_j \leftarrow t_j \beta$.

d) Return $t_* \leftarrow t_j$.

Hints:

a) Use **getGradient(f_handle,x_k)** to get the gradient vector at point x_k.

b) Throw an error with **error('someStringDescribingTheError');**
Be creative and formulate your personal error message string!

c) Transposition in Matlab: Use **d_k'** to get $d_k^\top$.

d) Consider storing the constants $f(x_k)$ and $\sigma \nabla f(x_k)^\top d_k$ in local variables.

e) Consider defining an anonymous function like $\phi(t_j) = f(x_k + t_j d_k)$.

f) Test the algorithm with the command **sheet01Script(2);**

Evaluation and Upload

Hand in the following files (unzipped) to StudOn using the **Exercises** object again:

a) **bisectionLineSearch.m**

b) **backtrackingLineSearch.m**

You can review the solution, comments on your returned files and your achieved credits in one week in the **Exercises** object.