NUMERICAL OPTIMISATION
ASSIGNMENT 5

MARTA BETCKE
KIKO RUL·LAN

EXERCISE 1

(a) Implement the BFGS method by modifying the `descentLineSearch` function. More help is provided inside Cody Coursework.
Submit your solution via ***Cody Coursework****.* **[20pt]**

(b) Make your implementation efficient as explained in the lecture i.e. avoid explicitly forming the inverse Hessian matrix H_k. Copy the code lines implementing the update of H_k into your report and briefly explain what makes the implementation efficient.
Submit your solution via ***TurnitIn****.* **[20pt]**

EXERCISE 2

Implement the SR-1 method by modifying the `trustRegion` function. More help is provided inside Cody Coursework. **Note:** Here you are not expected to provide an efficient implementation as it would require some changes to `solverCM2dSubspaceExt` which are out of scope at this point.
Submit your solution via ***Cody Coursework****.* **[20pt]**

EXERCISE 3

(a) Minimise the function

$$f(x, y) = (x - 3y)^2 + x^4$$

using `BFGS` (**Ex 1a**) and `SR1` (**Ex 2**) methods starting from $x_0 = (10, 10)^T$. Compare the performance of the methods. To this end provide any parameters and plots that you consider relevant.
Submit your solution via ***TurnitIn****.* **[20pt]**

(b) Both implementations return a sequence of matrices as a field of the `info` structure:

(i) $\{H_k^{\text{BFGS}}\}_{k\geq 0}$ when using `BFGS`,
(ii) $\{B_k^{\text{SR1}}\}_{k\geq 0}$ when using `SR1`.

Plot the error of these sequences obtained in **Ex 3a** with respect to the matrices they approximate. In particular, plot

(i) $\{||I - H_k^{\text{BFGS}}\nabla^2 f(x_k)||_2\}_{k\geq 0}$,
(ii) $\{||B_k^{\text{SR1}} - \nabla^2 f(x_k)||_2\}_{k\geq 0}$,

and explain your results.
Submit your solution via ***TurnitIn****.* **[20pt]**

Remark. The submission to ***TurnitIn*** should not exceed 4 pages. Avoid submitting code unless explicitly asked for and focus on explaining your results.