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CS 326: Computational Methods for Data Science

February – June 2022

Assignment I (**due 28 February 2022**)

Full Marks: 30

1. Write Python codes of two line search algorithms: Fibonacci search and Golden Section for the problem given in example 8.1.2 (same as in 8.1.3) in *Nonlinear Programming*, Bazaraa et al.
   a. **[10 marks]** Generate and print the values given in Table 8.1 (for Golden section method) and Table 8.2 (for Fibonacci method) and check if you get the same results as in the book.
   b. **[5 marks]** Check if the two search methods are asymptotically identical (run the code for 20 iterations and plot *iteration number* vs. *interval length* for the two methods)
   c. **[5 marks]** Next use the scipy.optimize.minimize_scalar function and verify your results of Golden section method.
2. **[10 marks]**

> Consider approximate line search on $f(x_1, x_2) = x_1^2 + x_1x_2 + x_2^2$ from $x = [1, 2]$ in the direction $d = [-1, -1]$, using a maximum step size of 10, a reduction factor of 0.5, a first Wolfe condition parameter $\beta = 1 \times 10^{-4}$, and a second Wolfe condition parameter $\sigma = 0.9$.

Using the scipy.optimize.line_search function, find the minima of this function. This library finds a solution that satisfies strong Wolfe conditions, i.e., it satisfies both first and second Wolfe conditions. Set initial point x_k=[1,2], initial direction p_k=[-1,-1], first Wolfe condition parameter c_1=0.0001 (i.e., β=0.0001), curvature condition (second Wolfe) parameter c_2=0.9 (σ=0.9), Maximum step size amax =10 and Maximum number of iterations maxiterint =10. Although the problem above asks to use a reduction factor of 0.5, the library increases alpha by a factor of two on each iteration (you can see it in line 442 of the source code).

Instructions:

1. Submit two files in LMS – (i) the code files and (ii) a pdf file with the report showing graphs, tables, comparative analysis etc.
2. How to save your file : **YourName_CDS_Assignement_1.pdf.**