Institute of Scientific Computing
Technische Universität Braunschweig
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Winter Term 2018/19
Assignment 7
Due date: 07.12.2018

Introduction to Scientific Computing

Instructions:

* *Students that ATTENDED the tutorial on 23.11. need to prepare solution for the problems that were given during the tutorial, and need to work this week in groups that were formed during the tutorial.*
* *Students that DID NOT ATTEND the tutorial on 23.11. need to work on the Exercise 3. For this problem one can work in groups consisting of 4-5 people.*
* *Assignment 7 has 48 points, 18 task 1, 14 task 2, 16 task 3. It is a lot of work and we know that. Next assignment will be less work.*

Exercise 1: Write stationary Newton solver without and with restarts.
Write damped Newton Solver, a Newton solver with line search. You can start programming without understanding according to algorithm scheme uploaded to studIP and understand on wednesday. Mind that on that page $|||F||| = ||(Df)^{-1}(\vec{x}_k)F||$.
Make convergence plots, using last assignments function.

Note: See wikipedia entry for backtracking line search for understanding line search in general better. In former versions of this task, Armijo line search was demanded. If you did that, stay with it. We switched because the monotony criterion for the damped Newton is easier to explain and to understand.

Exercise 2: Plot the pole example as contour plot. Run the methods on the pole example given in code with the given initial value and describe, plot the solution path into the contour plot, one plot each of the methods in question, and discuss what happens, especially why some algorithms work and others dont.

Exercise 3: Formulate Kepler problem as a Hamiltonian system. Explain how the equations are derived and why the Hamiltonian is conserved. Think of advantages of this way to see it.

Hint: In Stud.IP there is the file "Spring-Mass System.pdf". In this file you can also find the information related to Kepler problem.