SI211: Numerical Analysis
Project

Prof. Boris Houska

Deadline for the report: Dec 13, 2018;
Project presentations will take place on Dec 3 and Dec 6, 2018.

In this project we ask you to work on an optimization problem of your own choice. The only requirements are that you

- write your problem in the form

$$\min_{x \in \mathbb{R}^n} \ f(x) \ ,$$

where f should have a "meaningful" interpretation. The parameter vector x should be at least 2 dimensional in order to pass.

- implement an exact Newton method to solve your problem numerically, plot the distance of the iterates of the method to the optimal solution (use logarthmic scales!) and discuss your results.

- Optional: if you want to come up with your own opimization method instead of implementing an exact Newton method, please discuss this with prof. Houska or one of the TAs. If you have a good idea, we will accept this as a project topic, too, as long as the project is related to the methods that are discussed in the lecture.

The project consists of two parts: a report (≥ 3 pages) and a presentation. Your presentation should consist of 5 slides and you will have to present either on Dec. 3 or on Dec. 6, 2018.

1 Project Report

Write a short report (preferably in Latex) containing the following sections:

1. *Title and Authors* (find a good title + name of the author)

2. *Introduction* (describe the problem that you want to solve and cite relevant literature)

3. *Problem Formulation* (introduce a suitable mathematical notation do define the problem that you are trying to solve)

4. *Solution Method* (explain how you have implemented the Newton and Gauss-Newton method (please also submit your code along with the report) and compare their convergence rates.

5. *Numerical Results* (plot/visualize and explain your numerical results)

6. *Conclusion* (summarize the highlights of your results)

Please do keep in mind that the particular topic of your project is less important as long as it has something to do with numerical optimization. We take into account creative ideas, good writing style (write in full, short sentences, avoid complicated grammar if possible, write in logical paragraphs, find good section/subsection titles), technical correctness, effective notation, impressive and meaningful visualizations that are explaining that highlight the key points and novelty of your results, etc.. Please do consult with the TAs, as they might give you examples for research papers/reports that are relevant for you and can help you to learn about scientific writing. Also, you might search in google/baidu or other search engines for "scientific writing". Search for a scientific writing tutorial, e.g., from MIT or Stanford online courses (this is not strictly required for this course, but you will need this do to research!).

2 Presentation

Every group will get a 3-5min time slot on Dec 6 or Dec 11 to present their project (+ 4min presentation + 1min for questions from the audience). The presentation should consist of max 5 slides, preferably in pdf format. In order to "pass", you will need to:

1. prepare 5 clean and efficient slides, namely,

   - one title slide containing the project title and the name of all authors
   - one slide introducing/explaining the problem that you are solving
   - one slide about the numerical solution method/software implementation
   - one slide about the numerical results
   - one conclusion slide summarizing and assessing your results

   Don't use small fonts.

2. present your work freely in English and by using your own words

3. answer questions by the professor / TAs, or other people from the audience.