Information Concerning the Class

Nonlinear Optimization
Summer Term 2023

Who are You and What Do You Expect?

- B.Sc. Mathematics
- M.Sc. Mathematics
- M.Sc. Scientific Computing
- B.Sc. Computer Science
- M.Sc. Data and Computer Science
- others?

What Is This Class About?

Minimize	$f(x)$	where $x \in \mathbb{R}^n$	(objective function)
subject to	$g_i(x) \leqslant 0$	for $i = 1, \ldots, n_{\text{ineq}}$	(inequality constraints)
and	$h_j(x) = 0$	for $j = 1, \ldots, n_{\text{eq}}$	(equality constraints)

Content of This Class

- Chapter 0: Introduction
- Chapter 1: Numerical Techniques for Unconstrained Optimization Problems
- Chapter 2: Theory for Constrained Optimization Problems
- Chapter 3: Numerical Techniques for Constrained Optimization Problems
- Chapter 4: Differentiation Techniques

Goals of This Class

We would like to enable you to

- get to know a number of prominent numerical techniques to solve unconstrained and constrained problems
- get to know the optimality conditions for constrained optimization problems
- get hands-on experience in implementing and testing a few algorithms yourself
- learn about the use of numerical linear algebra techniques in optimization
- understand possibilities to obtain derivatives of functions

Some Highlights of This Class

- conjugate gradient (CG) method
- sequential quadratic programming (SQP) methods
- Karush-Kuhn-Tucker (KKT) conditions
- algorithmic differentiation (AD)

The Team

- Prof. Dr. Roland Herzog
- Dr. Georg Müller
- Dr. Evelyn Herberg
- M.Sc. Masoumeh Hashemi

Reach us at

scoop-teaching@uni-heidelberg.de

Class Concept

1. lectures
2. tutorials/labs
3. homework problems
4. exam

Lectures

- Mondays 11:15 in the Mathematikon lecture hall
- Tuesdays 11:15 in the Mathematikon lecture hall

- We will discuss selected parts of the lecture notes.
- We will discuss quiz problems upon request and answer your questions.

Recommendations:

- Study the week's material in the lecture notes before (or after) coming to the lectures.
- Try to answer the quiz questions.
- Bring any questions you have to the lecture and ask them.

Tutorials/Labs

- work on homework problems
- preferably in small groups
- tutors will offer help

Tutorial times (begins this Wednesday, April 19, 2023)

- Wednesdays 14:00
- Wednesdays 16:00
- Thursdays 14:00
- Fridays 11:00

in Mathematikon (INF 205), SR 11 (5th floor)

Pick your group!

Homework

- weekly problem sheets, posted on Mondays
- all problems are „homework“ problems
- problems are a mixture of theory/programming
- homework is due on Tuesdays the week after
- group work is encouraged
- submission (one per person) via Moodle
- homework will be „graded“ (pass/fail)
- sample solutions will be provided after the closing date
- compare your solution with the sample solution
- in case of questions, please ask your tutor

The successful completion of all problems on all but one (12 out 13) problem sheets is required for admission to the exam!

Exceptions and Organization

- **Tomorrow at 11:15** (April 18) we will meet in INF 328, SR 25 (ground floor)!
- no lectures on Monday, May 1 (Labor Day) and Monday, May 29 (Whit Monday)

  Nevertheless, we will keep to the weekly structure of the lecture's content.
- no tutorials on Thursday, May 18 (Ascension Day) and Thursday, June 8 (Corpus Christi)

  Please come to another tutorial if you are affected.
- Please see the `schedule.pdf` for details.
- You will find all information at `https://tinyurl.com/scoop-nlo`.

Exam

Depending on how many of you want to take the exam:

- oral examination or
- written examination (120 minutes)

The successful completion of all problems on all but one (12 out 13) problem sheets is required for admission to the exam!

The exam will cover the material of the lecture notes (unless otherwise indicated).

Coding a program will not be required in the exam.

Summary of the Offerings

- lecture notes
- two weekly lectures
- weekly tutorials/labs
- homework problems and sample solutions
- `https://tinyurl.com/scoop-nlo`
- scoop-teaching@uni-heidelberg.de

What We Expect

- Prepare for the components that you will be using.
- Actively participate in the components that you are using.
- Give us feedback.

Immediate TODOs

- pick a tutorial group
- register for the course in Moodle (for homework submission)
- get the lecture notes
- study the lecture notes until „end of week 1“ marker

Any Questions?

Future Perspectives

- (Grundlagen der Optimierung in the Fall 2023)
- Infinite-Dimensional Optimization in the Fall 2023
- Convex Optimization
- Optimization on Manifolds
- Optimization in Machine Learning
- Optimization with (Partial) Differential Equations

- interesting topics for seminars, theses and software practicals in our group *Scientific Computing and Optimization (SCOOP)*

We are looking forward to working with you!