SF252 Matrix computations for large-scale systems
7.5 ECTS

Course data

- Study period 2. Exam in January. Lectures: 15. Exercise sessions: None
- Computer homeworks: 3 corresponding to 3.5 ECTS
- Exam: corresponding to 3.5 ECTS
- Students following the course: 13 (+ 7 PhD students taking SF3580), Students taking the exam: 10, Registered students: 11, Examinationgrad: 64%, Prestationsgrad: 78%
- Four blocks
  - Eigenvalue problems
  - Linear systems
  - QR-method
  - Matrix functions
- Learning activities:
  - Lectures
  - Homeworks
  - Wiki – course training area
  - Online video demos

Aim

In this course we will learn some of the most common numerical techniques and algorithms used to efficiently solve problems expressed using large matrices. We focus on detailed understanding about the performance of these methods when they are applied to large-scale systems and study topics such as convergence, accuracy and efficiency.

Changes compared to last year

More online lecture notes have been written. They are now complete in the sense that all main points in the course are in the lecture notes, exactly in the order covered in the course. The lecture notes corresponding to some blocks require reading in the course book and specific page references are given.

The concept of course wiki has been introduced. The students (and teacher) are expected to answer and pose exercise questions on an particularly designed web page. The work on the wiki is coupled to the homework. The teacher checks the questions and solutions, and a selected set of the course wiki questions are marked as appropriate for exam preparation. The exam preparation questions are prepared in a separate PDF-file.

The lecture style has changed and now include more slides made available online, but still focused on black-board teaching.

More online video material have been added. One subblock was only covered in the form of an online video lecture (derivation of Lanczos from Arnoldi's method).

Conclusions

The teachers perceived the students learning as high, concluded from, e.g. activities during the lectures, answers to exam questions. One exam question was inspired by a research

paper and was solved by half of the students. The teacher also feels that the exam was at least as difficult this year, but the students results were considerable better.

The experience with the course wiki was very positive for the teacher and appears to have been well received by the students. The course wiki added another way to interact with the students, which was perceived to increase the activity of the students outside the class-room. The course wiki seemed to increase the student motivation of the ambitious students. It provided more training material for less ambitious students, and the training material can be recycled next year. In total 132 questions were marked as appropriate for exam preparation (out of more than 200 questions posed in total).

The students view on the course-training wiki was consistent, based on direct input from students and course evaluation:

"Wiki is the best study experience I had in my entire student life."

"... a lot of nice questions were posted and the learning due to these is substantial. "

The test with online video lecture subblock was successful, since the students could answer questions related to it. If this is done for more parts of the course it is important to systematically connect / follow-up the subblock to other learning activities (lectures or wiki).

Proposed changes for next year

The online lecture notes corresponding to block A can be completed with basic methods. Online lecture notes for Block B regarding CGNE-methods can be extended.

The organization of the course wiki needs some fine-tuning. The requirement to pose and answer questions should be restricted only to those who hand in the homework by the deadline for bonus, since late posts in a blocks were often of lower quality and has low value from a learning perspective. The course wiki can be processed further by the teacher before moving on to the next course block, e.g., by completing/adding more questions and marking some questions as suitable for exam preparations. Such a moderator activity can be suitable for TA.

In the course evaluation students requested that the first lecture of the blocks put the topic more into context (with further examples), e.g., by comparison to basic matlab commands like eigs, backslash, etc. I will modify the introduction of the blocks.

Further tests with subblocks where the lecture is a video can be done.

Reactions on student comments:

"I think it would be better if block 4 was more like the previous blocks (in a learning perspective) since as a student I am used to how you are teaching and then suddenly in the end it is not the same, then we need to get used to how you learn again and that is a little time consuming in my perspective."

I will attempt to increase the consistenty in style between blocks

"It would have been nice to see how GMRES compares to other iterative solvers for linear systems, such as the Jacobi and Gauss-Seidel methods for discretized Poisson equations which often arise in computational physics."

The scope of the course is already big, and this can unfortauntely not be easily included in this course.