

SF2524 Matrix computations for large-scale systems
7.5 ECTS

Course data

- Study period 2. Exam in January. Lectures: 15. Exercise sessions: None
- Homeworks (3): corresponding to 3.5 ECTS
- Exam: corresponding to 4 ECTS
- Student results:
 - Students following the course: 14 (+ 2 SU-students)
 - Performance index: 72% (expected by Feb 15: 82%)¹
 - Examination index 57% (expected by Feb 15: 79%)
- Four blocks
 - Eigenvalue problems
 - Linear systems
 - QR-method
 - Matrix functions
- Learning activities:
 - Lectures (with black-board, slides and live programming)
 - Homeworks
 - Course training area (moderated wiki)
 - Online video demos
 - Quizzes

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

This is the first year we run this course in CANVAS. A wiki-course-training area was used previous year, but this year integrated into the CANVAS system (using the REST-API). The course training area was moderated by myself and a teaching assistant. We have added quizzes to the course this year, including one quiz involving (essentially) prerequisite knowledge. The exam points and layout was changed.

Conclusions

Overall the teacher is satisfied with the achieved level of understanding. The students results on exam and homeworks were satisfactory from teachers perspective. The course evaluation is consistent with the teachers view of the course.

Comments on changes from last year:

- The change to CANVAS system was perceived as positive. Student comments during course “It's great that all information is available in one place”. “I liked the

¹ Four students did not hand in their homework by the time of this course analysis, but are expected to be completed and reported by Feb 15.

implementation of canvas for this course.”

- The course training area (wiki) was positively perceived by both teachers and students. “Good and really helpful!”, “Working through the wiki is the best exam preparation you will ever get”. See longer comments from course evaluation below. The selected problems from previous year appeared valuable to students this year. The moderation worked smooth with a teaching assistant.
- The quiz concerning prerequisites appeared valuable for learning. In particular, in contrast to previous year, once we needed to use the Jordan decomposition, the students were not completely new to it, and appear to have achieved a deeper understanding of the derivation. The other quizzes, were not taken by so many students (see also comment below) and did not have the intended learning function.

Further interpretation of course evaluation:

The students perceived the course as medium to very difficult, which is interpreted as adequate for the student group. Students felt they learned the most from lectures and homeworks. The written course material PDF-files were seen as very useful. Those who did the wiki felt wiki made them reflect on the material more, and the exam preparation results from the wiki were useful. Students said the setup of the lectures were appropriate “It is very suitable to do numerics with theory on black board and live-programming on a computer”.

Several bachelor students attended the course, and perceived the course as difficult, but still very positive and received adequate grades. Some bachelor students (and other students) did not have the prerequisite knowledge in complex analysis (contour integrals and analytic functions).

Over all students were happy with the homeworks. Two students commented that some of the homework problems were easy or could be done without deep understanding (since the algorithms were given in the PDF-files).

In the exam several students failed to interpret a semilog-plot and its relation to convergence. Block 4 on matrix functions was perceived as the most fun block.

One student requested a couple of exercise session. I don't feel this is proportionate considering the size of the student group taking this course and the fact that they have moderated wiki as well as access to TA during specified hours.

For next year

We will certainly continue and develop the course training area (wiki). Further videos can be added. Some parts of the written PDF-files for block 1 and 3 can be slightly extended. If this is completed, the course can be based on the PDF-files instead.

The prerequisite quiz can be extended, e.g., two prerequisite quizzes (e.g. linear algebra, complex analysis). A quiz can be added about interpretation of semilog-figures and convergence factor / convergence order. The other quizzes can be integrated into the course in some other way to increase learning, for instance by changing them to pose slightly easier questions and make some of them mandatory (as a part of the homework).

Parts of the homeworks can be changed to be less straightforward to train more understanding, but maintaining the same difficulty level.

Selection of comments from course evaluation:

Questionnaire: Constructive comments on the learning experience of online learning activities:

a) the wiki

b) the quizzes

Student Answer:

a) I liked to think about what problem I want to get solved. Sometimes made me thinking out of the box (also in a bad way for others since I may have asked questions that are not important for this course anymore but that I would've liked to get solved actually). Sometimes I sadly had less time to properly solve harder questions or come up with appropriate good questions by myself due to a straight forward setting of the whole course.
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For the exam preparation: You said once in one of the last lectures: If you are able to solve the problems [in a self-critical way you will do well] in the exam. I totally have to agree! The summarized problems from last year were great and covered almost every single specific point of the topics we had. I used it a lot for preparation and it helped me very very much. Maybe you could enhance this to something like a question catalogue where you maybe modify some questions and add or remove some and enhance them further from year to year. They were just really great.

b) You already noticed it, that the quizzes were not used that much at all. I by myself really don't like the quizzes from canvas and [another] course I had to do like 15 and all of them were graded. Maybe it's not the best form to focus on.

Student Answer:

a) The wiki was really nice to work with. In this way you can help each other with the understanding of the course. Also the speed that the questions and answers were corrected was amazing.

b) I didn't really see the point of the quizzes. Maybe it's better to ask a question about those subjects in the regular homework.

Questionnaire: Constructive comments about

a) the lectures

b) the homework

c) the book & reading material

Student Answer:

a) I totally loved the idea of programming, you (the teacher) did some mistakes and solved them right ahead and explained those mistakes where you could sit in front of your own computers for hours for. The atmosphere was very private and I enjoyed that, gave me less a feeling of a lecture (which I find very dry). You tried to motivate us to participate but sadly we were rather quiet. I think especially in the size of this course you can use more interactive materials that gets us to think and react more during the lectures.

b) Oh I loved the homeworks. They were tough, but doable! A nice combination of programming and derivations. Loved how it was not too much just simple copy and paste of the algorithms from the lecture notes but rather implementing it for cases. I especially learned with the homeworks the difference between exact arithmetic and machine arithmetic since that was very nicely pointed out. The homeworks were also great for pointing out the specialities of the algorithms in a playful way, like why we sometimes use that and what are the benefits and disadvantages

c) [clip]

For the lecture notes they were awesome, I missed some lectures and I was fully able to read it afterwards. Nicely wrap up of all important stuff and algorithms. Liked how you didn't make people search for the final algorithms for hours between the pages and scrapping it together by yourself but directly summed it up in the end. That's the kind of sum up I would like to see in other courses more often. Also the hints for further reading in the book were great.

Student Answer:

a) The liveprogramming in the lectures was very usefull. Because I think it's always hard to convert the theory to practice and it's really nice to see some examples.

b) The homework was nice. It was a nice way to practice with the subjects.

c) The lectures notes are really nice and clear. I didn't have the book

Student Answer:

a) Very dynamic lectures, combining everything : blackboard, powerpoints, live demos with matlab, videos ... Everything was also put in a logic order : derivation of the algorithm on the blackboard -> live demos to illustrate that it works -> improvement of the algorithm -> live demos ... Very good and inspiring pedagogic methods !

b) In my opinion, homework had one problem : you could solve them without perfectly understanding the algorithms. Since they were detailed in the pdf, it was easy to just copy them and use them in matlab. They did not require to be understood very well. And there is a gap in this requirement between the homework and the exams.

c) Pdf were perfect !

Student comment:

The background quizz and pdf was useful to get back into some notions of linear algebra that I forgot.