SF2526 Numerical algorithms for data-intensive science
aka Numerics for data science
7.5 ECTS

Course data

- Study period 3. Exercise sessions: None
- Homeworks (3): corresponding to 3.5 ECTS
- Exam: corresponding to 4 ECTS
- Number of students (canvas): 24
- Lecturer / course responsible: Elias Jarlebring
- Teaching assistant: Joar Bagge
- Three blocks
  - Algorithms for low-rank data
  - Algorithmic spectral graph clustering
  - Data with Fourier and Toeplitz structure
- Learning activities:
  - Hybrid Lectures (with slides and ipad and live programming)
  - Zoom lectures (with slides and ipad and live programming, google forms quizzes)
  - Asyncynchronous activities: short videos with quizzes
  - Lectures (via zoom, . The lectures contained google form quizzes with break-out rooms.
  - Active learning workspace (moderated wiki) collected into exam prep problems

Aim

The course aims to provide an introduction to numerical algorithms used in data science. Applications are show to arise from various fields such as image/video analysis, classification of data and audio analysis and signal processing.

Analysis

Similar to previous years, the course lecture material are based on notes (block1.pdf, block2.pdf and block3.pdf) written by me, which are mostly self-contained or refer to specific pages in other material. The three homeworks are quite application oriented, with substantial programming and handling of data. The students could choose between MATLAB and Julia, and 15 % of the submissions were in Julia.

Due to lessening of covid restrictions, the lectures were given with a mix of completely digital and hybrid. The hybrid lectures were streamed over zoom. All lectures were recorded, anonymized, split into several components and made available online. When the recording did not work, a recorded lecture of previous years was made available.

In order to lessen the weight on the zoom lectures (historically sometimes perceived as too intense / fast to digest) I have introduced asynchronous activities: Between almost every lecture the students are expected to watch a short video with an introduction to the topic and also complete a canvas quiz. They are mandatory but can be completed at any time during the course.

The course uses, and has used since it started, the active collaborative learning activity called “active learning workspace” (previously called wiki activity) where students post

problems and answer problems, and get teacher feedback. This completely digital activity worked very well. Some creative / fun problems were submitted, e.g., problems from analysis of different metro maps using spectral clustering.

I am happy with the learning I observed during the course and the exam. There were no essentially no critical remarks in the course evaluation.

Changes from last year:

- Hybrid lectures.
- Asynchronous activities (videos recorded by me or from youtube, with quizzes)
- Homework: Spectral clustering was modified to better illustrate the importance of weighted norm
- Active learning workspace: Update in visual appearance

Further analysis:

I did spend a lot of effort on video recording and video editing the lectures (cutting out unimportant things, breaks, etc). This was appreciated, but it might have been the reason why so few students attended the hybrid lectures in the classroom – on average 3 students. Next year, I plan to make the classroom lectures more like workshops, which are almost mandatory.

The first lecture was cancelled because I had covid. However, putting up the lecture of previous year seems to have been satisfactory under the circumstances, although I noticed not all students watched it.

For next year, I will provide more skeleton code in Julia, and think more about specific applications of the signal processing part, e.g. Durbins algorithm.

Selection of student comments / comments for next year students:

I really like the concept of the active learning workspace and think that I might recommend it to my professors and my home university in Germany.

Elias is a really friendly teacher with nice enthusiasm! I feel that the course is very familiar and it's an open atmosphere!

This is a great course and I'm very glad I chose it! I think everything has been very good (hence I couldn't think of much to comment on) especially all the activities besides the lectures. It's been very helpful that the lectures are recorded since I learn more from the lectures when I can pause to think and repeat a section I don't understand.

The quizzes and videos were in my opinion a good possibility to recap the lectures and prepare for the next one. By making the quizzes mandatory it is also ensured that you really do that work - however I would leave the final deadline that late so you don't have to worry if you don't have the time to do them instantly.

I was happy that lectures were recorded, so my schedule became more flexible

I liked the live demos during the lectures and the change between handwritten notes and slides however sometimes the handwriting was a bit fast if you want to keep up in real time. (Maybe a few seconds pause before sliding further down to copy the rest of the

notes)

I really liked [the homeworks] and they showed how to practically use the content from the lectures and not pure theoretical exercises

I think [the asynchronous activities] worked very well. I provided more feedback in one of the quizzes.

I really appreciate the mixed lecture setup, and that you made recordings of the lectures available.

I did the homeworks in Julia, and it would have been nice with more Julia support (for example Julia code templates and hints of what functions to use as is currently mostly provided for Matlab). I saw working in Julia as a great opportunity to learn a new language and am happy that I did, but I would imagine that the lack of apparent support would discourage quite a few people from using the language.

The two first blocks were awesome since they had clear connections to data science, e.g. low-rank approx. and clustering. Block 3 could perhaps incorporate more data or real-life examples, as of now, I felt the content with Durbins etc being a bit boring.

The reading material was good and concise.

Recommendation to next year students: Participate in the active learning workspace. Especially creating problems helps you in terms of understanding the content

Recommendation to next year students: Post/answer questions in the Active Learning Workspace while working with the material, do not leave all questions/answers until the last day.

Recommendation to next year students: Take enough time to do the homework and also definitely go through the suggested reading

The question “Would you like to see the use of the teaching techniques in this course in other courses?” was answered: 70% in general yes. 30% maybe