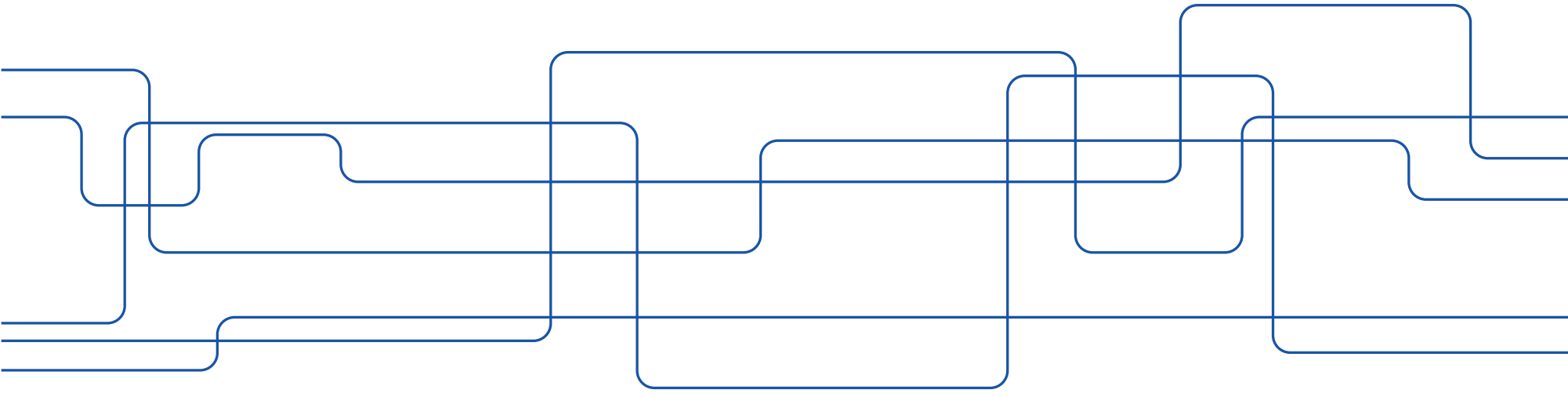
KTH ROYAL INSTITUTE
OF TECHNOLOGY

Lecture 1

Welcome to EQ2820 / EM3220 Matrix Algebra

Magnus Jansson and Mats Bengtsson, March 19, 2020



EQ2820 / FEM3220 Matrix Algebra

- An accelerated program MSc course / PhD course
- Course organizer: Magnus Jansson (magnus.jansson@ee.kth.se, 08-790 8443)
- Lectures by: Magnus Jansson, and Mats Bengtsson
- Course homepages:
  - `https://www.kth.se/social/course/EQ2820/`
  - `https://www.kth.se/social/group/em3220-matrix-algebr/`
- Please register to the course by email to Magnus if you have not already done so.

Outline

- Organization
- Schedule
- Contents
- Chapter 0: Review and Miscellanea

Course organization

- Main course literature: "Matrix Analysis (2nd ed.)" by R.A. Horn and C. R. Johnson.
- We will also use a few chapters from "Topics in Matrix analysis" by the same authors (this book is available online via KTH library or directly at the publisher Cambridge's site)
- + additional material in the form of lecture slides.
- Format: Lectures and homework on a weekly basis.
- Course contents can be learnt by cooperative discussions, but homework problems should be solved *individually* and handed in in due time for grading. Please recall the KTH rules for examination and the KTH EECS code of honour.

Requirements

- Number of credits:
  Master students: 7.5 ECTS (graded by F,E,D,C,B,A)
  PhD students: 10 ECTS (Pass/Fail)
- Individual solutions to homework problems, and active participation.
  Preliminary grading for the masters level course will be: E=60%, D=65% , C=70%, B=80%, A=90% of the overall max total score.
- For PhD students we require at least 80%, and the additional tasks:
  - peer grading of homework
  - presentation of selected topics in matrix algebra (this may be altered to something else)

Preliminary Schedule

(no physical meetings, "lectures" may take different formats from time to time)

Lect	Date	Time	Room
1 (MJ)	Thu. 19/3	13-15	
2 (MJ)	Thu. 26/3	13-15	
3 (MB)	Wed. 2/4	13-15	
4 (MB)	Wed. 8/4	13-15	
5 (MB)	Thu. 23/4	13-15	
6 (MJ)	Thu. 30/4	13-15	
7 (MB)	Thu. 7/5	13-15	
8 (MJ)	Thu. 14/5	13-15	
9 (MJ)	Mon. 18/5	15-17	

For PhD students there will then perhaps be some additional lectures with presentations.

Course Outline

1. Ch 0: Review : vector spaces, inner product, determinants, rank
2. Ch. 1: Eigenvalues, eigenvectors, similarity, characteristic polynomial
3. Ch. 2-3: Unitary equivalence, QR-factorization, canonical forms, polynomials and matrices
4. Ch. 4: Hermitian and symmetric matrices, variational characterization of eigenvalues, simultaneous diagonalization
5. Ch. 5: Norms for vectors and matrices
6. Ch. 7: Positive definite matrices, singular value decomposition
7. Ch. 6,8: Location and perturbation of eigenvalues nonnegative matrices, positive matrices, stochastic matrices
8. (HJ "Topics ..." + add): Field of values, stable matrices, Lyapunovs theorem
9. (HJ "Topics ..." + add): Matrix equations and the Kronecker product, vectorization, Khatri-Rao product, differentiation

Homework submission

Homework solutions should be submitted in PDF format (scanned handwritten solutions, or typeset). Make sure that the scanned versions are readable but still of a reasonable file size.

Filenames:

Name your PDF-file as:

HWX_FN_LN.pdf

where

X is the assignment number,
FN = first name,
LN = last name.

Homework submission cont.

PhD students submit by email to
`magnus.jansson@ee.kth.se`.

MSc students submit under *assignments* in Canvas.

PhD student peer grading

- We will divide PhD students into groups that jointly will do the grading of homework from another group.
- The homework to be graded will be emailed to the group and the graded homework should be sent back to `magnus.jansson@ee.kth.se` before the next lecture.
- At least two students in the grading group should contribute to the grading of each problem.
- Grading scale for each individual problem: 0 points (0-40% correct), 1 p (40-60% correct), 2 p (60-80% correct), 3 p (80-100% correct)

Peer grading cont'd

Note that the peer grading is an essential part of the learning activities in the course. The following quote is from the learning outcomes in the course plan:

"Show improved skills in problem solving and proof writing as well as in critical assessment of proofs and solutions."

Seeing others solutions to problems you have been working on yourself may give new insights and you will have to practice critical assessment of proofs and solutions.

Peer grading cont'd

- One of the reasons for dividing you into groups is that we would like to see some "group work" and to let you have some fellow students that you naturally could discuss with regarding, e.g., issues in the solutions and how to grade them. We let you decide the detailed working procedures within your groups, keeping the motivation of the peer grading in mind.
- The reason for the statement "At least two students in the grading group should contribute to the grading of each problem." is exactly to avoid that "each person grades one other person's homework." In this case there would not really be any need of having the groups. We do not want that the grade is only relying on a single persons view.

Summary

- "Lectures" will be published each week according to schedule.
- A new set of homework problems will be released each week and solutions are due before the next lecture.
- PhD students will also get a grading task to be completed before next lecture.
- Important: It is clearly VERY important to keep deadlines! (in exceptional cases, check for extension)
- Questions can be sent by email. QAs of general interest will be published on course homepages.