MATH 4370 / MATH 7370
Fall 2023
Project assignment 1 (PA1)

Due no later than Friday 13 October 2023 at 23:59

The aim of the project assignments is to nudge you along towards your final project. This is done by setting and testing milestones.

1. By mid-October, you should have chosen a type of project and a rough area for the project and have started basic reading about your project.
2. By mid-November, you should have done more reading on the subject, have identified the main references you need and should prepare to start working in earnest on the project.

Things will be easier if you devote time to the project on a regular basis rather than try to cram everything at the end of term, when you will be, for some of you, writing final examinations in other courses.

Instructions/remarks

- This assignment is the same for students registered in both versions of the course.
- This assignment (PA1) is due no later than Friday 13 October at 23:59.
- This assignment must be submitted before PA2.
- Submissions must be typeset using LaTeX, Libre Office or Word and submitted in PDF format. No other formats will be accepted.
- MATH 4370 students are allowed to work in pairs. In this case, please return a single project assignment bearing your two names.
- Finally, an important remark: of course, your subject may evolve between different PA's as a response to the feedback you receive. These assignments are by no means a contract and if you were to change topics later, that would have no consequence. (Except that you would have less time to complete the project, of course, if you were to switch topics late during term.)

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1 Remarks about the project

I will update the information in this section from time to time, to reflect discussions we have about the project, questions from some of you, etc. So check this assignment from time to time, even if you have already returned it, as this is where project instructions will be for now. This document was produced September 6, 2023.

1. There are 3 types of projects you can work on:

   (a) **Commentary of an article.** Mathematical papers are typically arid: most background details are not provided, because it is assumed that the reader either knows the required definitions and results or is able to read about them. For this type of project, you will be given a paper, typically not very recent, and will have to explain the result in your own words. I would also expect that if there is any type of computational work in the paper, you try to reproduce it or carry out something similar.

   (b) **Preparation of a set of lectures on a topic.** Suppose I were to go away for a week and asked you to stand in for me. Prepare a set of notes that can be used to teach roughly a week worth of material. This should include definitions, results, proofs, examples and perhaps even numerical code.

   (c) **Research project.** This is more geared towards students already working on research of their own. Take your research topic and come up with a question that could be addressed using linear algebra or matrix analysis. Note that for a grad student, both other types of projects also work very well, as choosing a topic interesting for your work would allow you to learn more about it.

2. Your submission in December will have to be between 10 and 20 pages. If needed, you will also be able to submit computer appendices.

3. Submissions will be typeset using LaTeX, Libre Office or Word and submitted in PDF format.

4. Properly formatted Maple or Maxima worksheets will also be accepted, as well as Jupyter notebooks. In this case, I will still expect a PDF submission, although the worksheets/notebooks will be welcome as companions.

2 Questions for PA1

1. Type of project you will be working on: article commentary, lecture notes or research project.
2. Name of the paper/project you will be working on.
3. General area of matrix theory your project is in. [Answers can range from *subjects*, e.g., matrix norms, nonnegative matrices, to *techniques*, e.g., Schur decomposition, to *application areas*, e.g., Markov chains, economics, data science..]
4. A minimum of one typeset page summary of the main points that the paper develops or the lecture notes cover. In the case of a paper, you can use the abstract to help you with this, but please, do not strictly paraphrase the abstract, expand on it.
5. Main mathematical concepts used in the paper.
6. Preliminary link of the main concepts to references in the literature. For instance, if the paper relies heavily on similarity transformations, you could say "Similarity transformations: Horn & Johnson, Chapter 1".
7. Anticipated difficulties. As indicated, you will need to be able to explain the content of the paper or the topic in the lecture notes in detail. Where do you anticipate knowledge gaps to lie? For instance, if the paper uses three main concepts and that you feel that you understand well two of them, list the one that you feel uncomfortable with.
8. Preliminary "computer plan". You will be expected to consider some algorithmic or numeric problems linked to the paper or the topic. Outline a few possible aspects that could be investigated computationally. Note that for the project, you can also use computer algebra software such as `Maxima`, `Maple` or `Mathematica`.
   In rare instances, it may not make sense to have any computer work at all. If that is the case, convince me: explain why computer work is not appropriate in your project. If I "buy it", then you will not be marked on that aspect. Note that other evaluation criteria will be looked at in more detail, as a consequence.