Handout 8

Exam

The exam dates are Wednesday, January 2nd, 2019 to Friday, January 4, 2019.

Topic: Non-negative Matrix Factorization (NMF)

In the next three weeks the topic is non-negative matrix factorization (NMF). The material on this topic is uploaded on BlackBoard. You can find

Slides: Slides from Monday 22/10 lecture.

Paper: The manuscript Hobolth, Guo, Kousholt and Jensen (2018): A unifying framework and comparison of algorithms for non-negative matrix factorization.

Code: NQPAlgorithms.R contains implementations of solutions to the non-negative quadratic programming (NQP) problem (aka the non-negative least square (NLS) problem). Testproblem.R contains code for comparing the algorithms on a test problem.

The tentative plan for week 43, 44 and 45 is as follows:

Week 43:

    Monday 22/10: Introduction to NMF and groups.

    Wednesday 24/10: Prepare presentation.

    Thursday 25/10: Prepare presentation. Get back 1st mandatory project.

Week 44:

    Monday 29/10: Prepare presentation: A discussion with me is mandatory to ensure high quality of the presentation.

    Wednesday 31/10: Presentation: The MM-algorithm.

    Thursday 1/11: Compare the algorithms on a test problem: Discuss Figure 6 in Hobolth, Guo, Kousholt and Jensen (2018).

Week 45:

    Monday 5/11: Two presentations: The EM-algorithm and Cone Projection.

    Wednesday 7/11: Paper discussion: Alexandrov *et al.* (2013).

    Thursday 8/11: NMF on data from Alexandrov *et al.* (2013).

The groups are:

MM-algorithm: Sophie, Rejane, Alejandro, Matej.

EM-algorithm: Elias, Maiken, Ky, Freja.

Cone Projection: Ragnhild, Camilla, Mateo, Emil.

Presentations of basic algorithms for the NLS problem

We can broadly identify three classes of algorithms for the non-negative least square (NLS) problem: The MM-algorithm, the EM-algorithm, and Cone Projection. Each group is responsible for a presentation, demonstration and exercise about their algorithm.

In particular each group should:

- Give a basic introduction to the algorithm.

- Explain and derive the algorithm in detail in the case of NLS.

- Explain the implementation of the algorithm in the case of NLS.

- Provide a demonstration of the use of the algorithm.

- Formulate at least one exercise for illustration of the algorithm.

Furthermore here are some specific items that should also be covered within the three algorithms:

MM-algorithm: Note that this is a general optimization method. Provide an example of the MM-algorithm where it is applied outside of the NLS problem.

EM-algorithm: Explain that coordinate descent and gradient descent are special cases of the EM algorithm.

Cone Projection: Give a detailed explanation of a projection on a linear subspace.