

# Homeworks

Computational Linear Algebra for Large Scale Problems

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# General information

## Work to do

- 2 mandatory homeworks
  - Project on **PageRank**
  - Project on **Principal Component Analysis**
- 1 non-mandatory homework

## How to do it

- Groups of 1 or 2 people.
- Code in your favorite programming language.
- Write a report presenting the results.

## Exam

1. Present your work using slides or in any other **convincing** way you find appropriate.
2. Answer questions about the **mathematical** content of your report.

## How to deliver

Upload to the “Homeworks” section of the teaching portal a **zip archive** containing:

- the reports presenting the results
- the code used to produce the results

**One deliverable per group. File name must contain your surnames.**

# Project on PageRank

## THE \$25,000,000,000\* EIGENVECTOR THE LINEAR ALGEBRA BEHIND GOOGLE

KURT BRYAN<sup>1</sup> AND TANYA LEISE<sup>2</sup>

**Abstract.** Google's success derives in large part from its PageRank algorithm, which ranks the importance of webpages according to an eigenvector of a weighted link matrix. Analysis of the PageRank formula provides a wonderful applied topic for a linear algebra course. Instructors may assign this article as a project to more advanced students, or spend one or two lectures presenting the material with assigned homework from the exercises. This material also complements the discussion of Markov chains in matrix algebra. Maple and Mathematica files supporting this material can be found at [www.mae-lafayette.edu/~kbryan](http://www.mae-lafayette.edu/~kbryan).

Figure: The paper

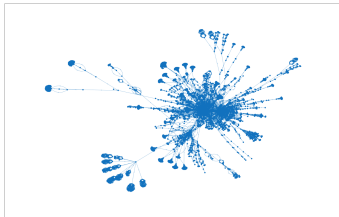


Figure: Graph of the dataset

Inside the folder Homeworks/PageRank on the teaching portal, you will find the paper on the left and a file containing a dataset.

- **Read** the paper to understand the PageRank algorithm.
- **Solve** two exercises of your choice.
- Write a **code** to implement it.
- **Test** the code on the two graphs in the paper (Fig. 2.1 and 2.2).
- **Test** the code on the given dataset.
- **Write** a report containing:
  - A mathematically sound description of the algorithm.
  - The results.
  - The solution to the **two exercises**.

## How to get a good grade

- Implement the algorithms yourselves, using basic data structures. Using libraries correctly will still get you a nice grade.
- Know and be able to explain the mathematics in PageRank.

## Additional (non-mandatory) homework

You can:

- Solve at least 10 more exercises from the PageRank paper. The report shall then contain the solutions and you will be asked to justify them.
- Choose a topic of your choice involving the implementation of the algorithms seen during the semester (listen to our advices during lessons!). The report shall contain a **mathematical** description of the problem you want to solve, the results you obtained and the code that you produced. You will be questioned about the mathematics.