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Sheet 3

Introduction

The goal of this exercise is to show the importance fast solvers with respect to the arising linear system of equation when solving the poisson problem with FDM or FEM. Therefore, we first want to analyze the gauss solver for general matrices. Afterwards, we want to consider the so called triplet format or cooordinate storage format for sparse matrices and the corresponding matrix vector multiplication. With this and assuming the matrix is s.p.d and sparse, the cg method can be applied, which we want to compare with the gauss method.

Exercise

1) Download the material from the homepage.

2) What does the Makefile do?

3) Try to run the Makefile, which will directly run the file demo.c. Try to understand the results.

4) Increase the dimension of A in a meaningful manner. Save the corresponding runtime for solving the linear system of equation and plot them afterwards over the dimension of A.

5) Try to understand the so called triplet format. It is also called the coordinate storage format.

6) Write a function, which implements the matrix vector multiplication for a matrix A given in the triplet format and a vector x.

7) Write a function, which implements the cg method for solving a system of linear equations $A \cdot x = b$, where A is s.p.d and given in the triplet format and b is a given vector.

8) Increase the dimension of A in a meaningful manner. Save the corresponding runtime for solving the linear system of equations and plot them afterwards over the dimension of A. Compare the runtime with the gauss solver.

Hints

(i) You are allowed to use GOOGLE!

(ii) Take care of a good structure and overview!