Intensive Computation

Homework 2 - Direct and iterative methods for linear systems

28th march 2018

Exercise 1
- Write a function that implements the Gaussian elimination method.
- Call the function on a sparse matrix (represented in the standard way, without using a compact representation), having a given sparsity value.
- Use the command `spy` to visualize the sparsity pattern at each iteration of the Gaussian elimination algorithm and produce a movie to show how the final upper triangular matrix fills up.
- Compute the sparsity at each iteration and show it on a graph.

Exercise 2

- Write a function for each pivoting technique for the Gaussian elimination method (Gaussian Elimination with Partial Pivoting/ Complete pivoting/ Rook Pivoting), that is functions GEPP, GECP, GERP.
- Call each function on random generated matrices of size n>= 50, and compute the execution time (using the same matrix for the three techniques), averaging on a set of matrices large enough.

Exercise 3

- Write a function that implements the Jacobi iterative method for a sparse matrix represented using a compact format at your choice.
- Write a function that implements the Gauss-Seidel iterative method for a sparse matrix represented using a compact format at your choice.

Use the two following criteria for checking the convergence of the two methods and compare the number of iterations needed to stop:
- E1: Error obtained by using the exact values (found with Exercise 1 or Matlab function): $\left\|e^{(k)}\right\| = \left\|x - x^{(k)}\right\|$
- E2: Difference between two successive iterations: $\left\|e^{(k)}\right\| = \left\|x^{(k)} - x^{(k-1)}\right\|$