

Computational Mathematics II / Numerical Algebra
Final
Spring 2008
Hand in by the end of the day of May 23

- 1) Explain why sparse matrices deserve a special implementation
- 2) Write a non-singular random 3×3 integer matrix that contains at least 5 different numbers and find its Hermite normal form by hand. Write down your work.
- 3) Do one of the following.
 - a) Write a detailed pseudocode for the Hermite Normal Form algorithm that is described in Yap's book. Assume that a multiple GCD subroutine is available.
 - b) Do any problem from Chapters 3, 6 or 8 of Davis's book that involves working and running CSparse library or Matlab code. The problem that you chose cannot be a pseudocode writing problem.
 - c) In Matlab, write a program that creates the rigidity matrix from a graph and finds the space of infinitesimal motions. Try this problem on graphs of increasing size and save the statistics (results and the execution time). Write a short report that give an idea for what graph sizes Matlab's implementation of sparse matrix methods is feasible on a typical PC or laptop.

It is up to you how you read in a graph. You can read it from a file containing graph's adjacency list or use Matlab tools for dealing with graphs.
 - d) Estimate from above (by a theoretical arguments, not just by referring to experiments mentioned in the book) the largest of the numbers that may occur during the execution of the *generic* Hermite normal form algorithm (i.e. without the smart multiple GCD algorithm).