Assignment 8

The assignments include the sparse matrix module SPARSEM. An example of the use of this module is in file test.f90 in directory /scr/course/test1. Because of complexity, this program needs to be compiled by the command:

make

For make to work, copy file Makefile as well as all the other files from the same directory.

For programs with name other than test, make and Makefile can still be used, but replace "test" with the name of your program in file Makefile.

For Windows, the following files need to be compiled in this particular order:
kind.f90 sparse2.f sparse.f90 fspak90.f90 fspak.f fspaksub.f sparssub.f second.f

1. Examine data structures for different matrix formats in file sparse.f90. Examine procedures implementing **zerom**.

2. Consider the following system of equations Ax=b:

$$\begin{bmatrix} 363018 \\ 304123 \\ 182314 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 150 \\ 181 \\ 106 \end{bmatrix}$$

a) Set this system of equation with densem, dense_symm, and sparse_hash matrices,
b) convert the format sparse_hash to sparse_ija,
c) print all matrices,
c) solve by iteration using the four data types,
d) print sparse matrices in internal format (printm(x,'internal')

Optional

3. Consider the following matrix A of dimension n x n:

Error!

where rnd is a random number distributed in the range <0,1), p=max(1,n/10), and the vector of right hand sides is generated as:

$y_i = 20.0+\text{mod}(i,6)$

Random number x can be generated by subroutine random_number(x). ATTENTION: Matrix X may not be positive definite for large n!

Using modules sparsem and sparseop, write a program that:

a) sets up a matrix A and vector y,

b) solves the system of equations A x = y

- iteratively
- by FSPAK90 (sparse storage only)

for n=10 and n=500, and densem and sparse_hash matrix types. With FSPAK90, the sparse_hash matrix needs to be converted to sparse_ija matrix.

For n=500, record CPU time, which under UNIX can be obtained by preceding the executable by command time, e.g.,

time a.out

Additionally, for each format:

c) print the contents of the matrix (n=10) or its section A(120:125,120:125) (n=500)

e) find the determinant of A

4. Modify program BLUP.F90 so that the coefficient matrix is stored and solved as a sparse matrix structure.