Tasks

1 Introduction

1.1 Computing system components

Describe the following:

1. The date you started doing the exercise and the date you completed it.

2. The characteristics of the computer system you used to carry out this lab exercise (e.g., Y/C, laptop, home PC).

(i) Fill in the details of the system on which you will run your experiments as listed in Table 1. Please indicate Is it necessary for the data you provide to indicate where or how you obtained them? For Windows users you can download special programs such as cpuz from http://www.cpuid.com/ which will give you the information requested. For Linux users you can find the requested information via the cat /proc/meminfo and cat/proc/cpuinfo commands.

(ii) The MATLAB version you used and information about the relevant libraries.

(iii) The table that results when you run the bench command.

2 Sparse representations and register constructions

1. Construct a function sp_mat2latex

[val ,row_ip,col_ip]= sp_mat2latex(A,sp_type)

which returns, in LATEX code, the sparse CSR and CSC representation of a register that is in sparse form in MATLAB. That is, given A of type sparse and the string sp_type, the code generates the LATEX instructions that produce the tables val, row_ptr, col_idx if sp_type=='csr' and it is in CSR form. If sp_type=='csc', then it is the CSC format and produces the tables val, row_idx and col_ptr. For example, if

$$A = \begin{pmatrix} 0.3984 & 0.1895 & 0.8423 & 0.0000 \\ 0.0000 & 0.5458 & 0.0000 & 0.0000 \\ 0.9416 & 0.4122 & 0.1788 & 0.0000 \\ 0.0000 & 0.0000 & 0.7134 & 0.0000 \end{pmatrix}$$

then the function

matrix2latex2(A, 'csr')

has the effect of producing the following:

```
$$ val= \begin{tabular}{|||||||||||||||||}\hline
    0.3984 &0.1895 &0.8423 &0.5458 &0.9416 &0.4122 &0.1788 &0.7134  \\  \hline
\end{tabular}$$
$$ IA = \begin{tabular}{|||||||||||||||||}\hline
    1 &2 &3 &2  &1  &2  &3  &3  \\  \hline
\end{tabular}$$
$$ JA = \begin{tabular}{|||||||||||}\hline
    1  &4  &5  &8  &9  \\  \hline
\end{tabular}$$
```

which if inserted into LATEX text will produce the following:

$$val = \begin{array}{|c|c||c|c|c|c|c|c|} \hline 0.3984 & 0.1895 & 0.8423 & 0.5458 & 0.9416 & 0.4122 & 0.1788 & 0.7134 \\ \hline \end{array}$$

$$IA = \begin{array}{|c|c||c|c|c|c|c|c|} \hline 1 & 2 & 3 & 2 & 1 & 2 & 3 & 3 \\ \hline \end{array}$$

$$JA = \begin{array}{|c|c||c|c|c|} \hline 1 & 4 & 5 & 8 & 9 \\ \hline \end{array}$$

2. Construct a function blkToeplitzTrid(n,B,A,C) that given the square registers A,B,C of size m × m, constructs in sparse form the Toeplitz block Toeplitz triangular register:

$$\begin{pmatrix} A & C & 0 & \cdots & \\ B & A & C & \ddots & \\ 0 & \ddots & \ddots & \ddots & \\ \vdots & & B & A & C \\ & & 0 & B & A \end{pmatrix}$$

The matrix has n blocks on the main diagonal and is therefore mn × mn. The scoring will take into account the number of instructions you used to construct it, i.e. you should aim for your function to be implemented with the fewest number of MATLAB instruction lines or calls to MATLAB functions itself.

3. Construct a function sp_mx2bccs

[val ,brow_idx,bcol_ptr]= sp_mx2bccs(A,nb)

which given a square sparse register A and an integer nb (block size), yields a representation that we call BCCS (block compressed column storage). BCCS is the block-column representation corresponding to the (more extensively studied in the literature) BCRS (block compressed row storage.

A simplification here is that we assume the same nb for columns and rows (we could generalize and have different block sizes for columns and rows.) For example, the register

$$A = \left(\begin{array}{cc|cc|cc} 0 & 0 & 0 & 0 & 4 & 2 \\ 0 & 0 & 1 & 1 & 2 & 2 \\ \hline 6 & 3 & 0 & 0 & 0 & 0 \\ 3 & 0 & 0 & 0 & 0 & 0 \\ \hline 2 & 1 & 0 & 0 & 2 & 1 \\ 1 & 1 & 0 & 0 & 1 & 1 \end{array}\right)$$

for nb=2, has the following BCCS representation:

val=	6	3	3	0	2	1	1	1	0	1	0	1	4	2	2	2	2	1	1	1

brow_idx=	2	3	1	1	3

bcol_ptr=	1	3	4	6