CSV880

Assignment I

Due on 21st February 2014

Write an MPI program to perform the template (averaging) based computations on a matrix A specified as follows.

Command Line Arguments: *inpFile outFile* m n p q s ℓ a b c d e

Processing: The program will read a matrix A of size $m \times n$ comprising of floating point numbers from *inpFile*. The program should run on $p \times q$ ranks logically arranged as a 2-D grid. The matrix should be distributed on the ranks in a block-cyclic distribution with block size $s \times s$. The program will perform ℓ iterations: in each iteration, it will perform the following operation:

$$A[i][j] = \frac{a \cdot A[i-1][j] + b \cdot A[i][j-1] + c \cdot A[i][j] + d \cdot A[i][j+1] + e \cdot A[i+1][j]}{a+b+c+d+e}.$$

All the entries on the RHS should be values computed at the end of the previous iteration (not values of the current iteration). If some entry is missing, then it is not considered in the numerator and the corresponding co-efficient is not considered in the denominator. For e.g.

$$A[0][0] = \frac{c \cdot A[0][0] + d \cdot A[0][1] + e \cdot A[1][0]}{c+d+e}$$

The output should be written to *outFile*. The format of the input and output files is as follows. There are m lines in the input file. Each line specifies n space-delimited floating point numbers.

For example when the arguments are: *in out* 6 6 2 2 2 1 0.2 0.2 0.2 0.2 0.2, and the contents of the file *in* are:

```
1.0 2.0 3.0 4.0 5.0 6.0
2.0 3.0 4.0 5.0 6.0 7.0
3.0 4.0 5.0 6.0 7.0 8.0
4.0 5.0 6.0 7.0 8.0 9.0
5.0 6.0 7.0 8.0 9.0 10.0
6.0 7.0 8.0 9.0 10.0 11.0
```

then the output written to the file *out* should be (up to 2 digits precision):

```
1.67 2.25 3.25 4.25 5.25 6.0
2.25 3.0 4.0 5.0 6.0 6.25
3.25 4.0 5.0 6.0 7.0 7.25
4.25 5.0 6.0 7.0 8.0 9.25
5.25 6.0 7.0 8.0 9.0 10.25
6.0 6.75 7.75 8.75 9.75 10.33
```

Note that using block-cyclic distribution, as an example, rank $(0, 0)$ would own the input data:

1.0	2.0	5.0	6.0
2.0	3.0	6.0	7.0
5.0	6.0	9.0	10.0
6.0	7.0	10.0	11.0