# Final

Write a C/MPI program that implements the **block matrix version** of Fox's matrix multiplication algorithm (see Lecture Notes 5). Your program should be able to multiply two $n \times n$ matrices on a $p \times p$ Cartesian grid, where $p \leq n$. For simplicity, you may assume that $n$ is divisible by $p$.

In your program, process 0 of the 2D grid should read the matrices **A** and **B** from a file. The input file should be formatted as follows:

```
< matrix dimension n >
< elements of matrix A >
< elements of matrix B >
```

A sample input file might look like this:

```
   8
   3.0   -10.0    22.0    -4.0     3.0    23.0    -9.0    15.0
  11.0   -21.0    22.0    12.0    12.0   -21.0     6.0   -24.0
  11.0    13.0    11.0     5.0    11.0     4.0     6.0   -18.0
  -8.0     6.0    10.0    18.0     3.0     4.0    13.0    10.0
 -11.0    -3.0    20.0    13.0     1.0    18.0     5.0     2.0
   1.0    23.0   -21.0    11.0     5.0     1.0     1.0     5.0
 -20.0    13.0    15.0     4.0     5.0    19.0     5.0     7.0
   6.0    -8.0    -7.0     6.0    -2.0     3.0     3.0     9.0
  12.0     2.0   -14.0    10.0   -23.0   -21.0    14.0   -24.0
  16.0     8.0    16.0     4.0     8.0    11.0   -10.0   -21.0
   5.0     4.0    24.0    22.0    23.0     1.0    -1.0    21.0
 -22.0    24.0    24.0     5.0    24.0    17.0    14.0    11.0
  22.0   -17.0     5.0     2.0     6.0    23.0     4.0   -16.0
  24.0   -16.0    24.0   -16.0    -3.0    13.0     7.0     8.0
   7.0    17.0   -13.0     3.0    11.0    22.0    17.0     7.0
  14.0    23.0    15.0     6.0    16.0    22.0   -14.0    15.0
```

After reading **A** and **B**, your program should distribute the matrices among the processes of the 2D grid using **block checkerboard decomposition**, perform matrix multiplication on the sub-matrices locally in each process, then gather the sub-matrices into the entire product matrix **C** in process 0. Finally, print the original matrices **A** and **B**, and the product matrix **C**, from process 0.

Test your program using the accompanying files named **inmatrix<n>** which contains **n x n** matrices **A** and **B**. The correct output of the program for input file **inmatrix<n>** is in file **outmatrix<n>**.

The output of your program should follow the format depicted in the sample output below for the input file **inmatrix8** (8 x 8 matrices).

```
% mpirun –n 4 blockfox
% Enter filename: inmatrix8

Matrix size = 8 x 8
Grid size = 2 x 2

Matrix A:
    3.0  -10.0   22.0   -4.0    3.0   23.0   -9.0   15.0
   11.0  -21.0   22.0   12.0   12.0  -21.0    6.0  -24.0
   11.0   13.0   11.0    5.0   11.0    4.0    6.0  -18.0
   -8.0    6.0   10.0   18.0    3.0    4.0   13.0   10.0
  -11.0   -3.0   20.0   13.0    1.0   18.0    5.0    2.0
    1.0   23.0  -21.0   11.0    5.0    1.0    1.0    5.0
  -20.0   13.0   15.0    4.0    5.0   19.0    5.0    7.0
    6.0   -8.0   -7.0    6.0   -2.0    3.0    3.0    9.0
Matrix B:
   12.0    2.0  -14.0   10.0  -23.0  -21.0   14.0  -24.0
   16.0    8.0   16.0    4.0    8.0   11.0  -10.0  -21.0
    5.0    4.0   24.0   22.0   23.0    1.0   -1.0   21.0
  -22.0   24.0   24.0    5.0   24.0   17.0   14.0   11.0
   22.0  -17.0    5.0    2.0    6.0   23.0    4.0  -16.0
   24.0  -16.0   24.0  -16.0   -3.0   13.0    7.0    8.0
    7.0   17.0  -13.0    3.0   11.0   22.0   17.0    7.0
   14.0   23.0   15.0    6.0   16.0   22.0  -14.0   15.0

Product Matrix C:
  839.0 -309.0 1139.0  155.0  351.0  281.0 -126.0  854.0
 -892.0  -88.0 -556.0  804.0  190.0 -629.0  849.0   93.0
  413.0 -273.0  241.0  297.0   56.0   49.0  509.0 -623.0
   47.0  840.0  972.0  295.0 1203.0 1177.0  191.0  699.0
  151.0  172.0 1300.0  124.0 1040.0  850.0  225.0 1083.0
  244.0  397.0  225.0 -278.0   60.0  658.0  -67.0 -817.0
  654.0   77.0 1465.0  -35.0 1145.0 1272.0 -229.0  778.0
  -48.0  308.0  -78.0  -85.0  -63.0  138.0  193.0  155.0
%
```

## Submitting Your Assignment

- Be sure to properly comment your code. Points will be taken off for improperly commented or uncommented code.
- Upload your program as a plain text file. Write your full name clearly in comments at the top of your program.
- Include screenshot of how the code ran.