ACM40640 Assignment 2

ICHEC

Deadline: 23th April 2024 at 5:30pm

1 Introduction

Please carry out all sections and document the code with appropriate comments. The assignments should be your own work. Marks will be deducted if there is copying between students or from online sources. Upload the files to BrightSpace by the deadline.

2 Communication in a Ring

1. Communication in a ring:

    - Write a MPI program where each rank sends a message to its right neighbour.
    - The message is passed around the ring until it reaches the originator rank.
    - At this point the **message** should contain the sum of all the ranks.
    - So at termination all ranks should have the sum of the ranks.

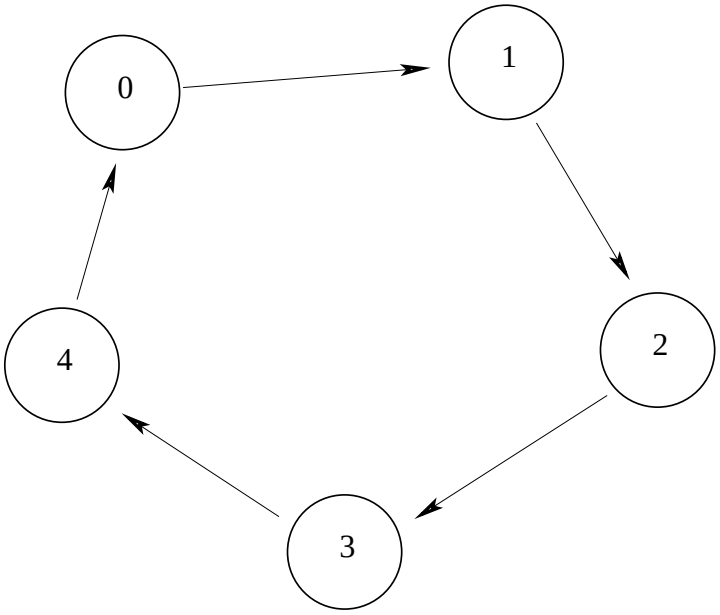

Figure 1. Five processes logically arranged in a ring: the left neighbor of P_0 is P_4 and its right neighbor is P_1. For the eaxample, each rank will have a message which contains the value 10 at termination.

2. Questions:

    - Use non-blocking communications.
    - Write an equivalent operation that does the same using MPI_Ireduce().

3 Find Determinant using Cramer's Rule

3. Use Cramer's rule to find the determinant of the 5x5 matrix below, using 5 MPI processes. Calculate and print the result on rank 0. The actual result is $-2678797333.0/88905600000.0$.

   - Below is an example of Cramer's rule (`http://en.wikipedia.org/wiki/Cramer's_rule`) for a 4x4 matrix.

$$\det\left(\begin{bmatrix} a & b & c & d \\ e & f & g & h \\ i & j & k & l \\ m & n & o & p \end{bmatrix}\right) = a\det\left(\begin{bmatrix} f & g & h \\ j & k & l \\ n & o & p \end{bmatrix}\right) - b\det\left(\begin{bmatrix} e & g & h \\ i & k & l \\ m & o & p \end{bmatrix}\right)$$
$$+ c\det\left(\begin{bmatrix} e & f & h \\ i & j & l \\ m & n & p \end{bmatrix}\right) - d\det\left(\begin{bmatrix} e & f & g \\ i & j & k \\ m & n & o \end{bmatrix}\right)$$

   - The 5x5 matrix

$$\begin{pmatrix} 1 & -\frac{1}{2} & -\frac{1}{3} & -\frac{1}{4} & -\frac{1}{5} \\ -\frac{1}{2} & \frac{1}{3} & -\frac{1}{4} & -\frac{1}{5} & -\frac{1}{6} \\ -\frac{1}{3} & -\frac{1}{4} & \frac{1}{5} & -\frac{1}{6} & -\frac{1}{7} \\ -\frac{1}{4} & -\frac{1}{5} & -\frac{1}{6} & \frac{1}{7} & -\frac{1}{8} \\ -\frac{1}{5} & -\frac{1}{6} & -\frac{1}{7} & -\frac{1}{8} & \frac{1}{9} \end{pmatrix}$$