

Parallel Computing

CS 1202

CIE 3

13th March 2013

1. Discuss the parallel algorithm for the pipelined version of Gaussian elimination with column pivoting to solve a system of linear equations $Ax = b$. How this algorithm is different from the column-oriented and row-oriented algorithms? [5M] Discuss its scalability? [2M]

2. Discuss briefly the algorithm for parallel sorting by regular sampling. Discuss its algorithmic complexity and scalability? [6M]

3. Discuss the Cannon's algorithm briefly. Is it scalable, discuss? [5M] Does the algorithm works for the case when matrix dimension is not a multiple of 'p', the number of processes? If not, how will you modify it to make it work for this case? [2m]

[1 Mark each]

4. In **MPI_Comm_split**, if two processes of the same color are assigned the same key, then [B]

- a) error results.
- b) their rank numbers in the new communicator are ordered according to their relative rank order in the old communicator.
- c) they both share the same rank in the new communicator.

5. **MPI_Comm_split(old_comm, color, key, new_comm)** is equivalent to **MPI_Comm_create(old_comm, group, new_comm)** when [B]

- a) $color=lam, key=0$; calling process lam belongs to group; ELSE $color=MPI_UNDEFINED$ for all other processes in old_comm .
- b) $color=0, key=lam$; calling process lam belongs to group; ELSE $color=MPI_UNDEFINED$ for all other processes in old_comm .
- c) $color=0, key=0$

6. With **MPI_Cart_shift(comm, direction, displ, source, dest)**, if the calling process is the first or the last entry along the shift direction and that $displ$ is greater than 0, then [B]

- a) error results.
- b) **MPI_Cart_shift** returns $source$ and $dest$ if periodicity is imposed along the shift direction. Otherwise, $source$ and/or $dest$ return $MPI_UNDEFINED$.
- c) error results unless periodicity is imposed along the shift direction.

7. Assume the only communicator used in this problem is **MPI_COMM_WORLD**. After calling **MPI_INIT**, process 1 immediately sends two messages to process 0. The first message sent has tag 100, and the second message sent has tag 200. After calling **MPI_INIT** and verifying there are at least 2 processes in **MPI_COMM_WORLD**, process 0 calls **MPI_RECV** with the source argument set to 1 and the tag argument set to 200. Choose the best answer. [A]

- a) Process 0 is deadlocked, since it attempted to receive the second message before receiving the first.
 - b) Process 0 receives the second message sent by process 1, even though the first message has not yet been received.
 - c) None of the above.
8. When using **MPI_Cart_create**, if the cartesian grid size is larger than processes available in old_comm, then: [A]
- a) error results.
 - b) the cartesian grid is automatically reduced to match processes available in old_comm.
 - c) more processes are added to match the requested cartesian grid size if possible; otherwise error results.
9. In MPI, a reduction (MPI_Reduce) is a form of **__Collective (All-to-one)__** communication.
10. What is meant by the term “Embarrassingly Parallel” computation? [B]
- a) All parallel computations are embarrassingly parallel computations
 - b) A computation that can be divided into parallel parts in an obvious fashion without the parts generally needing to communicate with each other.
 - c) One that is simple.
 - d) A computation that cannot be divided into parallel parts.
 - e) A P2P (peer-to-peer) computation
 - f) None of the other answers
11. Consider an MPI code running on four processors, denoted A, B, C, and D. In the default communicator MPI_COMM_WORLD their ranks are 0-3, respectively. Assume that we have defined another communicator, called USER_COMM, consisting of processors B and D. Which one of the following statements about USER_COMM is always true? [D]
- a) Processors B and D have ranks 1 and 3, respectively.
 - b) Processors B and D have ranks 0 and 1, respectively.
 - c) Processors B and D have ranks 1 and 3, but which has which is in general undefined.
 - d) Processors B and D have ranks 0 and 1, but which has which is in general undefined.