

## Parallel Computing

CS 1202

CIE 3

13<sup>th</sup> 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 [ ]
  - 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 [ ]
  - 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 [ ]
  - 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) 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) 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 \_\_\_\_\_ communication.
10. What is meant by the term “Embarrassingly Parallel” computation? [ ]
- 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? [ ]
- 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.