Message passing and MPI

Assignments and problems

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CS-594 lecture 2 Spring 2003

Rules

- Two weeks to complete assignments and problems. Hand in by midday 3rd Feb03.
- If you have problems and do not ask for help (until 10 minutes before the deadline) beware!
- Hand-in written work either on paper or Email to me fagg@cs.utk.edu
- Code is to be tarred with makefiles, output etc and a MD5 signature sent to me.
  - Md5 mywork.tar |& mail fagg@cs.utk.edu
  - Code is to run on hydra or torc machines. If I cannot verify it by remaking it and running it then I will assume it does not!
  - Broken code with comments gets more points that non working non commented code.
  - A short description of design is always needed.

Part A
Correctness and buffering?

Proc 0	Proc 1
MPI_Send (data,size.. 1)	MPI_Send (data,size.. 0..)
MPI_Recv (indata,insize..1..)	MPI_Recv (indata, insize.. 0..)

Above is a head to head send. This might or might not work depending on the system, MPI implementation or other factors such as timing.

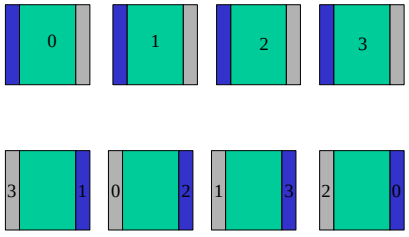
1. Write a paragraph on why the above is an incorrect [non-deterministic] MPI code.
2. Re-write the above code in 3 different ways to make it work (hint, there are 4 simple ways)

Extra under MPICH at what data size does the above break?

Part B
3 ring codes

1. Write a simple code that sends integer numbers around a ring of 4 nodes (from node 0->1->2->3->0).
2. Alter the above code so that every node 'swaps' their bottom most edge of a 2D [random] matrix with the top edge of the next node around a ring. After the code has run each node should have different data in the top and bottom edges of their matrix.
   - Hint, it could be two rings in opposite directions or a real swap!
3. Do the same but sending right and left columns of data (I.e. in C non contiguous data). You should show both packed data and a derived data type. (Which is faster and why?)
4. Question. In 2&3 we have 'n' random matrices. How do we keep them random (which is important for Monte Carlo simulations) on a parallel machine? Why would it not be random across all nodes?
   - Hint, look up Knuths semi-numeric algorithms vol2 and leap-frog generators

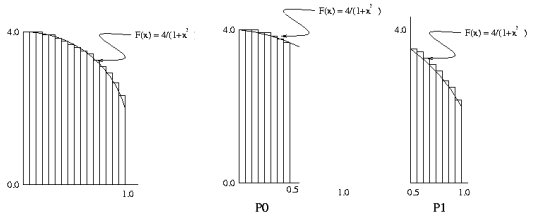
Part B



Part C
Collecting with collectives

1. Write a SPMD code with 1 master and 3 slaves that calculates pi using code handed out in class.
   - Use p2p calls.
   - Master sends out slices
   - Slaves calculate integral slices
   - Master sums to get pi.
2. Change the above to use collective calls
   - Master sends out slices all at once
   - Master receives all slices at once
   - Master sums to get pi.
3. Change 2 so that the master does not have to sum the data explicitly but the collective for receiving the partial results does this.

Part C



Part D

Load balancing and Scalable supercomputers?

At the end of Part C you should have used two collectives. Are these scalable and do they allow load balancing for overloaded nodes?

- If non-blocking calls were used in C-1 describe in ½ a page how this could allow load balancing compared to the collectives solution in C-3.
  - Hint, look up bag of tasks computing.
- Describe in a page how you would implement a broadcast that works faster than O(N) for N nodes where N is very large.
  - Hint, what topologies would you use and why?