CISC 811: High Performance Computing, Assignment 5

Set March 22nd due April 5th
Office: 308A Stirling Hall. Please email if you wish to set a time for an appointment.

Q1. (Derived data-types.) In the lectures we explicitly looked at deriving the boundary data-types for the 2d Poisson problem in the 2d domain decomposition. For the x-boundary it was necessary to use `MPI_TYPE_VECTOR` to define a datatype including the stride through the array. In this question we'll look at how this method works in three dimensions.

(a) Use the Cartesian primitives and derived data-types to write a program to perform the boundary exchange for a 2d domain decomposition of a 3d cubic problem. For simplicity assume the the global grid is of size 128^3 and it is non-periodic. Use a 2x2 domain decomposition (i.e. 4 processors). You may check the accuracy of your code by initializing the grid pieces to the rank of the processor they are on.

(b) Repeat the above but this time for a 3d domain decomposition. Use the same size global grid, and a 2x2x2 processor grid.

Q2. (MPI I/O) As shown in the lecture, MPI I/O allows you to do simple (multiple file) and true (single file) parallel I/O. For the code you developed in Q1(b) add in an I/O routine that writes out each processor's array (after the message exchange) into a separate file using the `MPI_File` routines.

Note: this is a very bad way to do the I/O for this kind of data distribution, it would be much better to use `MPI_TYPE_CREATE_DARRAY`. *See Using MPI-2.*

Q3 (Research) There is really only one significant alternative to the Globus toolkit. What is it? Describe some of the design and philosophical differences between this alternative and Globus.