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#include <iostream>
#include <ostream>
#include <sstream> //for stringstream/ostringstream/istringstream

#include <stdio.h>
#include <string.h>
#include <mpi.h>

using std::cout;
using std::endl;
using std::ostringstream;

int main(int argc, char **argv) {
    int    comm_sz;    /* number of processes */
    int    my_rank;    /* process rank */

    //Initialize the command line arguments on every process
    MPI_Init(&argc, &argv);

    //Get the number of processes in MPI_COMM_WORLD, and put
    //it in the 'comm_sz' variable; ie., how many processes
    //are running this program (the same as what you put in the
    //-np argument).
    MPI_Comm_size(MPI_COMM_WORLD, &comm_sz);

    //Get the rank of this particular process in MPI_COMM_WORLD,
    //and put it in the 'my_rank' variable -- ie., what number
    //is this process
    MPI_Comm_rank(MPI_COMM_WORLD, &my_rank);

    int array_size = 20;
    double* array = new double[array_size];

    int slice_size = array_size / comm_sz;
    double* array_slice = new double[slice_size];

    for (int i = 0; i < slice_size; i++) {
        array_slice[i] = 0;
    }

    if (my_rank == 0) {
        srand48(time(NULL));
        for (int i = 0; i < array_size; i++) {
            array[i] = drand48();
        }
    } else {
        for (int i = 0; i < array_size; i++) {
            array[i] = 0;
        }
    }

    ostringstream oss; /*Writing what we want to say to a string stream
                        and then writing it's contents to cout will
                        prevent interleaving of print statements to
                        the root process */

    if (my_rank == 0) {
        oss << "[process: " << my_rank << "]:";
        for (int i = 0; i < array_size; i++) {
            oss << " " << array[i];
        }
        cout << oss.str() << endl;
    }

    MPI_Barrier(MPI_COMM_WORLD);
}

```

```

MPI_Scatter(array /*the data we're scattering*/,
            slice_size /* the size of the data we're scattering
                        to each process */,
            MPI_DOUBLE /* the data type we're sending */,
            array_slice /*where we're receiving the data */,
            slice_size /*the amount of data we're
                        receiving per process*/,
            MPI_DOUBLE /* the data type we're receiving */,
            0 /*the process we're sending from*/,
            MPI_COMM_WORLD);

oss.str("");
oss.clear();
oss << "[process: " << my_rank << "]:";
for (int i = 0; i < slice_size; i++) {
    oss << " " << array_slice[i];
}
cout << oss.str() << endl;

//double all the data
for (int i = 0; i < slice_size; i++) {
    array_slice[i] *= 2;
}

MPI_Barrier(MPI_COMM_WORLD);

MPI_Allgather(array_slice /*the data we're scattering*/,
              slice_size /* the size of the data we're scattering */,
              MPI_DOUBLE /* the data type we're sending */,
              array /*where we're receiving the data */,
              slice_size /*the amount of data we're
                          receiving from each process*/,
              MPI_DOUBLE /* the data type we're receiving */,
              0 /*the process we're sending from*/,
              MPI_COMM_WORLD);

// We don't need the next line because the data is gathered to all processes:
//
//    0 /*the process we're sending from*/,
//    MPI_COMM_WORLD);

// if (my_rank == 0) {
//     oss.str("");
//     oss.clear();
//     oss << "[process: " << my_rank << "]:";
//     for (int i = 0; i < array_size; i++) {
//         oss << " " << array[i];
//     }
//     cout << oss.str() << endl;
// }

MPI_Finalize();
}

```