Chapter 5 MPI Topic: Data type

5.1 MPI data type

Elementary datatypes, derived datatype.

5.2 Elementary data types

Double x;

MPI_Send(&x, 1, MPI_DOUBLE, …)

MPI_TYPE_CREATE_F90_INTEGER(INTEGER R, INTEGER NEWTYPE, INTEGER IERROR) ! create new type for kind defined datatype.

5.3 Derived datatypes

Problem: MPI communication routines can only send multiples of a single data type; not possible to send items of one type if they are not contiguous in memory.

Solutions: create a new contiguous data type consisting of an array of elements of another datatype. Also vector data type, and indexed data type for not regular spaced data. A struct data type can accommodate multiple data types.

Basic calls

MPI_Datatype newtype;

MPI_Type_commit (&newtype)

MPI_Type_free (&newtype)

MPI_Type_contiguous (count, oldtype, newtype, ierror)

MPI_Type_vector (count, blocklength, stride, oldtype, newtype, ierror)

MPI_Type_indexed (count, array_of_blocklengths, array_of_displacements, oldtype, newtype, ierror)

Int MPI_Type_create_struct (int count, int blocklengths[], MPI_Aint displacements[], MPI_Datatype types[], MPI_Datatype *newtype);

5.4 More about data

With derived types, the sender and receiver can declare a different datatype for the send and receive buffer as long as these have the same datatype signature.

How the send huge number of elements.

In older communication libraries derived datatypes can be packed from its original containers into a buffer and likewise unpack it at the receiver into its destination data structures.

Questions

1. How to understand figure 5.4?

2. what is datatype signature, how can it make the sender and the receiver use different data type?

Exercise

5.1

Send the whole rows with row number 4i (i =0, 1, …, N-1)

Send the selected elements with row number 4i + k (i = 0, 1, …, N-1; k = 1, 2, 3),

MPI_Type_vector (N, 1, 4, MPI_DOUBLE, &MPI_newtype);

MPI_Send(&(A[4i+k][0], 1, MPI_newtype, …);

5.5

In column-major storage, the last element of the column and the first element of next column in the submatrix are separated by a stride which equal to M-m.