Collective Operations

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- int MPI_Bcast(void *buffer, int count, MPI_Datatype datatype, int root, MPI_Comm comm)

- int MPI_Reduce(const void *sendbuf, void *recvbuf, int count, MPI_Datatype datatype,MPI_Op op, int root, MPI_Comm comm)

Broadcast

- **MPI_Bcast** distributes data from one process (the root) to all others in a communicator.

```
int array[100];
int root = 0;
…
MPI_Bcast(array,100,MPI_INT,root,MPI_COMM_WORLD);
```

Reduce

- **MPI_Reduce** combines data from all processes in communicator and returns it to one process.

Computation of π

- The value of π is equal to this definite integral:

$$\int_0^1 \frac{4}{\left(1 + x^2\right)} \, dx$$

Computation of π

- We can approximate this value using the midpoint rule, a numerical integration method.

$$h \sum_{i=1}^{n} \frac{4}{1+\left(\frac{i-0.5}{n}\right)^2}$$

where $h = \frac{1}{n}$

Parallel Region

1. Process 0 reads the value of n

2. The value of n is broadcast to all MPI processes.

3. Each MPI process calculates its partial sum using a portion of the intervals assigned to it.

4. The individual results from each process are reduced using MPI_Reduce to obtain the total sum on the root process (process with $rank$ 0).