15-440
Distributed Systems
Collective Routines in MPI

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Collective Communication

- Collective communication allows you to exchange data among a group of processes
- It must involve **all** processes in the scope of a communicator
- The communicator argument in a collective communication routine should specify which processes are involved in the communication
- Hence, it is the programmer's responsibility to ensure that all processes within a communicator participate in any collective operation

Patterns of Collective Communication

- There are several patterns of collective communication:

1. *Broadcast*
2. *Scatter*
3. *Gather*
4. *Allgather*
5. *Alltoall*
6. *Reduce*
7. *Allreduce*
8. *Scan*
9. *Reducescatter*

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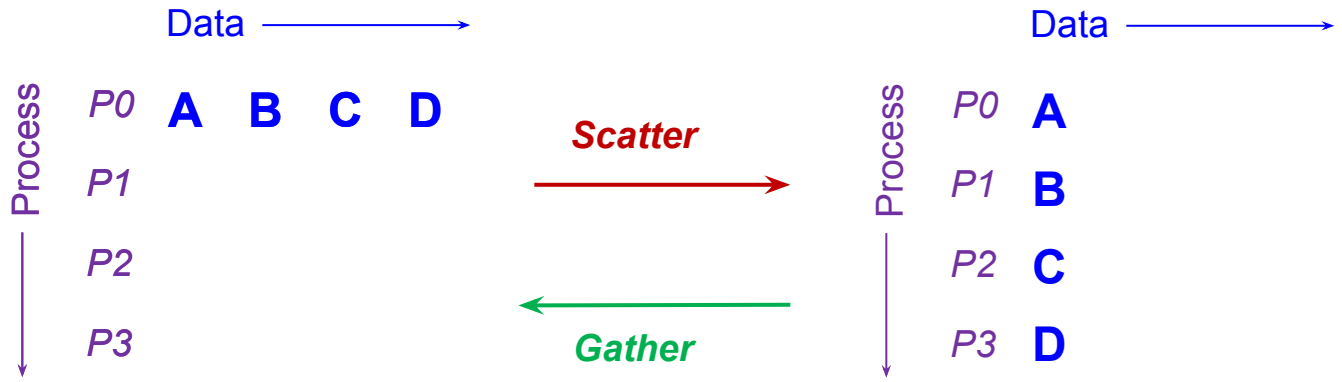
Scatter and Gather

- ***Scatter*** distributes distinct messages from a single source task to each task in the group
- ***Gather*** gathers distinct messages from each task in the group to a single destination task

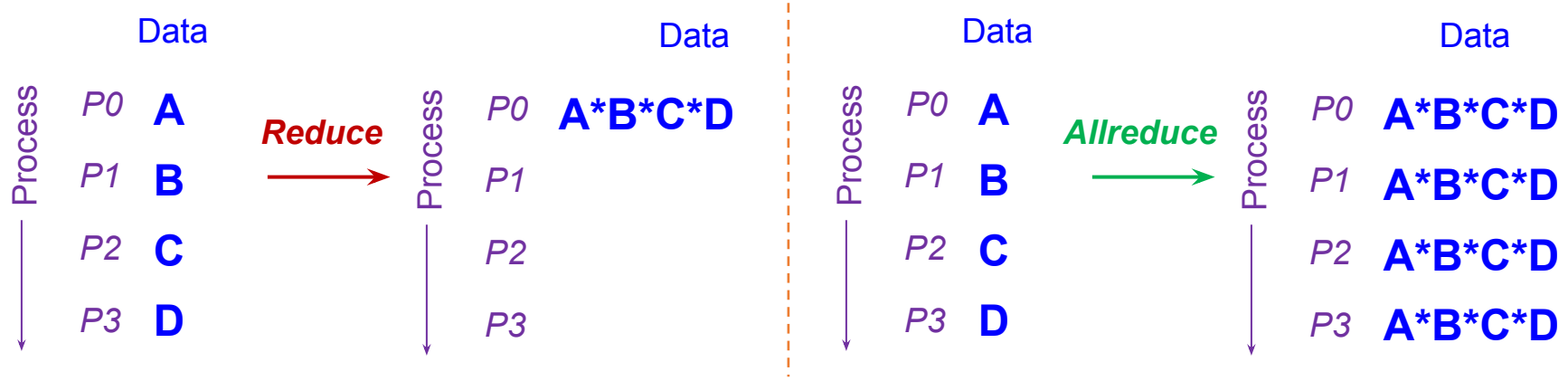


int MPI_Scatter (void ***sendbuf**, int **sendcnt**, MPI_Datatype **sendtype**, void ***recvbuf**, int **recvcnt**, MPI_Datatype **recvtype**, int **root**, MPI_Comm **comm**)

int MPI_Gather (void ***sendbuf**, int **sendcnt**, MPI_Datatype **sendtype**, void ***recvbuf**, int **recvcount**, MPI_Datatype **recvtype**, int **root**, MPI_Comm **comm**)

Reduce and All Reduce

- ***Reduce*** applies a reduction operation on all tasks in the group and places the result in one task
- ***Allreduce*** applies a reduction operation and places the result in all tasks in the group. This is equivalent to an MPI_Reduce followed by an MPI_Bcast



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

int MPI_Allreduce (void ***sendbuf**, void ***recvbuf**, int **count**, MPI_Datatype **datatype**, MPI_Op **op**, MPI_Comm **comm**)