Collective Communication
Operations on various topologies

Murat Manguoğlu
Middle East Technical University
Computer Engineering

CENG478 – Spring 2019
one to all broadcast ↔ all to one reduction

MPI_Bcast ↔ MPI_Reducce

- Linear array
- Ring
- 2D Mesh
- 3D Mesh
- Hypercube

On the board
all to all broadcast ↔ all to all reduction

MPI_Allgather ↔ MPI_Reduce_scatter

• Ring
• Linear array
• 2D Mesh
• Hypercube
All reduce

MPI_Allreduce

- Ring
- Linear array
- 2D Mesh
- Hypercube

On the board
Prefix Sum

Example: \([0,1,2,3,4,5,6,7] \rightarrow [0,1,3,6,10,15,21,28]\)

**Algorithm 4.9** Prefix sums on a \(d\)-dimensional hypercube.

```plaintext
1. procedure PREFIX_SUMS_HCUBE(my_id, my_number, d, result)
2. begin
3.   result := my_number;
4.   msg := result;
5.   for i := 0 to d - 1 do
6.     partner := my_id XOR \(2^i\);
7.     send msg to partner;
8.     receive number from partner;
9.     msg := msg + number;
10.   if (partner < my_id) then result := result + number;
11. endfor;
12. end PREFIX_SUMS_HCUBE
```
scatter ↔ gather

MPI_Scatter ↔ MPI_Gather

- Linear array
- Hypercube
all to all personalized communication

MPI_Alltoall

- Ring
- Hypercube

On the board