# Distributed Algorithms

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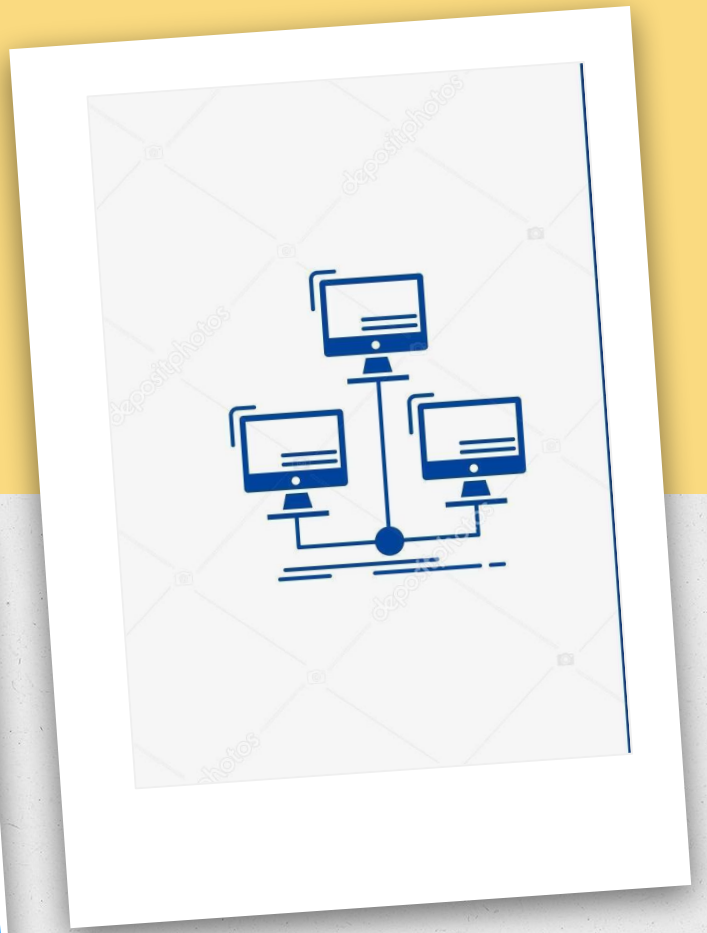
A distributed algorithm is an algorithm designed to run on computer hardware constructed from interconnected processors.

**What are distributed Algorithms ?**



# Message Passing Interface


What is OpenMPI?

SimGrid is a toolkit that
provides core functionalities
for the simulation of distributed applications
in heterogeneous distributed environments.


## What is SIMGRID?

# SMPI functions :

- MPI_Barrier
- MPI_Send
- MPI_Recv
- MPI_Bcast

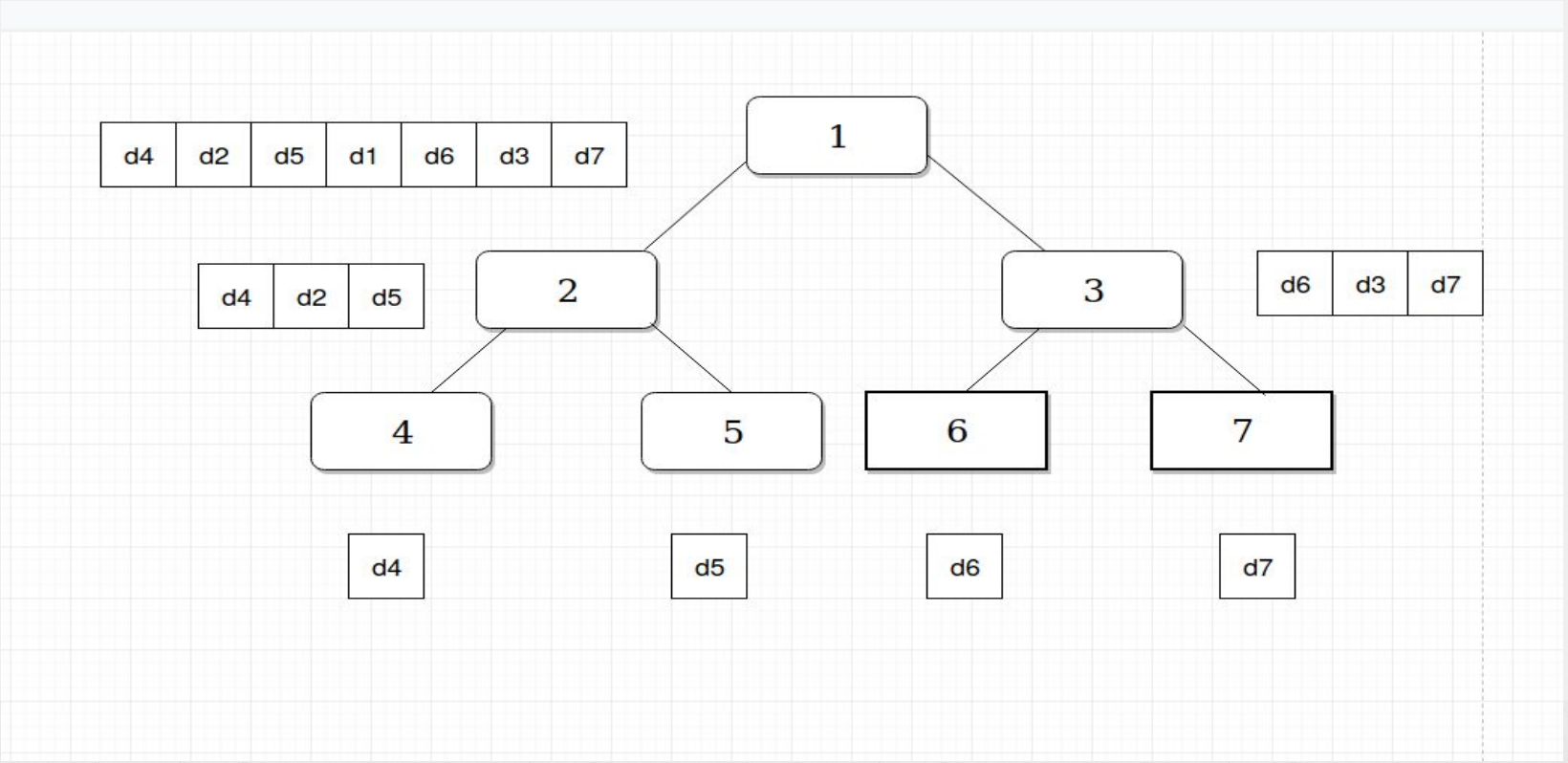
# Algorithms :

- Broadcast
- Reduce
- Gather
- Scatter
- Pi calculation

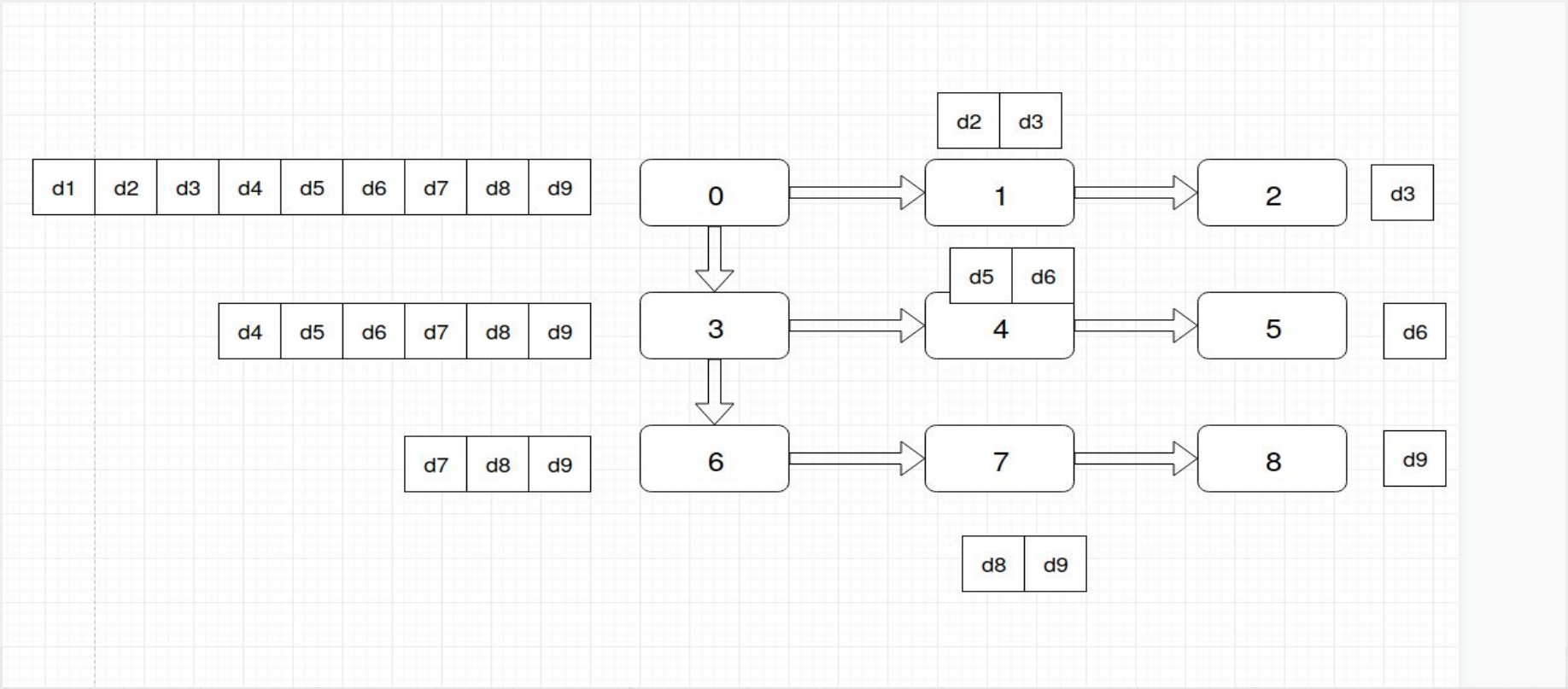
# Architectures :

- Linear Array
- Matrix
- Tree
- Fully Connected Graph
- Hypercube

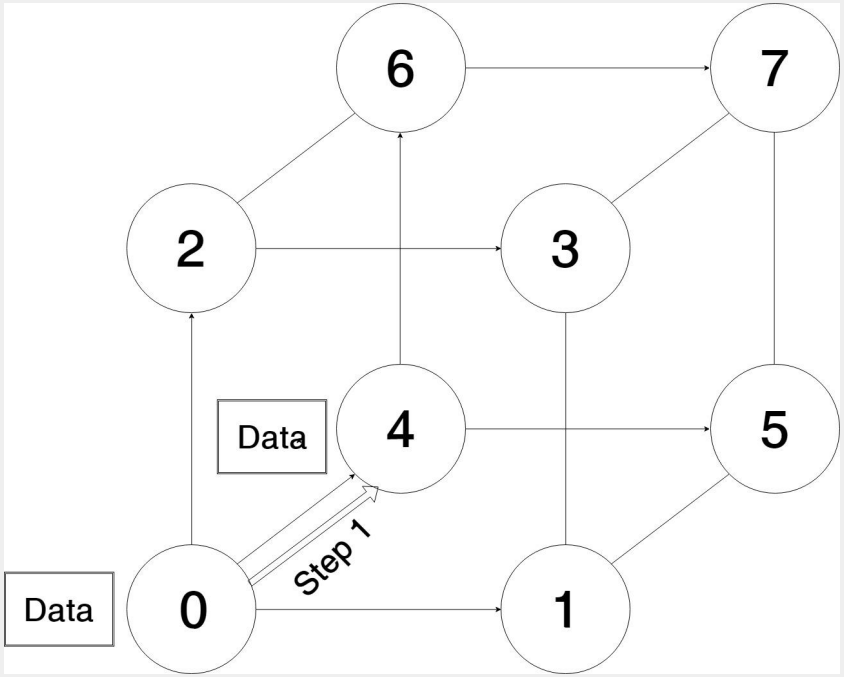
# Tree-Gather



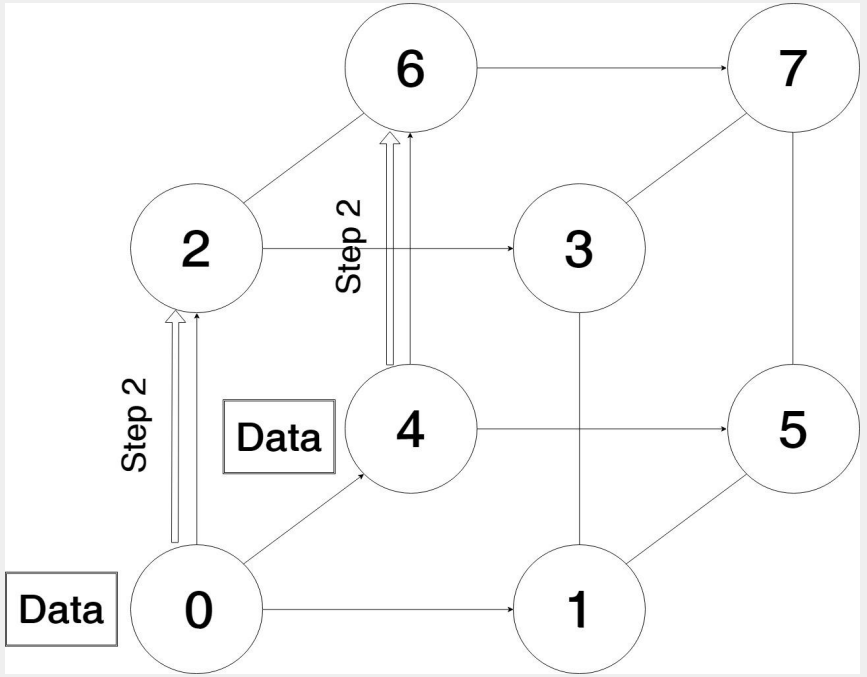
# Matrix-Scatter



# Pi-Hypercube

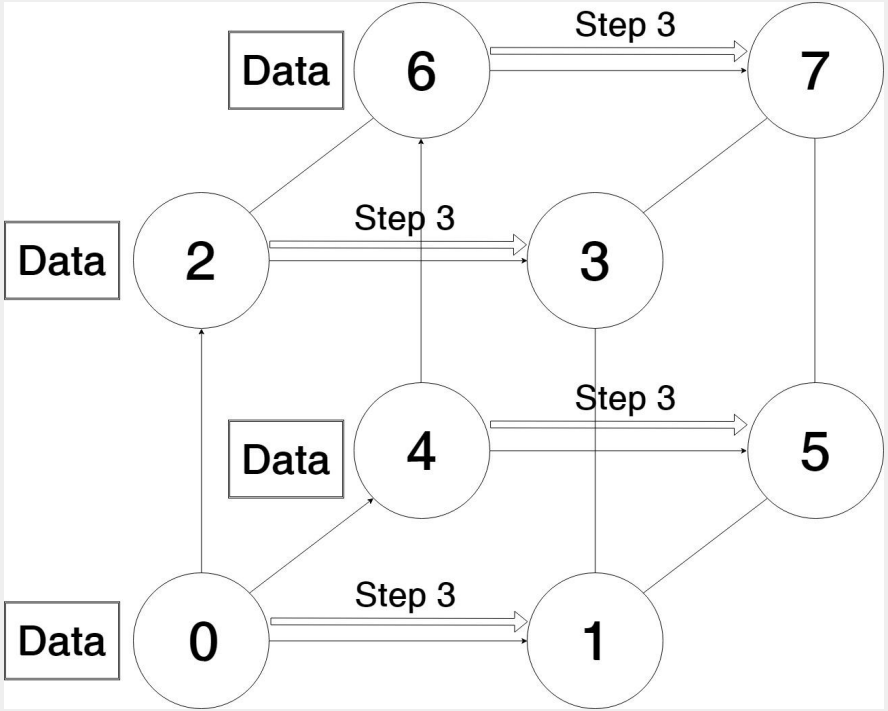



Broadcast Step 1



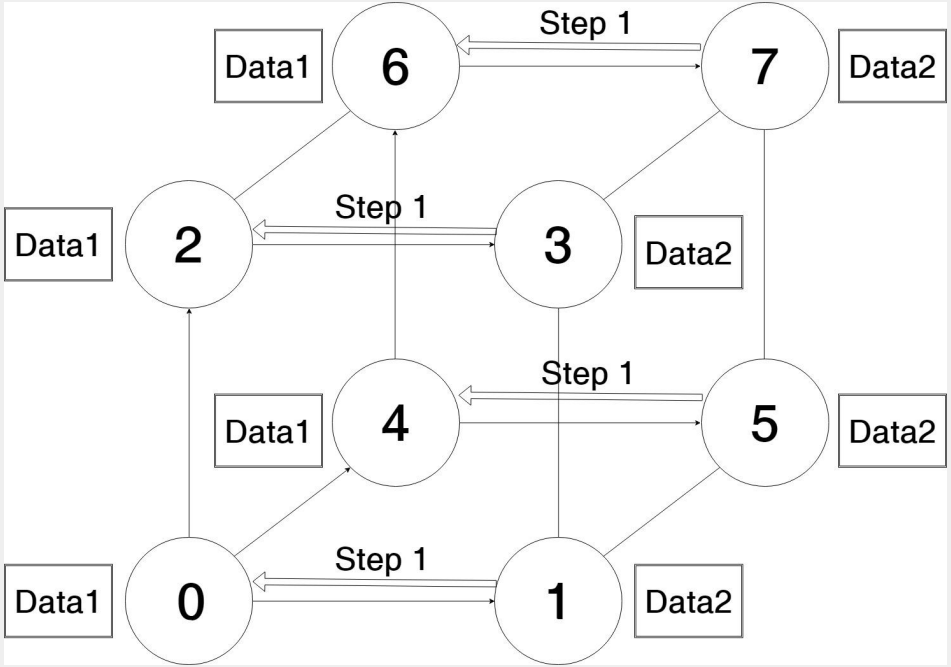

Broadcast Step 2

# Pi-Hypercube

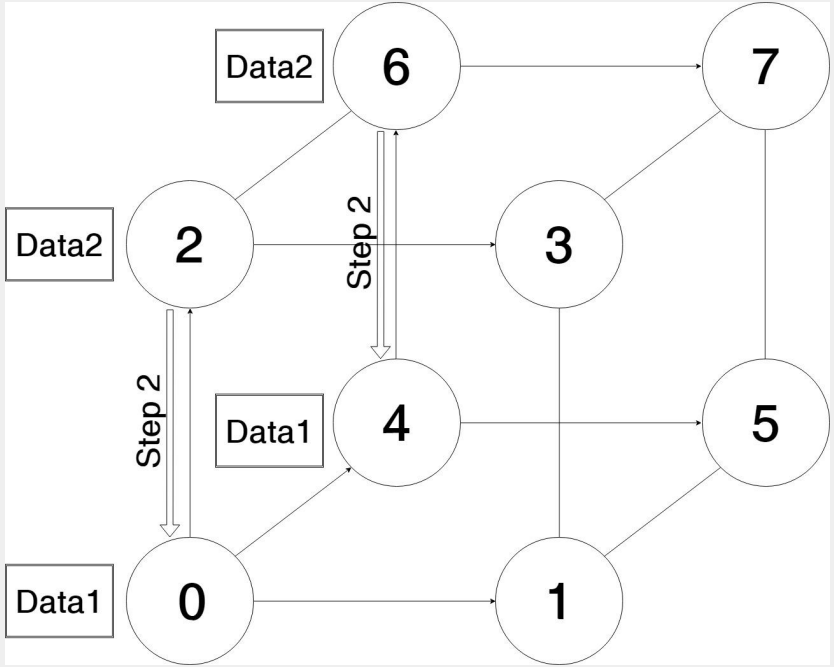



Broadcast Step 3

# Pi-Hypercube

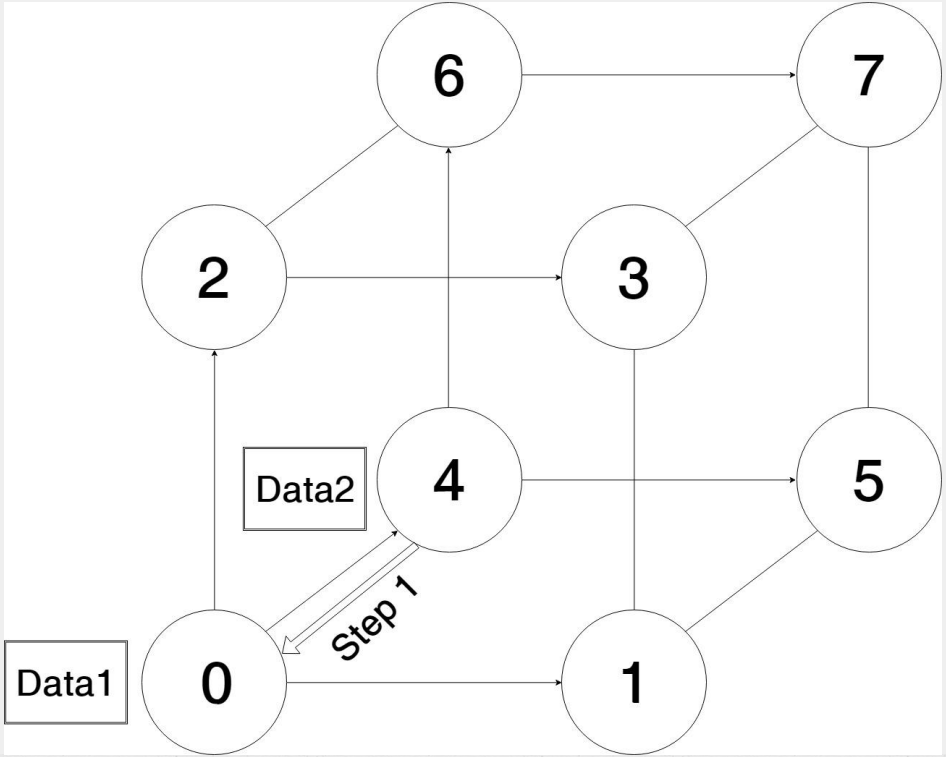



Reduce Step 1



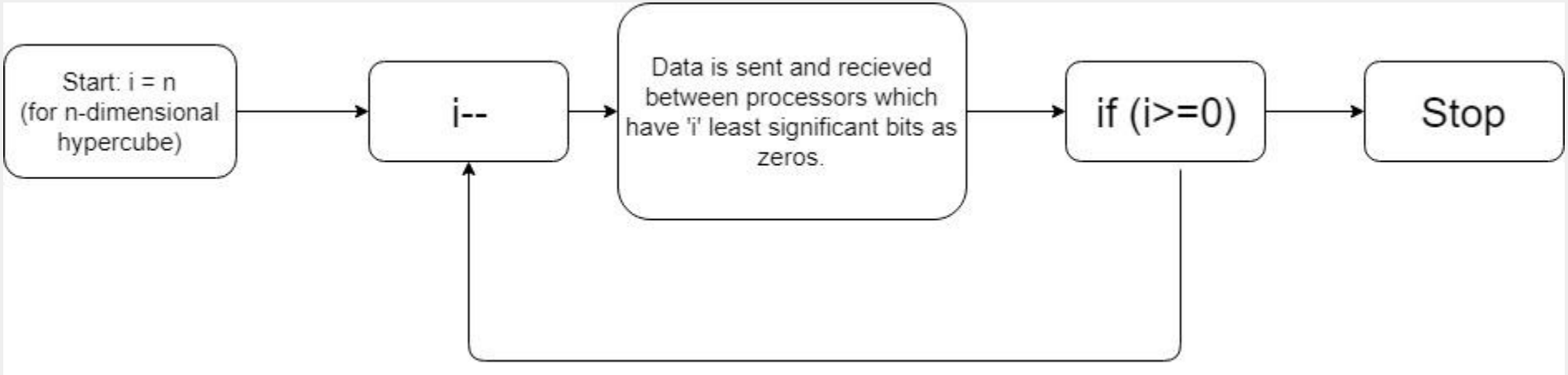

Reduce Step 2

# Pi-Hypercube




Reduce Step 3

# Pi-Hypercube: Algorithm



# Parameters set 1:

- Latency : 100us
- Bandwidth : 50MBps
- Speed : 1Gf (Gigaflops)

# Table1

| | Linear array | Matrix | Tree | Fully connected graph | HyperCube |
|---|---|---|---|---|---|
| Broadcast | 0.000606000 | 0.000809000 | 0.000404000 | 0.000211000 | 0.000313000 |
| Reduce | 0.000604000 | 0.000806000 | 0.000806000 | 0.000682000 | 0.000642000 |
| Scatter | 0.001007000 | 0.002217000 | 0.001410000 | 0.000432000 | 0.001577000 |
| Gather | 0.000604000 | 0.001613000 | 0.001209000 | 0.000716000 | 0.001424000 |
| Pi calculation | 0.001210000 | 0.001616000 | 0.001213000 | 0.001079000 | 0.001532000 |

# Parameters set 2:

- Latency : 100us (common ) , 1000us for 1 link
- Bandwidth : 50MBps(common)
- Speed : 1Gf (Gigaflops)

# Table2

| | Linear array | Matrix | Tree | Fully connected graph | HyperCube |
|---|---|---|---|---|---|
| Broadcast | 0.002419000 | 0.002217000 | 0.002217000 | 0.002017000 | 0.002020000 |
| Reduce | 0.002417000 | 0.002418000 | 0.002619000 | 0.002495000 | 0.002550000 |
| Scatter | 0.006447000 | 0.016722000 | 0.012290000 | 0.002100000 | 0.002280000 |
| Gather | 0.006044000 | 0.005239000 | 0.006649000 | 0.002466000 | 0.003229000 |
| Pi calculation | 0.004836000 | 0.004636000 | 0.004839000 | 0.004880000 | 0.005160000 |

# Parameters set 3:

- Latency : 100us (common )
- Bandwidth : 50MBps(common),500MBps(for one link)
- Speed : 1Gf (Gigaflops)

# Table3

| | Linear array | Matrix | Tree | Fully connected graph | HyperCube |
|---|---|---|---|---|---|
| Broadcast | 0.000605000 | 0.000809000 | 0.000404000 | 0.000206000 | 0.000761000 |
| Reduce | 0.000604000 | 0.000806000 | 0.000806000 | 0.000712000 | 0.000722000 |
| Scatter | 0.001007000 | 0.002217000 | 0.001410000 | 0.000246000 | 0.001590000 |
| Gather | 0.000604000 | 0.001613000 | 0.001209000 | 0.000651000 | 0.001423000 |
| Pi calculation | 0.001210000 | 0.001616000 | 0.001212000 | 0.001190000 | 0.001450000 |

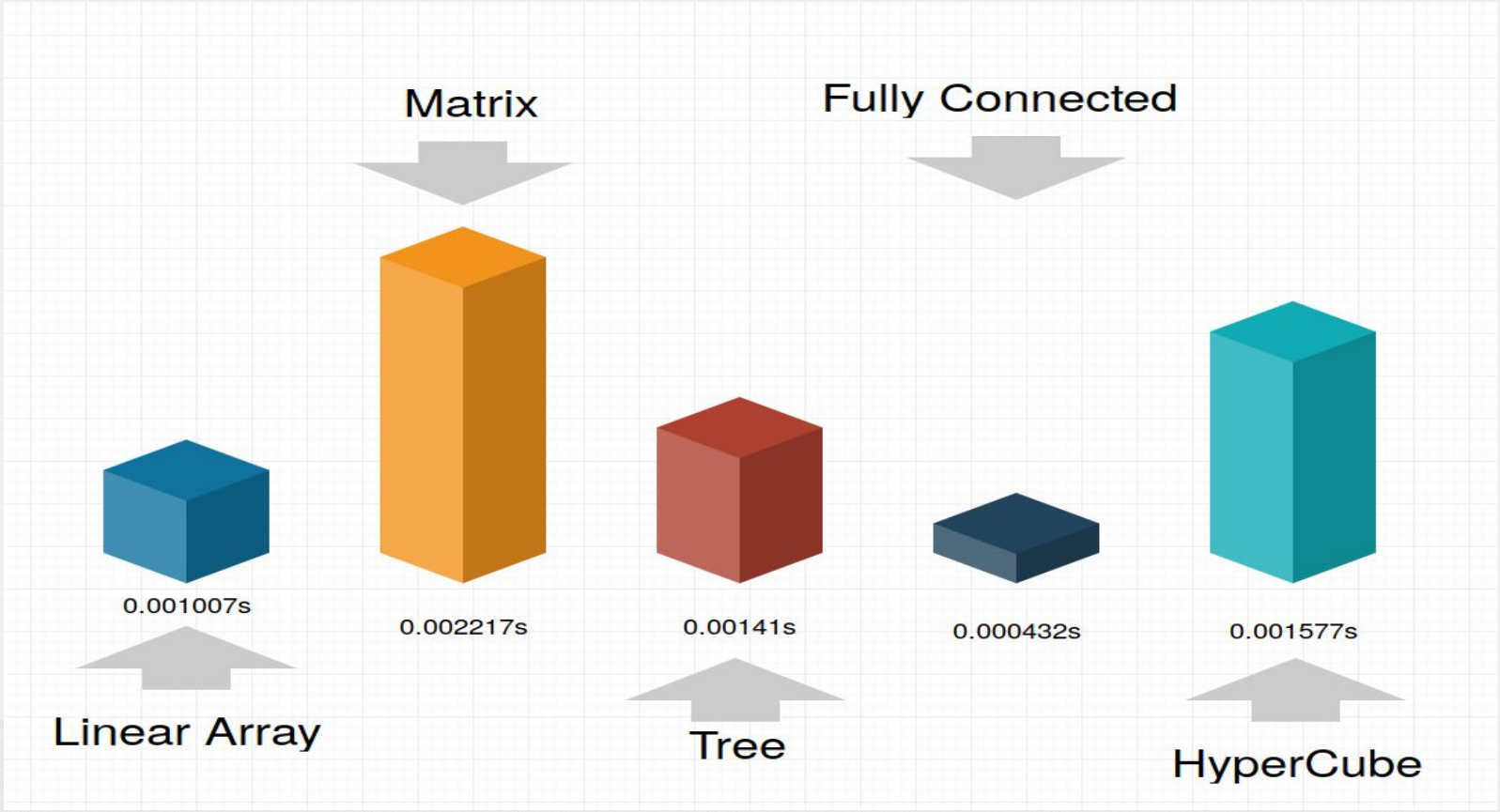
# Parameters set 4:

- Latency : 100us (common )
- Bandwidth : 50MBps(common)
- Speed : 1Gf (Gigaflops),1Mf(for one processor)

# Table4

| | Linear array | Matrix | Tree | Fully connected graph | HyperCube |
|---|---|---|---|---|---|
| Broadcast | 0.000605000 | 0.000809000 | 0.000404000 | 0.004140000 | 0.006510000 |
| Reduce | 0.000604000 | 0.000806000 | 0.000806000 | 0.038800000 | 0.098400000 |
| Scatter | 0.001007000 | 0.002217000 | 0.001410000 | 0.049300000 | 0.132600000 |
| Gather | 0.000604000 | 0.001613000 | 0.001210000 | 0.057880000 | 0.012300000 |
| Pi calculation | 0.001212000 | 0.001620000 | 0.001215000 | 0.032280000 | 0.032970000 |

# Scatter-graph:



# References:


1. https://simgrid.github.io/SMPI_CourseWare/

2. http://pages.cs.wisc.edu/~tvrdik/11/html/Section11.html

3. http://parallelcomp.uw.hu/ch04lev1sec1.html