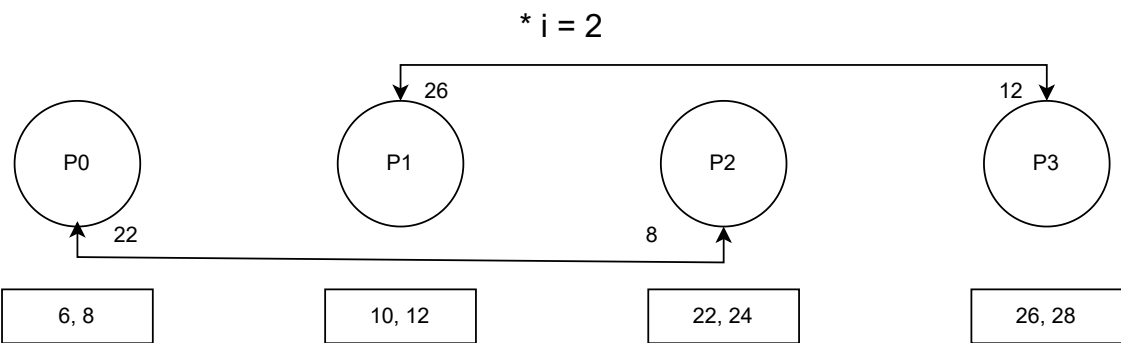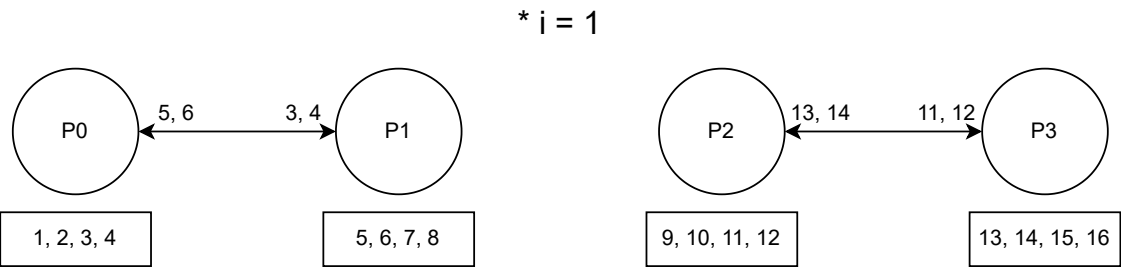# Vector Halving and Distance Doubling Allreduce [SUM]
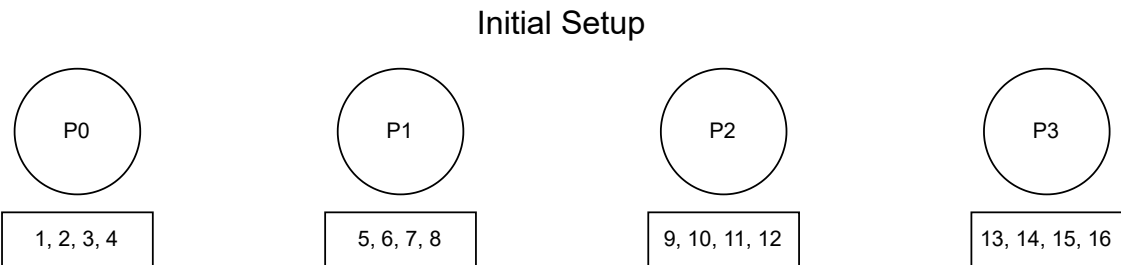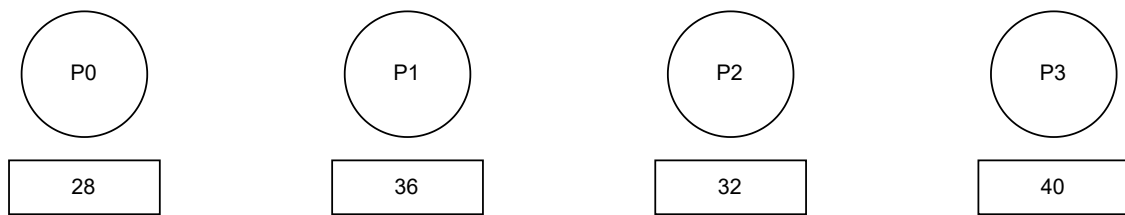
1° Step: Reduce-Scatter [Recursive Halving and Distance Doubling]

Initial Setup

P0	P1	P2	P3
1, 2, 3, 4	5, 6, 7, 8	9, 10, 11, 12	13, 14, 15, 16

* i = 1

P0 ←→ P1 (5, 6 | 3, 4)   P2 ←→ P3 (13, 14 | 11, 12)

P0	P1	P2	P3
1, 2, 3, 4	5, 6, 7, 8	9, 10, 11, 12	13, 14, 15, 16

* i = 2

P0 → P1: 26   P3: 12
P0 ← 22   P2: 8

P0	P1	P2	P3
6, 8	10, 12	22, 24	26, 28

Intermedie Result

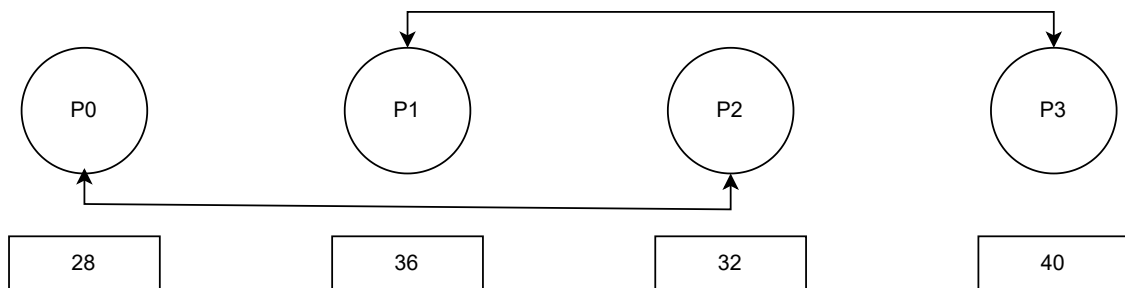| P0	P1	P2	P3
28	36	32	40
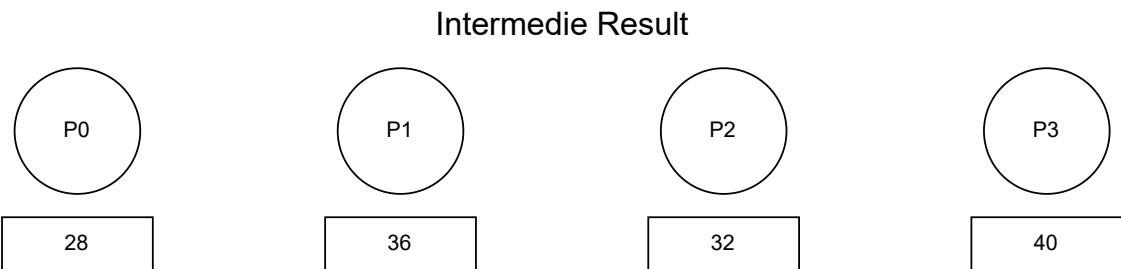
2° Step: Allgather [Recursive Doubling and Distance Halving]

Intermedie Result

P0	P1	P2	P3
28	36	32	40

* i = 1

P0	P1	P2	P3
28	36	32	40

* i = 2

P0	P1	P2	P3
28, 32	36, 40	28, 32	36, 40

Final Result

P0	P1	P2	P3
28, 32, 36, 40	28, 32, 36, 40	28, 32, 36, 40	28, 32, 36, 40