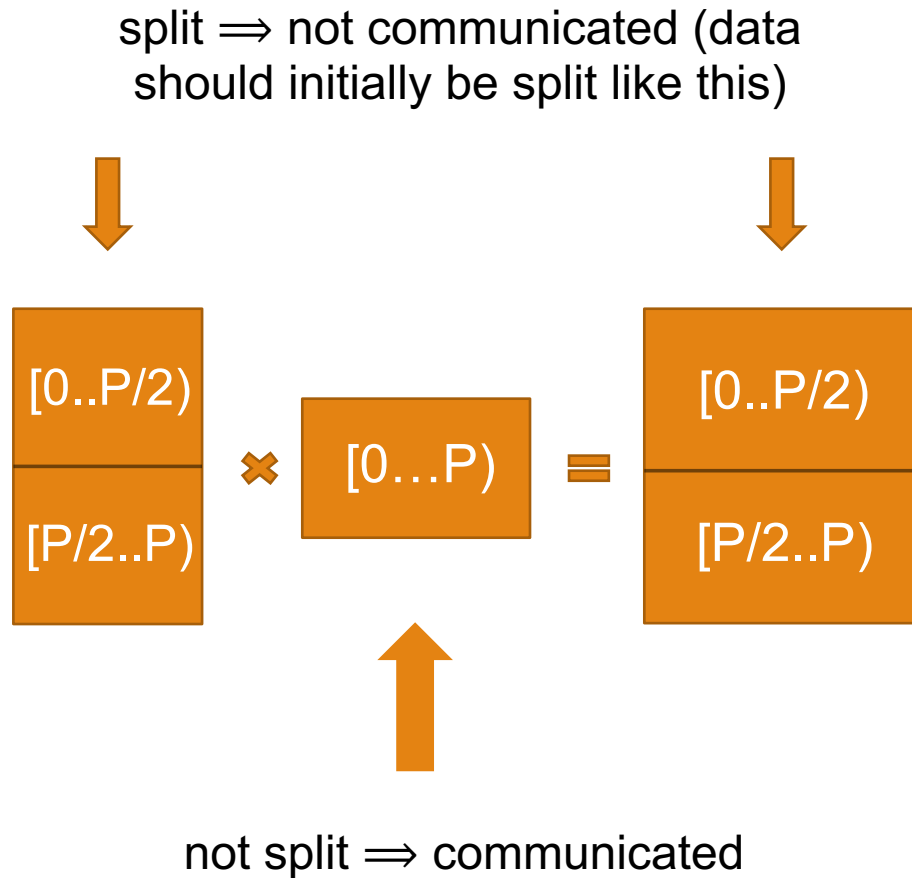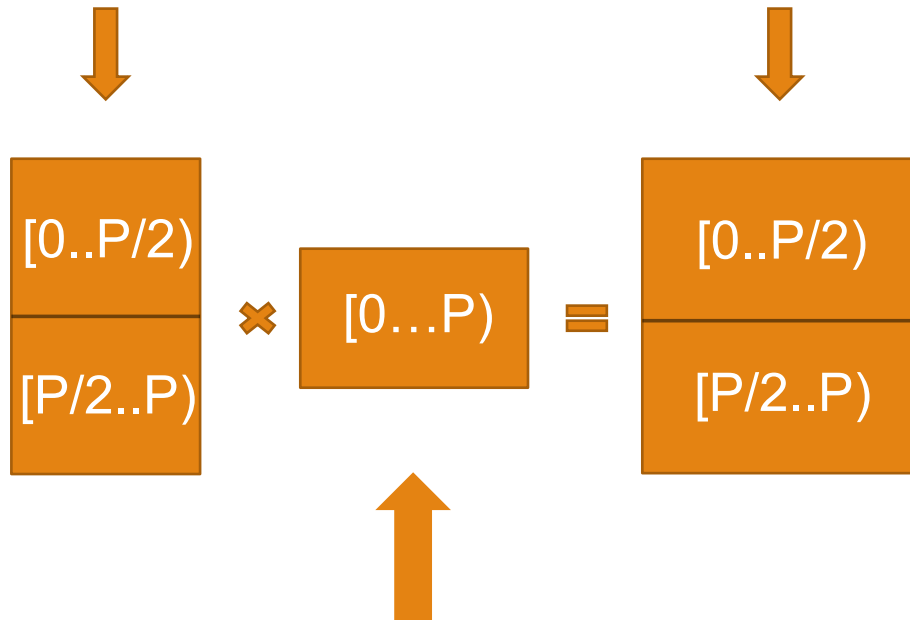# Parallel Step: Closer Look
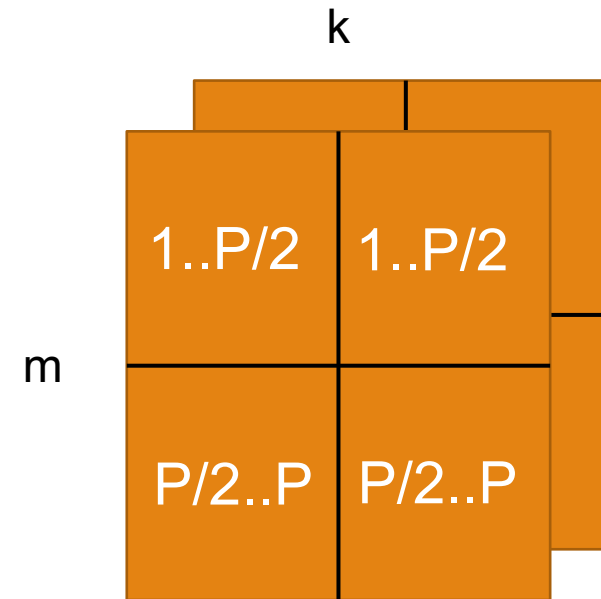

split $\Rightarrow$ not communicated (data should initially be split like this)

[0..P/2)

[P/2..P)

$\times$

[0…P)

$=$

[0..P/2)

[P/2..P)

not split $\Rightarrow$ communicated

SPLIT

[0..P/2)

[P/2..P)

[0..P/2)

0,   1   … P/2-1

P/2, P/2+1…P-1

[P/2..P)

[0..P/2)

[P/2..P)

[0..P/2)

[P/2..P)

communication

cscs

ETH *zürich*
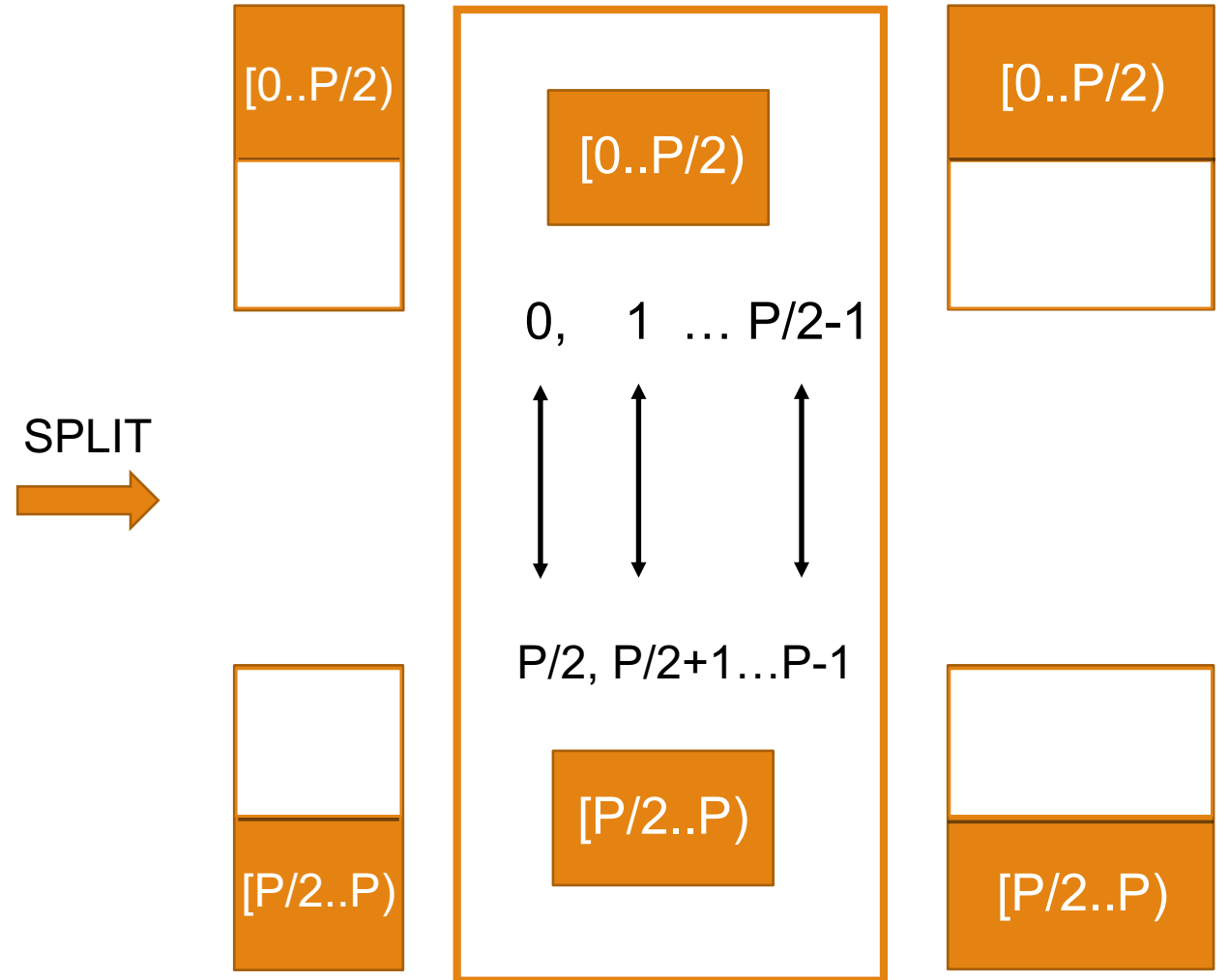
Data Layout

split ⟹ not communicated (data should initially be split like this)

[0..P/2)			[0..P/2)
[P/2..P)	✗	[0…P) =	[P/2..P)

not split ⟹ communicated

k

m

1..P/2	1..P/2
P/2..P	P/2..P

1. Parallel (m/2)

2. Parallel (n/2)

3. Sequential(k/2)

4. Base case: any load-balanced layout

ETH *zürich*

$$\{0, 1, \dots, i, \dots, P - 1\}$$

$$\{0, \frac{P}{2}, 1, \frac{P}{2} + 1, \dots, i, \frac{P}{2} + i, \dots, P - 1\}$$
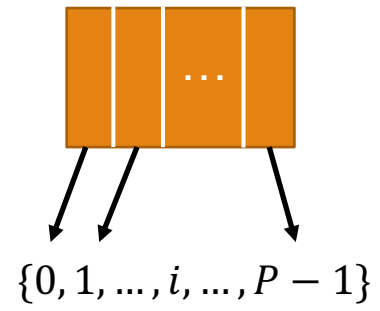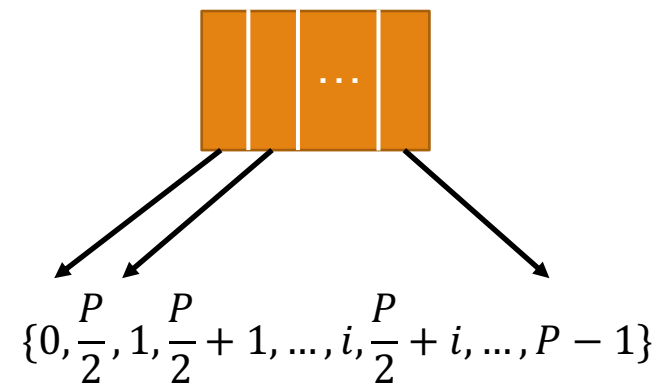
BEFORE
COMMUNICATION

| 0 | 1 | 2 | 3 |

AFTER
COMMUNICATION

| 0 | 1 | 0 | 1 | | 2 | 3 | 2 | 3 |

BEFORE
COMMUNICATION

| 0 | 2 | 1 | 3 |

AFTER
COMMUNICATION

| 0 | 0 | 1 | 1 | | 2 | 2 | 3 | 3 |