HPCA project

Batch Sort et Merge Path Sort

AlGORITHM OVERVIEW

POLYTECH SORBONNE

SORBONNE UNIVERSITÉ

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PROBLEM TO SOLVE

How to sort efficiently an array of elements **using GPU** ?

variable names :

- A,B and M are array of int
- A,B are sorted
- We save our result in M
- M is not sorted on the initialisation

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Of two sorted array,
A and B

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Of two sorted array,
A and B

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“MERGE SORT” ON GPU

tree approach

04

SORT WITH BATCHES

tree approach, batches
and streams

01

MERGE ON ONE BLOCK

ALGO mergeSmall_k

A

1	2	5	6	6	9	11	15	16

B

4	7	8	10	12	13	14

ALGO mergeSmall_k

A \ B	4	7	8	10	12	13	14
1							
2							
5							
6							
6							
9							
11							
15							
16							

ALGO mergeSmall_k

A \ B	4	7	8	10	12	13	14
1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1
5	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
9	0	0	0	1	1	1	1
11	0	0	0	0	1	1	1
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0

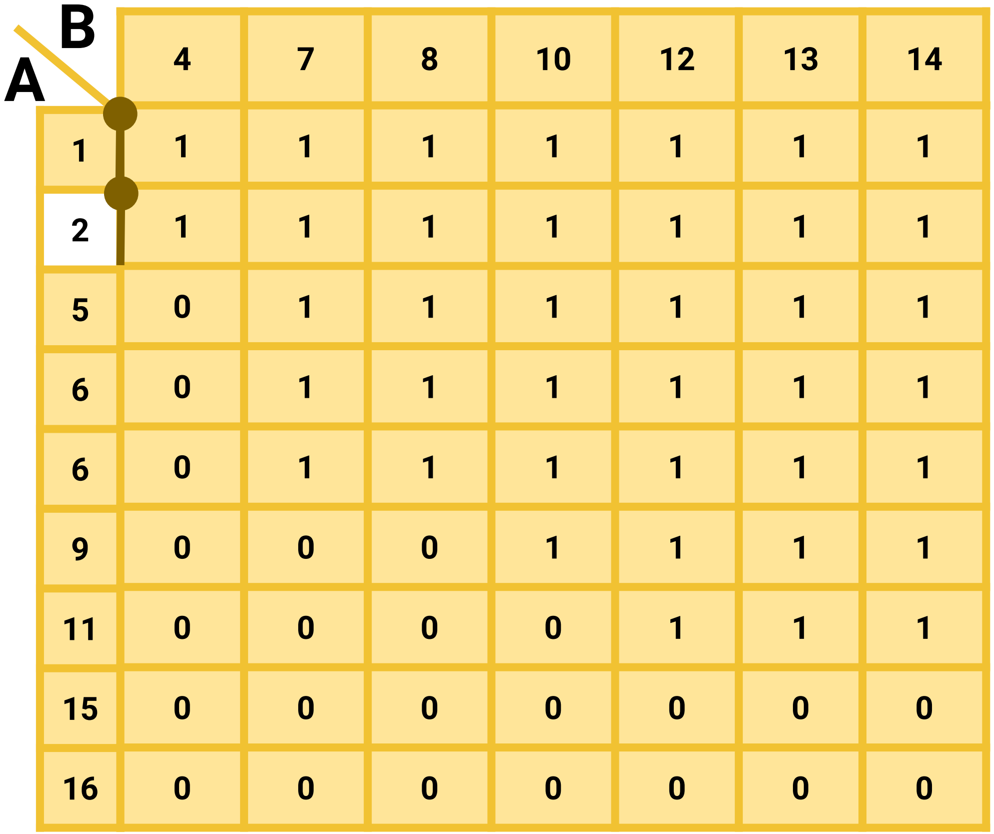
ALGO mergeSmall_k

B A	4	7	8	10	12	13	14
1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1
5	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
9	0	0	0	1	1	1	1
11	0	0	0	0	1	1	1
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0

M

1

ALGO mergeSmall_k

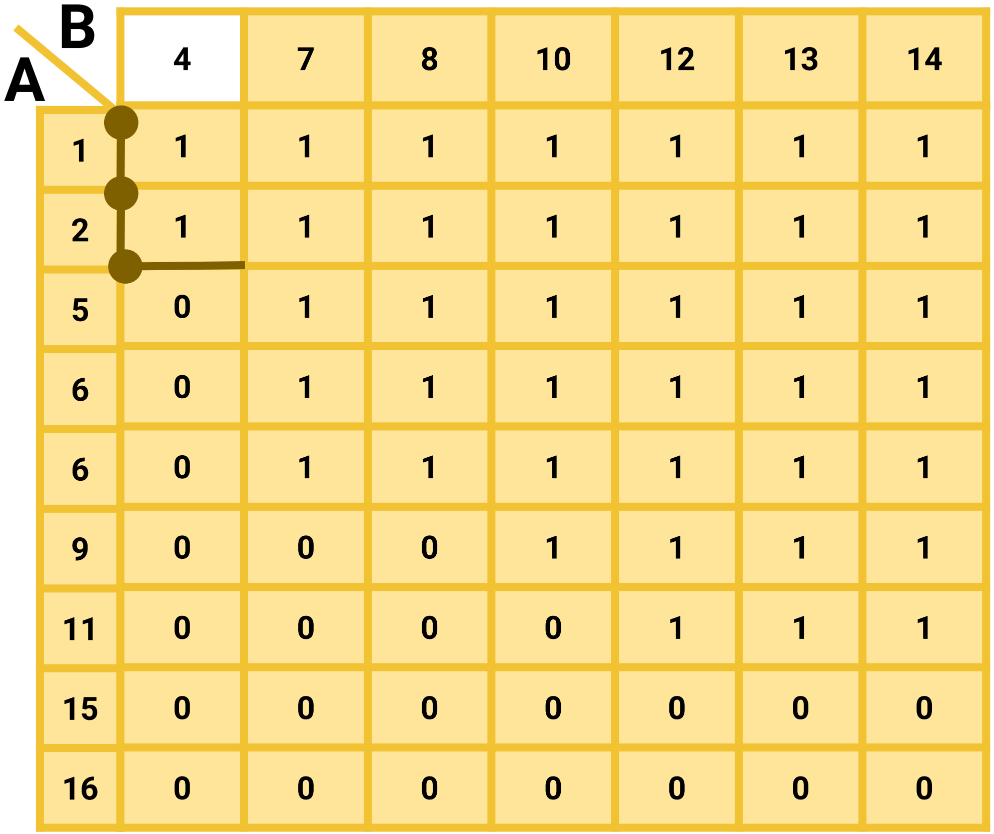


A \ B	4	7	8	10	12	13	14
1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1
5	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
9	0	0	0	1	1	1	1
11	0	0	0	0	1	1	1
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0

M

1	2

ALGO mergeSmall_k

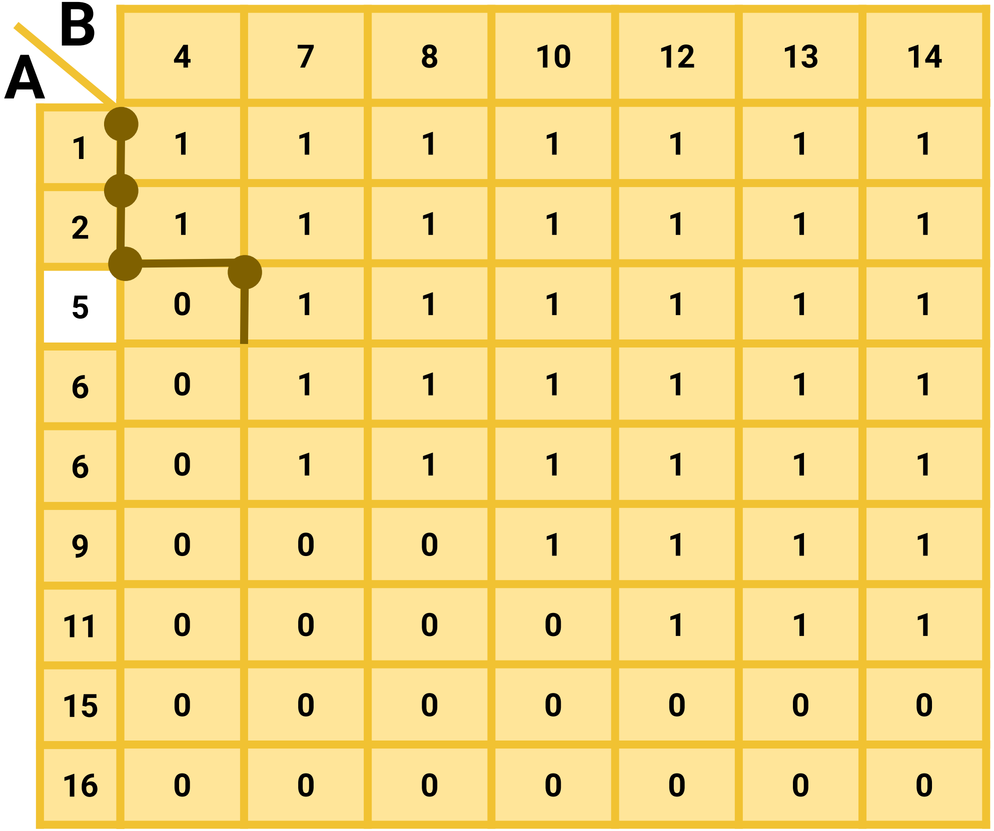


A \ B	4	7	8	10	12	13	14
1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1
5	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
9	0	0	0	1	1	1	1
11	0	0	0	0	1	1	1
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0

M

1	2	4

ALGO mergeSmall_k

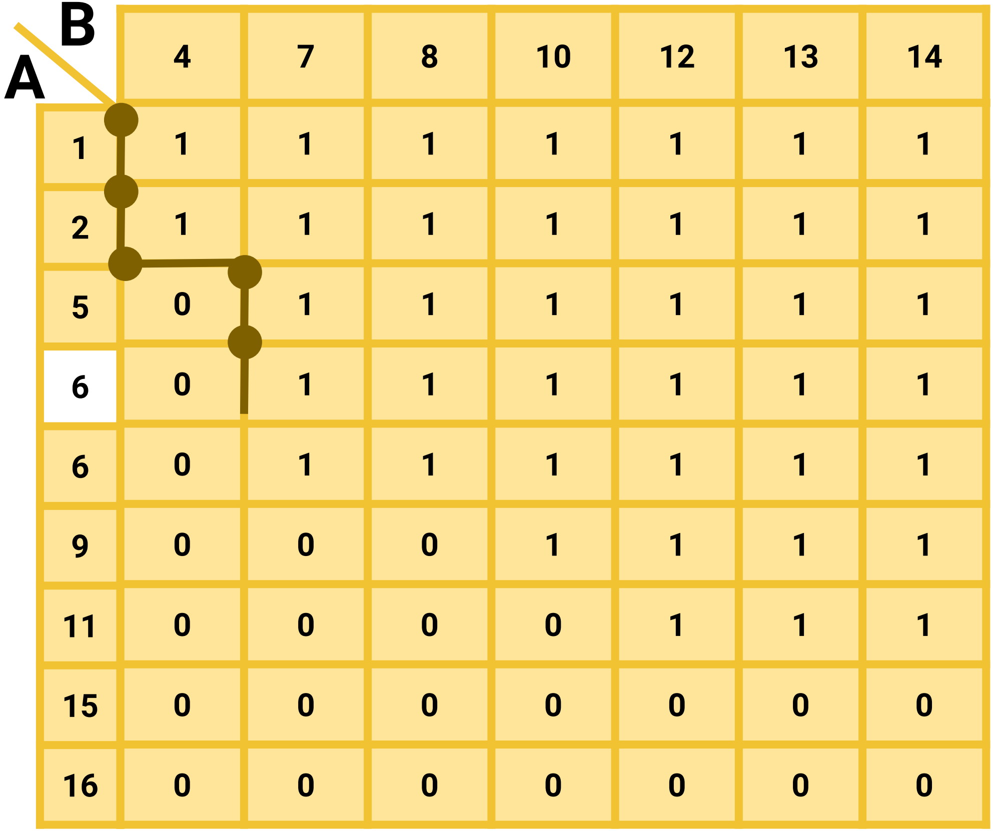


A \ B	4	7	8	10	12	13	14
1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1
5	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
9	0	0	0	1	1	1	1
11	0	0	0	0	1	1	1
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0

M

1	2	4	5

ALGO mergeSmall_k

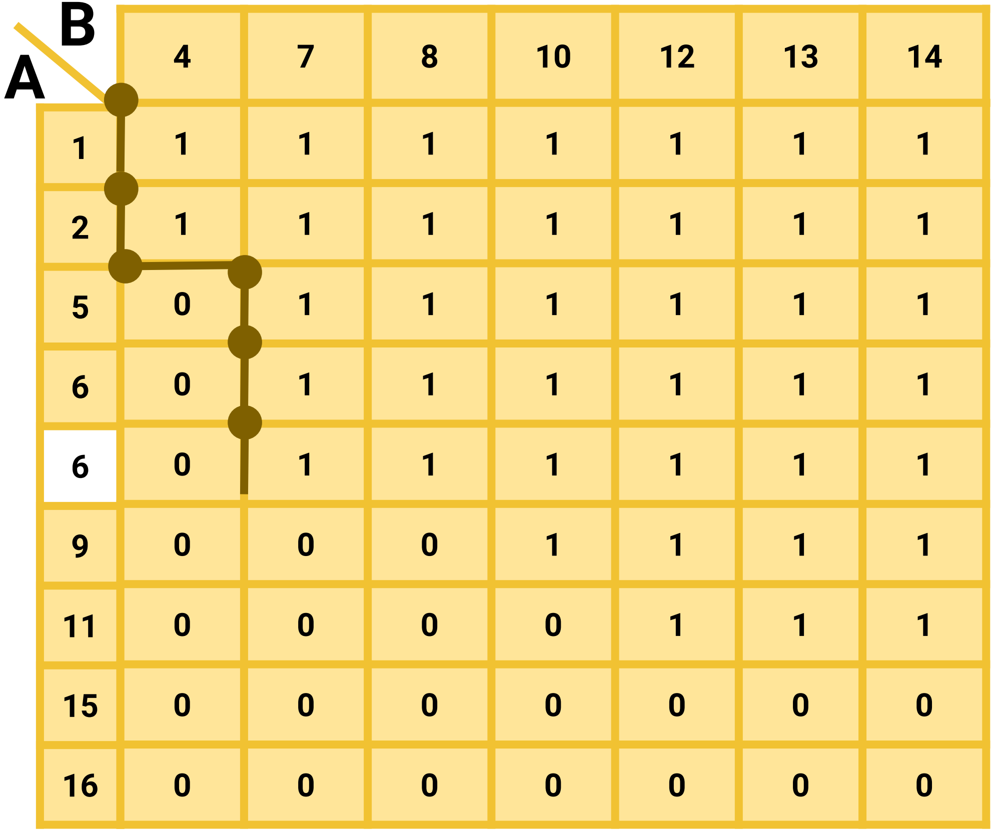


A \ B	4	7	8	10	12	13	14
1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1
5	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
9	0	0	0	1	1	1	1
11	0	0	0	0	1	1	1
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0

M

1	2	4	5	6

ALGO mergeSmall_k



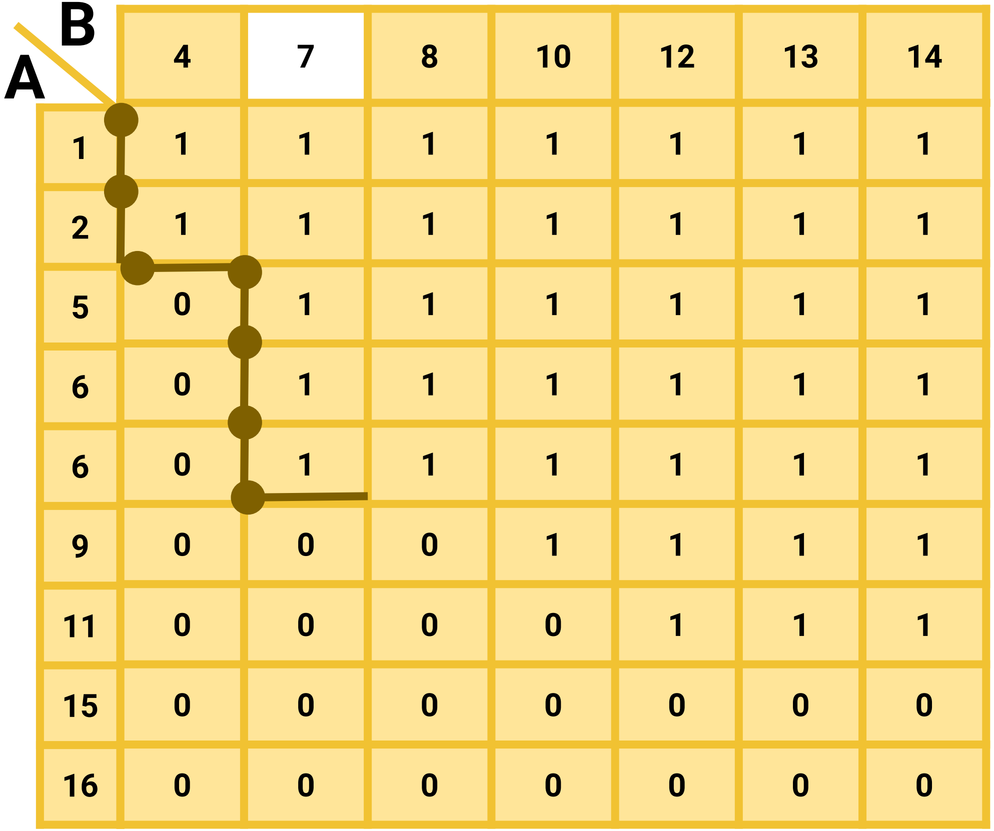
A \ B	4	7	8	10	12	13	14
1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1
5	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
9	0	0	0	1	1	1	1
11	0	0	0	0	1	1	1
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0

M

1	2	4	5	6

… 6

ALGO mergeSmall_k



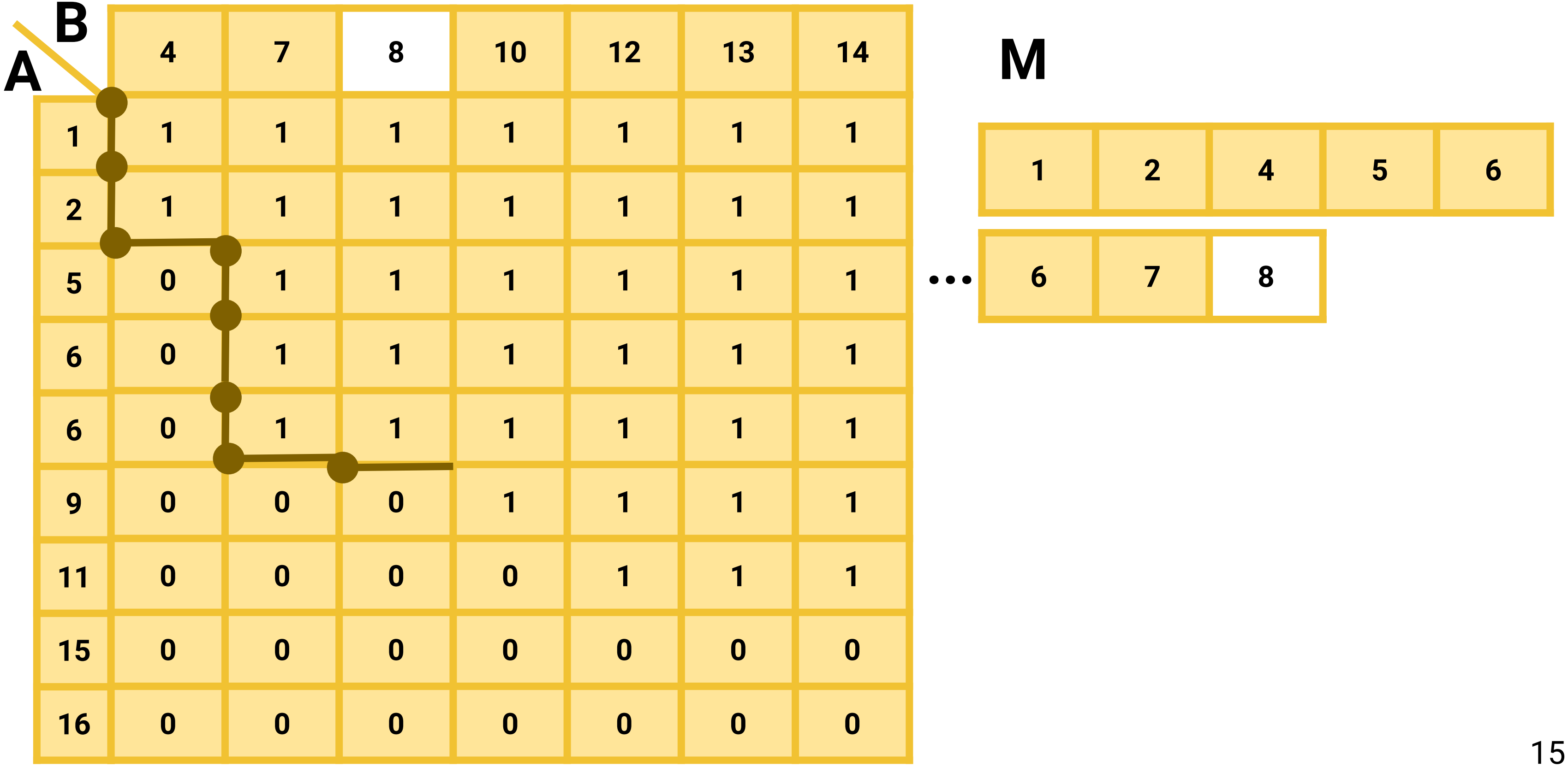
A \ B	4	7	8	10	12	13	14
1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1
5	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
9	0	0	0	1	1	1	1
11	0	0	0	0	1	1	1
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0

M

1	2	4	5	6

...	6	7

ALGO mergeSmall_k



A \ B	4	7	8	10	12	13	14
1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1
5	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
9	0	0	0	1	1	1	1
11	0	0	0	0	1	1	1
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0

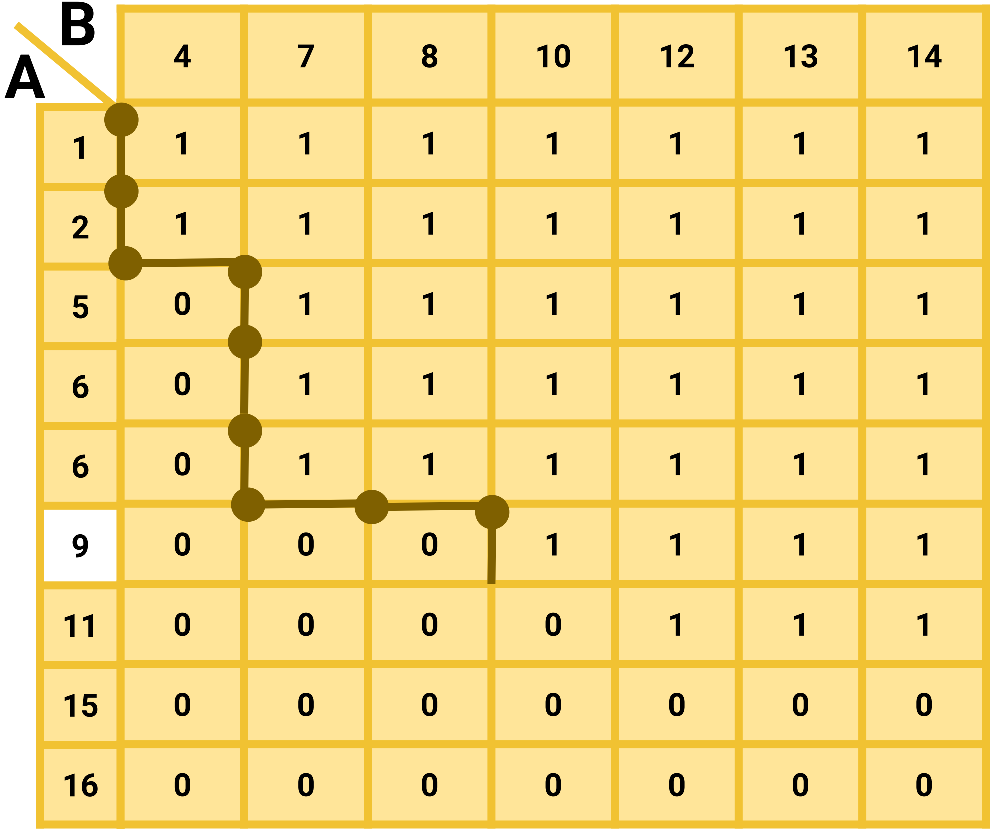
M

1	2	4	5	6

…

6	7	8

ALGO mergeSmall_k



A \ B	4	7	8	10	12	13	14
1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1
5	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
9	0	0	0	1	1	1	1
11	0	0	0	0	1	1	1
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0

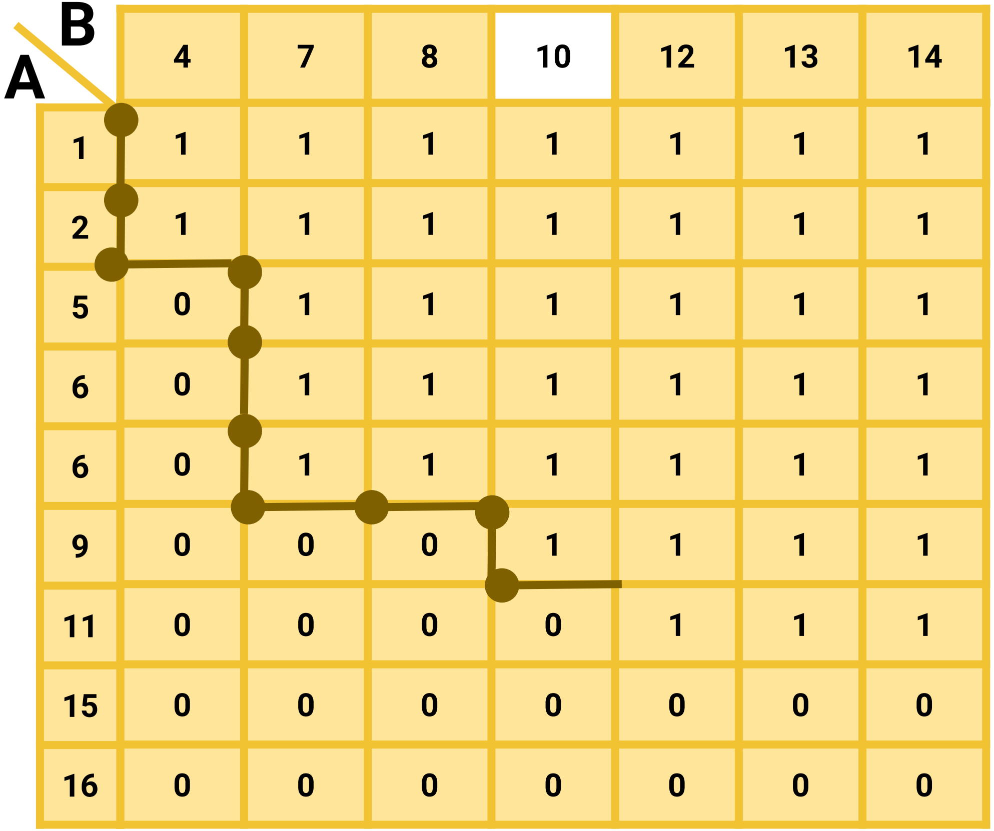
M

1	2	4	5	6

…

6	7	8	9

ALGO mergeSmall_k



A \ B	4	7	8	10	12	13	14
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2	1	1	1	1	1	1	1
5	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
9	0	0	0	1	1	1	1
11	0	0	0	0	1	1	1
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0

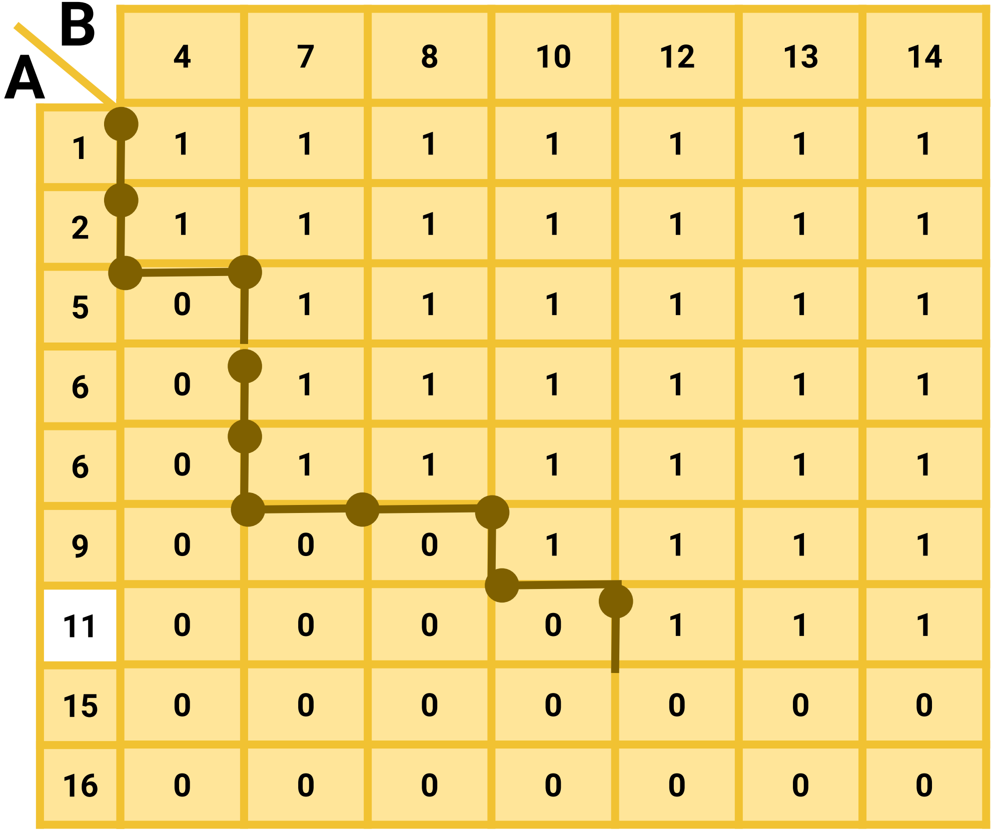
M

1	2	4	5	6

…

6	7	8	9	10

ALGO mergeSmall_k



A \ B	4	7	8	10	12	13	14
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2	1	1	1	1	1	1	1
5	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
9	0	0	0	1	1	1	1
11	0	0	0	0	1	1	1
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0

M

1	2	4	5	6

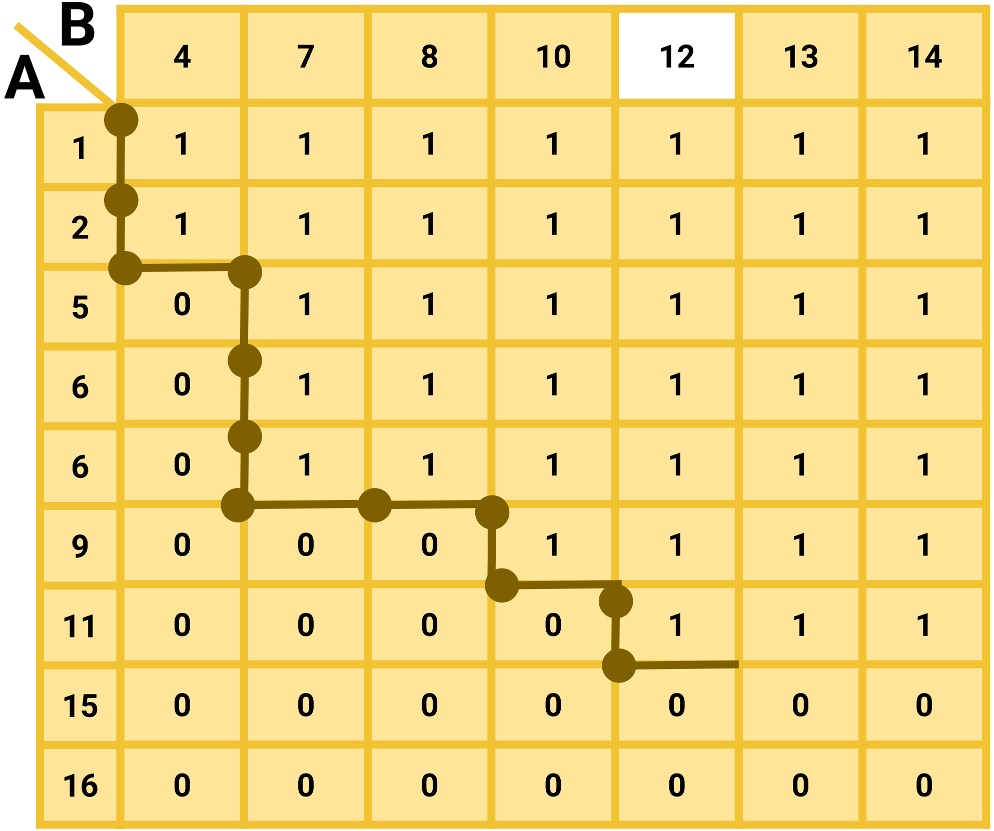
...

6	7	8	9	10

...

11

ALGO mergeSmall_k



B A	4	7	8	10	12	13	14
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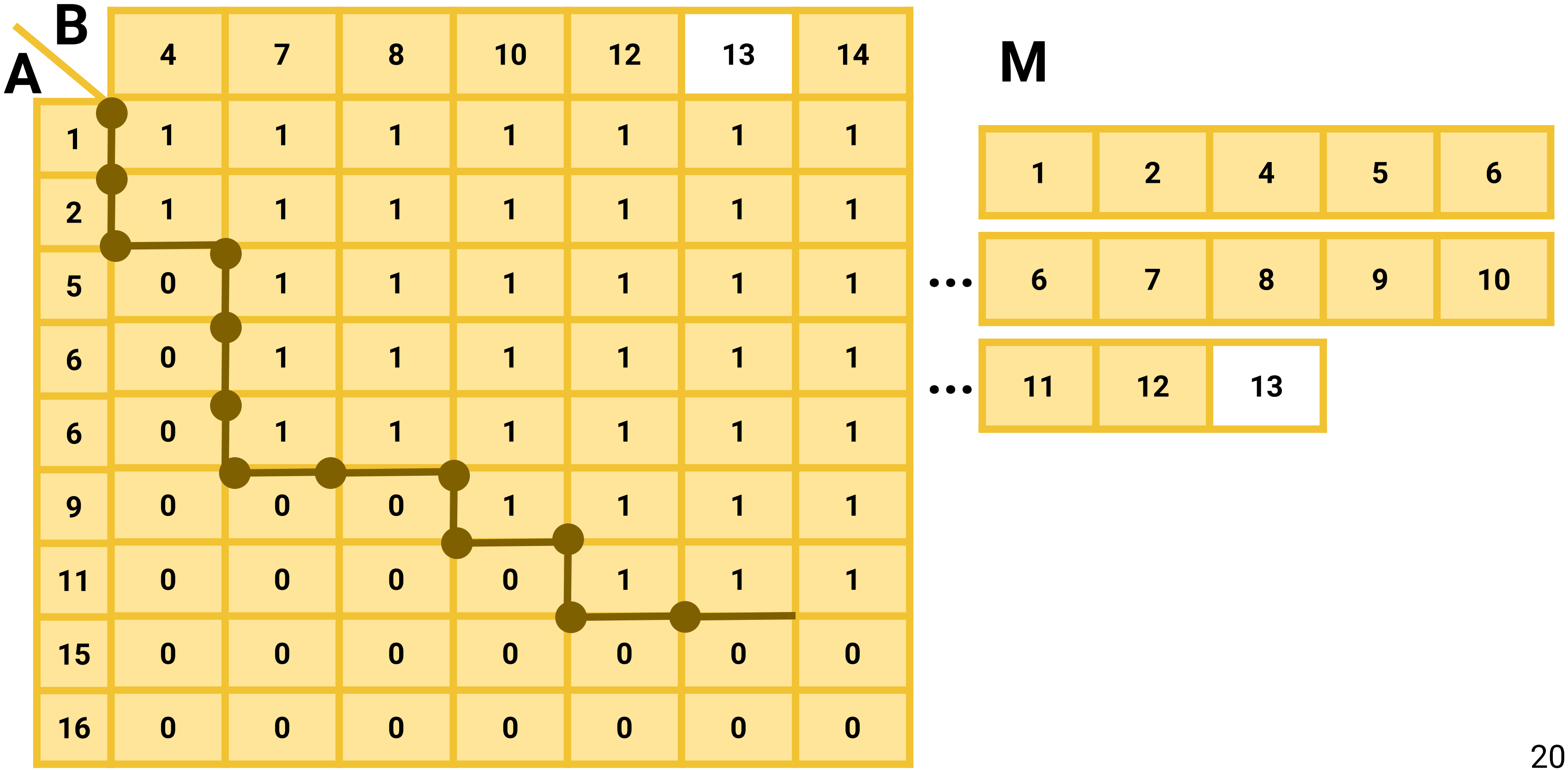
2	1	1	1	1	1	1	1
5	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
9	0	0	0	1	1	1	1
11	0	0	0	0	1	1	1
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0

M

	1	2	4	5	6
…	6	7	8	9	10
…	11	12			

ALGO mergeSmall_k



A \ B	4	7	8	10	12	13	14
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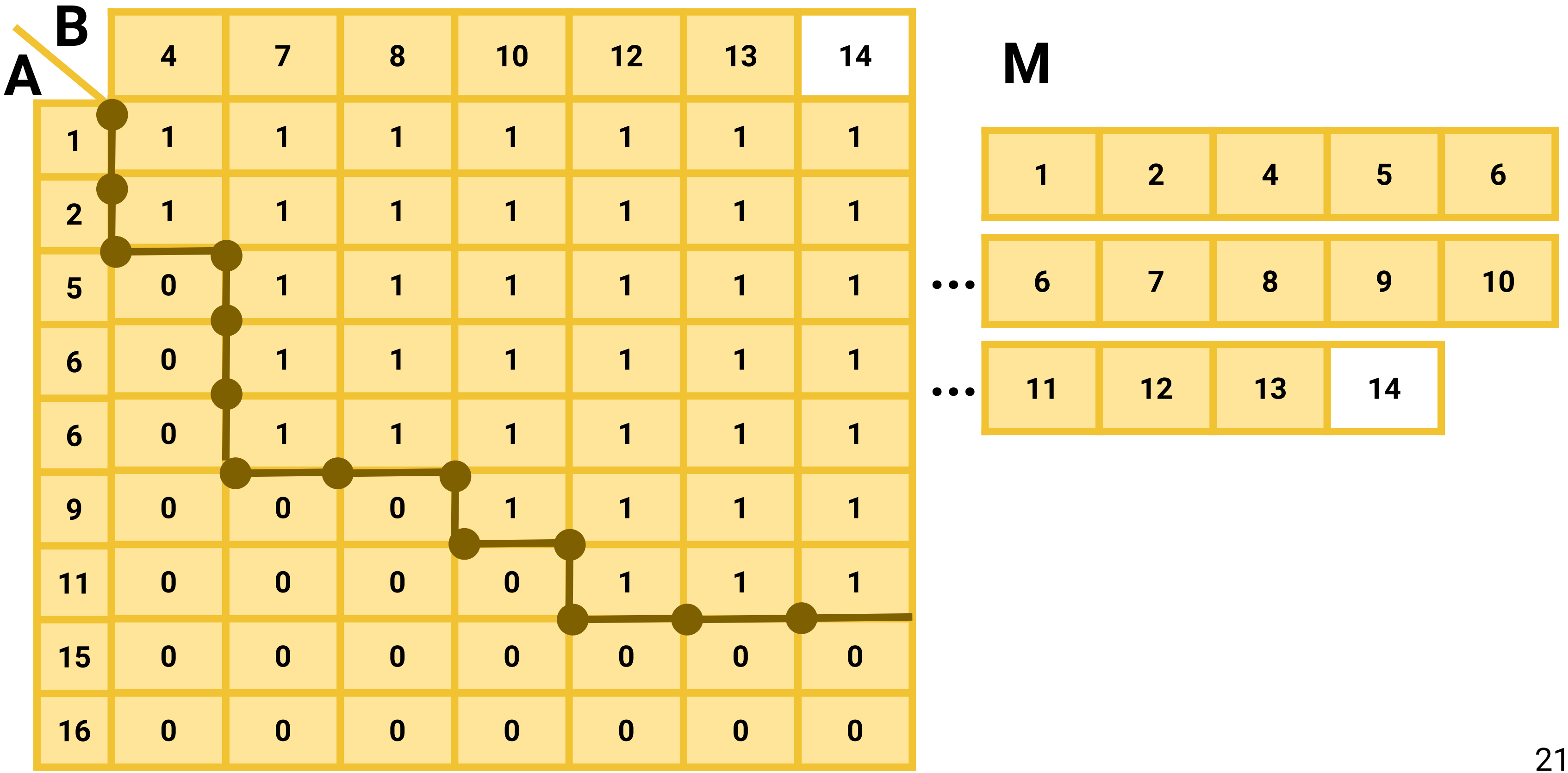
2	1	1	1	1	1	1	1
5	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
9	0	0	0	1	1	1	1
11	0	0	0	0	1	1	1
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0

M

	1	2	4	5	6
•••	6	7	8	9	10
•••	11	12	13		

ALGO mergeSmall_k



A \ B	4	7	8	10	12	13	14
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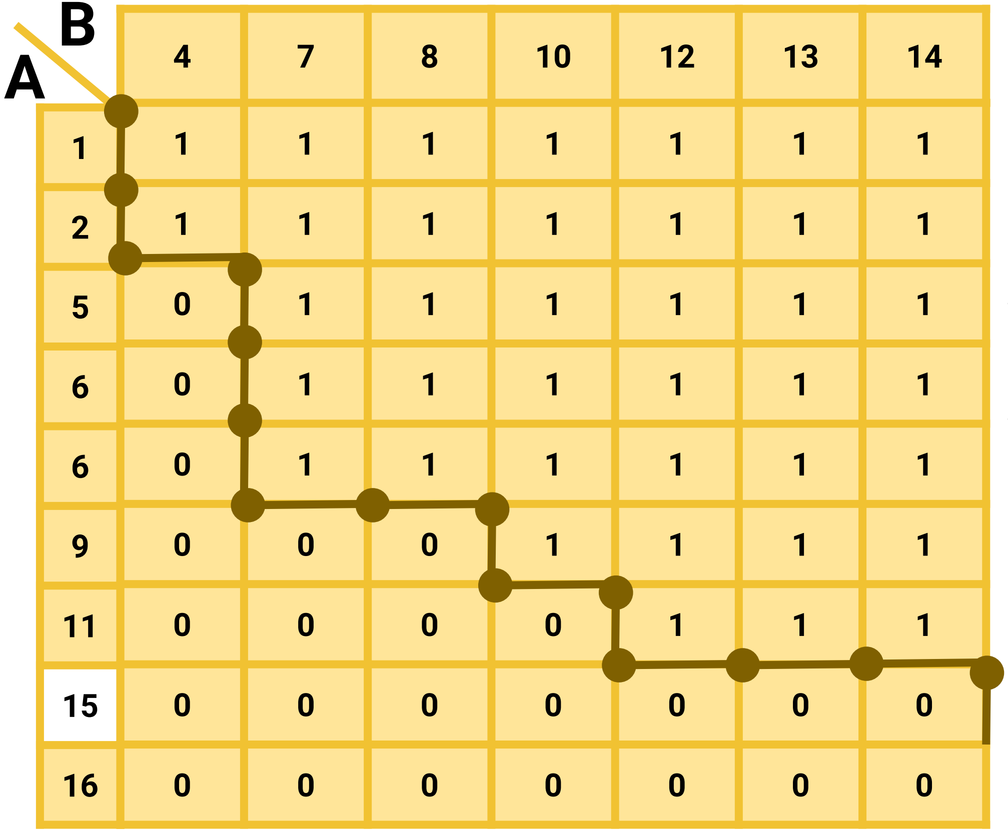
2	1	1	1	1	1	1	1
5	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
9	0	0	0	1	1	1	1
11	0	0	0	0	1	1	1
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0

M

	1	2	4	5	6
•••	6	7	8	9	10
•••	11	12	13	14	

ALGO mergeSmall_k



A \ B	4	7	8	10	12	13	14
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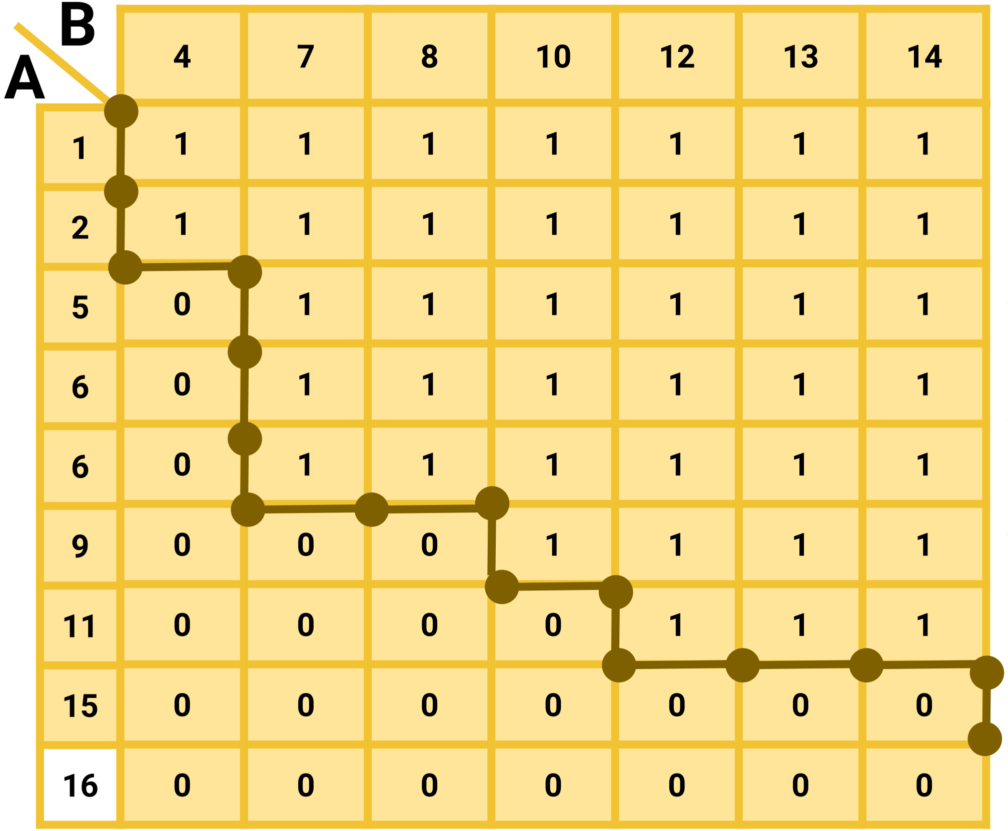
2	1	1	1	1	1	1	1
5	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
9	0	0	0	1	1	1	1
11	0	0	0	0	1	1	1
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0

M

	1	2	4	5	6
...	6	7	8	9	10
...	11	12	13	14	15

ALGO mergeSmall_k



A \ B	4	7	8	10	12	13	14
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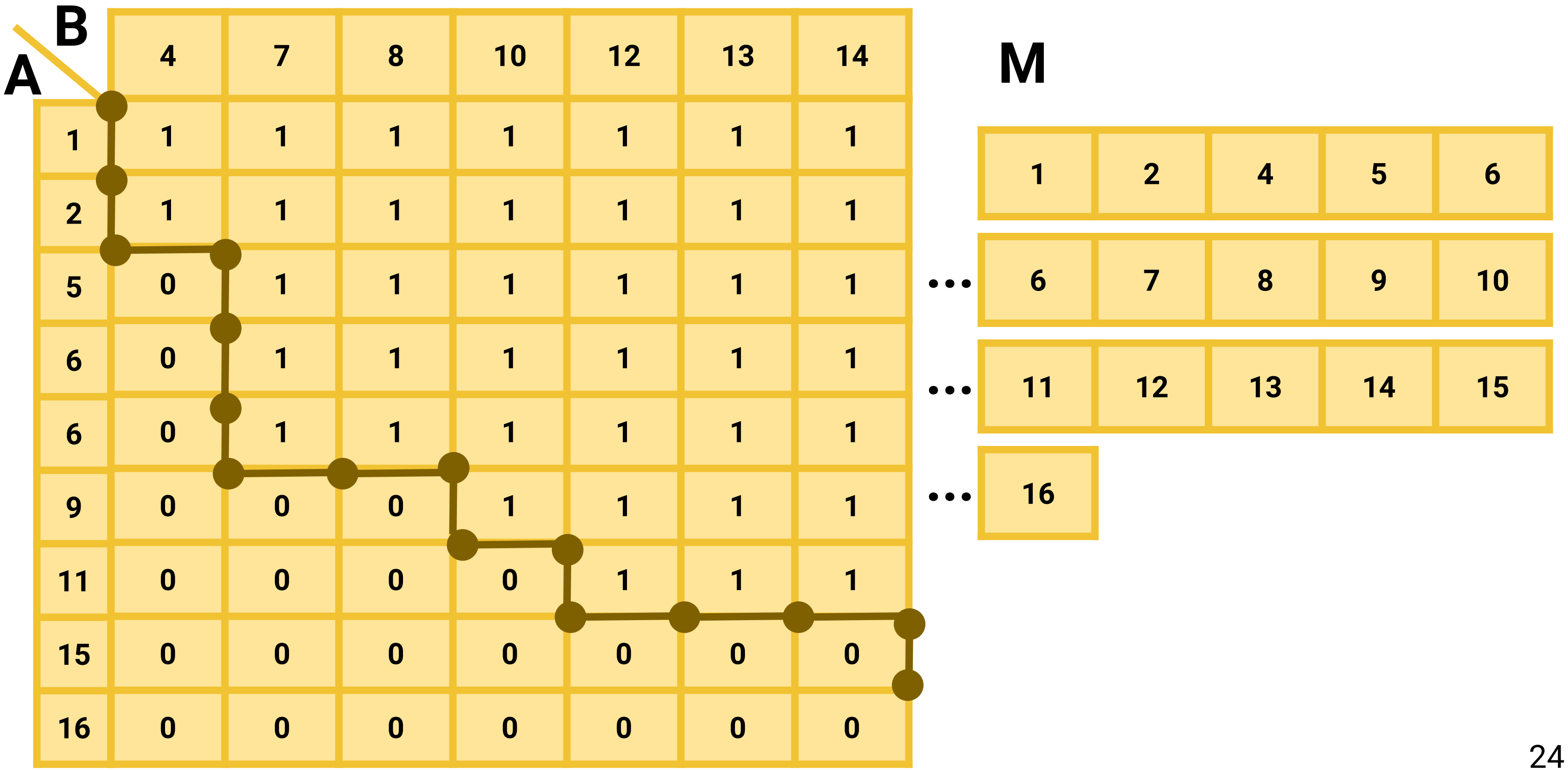
2	1	1	1	1	1	1	1
5	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
9	0	0	0	1	1	1	1
11	0	0	0	0	1	1	1
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0

M

	1	2	4	5	6
•••	6	7	8	9	10
•••	11	12	13	14	15
•••	16				

ALGO mergeSmall_k



A \ B	4	7	8	10	12	13	14
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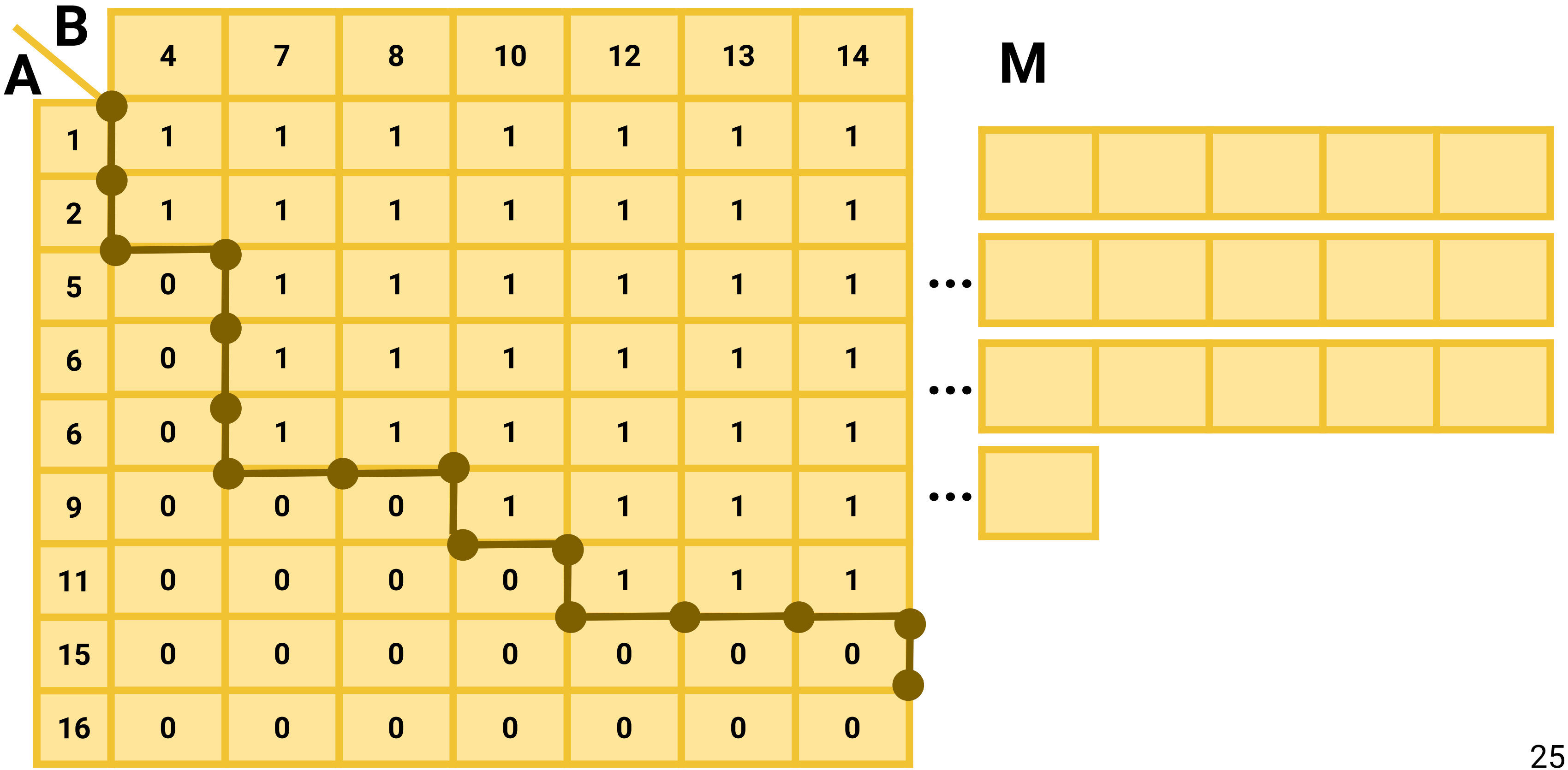
2	1	1	1	1	1	1	1
5	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
9	0	0	0	1	1	1	1
11	0	0	0	0	1	1	1
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0

M

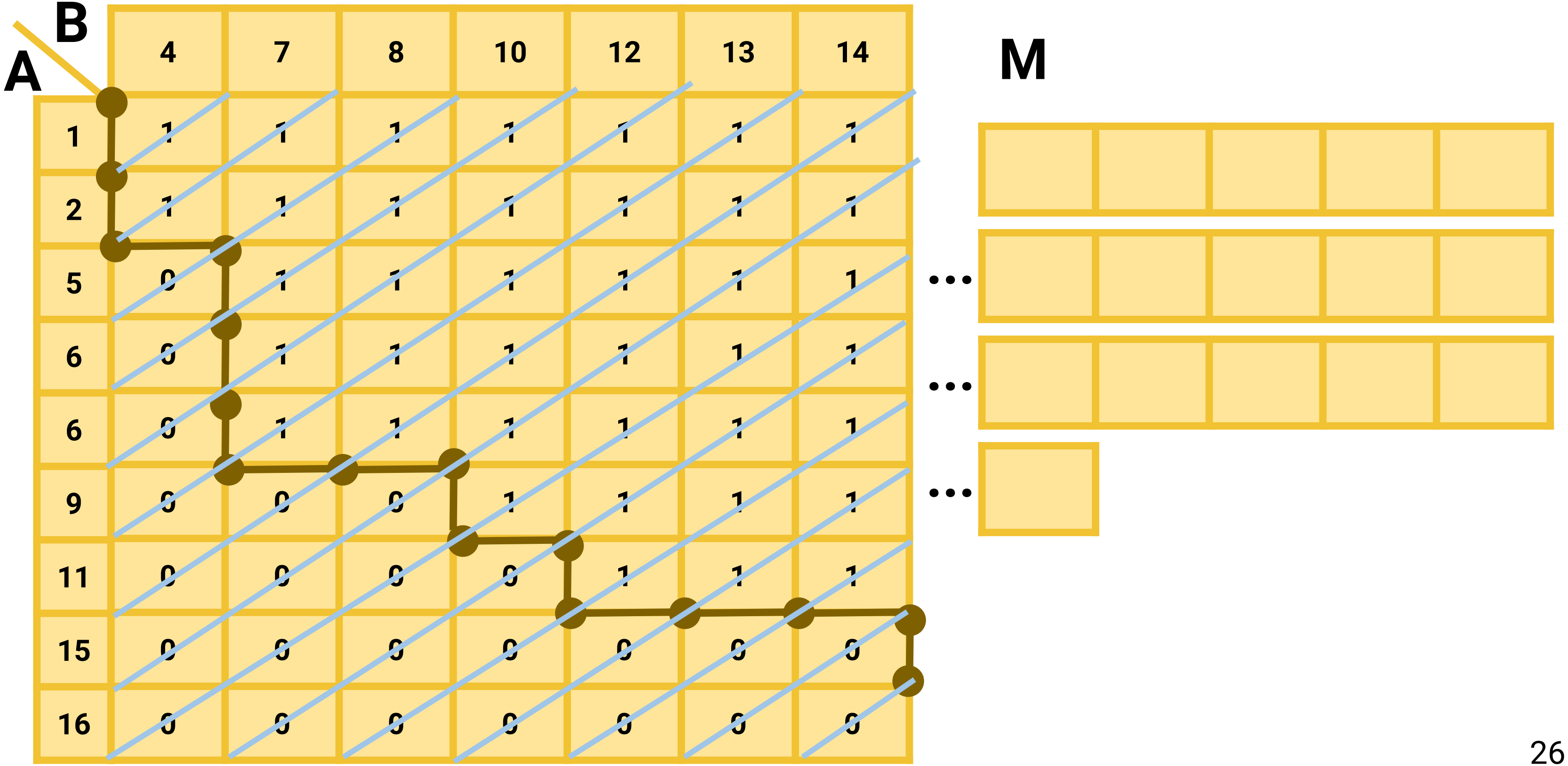
	1	2	4	5	6
...	6	7	8	9	10
...	11	12	13	14	15
...	16				

ALGO mergeSmall_k



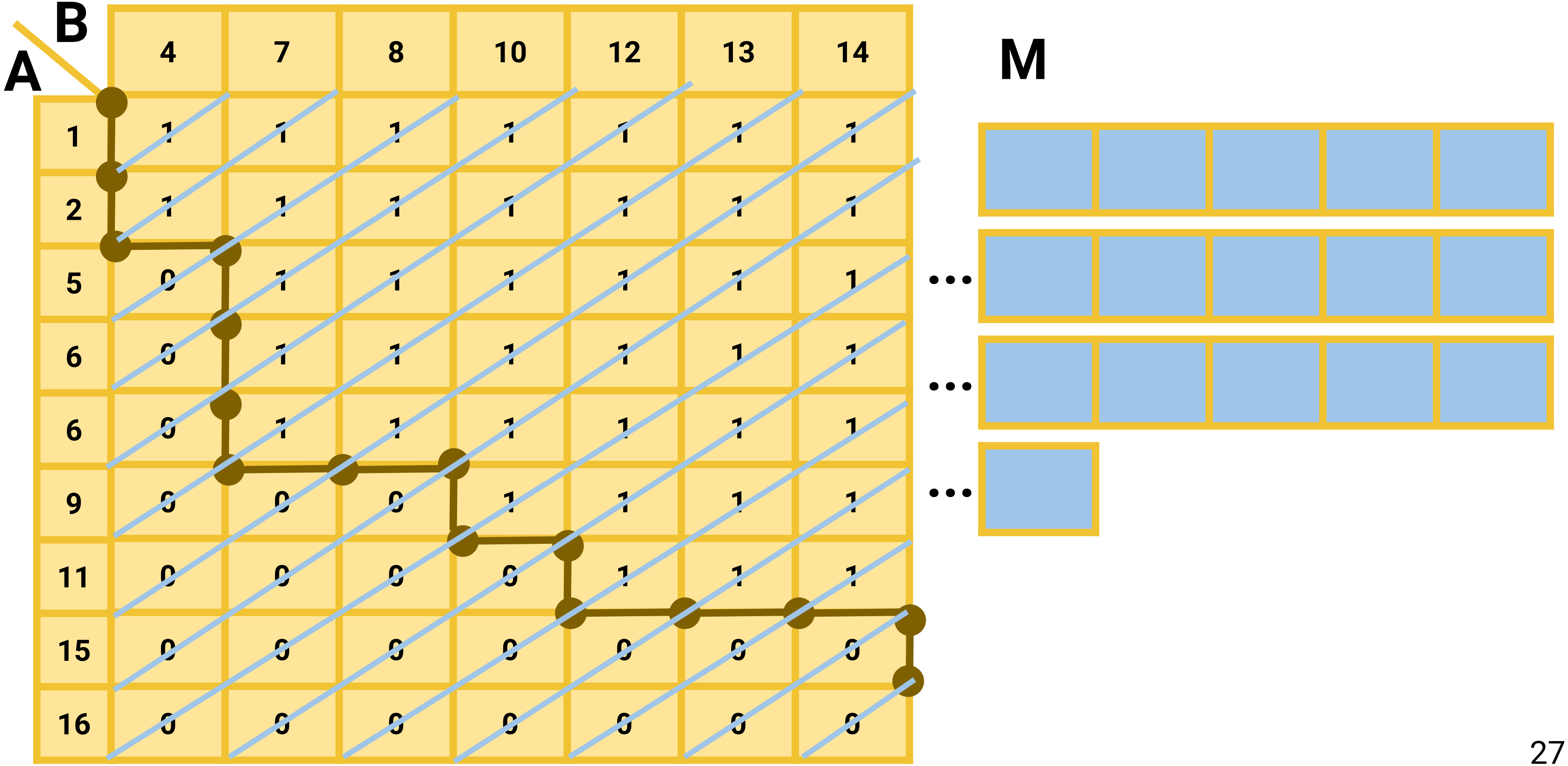
B A	4	7	8	10	12	13	14
1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1
5	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
9	0	0	0	1	1	1	1
11	0	0	0	0	1	1	1
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0

ALGO mergeSmall_k



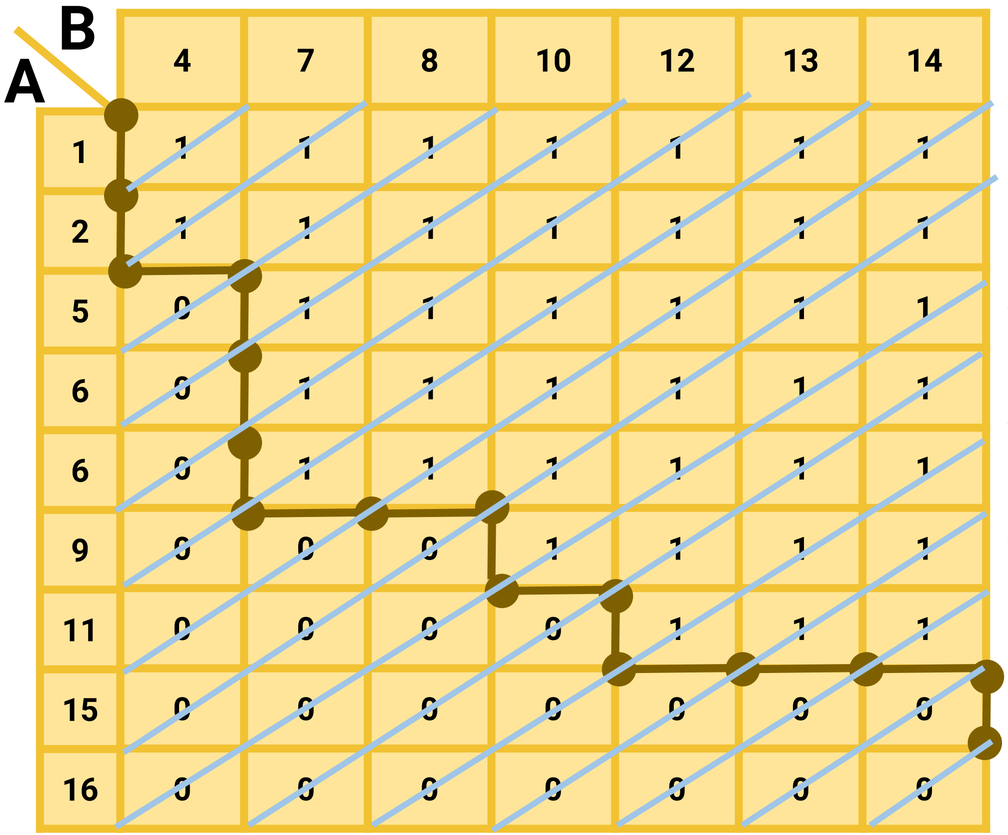
A \ B	4	7	8	10	12	13	14
1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1
5	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
9	0	0	0	1	1	1	1
11	0	0	0	0	1	1	1
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0

ALGO mergeSmall_k



A \ B	4	7	8	10	12	13	14
1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1
5	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
9	0	0	0	1	1	1	1
11	0	0	0	0	1	1	1
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0

ALGO mergeSmall_k



A \ B	4	7	8	10	12	13	14
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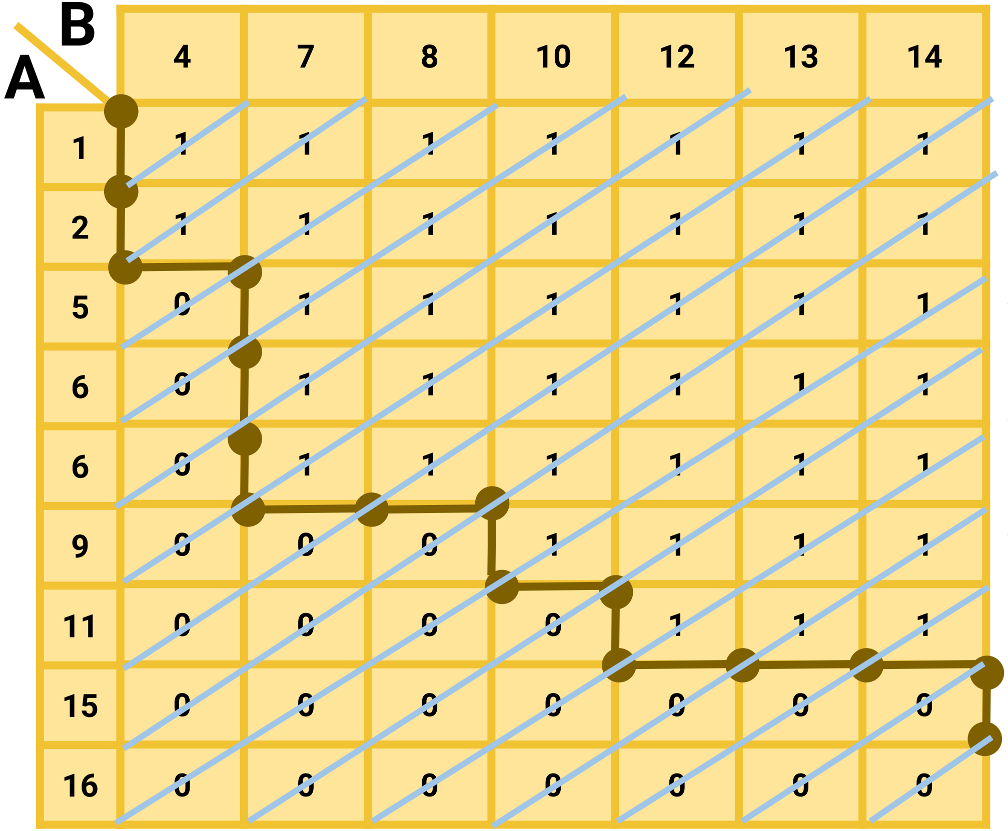
2	1	1	1	1	1	1	1
5	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
9	0	0	0	1	1	1	1
11	0	0	0	0	1	1	1
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0

M

	1	2	4	5	6
…	6	7	8	9	10
…	11	12	13	14	15
…	16				

ALGO mergeSmall_k

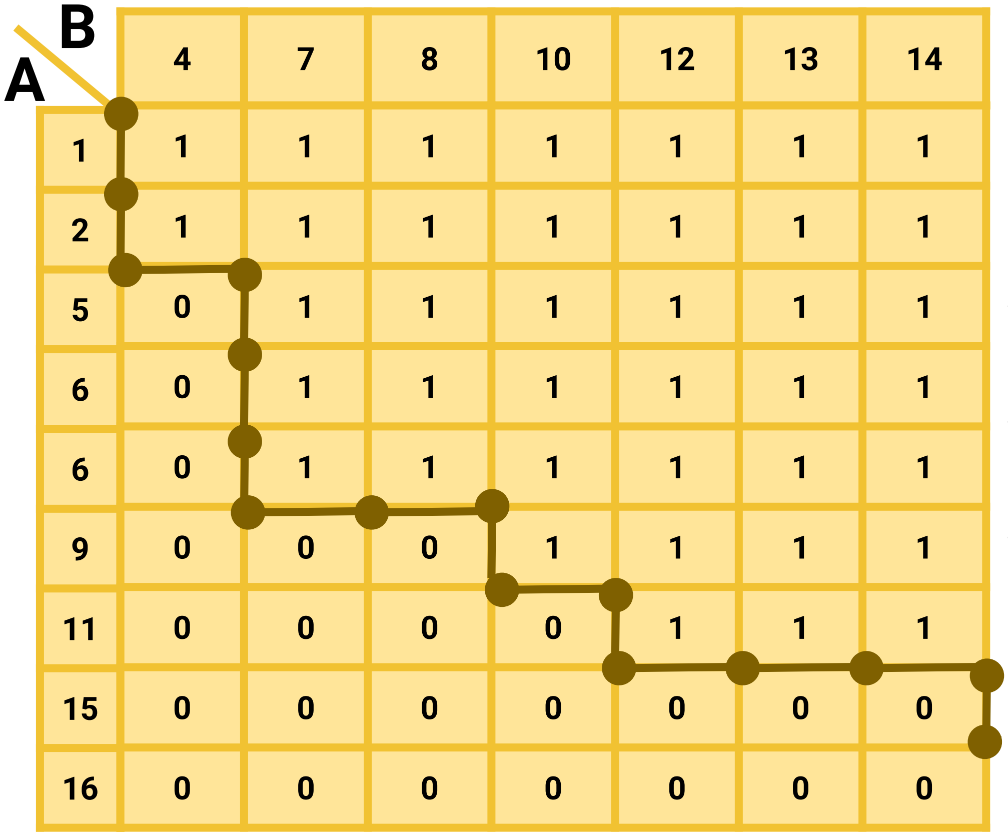


A \ B	4	7	8	10	12	13	14
1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1
5	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
9	0	0	0	1	1	1	1
11	0	0	0	0	1	1	1
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0

M

	1	2	4	5	6
…	6	7	8	9	10
…	11	12	13	14	15
…	16				

ALGO mergeSmall_k



A \ B	4	7	8	10	12	13	14
1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1
5	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
9	0	0	0	1	1	1	1
11	0	0	0	0	1	1	1
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0

M

	1	2	4	5	6
•••	6	7	8	9	10
•••	11	12	13	14	15
•••	16				

02

MERGE ON SEVERAL BLOCKS

ALGO pathBig_k

B A	4	7	8	10	12	13	14
1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1
5	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
9	0	0	0	1	1	1	1
11	0	0	0	0	1	1	1
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0

Path

1

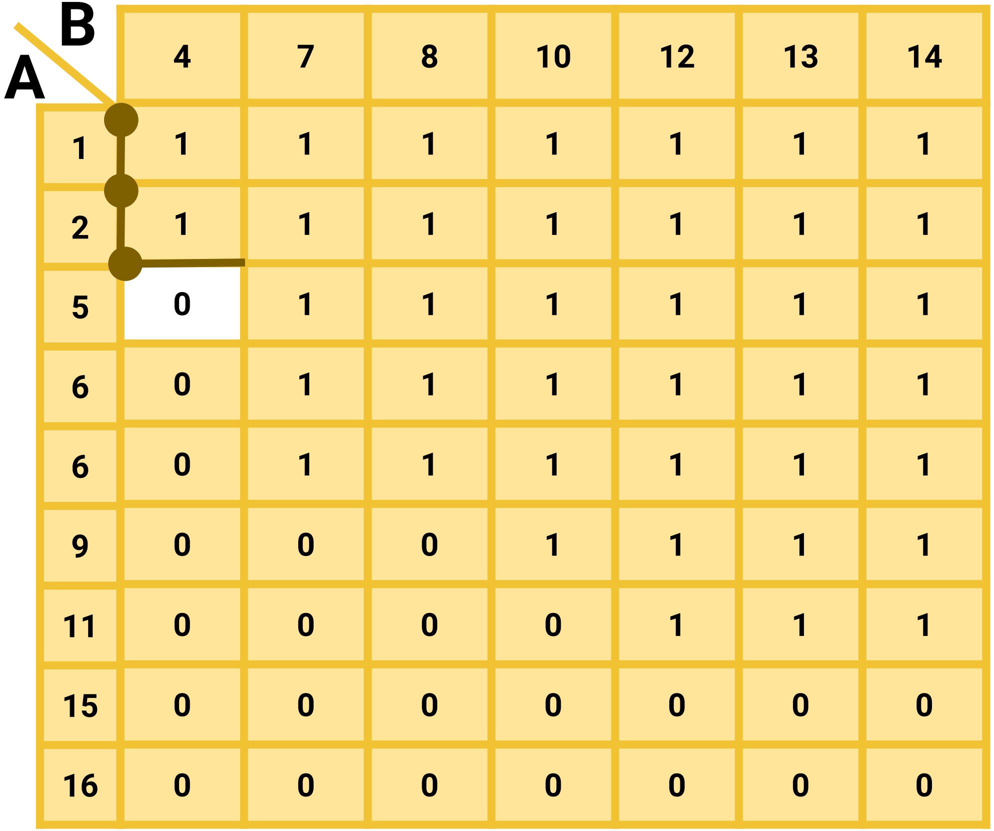
ALGO pathBig_k

B A	4	7	8	10	12	13	14
1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1
5	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
9	0	0	0	1	1	1	1
11	0	0	0	0	1	1	1
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0

Path

1	1

ALGO pathBig_k

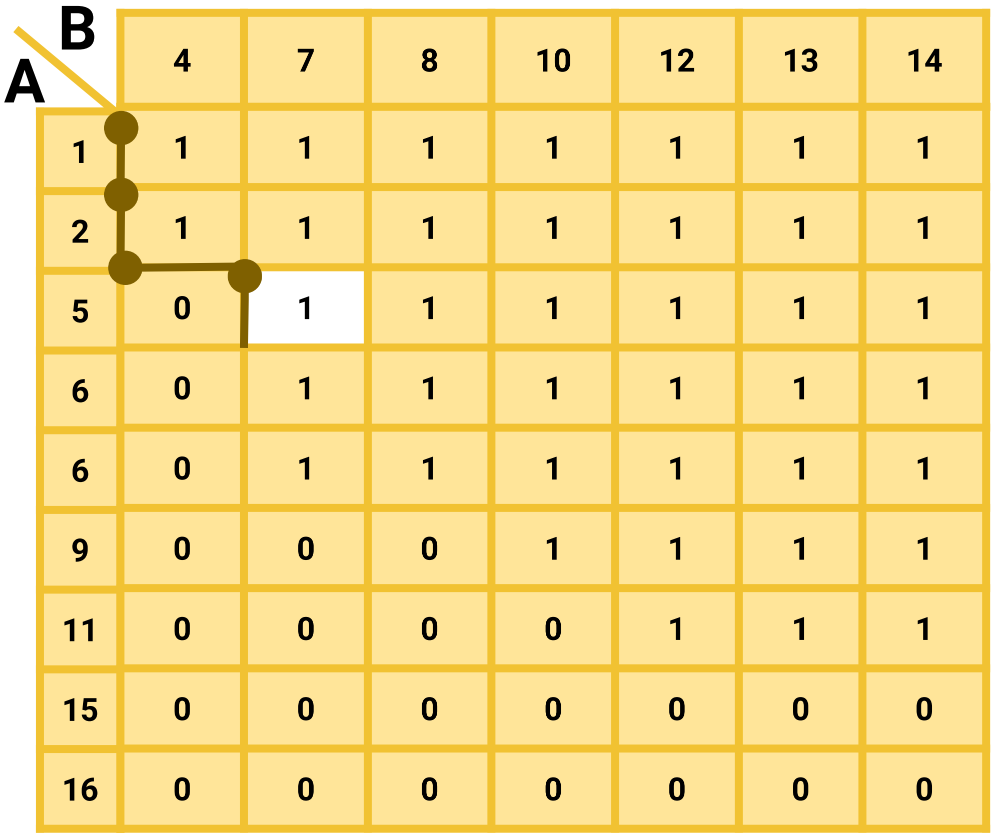


A \ B	4	7	8	10	12	13	14
1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1
5	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
9	0	0	0	1	1	1	1
11	0	0	0	0	1	1	1
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0

Path

1	1	0

ALGO pathBig_k

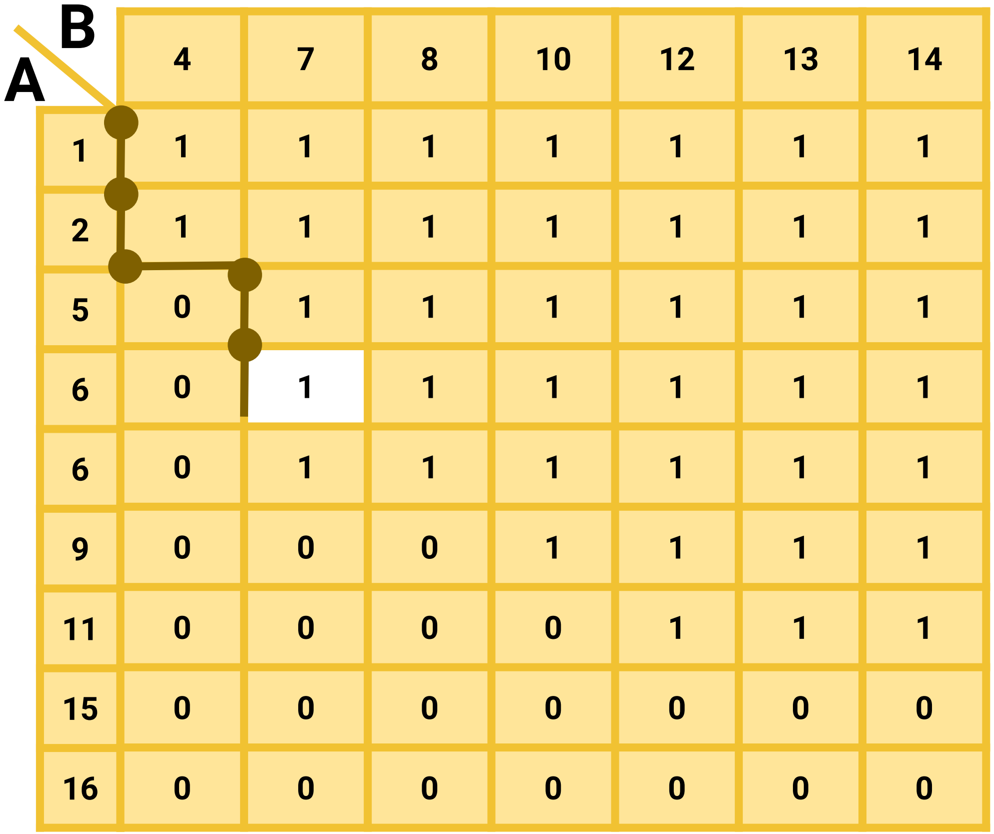


A \ B	4	7	8	10	12	13	14
1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1
5	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
9	0	0	0	1	1	1	1
11	0	0	0	0	1	1	1
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0

Path

1	1	0	1

ALGO pathBig_k

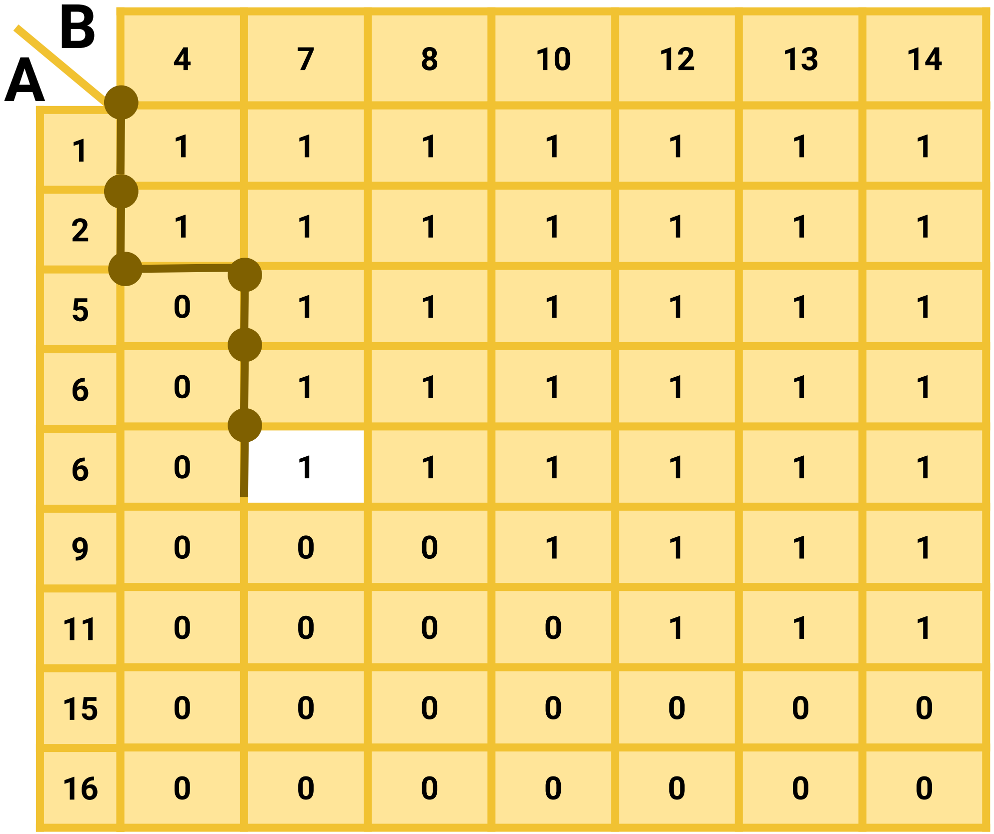


A \ B	4	7	8	10	12	13	14
1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1
5	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
9	0	0	0	1	1	1	1
11	0	0	0	0	1	1	1
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0

Path

1	1	0	1	1

ALGO pathBig_k



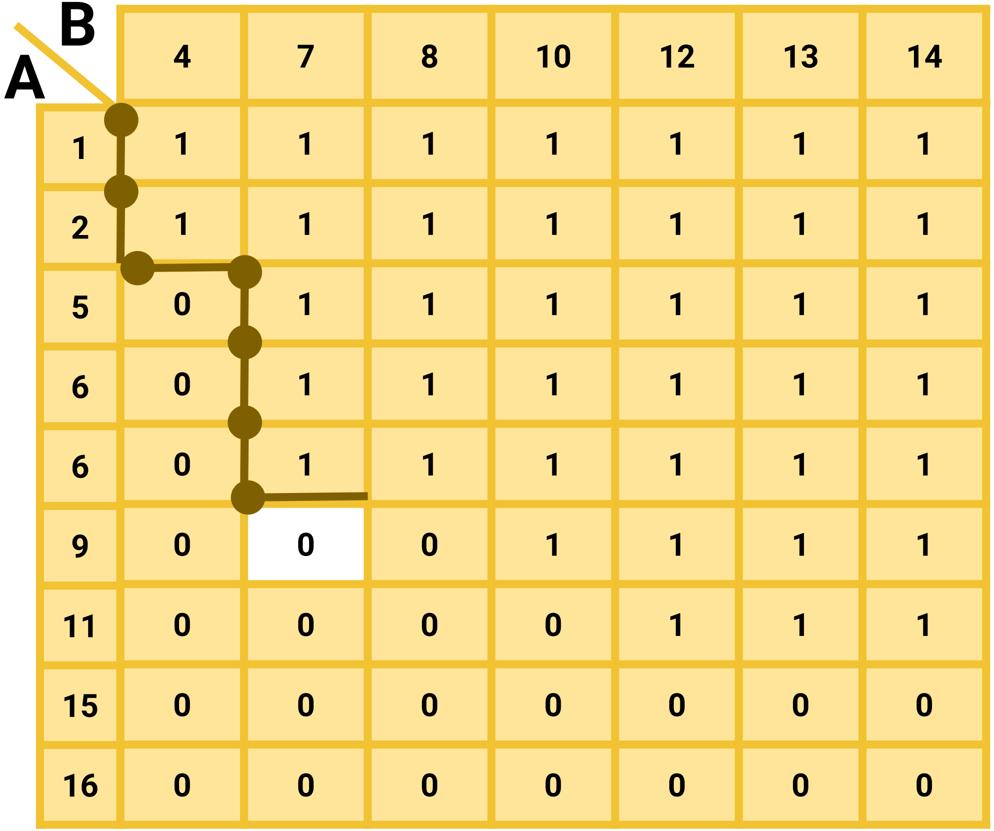
A \ B	4	7	8	10	12	13	14
1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1
5	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
9	0	0	0	1	1	1	1
11	0	0	0	0	1	1	1
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0

Path

1	1	0	1	1

… 1

ALGO pathBig_k



A \ B	4	7	8	10	12	13	14
1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1
5	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
9	0	0	0	1	1	1	1
11	0	0	0	0	1	1	1
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0

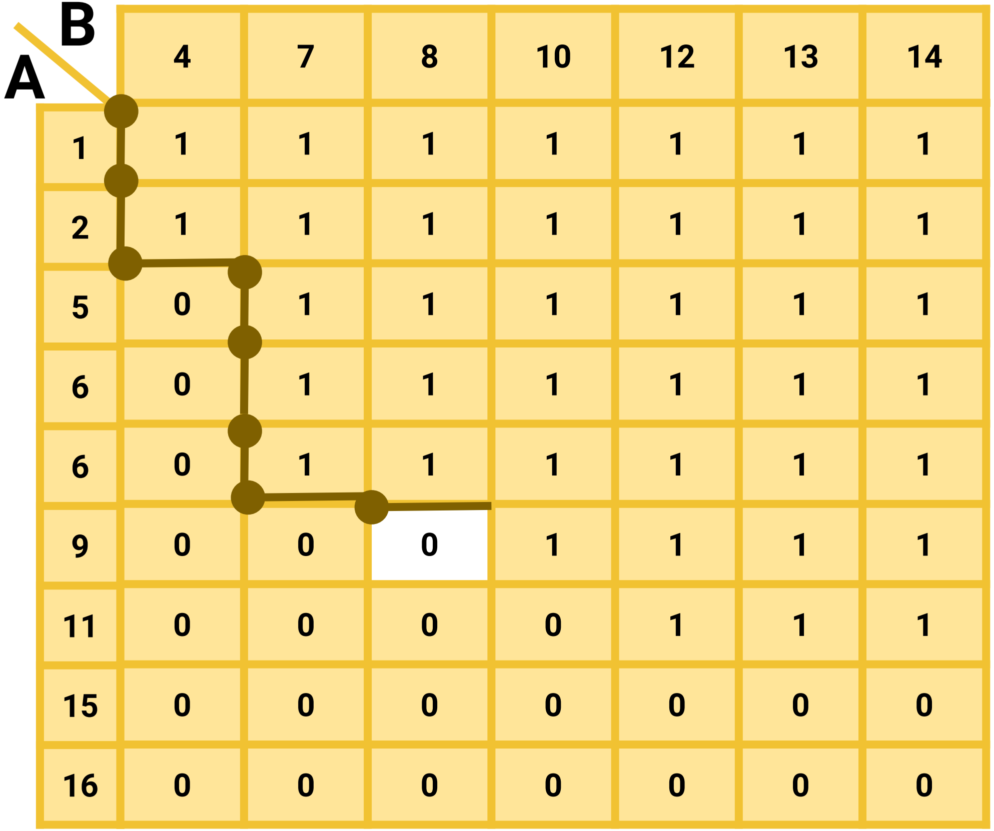
Path

1	1	0	1	1

…

1	0

ALGO pathBig_k



A B	4	7	8	10	12	13	14
1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1
5	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
9	0	0	0	1	1	1	1
11	0	0	0	0	1	1	1
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0

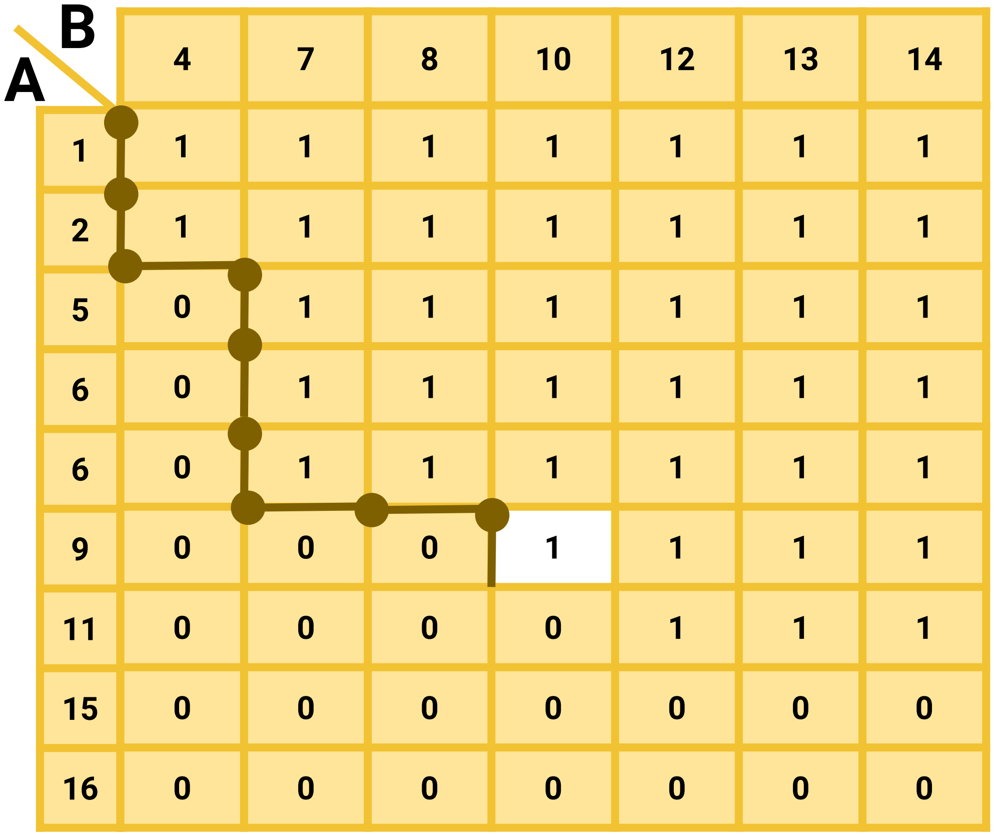
Path

1	1	0	1	1

…

1	0	0

ALGO pathBig_k



A \ B	4	7	8	10	12	13	14
1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1
5	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
9	0	0	0	1	1	1	1
11	0	0	0	0	1	1	1
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0

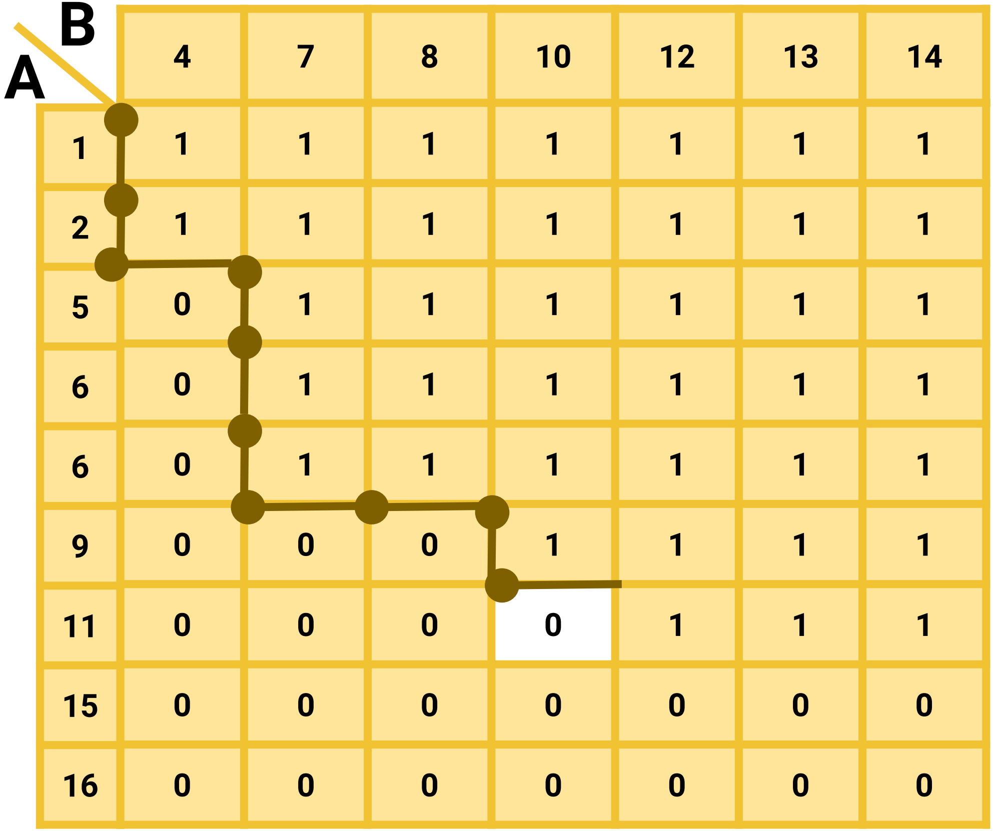
Path

1	1	0	1	1

…

1	0	0	1

ALGO pathBig_k



A \ B	4	7	8	10	12	13	14
1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1
5	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
9	0	0	0	1	1	1	1
11	0	0	0	0	1	1	1
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0

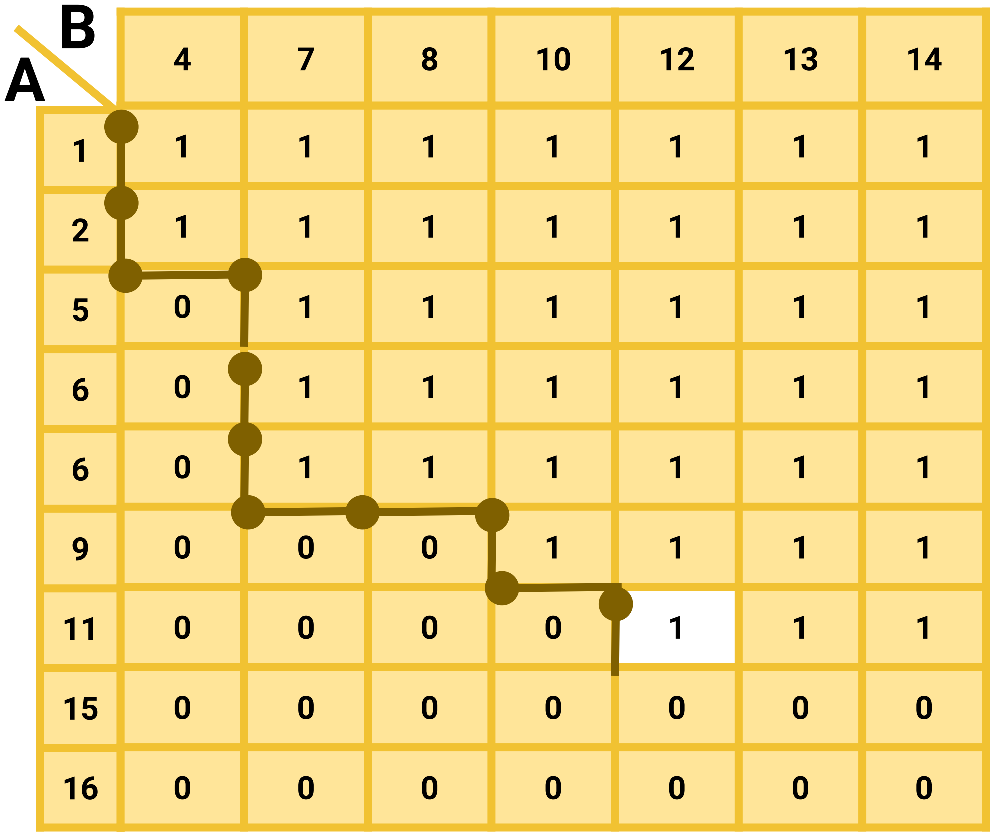
Path

1	1	0	1	1

...

1	0	0	1	0

ALGO pathBig_k



A \ B	4	7	8	10	12	13	14
1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1
5	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
9	0	0	0	1	1	1	1
11	0	0	0	0	1	1	1
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0

Path

1	1	0	1	1

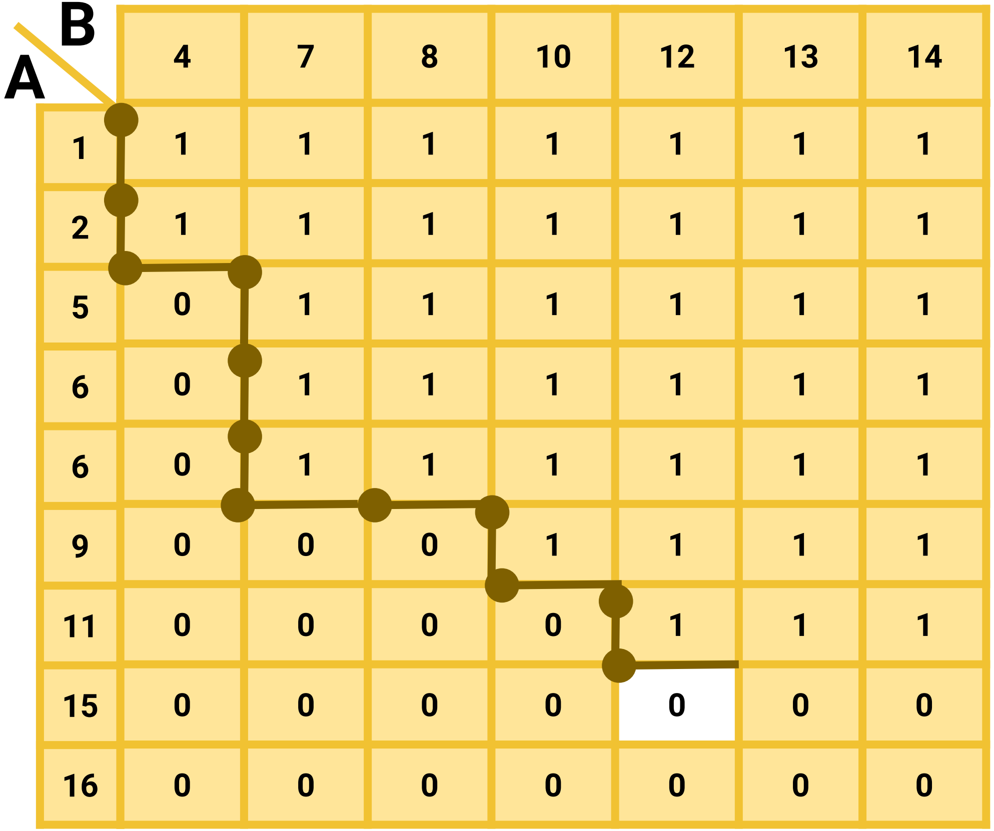
…

1	0	0	1	0

…

1

ALGO pathBig_k

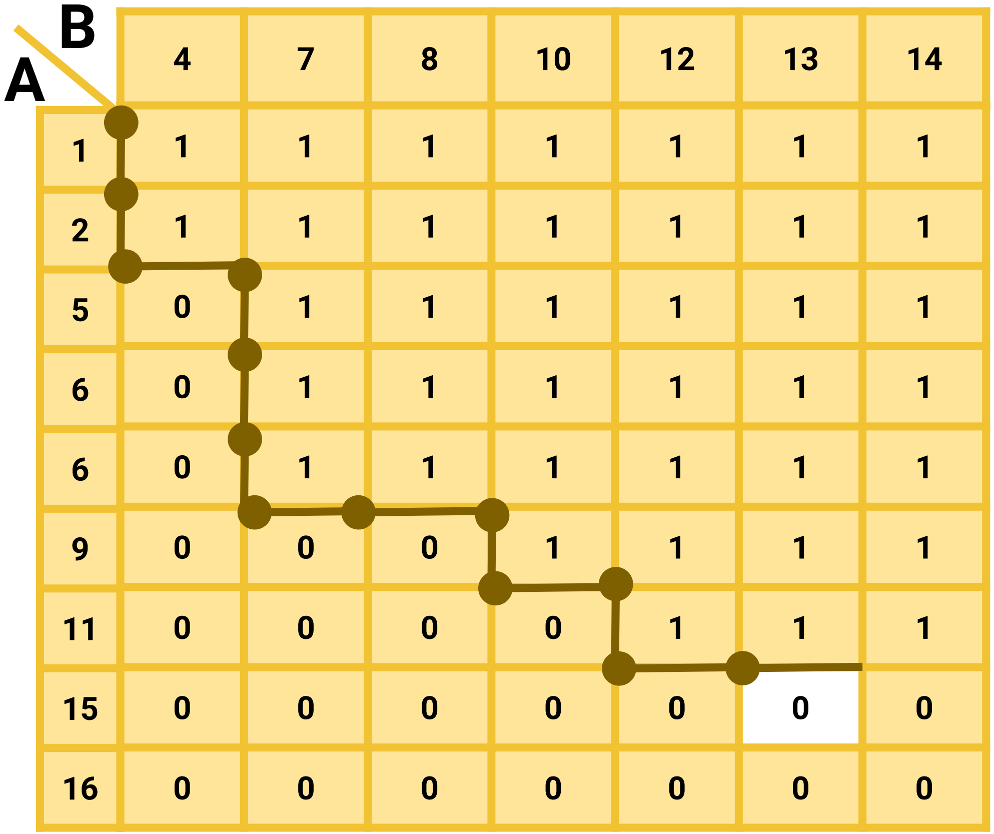


A \ B	4	7	8	10	12	13	14
1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1
5	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
9	0	0	0	1	1	1	1
11	0	0	0	0	1	1	1
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0

Path

	1	1	0	1	1
…	1	0	0	1	0
…	1	0			

ALGO pathBig_k



A \ B	4	7	8	10	12	13	14
1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1
5	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
9	0	0	0	1	1	1	1
11	0	0	0	0	1	1	1
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0

Path

1	1	0	1	1

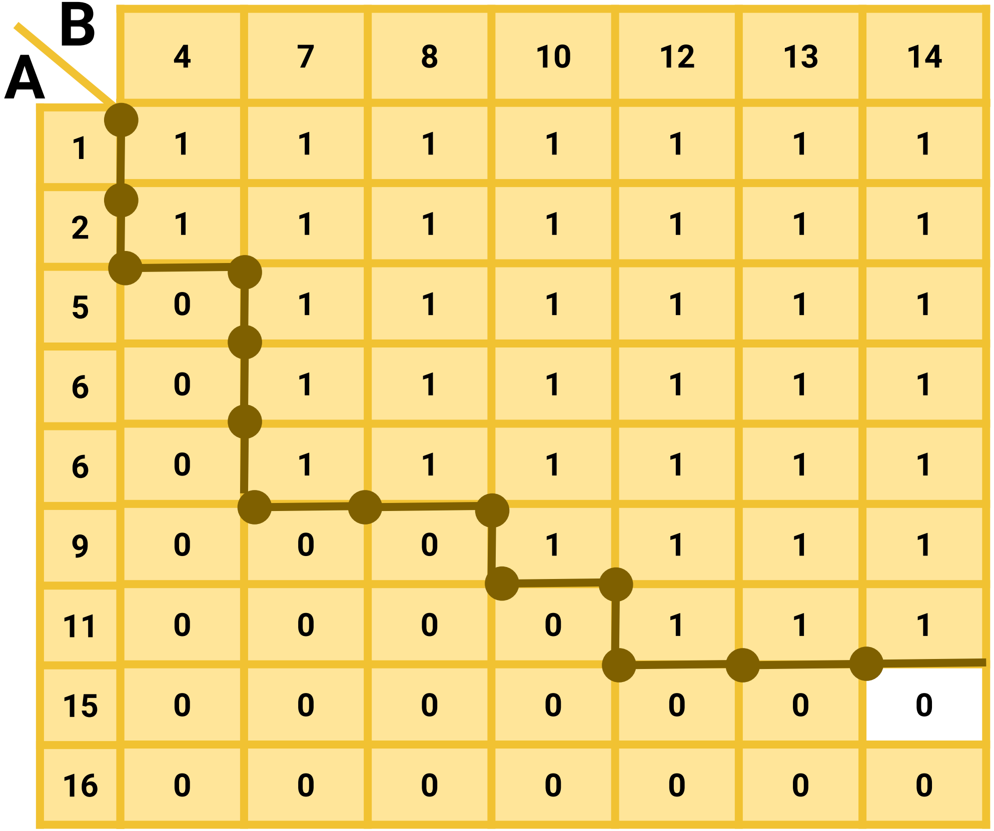
...

1	0	0	1	0

...

1	0	0

ALGO pathBig_k



A \ B	4	7	8	10	12	13	14
1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1
5	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
9	0	0	0	1	1	1	1
11	0	0	0	0	1	1	1
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0

Path

1	1	0	1	1

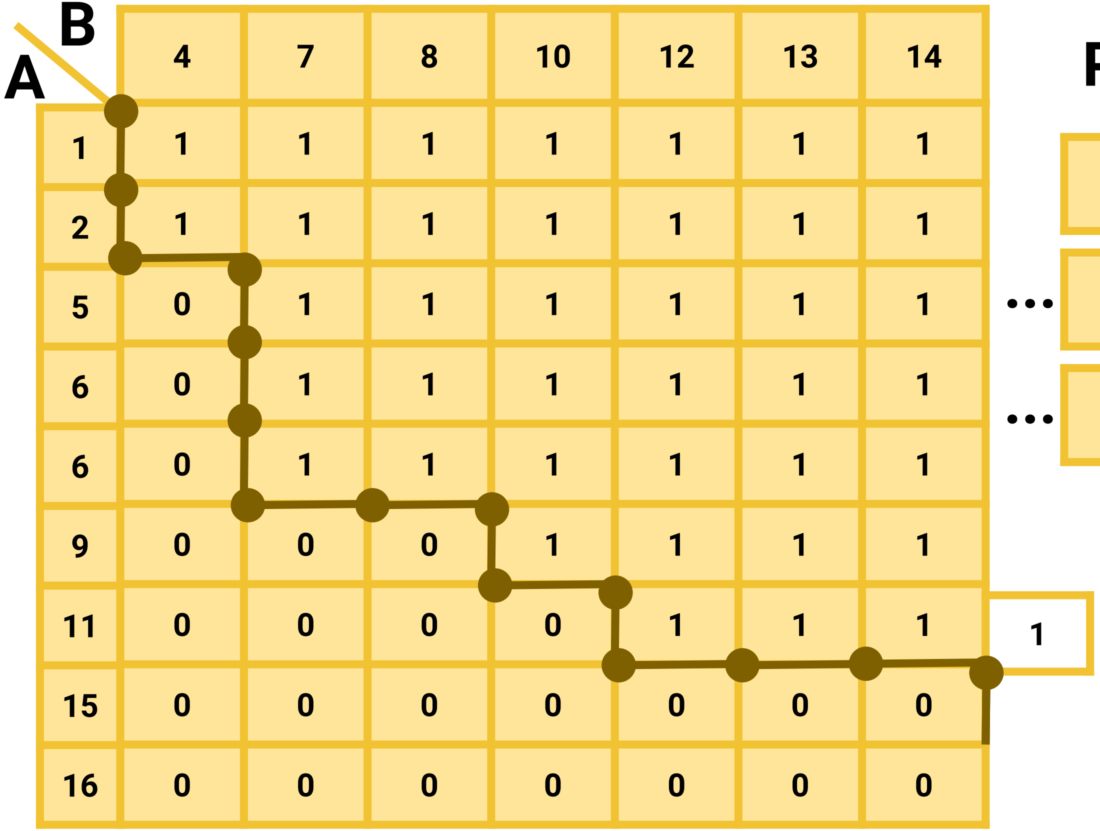
...

1	0	0	1	0

...

1	0	0	0

ALGO mergeSmall_k

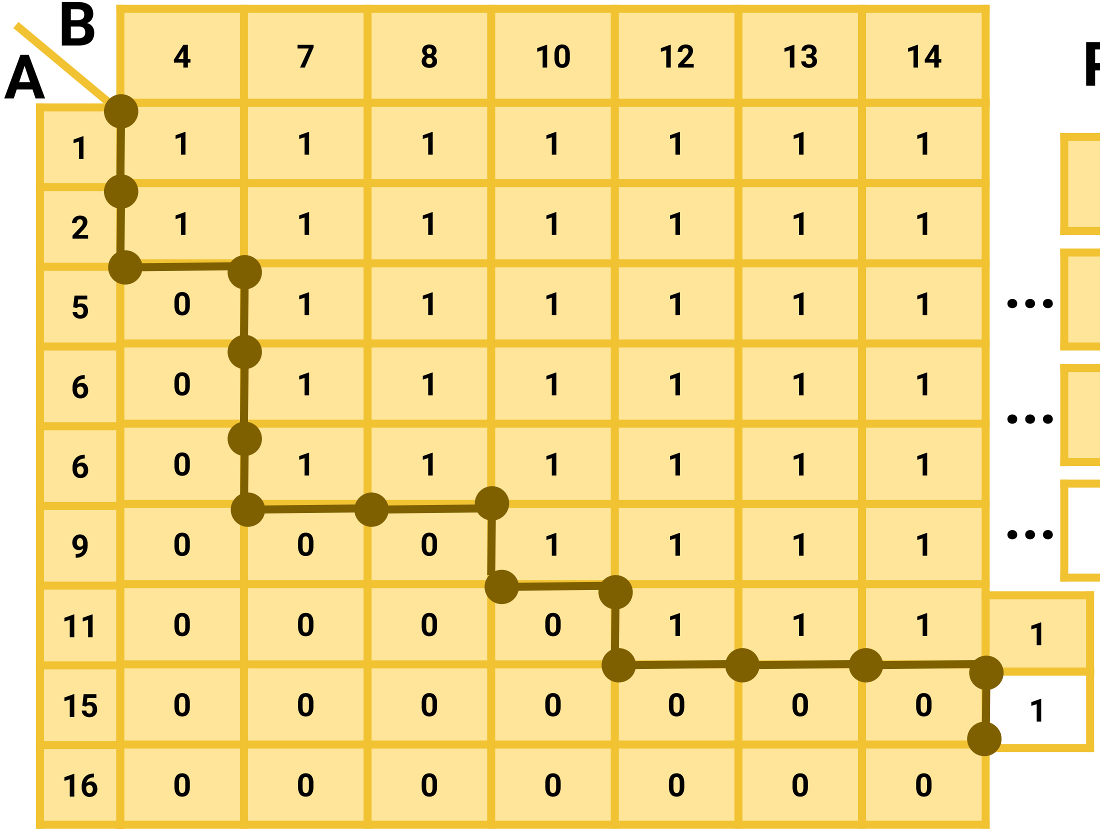


B A	4	7	8	10	12	13	14
1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1
5	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
6	0	1	1	1	1	1	1
9	0	0	0	1	1	1	1
11	0	0	0	0	1	1	1
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0

Path

	1	1	0	1	1
...	1	0	0	1	0
...	1	0	0	0	1

ALGO pathBig_k

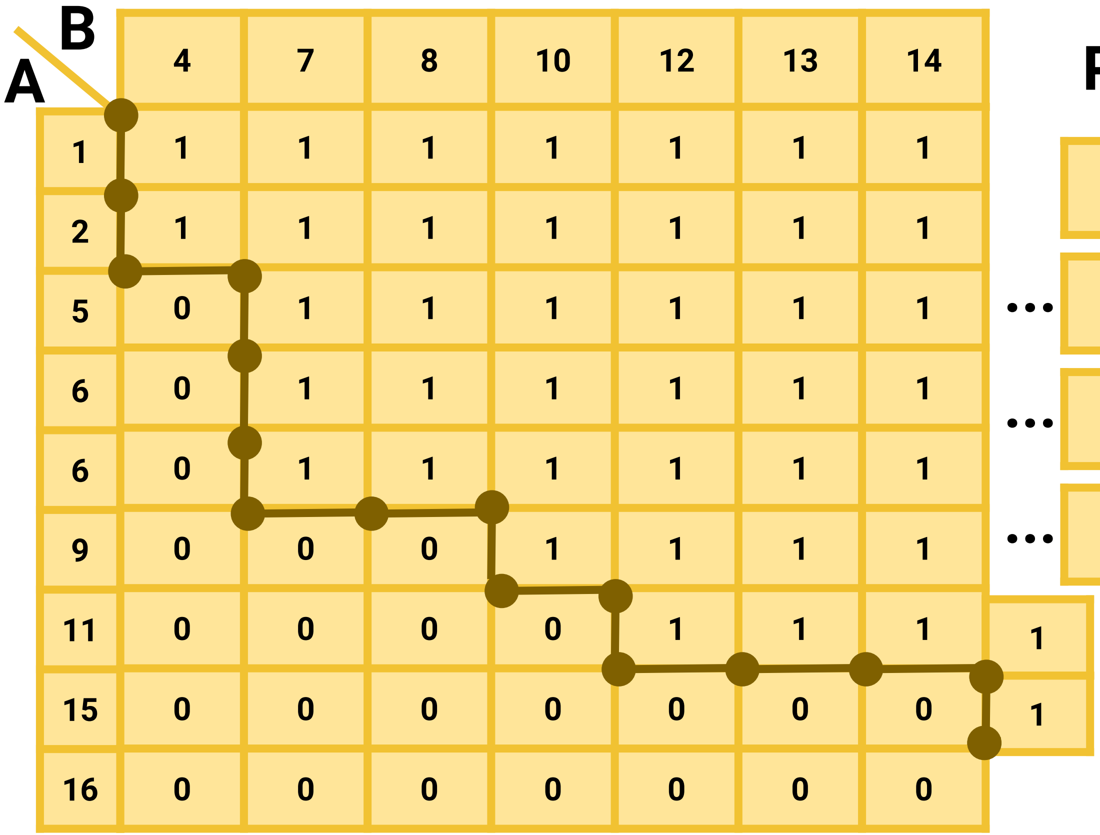


A \ B	4	7	8	10	12	13	14	
1	1	1	1	1	1	1	1	
2	1	1	1	1	1	1	1	
5	0	1	1	1	1	1	1	
6	0	1	1	1	1	1	1	
6	0	1	1	1	1	1	1	
9	0	0	0	1	1	1	1	
11	0	0	0	0	1	1	1	1
15	0	0	0	0	0	0	0	1
16	0	0	0	0	0	0	0	

Path

	1	1	0	1	1
…	1	0	0	1	0
…	1	0	0	0	1
…	1				

ALGO pathBig_k

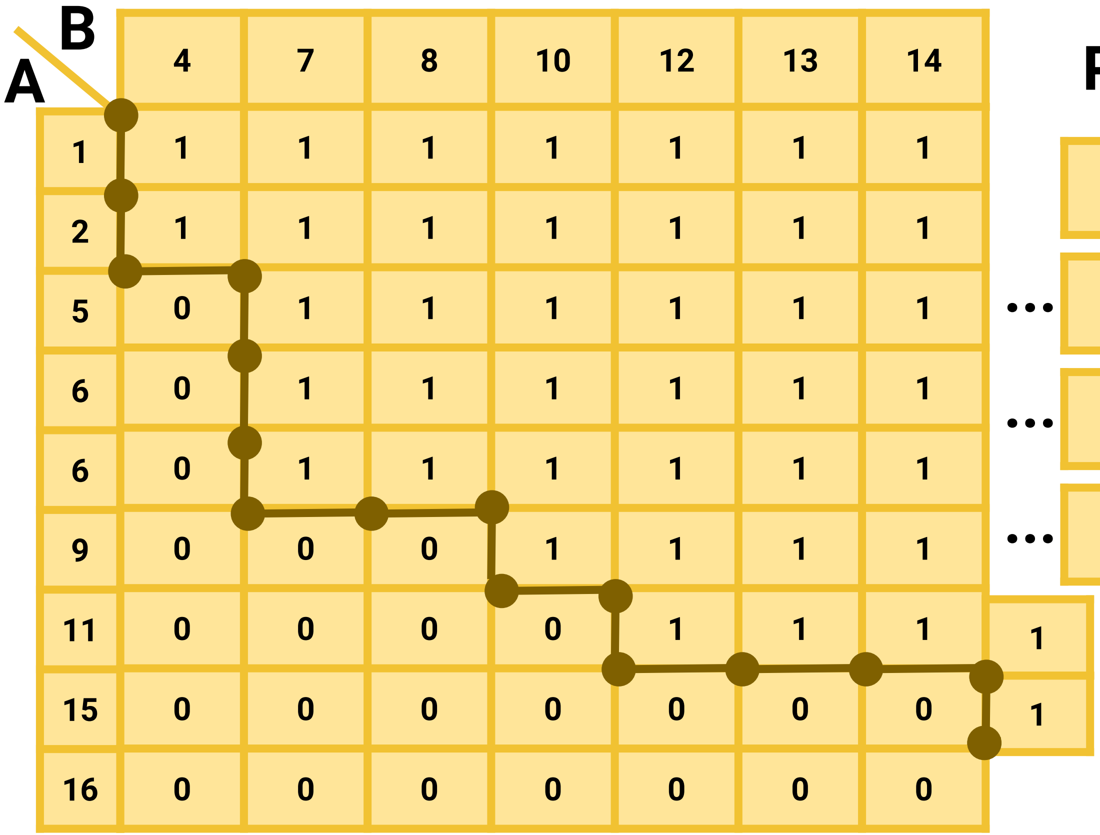


A \ B	4	7	8	10	12	13	14	
1	1	1	1	1	1	1	1	
2	1	1	1	1	1	1	1	
5	0	1	1	1	1	1	1	
6	0	1	1	1	1	1	1	
6	0	1	1	1	1	1	1	
9	0	0	0	1	1	1	1	
11	0	0	0	0	1	1	1	1
15	0	0	0	0	0	0	0	1
16	0	0	0	0	0	0	0	

Path

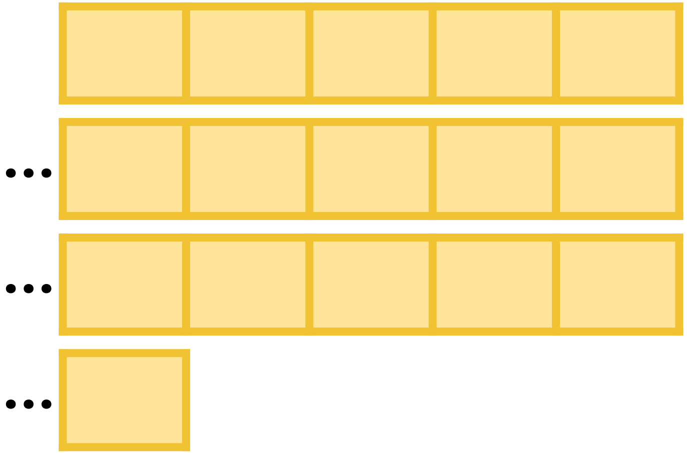
	1	1	0	1	1
…	1	0	0	1	0
…	1	0	0	0	1
…	1				

ALGO pathBig_k

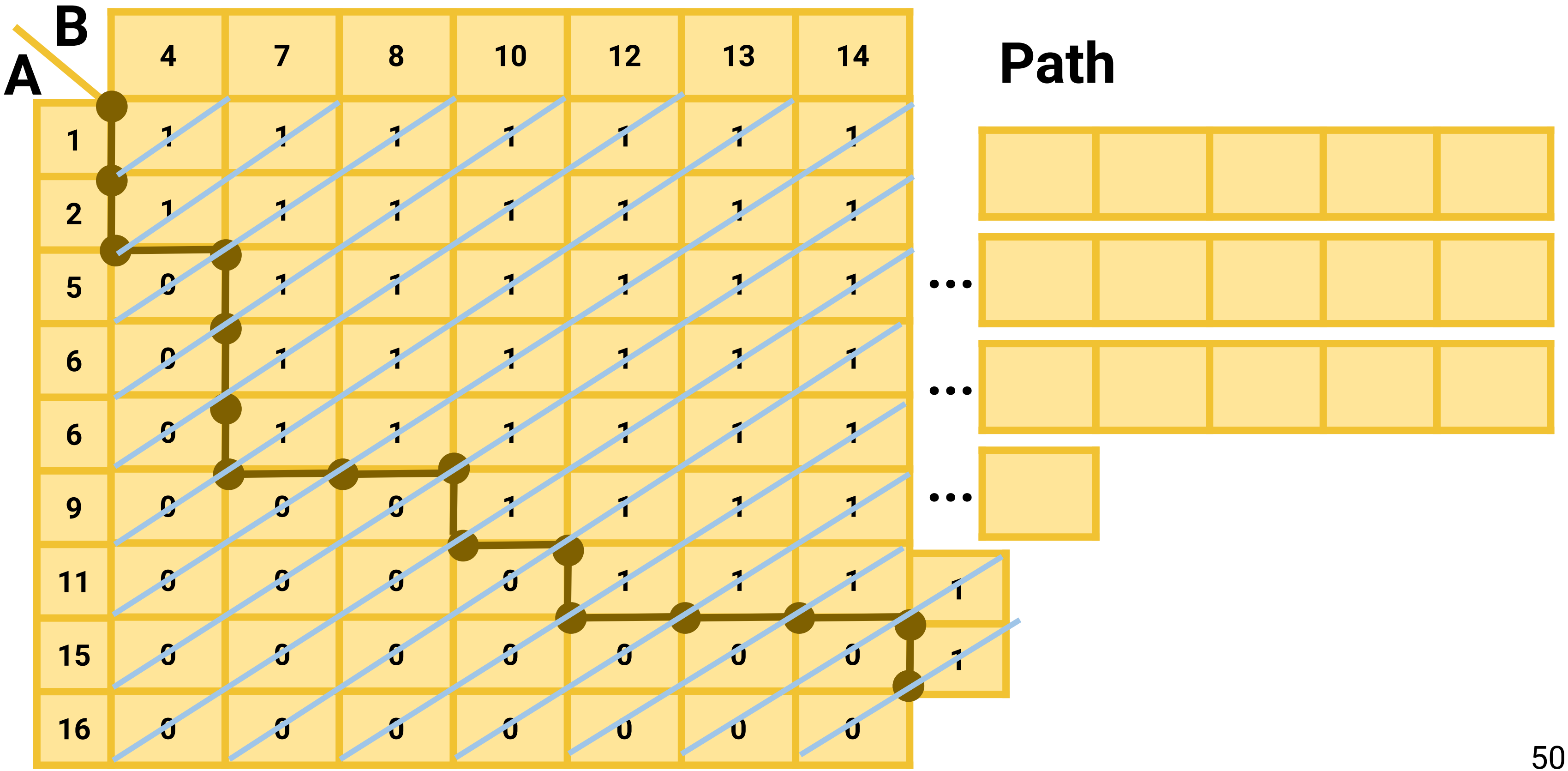


A \ B	4	7	8	10	12	13	14	
1	1	1	1	1	1	1	1	
2	1	1	1	1	1	1	1	
5	0	1	1	1	1	1	1	
6	0	1	1	1	1	1	1	
6	0	1	1	1	1	1	1	
9	0	0	0	1	1	1	1	
11	0	0	0	0	1	1	1	1
15	0	0	0	0	0	0	0	1
16	0	0	0	0	0	0	0	

Path

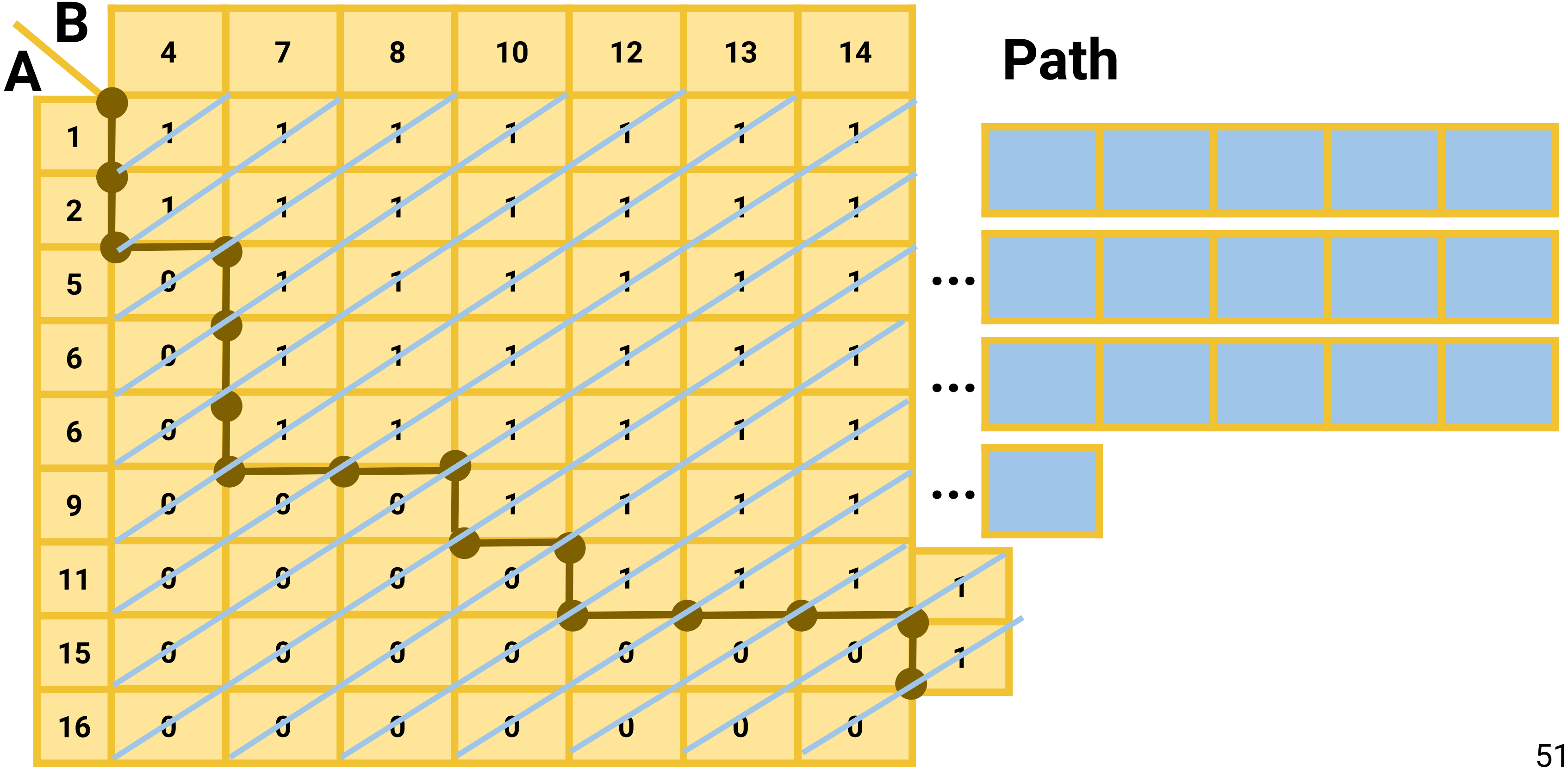


ALGO pathBig_k



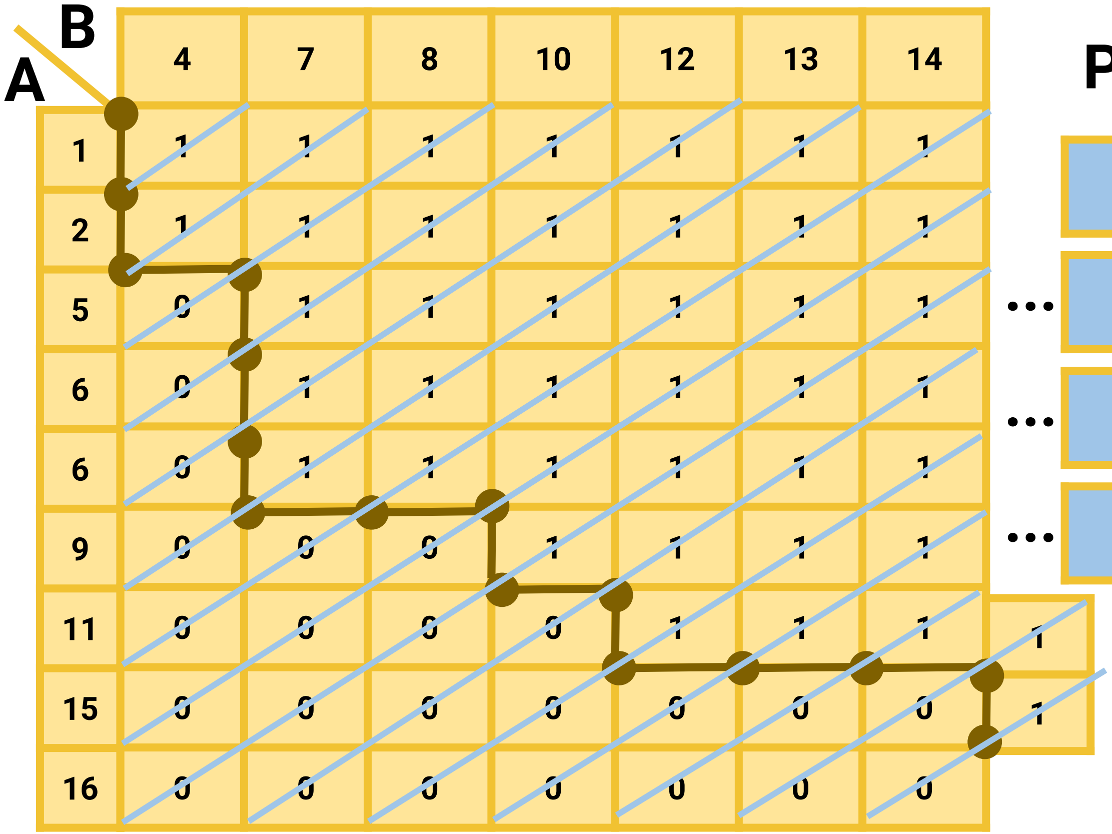
B A	4	7	8	10	12	13	14	
1	1	1	1	1	1	1	1	
2	1	1	1	1	1	1	1	
5	0	1	1	1	1	1	1	
6	0	1	1	1	1	1	1	
6	0	1	1	1	1	1	1	
9	0	0	0	1	1	1	1	
11	0	0	0	0	1	1	1	1
15	0	0	0	0	0	0	0	1
16	0	0	0	0	0	0	0	

ALGO pathBig_k



A \ B	4	7	8	10	12	13	14	
1	1	1	1	1	1	1	1	
2	1	1	1	1	1	1	1	
5	0	1	1	1	1	1	1	
6	0	1	1	1	1	1	1	
6	0	1	1	1	1	1	1	
9	0	0	0	1	1	1	1	
11	0	0	0	0	1	1	1	1
15	0	0	0	0	0	0	0	1
16	0	0	0	0	0	0	0	

ALGO pathBig_k

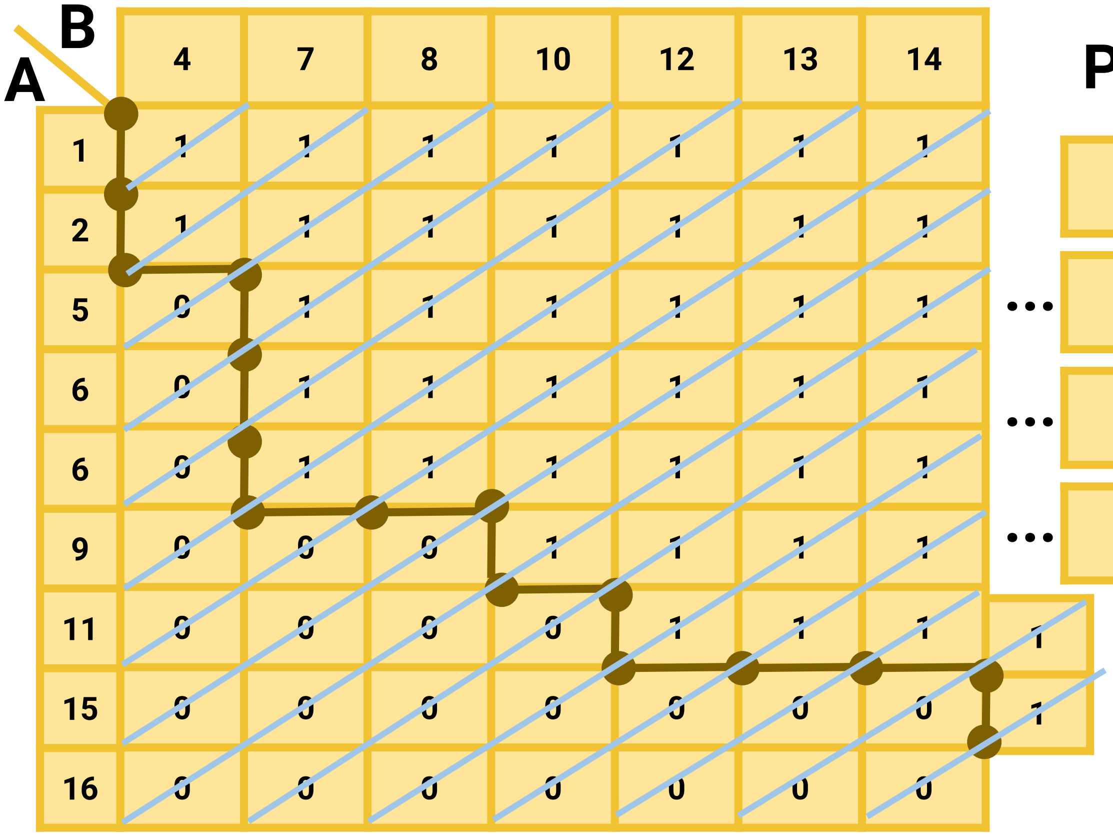


A \ B	4	7	8	10	12	13	14	
1	1	1	1	1	1	1	1	
2	1	1	1	1	1	1	1	
5	0	1	1	1	1	1	1	
6	0	1	1	1	1	1	1	
6	0	1	1	1	1	1	1	
9	0	0	0	1	1	1	1	
11	0	0	0	0	1	1	1	1
15	0	0	0	0	0	0	0	1
16	0	0	0	0	0	0	0	

Path

	1	1	0	1	1
…	1	0	0	1	0
…	1	0	0	0	1
…	1				

ALGO pathBig_k

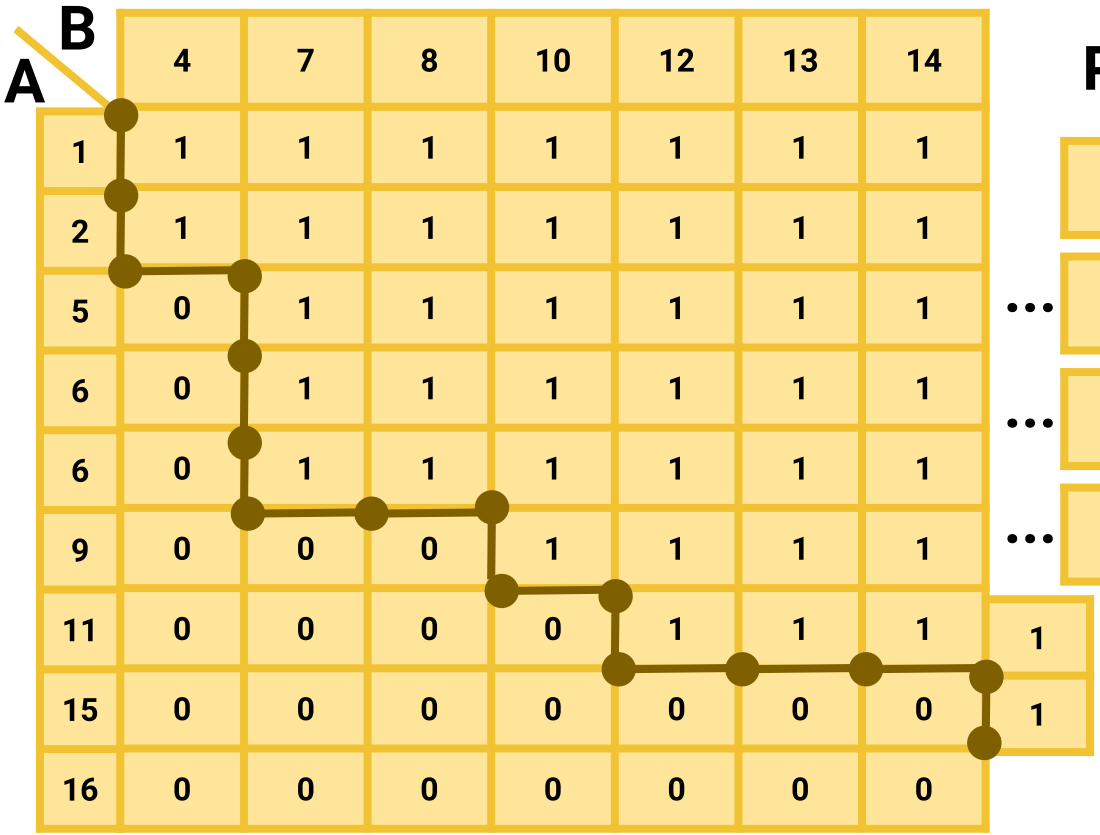


A \ B	4	7	8	10	12	13	14	
1	1	1	1	1	1	1	1	
2	1	1	1	1	1	1	1	
5	0	1	1	1	1	1	1	
6	0	1	1	1	1	1	1	
6	0	1	1	1	1	1	1	
9	0	0	0	1	1	1	1	
11	0	0	0	0	1	1	1	1
15	0	0	0	0	0	0	0	1
16	0	0	0	0	0	0	0	

Path

	1	1	0	1	1
…	1	0	0	1	0
…	1	0	0	0	1
…	1				

ALGO pathBig_k



B A	4	7	8	10	12	13	14	
1	1	1	1	1	1	1	1	
2	1	1	1	1	1	1	1	
5	0	1	1	1	1	1	1	
6	0	1	1	1	1	1	1	
6	0	1	1	1	1	1	1	
9	0	0	0	1	1	1	1	
11	0	0	0	0	1	1	1	1
15	0	0	0	0	0	0	0	1
16	0	0	0	0	0	0	0	

Path

	1	1	0	1	1
…	1	0	0	1	0
…	1	0	0	0	1
…	1				

ALGO mergeBig_k

A

1	2	5	6	6	9	11	15	16

B

4	7	8	10	12	13	14

Path

1	1	0	1	1	1	0	0	1	0	1	0	0	0	1	1

ALGO mergeBig_k

A

1	2	5	6	6	9	11	15	16

B

4	7	8	10	12	13	14

Path

1	1	0	1	1	1	0	0	1	0	1	0	0	0	1	1

M

1

ALGO mergeBig_k

A

1	2	5	6	6	9	11	15	16

B

4	7	8	10	12	13	14

Path

1	1	0	1	1	1	0	0	1	0	1	0	0	0	1	1

M

1	2

ALGO mergeBig_k

A

1	2	5	6	6	9	11	15	16

B

4	7	8	10	12	13	14

Path

1	1	0	1	1	1	0	0	1	0	1	0	0	0	1	1

M

1	2	4

ALGO mergeBig_k

A

1	2	5	6	6	9	11	15	16

B

4	7	8	10	12	13	14

Path

1	1	0	1	1	1	0	0	1	0	1	0	0	0	1	1

M

1	2	4	5

ALGO mergeBig_k

A

1	2	5	6	6	9	11	15	16

B

4	7	8	10	12	13	14

Path

1	1	0	1	1	1	0	0	1	0	1	0	0	0	1	1

M

1	2	4	5	6

ALGO mergeBig_k

A

1	2	5	6	6	9	11	15	16

B

4	7	8	10	12	13	14

Path

1	1	0	1	1	1	0	0	1	0	1	0	0	0	1	1

M

1	2	4	5	6	6

ALGO mergeBig_k

A

1	2	5	6	6	9	11	15	16

B

4	7	8	10	12	13	14

Path

1	1	0	1	1	1	0	0	1	0	1	0	0	0	1	1

M

1	2	4	5	6	6	7

ALGO mergeBig_k

A

1	2	5	6	6	9	11	15	16

B

4	7	8	10	12	13	14

Path

1	1	0	1	1	1	0	0	1	0	1	0	0	0	1	1

M

1	2	4	5	6	6	7	8

ALGO mergeBig_k

A

1	2	5	6	6	9	11	15	16

B

4	7	8	10	12	13	14

Path

1	1	0	1	1	1	0	0	1	0	1	0	0	0	1	1

M

1	2	4	5	6	6	7	8	9

ALGO mergeBig_k

A

1	2	5	6	6	9	11	15	16

B

4	7	8	10	12	13	14

Path

1	1	0	1	1	1	0	0	1	0	1	0	0	0	1	1

M

1	2	4	5	6	6	7	8	9	10

ALGO mergeBig_k

A

1	2	5	6	6	9	11	15	16

B

4	7	8	10	12	13	14

Path

1	1	0	1	1	1	0	0	1	0	1	0	0	0	1	1

M

1	2	4	5	6	6	7	8	9	10	11

ALGO mergeBig_k

A

1	2	5	6	6	9	11	15	16

B

4	7	8	10	12	13	14

Path

1	1	0	1	1	1	0	0	1	0	1	0	0	0	1	1

M

1	2	4	5	6	6	7	8	9	10	11	12

ALGO mergeBig_k

A

1	2	5	6	6	9	11	15	16

B

4	7	8	10	12	13	14

Path

1	1	0	1	1	1	0	0	1	0	1	0	0	0	1	1

M

1	2	4	5	6	6	7	8	9	10	11	12	13

ALGO mergeBig_k

A

1	2	5	6	6	9	11	15	16

B

4	7	8	10	12	13	14

Path

1	1	0	1	1	1	0	0	1	0	1	0	0	0	1	1

M

1	2	4	5	6	6	7	8	9	10	11	12	13	14

ALGO mergeBig_k

A

1	2	5	6	6	9	11	15	16

B

4	7	8	10	12	13	14

Path

1	1	0	1	1	1	0	0	1	0	1	0	0	0	1	1

M

1	2	4	5	6	6	7	8	9	10	11	12	13	14	15

ALGO mergeBig_k

A

1	2	5	6	6	9	11	15	16

B

4	7	8	10	12	13	14

Path

1	1	0	1	1	1	0	0	1	0	1	0	0	0	1	1

M

1	2	4	5	6	6	7	8	9	10	11	12	13	14	15	16

ALGO mergeBig_k

A

1	2	5	6	6	9	11	15	16

B

4	7	8	10	12	13	14

Path

1	1	0	1	1	1	0	0	1	0	1	0	0	0	1	1

M

1	2	4	5	6	6	7	8	9	10	11	12	13	14	15	16

ALGO mergeBig_k

A

1	2	5	6	6	9	11	15	16

B

4	7	8	10	12	13	14

Path

1	1	0	1	1	1	0	0	1	0	1	0	0	0	1	1

M

1	2	4	5	6	6	7	8	9	10	11	12	13	14	15	16

ALGO mergeBig_k

A

1	2	5	6	6	9	11	15	16

B

4	7	8	10	12	13	14

Path

1	1	0	1	1	1	0	0	1	0	1	0	0	0	1	1

ALGO mergeBig_k

A

1	2	5	6	6	9	11	15	16

B

4	7	8	10	12	13	14

Path

1	1	0	1	1	1	0	0	1	0	1	0	0	0	1	1
0	1	0	2	4	5	1	2	6	3	7	4	5	6	8	9

ALGO mergeBig_k

A

1	2	5	6	6	9	11	15	16

B

4	7	8	10	12	13	14

Path

1	1	0	1	1	1	0	0	1	0	1	0	0	0	1	1
0	1	0	2	4	5	1	2	6	3	7	4	5	6	8	9

M

ALGO mergeBig_k

A

1	2	5	6	6	9	11	15	16

B

4	7	8	10	12	13	14

Path

1	1	0	1	1	1	0	0	1	0	1	0	0	0	1	1
0	1	0	2	4	5	1	2	6	3	7	4	5	6	8	9

M

ALGO mergeBig_k

A

1	2	5	6	6	9	11	15	16

B

4	7	8	10	12	13	14

Path

1	1	0	1	1	1	0	0	1	0	1	0	0	0	1	1
0	1	0	2	4	5	1	2	6	3	7	4	5	6	8	9

M

ALGO mergeBig_k

A

1	2	5	6	6	9	11	15	16

B

4	7	8	10	12	13	14

Path

1	1	0	1	1	1	0	0	1	0	1	0	0	0	1	1
0	1	0	2	4	5	1	2	6	3	7	4	5	6	8	9

M

ALGO mergeBig_k

A

1	2	5	6	6	9	11	15	16

B

4	7	8	10	12	13	14

Path

1	1	0	1	1	1	0	0	1	0	1	0	0	0	1	1
0	1	0	2	4	5	1	2	6	3	7	4	5	6	8	9

M

ALGO mergeBig_k

A

1	2	5	6	6	9	11	15	16

B

4	7	8	10	12	13	14

Path

1	1	0	1	1	1	0	0	1	0	1	0	0	0	1	1
0	1	0	2	4	5	1	2	6	3	7	4	5	6	8	9

M

1	2	4	5	6	6	7	8	9	10	11	12	13	14	15	16

ALGO mergeBig_k

A

1	2	5	6	6	9	11	15	16

B

4	7	8	10	12	13	14

Path

1	1	0	1	1	1	0	0	1	0	1	0	0	0	1	1
0	1	0	2	4	5	1	2	6	3	7	4	5	6	8	9

M

1	2	4	5	6	6	7	8	9	10	11	12	13	14	15	16

03

“MERGE SORT” ON GPU

MERGE SORT ON CPU

8	4	12	2	2	1	5	7

MERGE SORT ON CPU

8	4	12	2	2	1	5	7

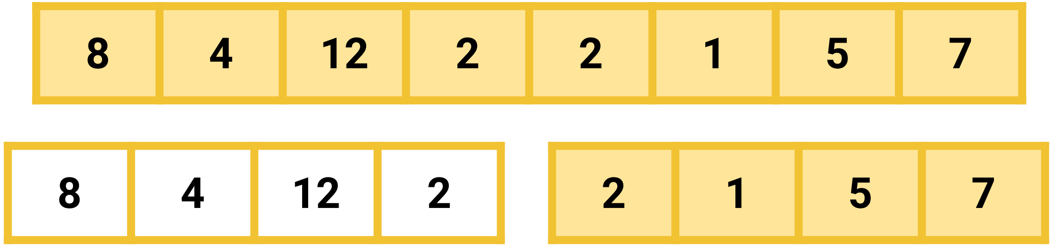
MERGE SORT ON CPU

8	4	12	2	2	1	5	7

8	4	12	2

2	1	5	7

MERGE SORT ON CPU

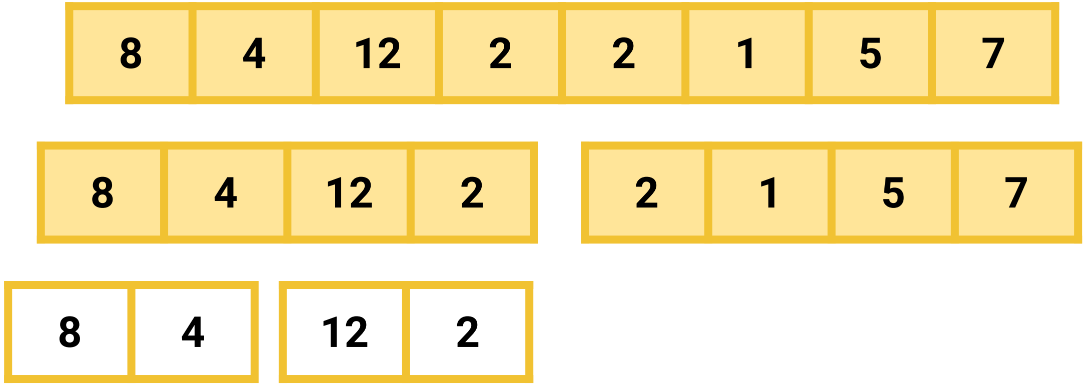


8	4	12	2	2	1	5	7

8	4	12	2

2	1	5	7

MERGE SORT ON CPU

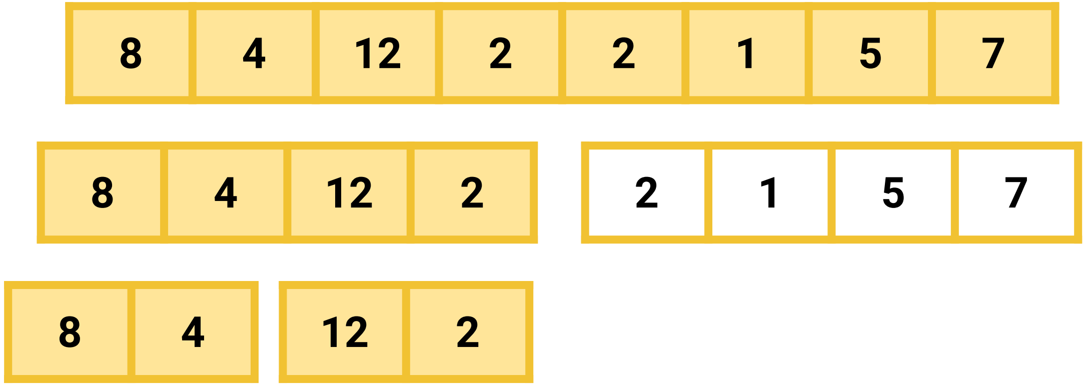


8 4 12 2 2 1 5 7

8 4 12 2   2 1 5 7

8 4   12 2

MERGE SORT ON CPU



8	4	12	2	2	1	5	7

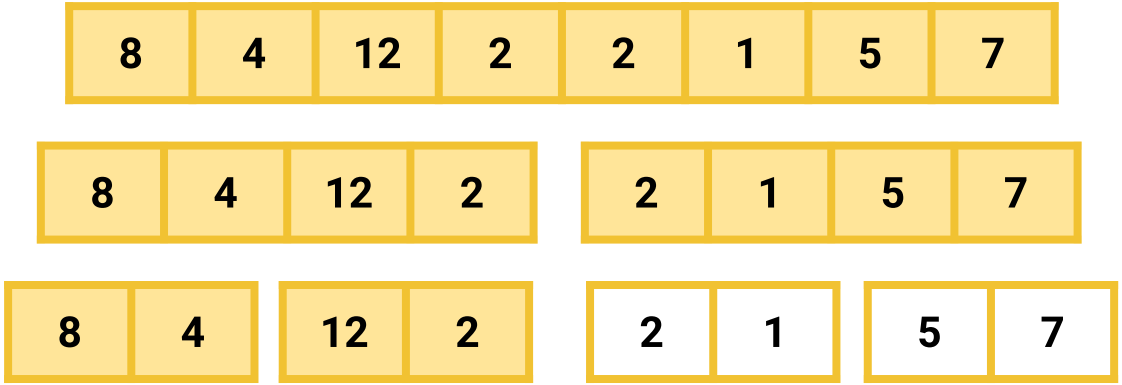
8	4	12	2

2	1	5	7

8	4

12	2

MERGE SORT ON CPU

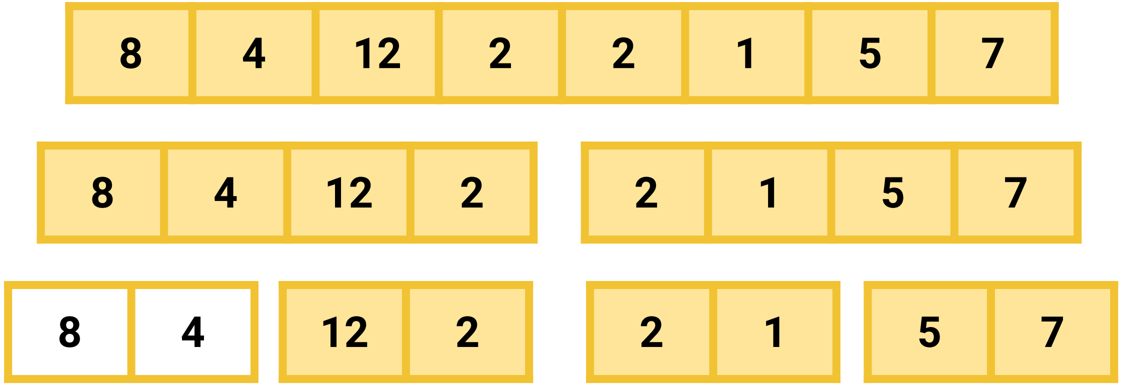


8 4 12 2 2 1 5 7

8 4 12 2 | 2 1 5 7

8 4 | 12 2 | 2 1 | 5 7

MERGE SORT ON CPU

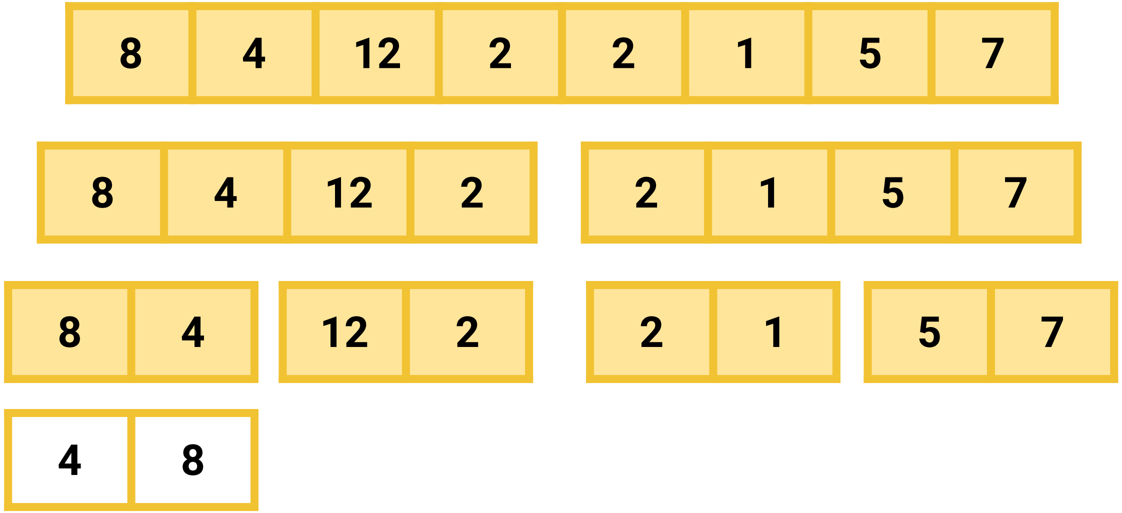


8 4 12 2 2 1 5 7

8 4 12 2 | 2 1 5 7

8 4 | 12 2 | 2 1 | 5 7

MERGE SORT ON CPU



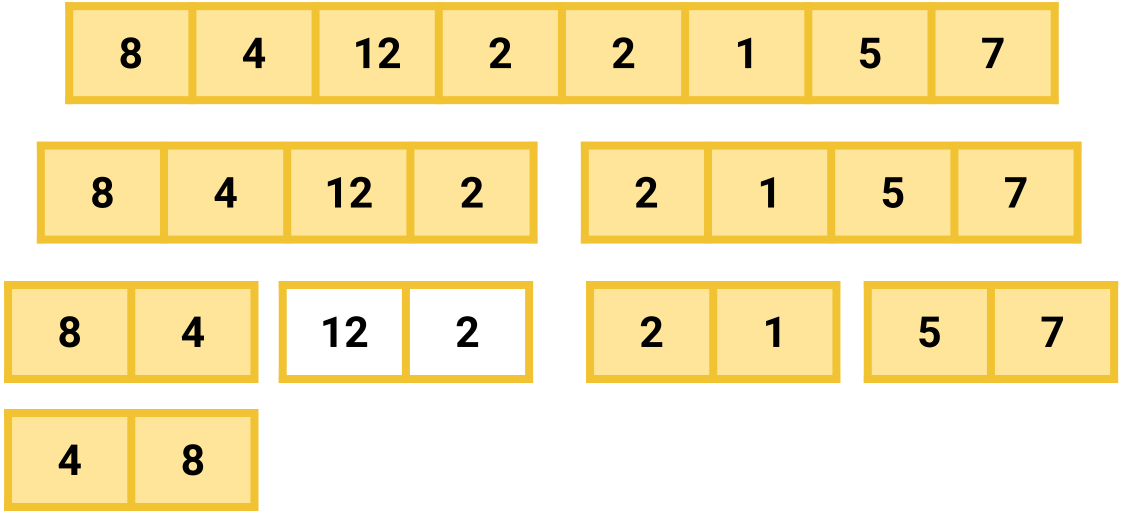
8 4 12 2 2 1 5 7

8 4 12 2 | 2 1 5 7

8 4 | 12 2 | 2 1 | 5 7

4 8

MERGE SORT ON CPU



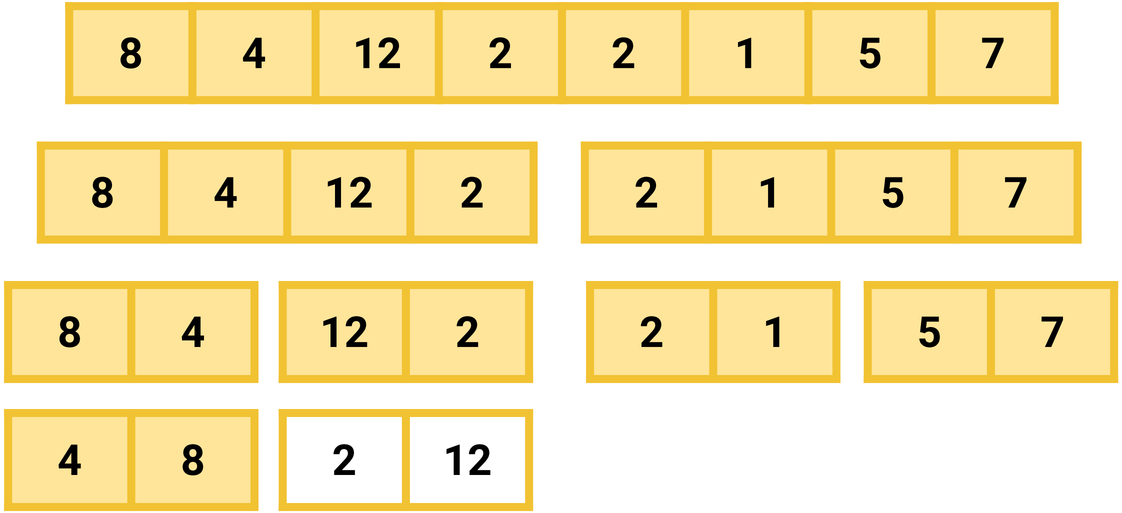
8 4 12 2 2 1 5 7

8 4 12 2 | 2 1 5 7

8 4 | 12 2 | 2 1 | 5 7

4 8

MERGE SORT ON CPU



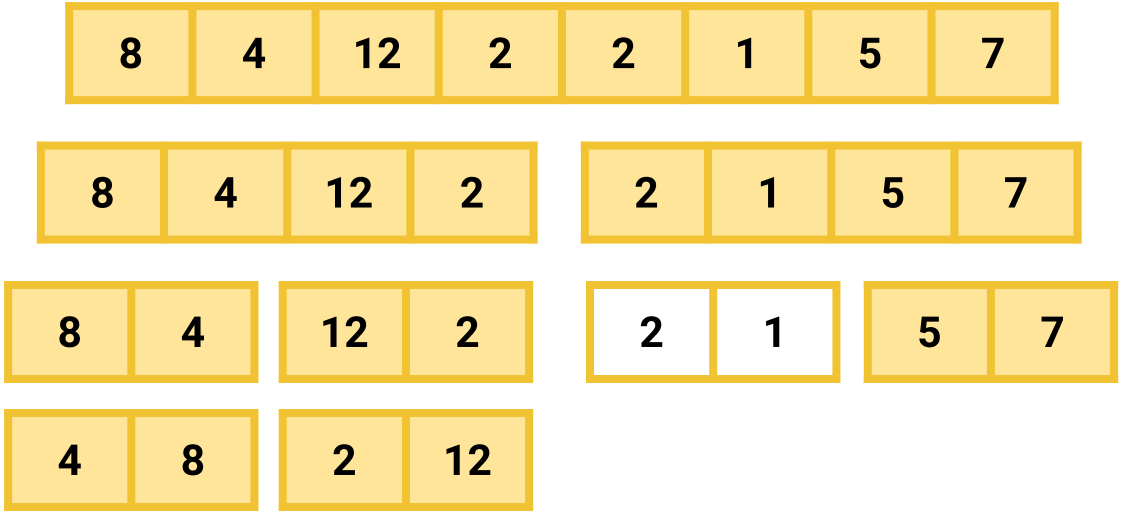
8 4 12 2 2 1 5 7

8 4 12 2 | 2 1 5 7

8 4 | 12 2 | 2 1 | 5 7

4 8 | 2 12

MERGE SORT ON CPU



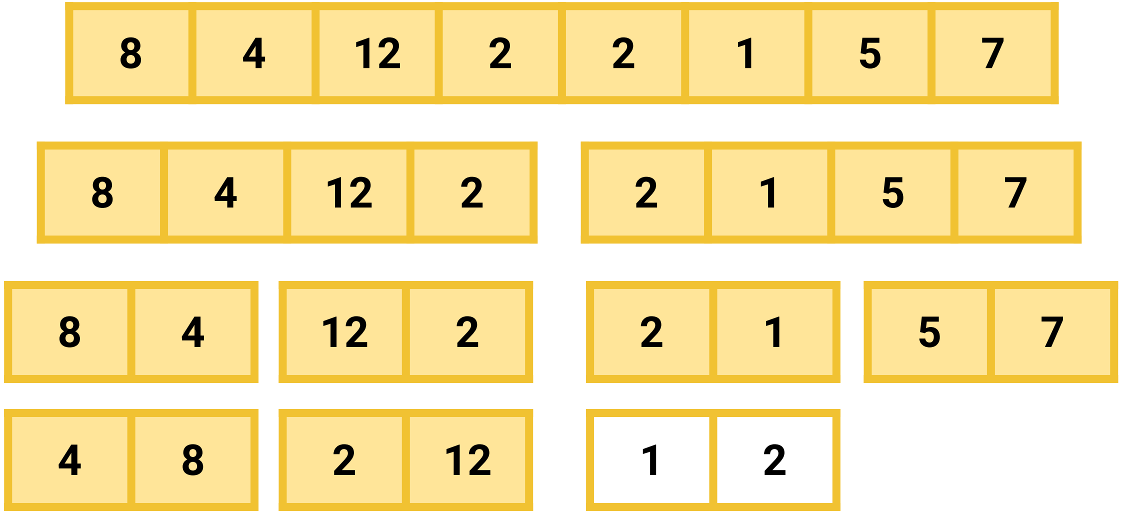
8 4 12 2 2 1 5 7

8 4 12 2 | 2 1 5 7

8 4 | 12 2 | 2 1 | 5 7

4 8 | 2 12

MERGE SORT ON CPU



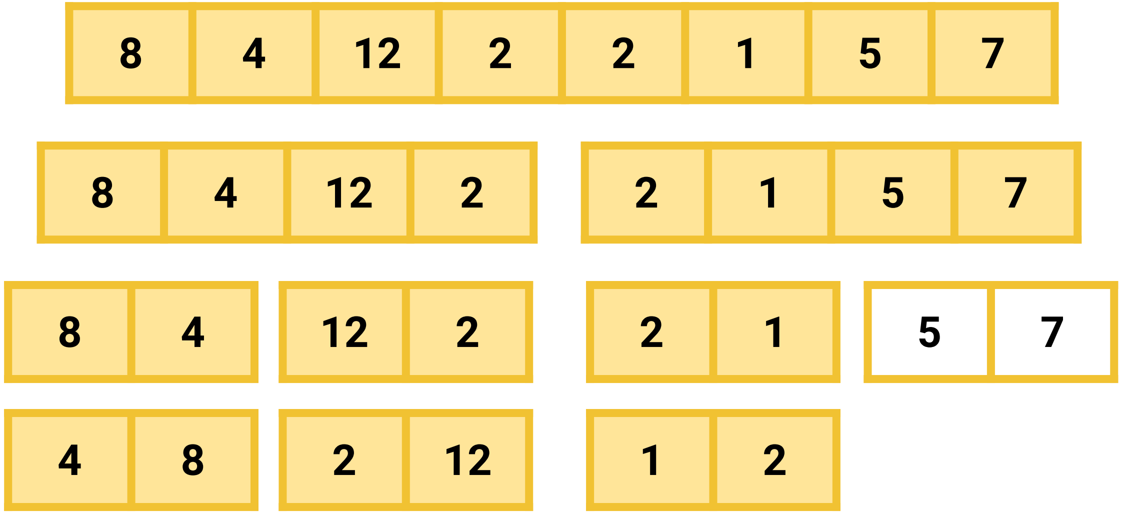
8 4 12 2 2 1 5 7

8 4 12 2 | 2 1 5 7

8 4 | 12 2 | 2 1 | 5 7

4 8 | 2 12 | 1 2

MERGE SORT ON CPU



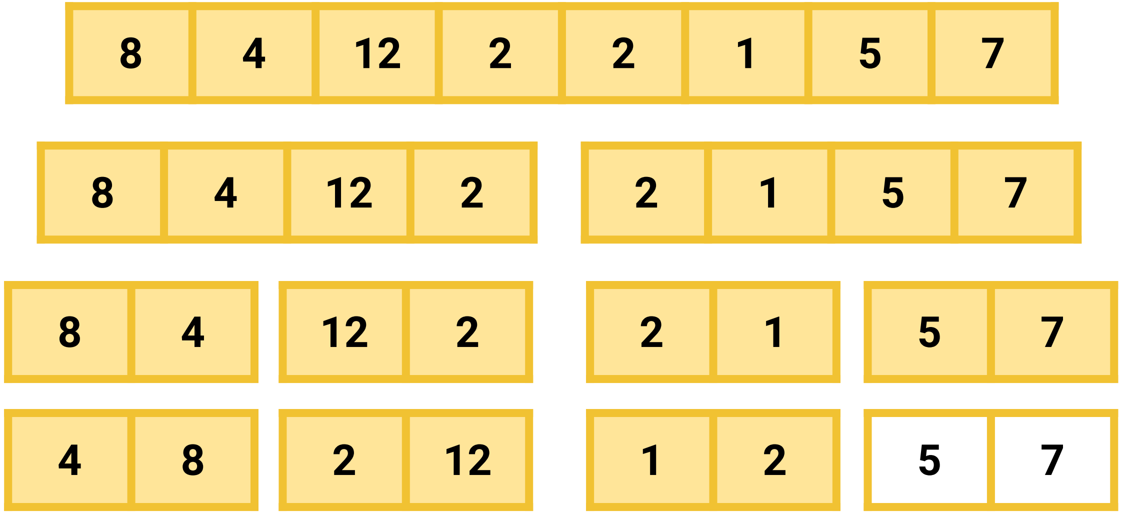
8 4 12 2 2 1 5 7

8 4 12 2 | 2 1 5 7

8 4 | 12 2 | 2 1 | 5 7

4 8 | 2 12 | 1 2

MERGE SORT ON CPU



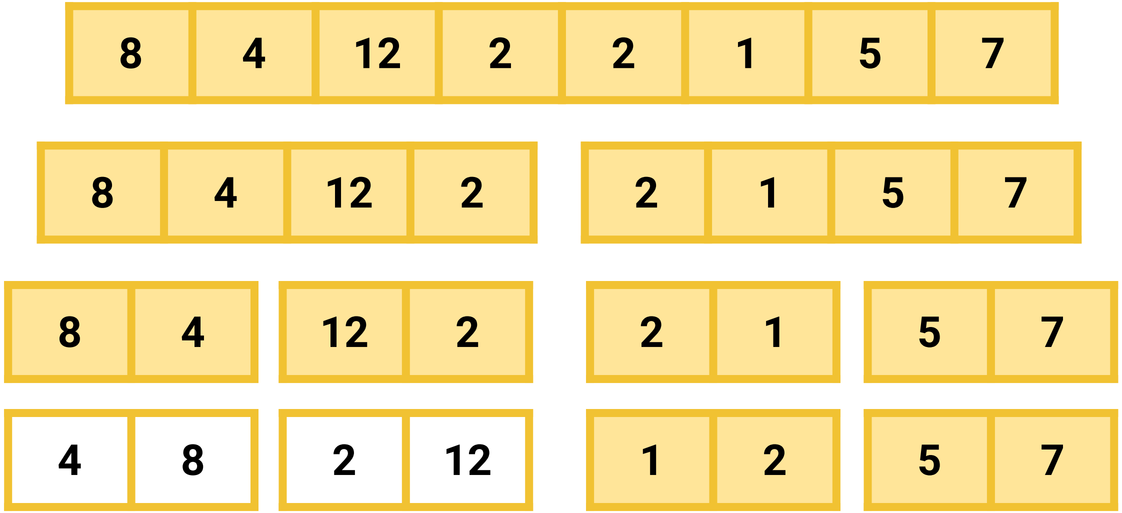
8 4 12 2 2 1 5 7

8 4 12 2 | 2 1 5 7

8 4 | 12 2 | 2 1 | 5 7

4 8 | 2 12 | 1 2 | 5 7

MERGE SORT ON CPU



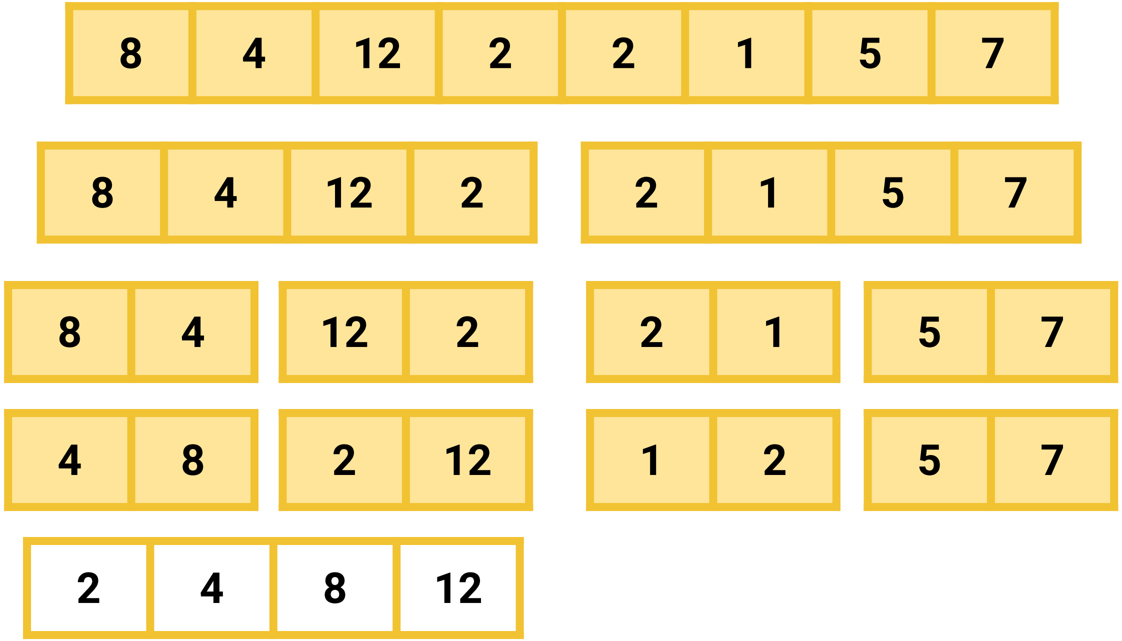
8 4 12 2 2 1 5 7

8 4 12 2 | 2 1 5 7

8 4 | 12 2 | 2 1 | 5 7

4 8 | 2 12 | 1 2 | 5 7

MERGE SORT ON CPU



8 4 12 2 2 1 5 7

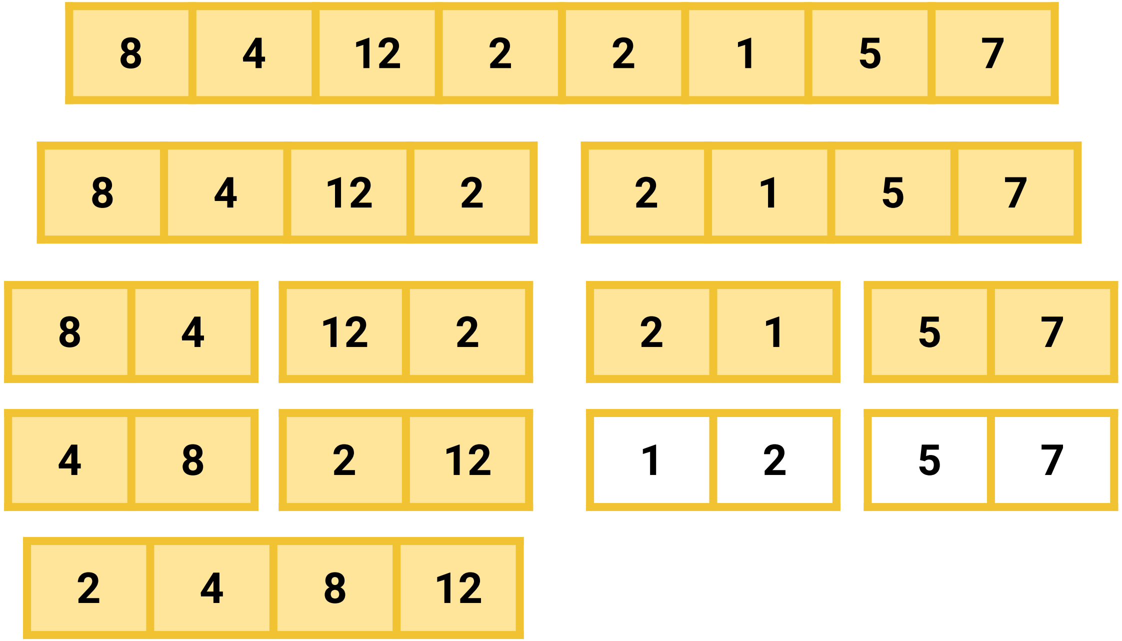
8 4 12 2 | 2 1 5 7

8 4 | 12 2 | 2 1 | 5 7

4 8 | 2 12 | 1 2 | 5 7

2 4 8 12

MERGE SORT ON CPU



8 4 12 2 2 1 5 7

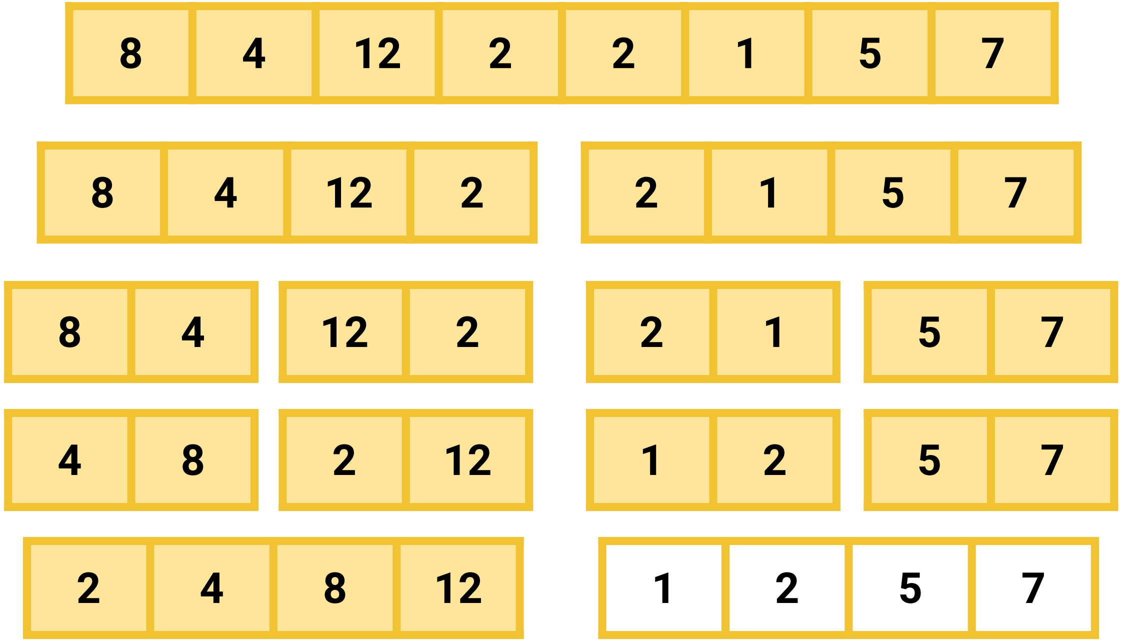
8 4 12 2 | 2 1 5 7

8 4 | 12 2 | 2 1 | 5 7

4 8 | 2 12 | 1 2 | 5 7

2 4 8 12

MERGE SORT ON CPU



8 4 12 2 2 1 5 7

8 4 12 2

2 1 5 7

8 4

12 2

2 1

5 7

4 8

2 12

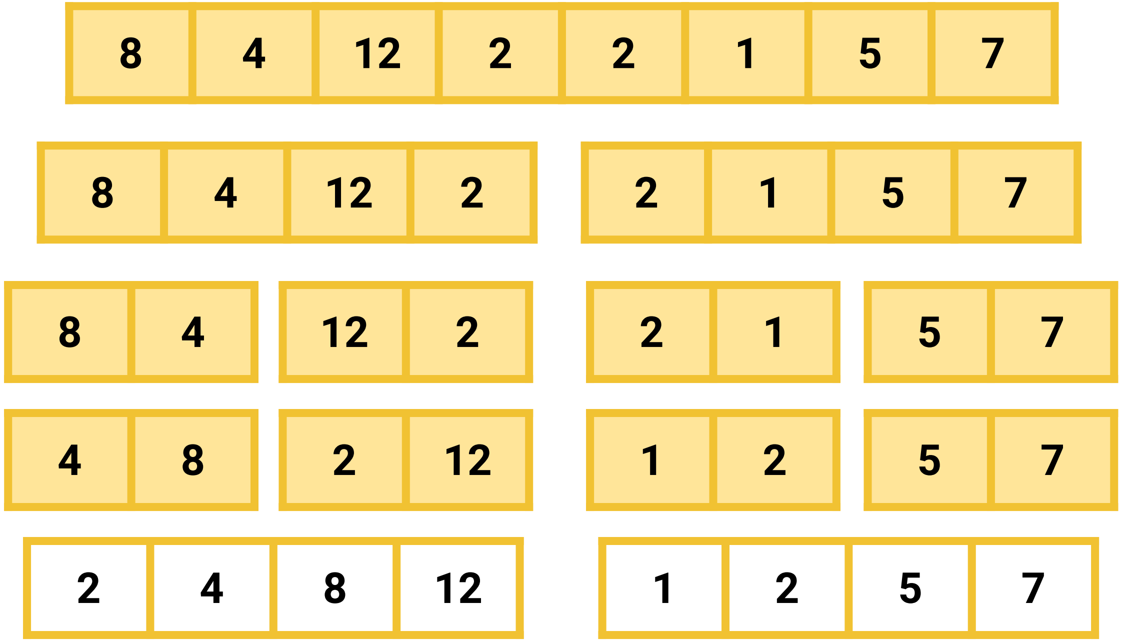
1 2

5 7

2 4 8 12

1 2 5 7

MERGE SORT ON CPU



8 4 12 2 2 1 5 7

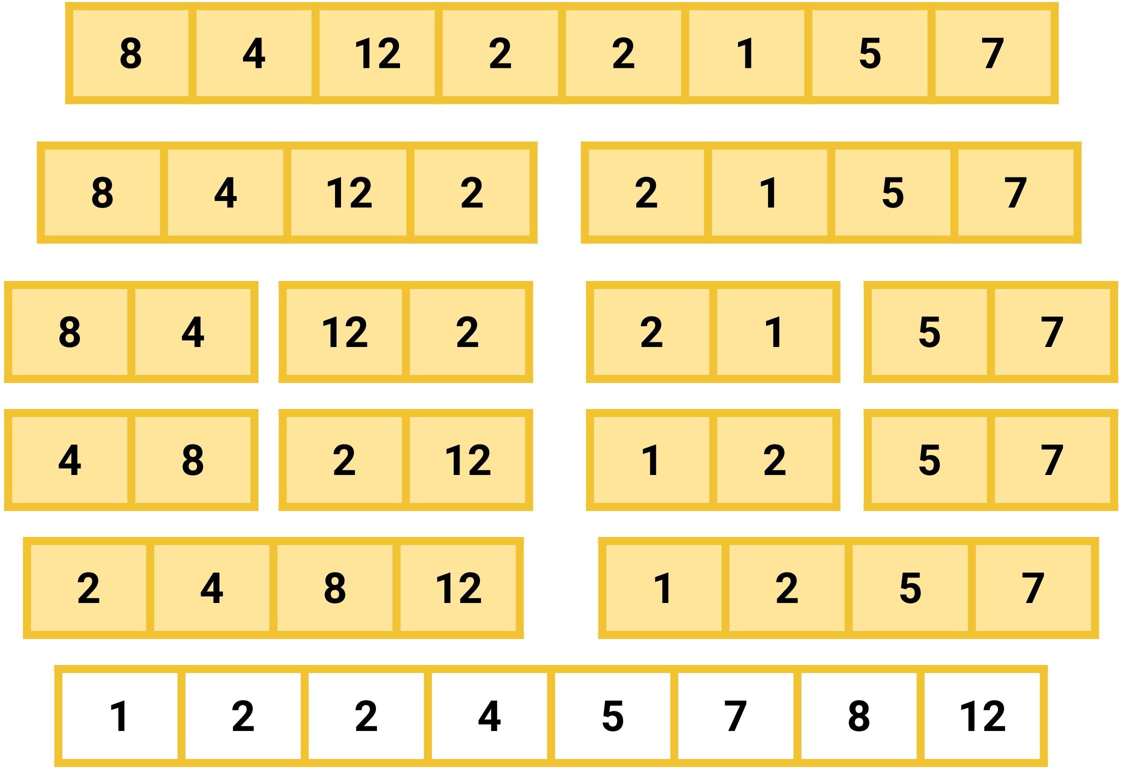
8 4 12 2 | 2 1 5 7

8 4 | 12 2 | 2 1 | 5 7

4 8 | 2 12 | 1 2 | 5 7

2 4 8 12 | 1 2 5 7

MERGE SORT ON CPU



8 4 12 2 2 1 5 7

8 4 12 2 | 2 1 5 7

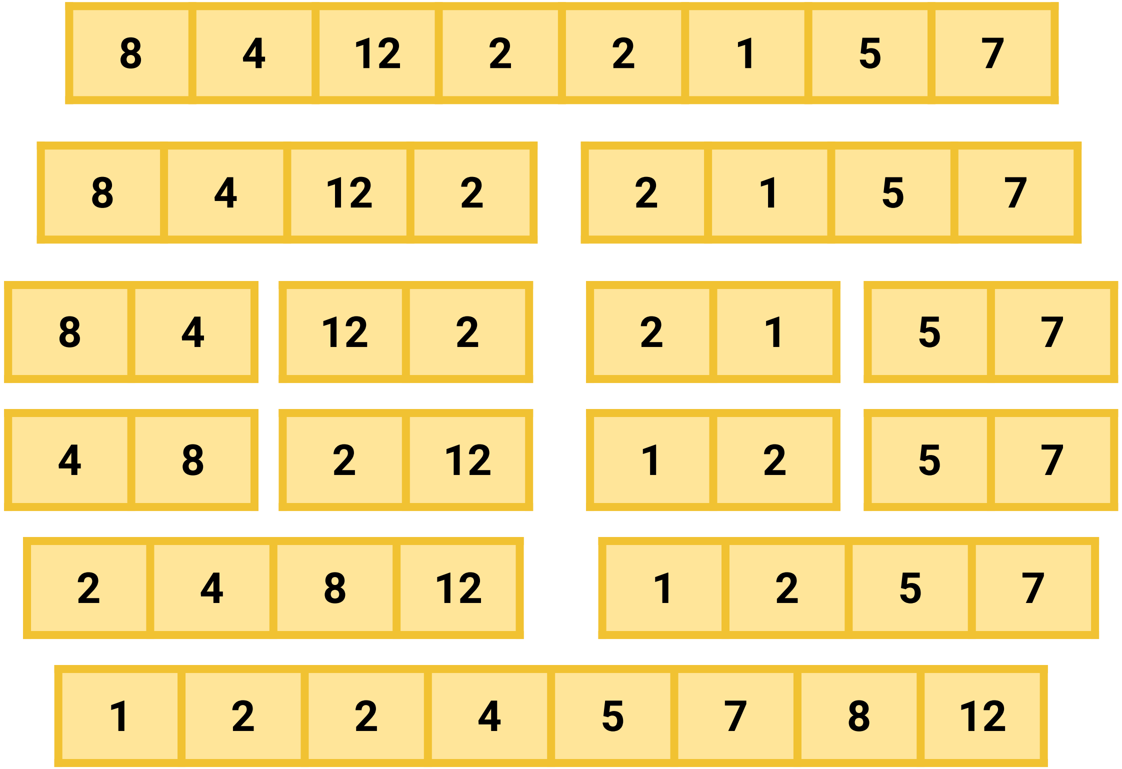
8 4 | 12 2 | 2 1 | 5 7

4 8 | 2 12 | 1 2 | 5 7

2 4 8 12 | 1 2 5 7

1 2 2 4 5 7 8 12

MERGE SORT ON CPU



8 4 12 2 2 1 5 7

8 4 12 2 | 2 1 5 7

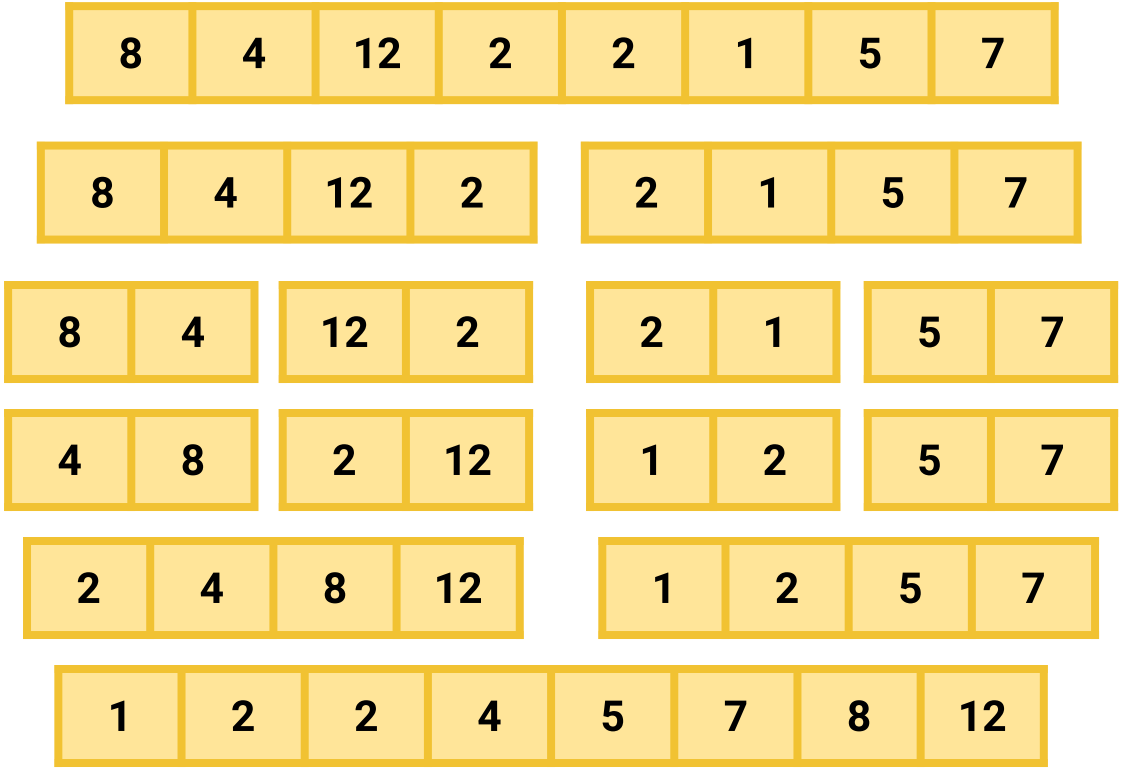
8 4 | 12 2 | 2 1 | 5 7

4 8 | 2 12 | 1 2 | 5 7

2 4 8 12 | 1 2 5 7

1 2 2 4 5 7 8 12

“MERGE SORT” ON GPU



8 4 12 2 2 1 5 7

8 4 12 2 | 2 1 5 7

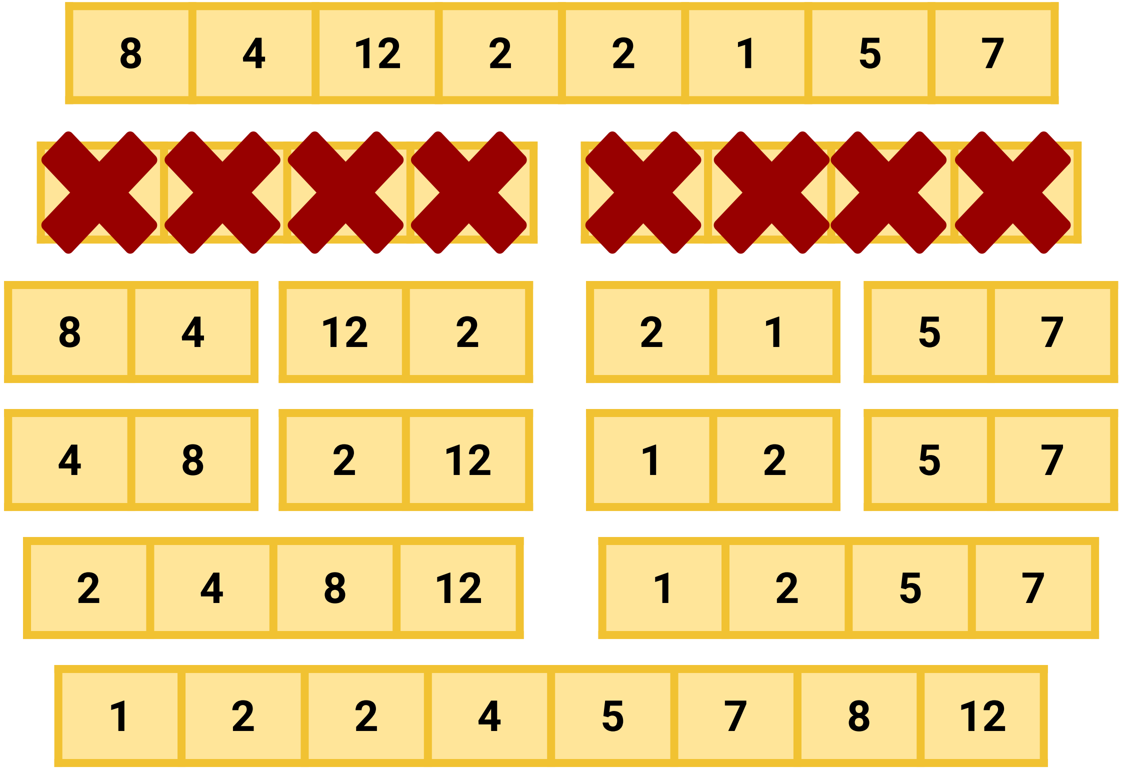
8 4 | 12 2 | 2 1 | 5 7

4 8 | 2 12 | 1 2 | 5 7

2 4 8 12 | 1 2 5 7

1 2 2 4 5 7 8 12

“MERGE SORT” ON GPU



8 4 12 2 2 1 5 7

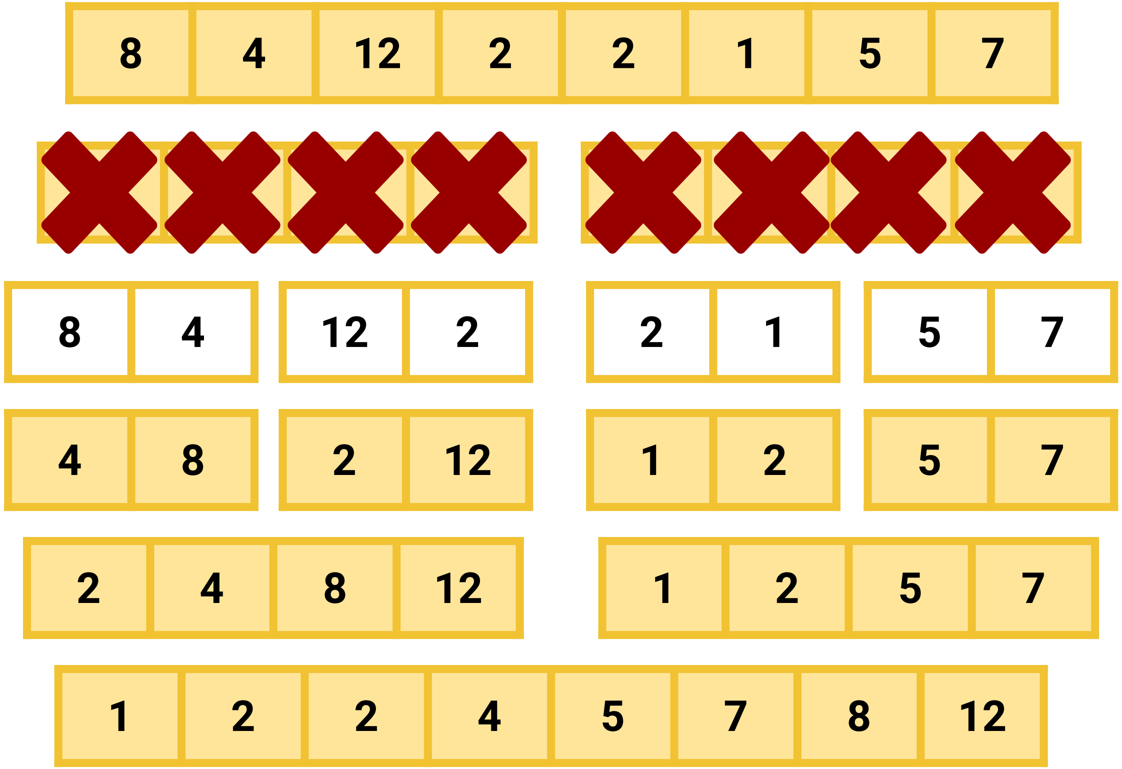
8 4 | 12 2 | 2 1 | 5 7

4 8 | 2 12 | 1 2 | 5 7

2 4 8 12 | 1 2 5 7

1 2 2 4 5 7 8 12

“MERGE SORT” ON GPU



8 4 12 2 2 1 5 7

8 4 | 12 2 | 2 1 | 5 7

4 8 | 2 12 | 1 2 | 5 7

2 4 8 12 | 1 2 5 7

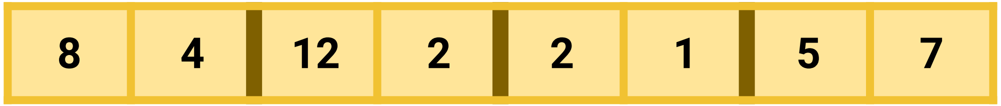
1 2 2 4 5 7 8 12

“MERGE SORT” ON GPU

8	4	12	2	2	1	5	7

“MERGE SORT” ON GPU

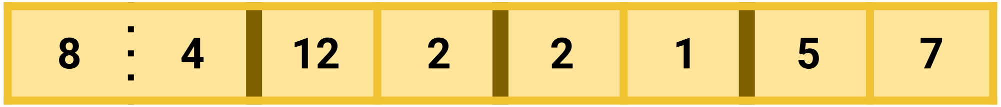
slice_size = 2
number_of_slices = 4



8	4	12	2	2	1	5	7

slice_size = 2
number_of_slices = 4

“MERGE SORT” ON GPU



8	4	12	2	2	1	5	7

NOTATIONS

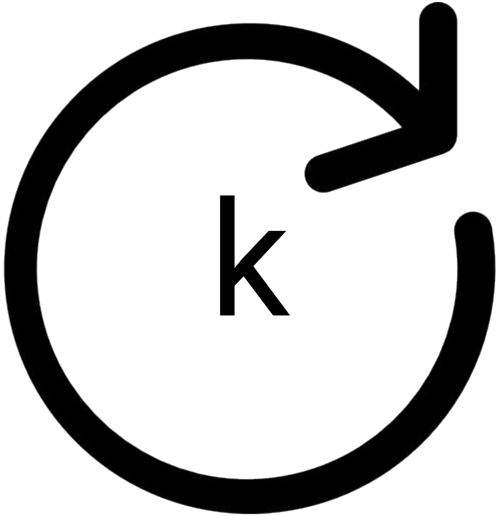
NOTATIONS

pathBig_k(A,B)

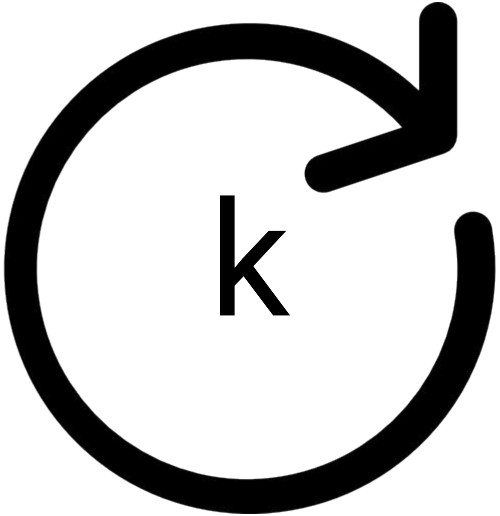
+

mergeBig_k(A,B)

NOTATIONS



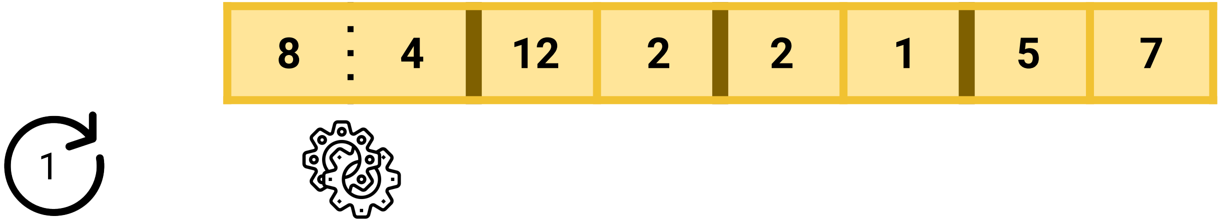
NOTATIONS



k loop tour

slice_size = 2
number_of_slices = 4

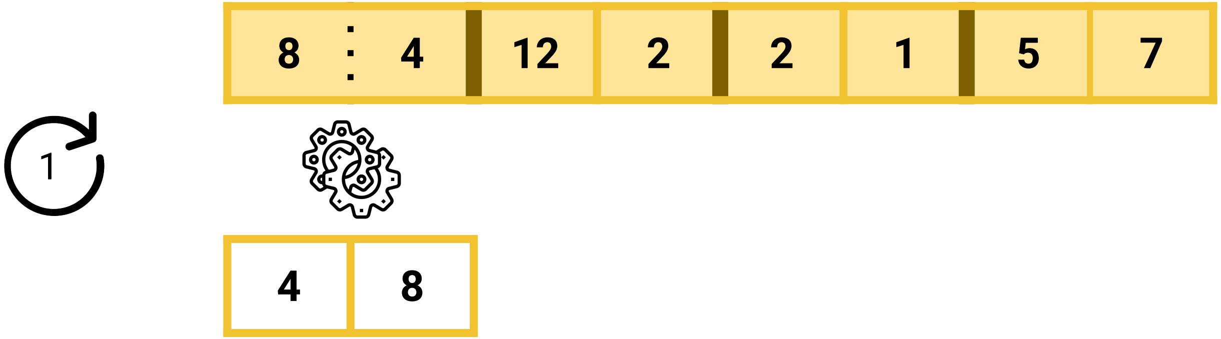
"MERGE SORT" ON GPU



8	4	12	2	2	1	5	7

slice_size = 2
number_of_slices = 4

“MERGE SORT” ON GPU

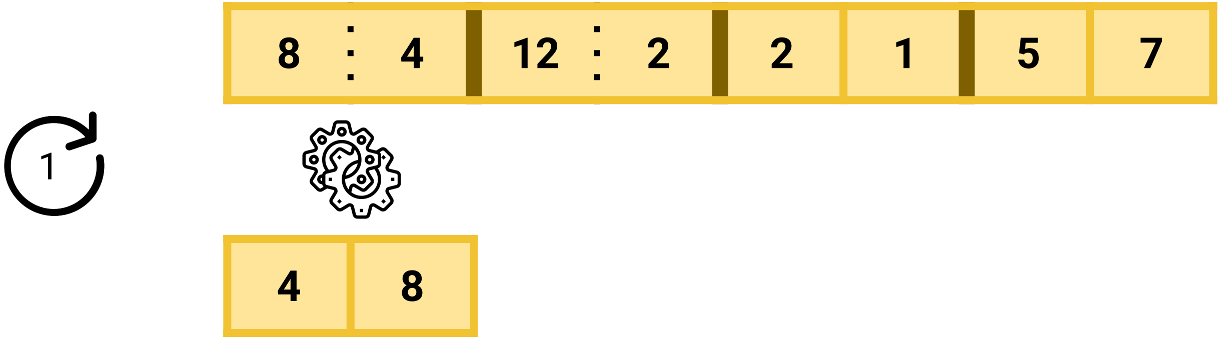


8	4	12	2	2	1	5	7

4	8

“MERGE SORT” ON GPU

slice_size = 2
number_of_slices = 4

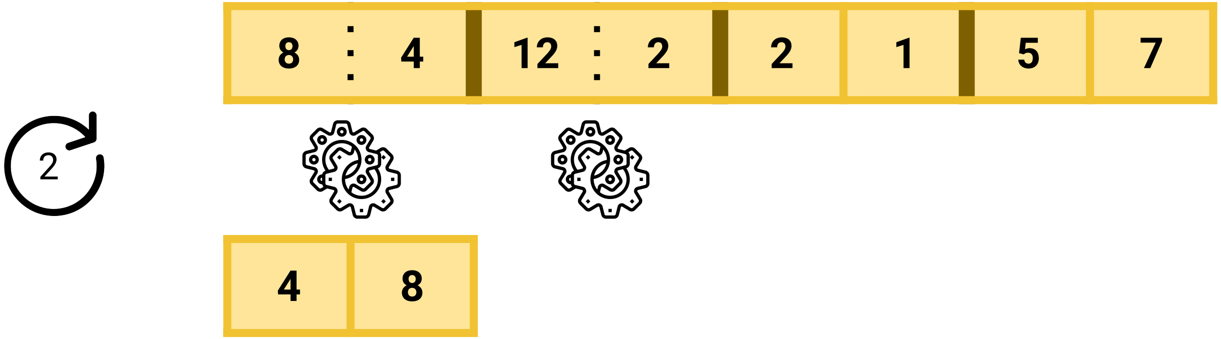

1

8 4 12 2 2 1 5 7

4 8

slice_size = 2
number_of_slices = 4

“MERGE SORT” ON GPU



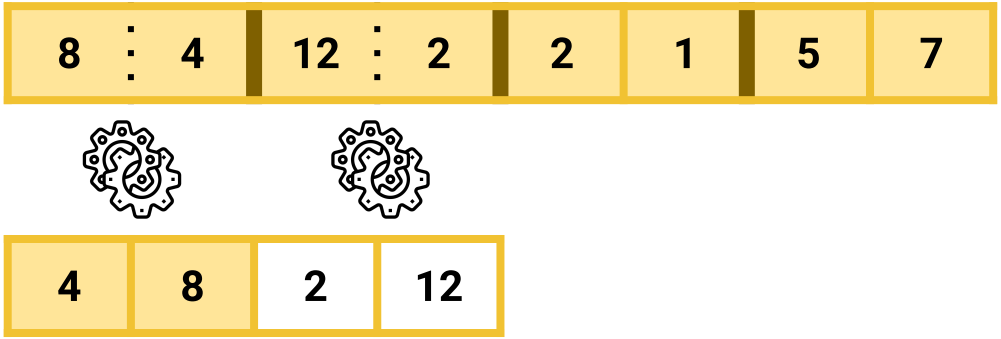
8	4	12	2	2	1	5	7

4	8

slice_size = 2
number_of_slices = 4

“MERGE SORT” ON GPU

2

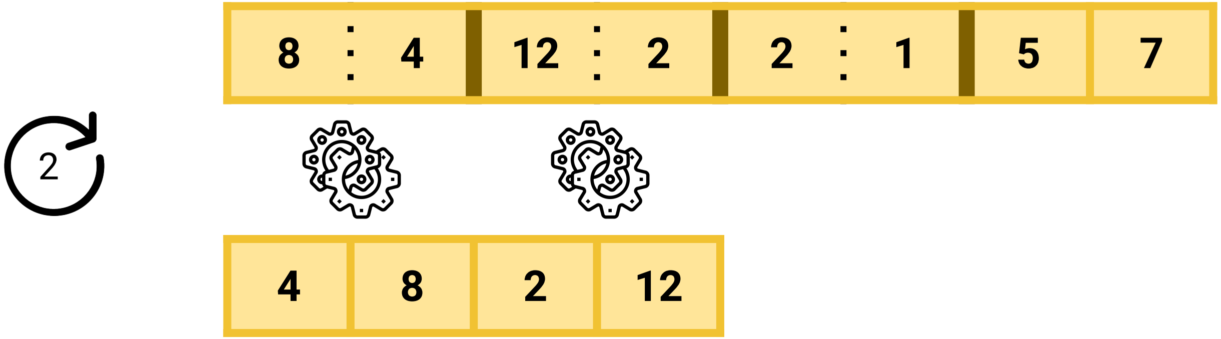


8	4	12	2	2	1	5	7

4	8	2	12

slice_size = 2
number_of_slices = 4

"MERGE SORT" ON GPU

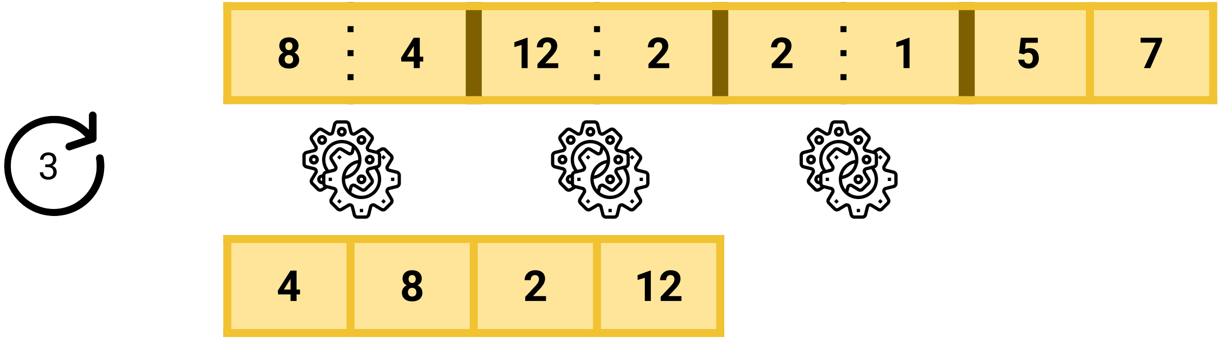


8	4	12	2	2	1	5	7

4	8	2	12

slice_size = 2
number_of_slices = 4

“MERGE SORT” ON GPU

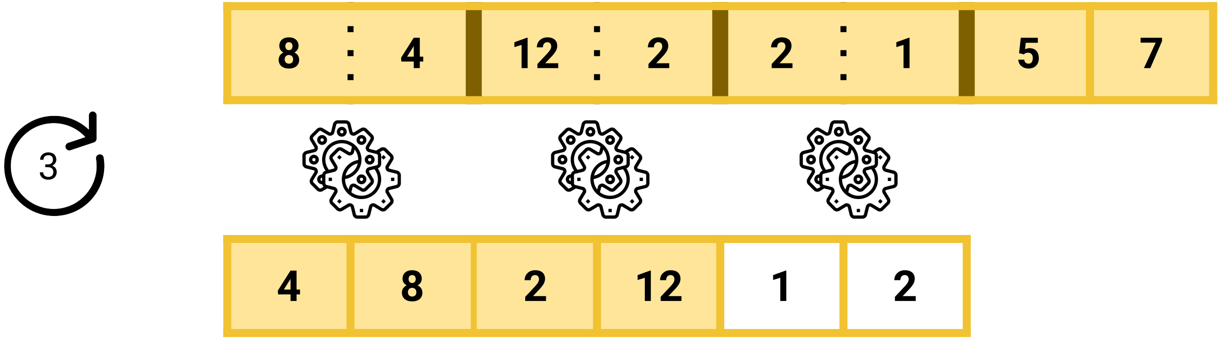


8	4	12	2	2	1	5	7

4	8	2	12

“MERGE SORT” ON GPU

slice_size = 2
number_of_slices = 4

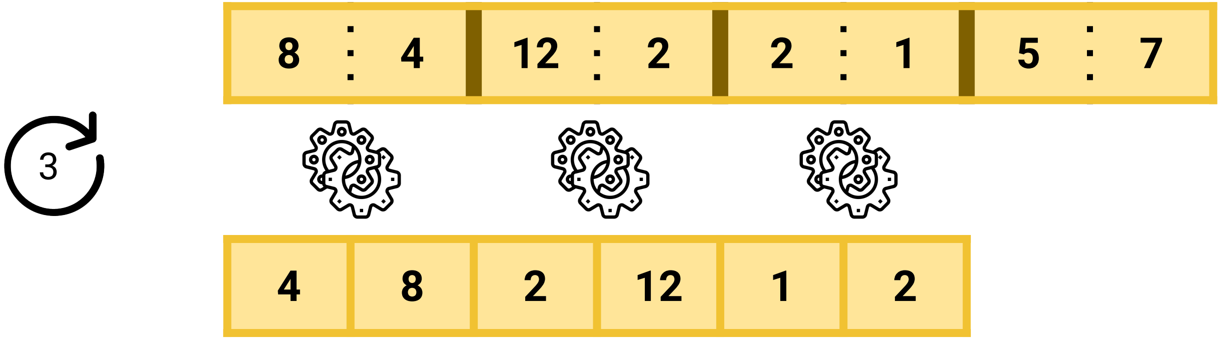


8	4	12	2	2	1	5	7

4	8	2	12	1	2

slice_size = 2
number_of_slices = 4

“MERGE SORT” ON GPU

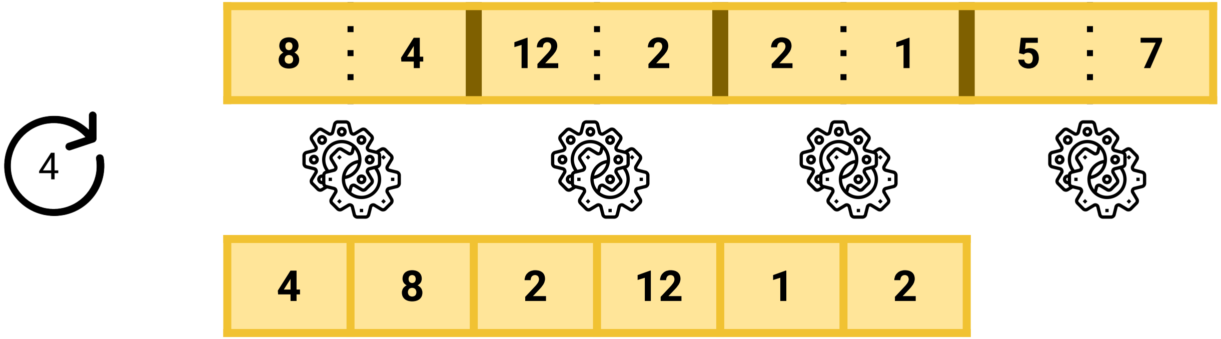


8	4	12	2	2	1	5	7

4	8	2	12	1	2

slice_size = 2
number_of_slices = 4

“MERGE SORT” ON GPU

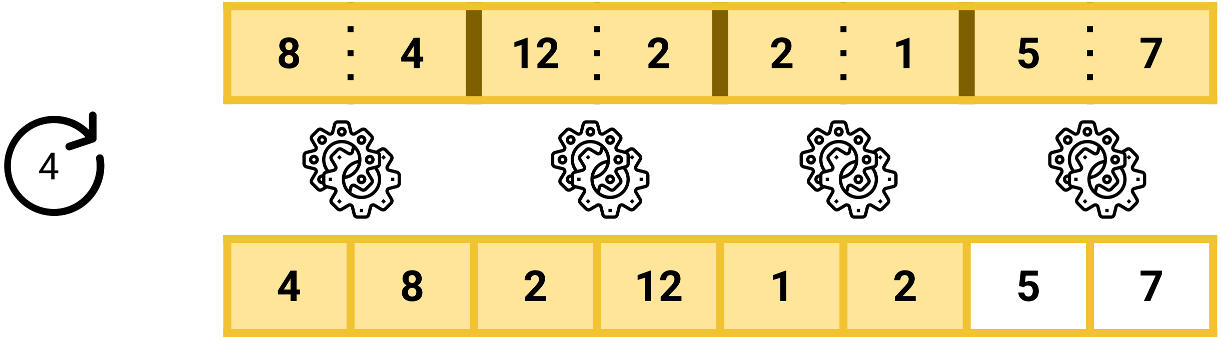


8 : 4 | 12 : 2 | 2 : 1 | 5 : 7

4	8	2	12	1	2

slice_size = 2
number_of_slices = 4

“MERGE SORT” ON GPU

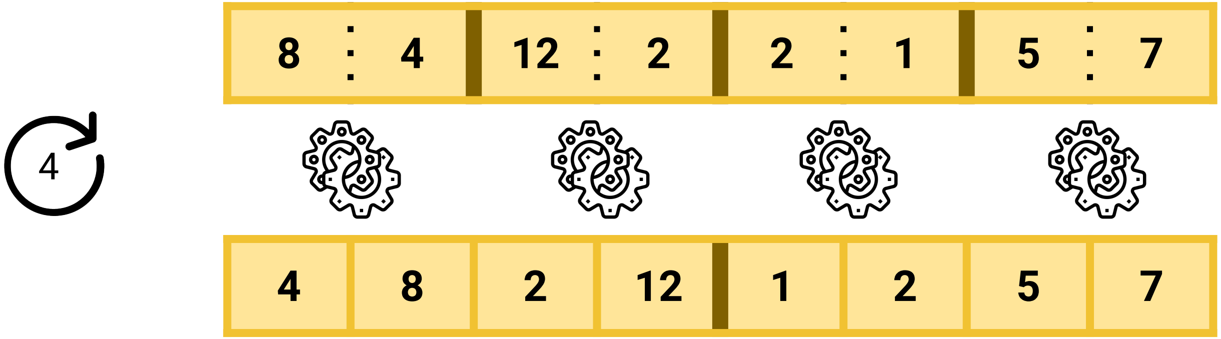


8	4	12	2	2	1	5	7

4	8	2	12	1	2	5	7

“MERGE SORT” ON GPU

slice_size = 4
number_of_slices = 2

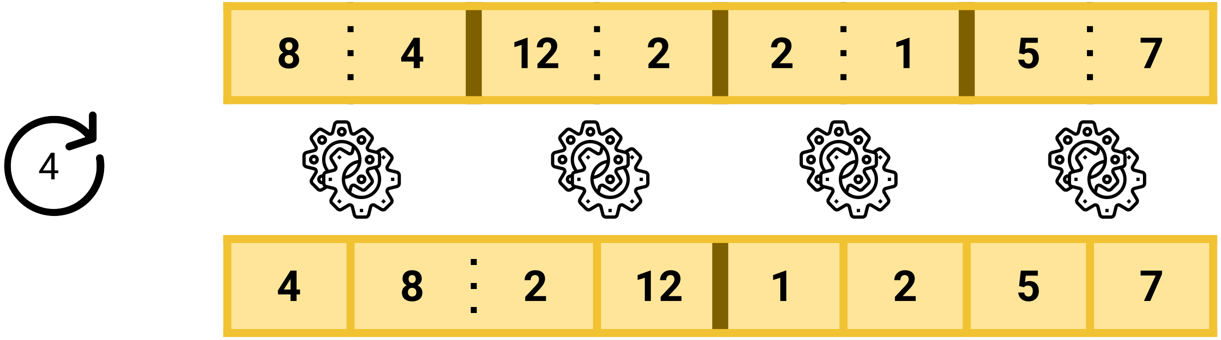


8	4	12	2	2	1	5	7

4	8	2	12	1	2	5	7

slice_size = 4
number_of_slices = 2

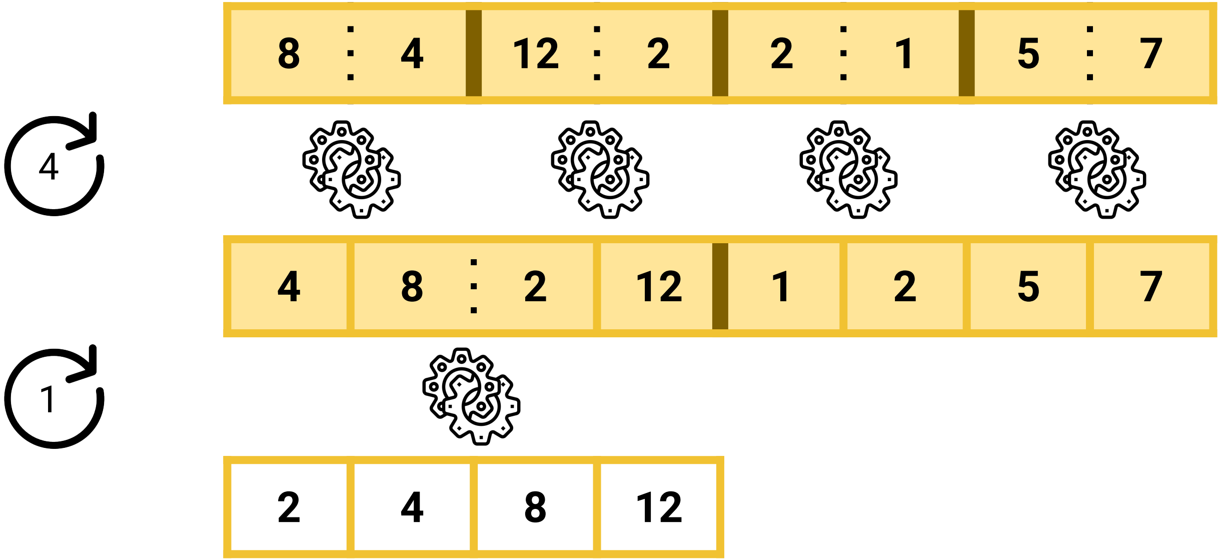
“MERGE SORT” ON GPU



8	4	12	2	2	1	5	7
4	8	2	12	1	2	5	7

slice_size = 4
number_of_slices = 2

“MERGE SORT” ON GPU



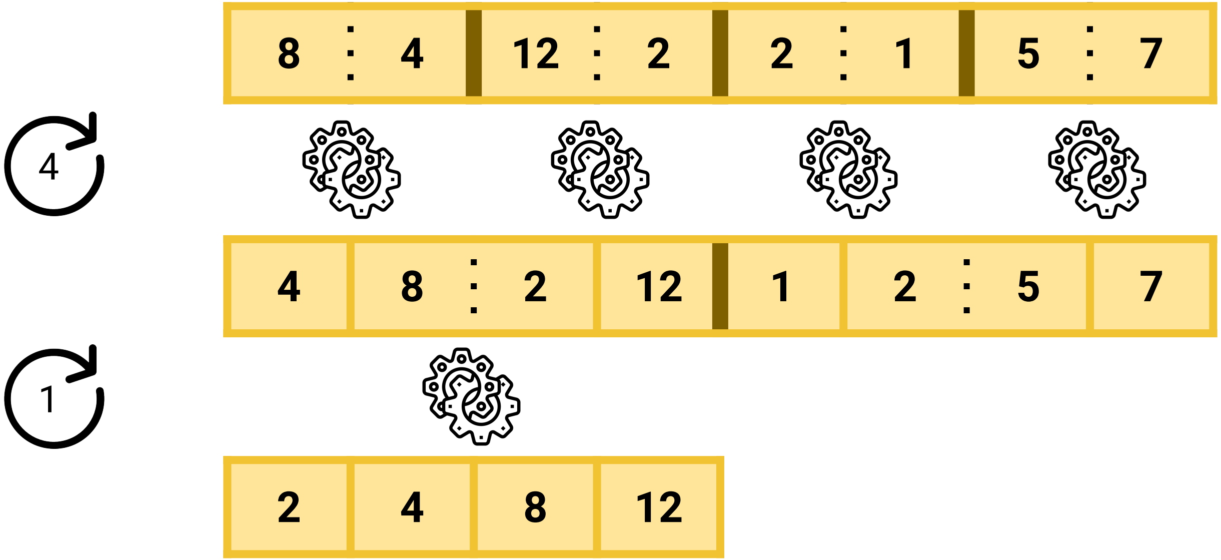
8 : 4 | 12 : 2 | 2 : 1 | 5 : 7

4 | 4 | 8 : 2 | 12 | 1 | 2 | 5 | 7

1 | 2 | 4 | 8 | 12

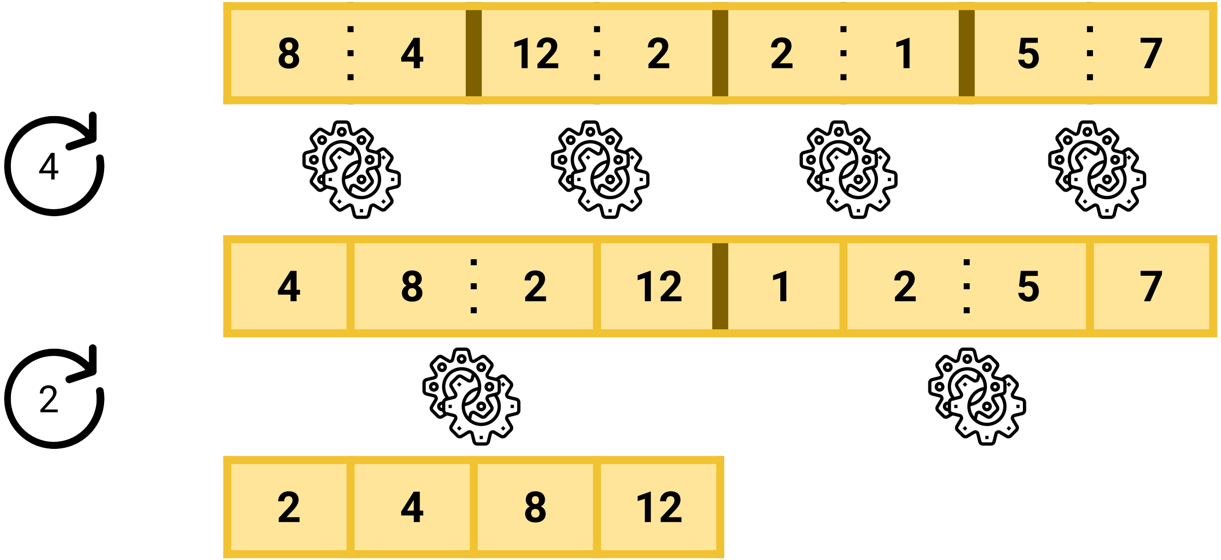
“MERGE SORT” ON GPU

slice_size = 4
number_of_slices = 2



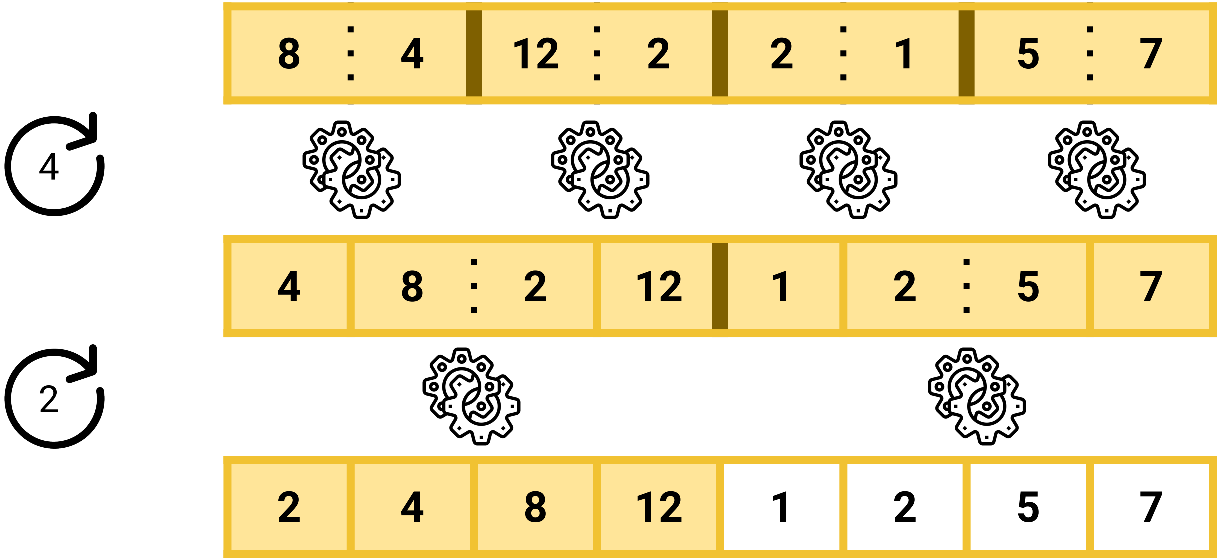
“MERGE SORT” ON GPU

slice_size = 4
number_of_slices = 2



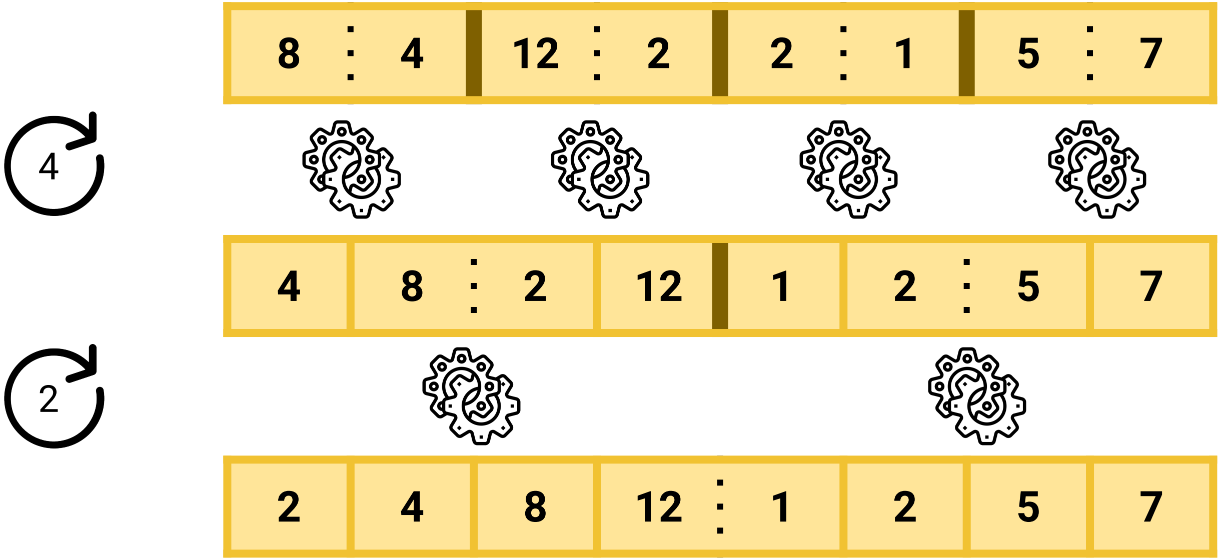
slice_size = 4
number_of_slices = 2

“MERGE SORT” ON GPU



slice_size = 8
number_of_slices = 1

“MERGE SORT” ON GPU



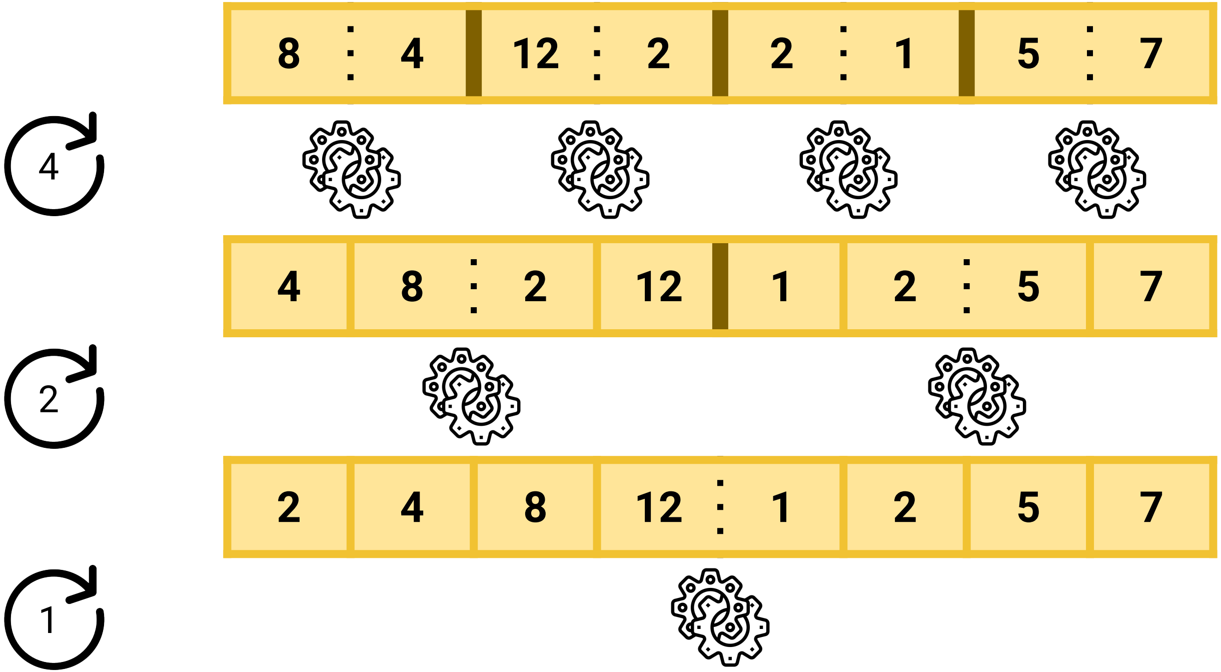
8 : 4 | 12 : 2 | 2 : 1 | 5 : 7

4 | 8 : 2 | 12 | 1 | 2 : 5 | 7

2 | 4 | 8 | 12 : 1 | 2 | 5 | 7

“MERGE SORT” ON GPU

slice_size = 8
number_of_slices = 1



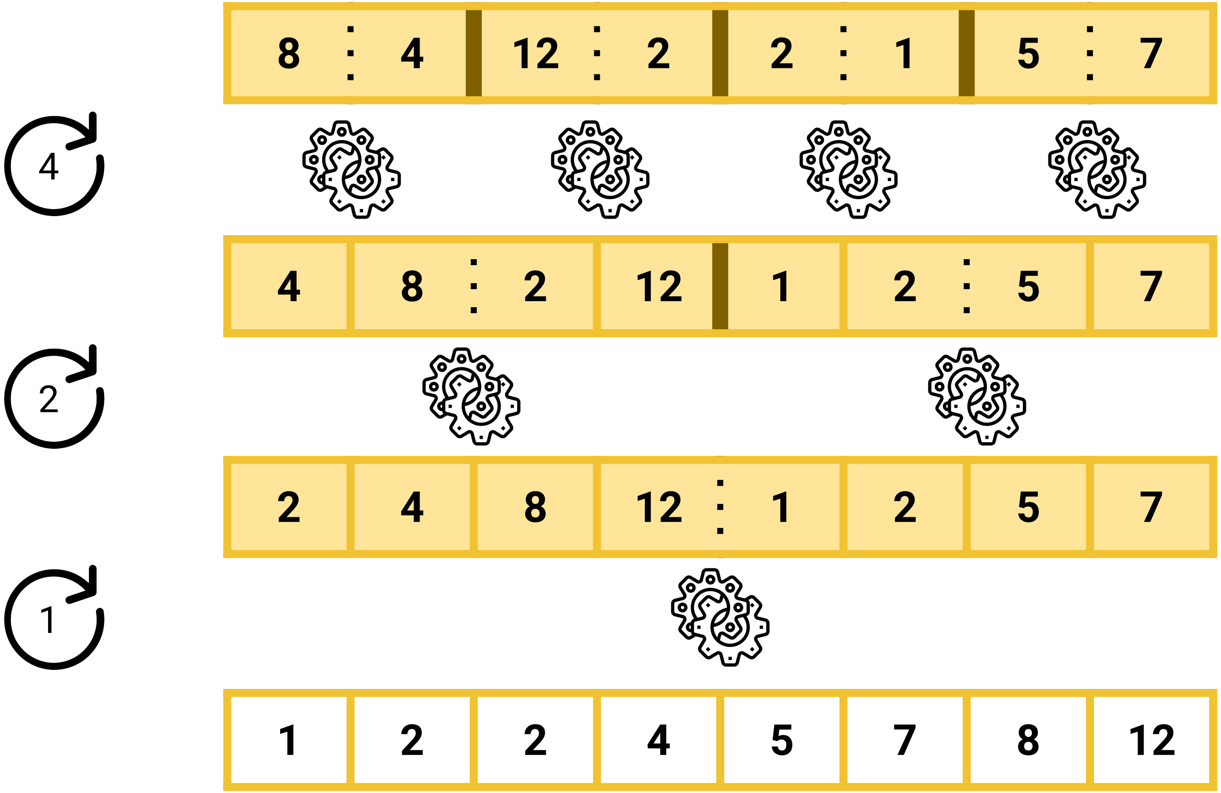
8 : 4 | 12 : 2 | 2 : 1 | 5 : 7

4 | 8 : 2 | 12 | 1 | 2 : 5 | 7

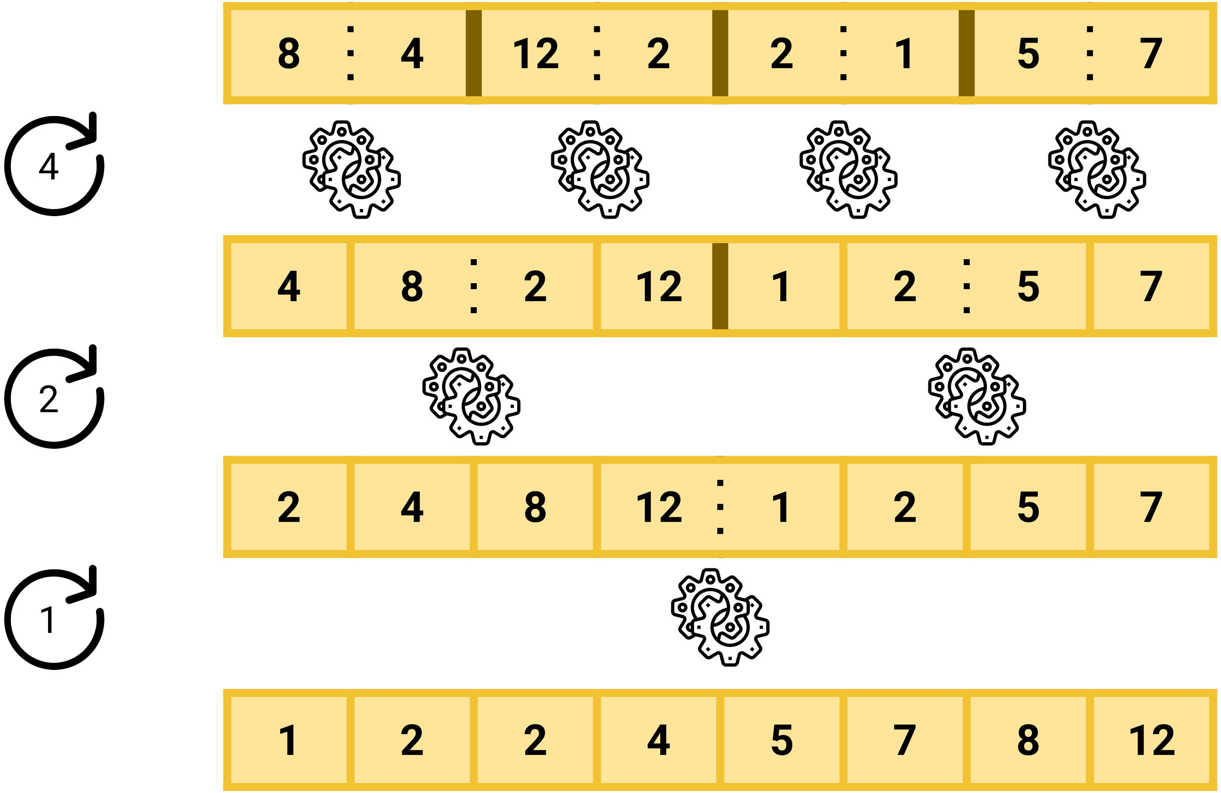
2 | 4 | 8 | 12 : 1 | 2 | 5 | 7

“MERGE SORT” ON GPU

slice_size = 8
number_of_slices = 1



"MERGE SORT" ON GPU



8 4 12 2 2 1 5 7

4 8 2 12 1 2 5 7

2 4 8 12 1 2 5 7

1 2 2 4 5 7 8 12

Ideal Case

Size of M is an exponent of 2

Every slices are full

More Often

M as any size

Some slices are not full

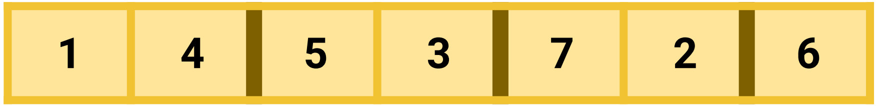
“MERGE SORT” ON GPU

1	4	5	3	7	2	6

“MERGE SORT” ON GPU

slice_size = 2

number_of_slices = 4



1	4	5	3	7	2	6

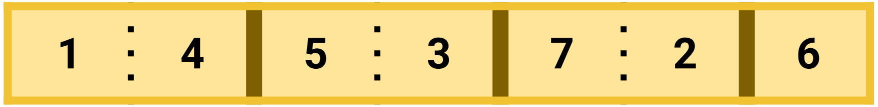
“MERGE SORT” ON GPU

slice_size = 2
number_of_slices = 4

1	4	5	3	7	2	6

“MERGE SORT” ON GPU

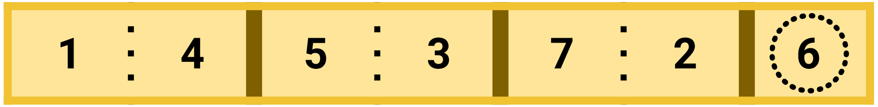
slice_size = 2
number_of_slices = **3**



1	4	5	3	7	2	6

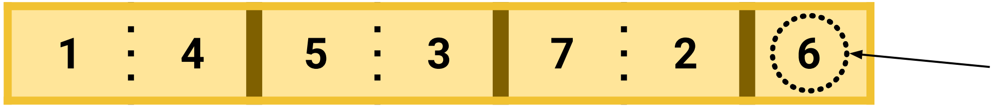
“MERGE SORT” ON GPU

slice_size = 2
number_of_slices = **3**



slice_size = 2
number_of_slices = **3**

“MERGE SORT” ON GPU



Remainder of 1 element

DEFINITION : REMAINDER

We call “remainder” an incomplete slice in our cutting

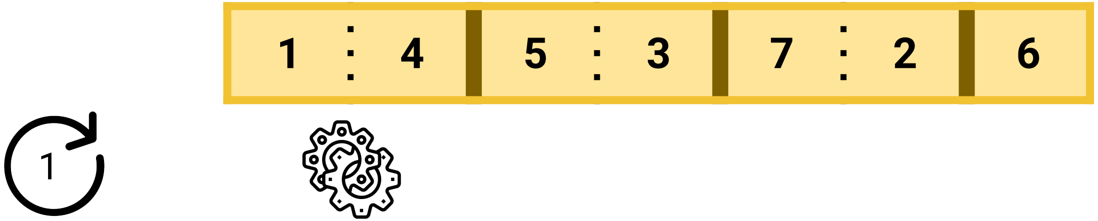
DEFINITION : REMAINDER

We call “remainder” an incomplete slice in our cutting

N.B : If there is a remainder, it’s always and only on the last slice

slice_size = 2
number_of_slices = **3**

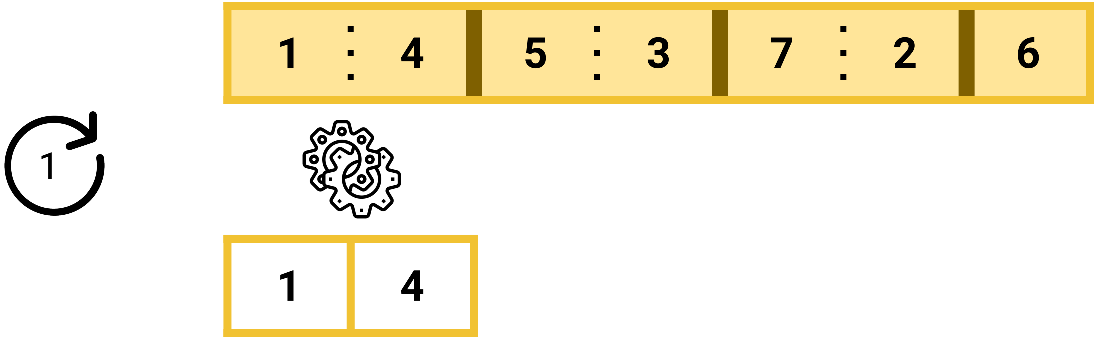
“MERGE SORT” ON GPU



1	4	5	3	7	2	6

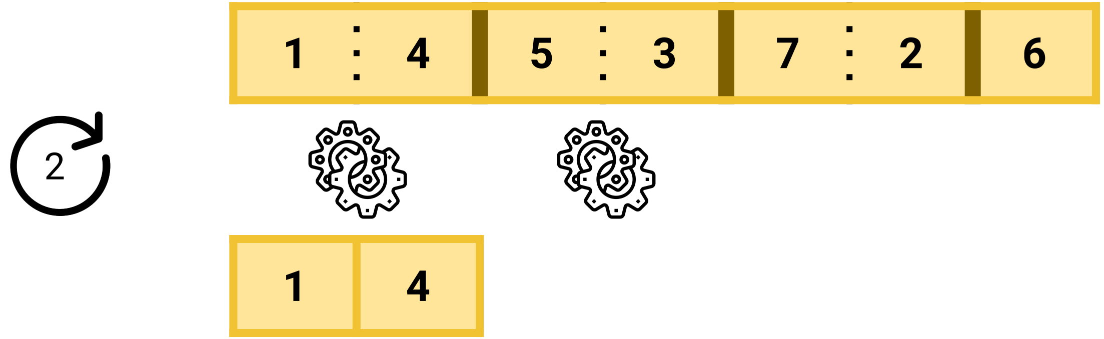
“MERGE SORT” ON GPU

slice_size = 2
number_of_slices = **3**



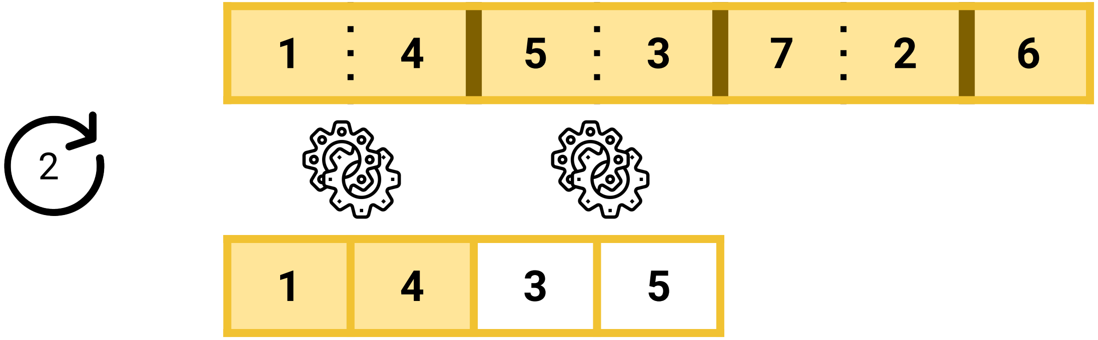
slice_size = 2
number_of_slices = **3**

"MERGE SORT" ON GPU



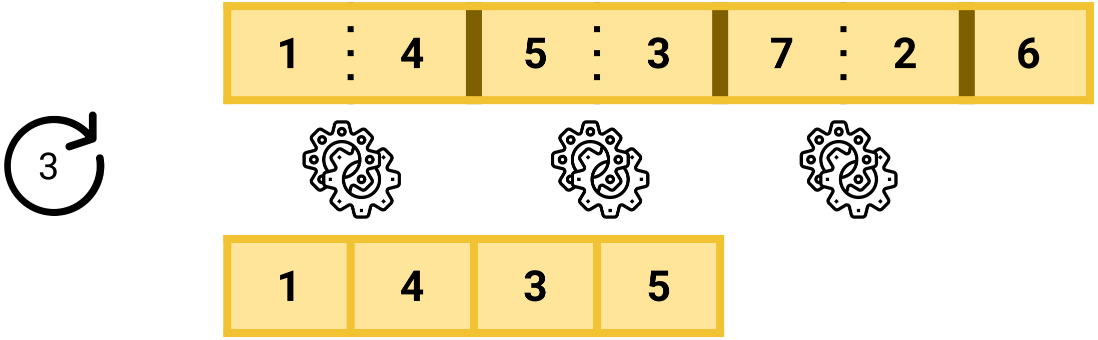
slice_size = 2
number_of_slices = **3**

“MERGE SORT” ON GPU



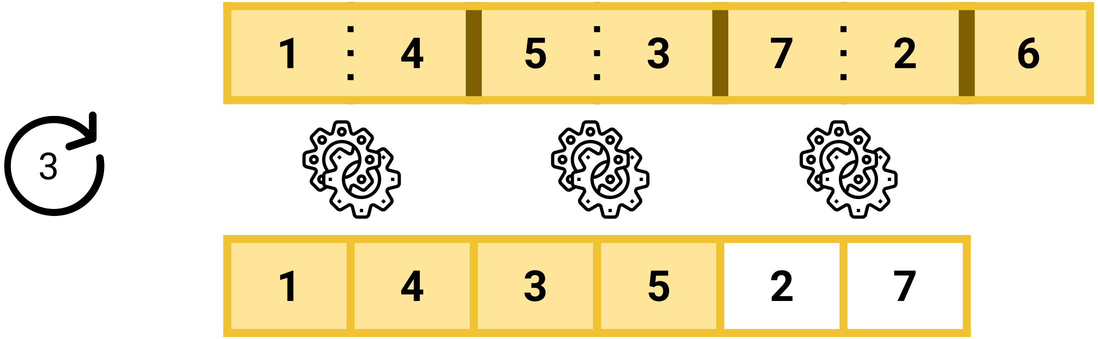
slice_size = 2
number_of_slices = **3**

“MERGE SORT” ON GPU



slice_size = 2
number_of_slices = **3**

“MERGE SORT” ON GPU

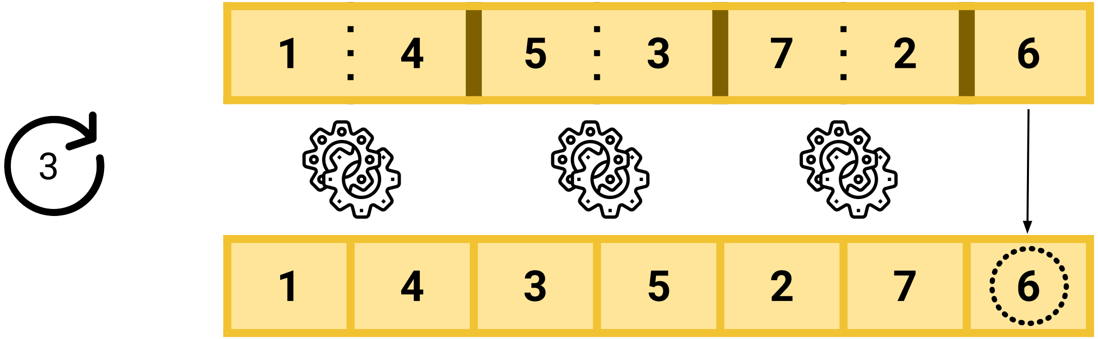


1	4	5	3	7	2	6

1	4	3	5	2	7

slice_size = 2
number_of_slices = **3**

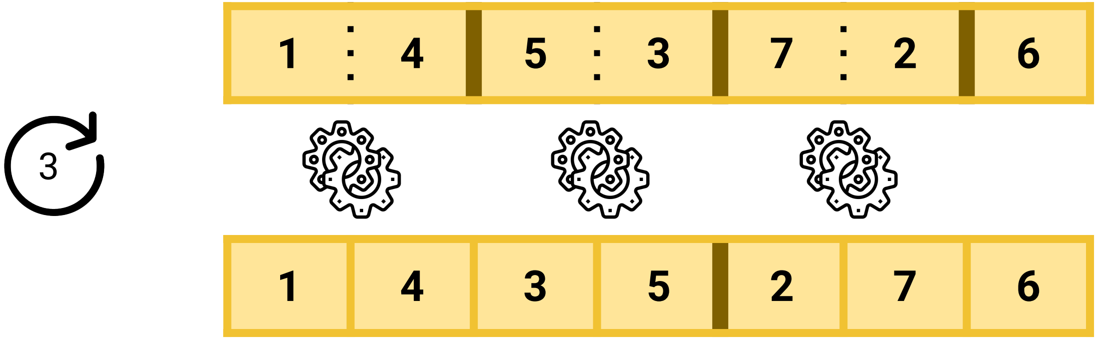
“MERGE SORT” ON GPU



1	4	5	3	7	2	6
1	4	3	5	2	7	6

slice_size = 4
number_of_slices = 2

“MERGE SORT” ON GPU

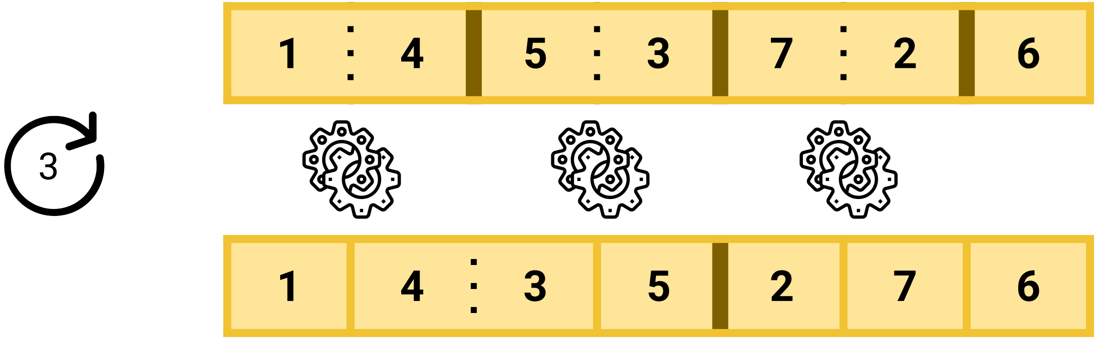


1	4	5	3	7	2	6

1	4	3	5	2	7	6

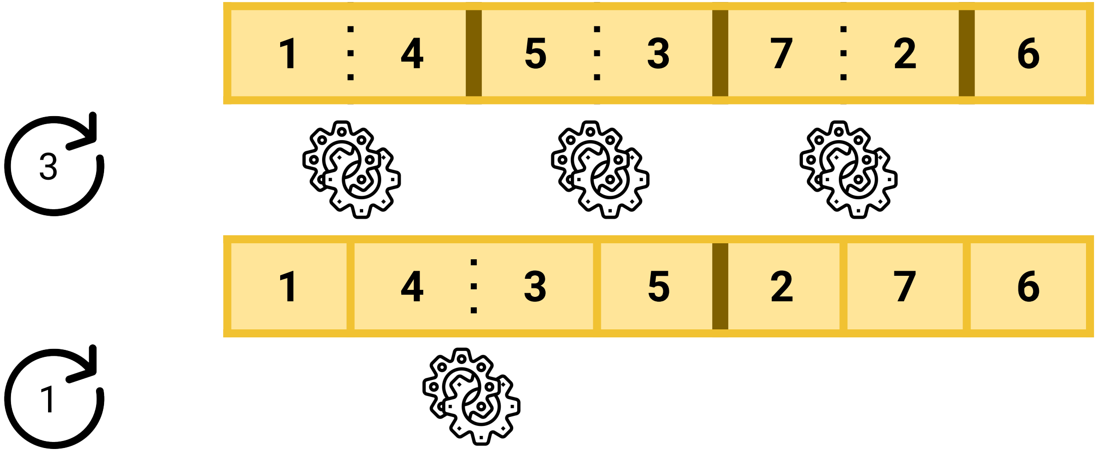
slice_size = 4
number_of_slices = **1**

"MERGE SORT" ON GPU



slice_size = 4
number_of_slices = **1**

“MERGE SORT” ON GPU



3

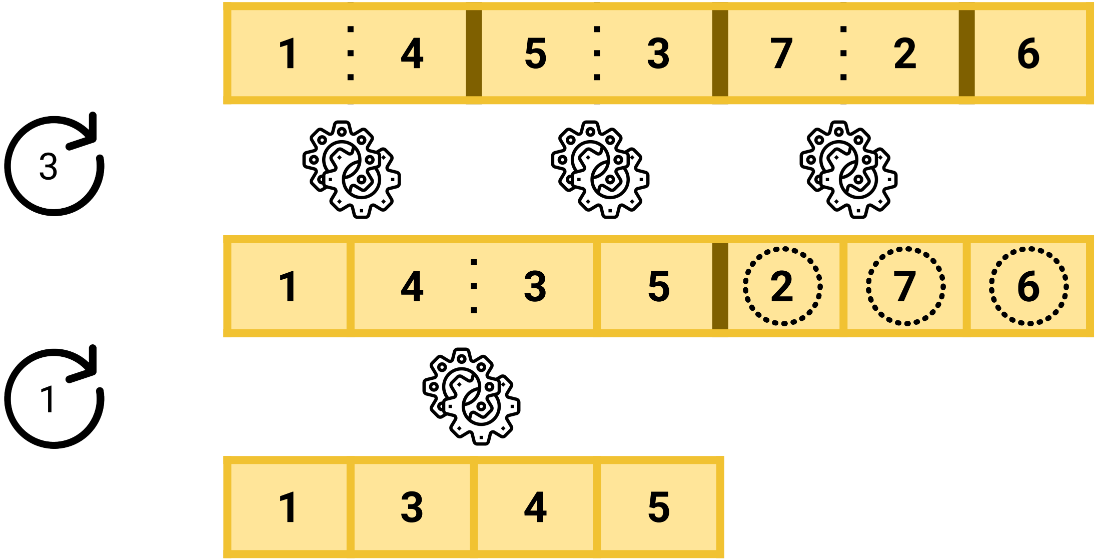
1 : 4 | 5 : 3 | 7 : 2 | 6

1

1 | 4 : 3 | 5 | 2 | 7 | 6

slice_size = 4
number_of_slices = **1**

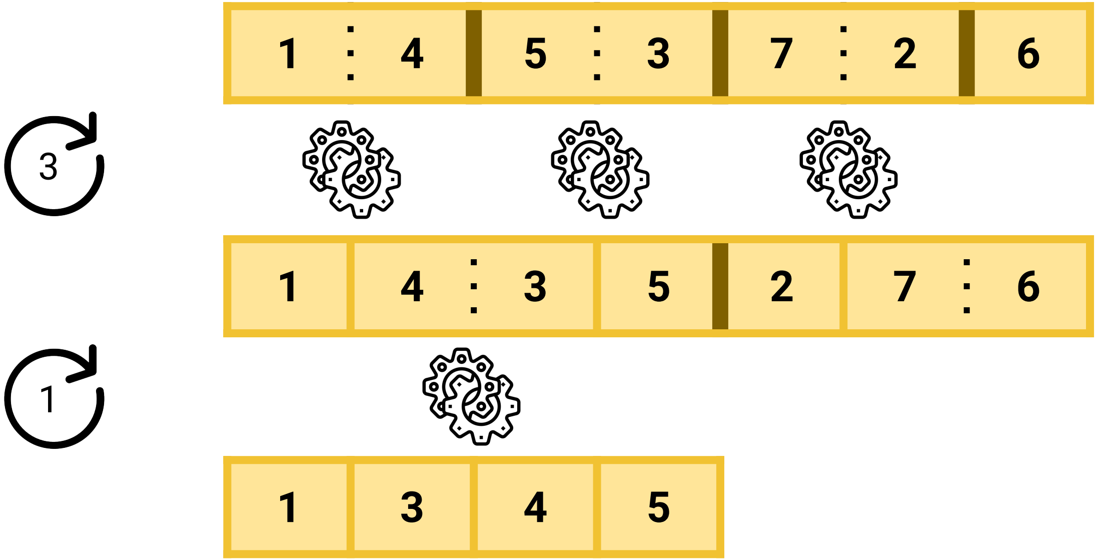
"MERGE SORT" ON GPU



Remainder of 3 elements

“MERGE SORT” ON GPU

slice_size = 4
number_of_slices = **1**



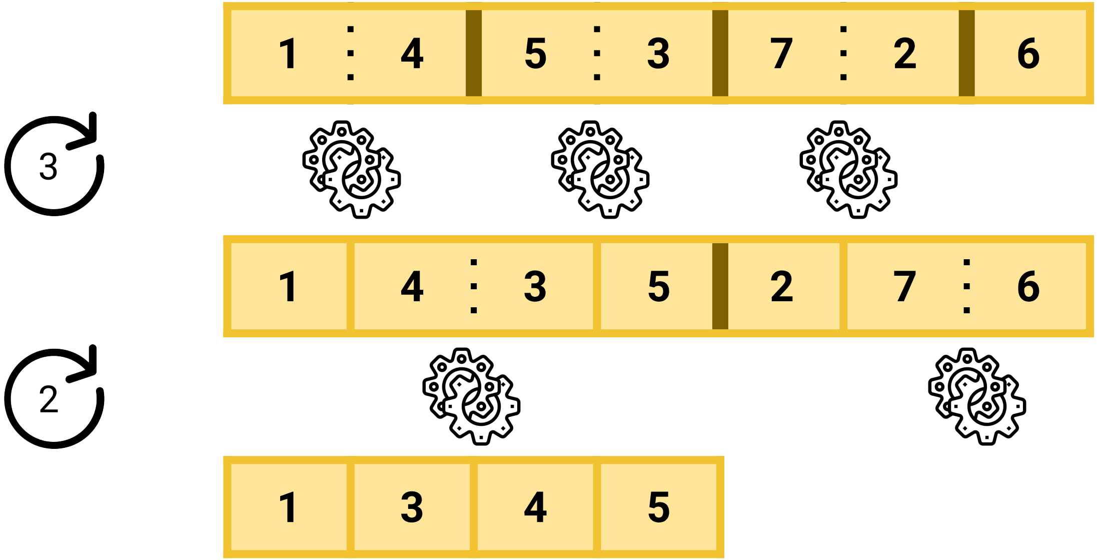
1 4 5 3 7 2 6

1 4 3 5 2 7 6

1 3 4 5

slice_size = 4
number_of_slices = **1**

“MERGE SORT” ON GPU



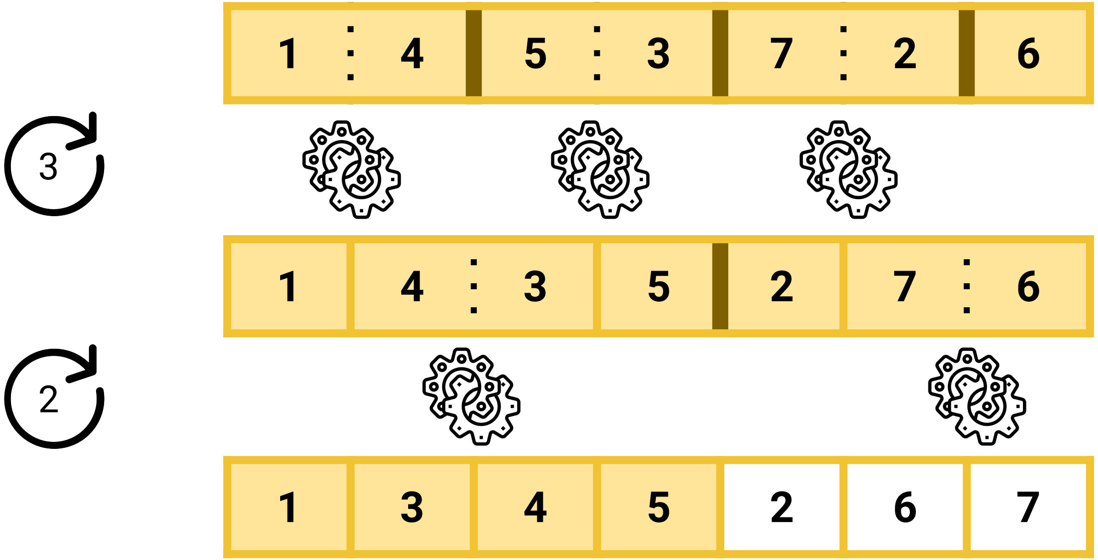
1	4	5	3	7	2	6

1	4	3	5	2	7	6

1	3	4	5

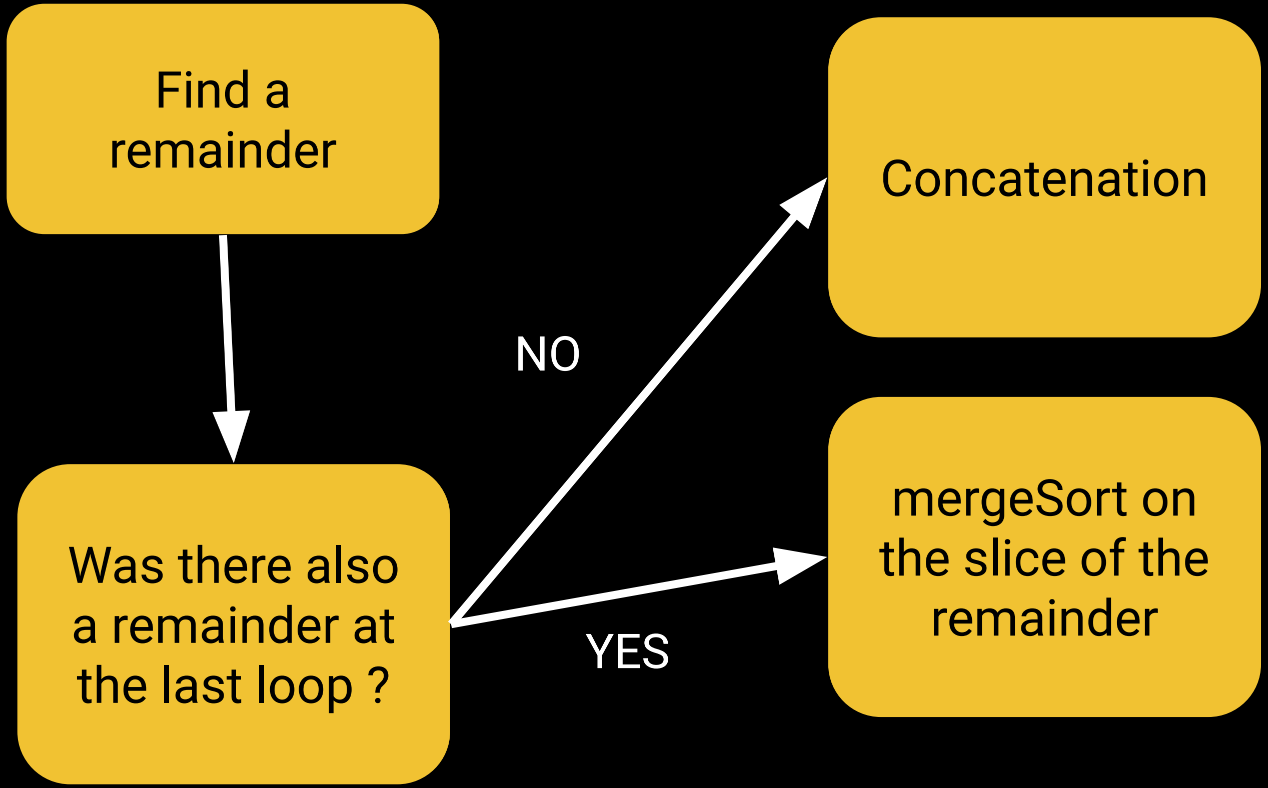
“MERGE SORT” ON GPU

slice_size = 4
number_of_slices = **1**



1	4	5	3	7	2	6
1	4	3	5	2	7	6
1	3	4	5	2	6	7

MANAGING THE REMAINDERS



Find a remainder

Was there also a remainder at the last loop ?

NO

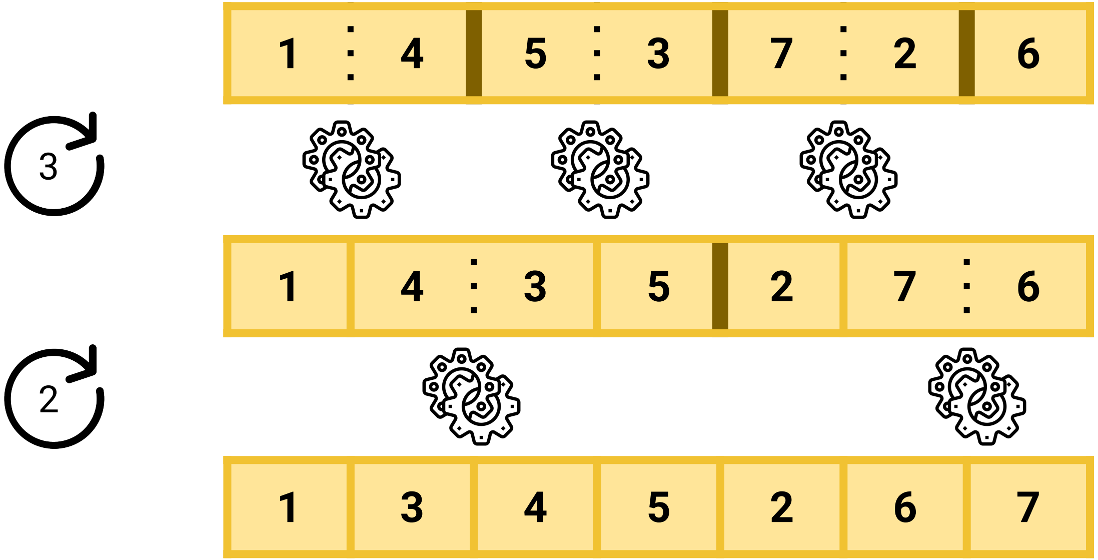
Concatenation

YES

mergeSort on the slice of the remainder

“MERGE SORT” ON GPU

slice_size = 8
number_of_slices =



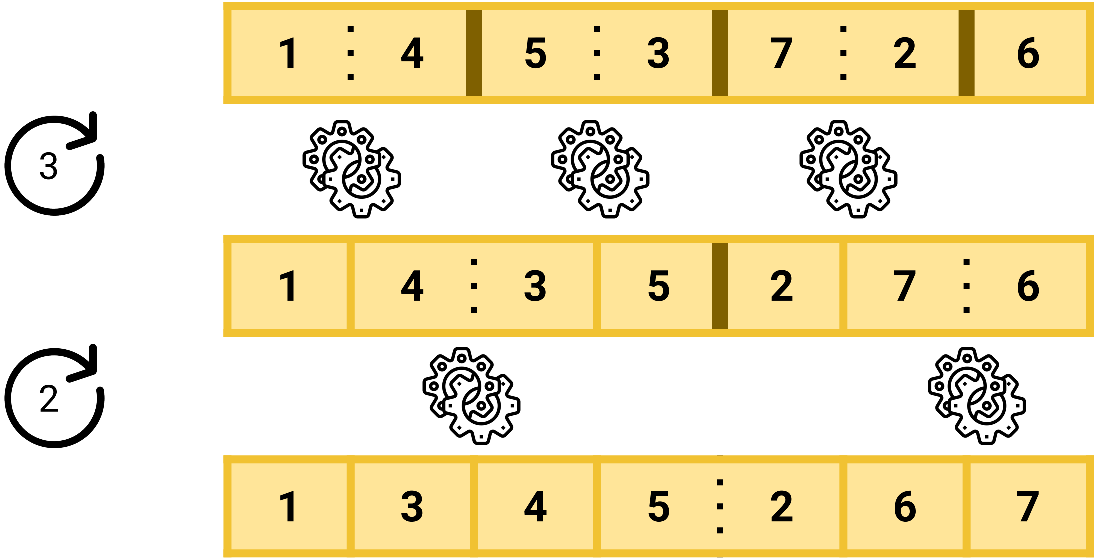
1 4 | 5 3 | 7 2 | 6

1 4 3 5 | 2 7 6

1 3 4 5 2 6 7

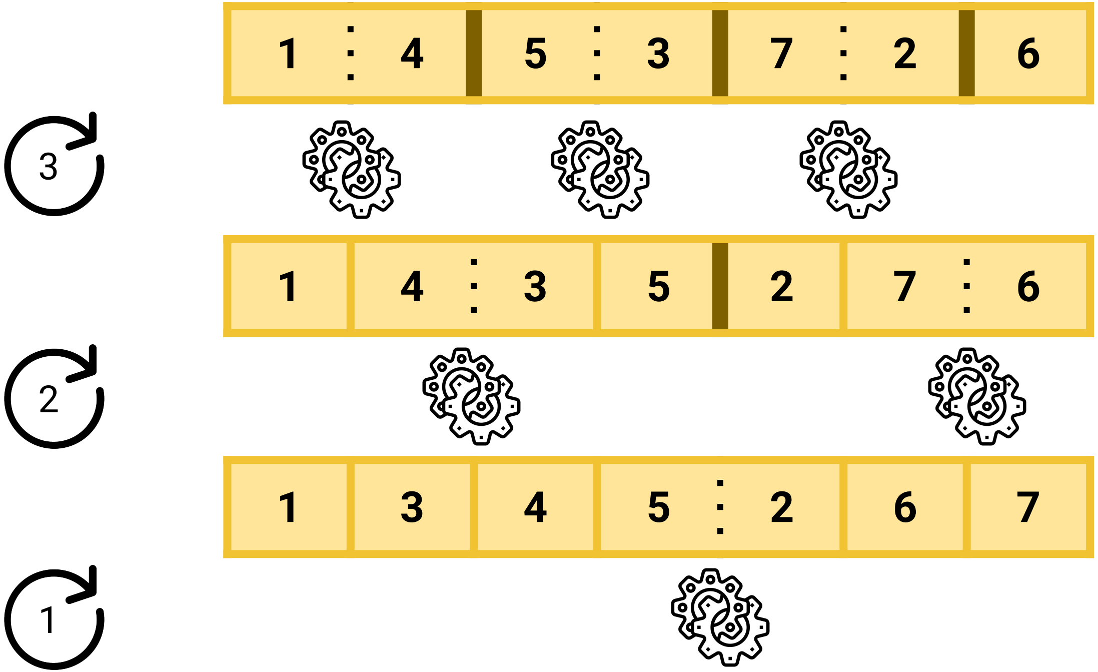
“MERGE SORT” ON GPU

slice_size = 8
number_of_slices = **1**



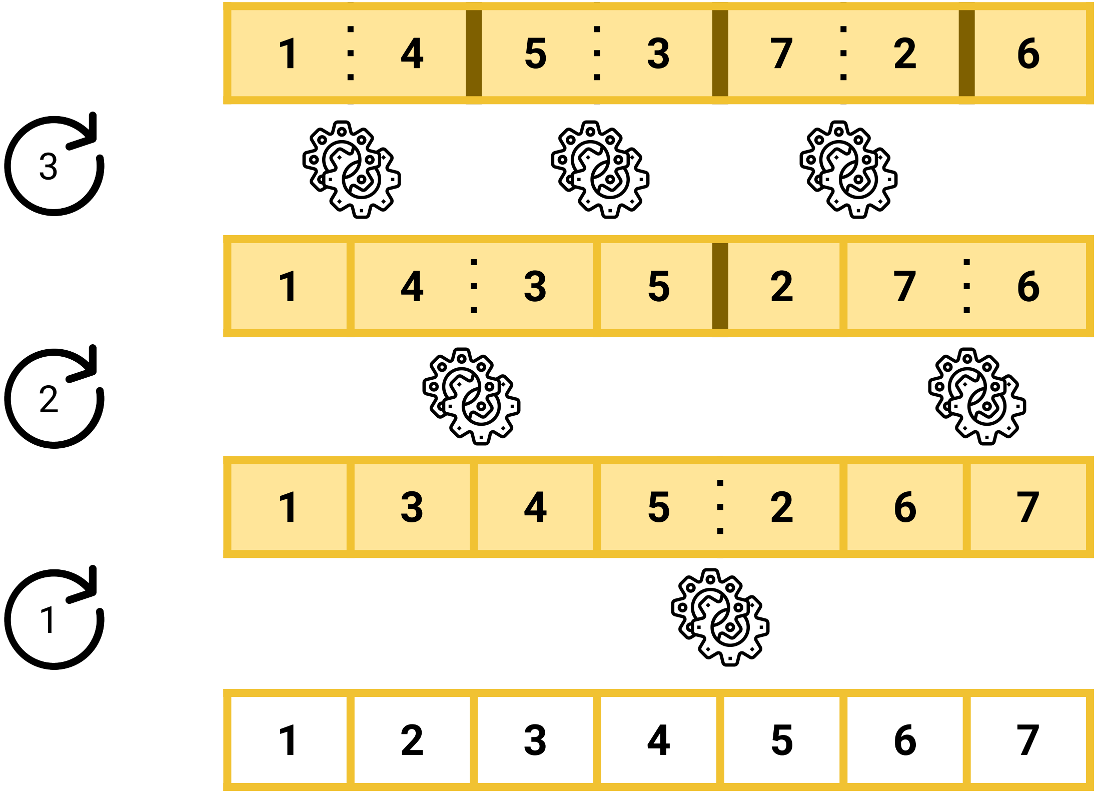
slice_size = 8
number_of_slices = **1**

“MERGE SORT” ON GPU



“MERGE SORT” ON GPU

slice_size = 8
number_of_slices = **1**



1 4 5 3 7 2 6

3

1 4 3 5 2 7 6

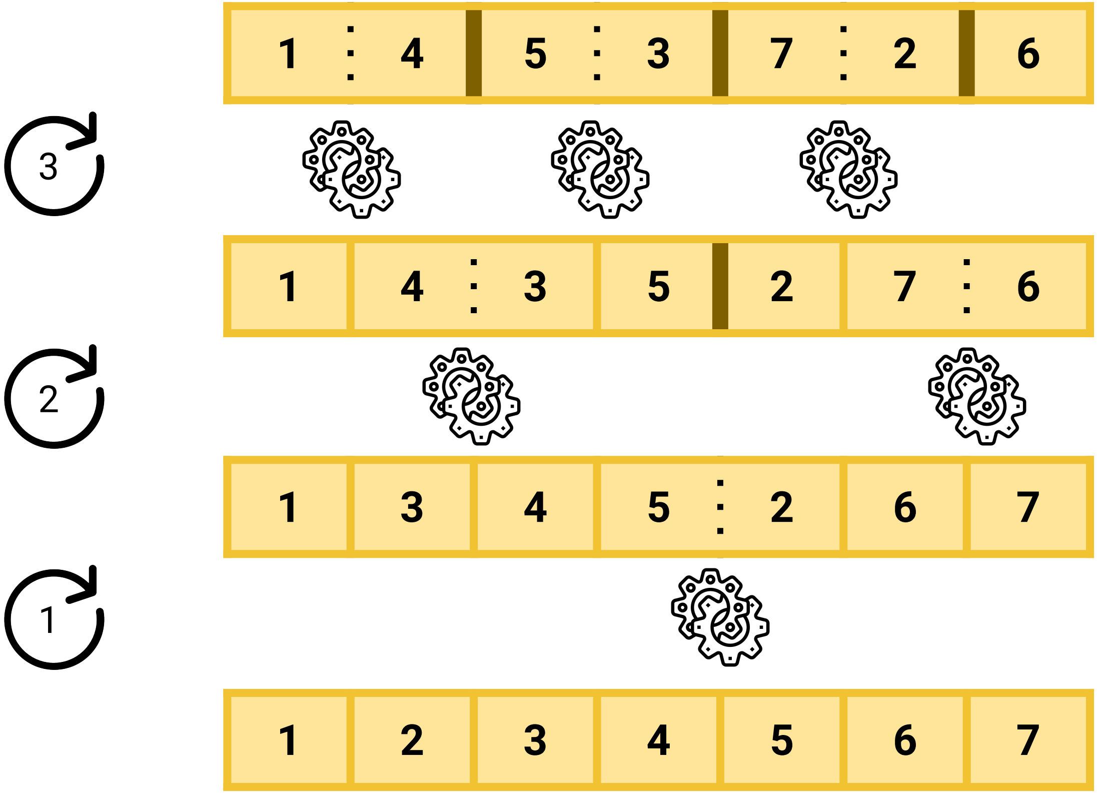
2

1 3 4 5 2 6 7

1

1 2 3 4 5 6 7

“MERGE SORT” ON GPU



“MERGE SORT” ON GPU

```
slice_size = 1
number_of_slices = 1
reste_prec_size = 0
reste_size = 0
```

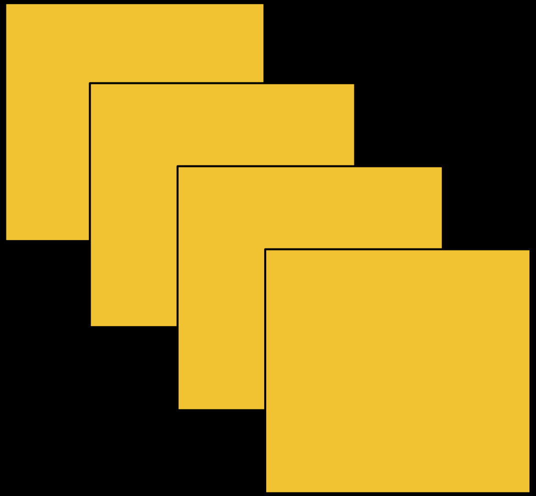
```
while (number_of_slices > 0)
    slice_size = 2*slice_size
    number_of_slices = size_M/slice_size
    reste_prec_size = reste_size
    reste_size = size_M%slice_size

    for (i=0, i<number_of_slices, i++)
        sort(M, slice_size, i)

    if (reste_prec_size!=0 && reste_size!=0)

        sort(M, reste_size + reste_prec_size, number_of_slices)
```

04

SORT WITH BATCHES

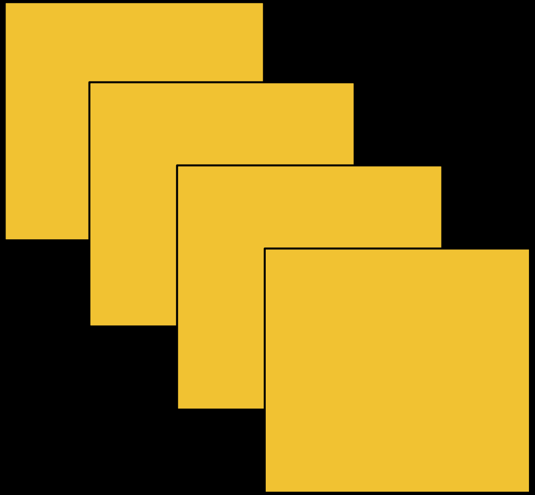
DEFINITION : BATCH

Sub array with at the most 1024 elements



DEFINITION : BATCH

Sub array with at the most 1024 elements
(ie the maximum number of threads on one block)



NOTATIONS

NOTATIONS

mergeSmallBatch_k(A,B)

NOTATIONS

//

NOTATIONS

//

In parallel

SORT ON ONE BATCH

8	4	12	… …	1	5	7

SORT ON ONE BATCH

t1	t2	t3	... ...	t1022	t1023	t1024

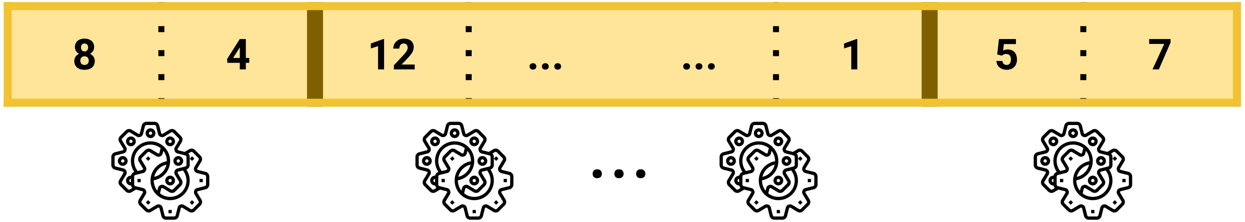
SORT ON ONE BATCH

8	4	12	… …	1	5	7

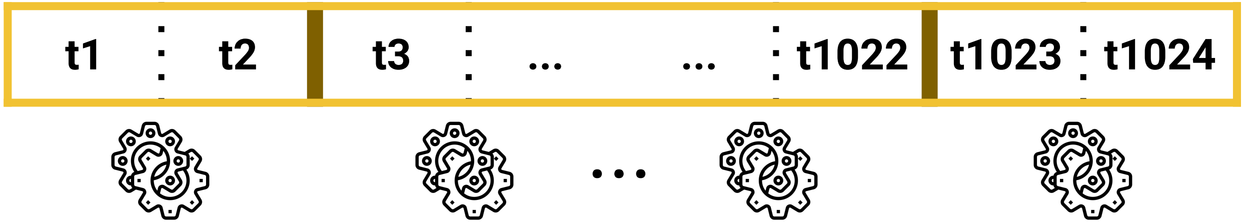
SORT ON ONE BATCH

8	4	12	... ...	1	5	7

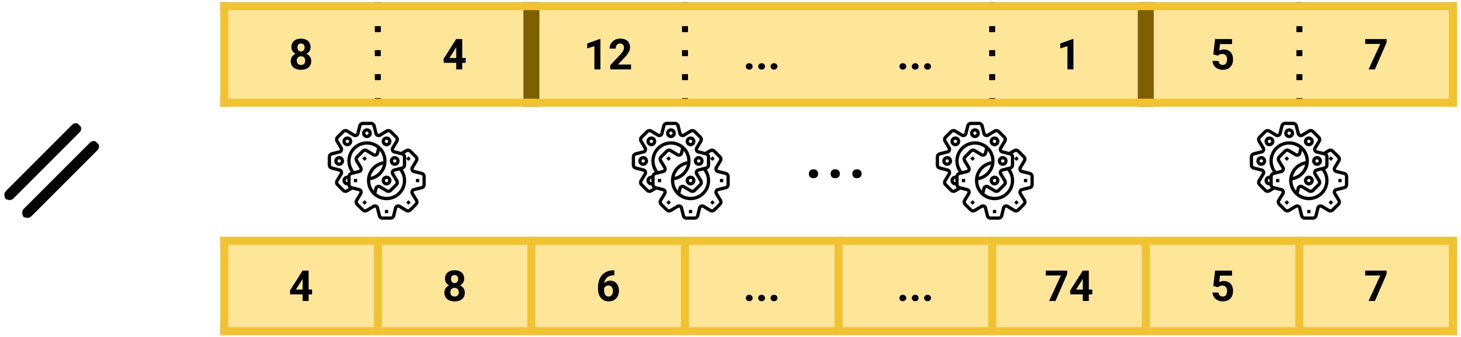
SORT ON ONE BATCH



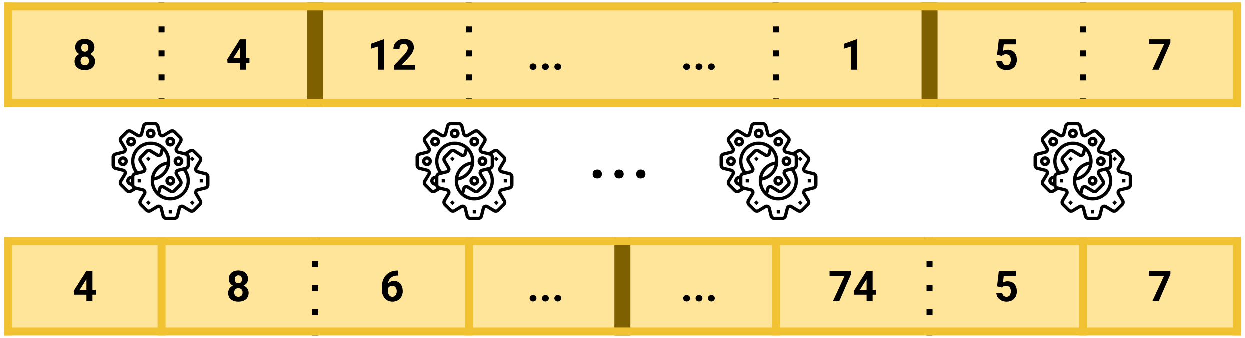
SORT ON ONE BATCH



SORT ON ONE BATCH



SORT ON ONE **BATCH**

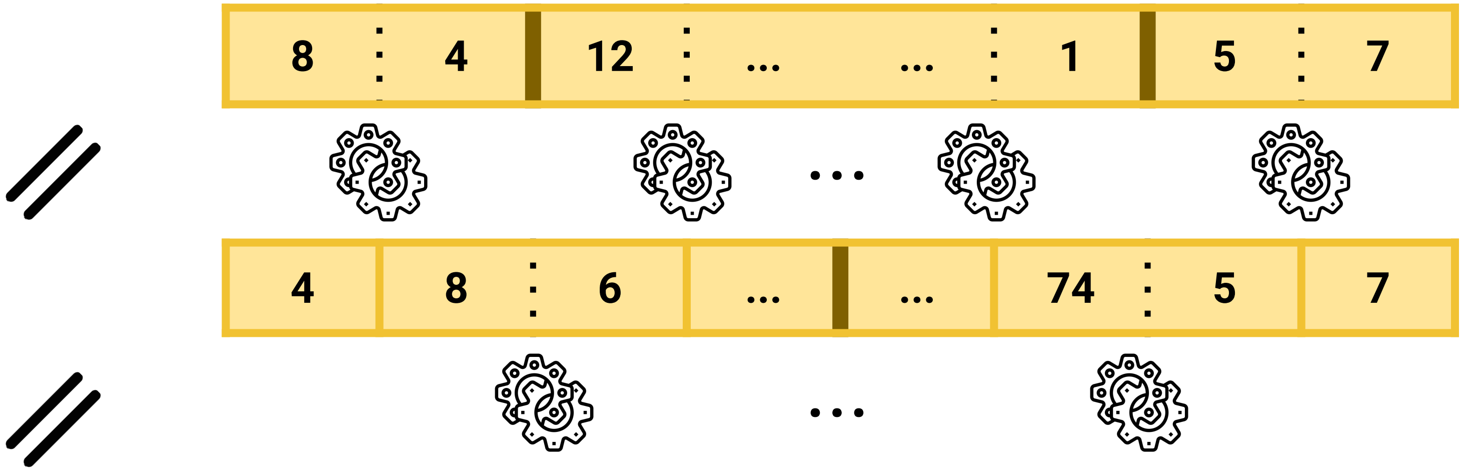


8 4 12 … … 1 5 7

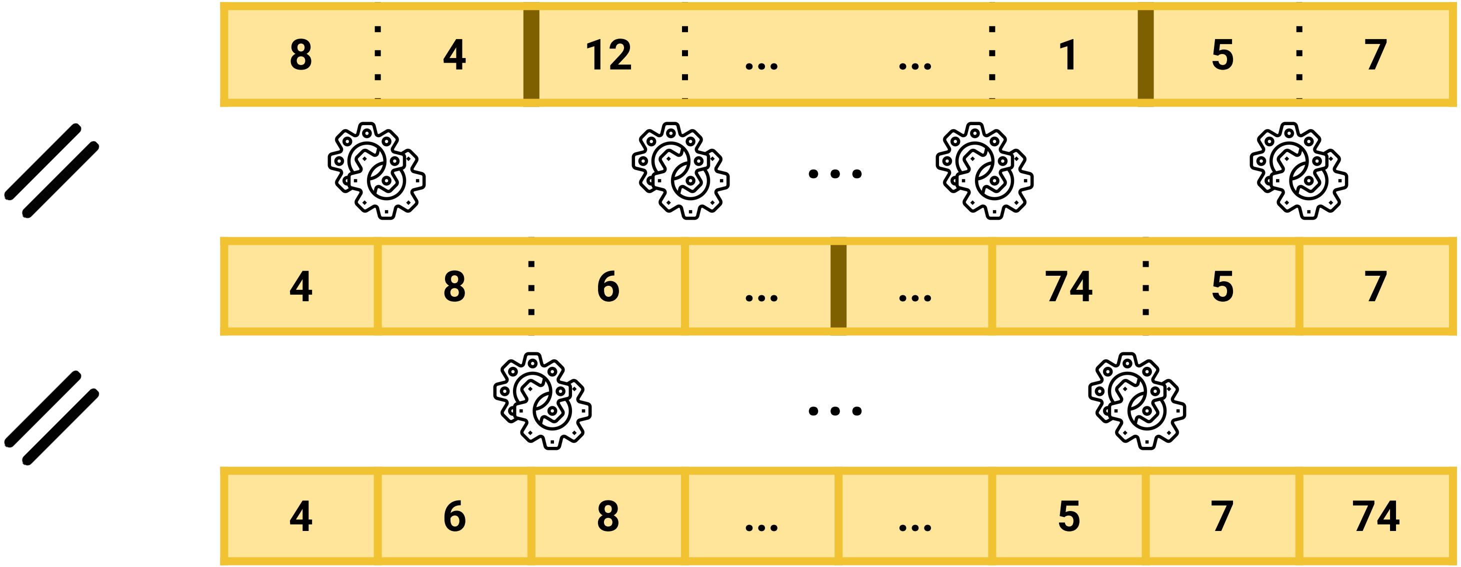
…

4 8 6 … … 74 5 7

SORT ON ONE BATCH



SORT ON ONE BATCH



8 4 12 … … 1 5 7

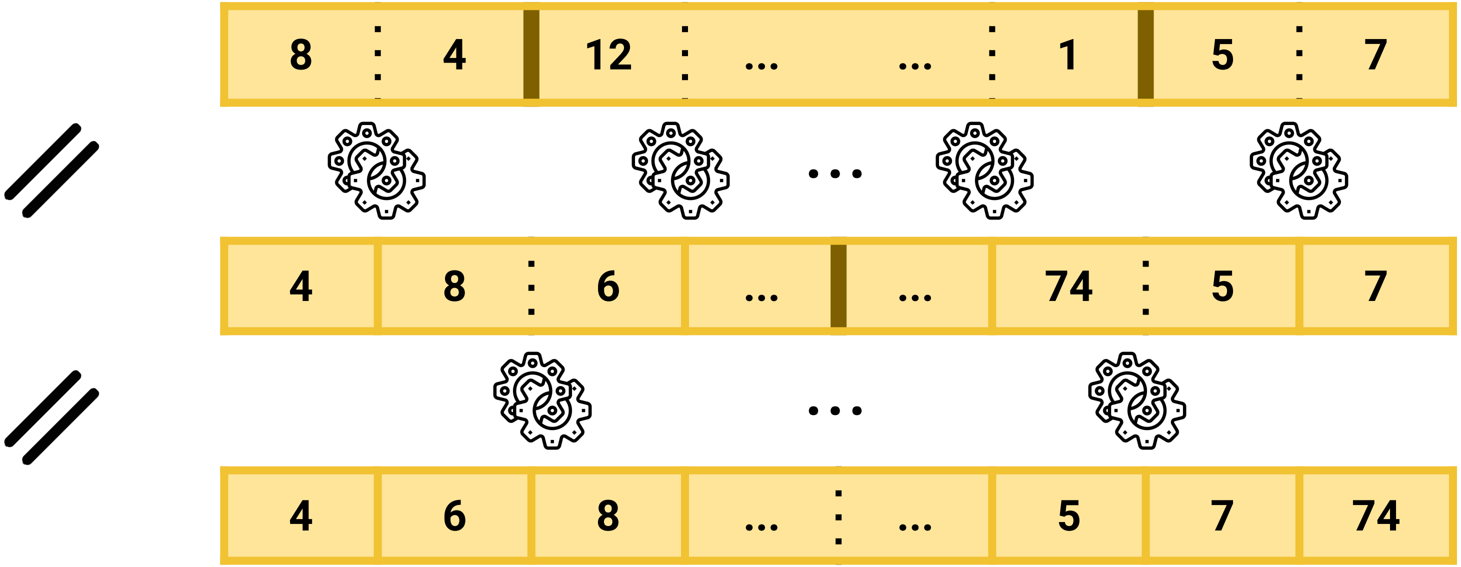
…

4 8 6 … … 74 5 7

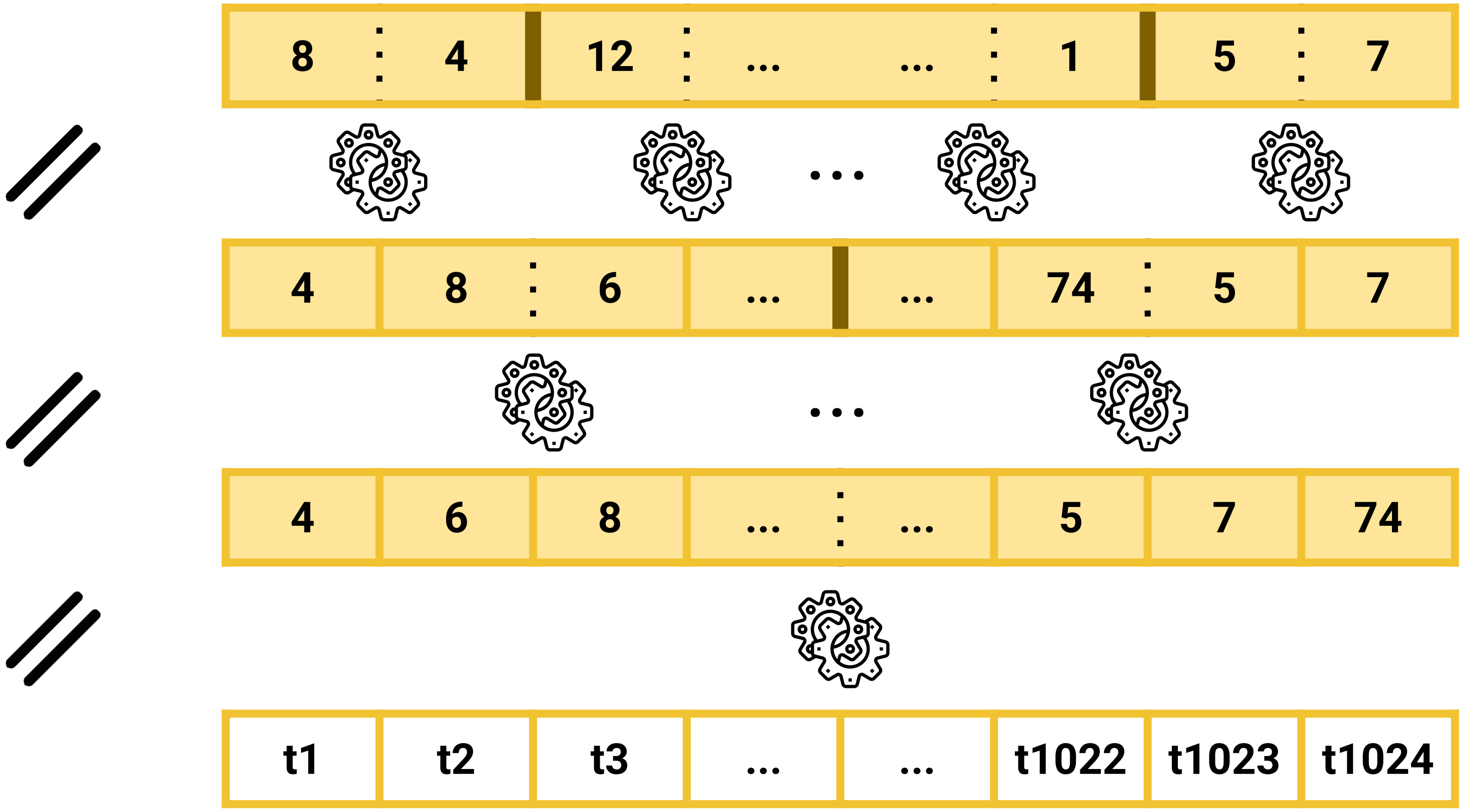
…

4 6 8 … … 5 7 74

SORT ON ONE BATCH



SORT ON ONE BATCH



8 4 12 … … 1 5 7

…

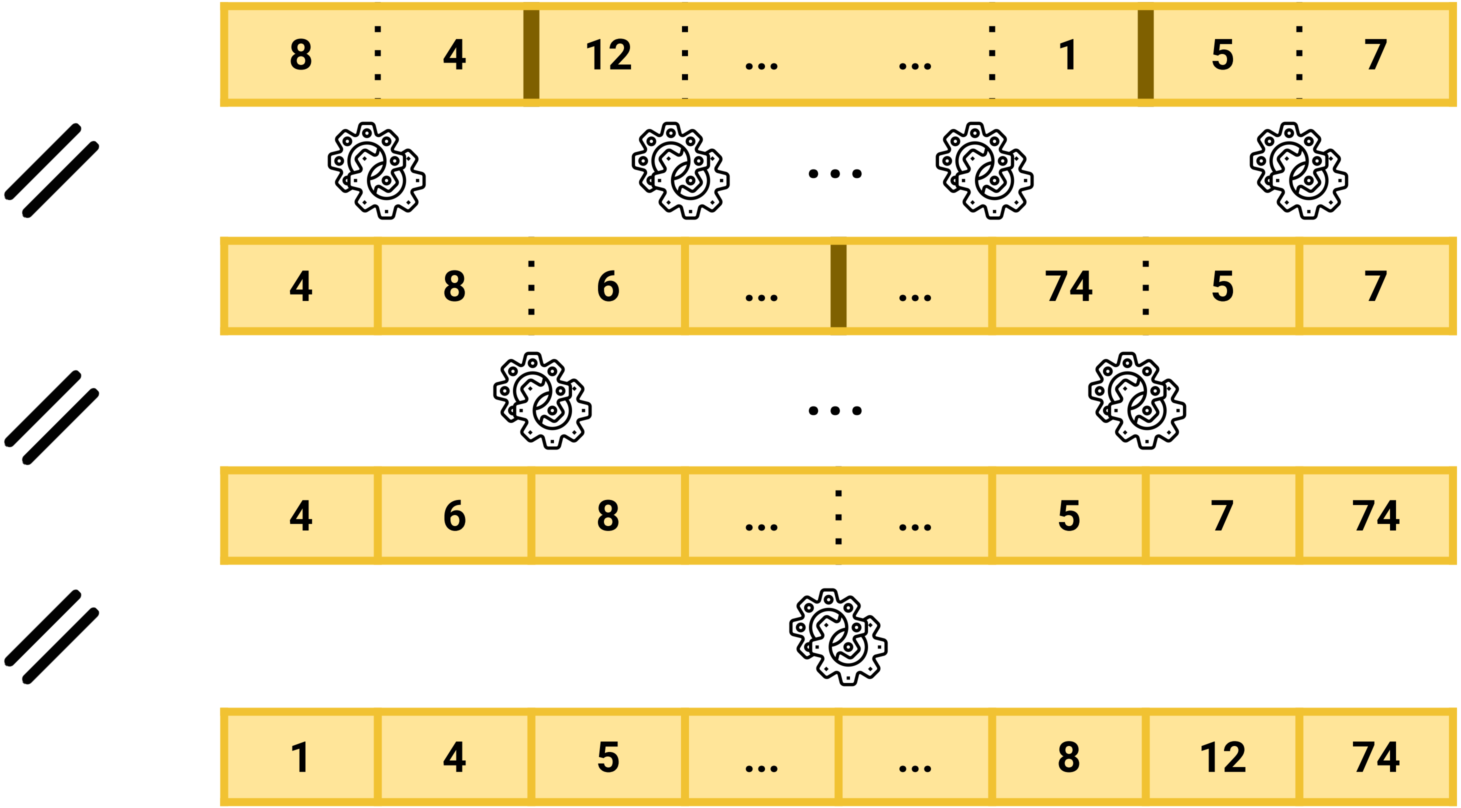
4 8 6 … … 74 5 7

…

4 6 8 … … 5 7 74

t1 t2 t3 … … t1022 t1023 t1024

SORT ON ONE BATCH



8 4 12 … … 1 5 7

…

4 8 6 … … 74 5 7

…

4 6 8 … … 5 7 74

1 4 5 … … 8 12 74

SMALL SORT

M

… … …	4	… … …	26	… … …	17	… … …	2

SMALL SORT

M

… … …	4	… … …	26	… … …	17	… … …	2

Batches of 1024 elements

SMALL SORT

M

… … …	4	… … …	26	… … …	17	… … …	2

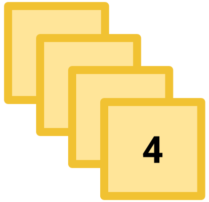
Batches of 1024 elements

SMALL SORT

M

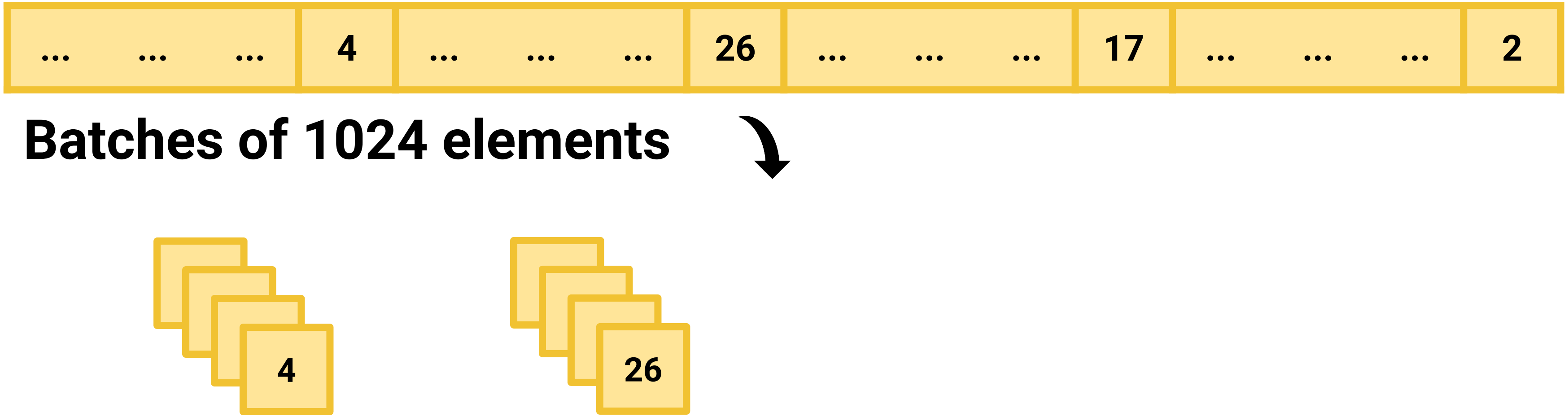
… … …	4	… … …	26	… … …	17	… … …	2

Batches of 1024 elements



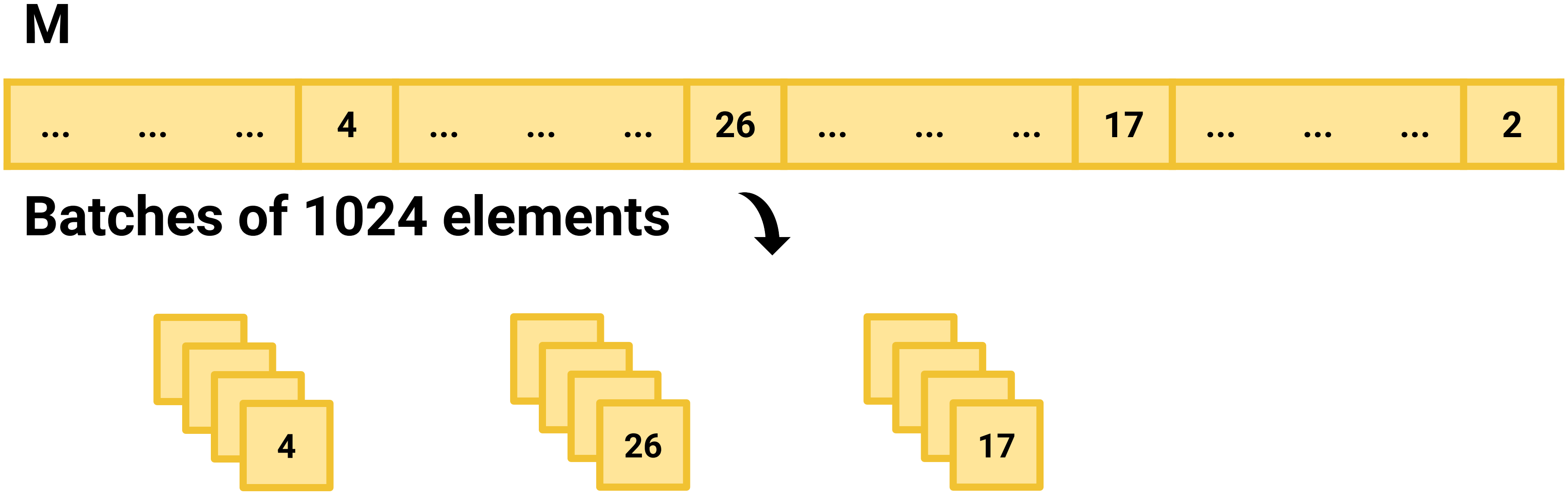
SMALL SORT

M



Batches of 1024 elements

SMALL SORT

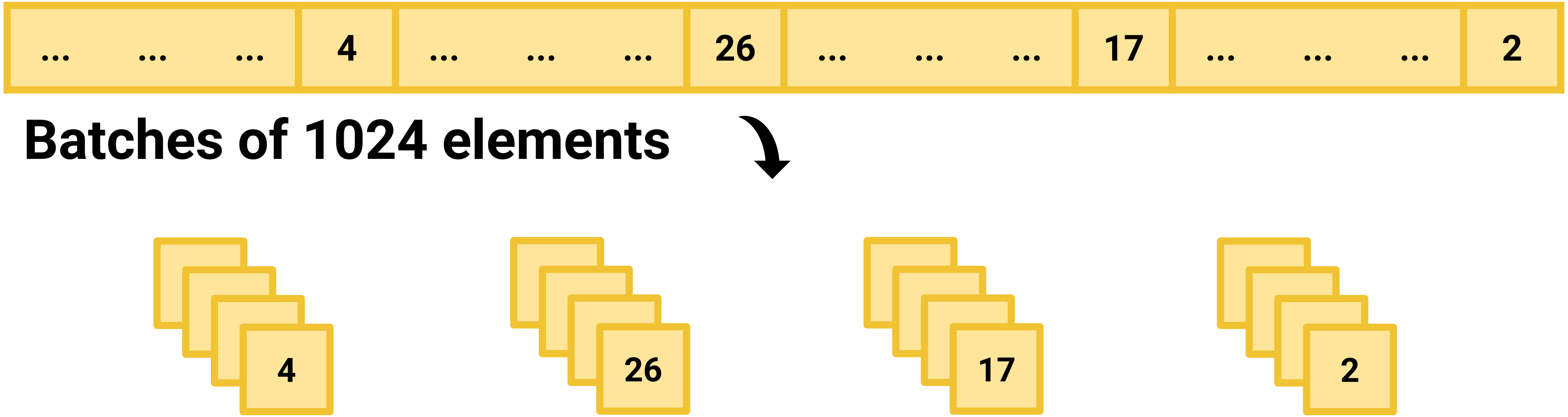


M

Batches of 1024 elements

SMALL SORT

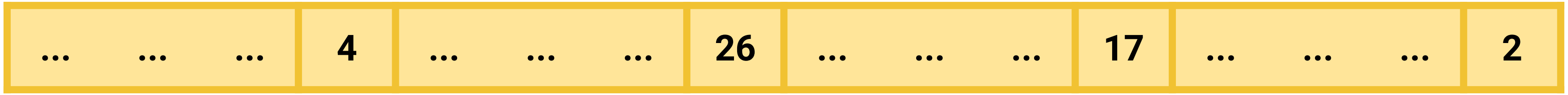
M



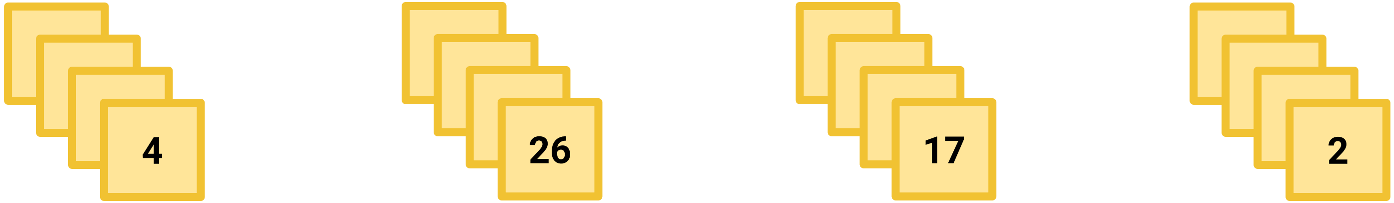
Batches of 1024 elements

SMALL SORT

M

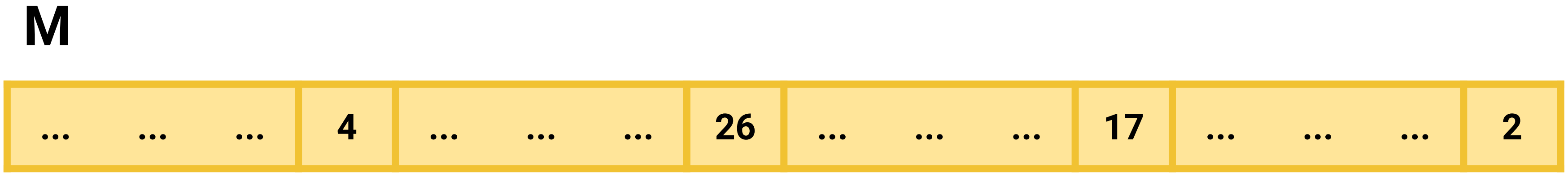


Batches of 1024 elements

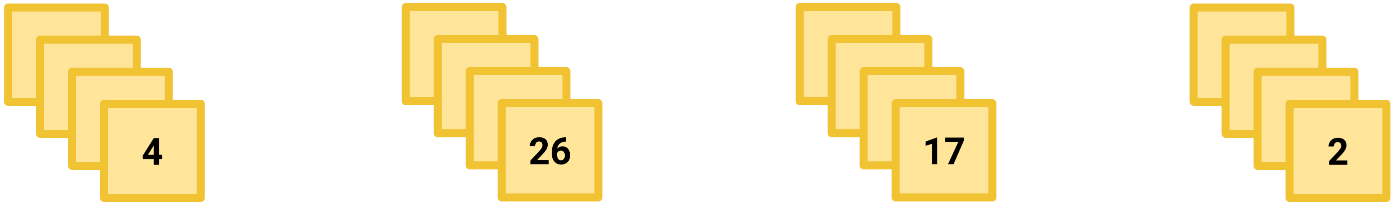


We sort each batch in parallel

SMALL SORT



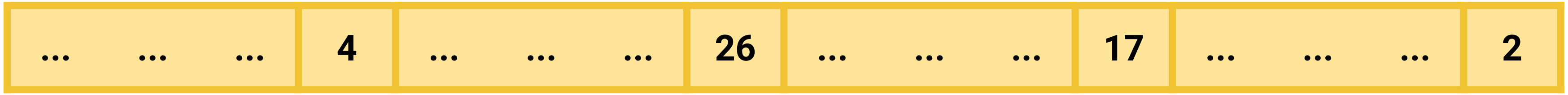
Batches of 1024 elements



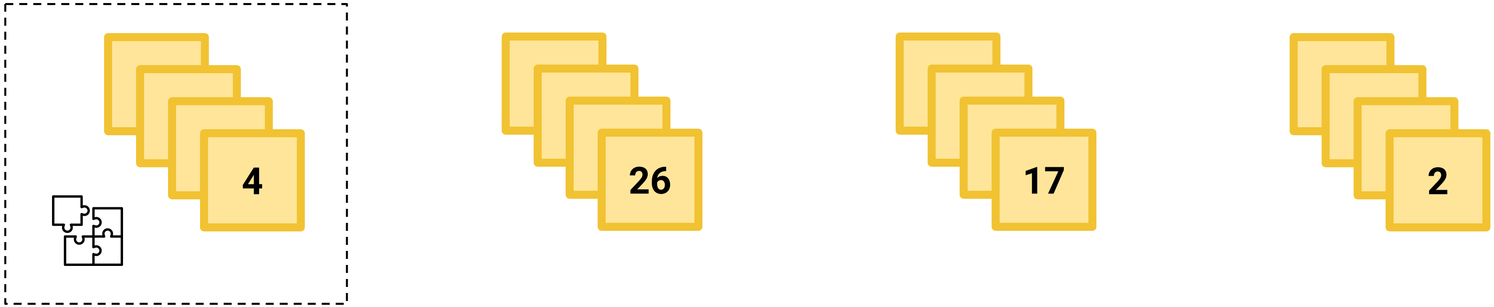
We sort each batch in parallel on one block

SMALL SORT

M



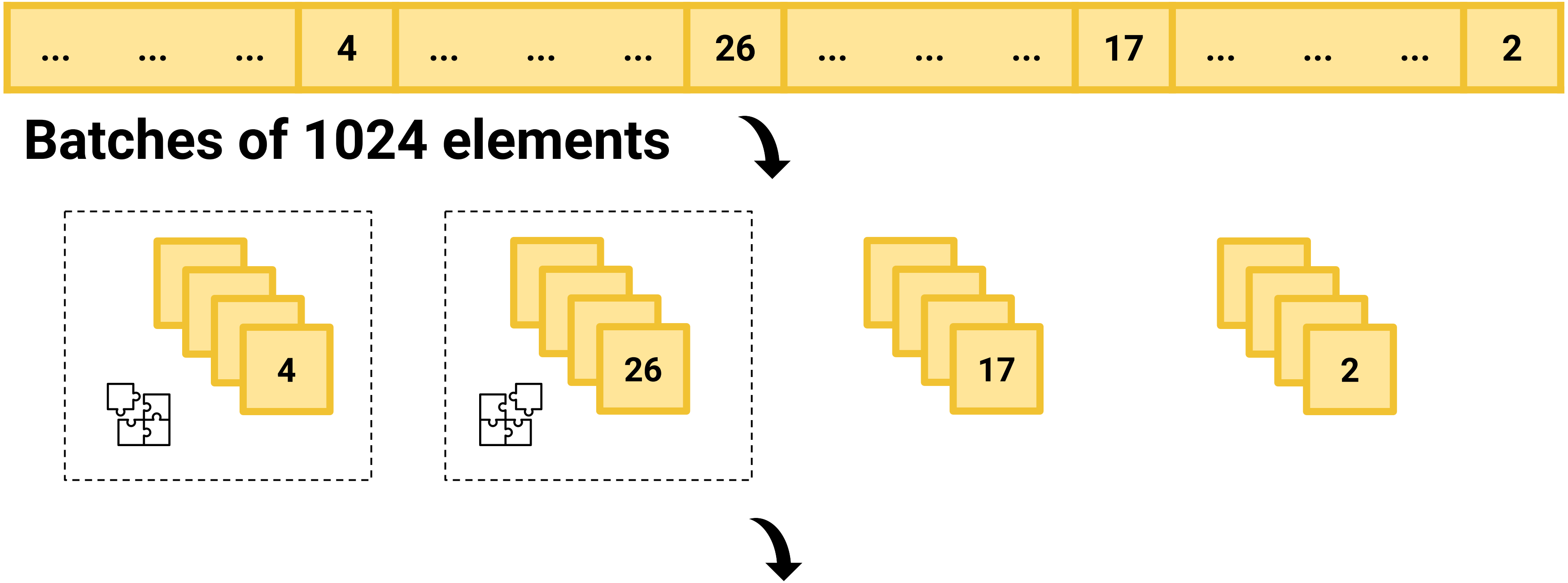
Batches of 1024 elements



We sort each batch in parallel on one block

SMALL SORT

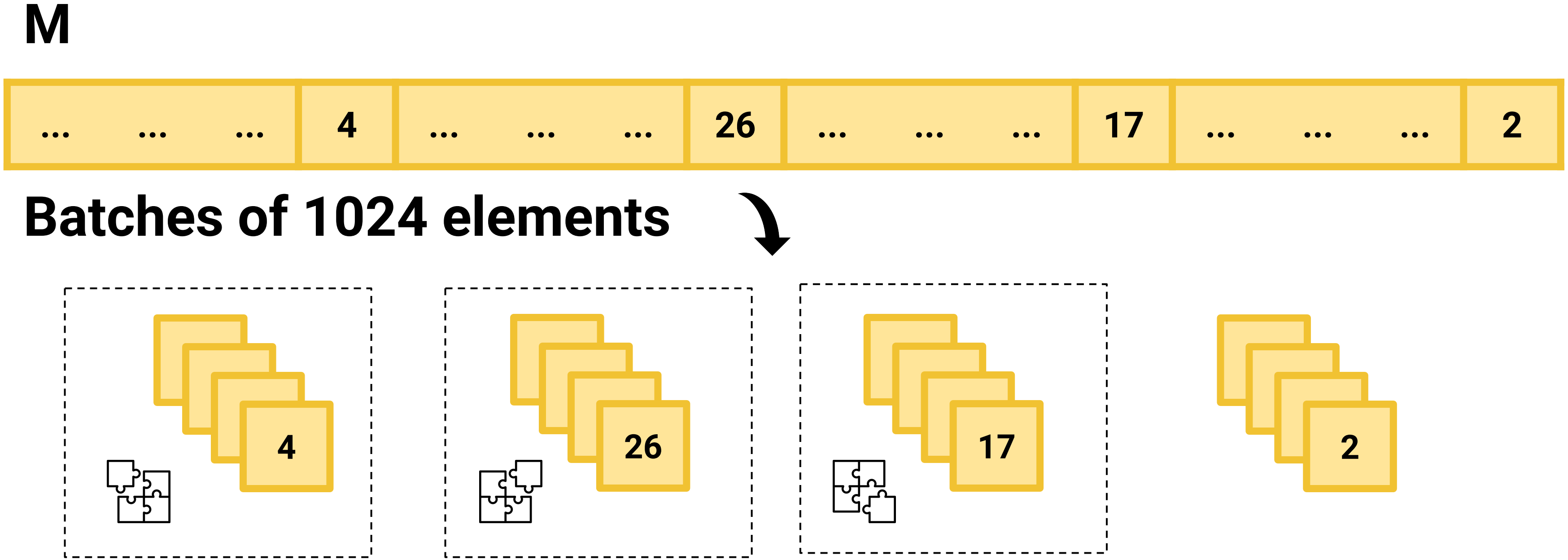
M



Batches of 1024 elements

We sort each batch in parallel on one block

SMALL SORT



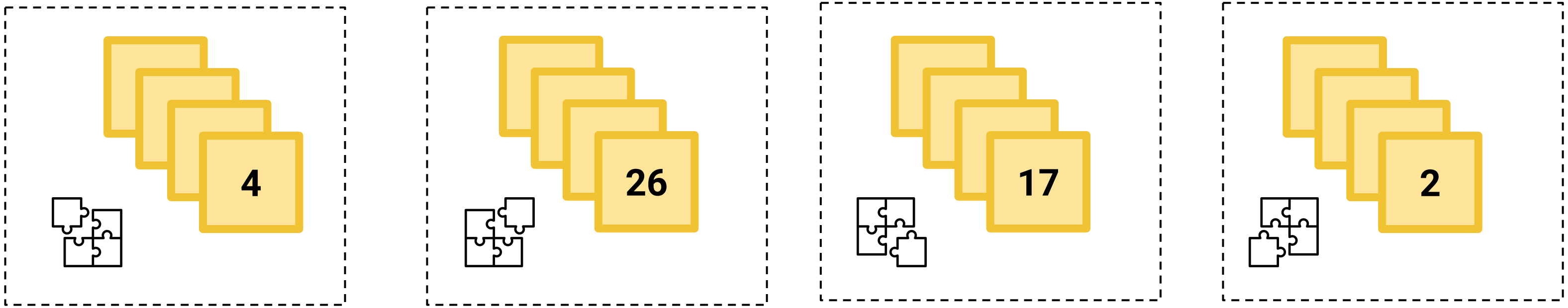
We sort each batch in parallel on one block

SMALL SORT

M

…	…	…	4	…	…	…	26	…	…	…	17	…	…	…	2

Batches of 1024 elements



We sort each batch in parallel on one block

BIG SORT

Batches of 1024 sorted elements

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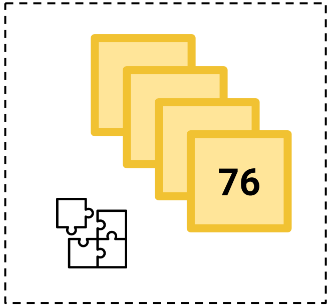
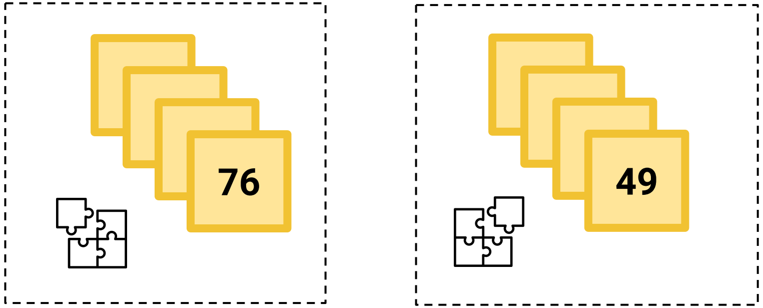
Batches of 1024 sorted elements



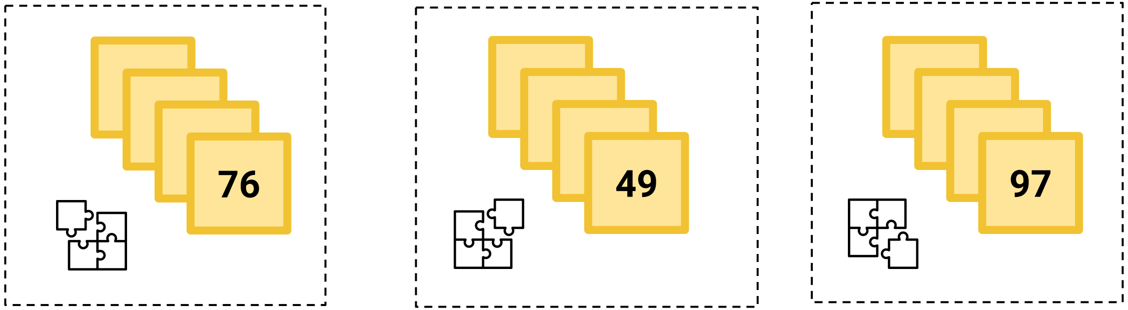
BIG SORT

Batches of 1024 sorted elements



BIG SORT

Batches of 1024 sorted elements



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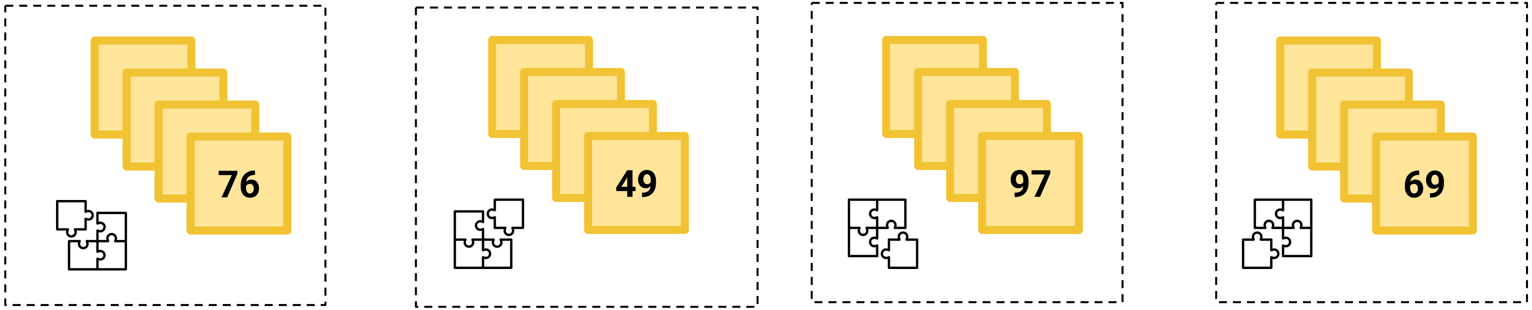
Batches of 1024 sorted elements



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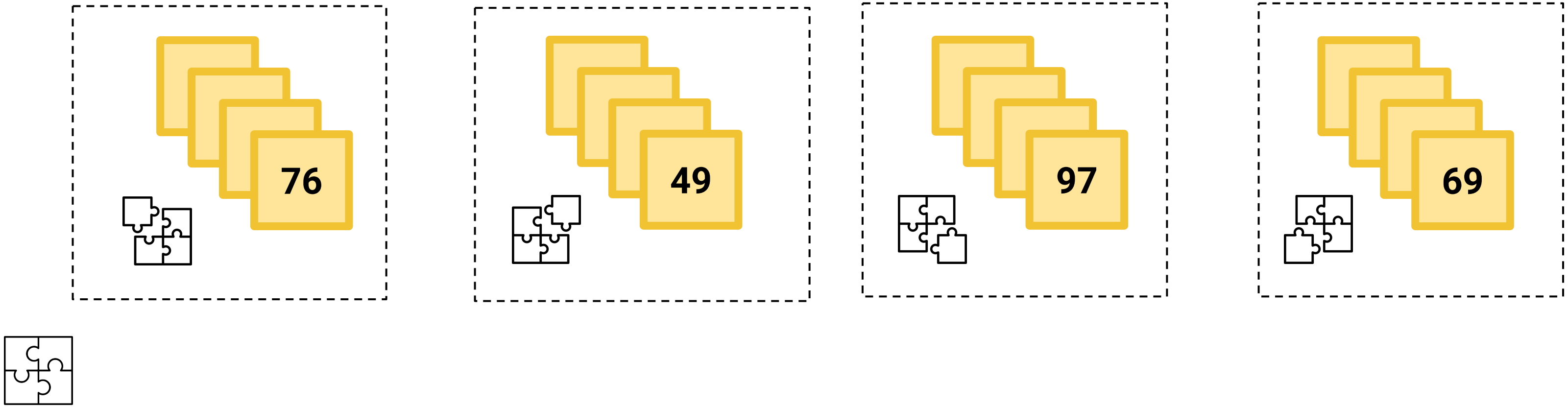
Batches of 1024 sorted elements



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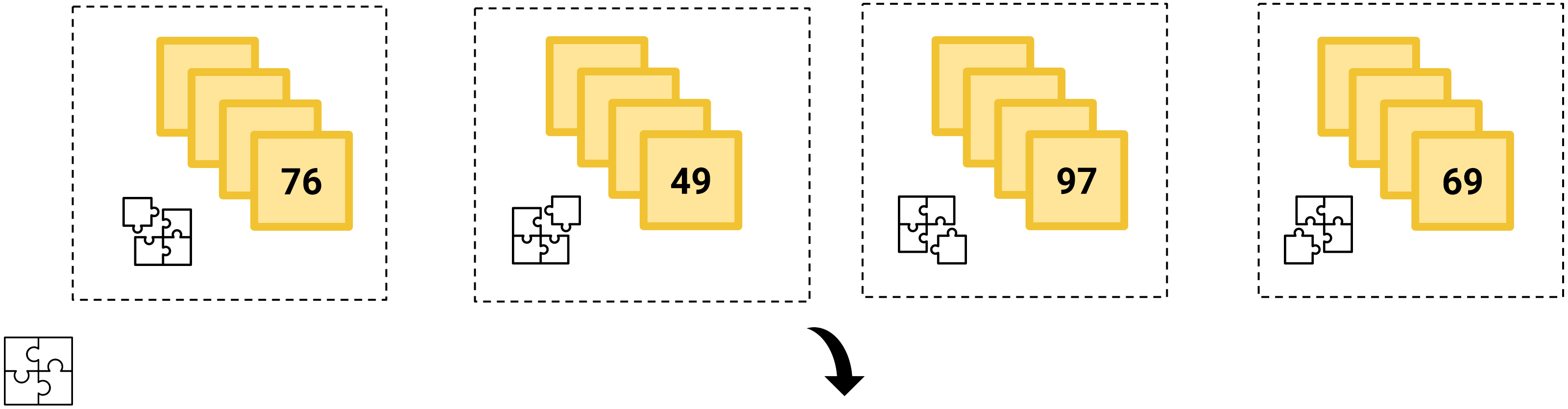
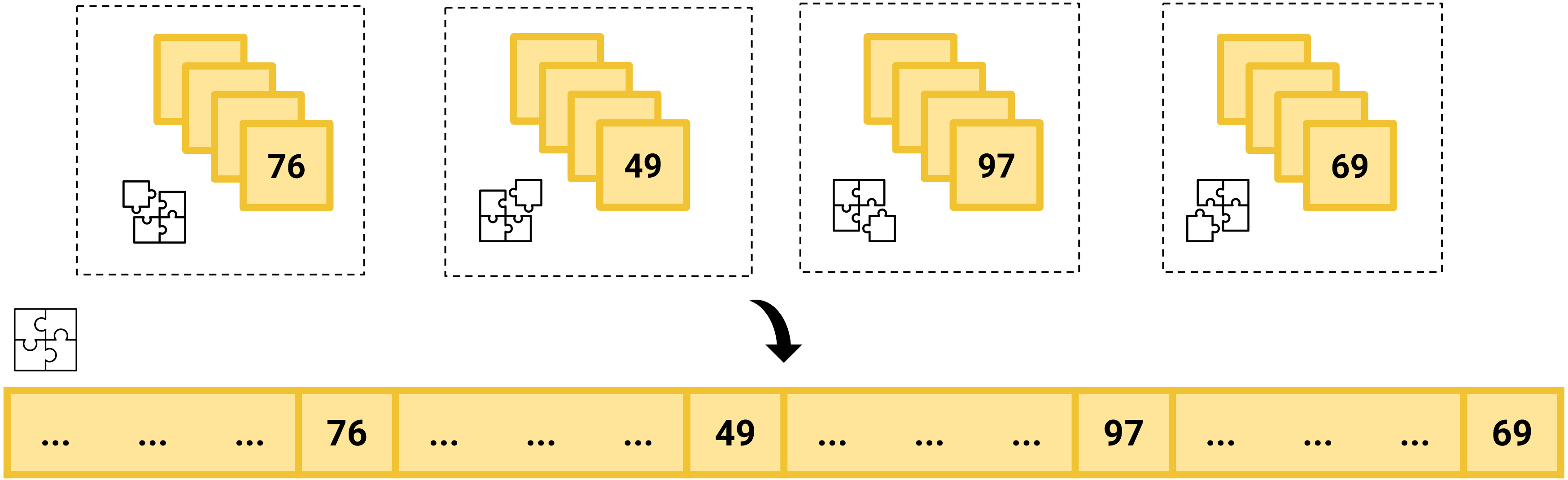
Batches of 1024 sorted elements



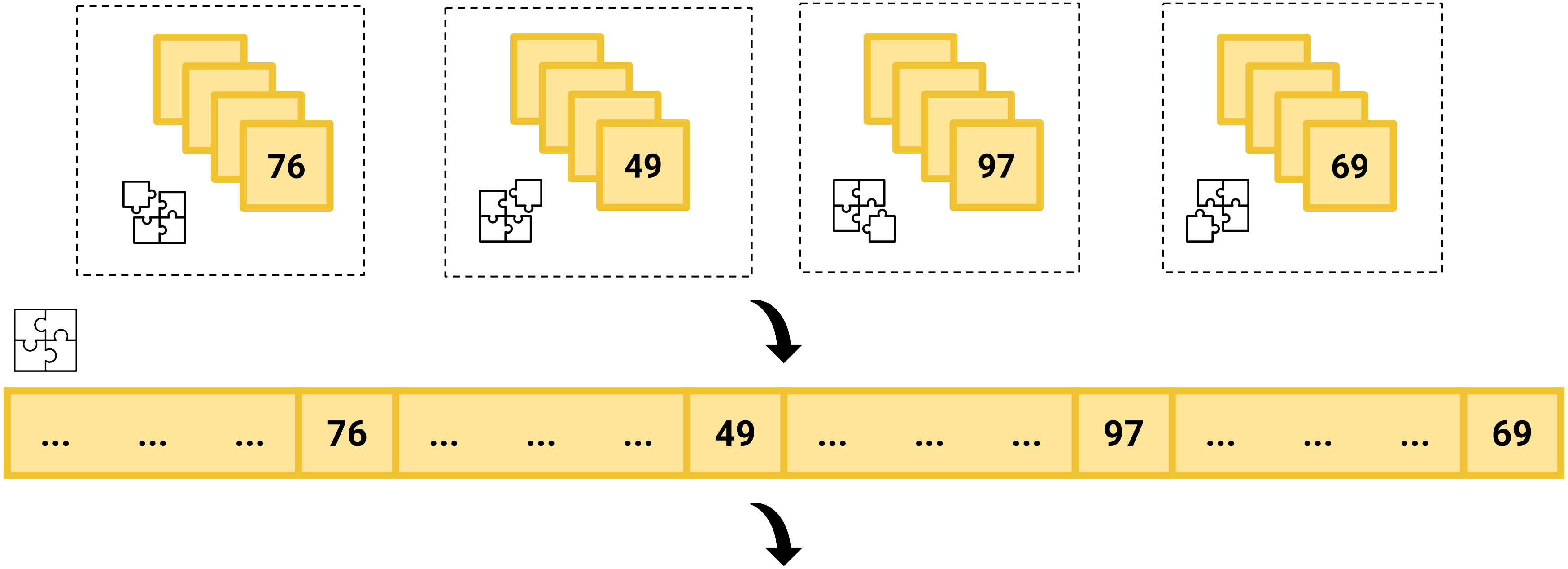
BIG SORT

Batches of 1024 sorted elements



BIG SORT

Batches of 1024 sorted elements



We sort the new reconstitued array

NOTATIONS

NOTATIONS

pathBig_k(A,B)

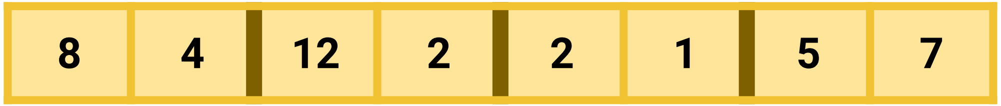
+

mergeBig_k(A,B)

GPU SORT

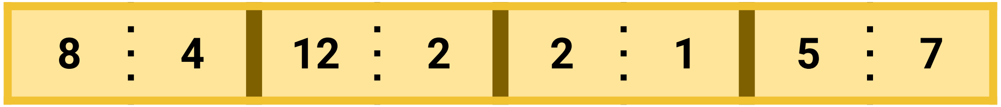
8	4	12	2	2	1	5	7

GPU SORT



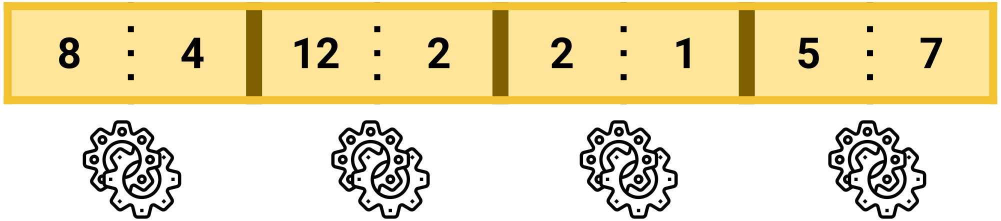
8	4	12	2	2	1	5	7

GPU SORT



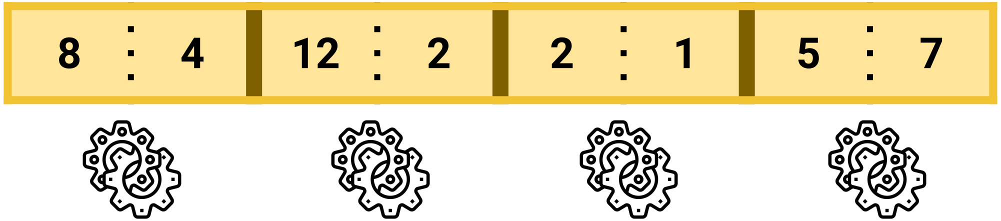
8	4	12	2	2	1	5	7

GPU SORT



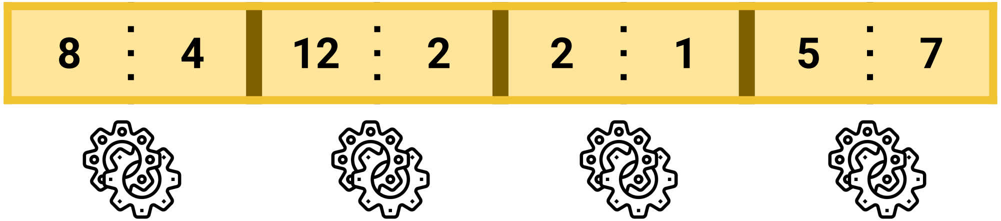
8 : 4 | 12 : 2 | 2 : 1 | 5 : 7

GPU SORT WITH STREAM



8	4	12	2	2	1	5	7

GPU SORT WITH STREAM



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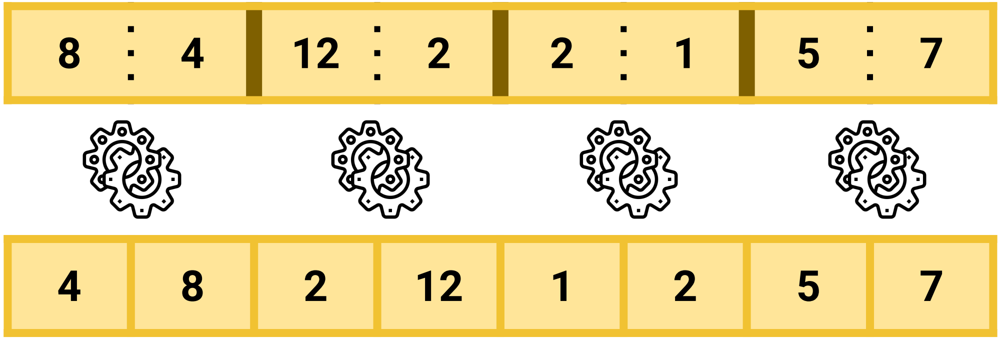
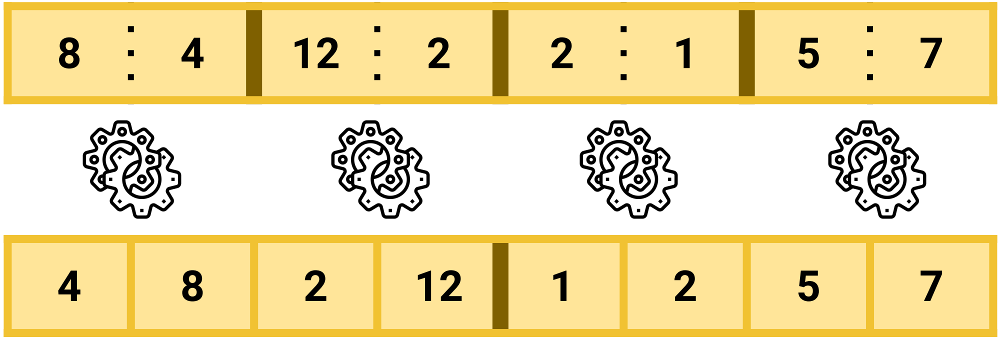
GPU SORT WITH STREAM



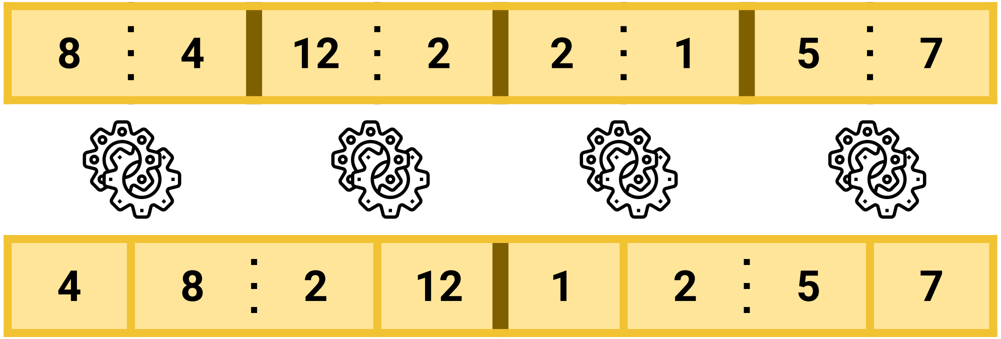
GPU SORT WITH STREAM



8	4	12	2	2	1	5	7

4	8	2	12	1	2	5	7

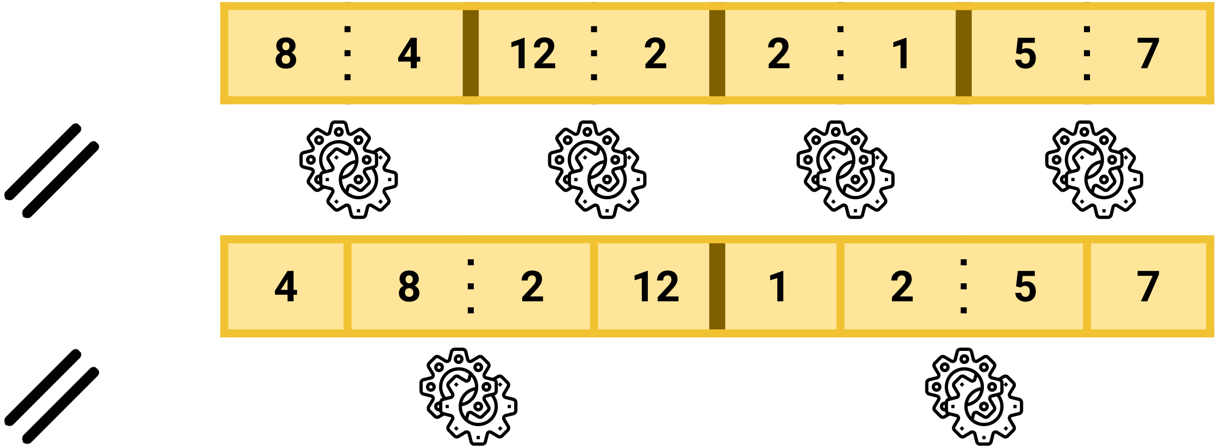
GPU SORT WITH STREAM



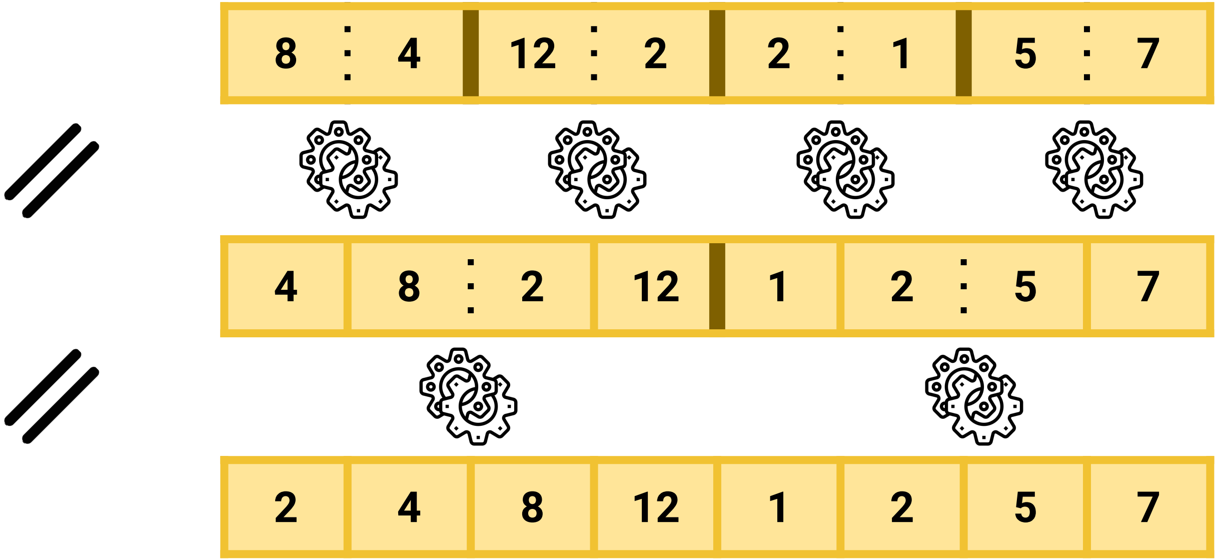
8 4 | 12 2 | 2 1 | 5 7

4 8 2 12 | 1 2 5 7

GPU SORT WITH STREAM



GPU SORT WITH STREAM

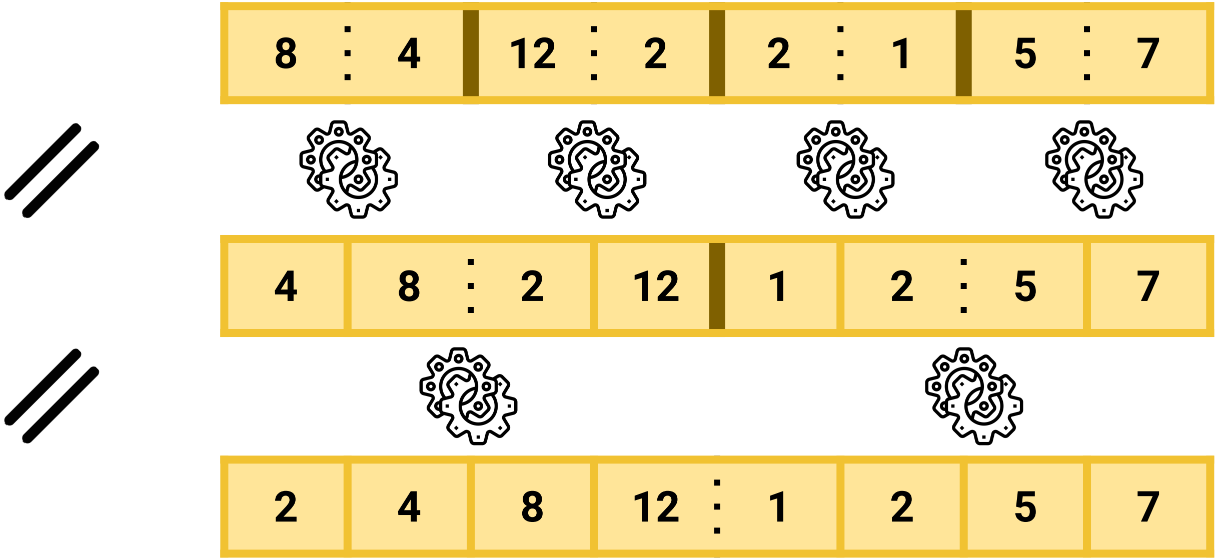


8 : 4 | 12 : 2 | 2 : 1 | 5 : 7

4 | 8 : 2 | 12 | 1 | 2 : 5 | 7

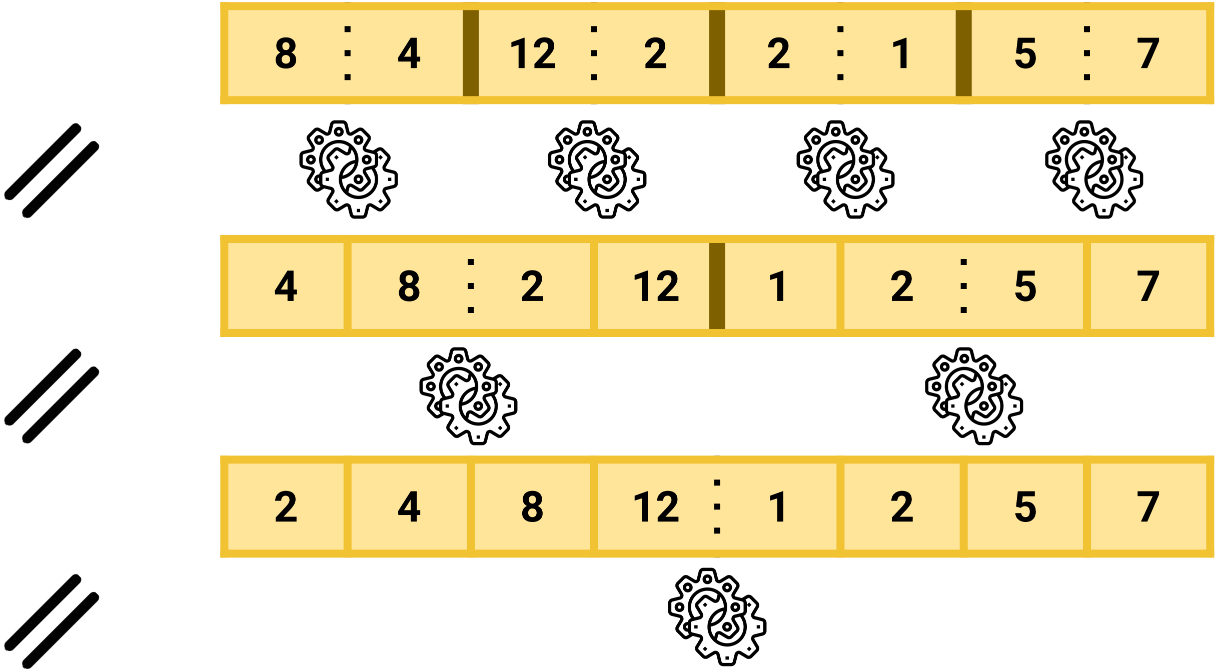
2 | 4 | 8 | 12 | 1 | 2 | 5 | 7

GPU SORT WITH STREAM

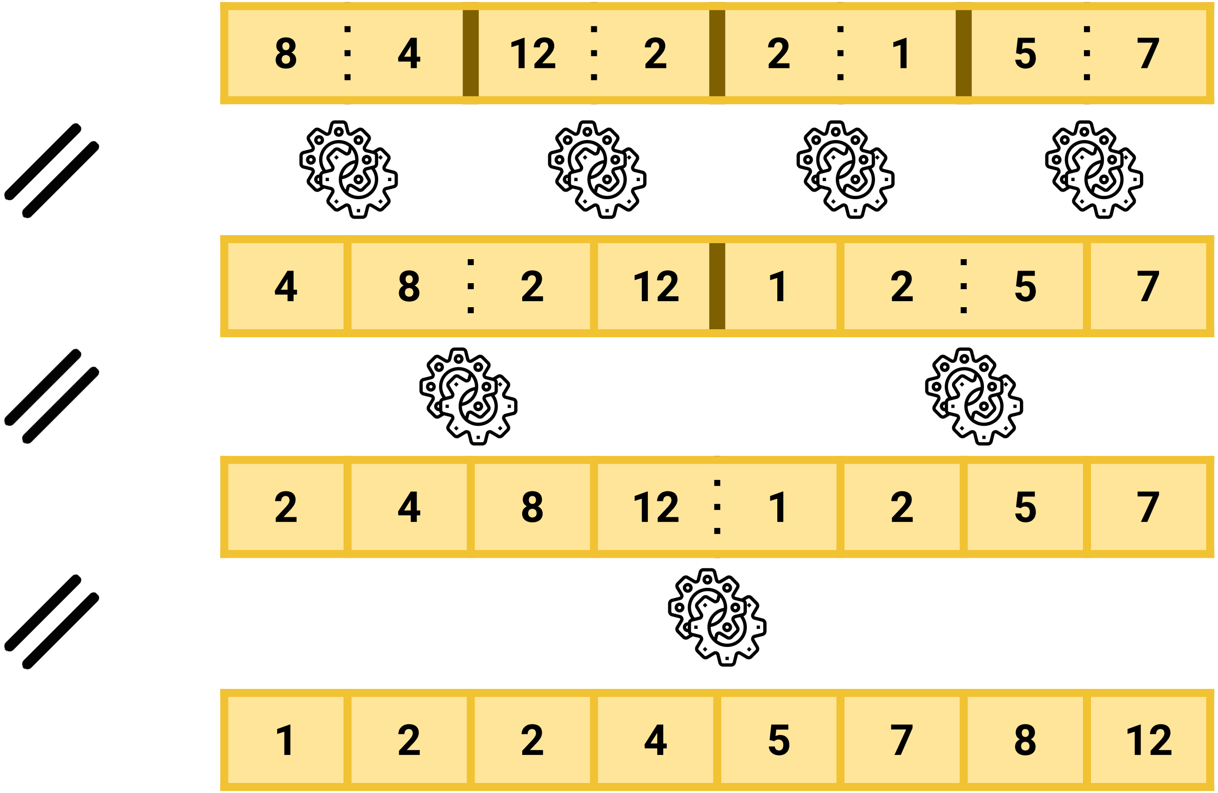


8	4	12	2	2	1	5	7
4	8	2	12	1	2	5	7
2	4	8	12	1	2	5	7

GPU SORT WITH STREAM



GPU SORT WITH STREAM



8 : 4 | 12 : 2 | 2 : 1 | 5 : 7

4 | 8 : 2 | 12 | 1 | 2 : 5 | 7

2 | 4 | 8 | 12 : 1 | 2 | 5 | 7

1 | 2 | 2 | 4 | 5 | 7 | 8 | 12

SMALL SORT

mergeSmall_Batch_k

Batches on shared memory

Very Fast

Impossible if batch_size > 1024

SMALL SORT

mergeSmall_Batch_k

Batches on shared memory

Very Fast

Impossible if batch_size > 1024

BIG SORT

pathBig_k and mergeBig_k

Streams

Global Memory

OUR GITHUB :

https://github.com/saulnierS/main5_hpc.git