Pooling

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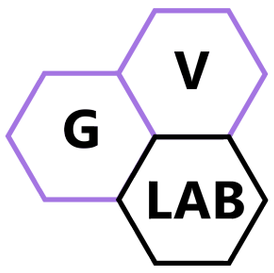
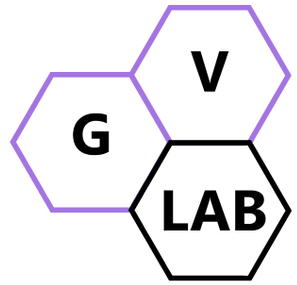


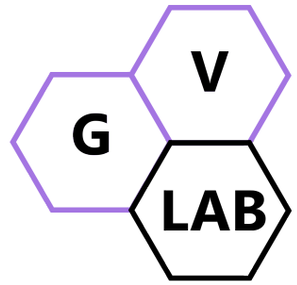
GVLab:
Graphics and Vision Laboratory

Faculty of Computer Science and Engineering,
HCMUT

2 Contents



3 Goal of pooling layer



- ❖Sampling feature spaces to remove redundant features
- ❖Reducing size of feature maps
- ❖Avoid overfitting (minor)

4

Max-pooling

Pooling's hyper-parameters

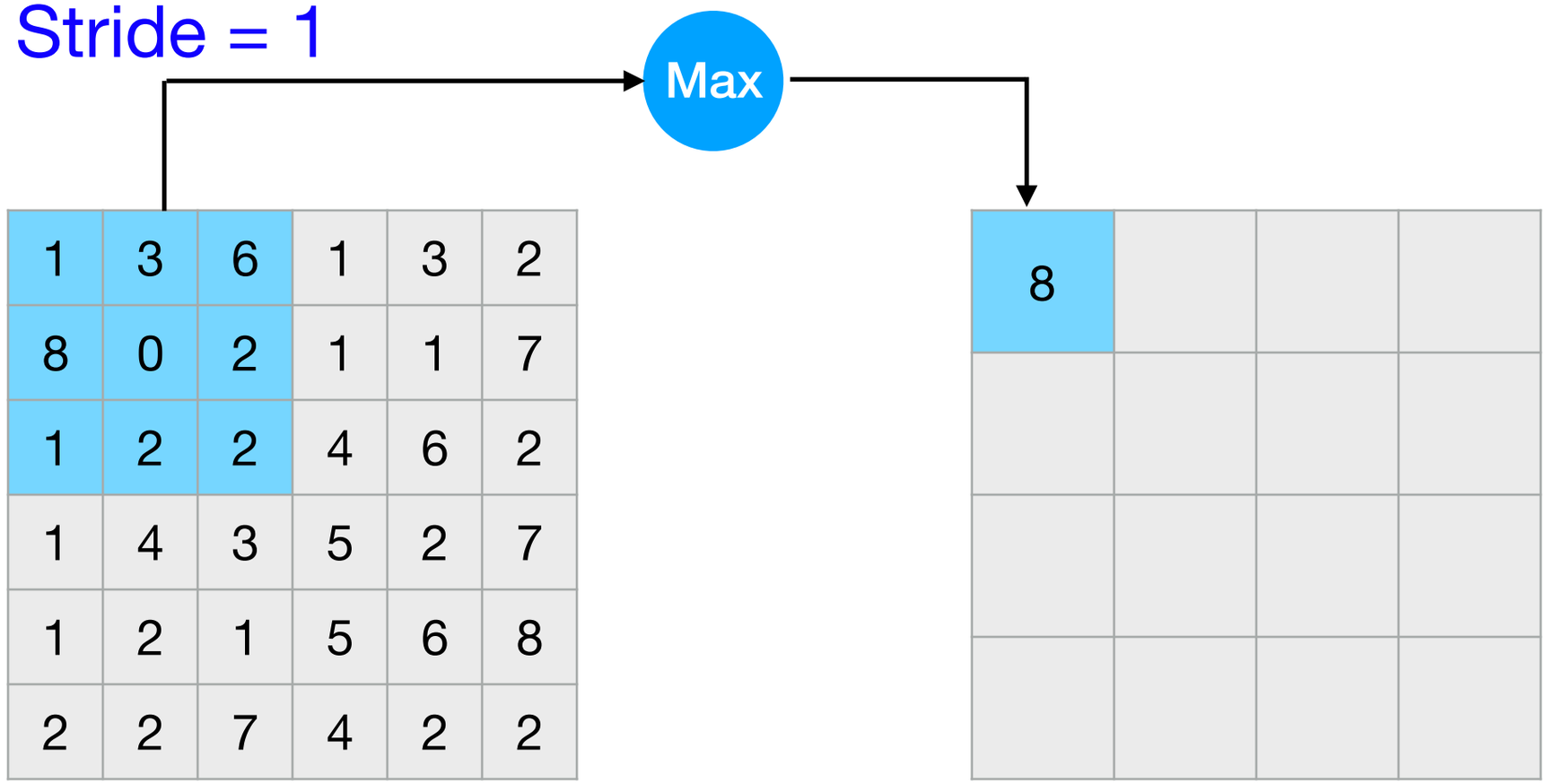
- (1) Type of pooling
- (2) Window size
- (3) Stride

$$\frac{\partial b}{}$$

Max-pooling

Pooling's hyper-parameters

- (1) Type = max-poling
- (2) Window size = 3x3
- (3) Stride = 1

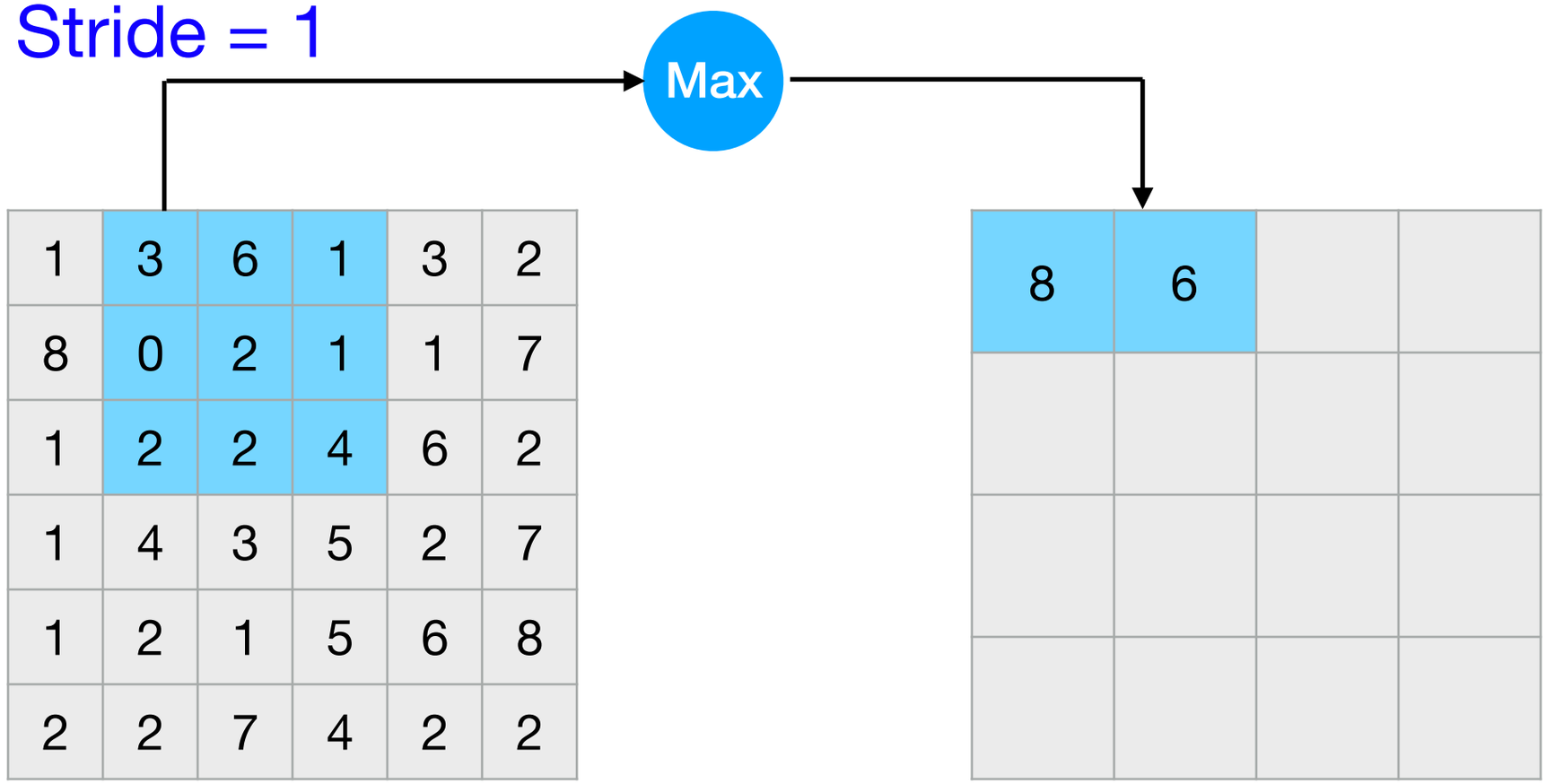


Input feature map **Output feature map**

Max-pooling

Pooling's hyper-parameters

- (1) Type = max-poling
- (2) Window size = 3x3
- (3) Stride = 1



Input feature map **Output feature map**

Max-pooling

Pooling's hyper-parameters

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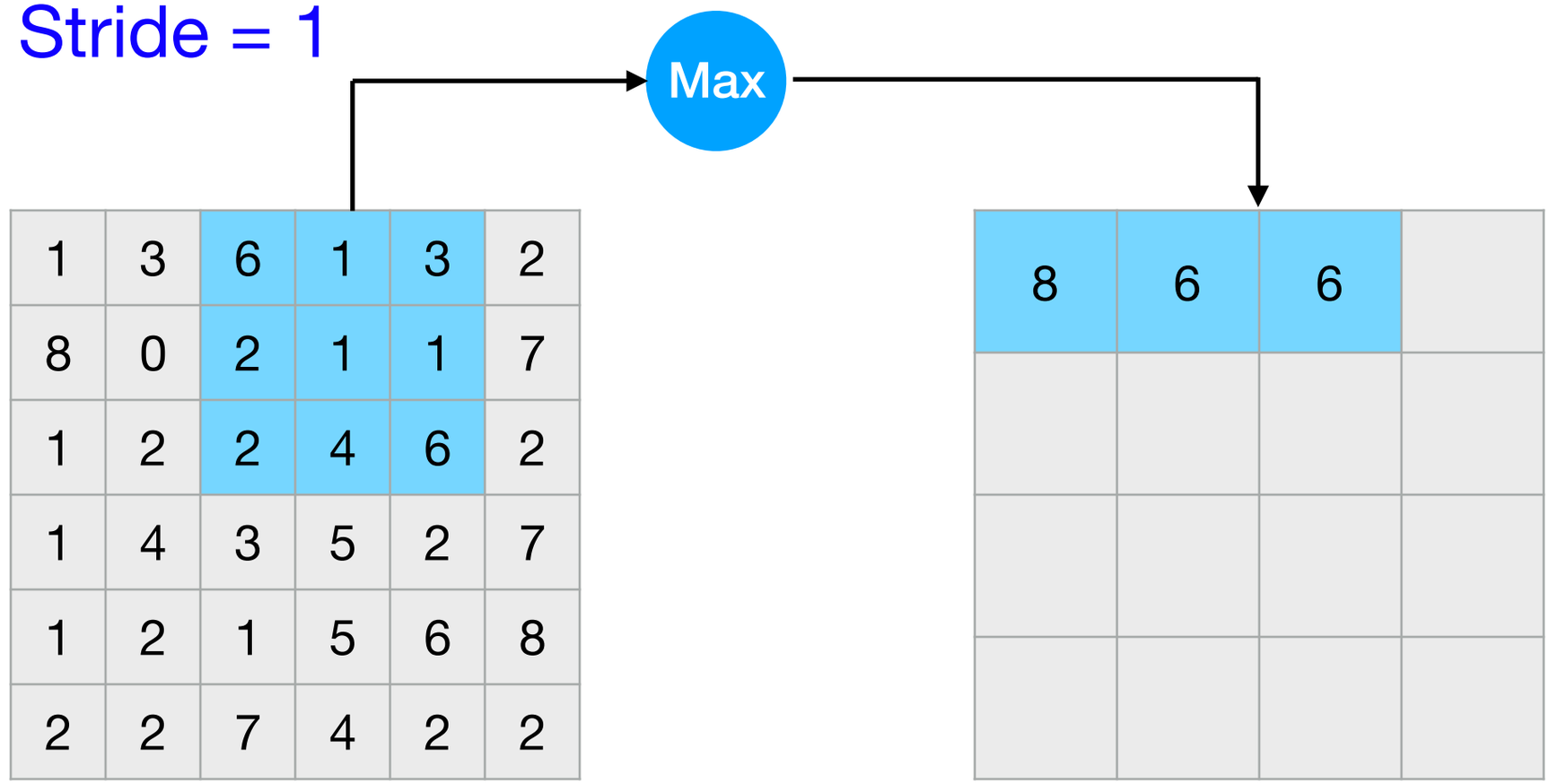

Input feature map **Output feature map**

Max-pooling

Pooling's hyper-parameters

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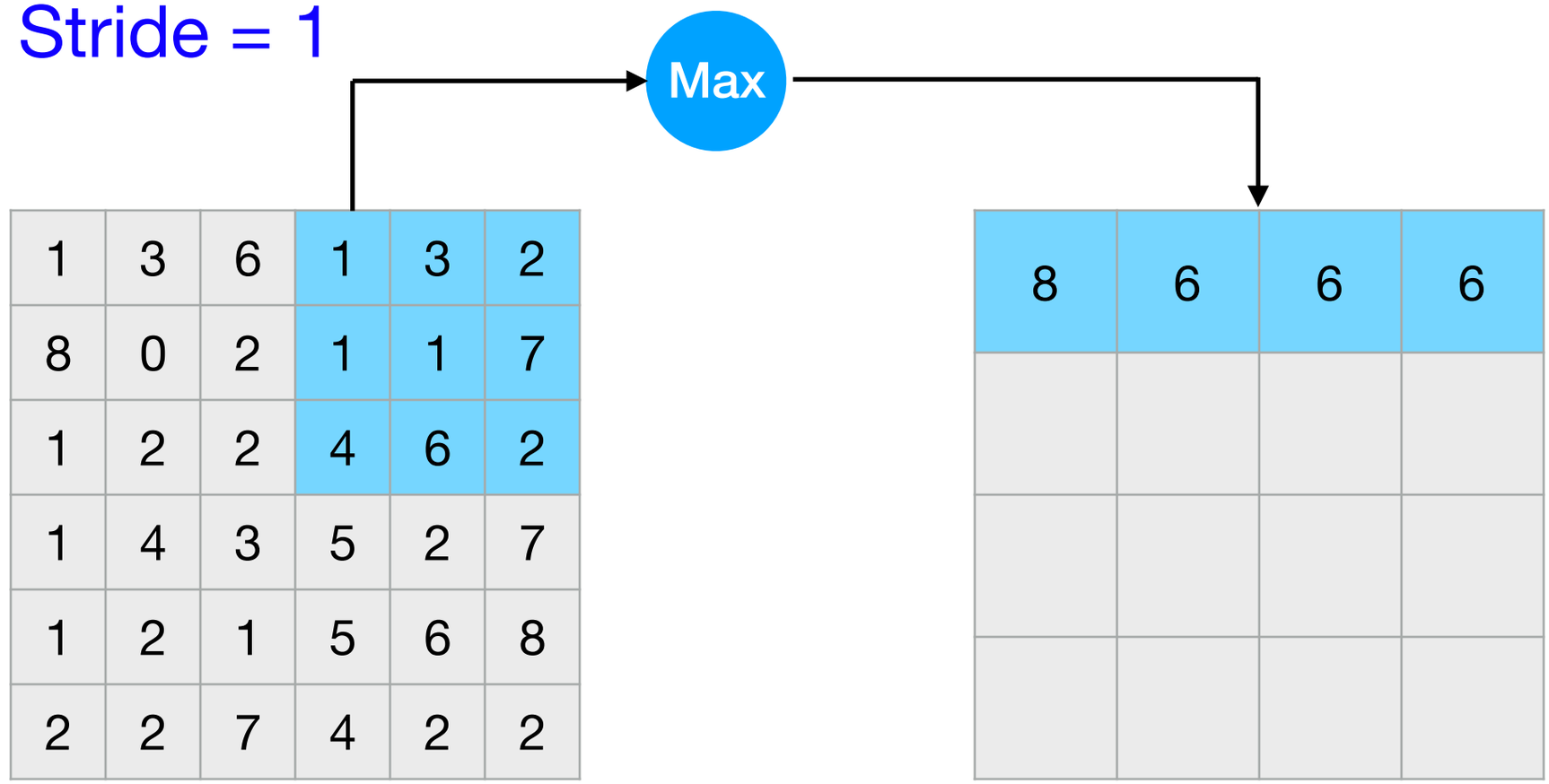
- (3) Stride = 1



Input feature map **Output feature map**

Max-pooling

Pooling's hyper-parameters

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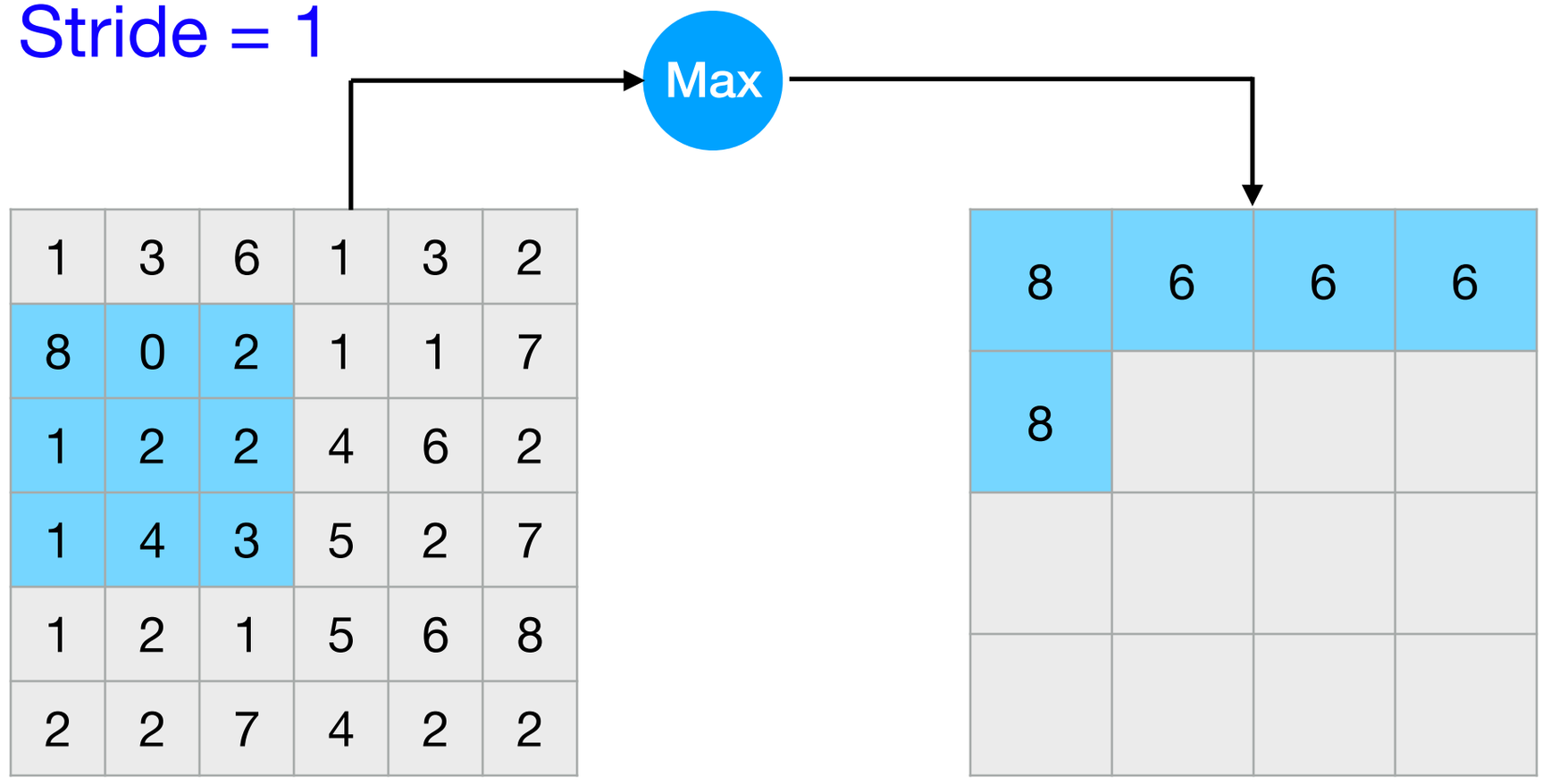
- (2) Window size = 3x3
- (3) Stride = 1



Input feature map **Output feature map**

Max-pooling

Pooling's hyper-parameters

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- (2) Window size = 3x3
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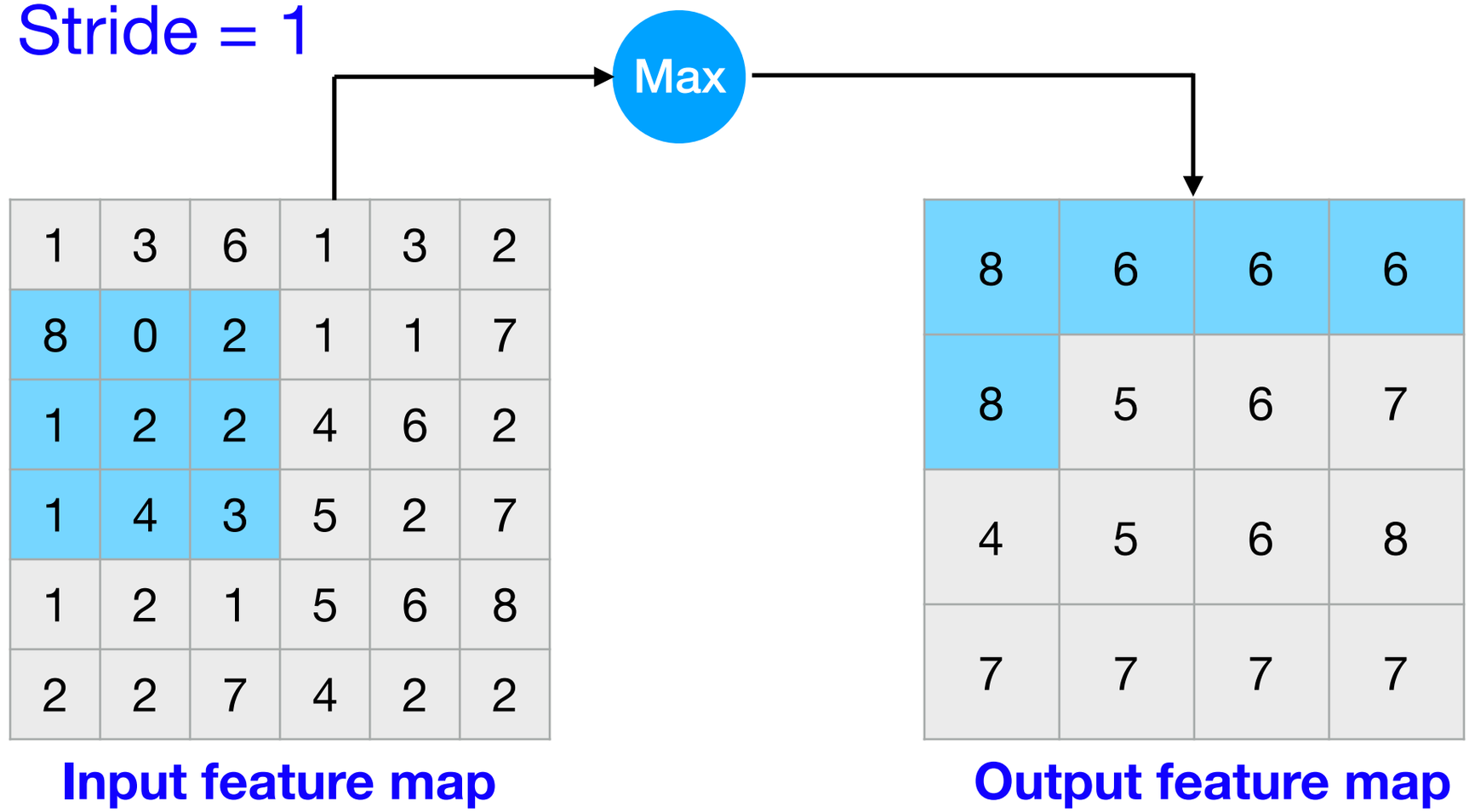

Input feature map **Output feature map**

Max-pooling

Pooling's hyper-parameters

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- (2) Window size = 3x3
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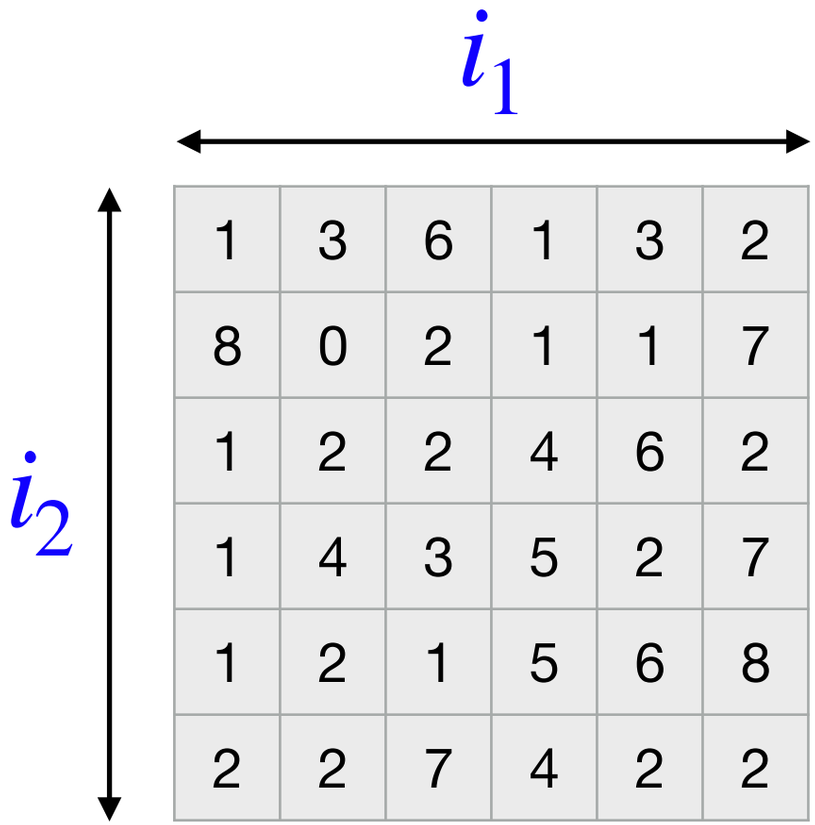


Input feature map

8	6	6	6
8	5	6	7
4	5	6	8
7	7	7	7

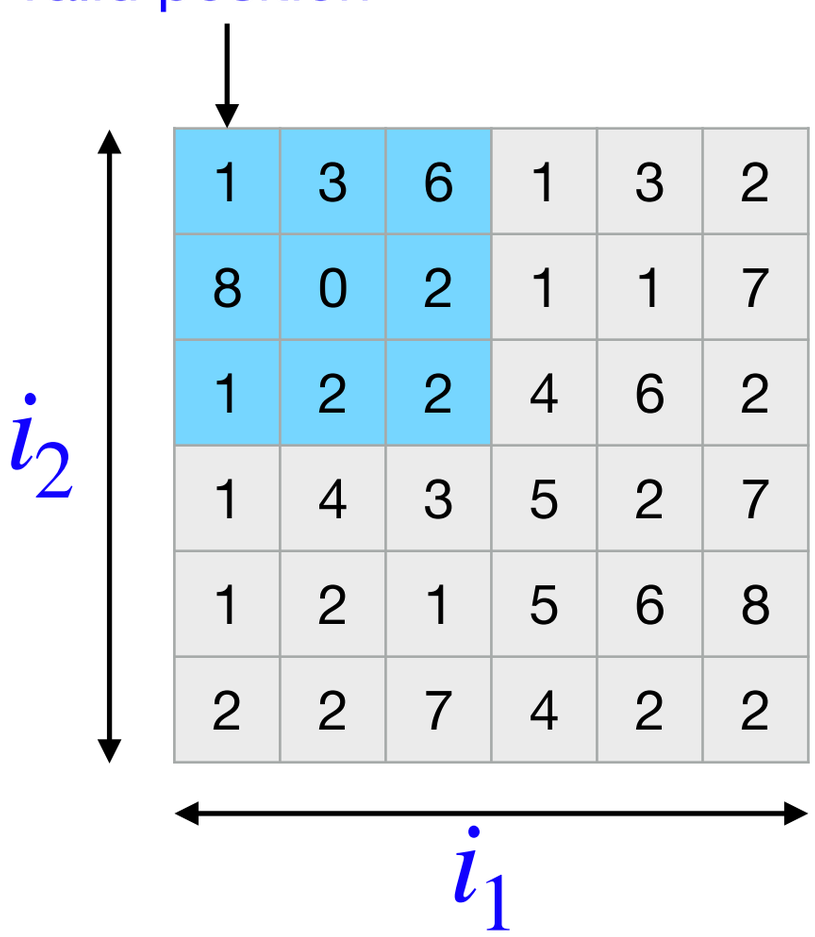
Output feature map

Max-pooling

Pooling's hyper-parameters

- (1) Type = max-poling
- (2) Window size = 3x3
- (3) Stride = 1

1st valid position



Max-pooling

Pooling's hyper-parameters

- (1) Type = max-poling
- (2) Window size = 3x3
- (3) Stride = 1

1st valid position

last valid position

∂b

$i_1 - k_1 + 1$

$(k_1 - 1)$

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

i_2

i_1

$$i_1 - k_1 + 1 = 6 - 3 + 1 = 4$$

$$i_2 - k_2 + 1 = 6 - 3 + 1 = 4$$

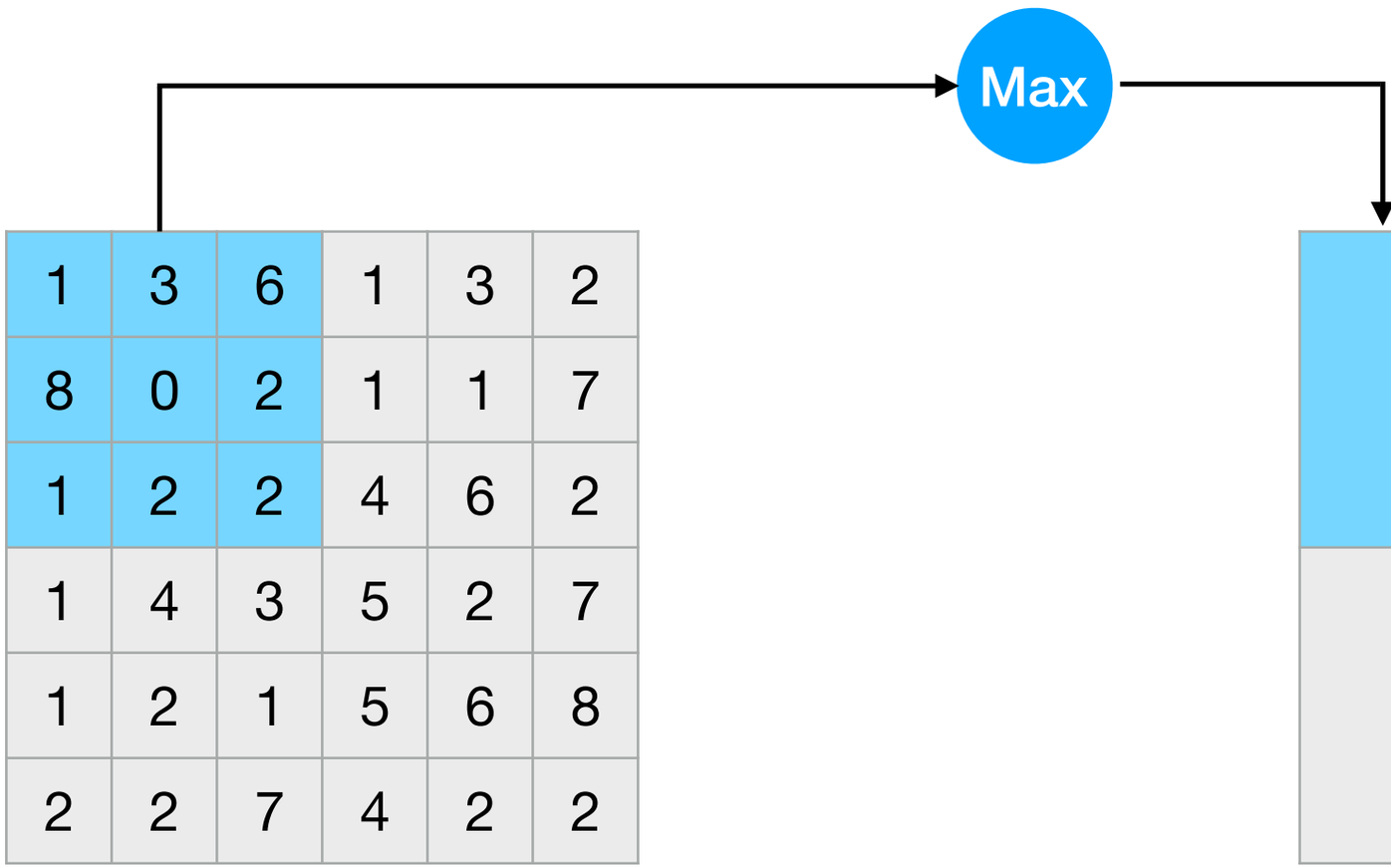
8	6	6	6
8	5	6	7
4	5	6	8
7	7	7	7

Output feature map

Max-pooling
Non-unit strides

Pooling's hyper-parameters
- ✳ (1) Type = max-poling
- ✳ (2) Window size = 3x3
- ✳ (3) Stride = 2

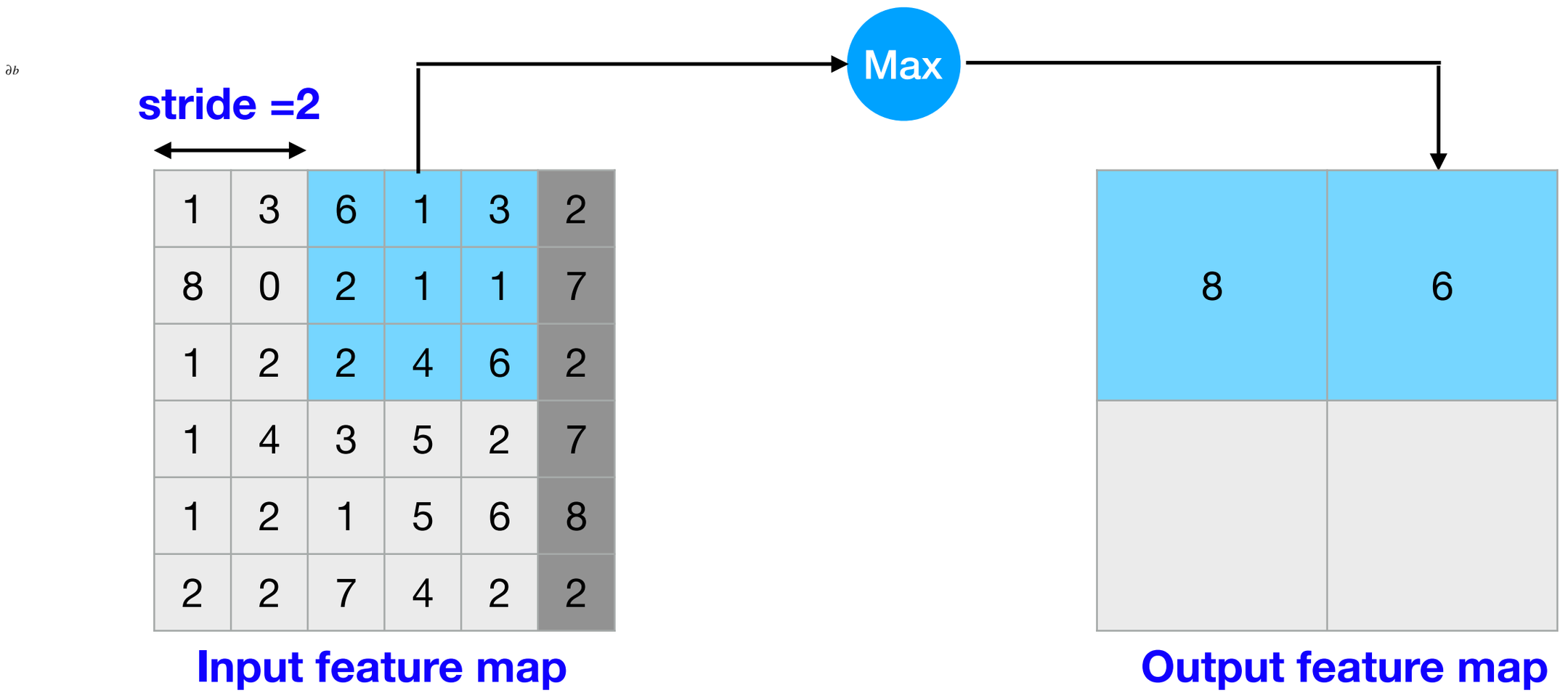
∂b



Input feature map **Output feature map**

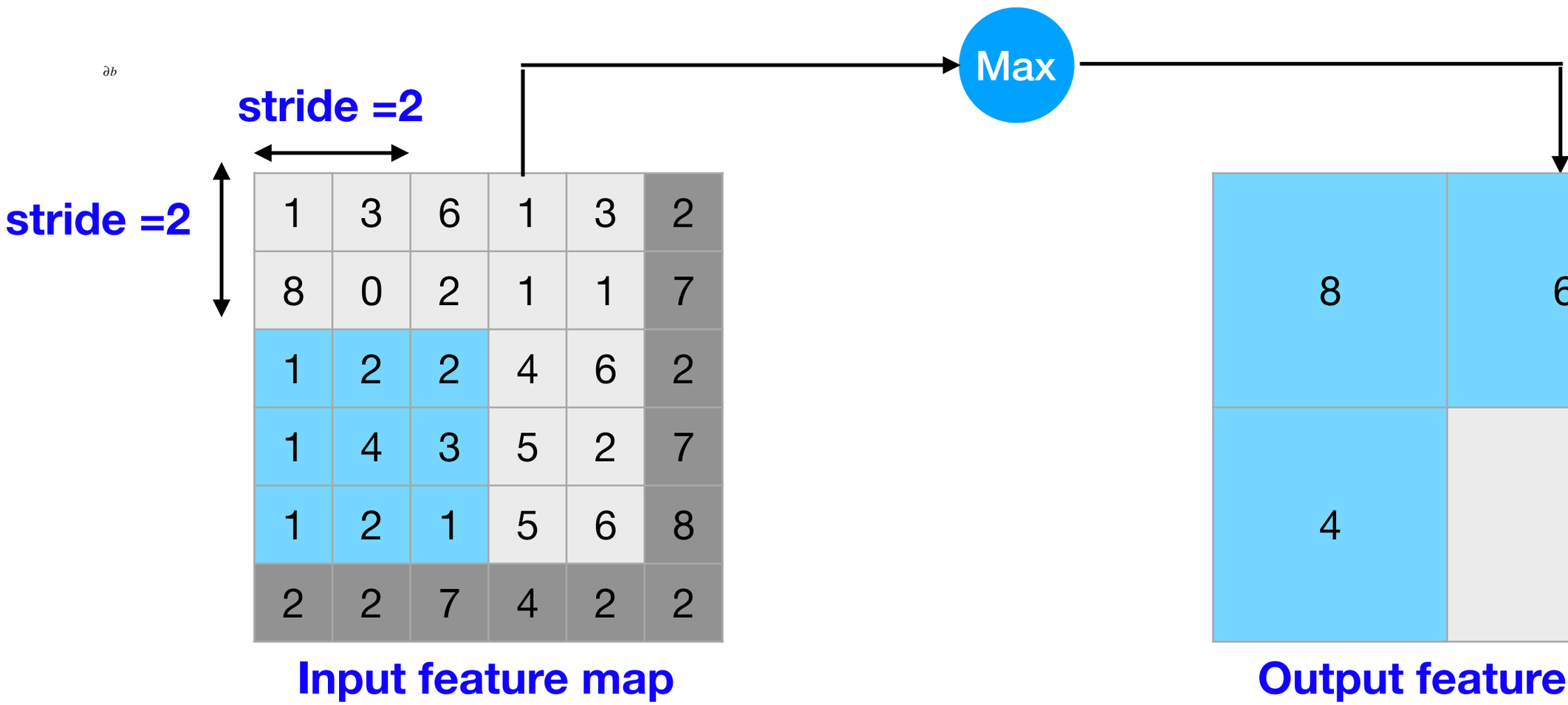
Max-pooling
Non-unit strides

Pooling's hyper-parameters
- ✳ (1) Type = max-poling
- ✳ (2) Window size = 3x3
- ✳ (3) Stride = 2



Max-pooling
Non-unit strides

Pooling's hyper-parameters
- ✳ (1) Type = max-poling
- ✳ (2) Window size = 3x3
- ✳ (3) Stride = 2



Max-pooling
Non-unit strides

Pooling's hyper-parameters
- ✳ (1) Type = max-poling
- ✳ (2) Window size = 3x3
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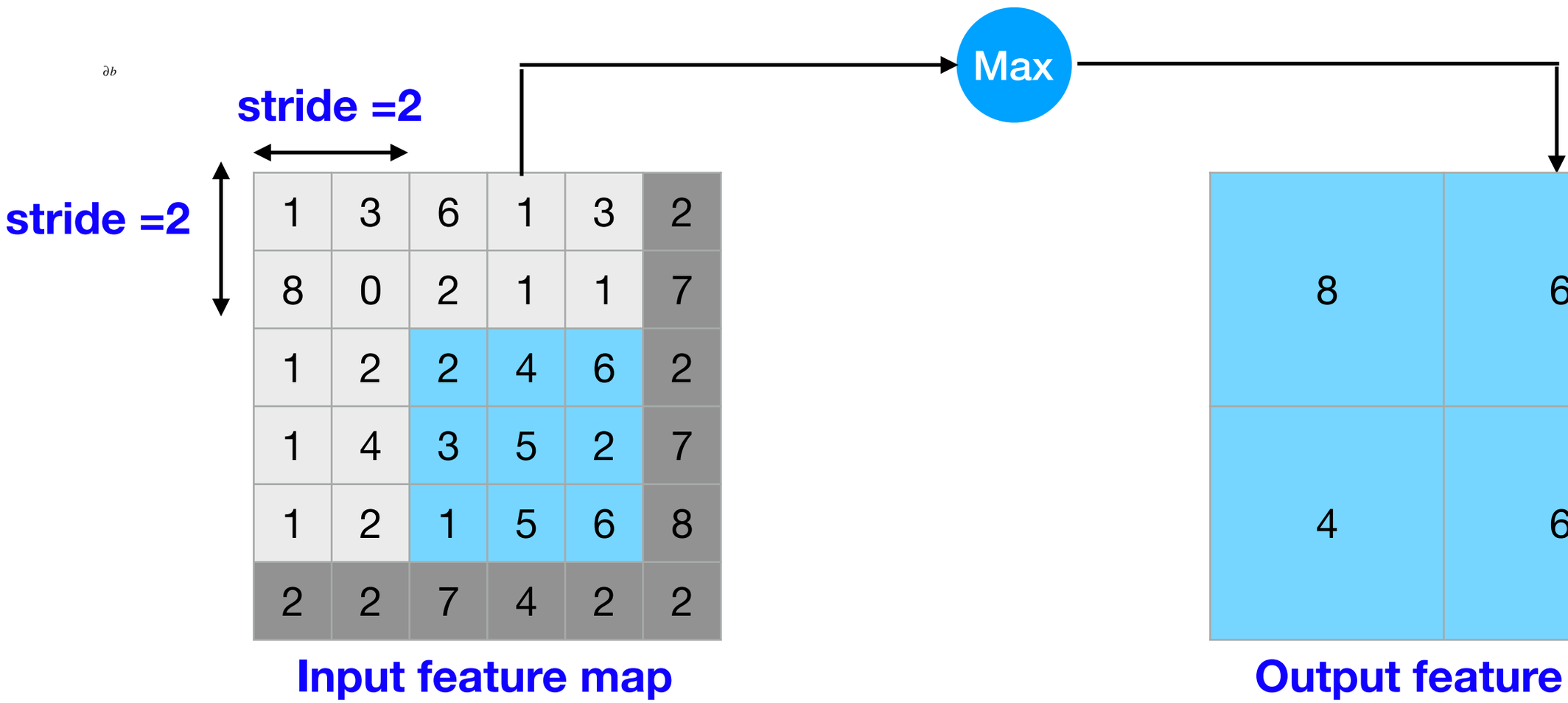
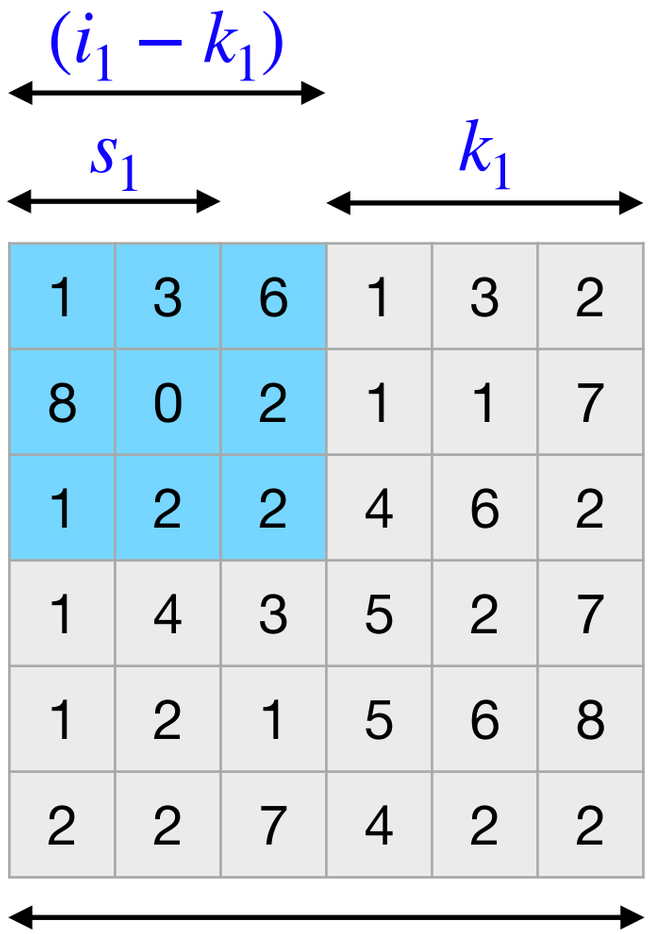
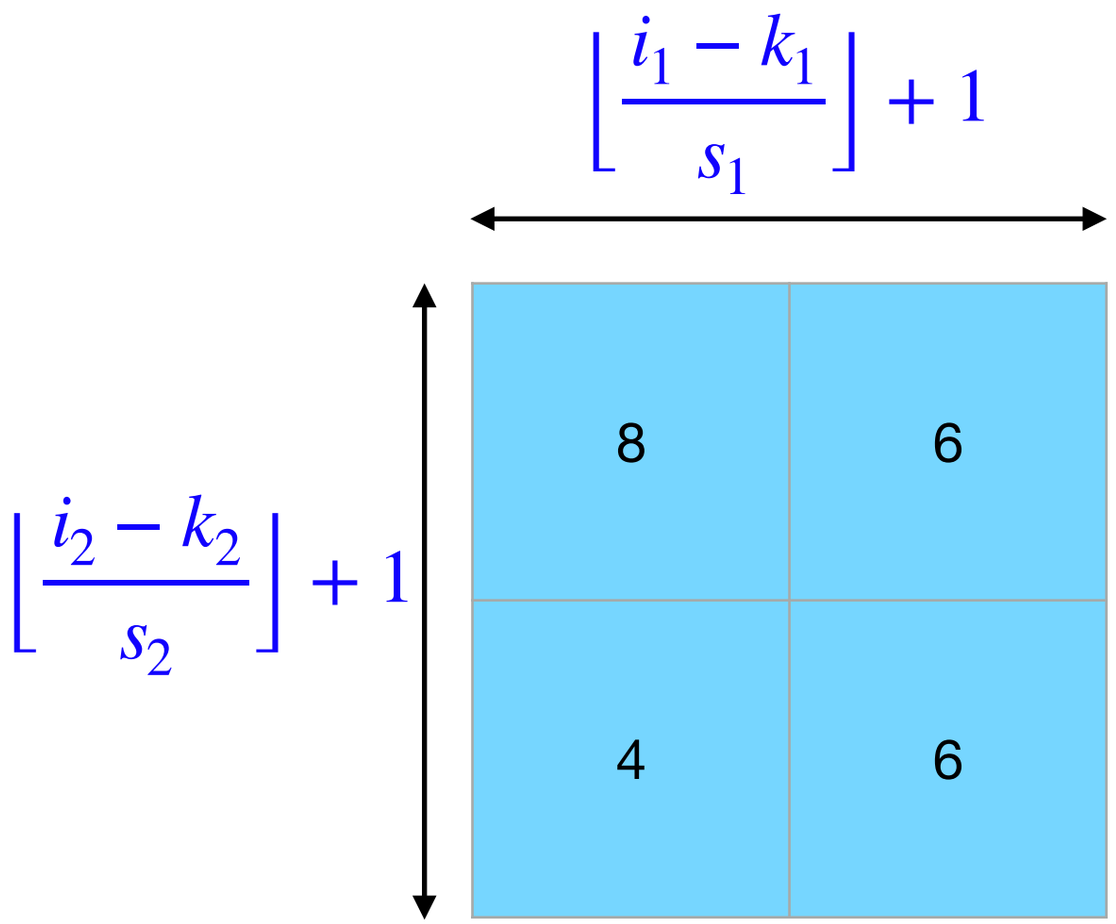


Max-pooling
Non-unit strides

∂b





Output feature map

Max-pooling
Non-unit strides

∂b

$(i_1 - k_1)$

s_1 k_1

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

$$\left\lfloor \frac{6-3}{2} \right\rfloor + 1 = 2$$

2

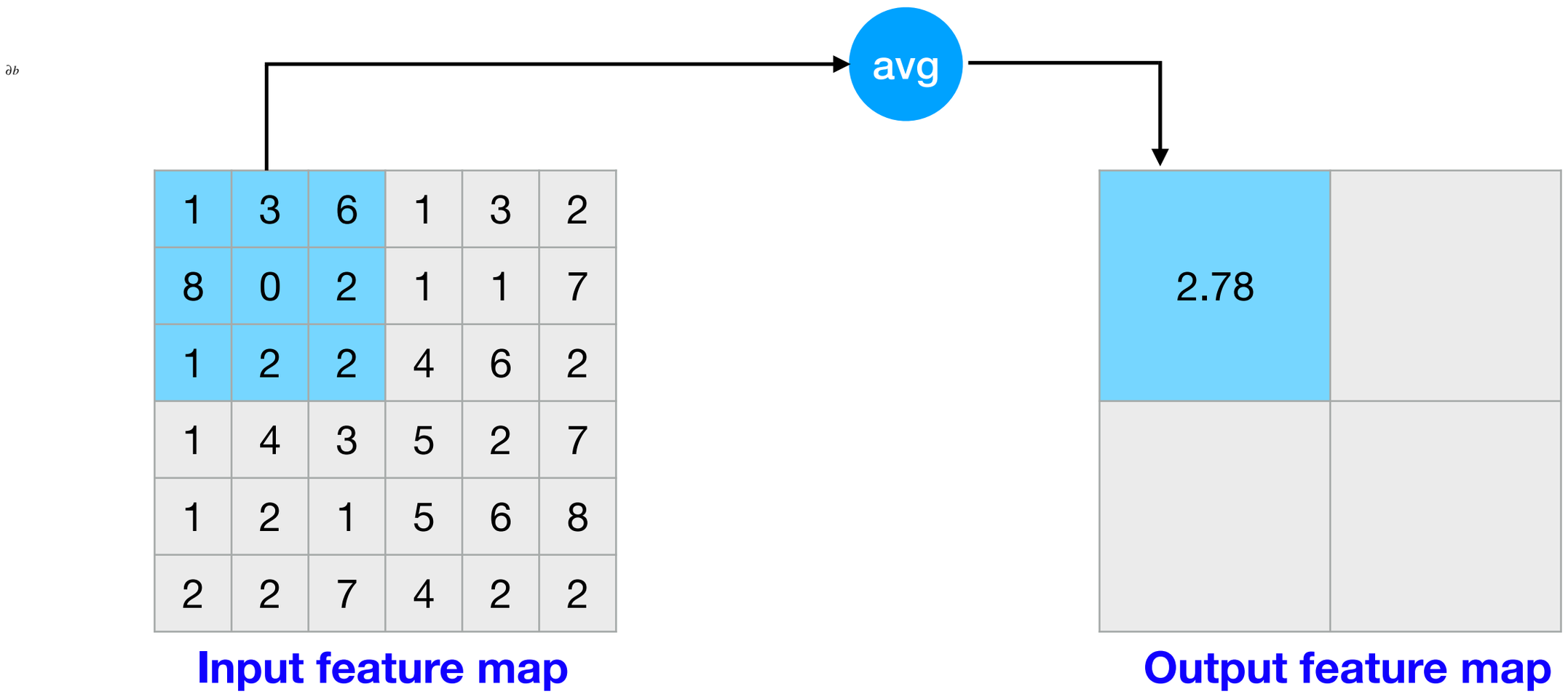
8	6
4	6

Output feature map

Other types of pooling

Pooling's hyper-parameters

- (1) Type = **average**
- (2) Window size = 3x3
- (3) Stride = 2

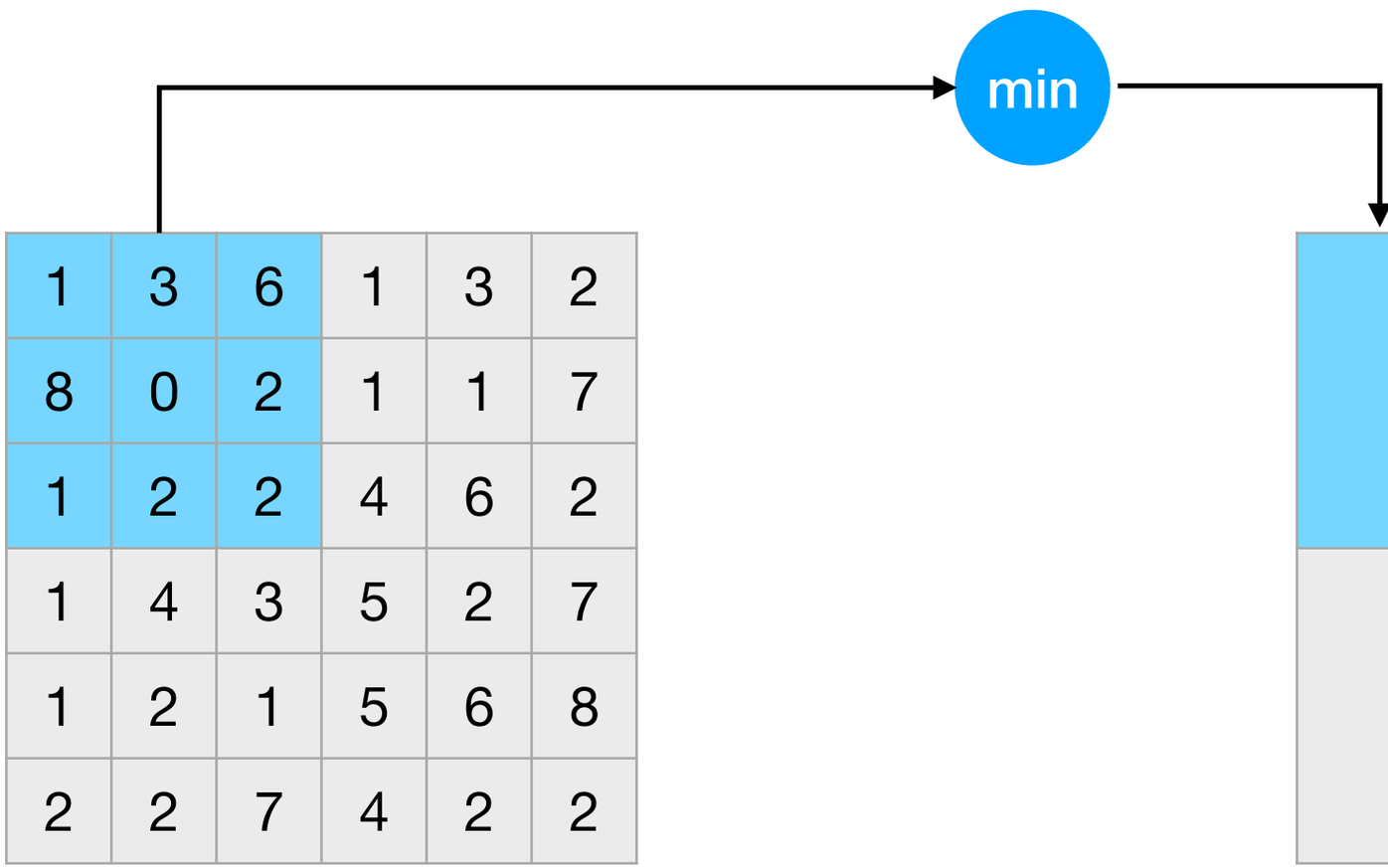


Other types of pooling

Pooling's hyper-parameters

- (1) Type = **min**
- (2) Window size = 3x3
- (3) Stride = 2

∂b



Input feature map **Output feature map**