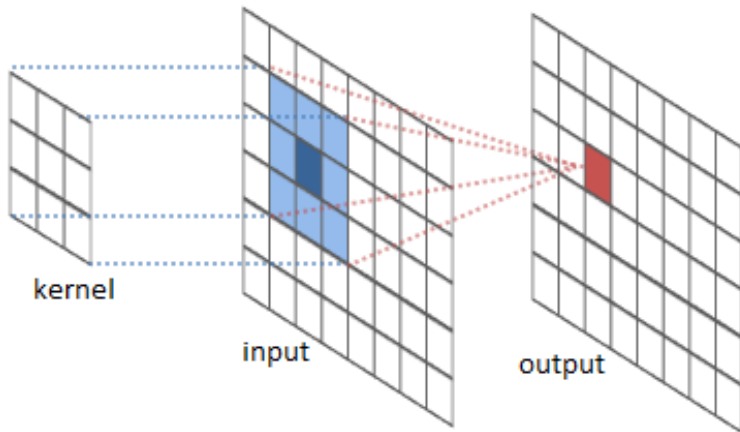


HW2 Sparse Matrices Convolution


$$\begin{bmatrix} 0 & 0 & 0 & 0 & 9 & 0 \\ 0 & 8 & 0 & 0 & 0 & 0 \\ 4 & 0 & 0 & 2 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 5 \\ 0 & 0 & 2 & 0 & 0 & 0 \end{bmatrix}$$


Rows	Columns	Values
5	6	6
0	4	9
1	1	8
2	0	4
2	2	2
3	5	5
4	2	2

Image Convolution

$$\begin{bmatrix} a & b & c \\ d & e & f \\ g & h & i \end{bmatrix} * \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$$

$$= (i * 1) + (h * 2) + (g * 3) + (f * 4) + (e * 5) + (d * 6) + (c * 7) + (b * 8) + (a * 9)$$

Image Convolution

- Using zero padding.

$$15 \cdot 2 + 0 \cdot 0 + 0 \cdot 0 + 0 \cdot 0 + 0 \cdot 1 + 0 \cdot 0 + 0 \cdot 3 + 0 \cdot 0 + 0 \cdot 1 = 30$$

2	0	0
0	1	0
3	0	1

Filter matrix

0	0	0				
0	0	0	0	0	0	0
0	0	15	0	0	22	0
	0	0	11	3	0	0
	0	0	0	0	-6	0
	0	0	0	0	0	0
	0	0	0	0	0	0

Image matrix

30					

Output matrix

Image Convolution

- Using zero padding.

$$0*2 + 15*0 + 0*0 + 0*0 + 0*1 + 0*0 + 0*3 + 0*0 + 0*1 = 0$$

2	0	0
0	1	0
3	0	1

Filter matrix

0	0	0	0	0	0
0	0	0	0	0	0
0	15	0	0	22	0
0	0	11	3	0	0
0	0	0	0	-6	0
0	0	0	0	0	0
0	0	0	0	0	0

Image matrix

30	0				

Output matrix

Image Convolution

- Using zero padding.

2	0	0
0	1	0
3	0	1

Filter matrix

	0	0	0		
0	0	0	0	0	0
0	15	0	0	22	0
0	0	11	3	0	0
0	0	0	0	-6	0
0	0	0	0	0	0
0	0	0	0	0	0

Image matrix

30	0	0			

Output matrix

Image Convolution

- Using zero padding.

2	0	0
0	1	0
3	0	1

Filter matrix

		0	0	0	
0	0	0	0	0	0
0	15	0	0	22	0
0	0	11	3	0	0
0	0	0	0	-6	0
0	0	0	0	0	0
0	0	0	0	0	0

Image matrix

30	0	0	44		

Output matrix

Image Convolution

- Using zero padding.

2	0	0
0	1	0
3	0	1

Filter matrix

0	0	0	0	0	0
0	15	0	0	22	0
0	0	11	3	0	0
0	0	0	0	-6	0
0	0	0	0	0	0
0	0	0	0	0	0

Image matrix

30	0	0	44	0	0
0	37	6	0	22	0
45	0	26	57	0	22
0	33	9	?		

Output matrix

Image Convolution

- Using zero padding.

2	0	0
0	1	0
3	0	1

Filter matrix

0	0	0	0	0	0
0	15	0	0	22	0
0	0	11	3	0	0
0	0	0	0	-6	0
0	0	0	0	0	0
0	0	0	0	0	0
				0	0
				0	0

Image matrix

30	0	0	44	0	0
0	37	6	0	22	0
45	0	26	57	0	22
0	33	9	11	-3	0
0	0	0	-18	0	-6
0	0	0	0	0	0

Output matrix

Sparse Matrices

- Details are described in CH2 Array on iLMS.

	row	col	value
smArray[0]	0	0	15
[1]	0	3	22
[2]	0	5	15
[3]	1	1	11
[4]	1	2	3
[5]	2	3	6
[6]	4	0	91
[7]	5	2	28

Eight non-zeros

col

row

15	0	0	22	0	15
0	11	3	0	0	0
0	0	0	6	0	0
0	0	0	0	0	0
91	0	0	0	0	0
0	0	28	0	0	0

Input

The first number describes the amount of matrix convolution we want to compute.



2

6	6	5
1	1	15
1	4	22
2	2	11
2	3	3
3	4	-6
3	3	4
0	0	2
1	1	1
2	0	3
2	2	1

First group

Second group

Input

Image matrix's #row, #col, #non-zeros.

Image matrix's non-zero term's row, col, value.

Example image matrix

0	0	0	0	0	0
0	15	0	0	22	0
0	0	11	3	0	0
0	0	0	0	-6	0
0	0	0	0	0	0
0	0	0	0	0	0

2

6 6 5
1 1 15
1 4 22
2 2 11
2 3 3
3 4 -6

First group

3 3 4
0 0 2
1 1 1
2 0 3
2 2 1

Second group

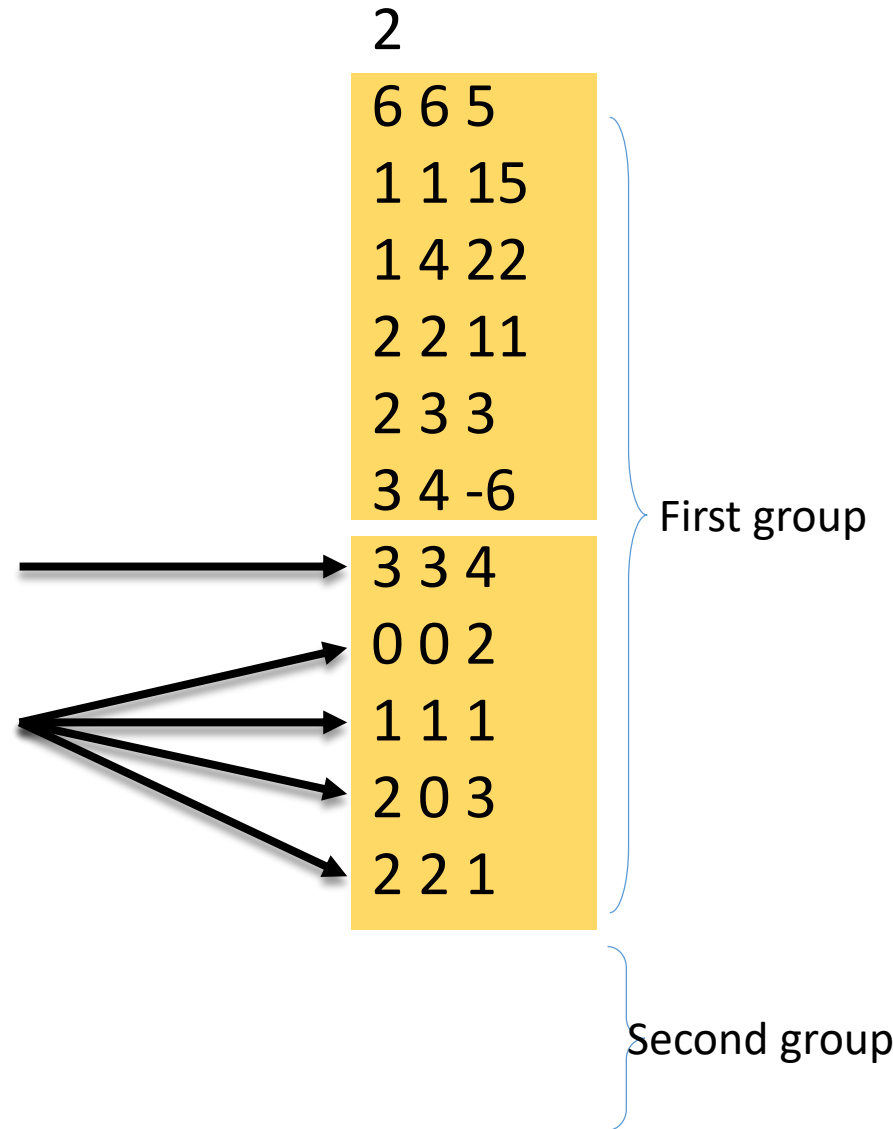
Input

Example filter matrix

2	0	0
0	1	0
3	0	1

Filter matrix's #row, #col, #non-zeros.

Filter matrix's non-zero term's row, col, value

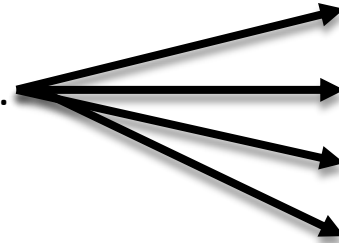


Output

Output matrix's #row, #col, #non-zeros.



Output matrix's non-zero term's row, col, value.



6 6 15
0 0 30
0 3 44
1 1 37
1 2 6
1 4 22
...

First result

Example output matrix

30	0	0	44	0	0
0	37	6	0	22	0
45	0	26	57	0	22
0	33	9	11	-3	0
0	0	0	-18	0	-6
0	0	0	0	0	0

[Empty yellow box]

Second Result