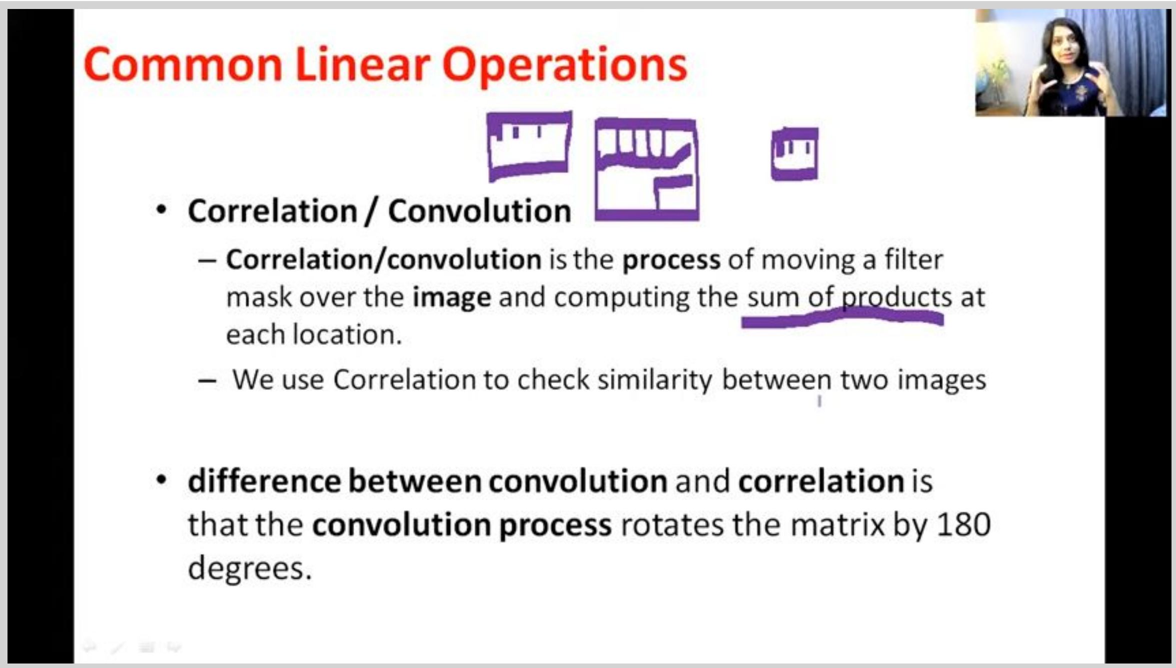
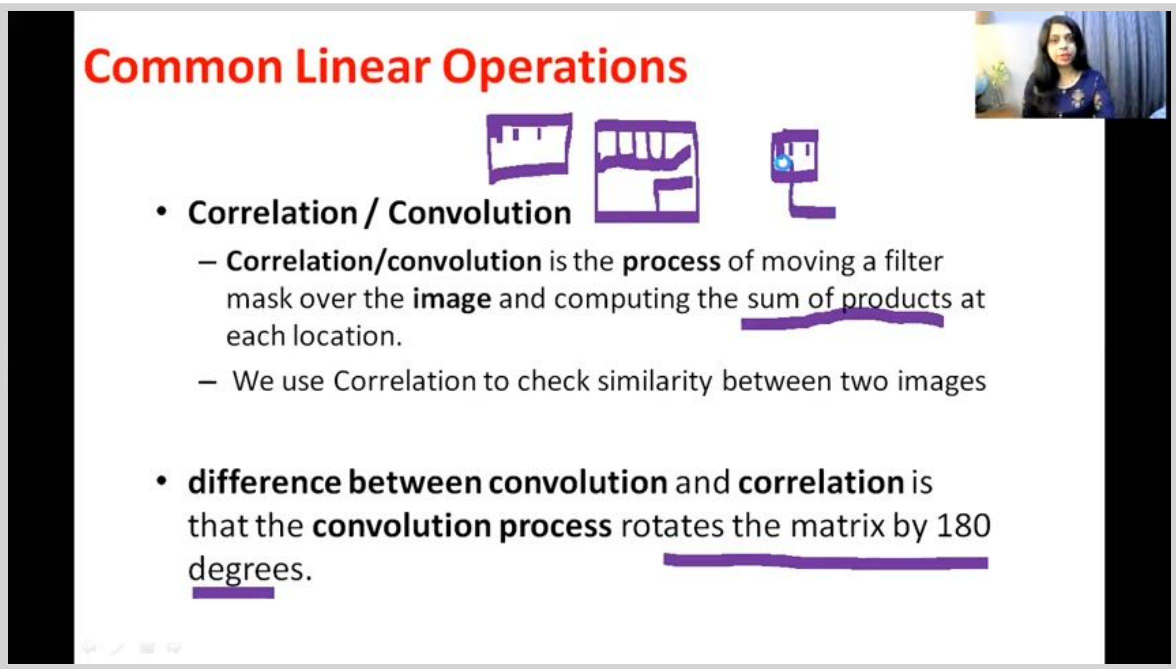
←

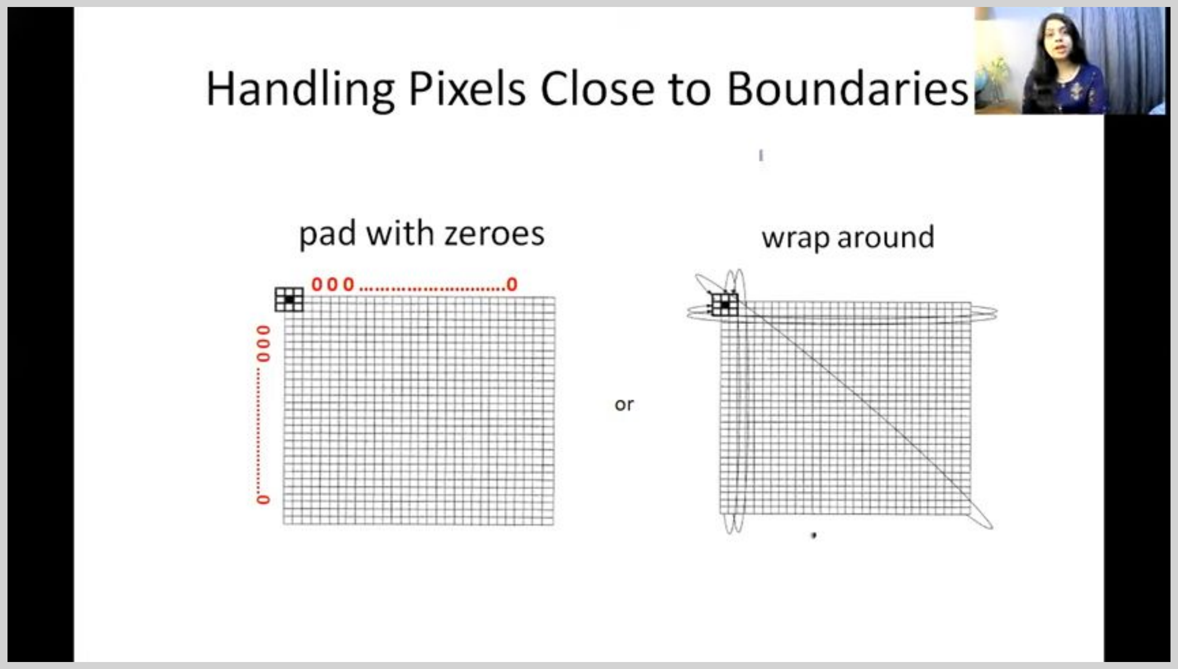
[01:31]



[01:56]

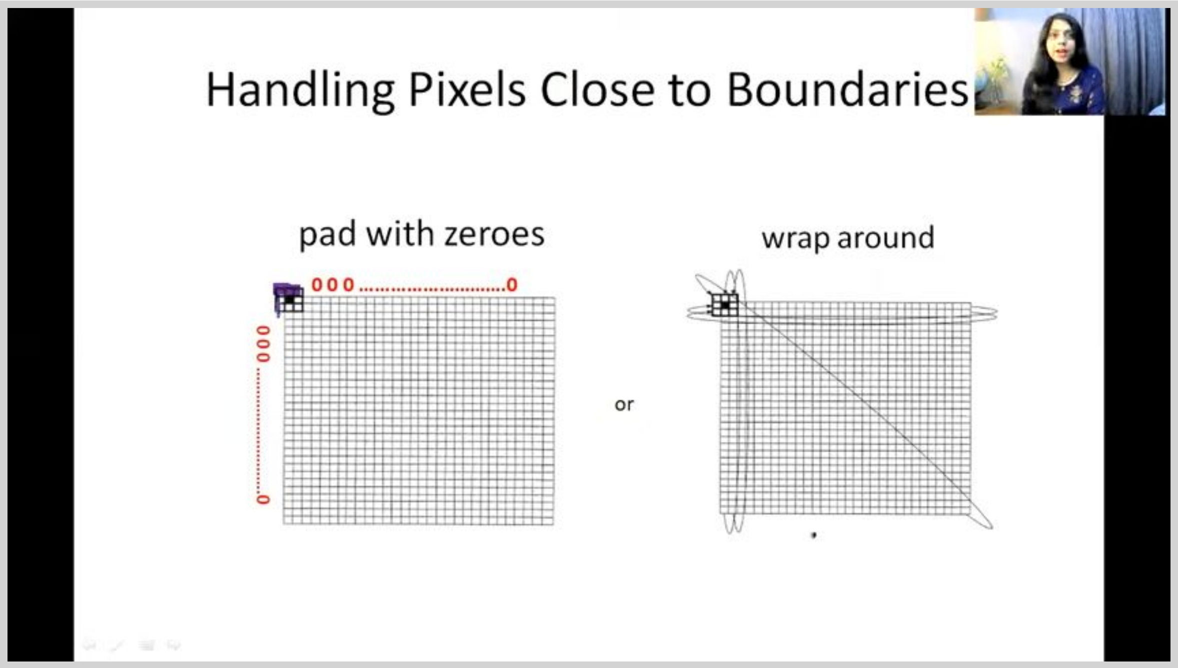


[02:04]



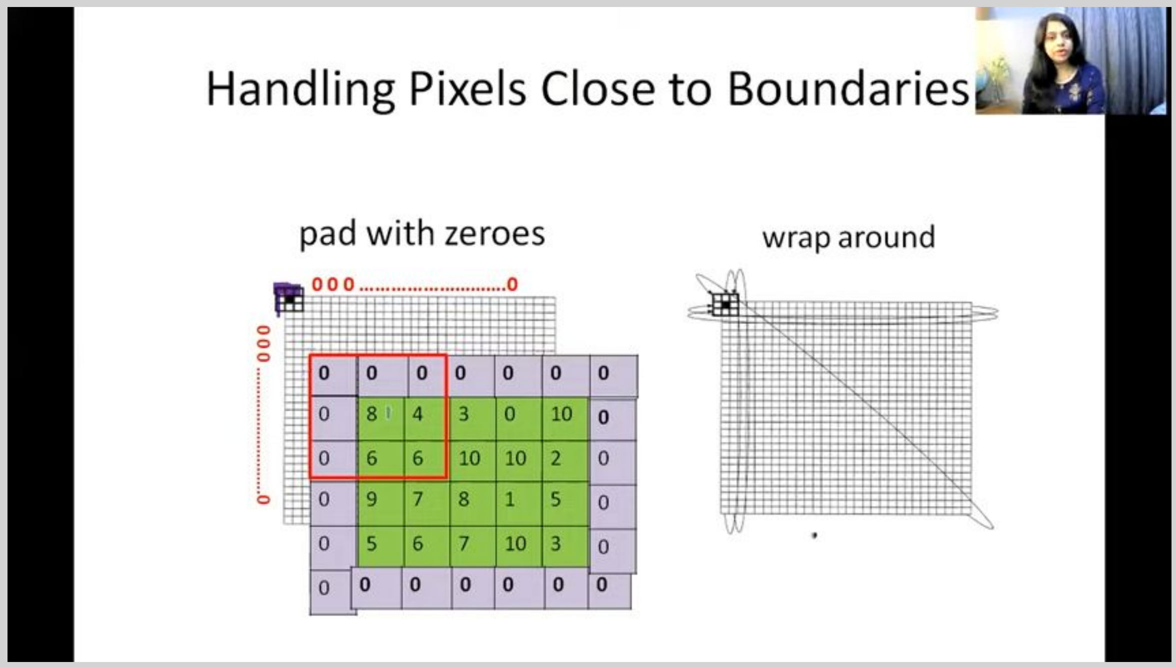
Handling Pixels Close to Boundaries
pad with zeroes
wrap around
000.............................0
000.............................0
or

02:27

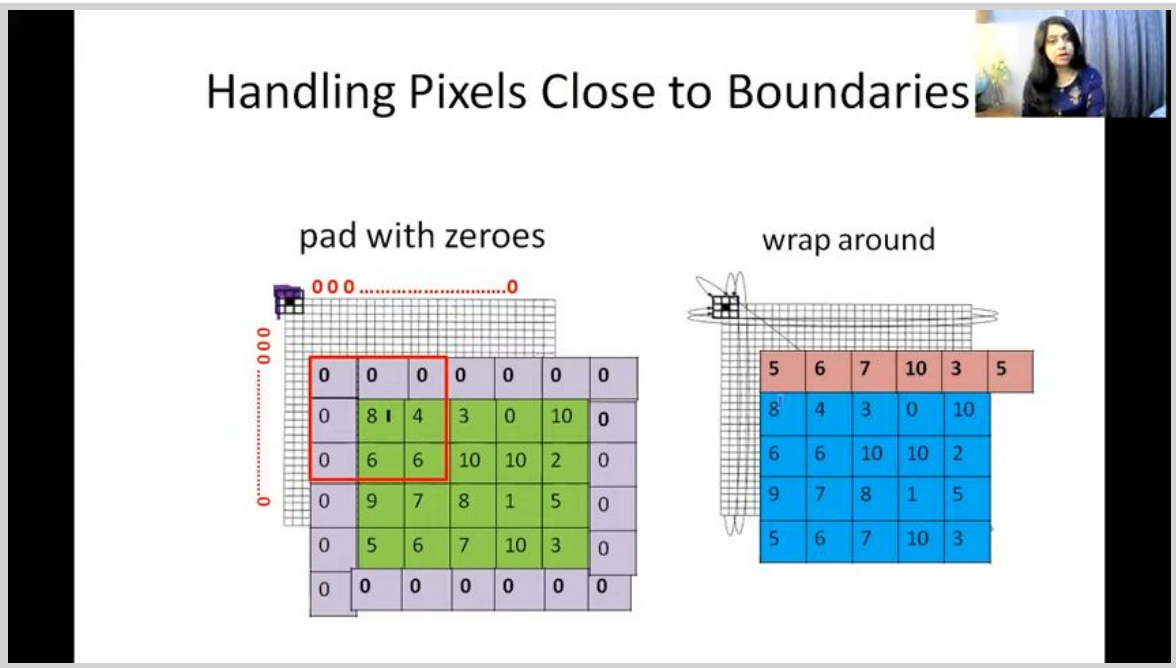


Handling Pixels Close to Boundaries
pad with zeroes
wrap around
000.............................0
000.............................0
or

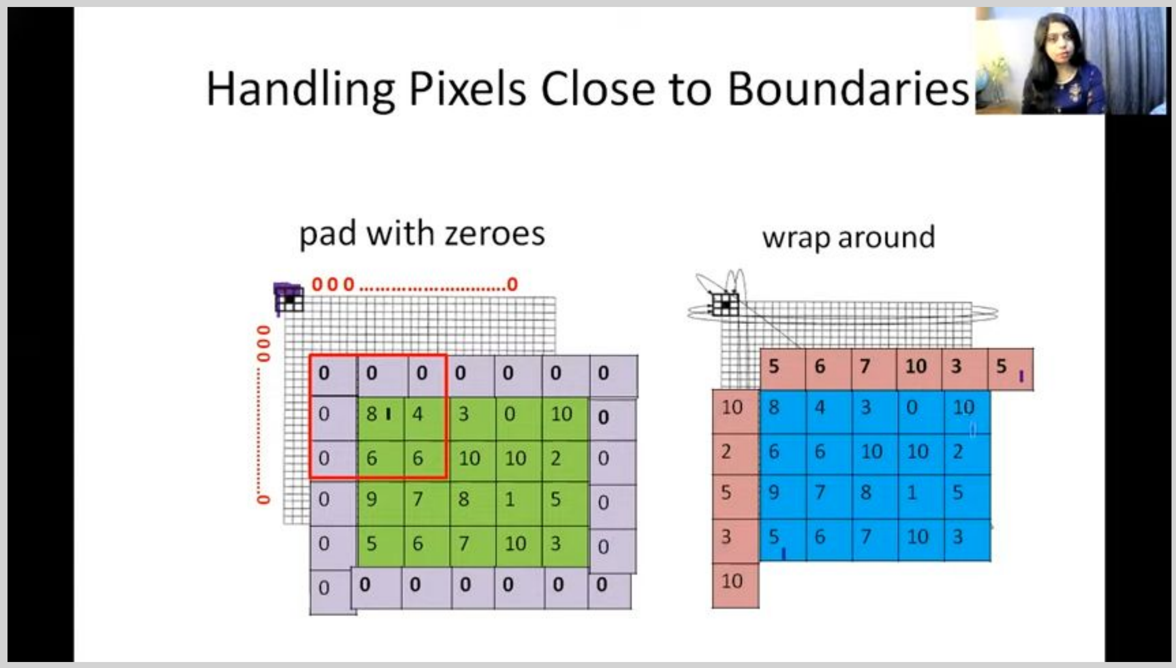
02:51


Handling Pixels Close to Boundaries
pad with zeroes
wrap around

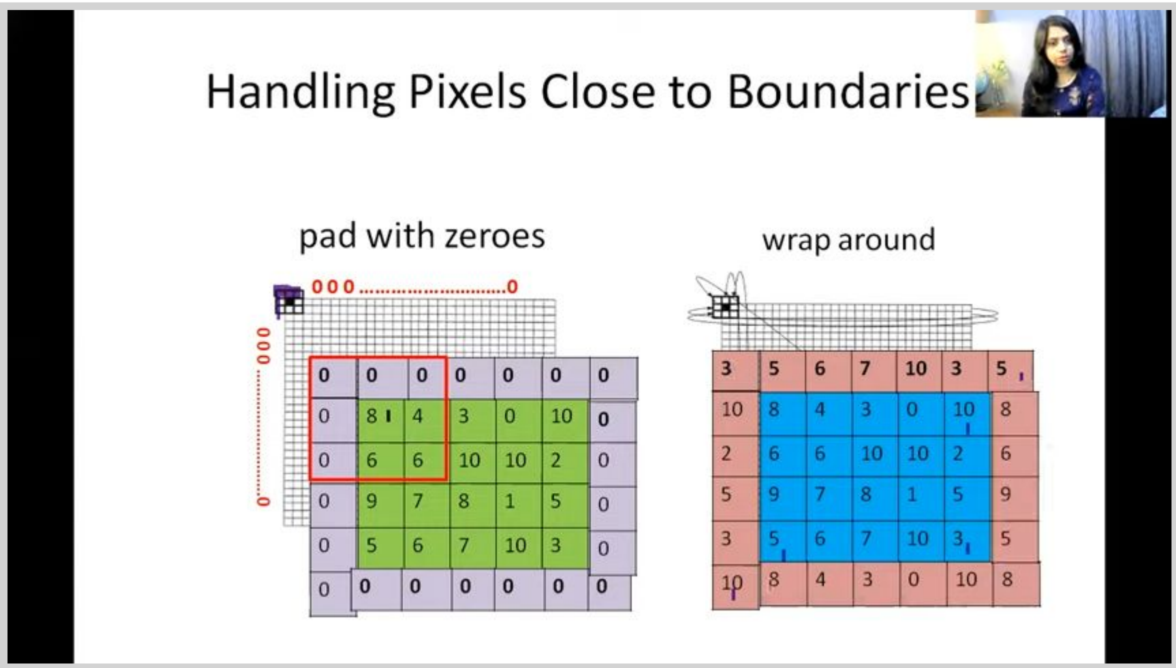
[03:11](#)


Handling Pixels Close to Boundaries
pad with zeroes
wrap around

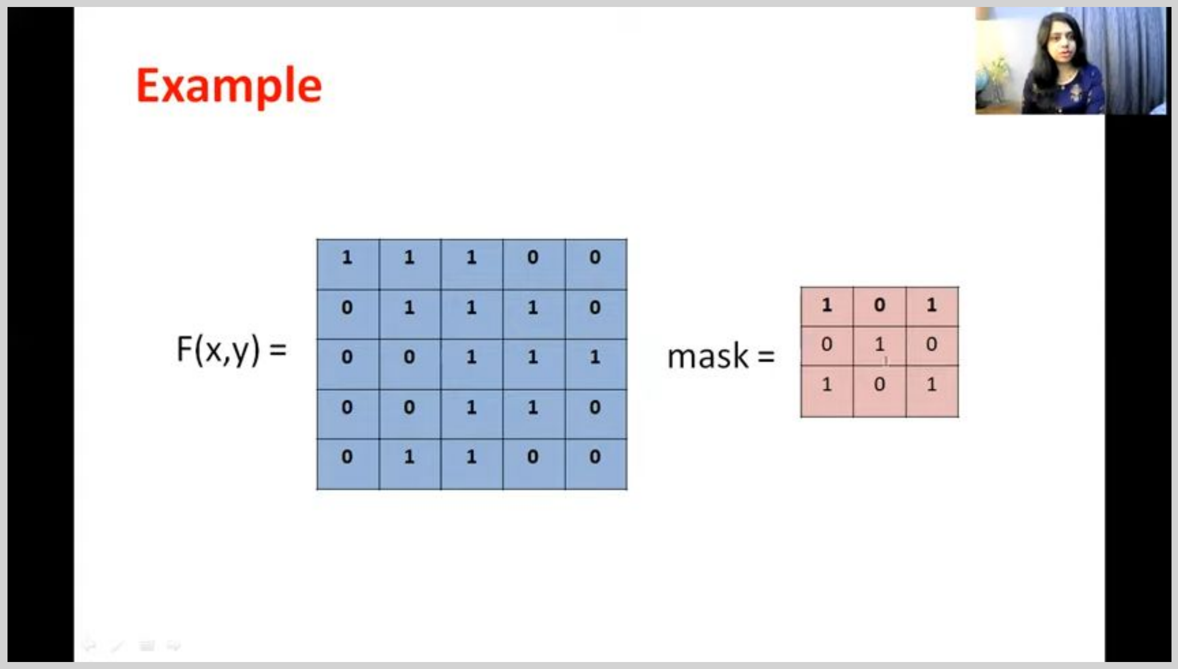
[03:20](#)


Handling Pixels Close to Boundaries
pad with zeroes
wrap around

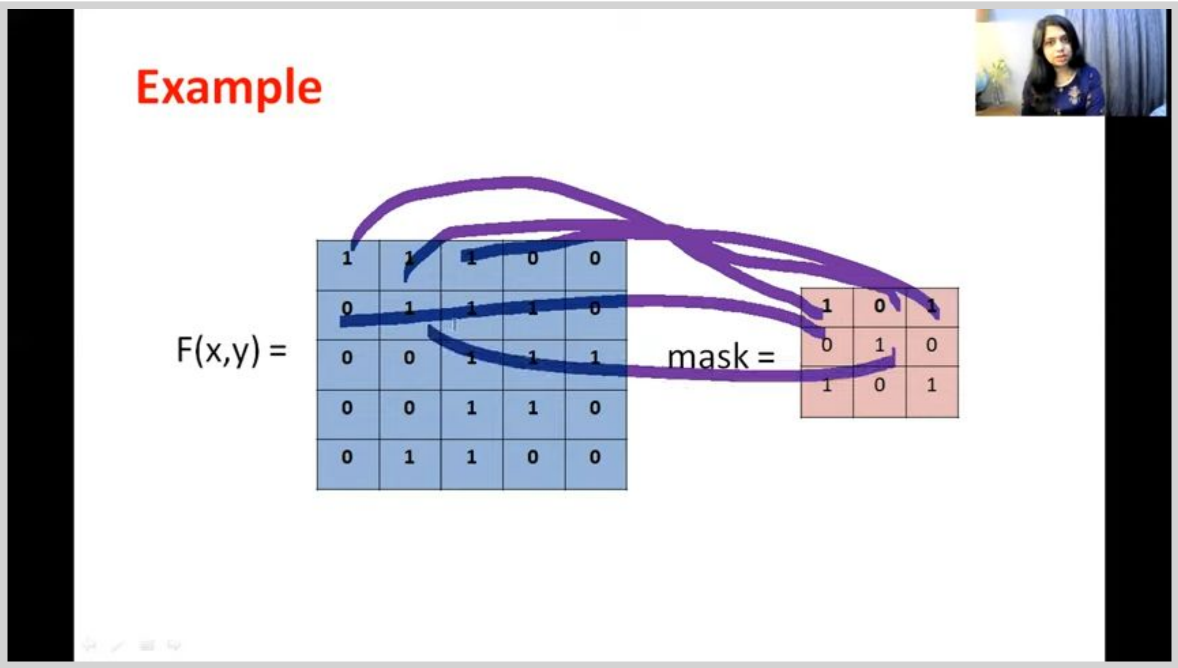
[03:37]


Handling Pixels Close to Boundaries
pad with zeroes
wrap around

[04:11]

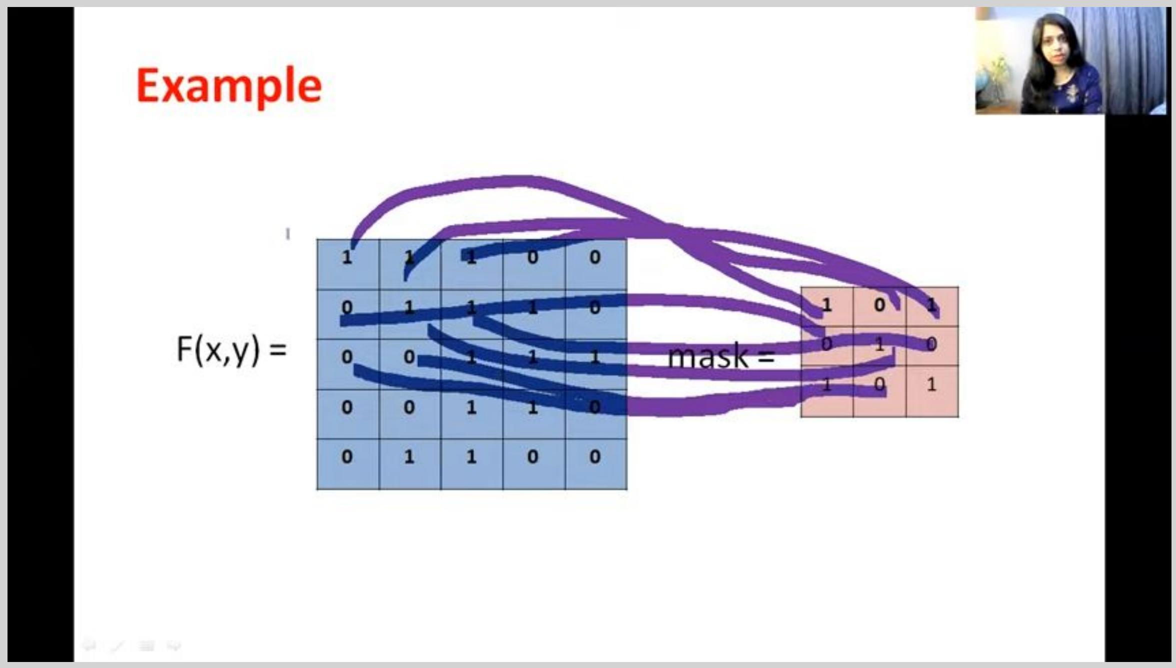


04:35

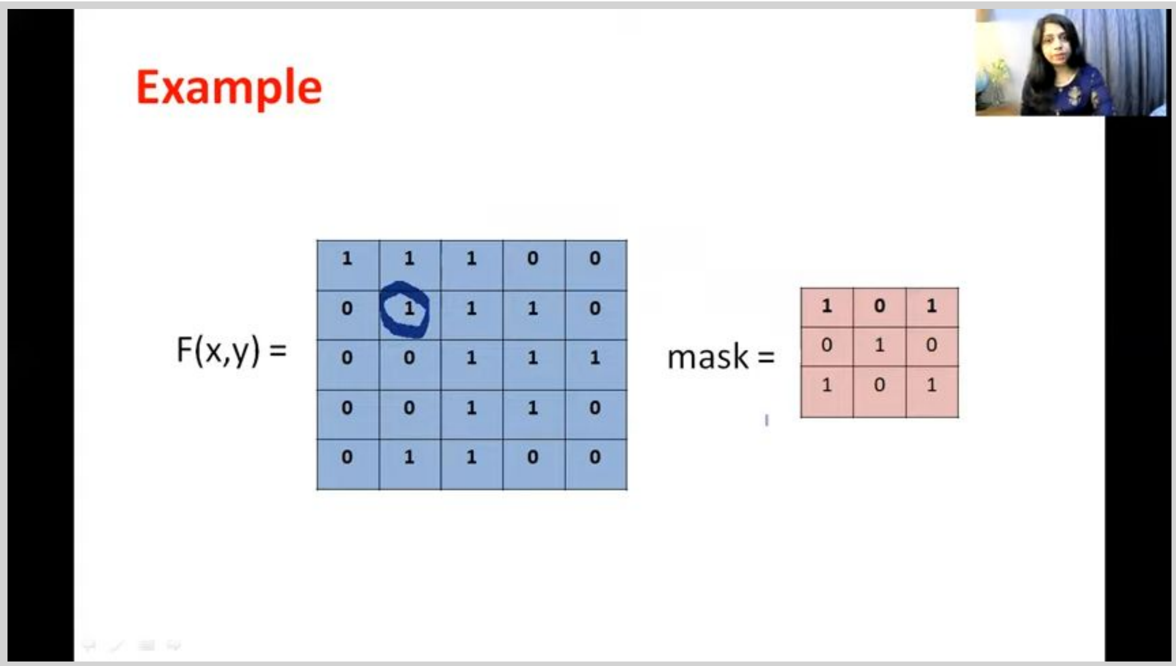


product

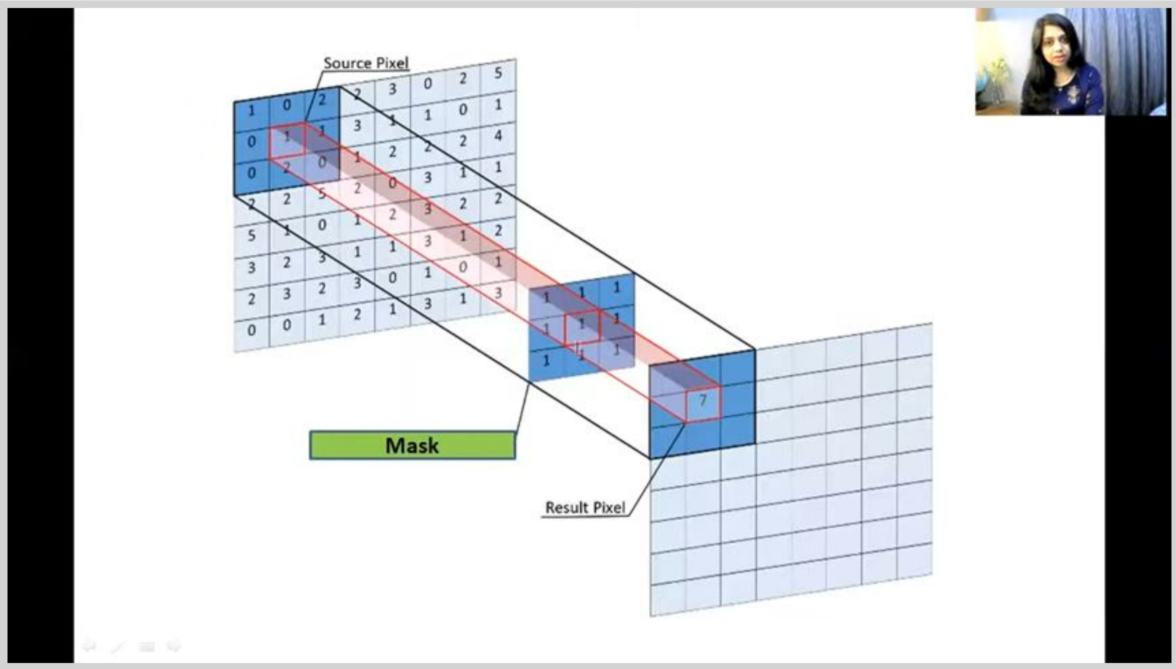
04:43


Example
F(x,y) =
mask =

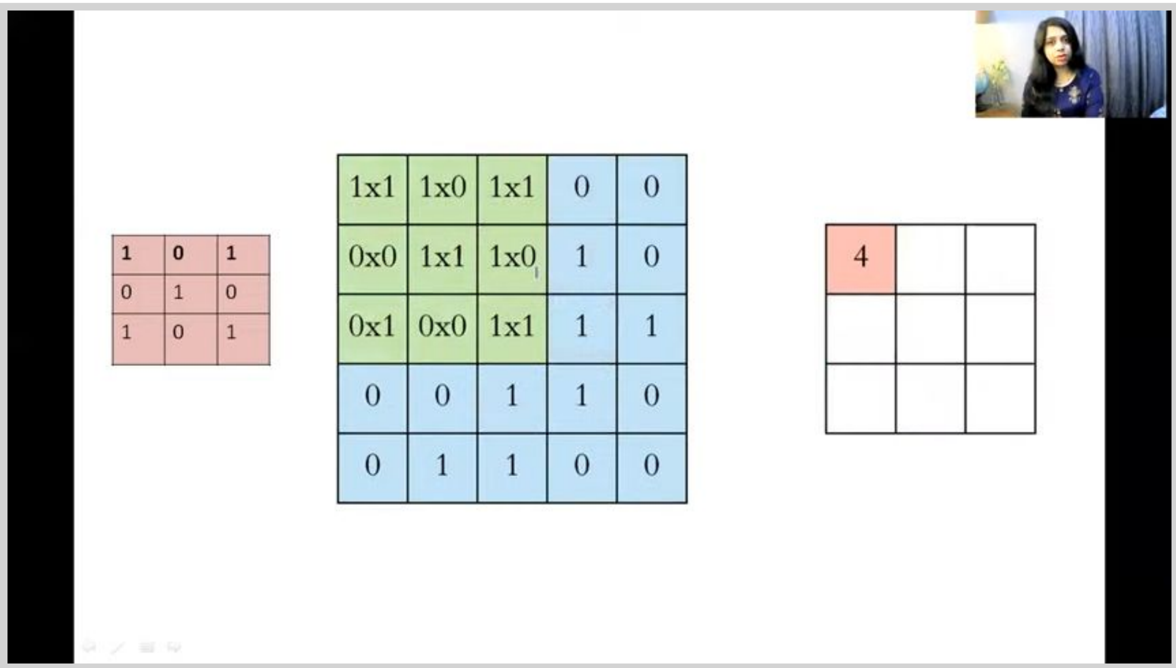
05:06


Example
F(x,y) =
1 1 1 0 0
0 1 1 1 0
0 0 1 1 1
0 0 1 1 0
0 1 1 0 0
mask =
1 0 1
0 1 0
1 0 1

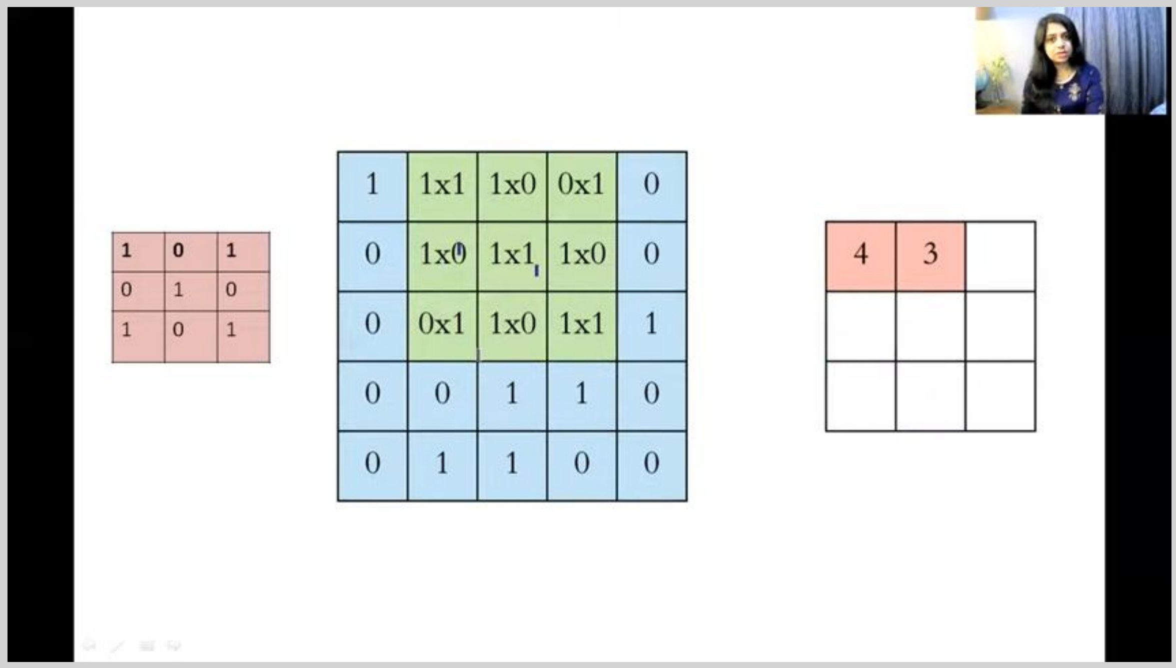
05:10


Source Pixel
Mask
Result Pixel

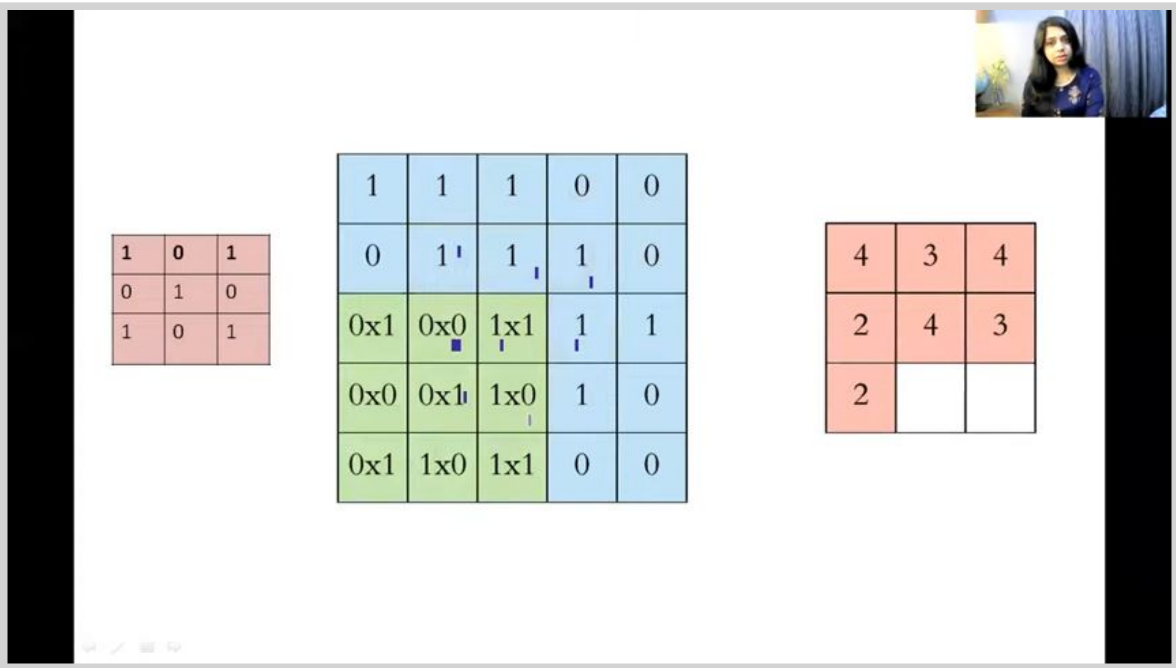
[05:33]


1 0 1
0 1 0
1 0 1
1x1 1x0 1x1 0 0
0x0 1x1 1x0 1 0
0x1 0x0 1x1 1 1
0 0 1 1 0
0 1 1 0 0
4

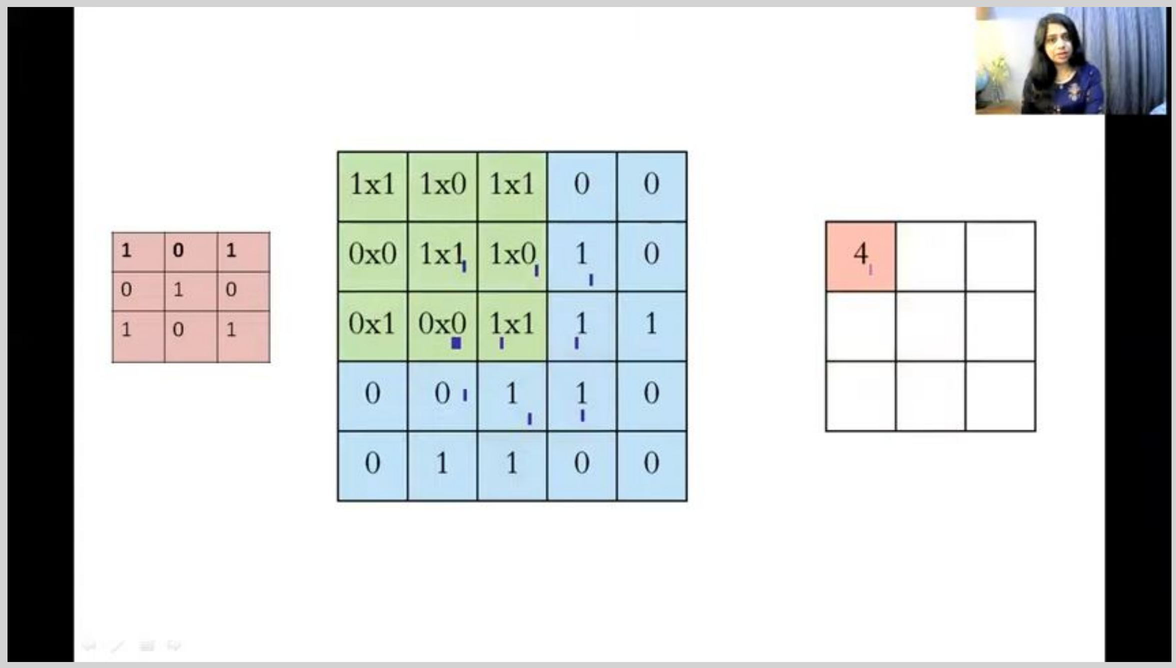
[05:34]


1 0 1
0 1 0
1 0 1
1 1x1 1x0 0x1 0
0 1x0 1x1 1x0 0
0 0x1 1x0 1x1 1
0 0 1 1 0
0 1 1 0 0
4 3

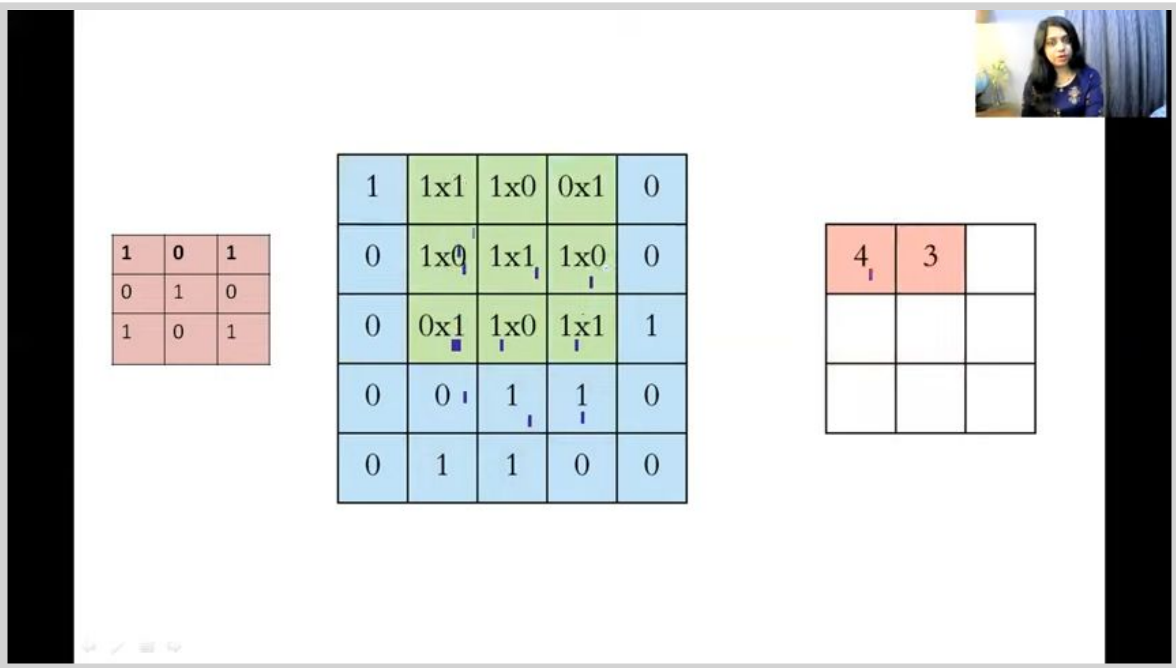
[05:39](#)


1 0 1
0 1 0
1 0 1
1 1 1 0 0
0 1 1 1 0
0x1 0x0 1x1 1 1
0x0 0x1 1x0 1 0
0x1 1x0 1x1 0 0
4 3 4
2 4 3
2

[05:42](#)

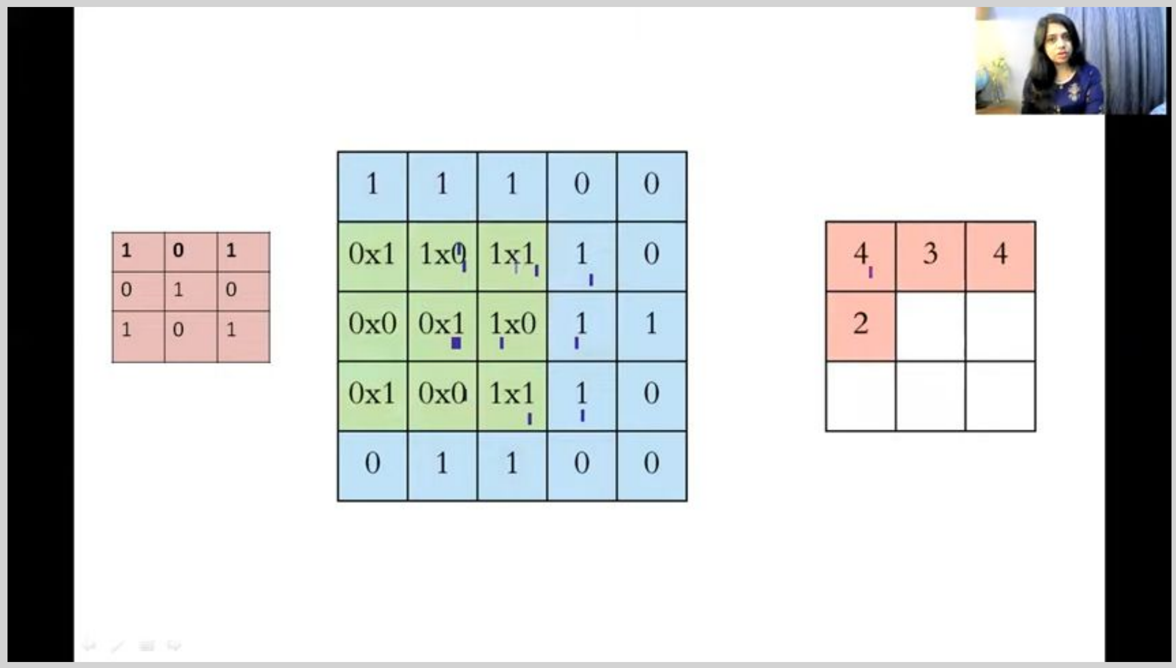


05:43

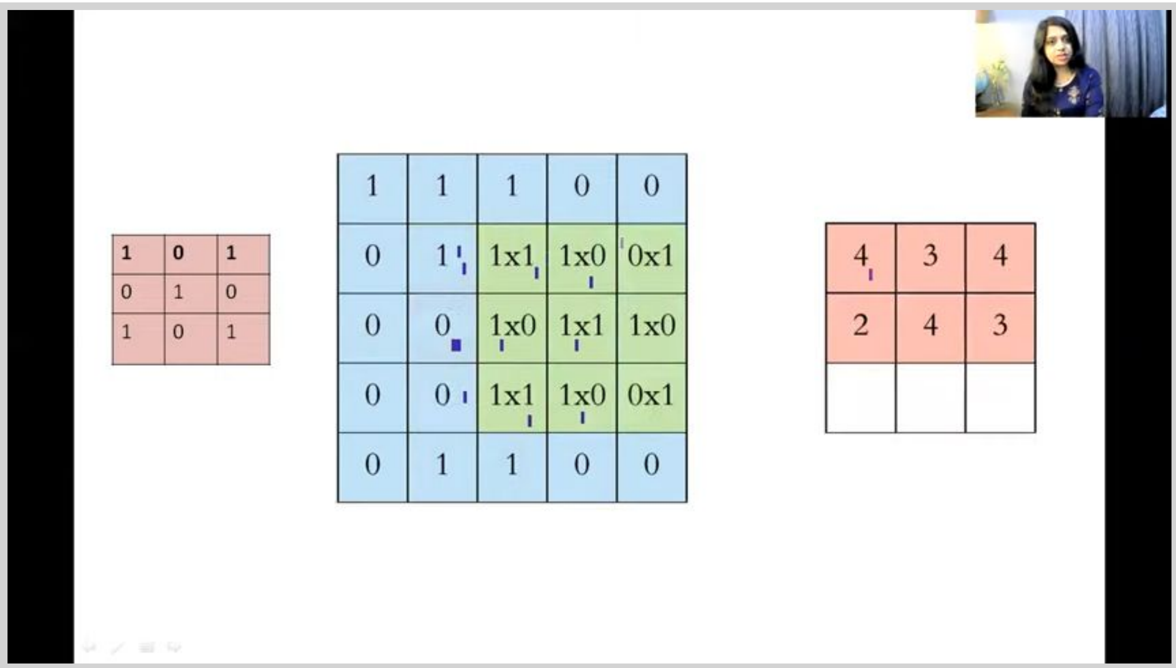


05:44

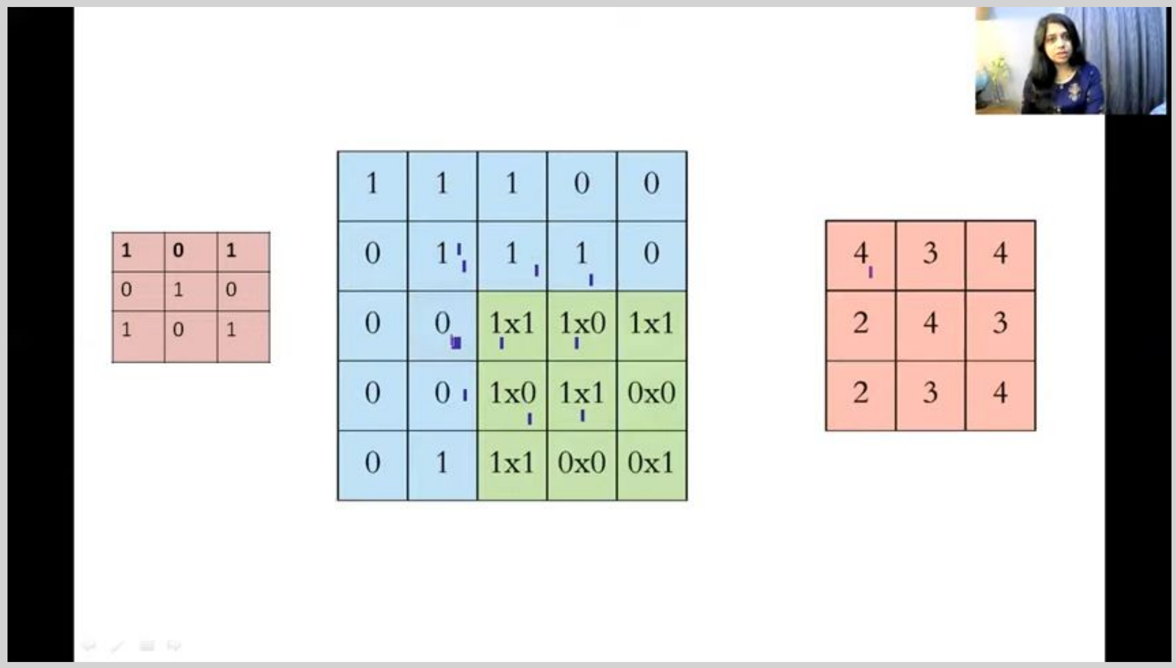
05:46


1 0 1
0 1 0
1 0 1
1 1 1 0 0
0x1 1x0 1x1 1 0
0x0 0x1 1x0 1 1
0x1 0x0 1x1 1 0
0 1 1 0 0
4 3 4
2

[05:47](#)


1 0 1
0 1 0
1 0 1
1 1 1 0 0
0 1 1x1 1x0 0x1
0 0 1x0 1x1 1x0
0 0 1x1 1x0 0x1
0 1 1 0 0
4 3 4
2 4 3

[05:51](#)



[06:19](#)

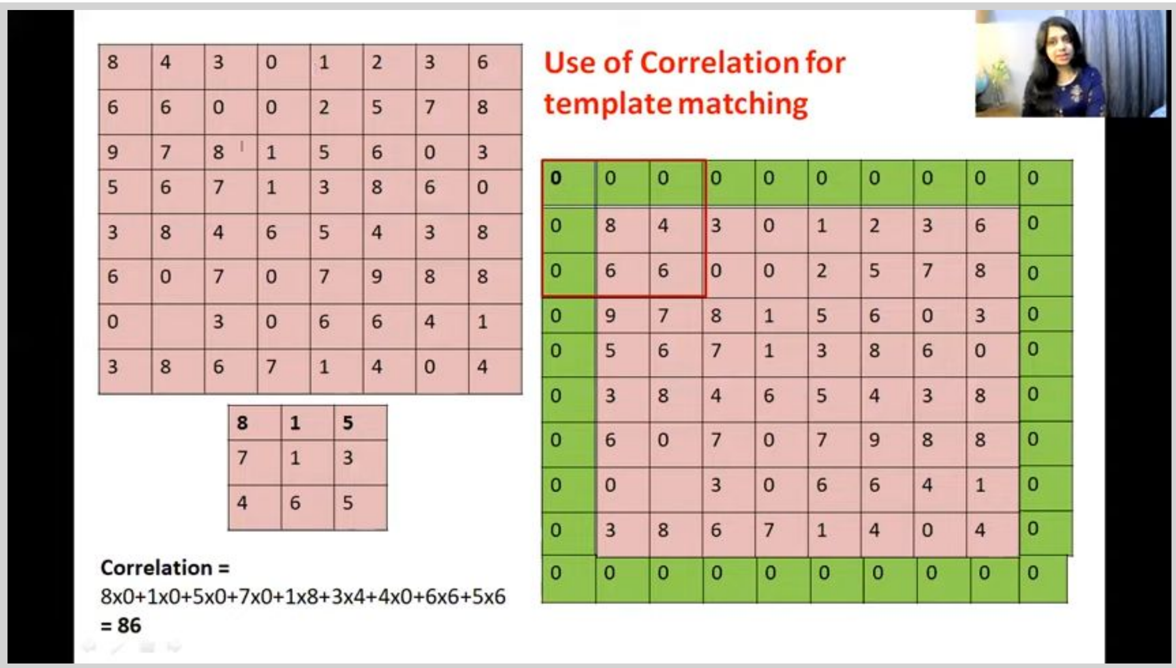
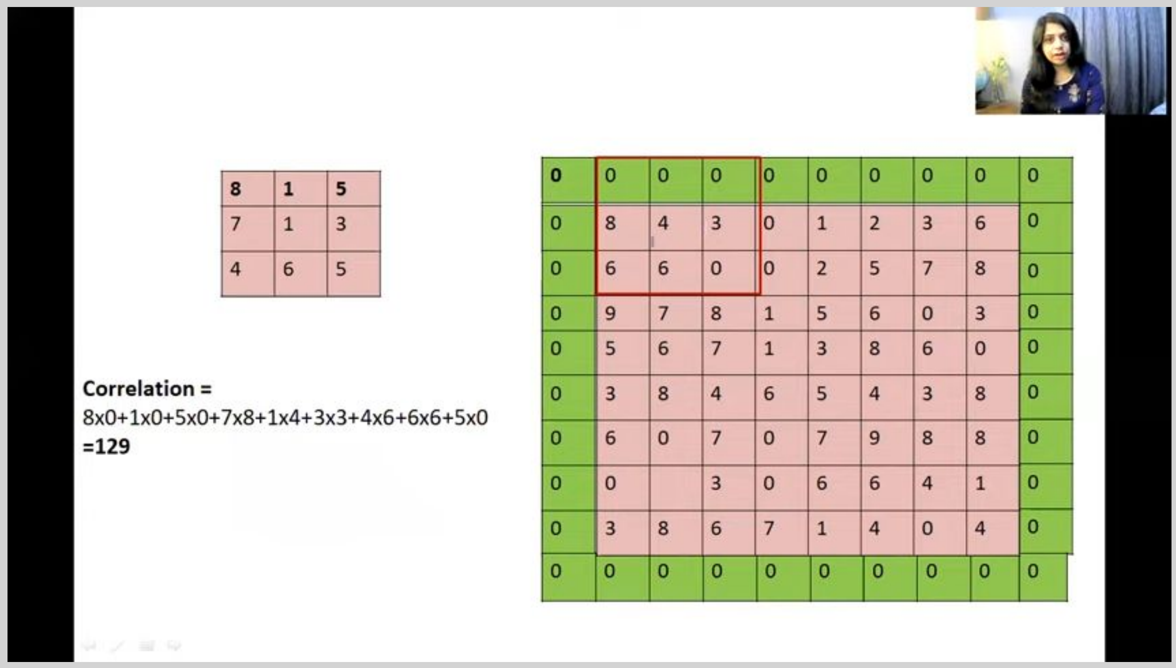
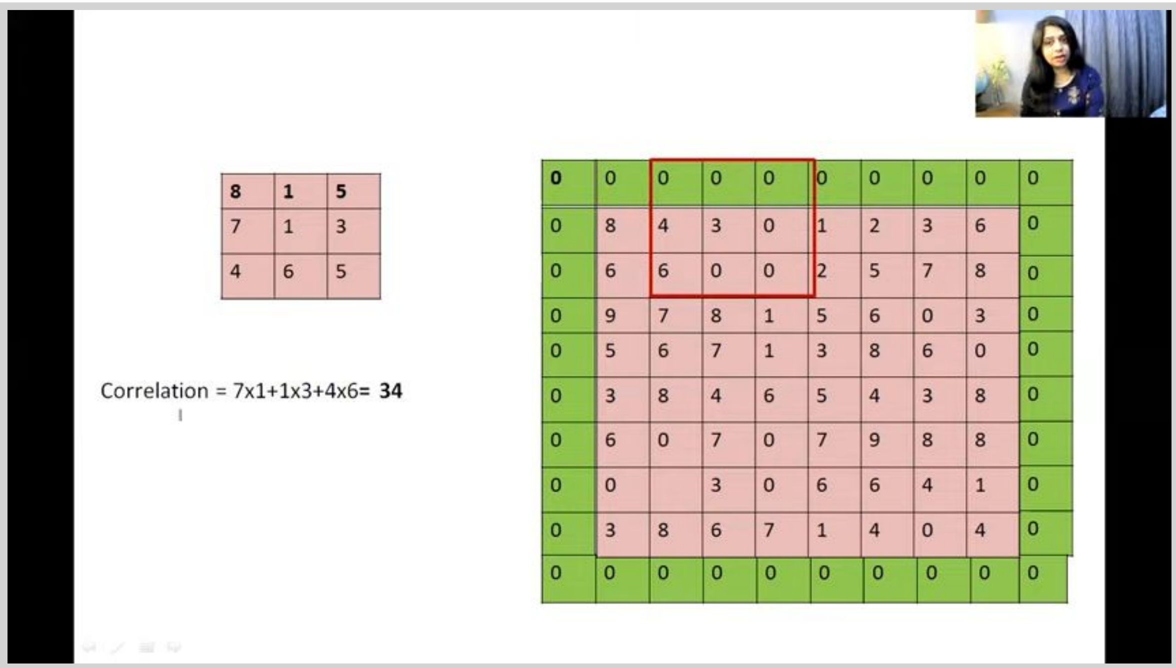


image 8 x 8

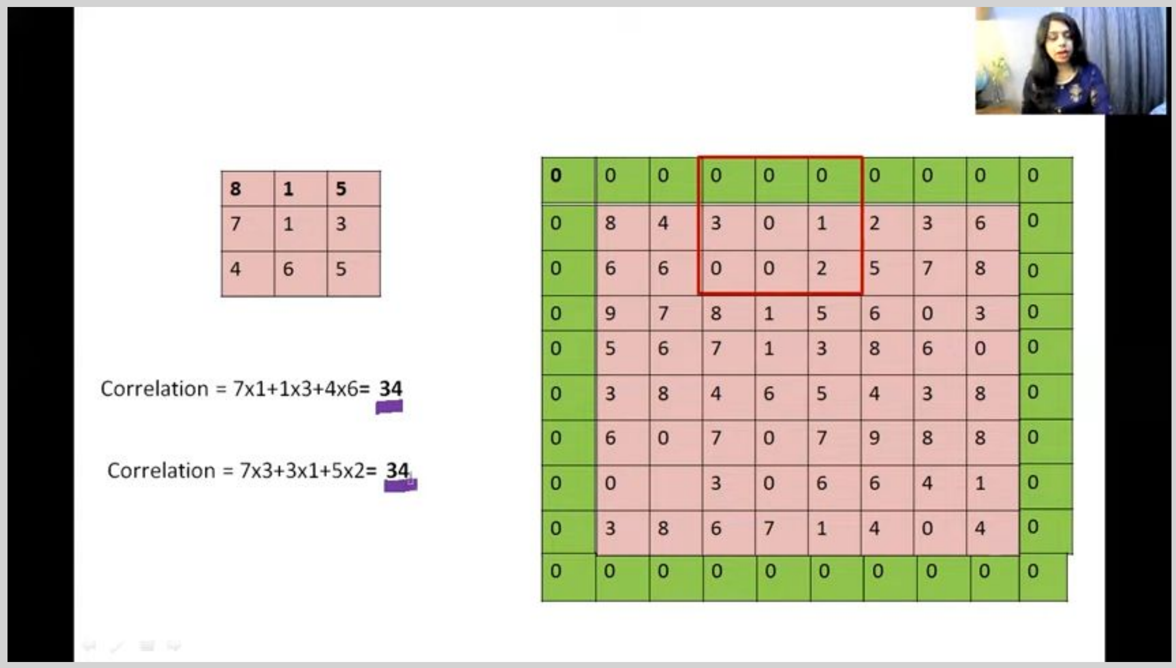
[07:31](#)


Correlation =
8x0+1x0+5x0+7x8+1x4+3x3+4x6+6x6+5x0
=129

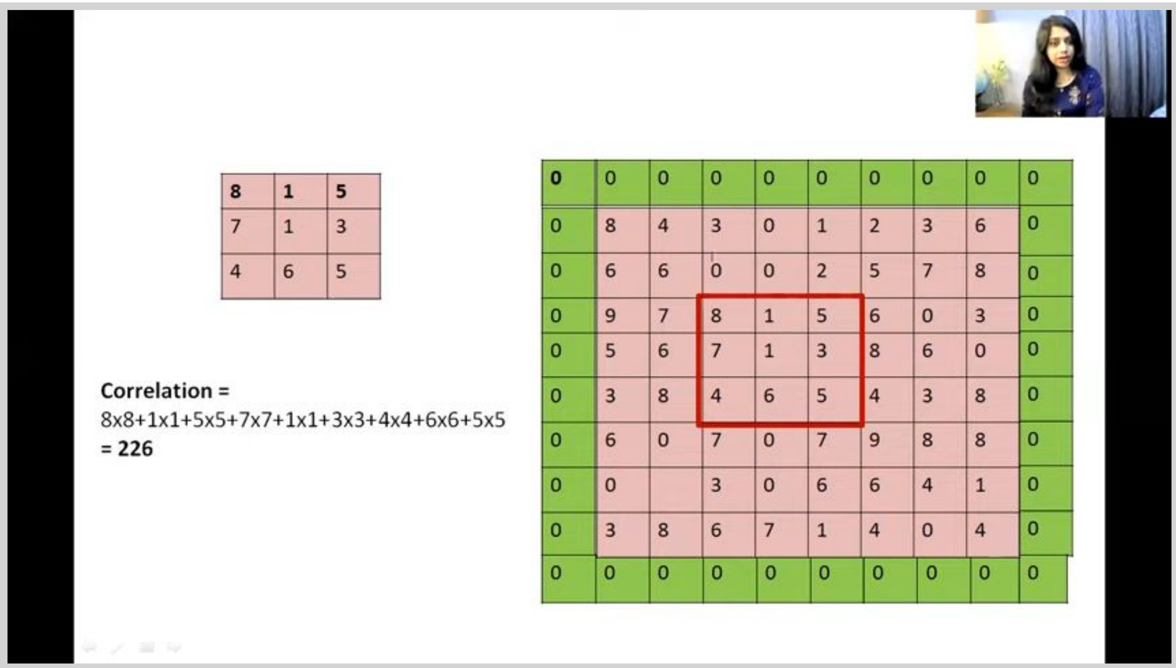
[07:38](#)


Correlation = 7x1+1x3+4x6= 34

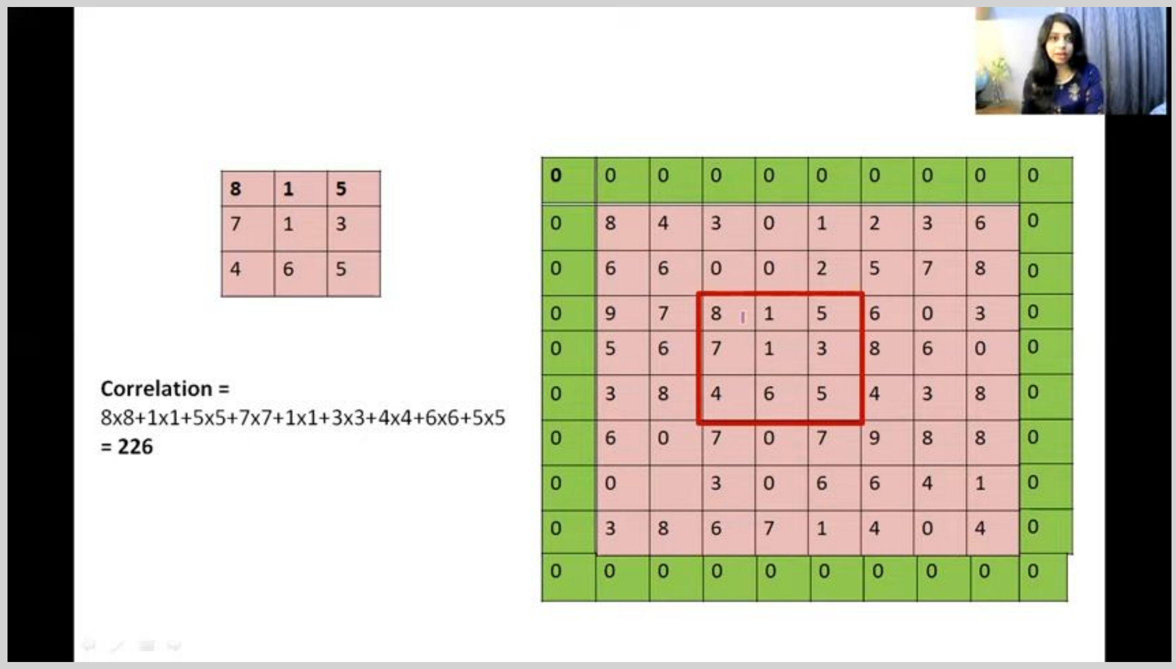
[07:57](#)


8 1 5
7 1 3
4 6 5
Correlation = 7x1+1x3+4x6= 34
Correlation = 7x3+3x1+5x2= 34
0 0 0 0 0 0 0 0 0 0
0 8 4 3 0 1 2 3 6 0
0 6 6 0 0 2 5 7 8 0
0 9 7 8 1 5 6 0 3 0
0 5 6 7 1 3 8 6 0 0
0 3 8 4 6 5 4 3 8 0
0 6 0 7 0 7 9 8 8 0
0 0 3 0 6 6 4 1 0
0 3 8 6 7 1 4 0 4 0
0 0 0 0 0 0 0 0 0 0

[08:02]


8 1 5
7 1 3
4 6 5
Correlation =
8x8+1x1+5x5+7x7+1x1+3x3+4x4+6x6+5x5
= 226
0 0 0 0 0 0 0 0 0 0
0 8 4 3 0 1 2 3 6 0
0 6 6 0 0 2 5 7 8 0
0 9 7 8 1 5 6 0 3 0
0 5 6 7 1 3 8 6 0 0
0 3 8 4 6 5 4 3 8 0
0 6 0 7 0 7 9 8 8 0
0 0 3 0 6 6 4 1 0
0 3 8 6 7 1 4 0 4 0
0 0 0 0 0 0 0 0 0 0

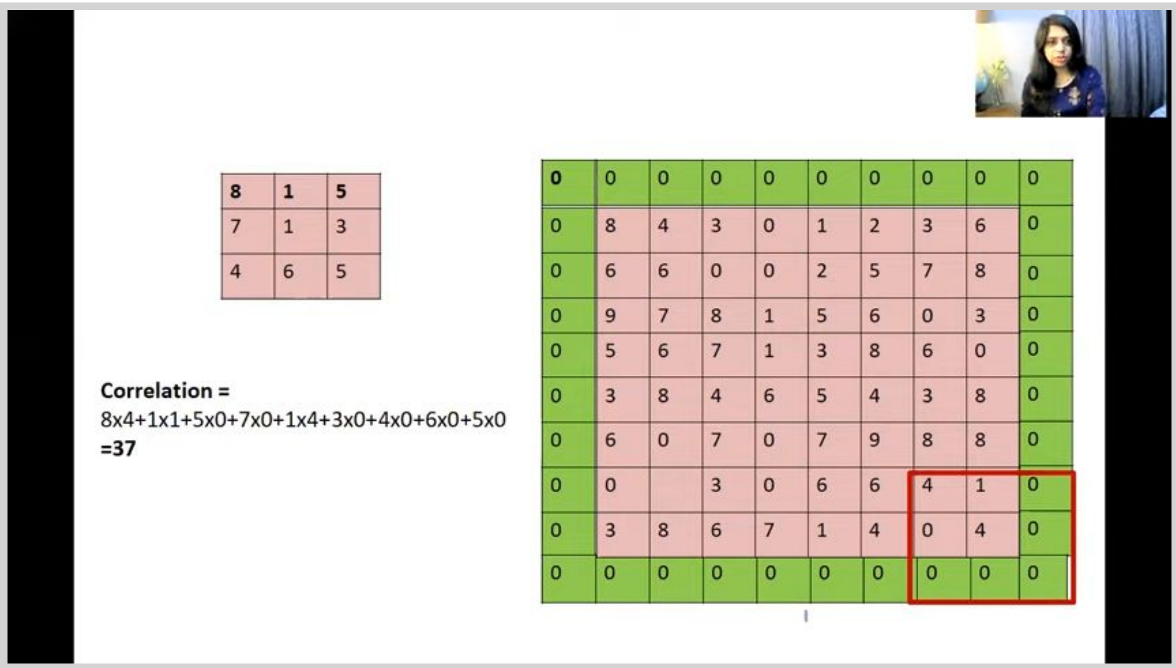
[08:16]



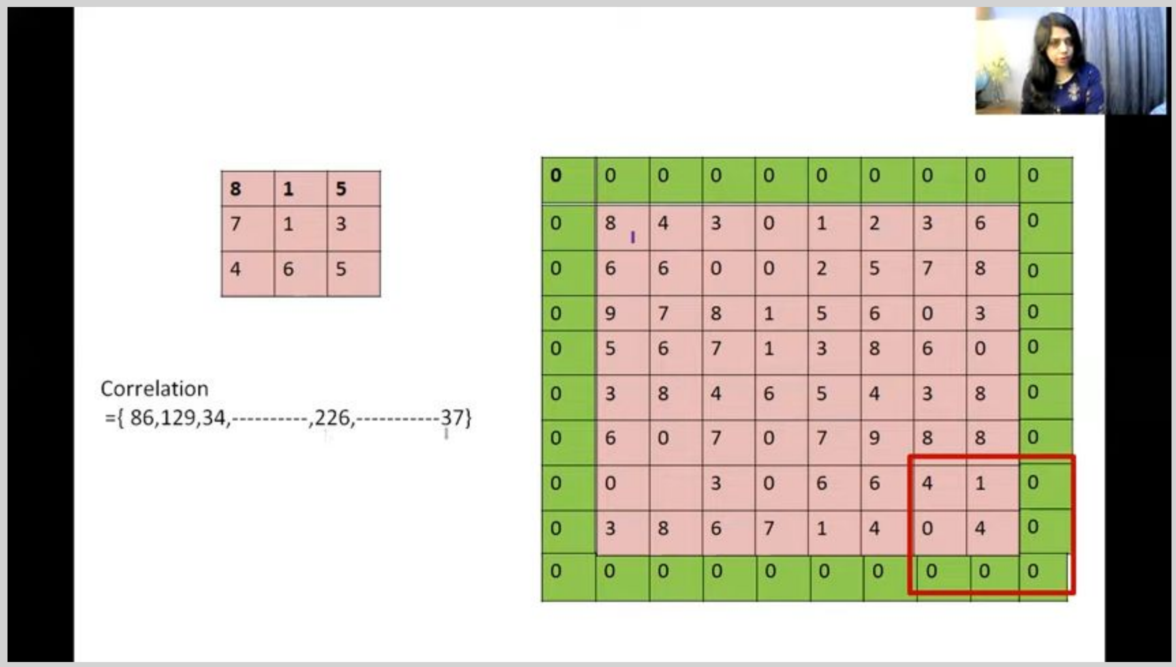
when mask and image value same :

you get the highest value like above..

[09:03]



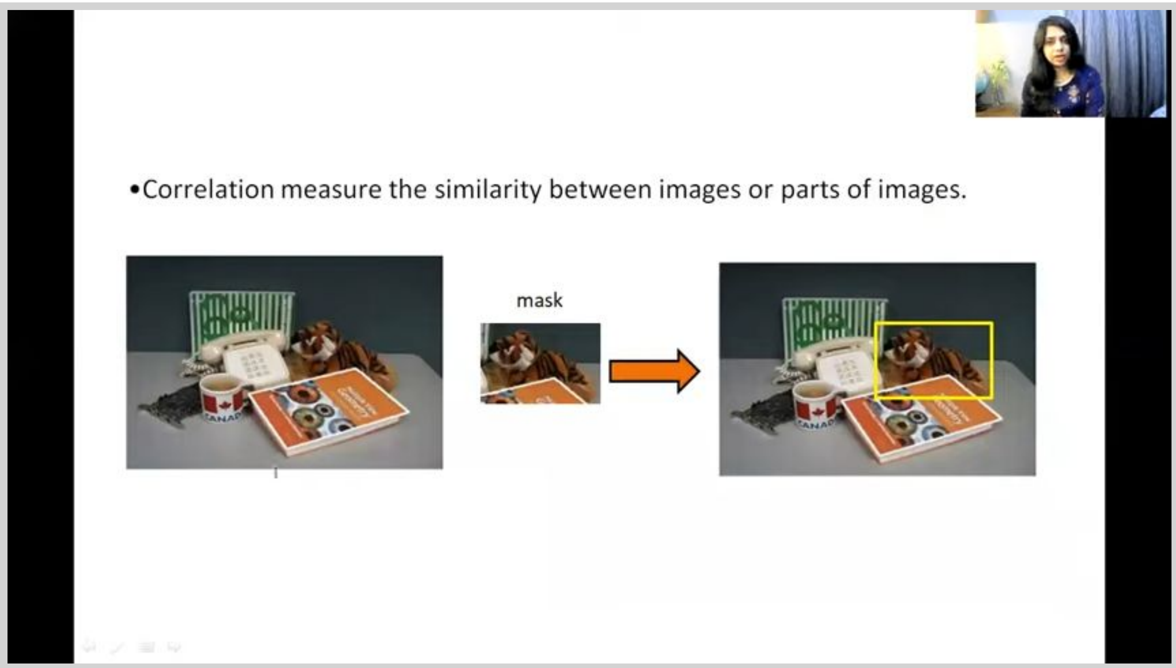
[09:29]



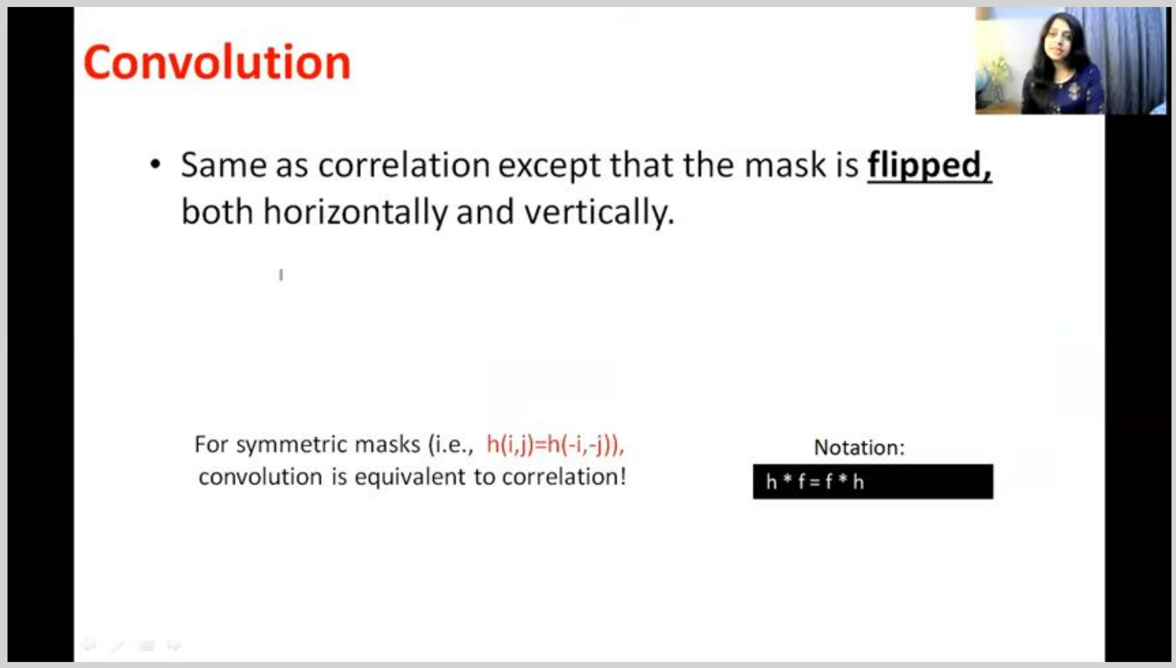
8	**1**	**5**
7	1	3
4	6	5

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

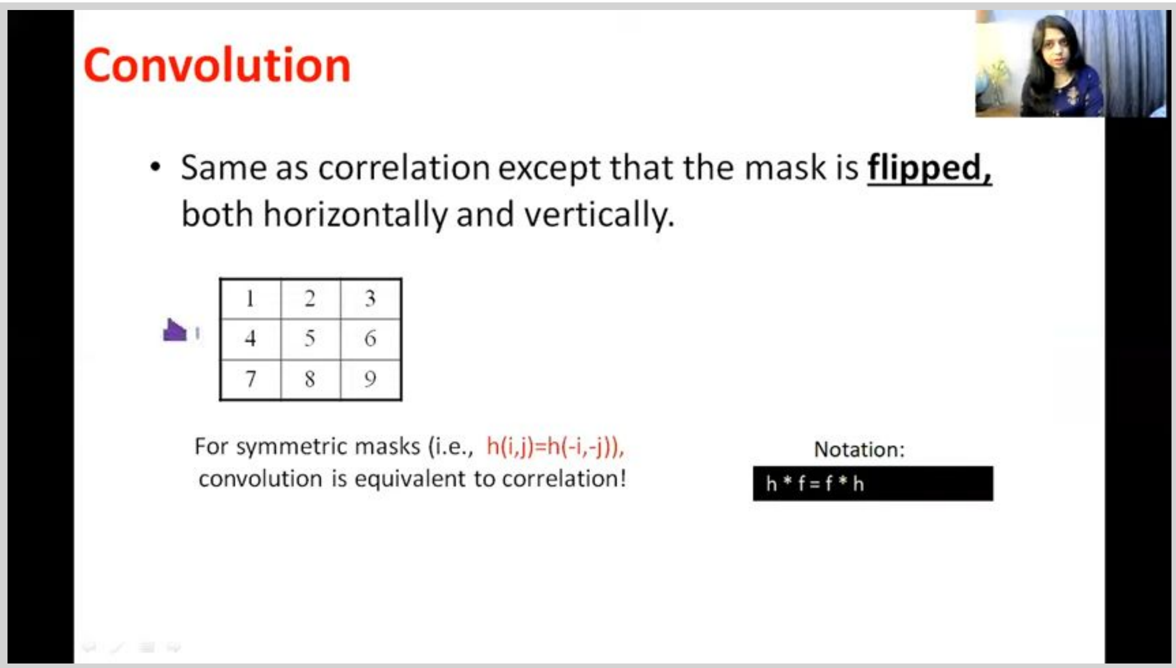
09:48



10:18

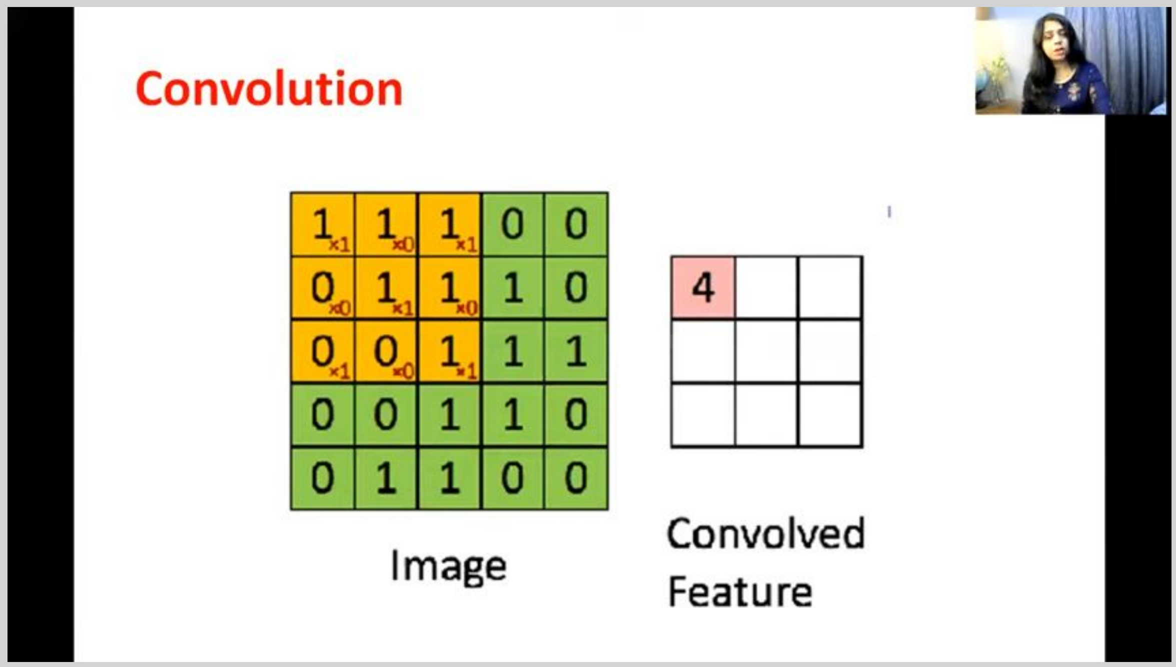


[10:35](#)

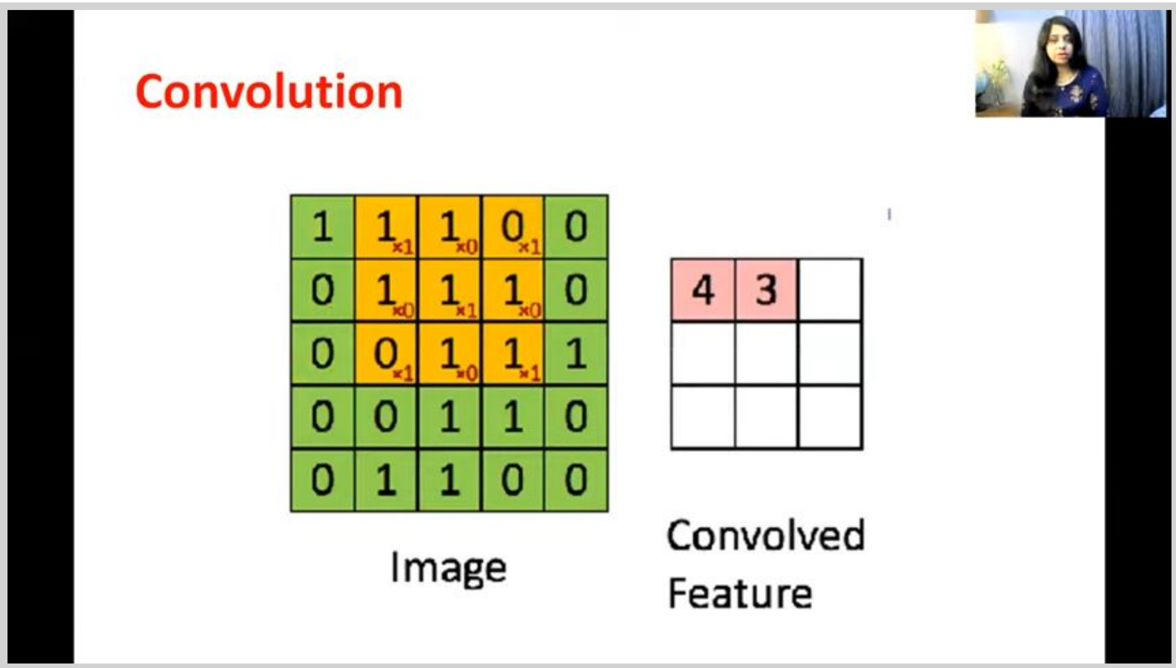


[11:04](#)

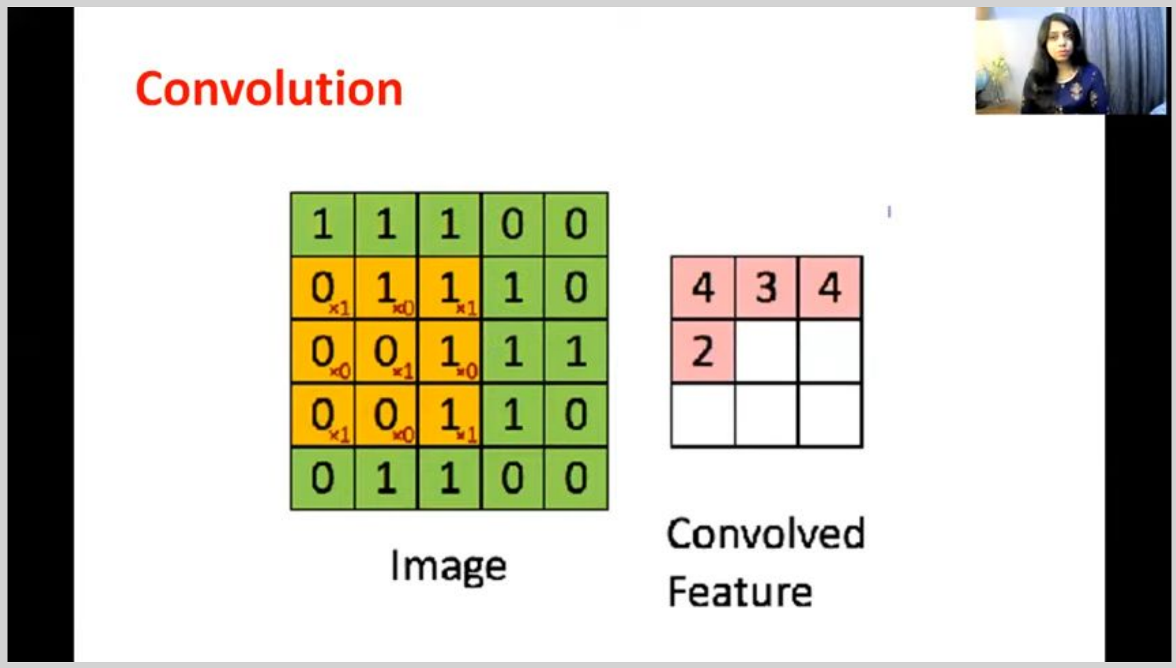
[11:16](#)


Convolution
1 1 1 0 0
0 1 1 1 0
0 0 1 1 1
0 0 1 1 0
0 1 1 0 0
Image
4
Convolved
Feature

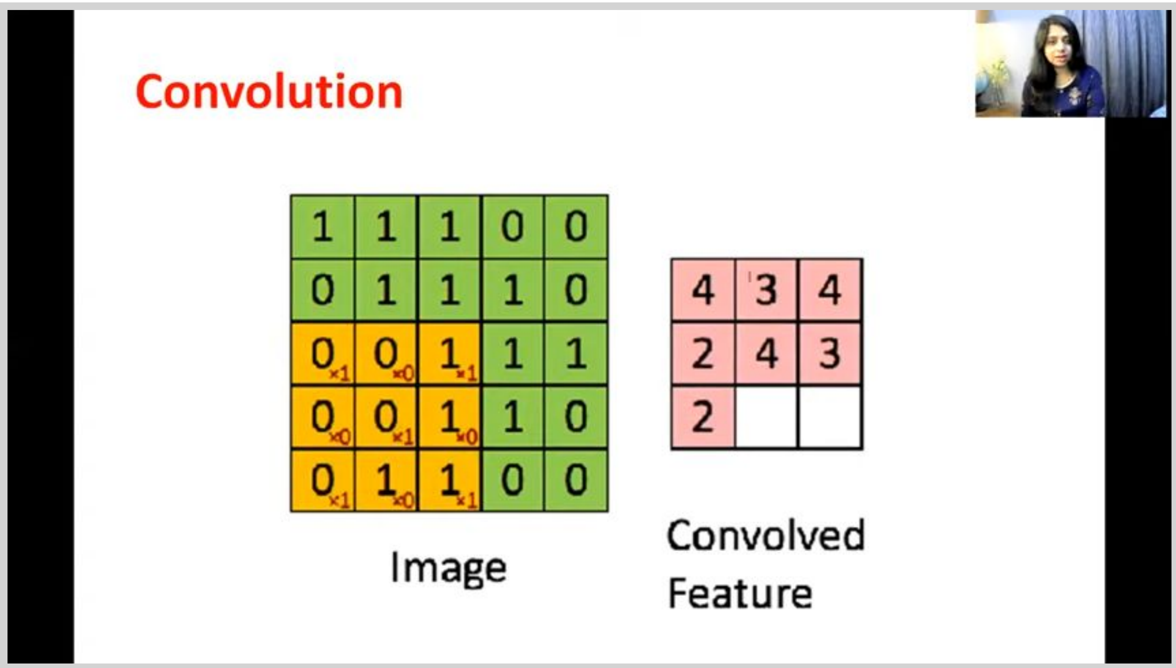
[11:18]


Convolution
1 1 1 0 0
0 1 1 1 0
0 0 1 1 1
0 0 1 1 0
0 1 1 0 0
Image
4 3
Convolved
Feature

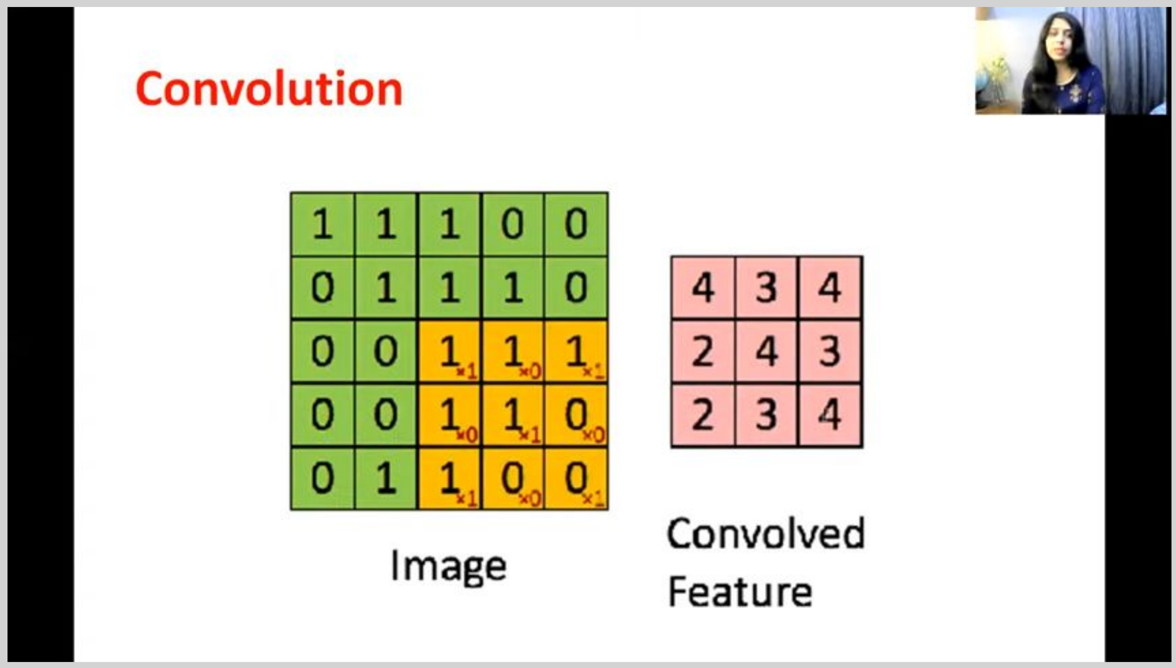
[11:18]


Convolution
1 1 1 0 0
0 1 1 1 0
0 0 1 1 1
0 0 1 1 0
0 1 1 0 0
4 3 4
2
Image
Convolved Feature

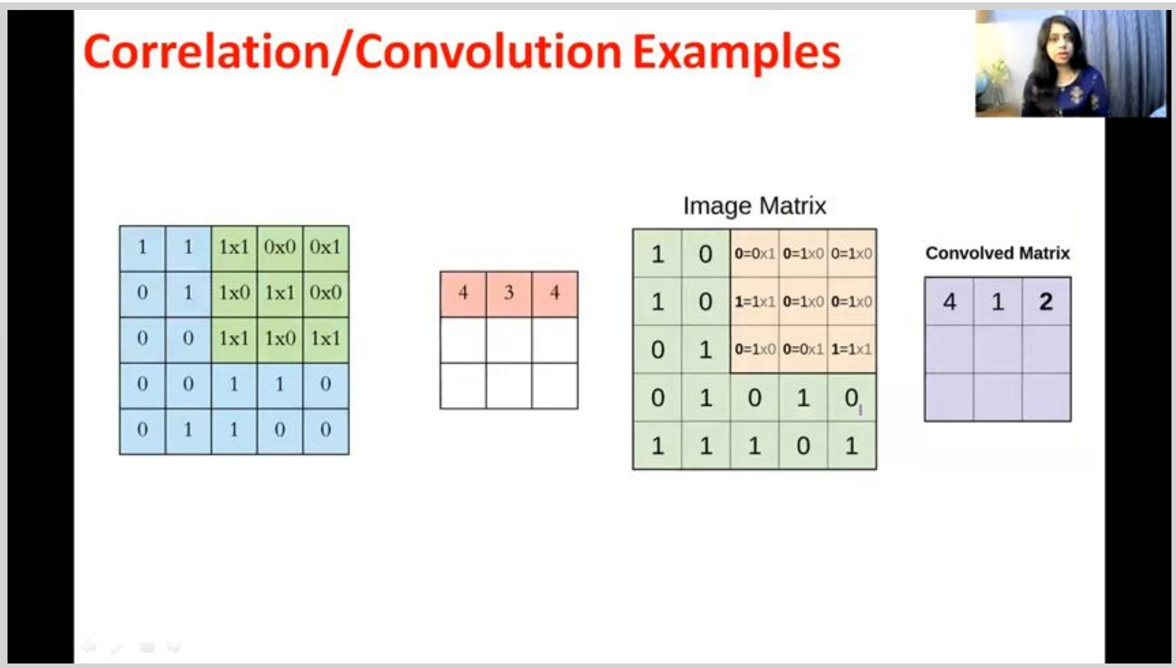
[11:22](#)


Convolution
1 1 1 0 0
0 1 1 1 0
0 0 1 1 1
0 0 1 1 0
0 1 1 0 0
4 3 4
2 4 3
2
Image
Convolved Feature

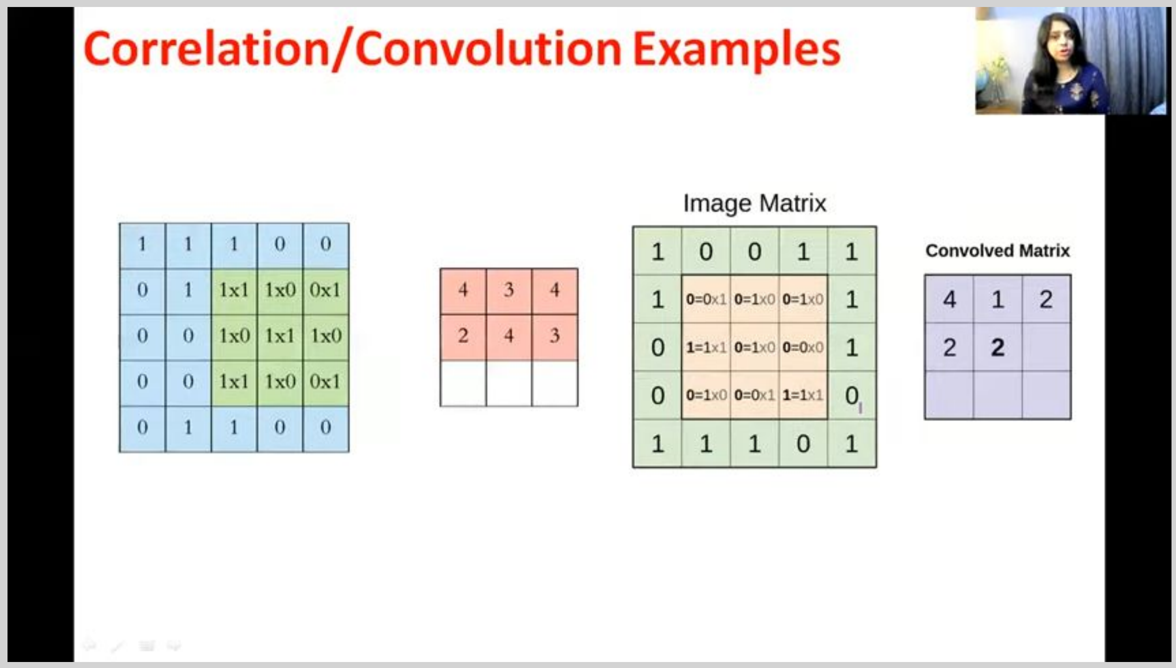
[11:24](#)


Convolution
Image
Convolved
Feature

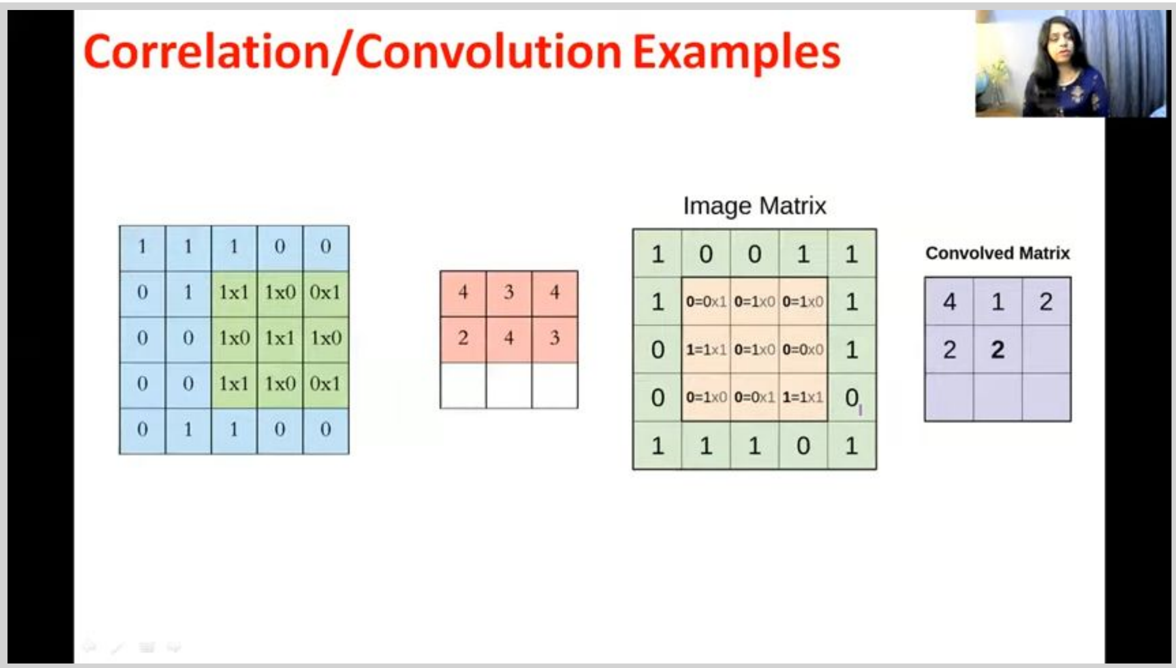
[11:41](#)


Correlation/Convolution Examples
Image Matrix
Convolved Matrix

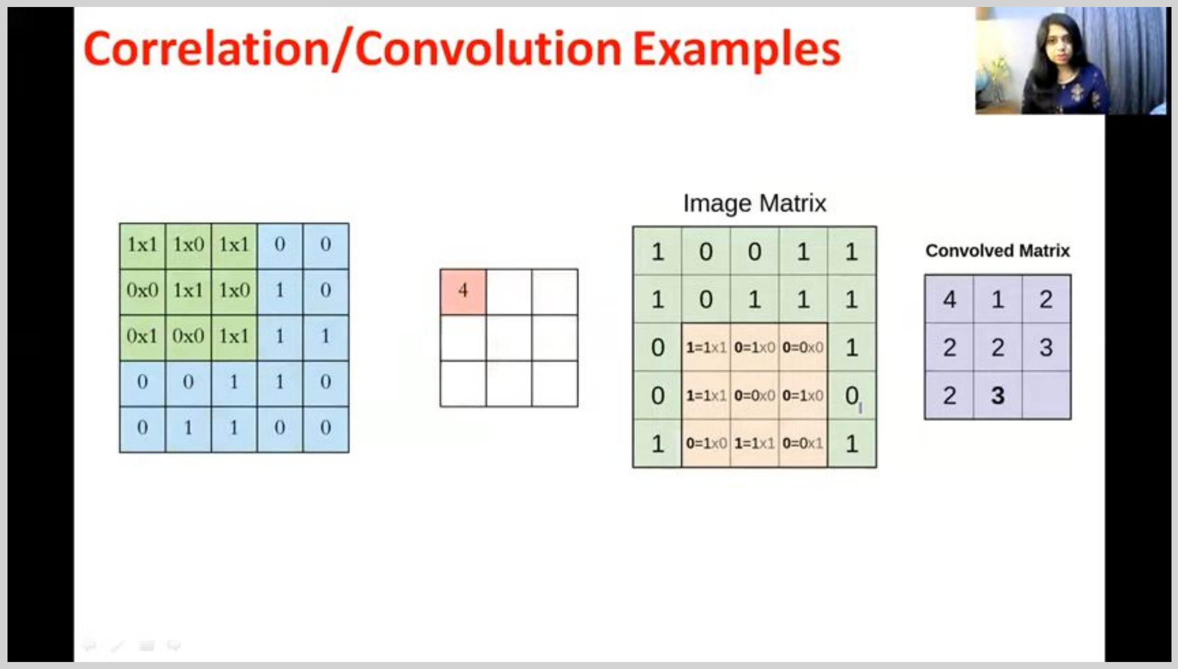
[11:43](#)


Correlation/Convolution Examples
Image Matrix
Convolved Matrix

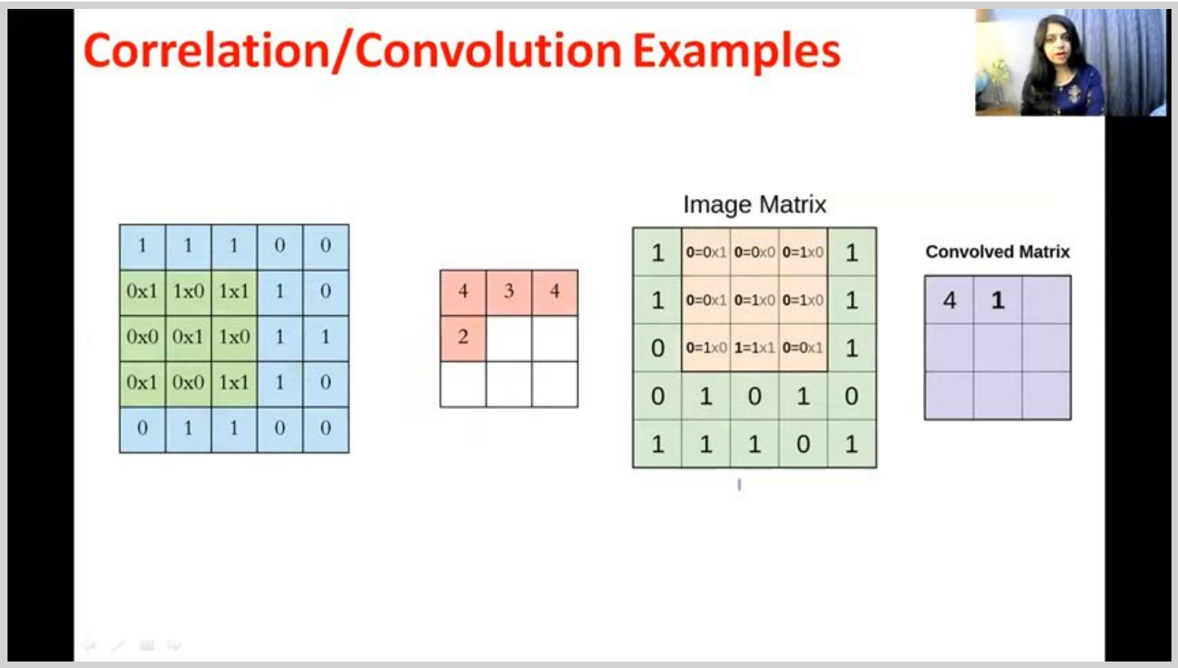
[11:44](#)

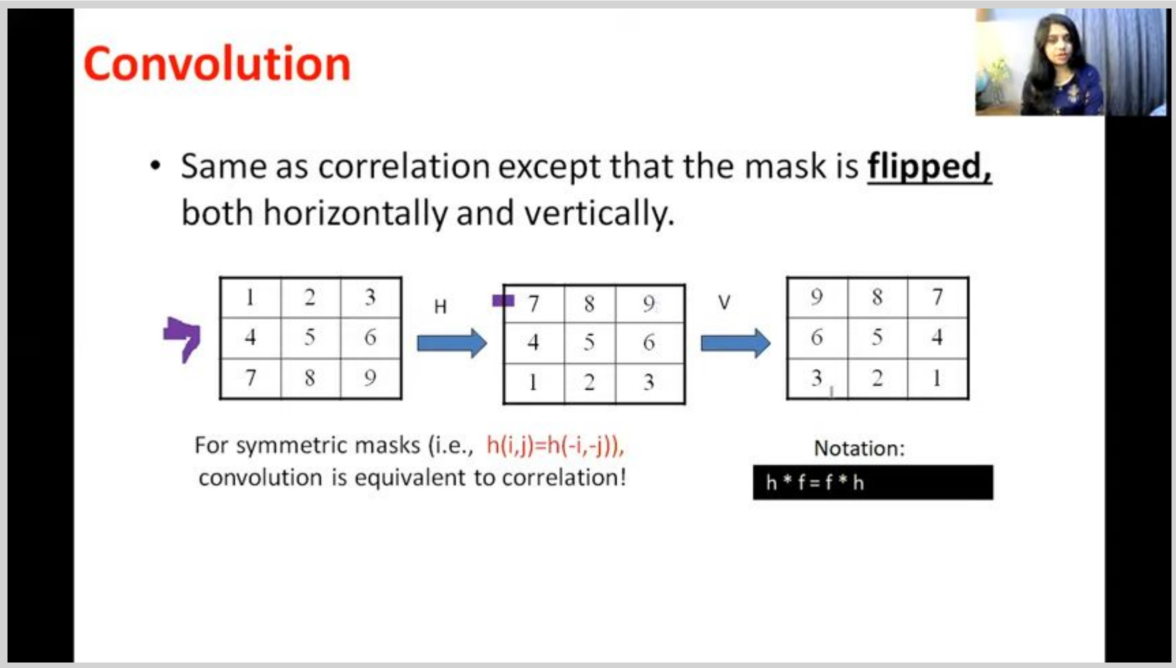

Correlation/Convolution Examples
Image Matrix
Convolved Matrix

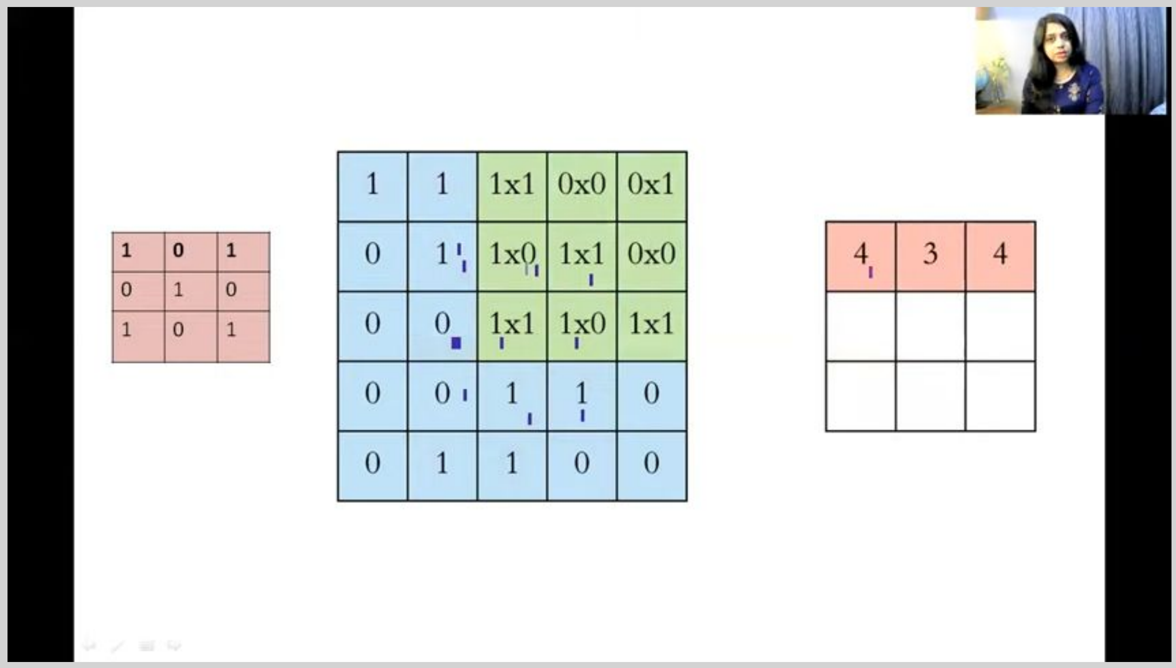
[11:47](#)


Correlation/Convolution Examples
Image Matrix
Convolved Matrix

[11:51]


Correlation/Convolution Examples
Image Matrix
Convolved Matrix


Convolution
• Same as correlation except that the mask is flipped, both horizontally and vertically.
1 2 3
4 5 6
7 8 9
H
7 8 9
4 5 6
1 2 3
V
9 8 7
6 5 4
3 2 1
For symmetric masks (i.e., h(i,j)=h(-i,-j)), convolution is equivalent to correlation!
Notation:
h * f = f * h


1 0 1
0 1 0
1 0 1
1 1 1x1 0x0 0x1
0 1 1x0 1x1 0x0
0 0 1x1 1x0 1x1
0 0 1 1 0
0 1 1 0 0
4 3 4