Module 1: A Beginner's Guide to Computer Vision

Video 3: Understanding a CNN - Convolutional Layer

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Recap

Forecasting Financial Trends

Churn Prediction

Loan Default Prediction

ANNs

Text Summarisation

Sentiment Analysis

Named Entity Recognition

RNNs

Image Classification

Face Recognition

Object Detection

CNNs

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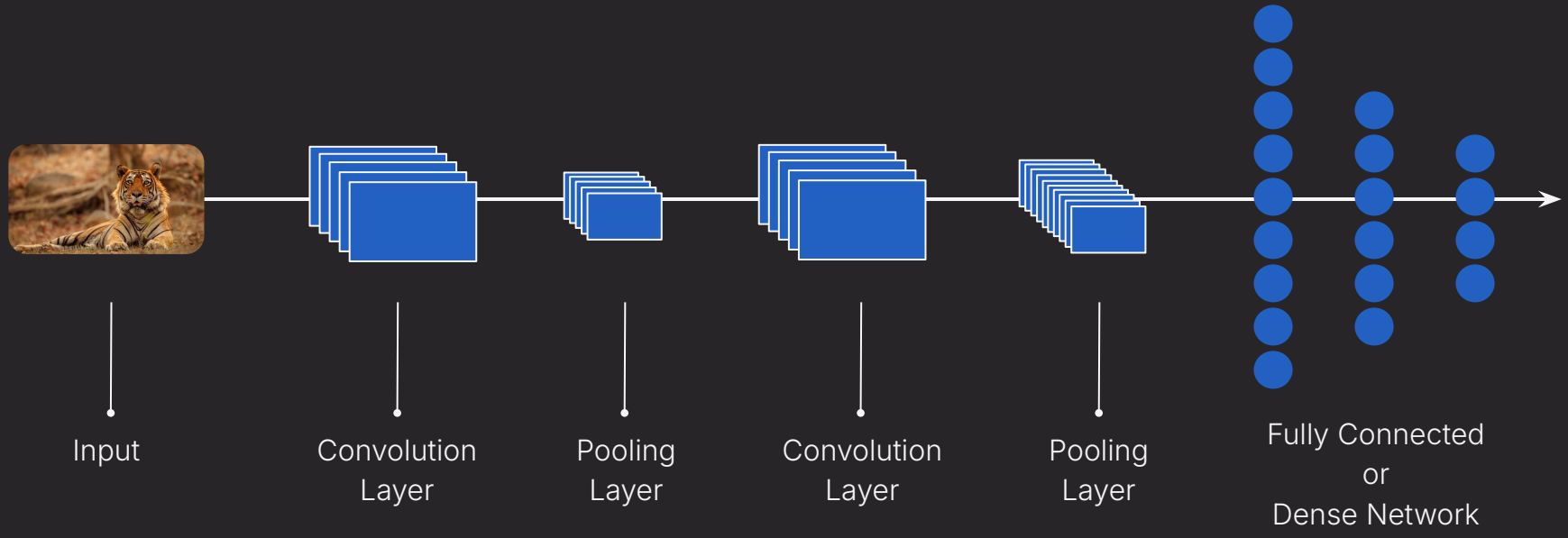
Convolutional Neural Networks



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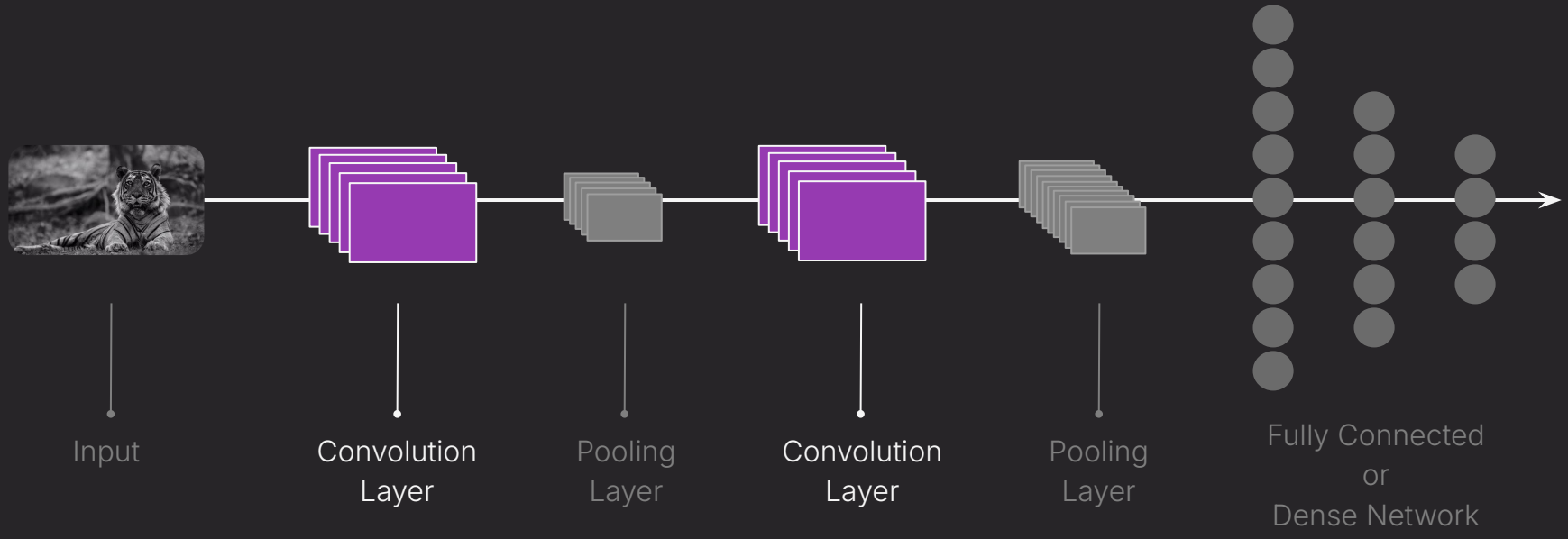
Convolutional Neural Networks



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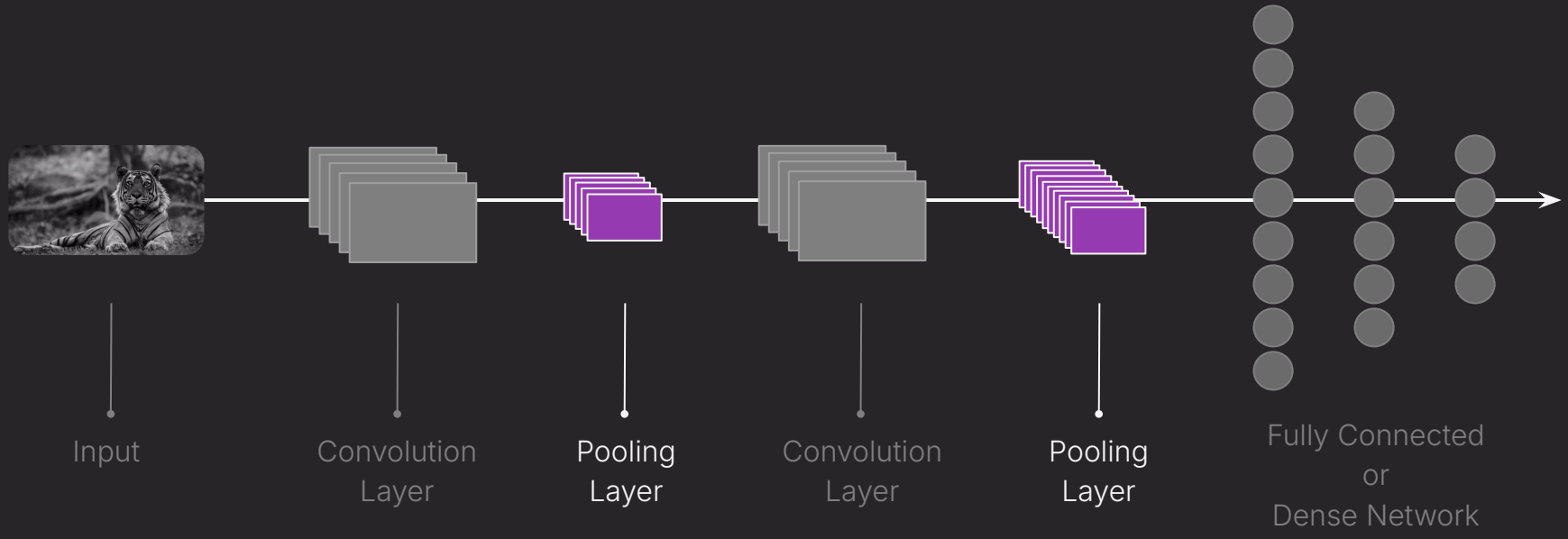
Convolutional Neural Networks



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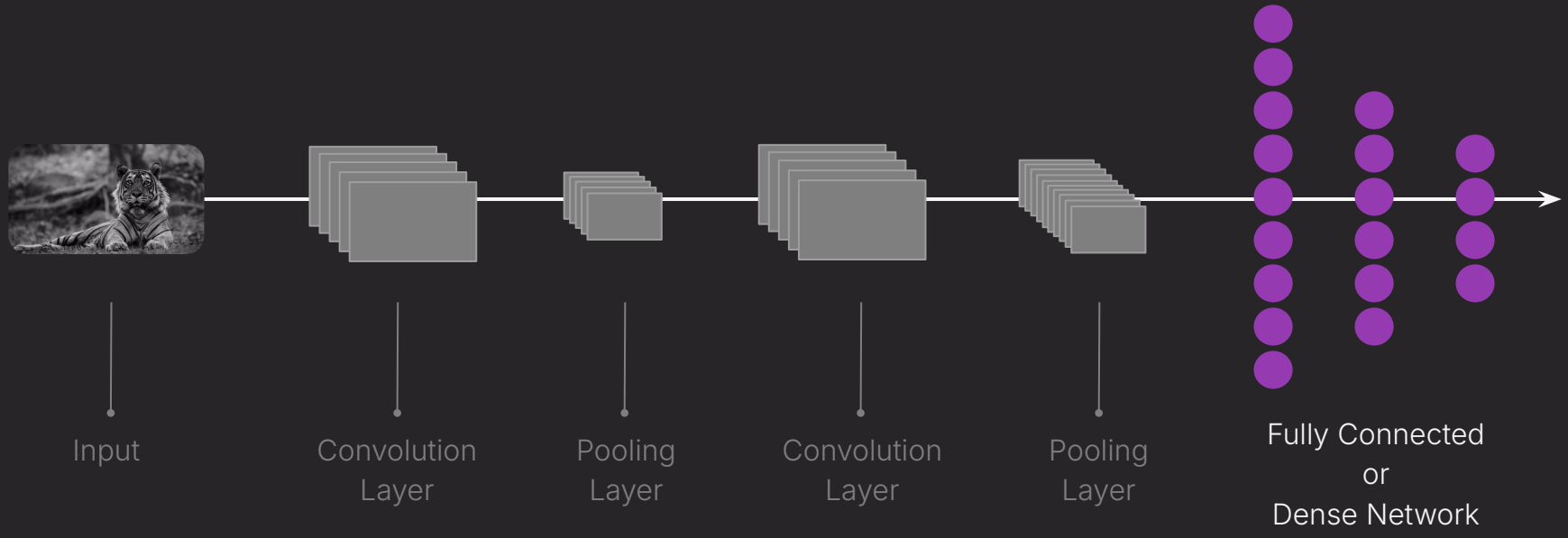
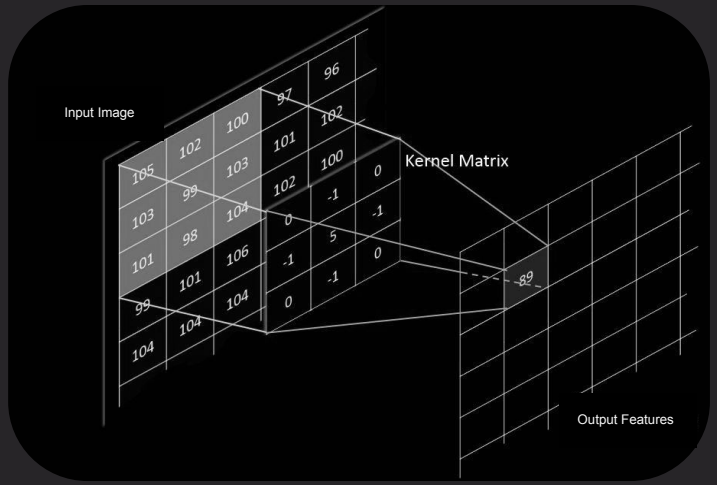
Convolutional Neural Networks



Convolution

- **Convolution** is a mathematical operation used to extract features from an image.
- Features enable image processing such as blurring, edge detection etc.



Convolution

Sample Image:

A sloth hanging off a branch from a tree

Convolution

How do we get a machine to recognize this image?

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Convolution

Image processing with kernels

Sample Image

*

-5	0	5
-0.5	0	0.5
-5	0	5

Vertical Filter

=

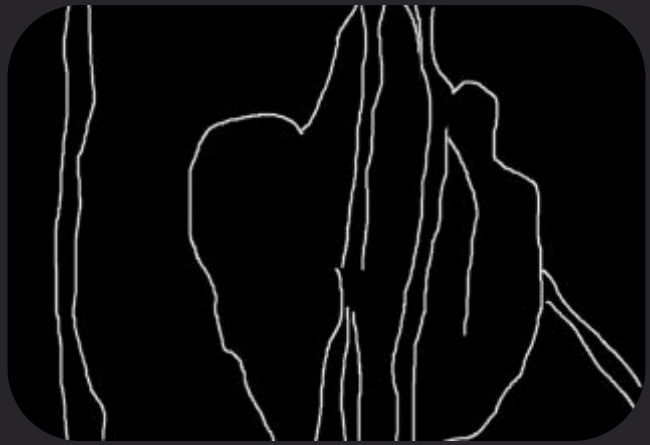


Image with edges

Convolution

Sample Image

*

-5	0	5
-0.5	0	0.5
-5	0	5

=

Round head

Big black nose

Caved-in-eyes

Convolution

Sample Image

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

Matrix of the image

Convolution

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

Matrix of the image

*

-5	0	5
-0.5	0	0.5
-5	0	5

Vertical Filter

Convolution

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

Matrix of the image

*

-5	0	5
-0.5	0	0.5
-5	0	5

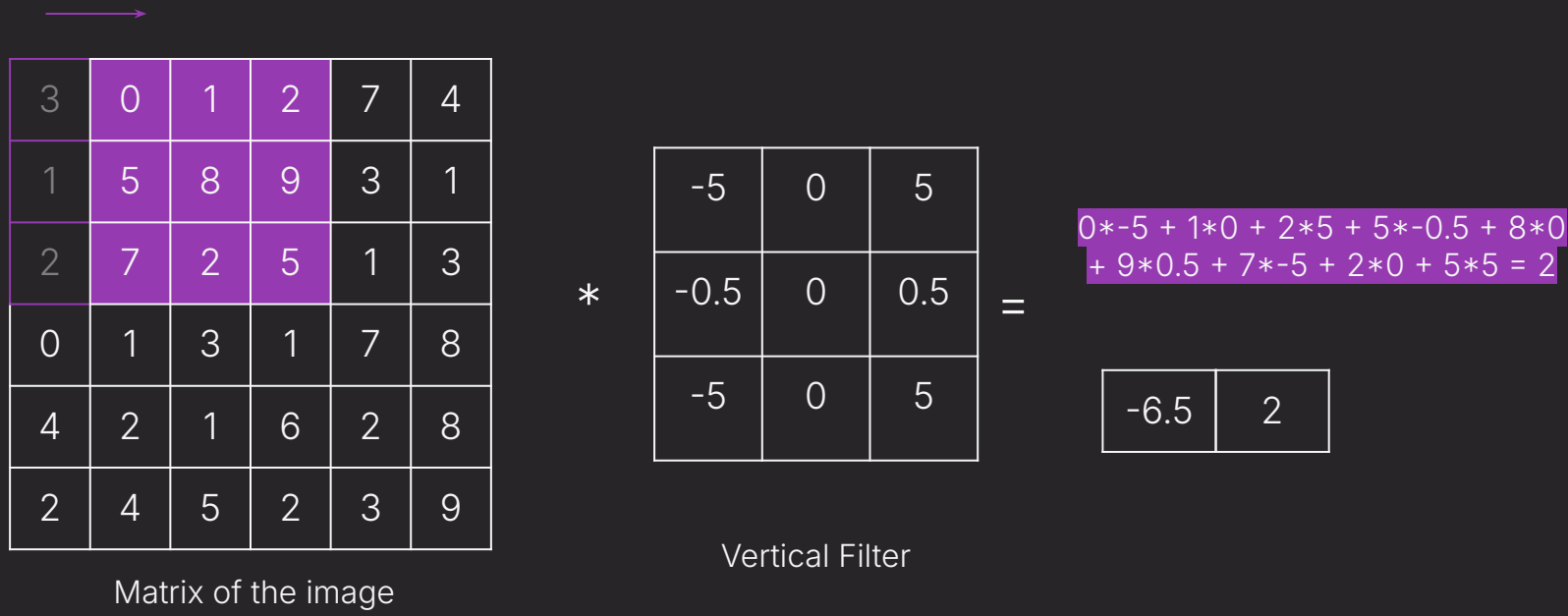
Vertical Filter

=

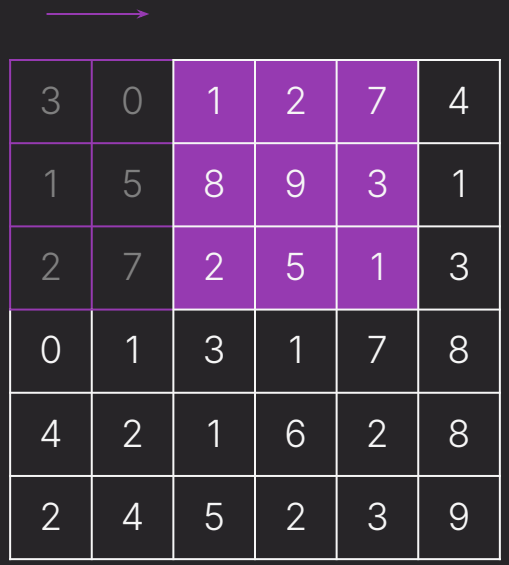
3*-5 + 0*0 + 1*5 + 1*-0.5 + 5*0 + 8*0.5 + 2*-5+ 7*0 + 2*5 = -6.5

-6.5

The Math Behind Convolution



The Math Behind Convolution



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

Matrix of the image

*

-5	0	5
-0.5	0	0.5
-5	0	5

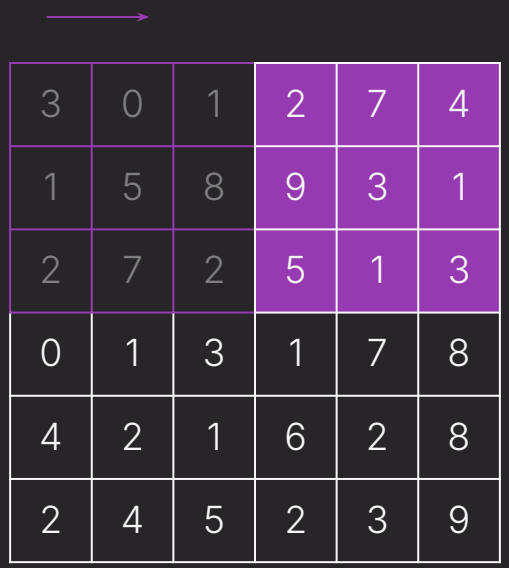
Vertical Filter

=

1*-5 + 2*0 + 7*5 + 8*-0.5 + 9*0 + 3*0.5 + 2*-5 + 5*0 + 1*5

-6.5	2	22.5

The Math Behind Convolution



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

Matrix of the image

*

-5	0	5
-0.5	0	0.5
-5	0	5

Vertical Filter

=

2* -5+7 * 0+4 * 5+9*-0.5 + 3* 0+ 1* 0.5 + 5* -5 + 1* 0 + 3* 5

-6.5	2	22.5	-4

The Math Behind Convolution

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

Matrix of the image

*

-5	0	5
-0.5	0	0.5
-5	0	5

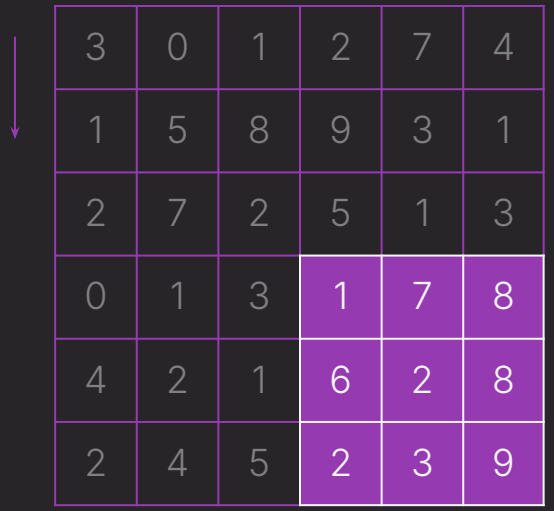
Vertical Filter

=

1*-5 +5* 0 + 8* 5 + 2*-0.5+ 7*
0+ 2* 0.5 + 0* -5+ 1* 0+ 3* 5

-6.5	2	22.5	-4
50			

Convolution



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

Matrix of the image

$*$

-5	0	5
-0.5	0	0.5
-5	0	5

Vertical Filter

$=$

-6.5	2	22.5	-4
50	19	-5.5	-6
-13.5	10	2	3.5
28.5	-8	10.5	71

Convoluted Matrix for the Image
(Striding = 1)

Convolution

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

Matrix of the image

Stride =2

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

Matrix of the image

Stride =2

=

-6.5	22.5
-13.5	2

Resultant 2×2 matrix

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UpNext: Hands-on