

CNN

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The CNN model, Step by Step

STEP 1: Convolution



STEP 2: Max Pooling

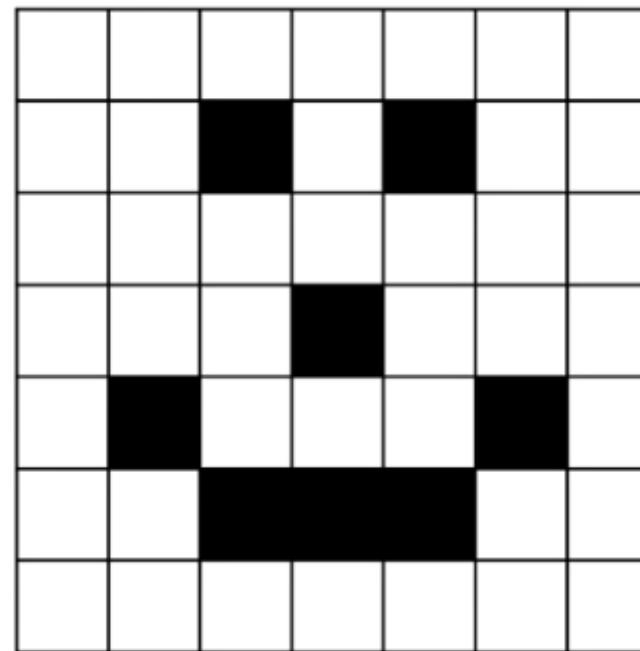


STEP 3: Flattening



STEP 4: Full Connection

Simple Input Image - Happy Face



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

To simplify, let's take a simple black and white image with 0 and 1 pixels

Step 1 - Convolution

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

Input Image

0	0	1
1	0	0
0	1	1

Feature Detector

Step 1 - Convolution

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



0	0	1
1	0	0
0	1	1

=

0				

Input Image

Feature Detector

Feature Map

Step 1 - Convolution

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

Input Image



0	0	1
1	0	0
0	1	1

Feature Detector



0	1			

Feature Map

Step 1 - Convolution

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



Input Image

0	0	1
1	0	0
0	1	1

Feature Detector



0	1	0		

Feature Map

Step 1 - Convolution

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

Input Image



0	0	1
1	0	0
0	1	1

Feature Detector



0	1	0	0	

Feature Map

Step 1 - Convolution

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

Input Image



0	0	1
1	0	0
0	1	1

Feature Detector

=

0	1	0	0	0

Feature Map

Step 1 - Convolution

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

Input Image



0	0	1
1	0	0
0	1	1

Feature Detector

=

0	1	0	0	0
0				

Feature Map

Step 1 - Convolution

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



0	0	1
1	0	0
0	1	1

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0	1	0	0	0
0	1			

Input Image

Feature Detector

Feature Map

Step 1 - Convolution

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



0	0	1
1	0	0
0	1	1



0	1	0	0	0
0	1	1		

Input Image

Feature Detector

Feature Map

Step 1 - Convolution

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



0	0	1
1	0	0
0	1	1

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0	1	0	0	0
0	1	1	1	

Input Image

Feature Detector

Feature Map

Step 1 - Convolution

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



Input Image

0	0	1
1	0	0
0	1	1

Feature Detector



0	1	0	0	0
0	1	1	1	0

Feature Map

Step 1 - Convolution

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



0	0	1
1	0	0
0	1	1

=

0	1	0	0	0
0	1	1	1	0
1				

Input Image

Feature Detector

Feature Map

Step 1 - Convolution

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



0	0	1
1	0	0
0	1	1

=

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

Input Image

Feature Detector

Feature Map

Step 1 - Convolution

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



0	0	1
1	0	0
0	1	1

=

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

Input Image

Feature Detector

Feature Map

Step 1 - Convolution

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



0	0	1
1	0	0
0	1	1



0	1	0	0	0
0	1	1	1	0
1	0	1	2	

Input Image

Feature Detector

Feature Map

Step 1 - Convolution

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



0	0	1
1	0	0
0	1	1

=

0	1	0	0	0
0	1	1	1	0
1	0	1	2	1

Input Image

Feature Detector

Feature Map

Step 1 - Convolution

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



0	0	1
1	0	0
0	1	1

=

0	1	0	0	0
0	1	1	1	0
1	0	1	2	1
1				

Input Image

Feature Detector

Feature Map

Step 1 - Convolution

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



0	0	1
1	0	0
0	1	1

=

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

Input Image

Feature Detector

Feature Map

Step 1 - Convolution

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



0	0	1
1	0	0
0	1	1

=

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

Input Image

Feature Detector

Feature Map

Step 1 - Convolution

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



0	0	1
1	0	0
0	1	1

=

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

Input Image

Feature Detector

Feature Map

Step 1 - Convolution

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



Input Image

0	0	1
1	0	0
0	1	1

Feature Detector

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

Feature Map

Step 1 - Convolution

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



0	0	1
1	0	0
0	1	1



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

Input Image

Feature Detector

Feature Map

Step 1 - Convolution

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



0	0	1
1	0	0
0	1	1

=

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

Input Image

Feature Detector

Feature Map

Step 1 - Convolution

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



0	0	1
1	0	0
0	1	1

=

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

Input Image

Feature Detector

Feature Map

Step 1 - Convolution

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



0	0	1
1	0	0
0	1	1

=

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

Input Image

Feature Detector

Feature Map

Step 1 - Convolution

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



0	0	1
1	0	0
0	1	1

=

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

Input Image

Feature Detector

Feature Map

Step 1 - Convolution

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



0	0	1
1	0	0
0	1	1

=

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

Input Image

Feature Detector

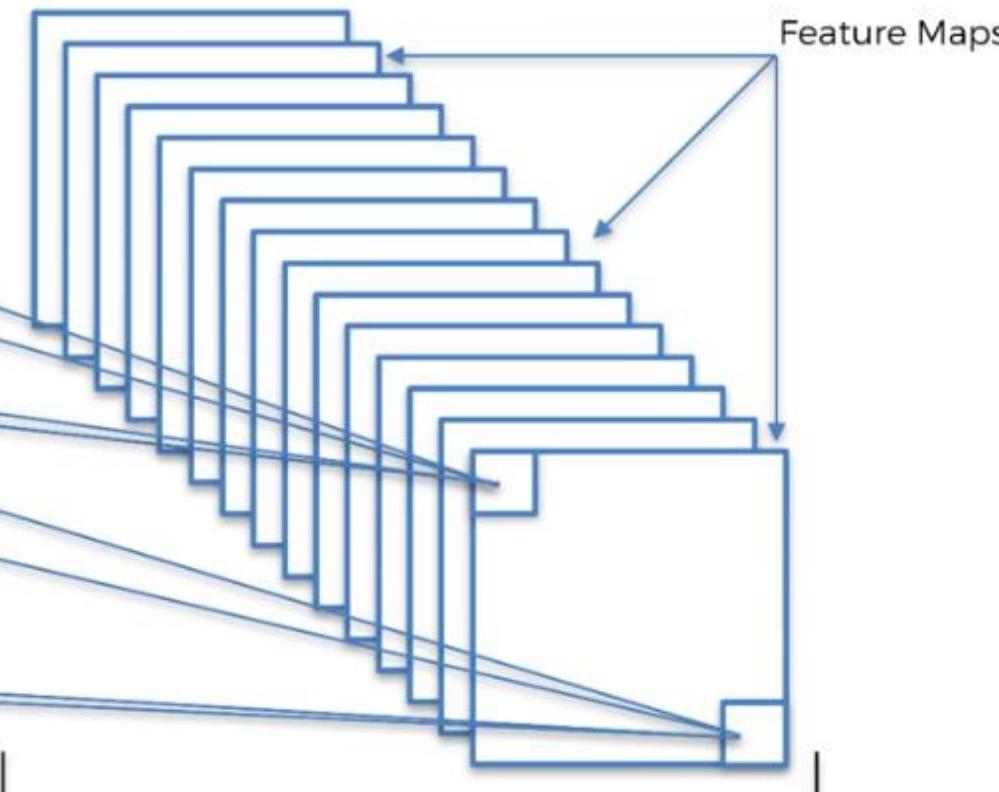
Feature Map

Step 1 - Convolution

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

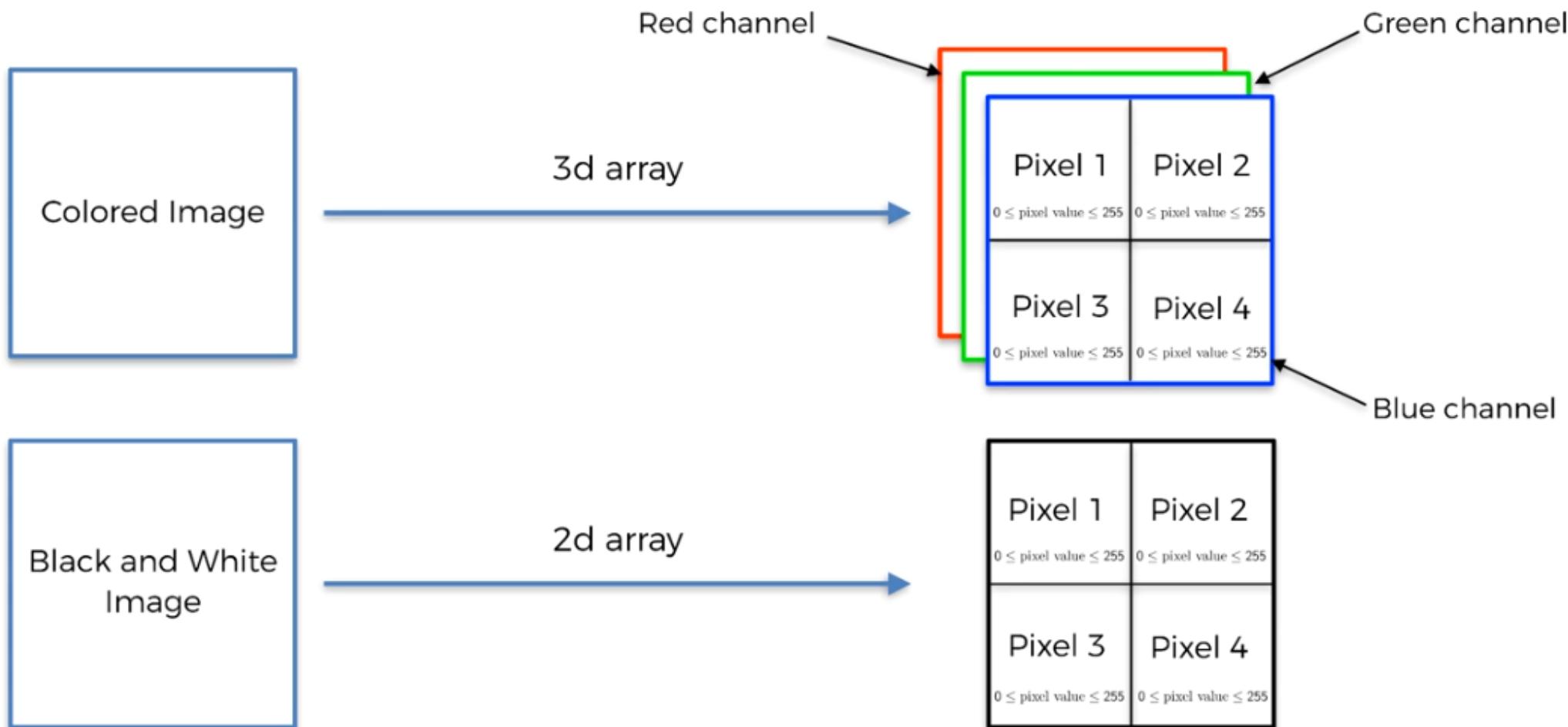
Input Image

We create many feature maps to obtain our first convolution layer



Convolutional Layer

Input Images are converted into arrays



The CNN model, Step by Step

STEP 1: Convolution



STEP 2: Max Pooling



STEP 3: Flattening



STEP 4: Full Connection

Step 2 - Max Pooling

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

Feature Map

Max Pooling

1		

Pooled Feature Map

Step 2 - Max Pooling

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

Feature Map

Max Pooling



1	1	

Pooled Feature Map

Step 2 - Max Pooling

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

Feature Map

Max Pooling



1	1	0

Pooled Feature Map

Step 2 - Max Pooling

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

Feature Map

Max Pooling



1	1	0
4		

Pooled Feature Map

Step 2 - Max Pooling

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

Feature Map



1	1	0
4	2	

Pooled Feature Map

Step 2 - Max Pooling

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

Feature Map

Max Pooling

1	1	0
4	2	1

Pooled Feature Map

Step 2 - Max Pooling

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

Feature Map

Max Pooling



1	1	0
4	2	1
0		

Pooled Feature Map

Step 2 - Max Pooling

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

Feature Map

Max Pooling



1	1	0
4	2	1
0	2	

Pooled Feature Map

Step 2 - Max Pooling

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

Feature Map

Max Pooling



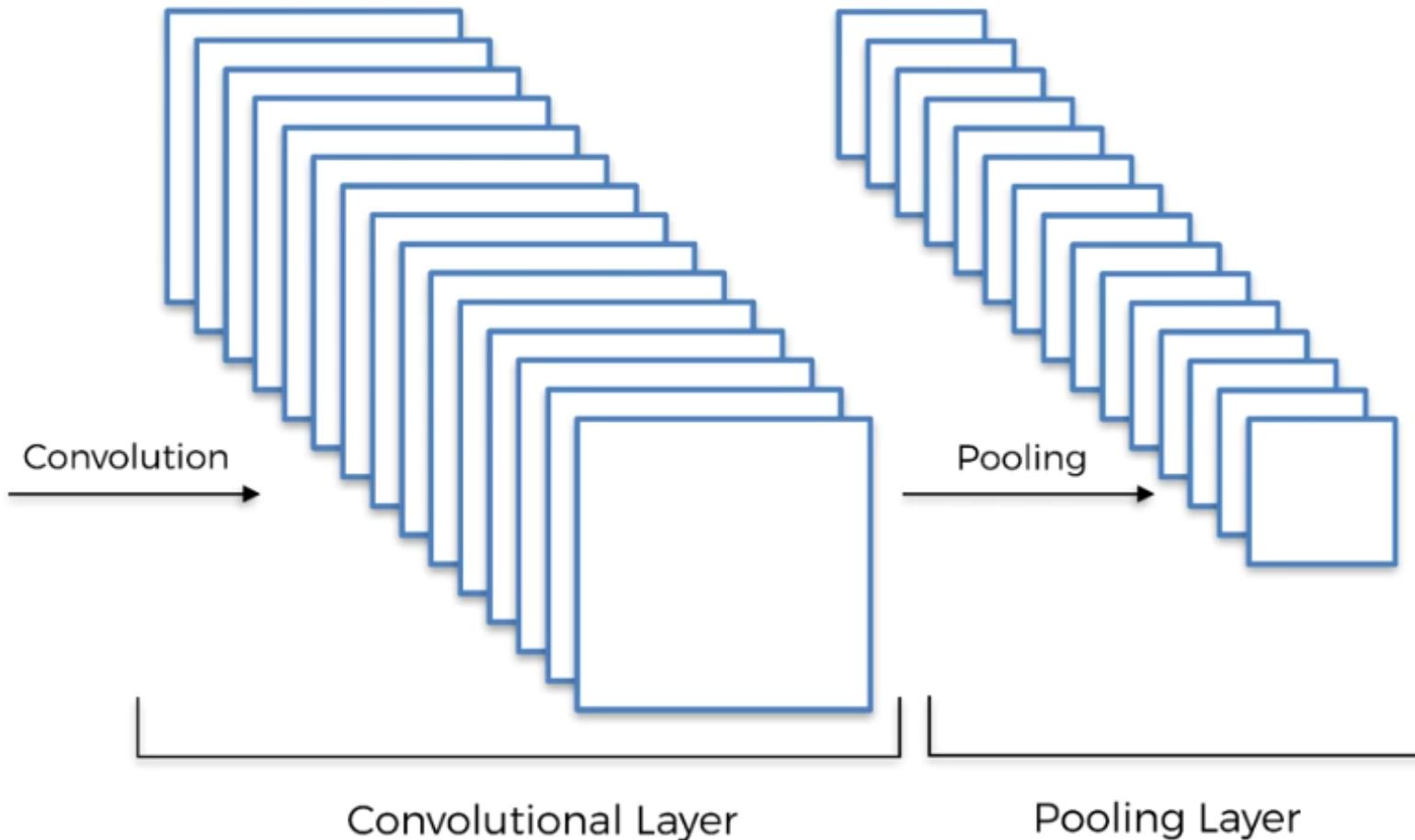
1	1	0
4	2	1
0	2	1

Pooled Feature Map

Step 2 - Max Pooling

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

Input Image



The CNN model, Step by Step

STEP 1: Convolution



STEP 2: Max Pooling



STEP 3: Flattening



STEP 4: Full Connection

Step 3 - Flattening

1	1	0
4	2	1
0	2	1

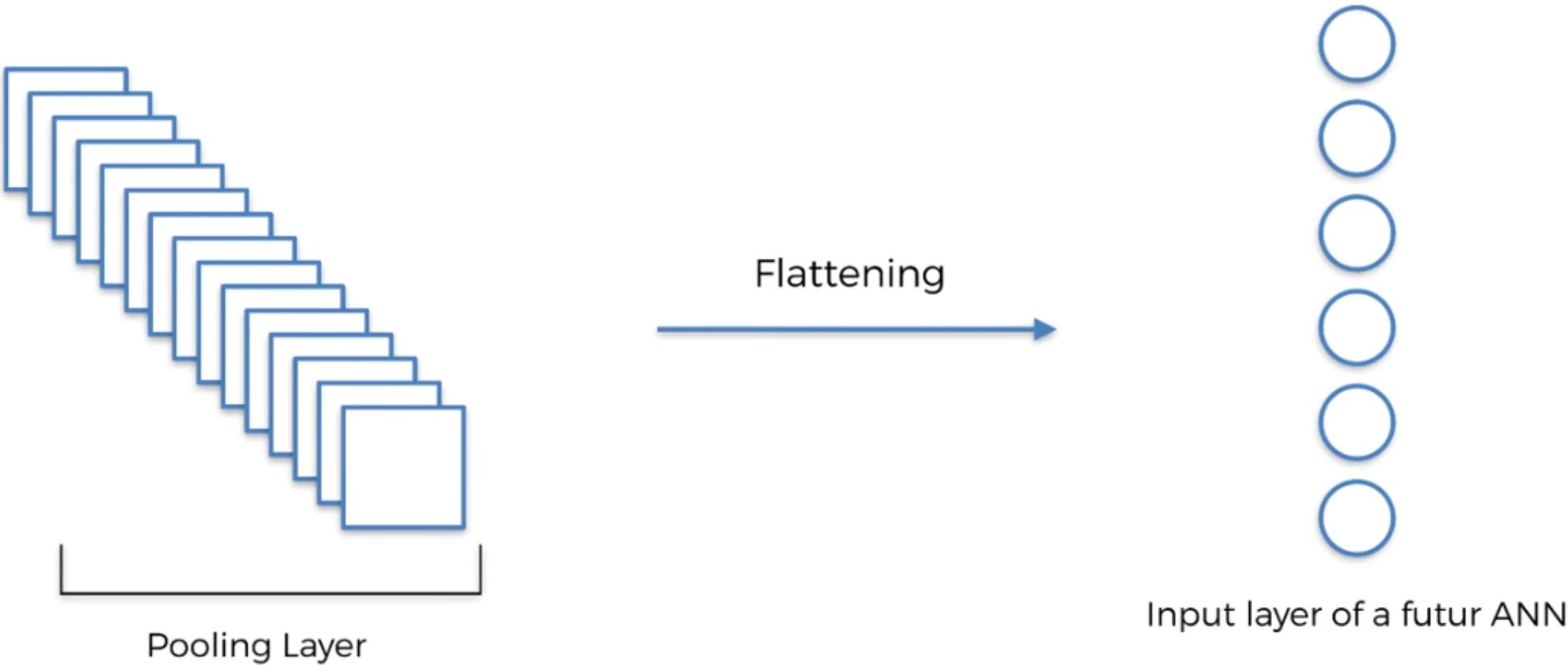
Pooled Feature Map

Flattening



1
1
0
4
2
1
0
2
1

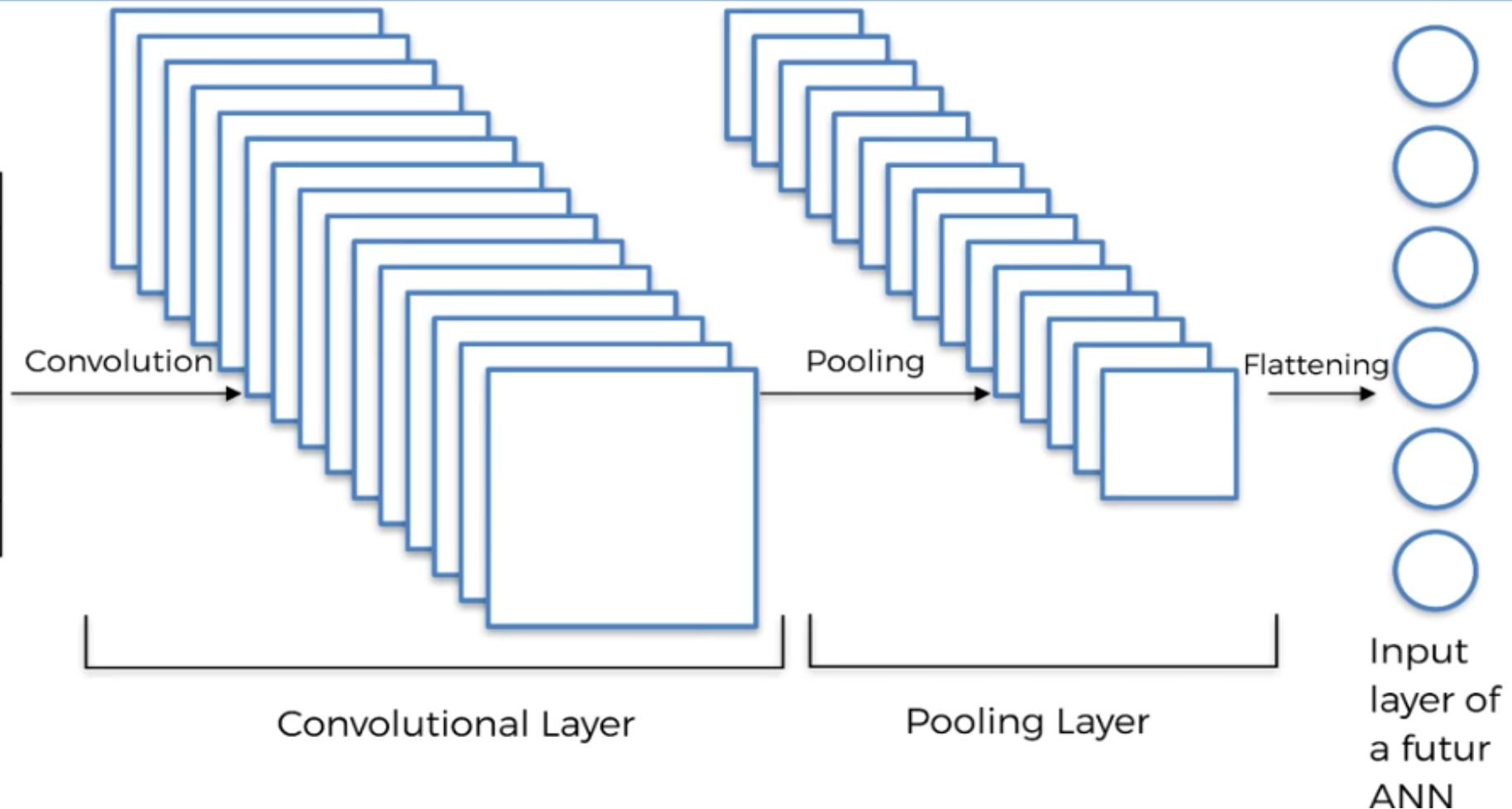
Step 3 - Flattening



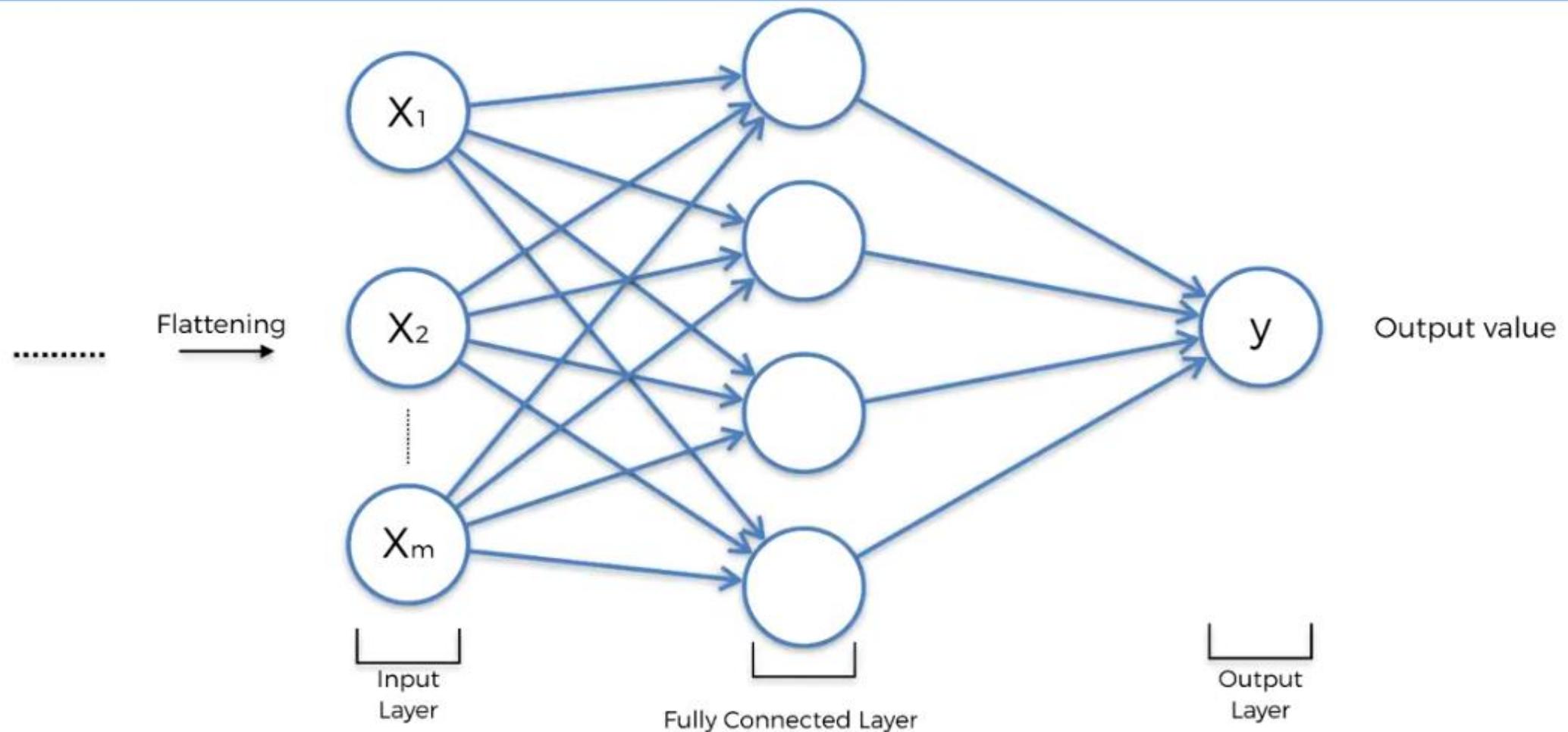
Step 3 - Flattening

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

Input Image

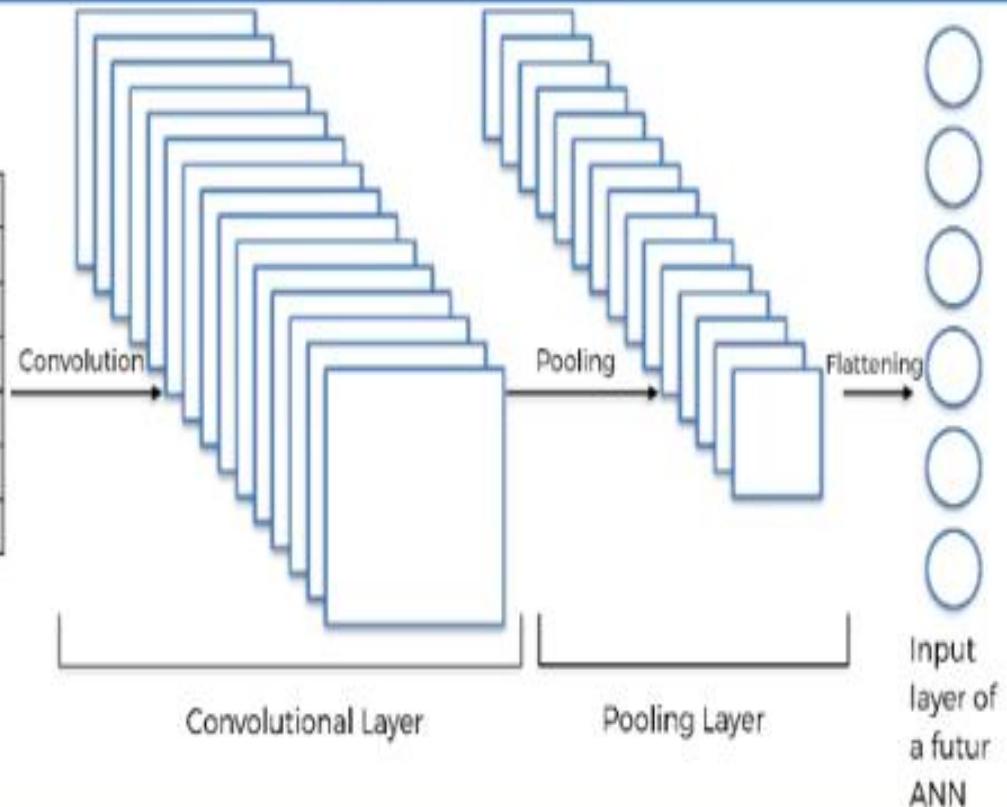


Step 4 - Full Connection

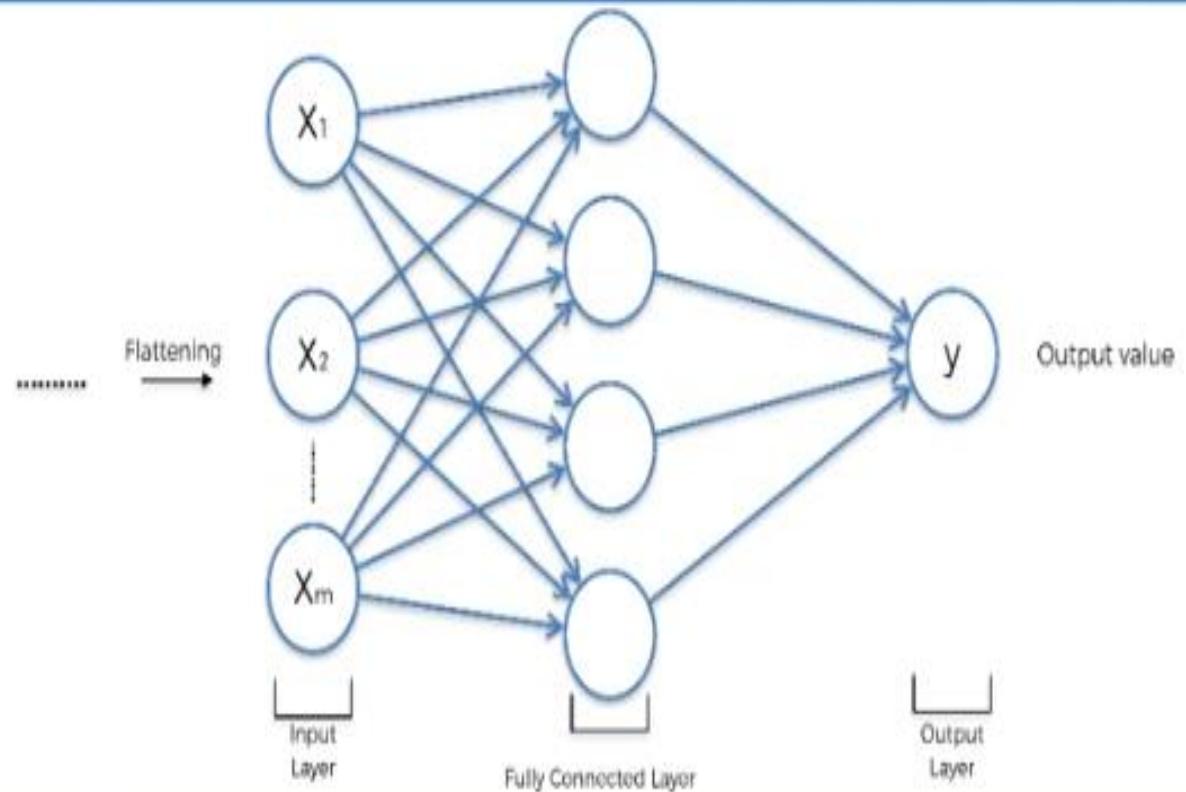


Step 3 - Flattening

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



Step 4 - Full Connection



The CNN model, Step by Step

STEP 1: Convolution



STEP 2: Max Pooling

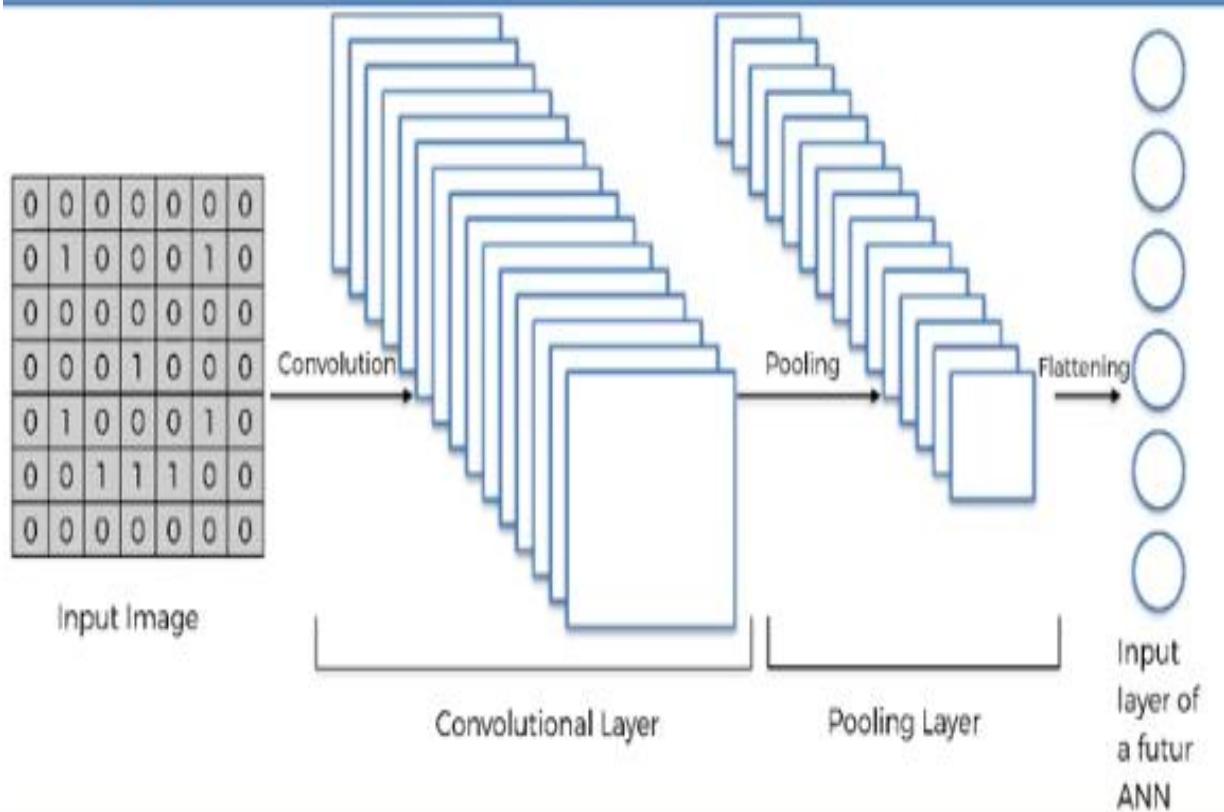


STEP 3: Flattening



STEP 4: Full Connection

Step 3 - Flattening



Step 4 - Full Connection

