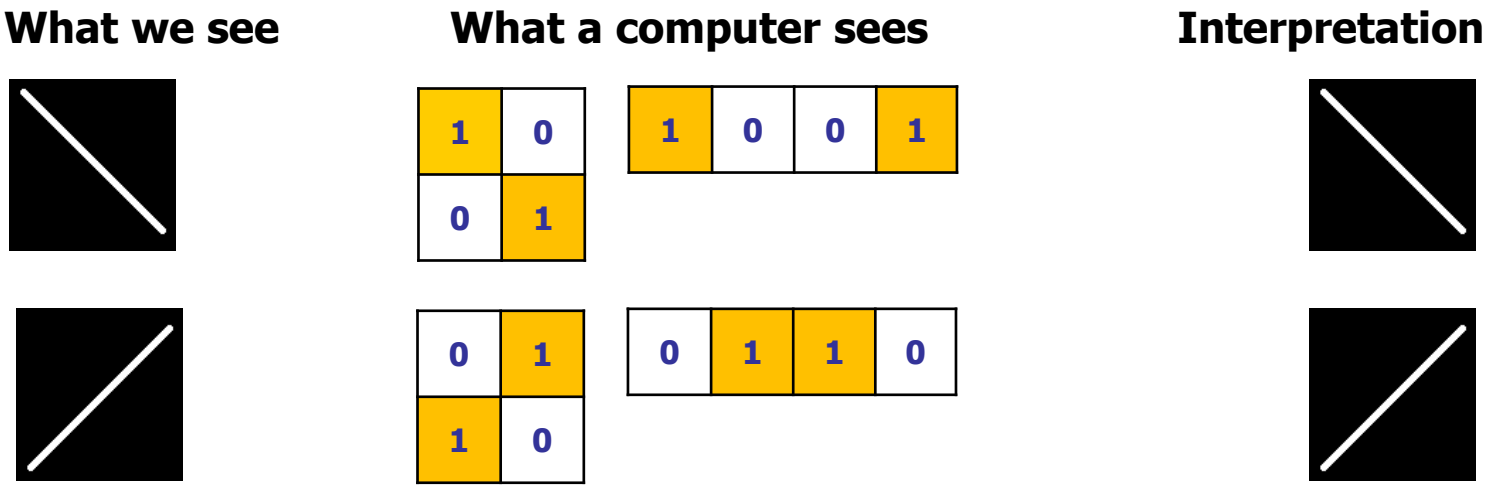
Convolutional Neural Network

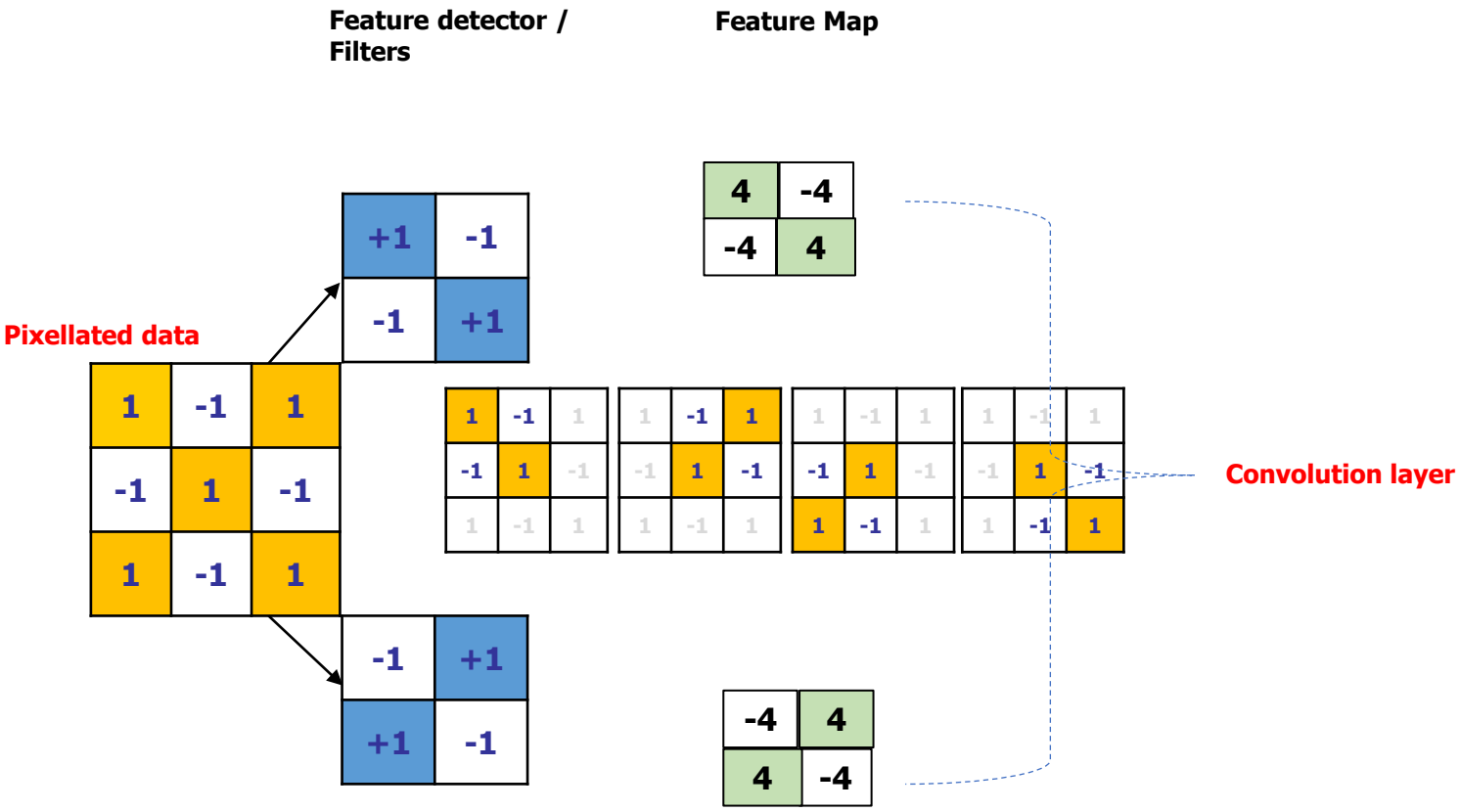
- How images can be interpreted



Different stages of image classification

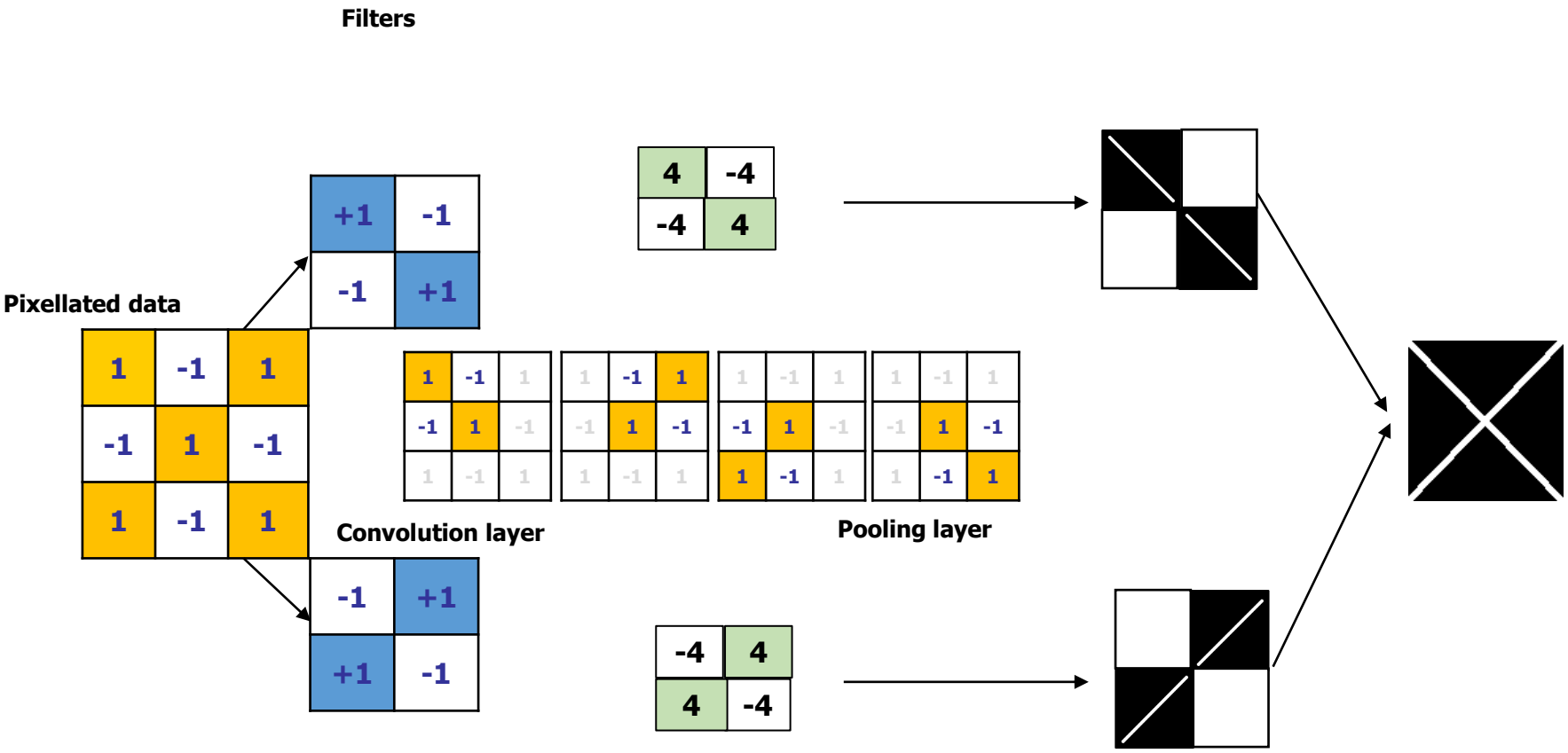
Convolution layer

- **Applying feature detectors / filters to the image to detect features**

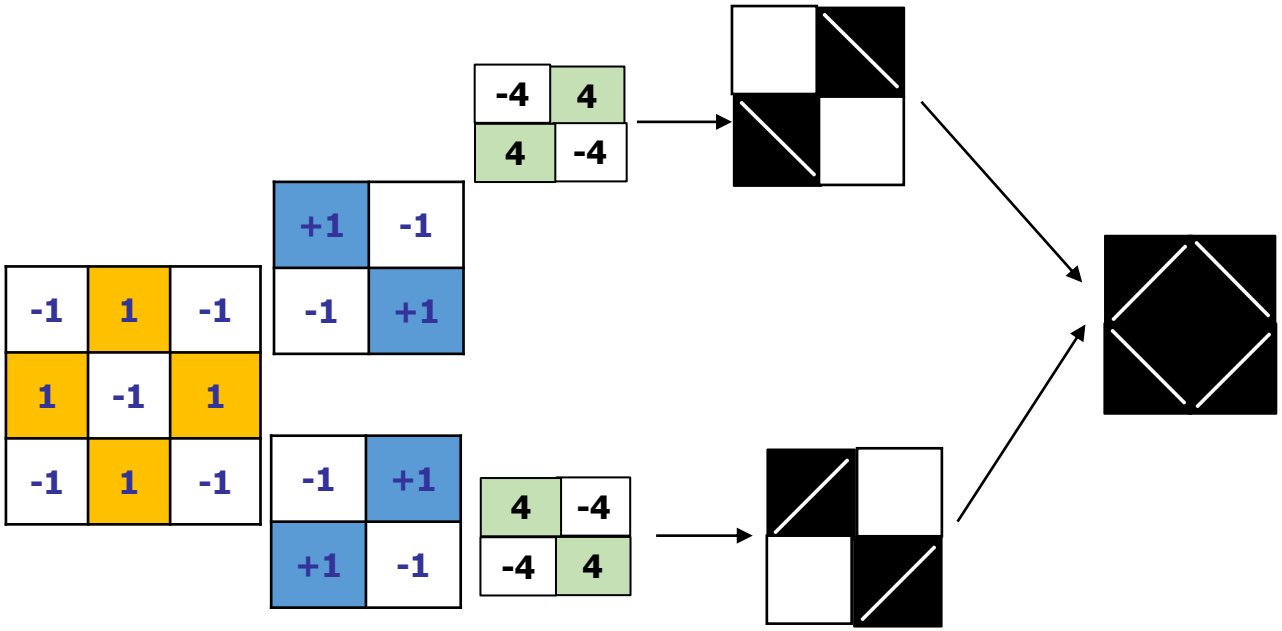


- A total of 8 filters applied on the input pixelated data

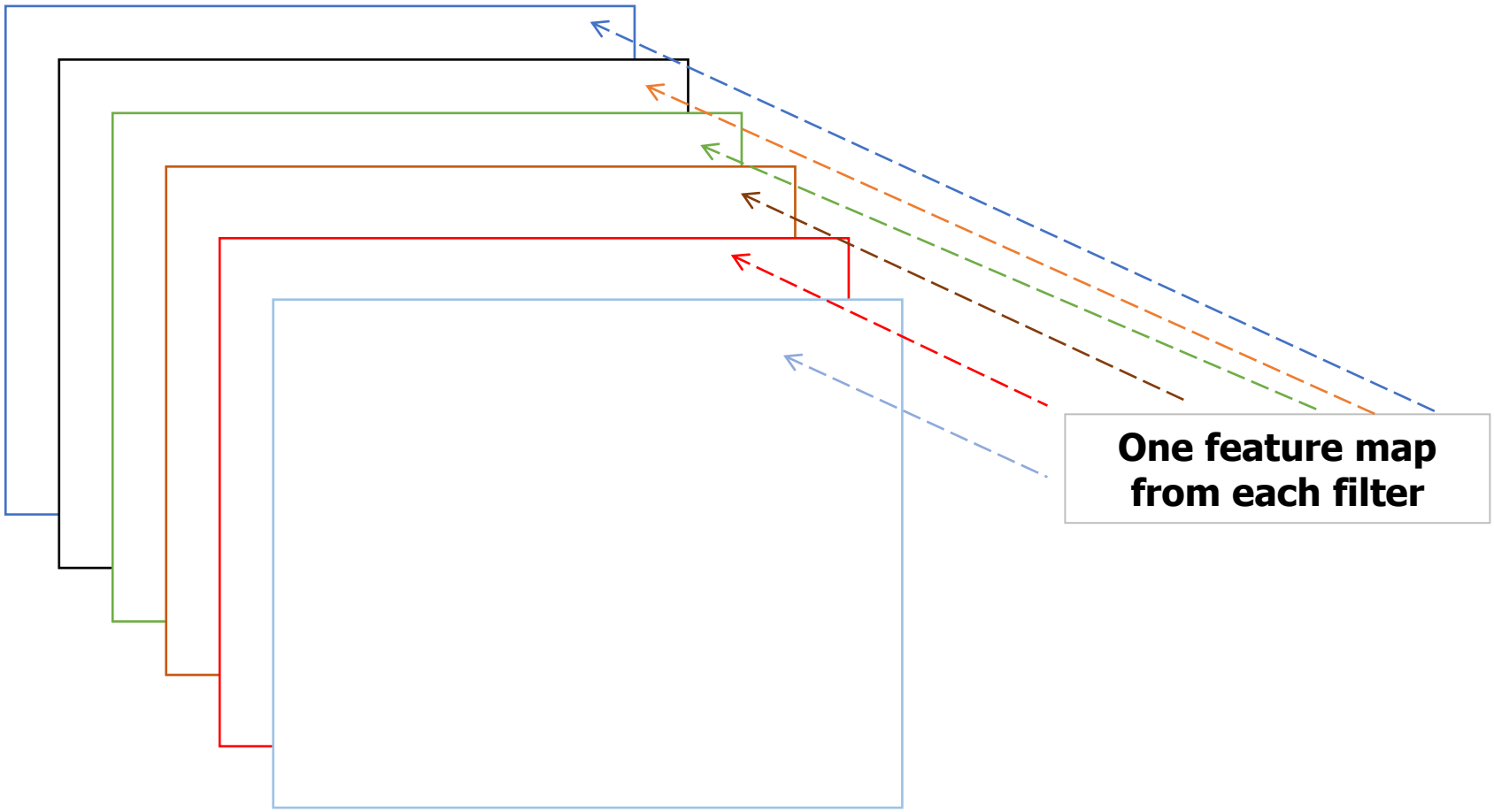
Convolution layer: Applying feature detectors / filters to the image



- A total of 8 filters applied on the input pixelated data


-1 1 -1
1 -1 1
-1 1 -1
+1 -1
-1 +1
-1 +1
+1 -1
-4 4
4 -4
4 -4
-4 4

Feature Map



Pooling

Max Pooling

Min Pooling

Sum Pooling

Average Pooling

Why Pooling ?

- CNN should be able to recognize an image; irrespective of the shape, direction, texture, lighting conditions, features etc.
- Spatial Invariance
- Ability to find features

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

Feature map

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

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

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

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

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

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

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

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

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

- **Max Pooling**
- **Stride of 1**
- **Stride can be any value**

2	4	2
1	1	4
0	2	1

Pooled feature map

- **Preserving the max features**
- **Reducing image size**
- **Removing data to prevent overfit**

Flattening

2	4	2
1	1	4
0	2	1

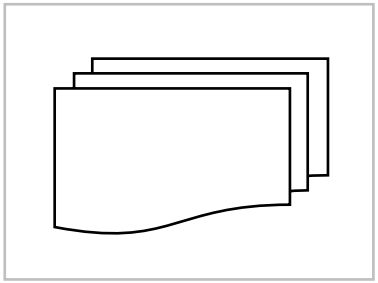
Pooled feature map

2
4
2
1
1
4
0
2
1

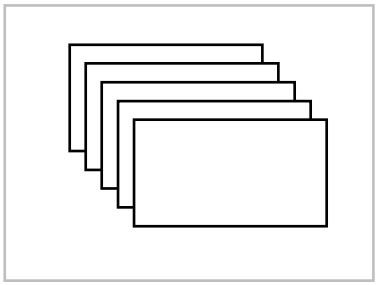
CNN Summary

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

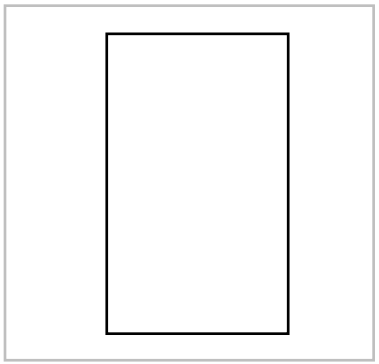
Input image



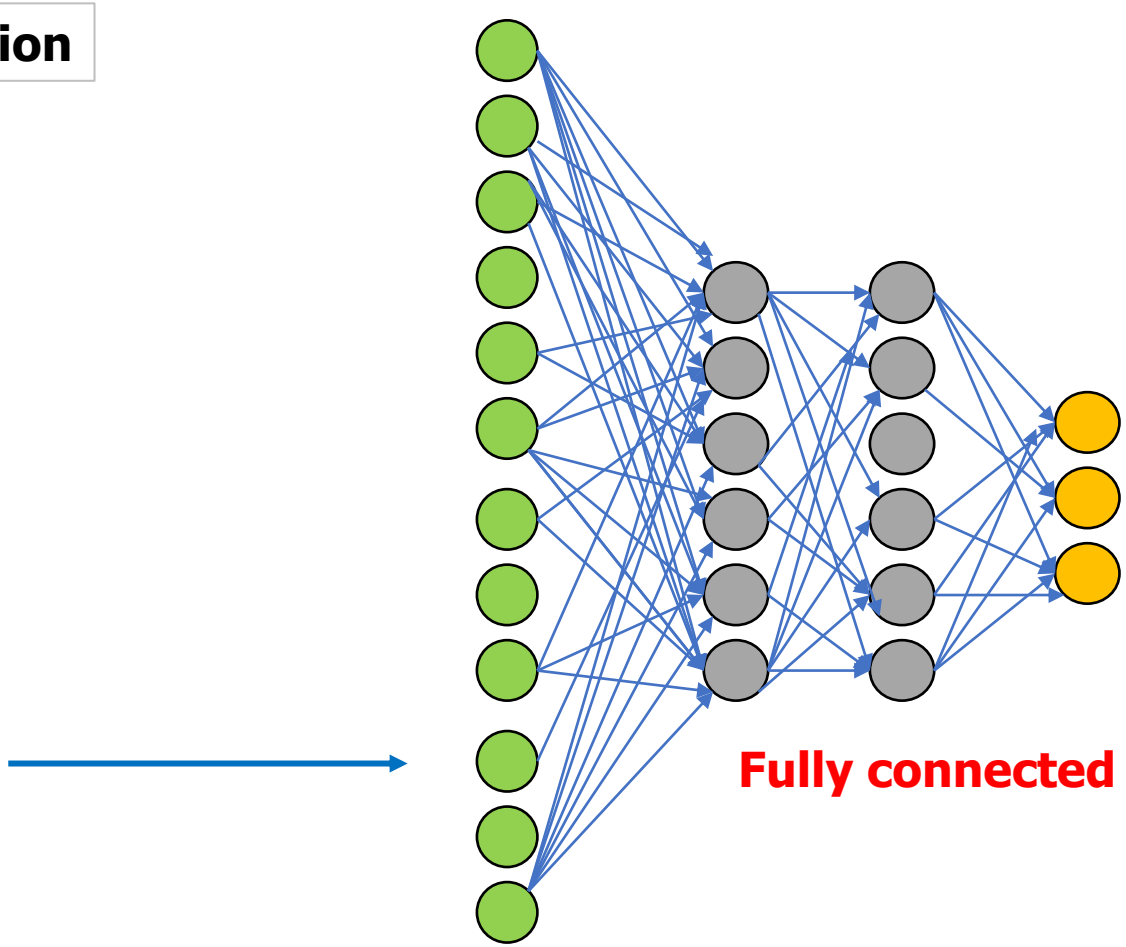
Convolution



Pooling



Flatten



Fully connected