

# MIDS W207

# Applied Machine Learning

Week 10  
Live Session Slides



-1	1	1	1	-1
-1	1	-1	1	-1
-1	1	1	1	-1
-1	-1	-1	1	-1
-1	-1	-1	1	-1
-1	-1	-1	-1	-1
-1	1	-1	-1	-1



-1	1	1	1	-1
-1	1	-1	1	-1
-1	1	1	1	-1
-1	1	1	1	-1
-1	-1	-1	1	-1
-1	-1	-1	1	-1
-1	-1	1	-1	-1
-1	1	-1	-1	-1

Location shifted

2

1	1	1	-1	-1
1	-1	1	-1	-1
1	1	1	-1	-1
-1	-1	1	-1	-1
-1	-1	1	-1	-1
-1	1	-1	-1	-1
1	-1	-1	-1	-1



1	1	1	-1	-1
1	-1	1	-1	-1
1	1	1	-1	-1
-1	-1	1	-1	-1
-1	-1	1	-1	-1
-1	1	-1	-1	-1
1	-1	-1	-1	-1



-1	1	1	1	-1
-1	1	-1	1	-1
-1	1	1	1	-1
-1	-1	-1	1	-1
-1	-1	-1	1	-1
-1	-1	1	-1	-1
-1	1	-1	-1	-1



Image size =  $1920 \times 1080 \times 3$

First layer neurons =  $1920 \times 1080 \times 3 \sim 6$  million



Hidden layer neurons = Let's say you keep it  $\sim 4$  million

Weights between input and hidden layer =  $6 \text{ mil} * 4 \text{ mil}$   
=  $24$  million



Koala's **eye**? = Y



Koala's **nose**? = Y



Koala's **ears**? = Y



Koala's **head**? = Y



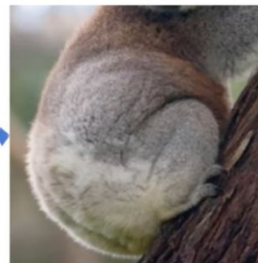
Koala's **hands**? = Y



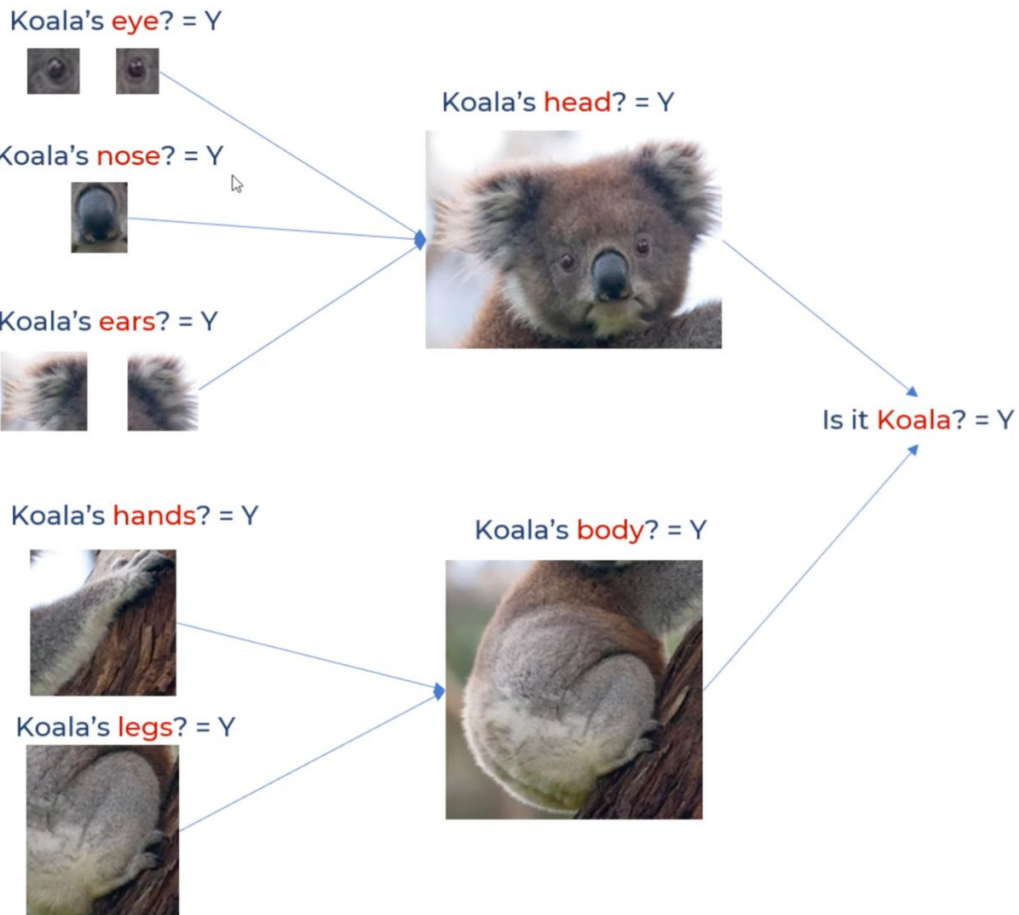
Koala's **legs**? = Y

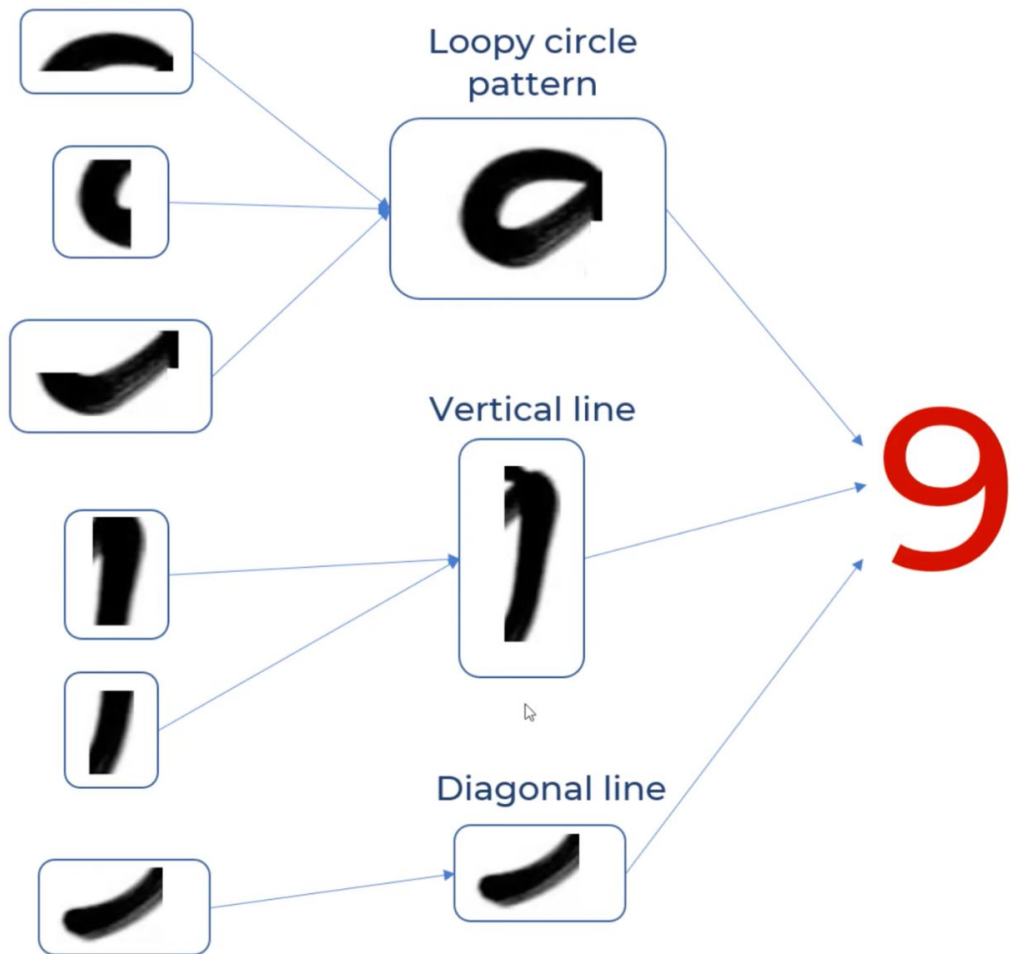


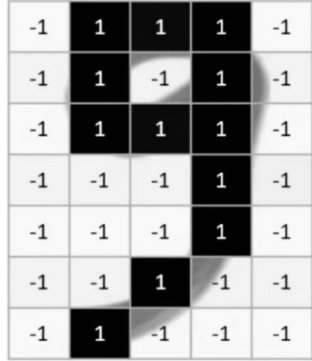
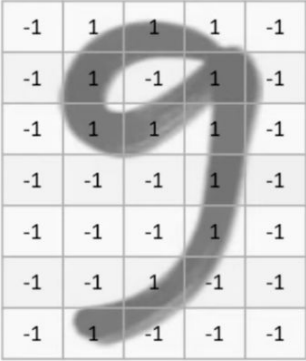
Koala's **body**? = Y



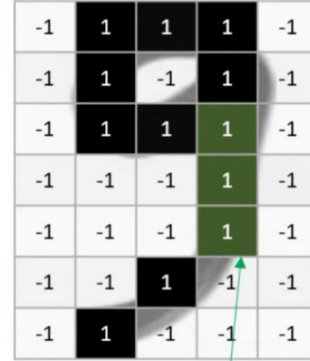
Is it **Koala**? = Y



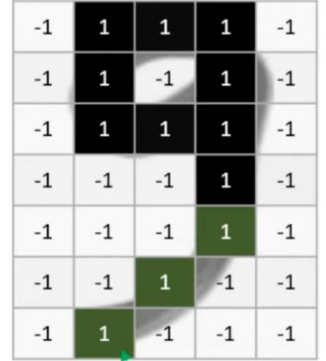




Loopy pattern  
filter



Vertical line  
filter



Diagonal line  
filter

$$-1+1+1-1-1-1-1+1+1 = -1 \rightarrow -1/9 = -0.11$$

-1	<b>1</b>	<b>1</b>	<b>1</b>	-1
-1	<b>1</b>	-1	<b>1</b>	-1
-1	<b>1</b>	<b>1</b>	<b>1</b>	-1
-1	-1	-1	<b>1</b>	-1
-1	-1	-1	<b>1</b>	-1
-1	-1	<b>1</b>	-1	-1
-1	<b>1</b>	-1	-1	-1

\*

<b>1</b>	<b>1</b>	<b>1</b>
<b>1</b>	<b>-1</b>	<b>1</b>
<b>1</b>	<b>1</b>	<b>1</b>

-0.11		

-1	<b>1</b>	<b>1</b>	<b>1</b>	-1
-1	<b>1</b>	-1	<b>1</b>	-1
-1	<b>1</b>	<b>1</b>	<b>1</b>	-1
-1	-1	-1	<b>1</b>	-1
-1	-1	-1	<b>1</b>	-1
-1	-1	<b>1</b>	-1	-1
-1	<b>1</b>	-1	-1	-1

\*

<b>1</b>	<b>1</b>	<b>1</b>
<b>1</b>	-1	<b>1</b>
<b>1</b>	<b>1</b>	<b>1</b>

-0.11	1	-0.11
-0.55	0.11	-0.33





-1	<b>1</b>	<b>1</b>	<b>1</b>	-1
-1	<b>1</b>	-1	<b>1</b>	-1
-1	<b>1</b>	<b>1</b>	<b>1</b>	-1
-1	-1	-1	<b>1</b>	-1
-1	-1	-1	<b>1</b>	-1
-1	-1	<b>1</b>	-1	-1
-1	<b>1</b>	-1	-1	-1

\*

<b>1</b>	<b>1</b>	<b>1</b>
<b>1</b>	-1	<b>1</b>
<b>1</b>	<b>1</b>	<b>1</b>

-0.11	<b>1</b>	-0.11
-0.55	0.11	-0.33
-0.33	0.33	-0.33
-0.22	-0.11	-0.22
-0.33	-0.33	-0.33

Feature Map

Loopy pattern detector

9 \* 

1	1	1
1	-1	1
1	1	1

 = 

	1			

Loopy pattern detector

6 \* 

1	1	1
1	-1	1
1	1	1

 = 

		1		

Loopy pattern detector

8 \* 

1	1	1
1	-1	1
1	1	1

 = 

	1			
		1		

Loopy pattern detector

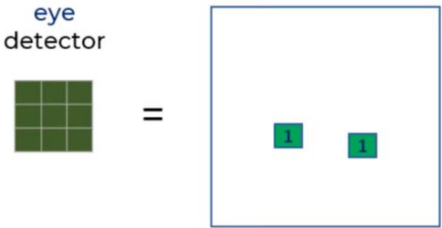
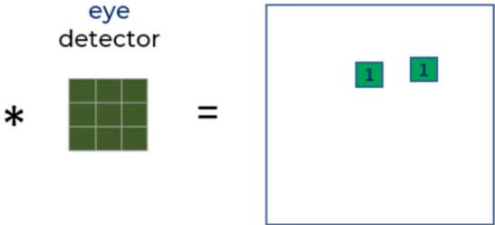
96 \* 

1	1	1
1	-1	1
1	1	1

 = 

	1			
			1	

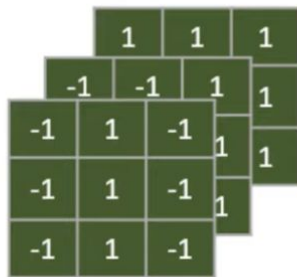
Location invariant: It can detect eyes in any location of the image





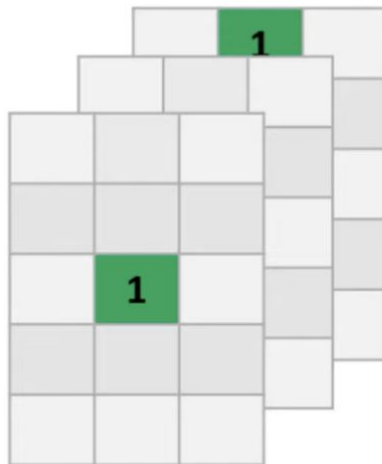
\*

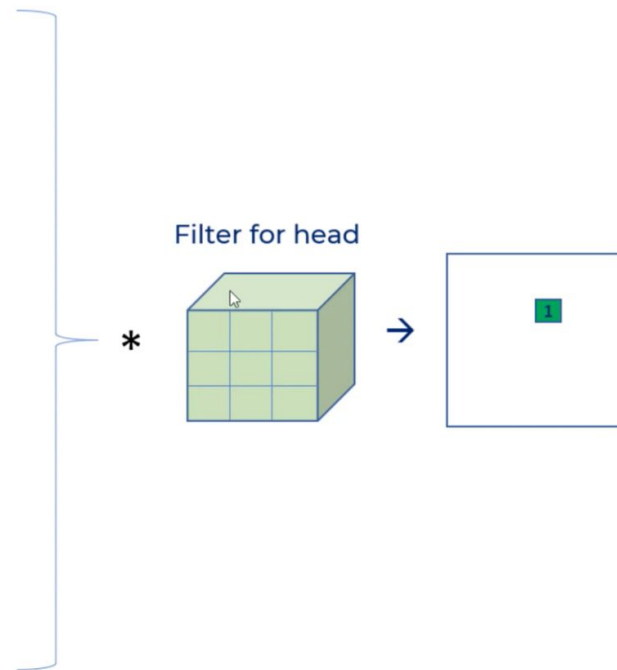
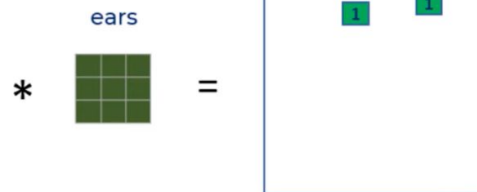
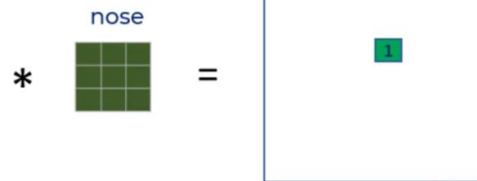
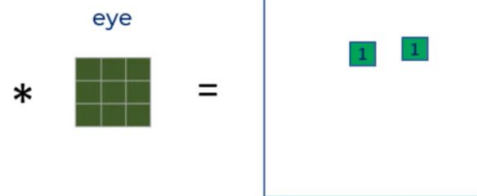
Filters



=

Feature Maps







eye

$$* \begin{bmatrix} \blacksquare & \blacksquare \\ \blacksquare & \blacksquare \end{bmatrix} = \begin{bmatrix} \blacksquare & \blacksquare \\ & \blacksquare \end{bmatrix}$$



nose

$$* \begin{bmatrix} \blacksquare & \blacksquare \\ \blacksquare & \blacksquare \end{bmatrix} = \begin{bmatrix} & \blacksquare \\ & \blacksquare \end{bmatrix}$$



ears

$$* \begin{bmatrix} \blacksquare & \blacksquare \\ \blacksquare & \blacksquare \end{bmatrix} = \begin{bmatrix} \blacksquare & \blacksquare \\ & \blacksquare \end{bmatrix}$$



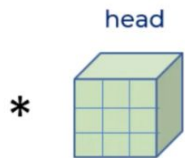
hands

$$* \begin{bmatrix} \blacksquare & \blacksquare \\ \blacksquare & \blacksquare \end{bmatrix} = \begin{bmatrix} & \blacksquare \\ & \blacksquare \end{bmatrix}$$



legs

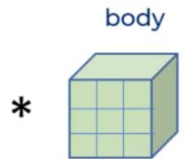
$$* \begin{bmatrix} \blacksquare & \blacksquare \\ \blacksquare & \blacksquare \end{bmatrix} = \begin{bmatrix} \blacksquare & \blacksquare \\ & \blacksquare \end{bmatrix}$$



\*



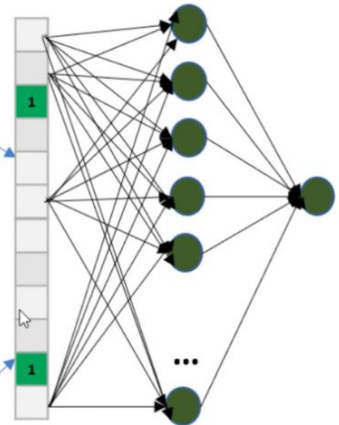
flatten



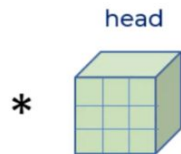
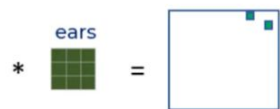
\*



flatten



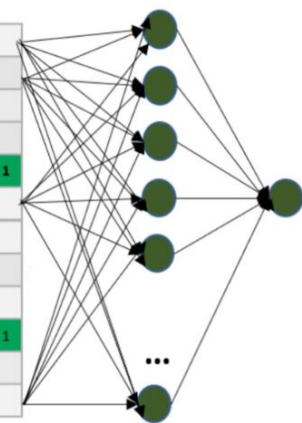
Is this Koala?



flatten



flatten



Is this  
Koala?

-1	1	1	1	-1
-1	1	-1	1	-1
-1	1	1	1	-1
-1	-1	-1	1	-1
-1	-1	-1	1	-1
-1	-1	1	-1	-1
-1	1	-1	-1	-1

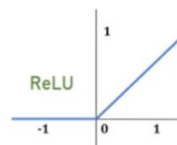
\*

Loopy pattern  
filter

1	1	1
1	-1	1
1	1	1

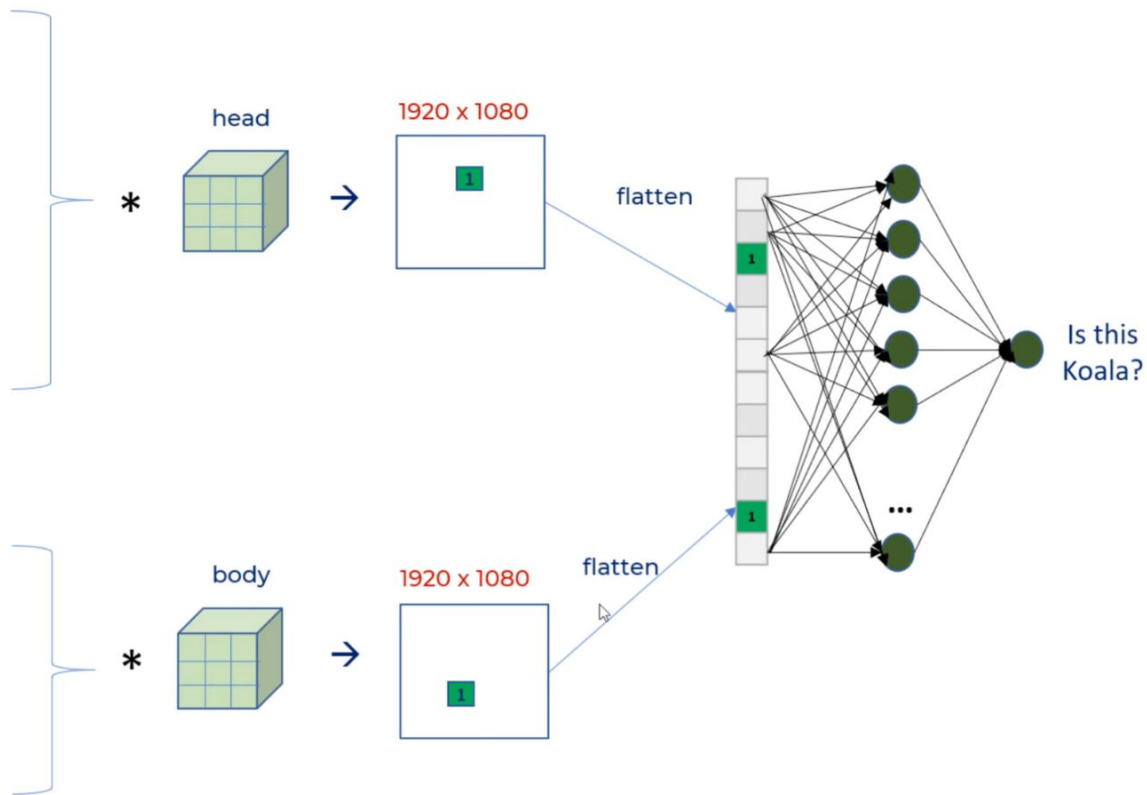
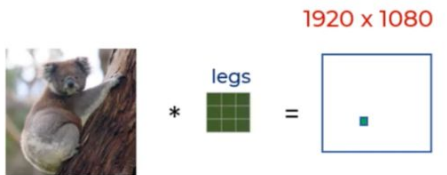
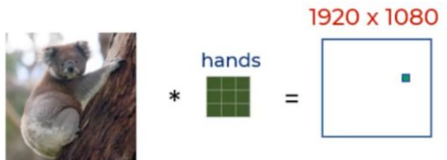
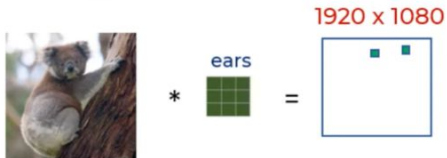
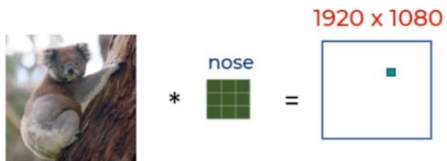
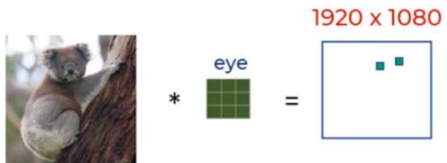


-0.11	1	-0.11
-0.55	0.11	-0.33
-0.33	0.33	-0.33
-0.22	-0.11	-0.22
-0.33	-0.33	-0.33



0	1	0
0	0.11	0
0	0.33	0
0	0	0
0	0	0





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

8	9
3	2

0	<b>1</b>	0
0	0.11	0
0	0.33	0
0	0	0
0	0	0

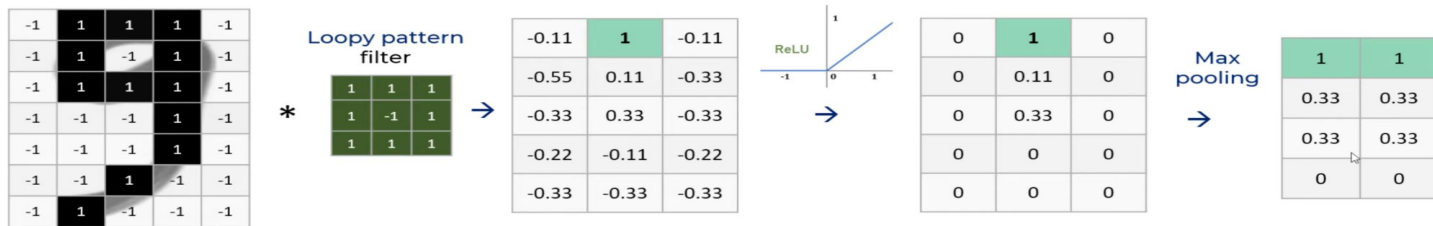
1	

2 by 2 filter with stride = 1

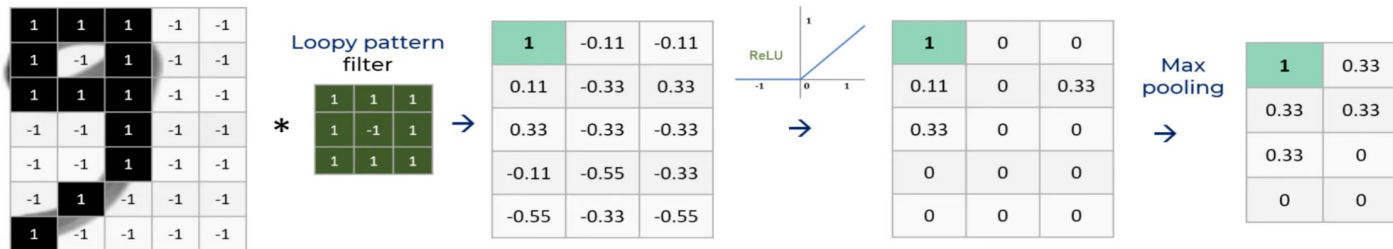
2 by 2 filter with stride = 2

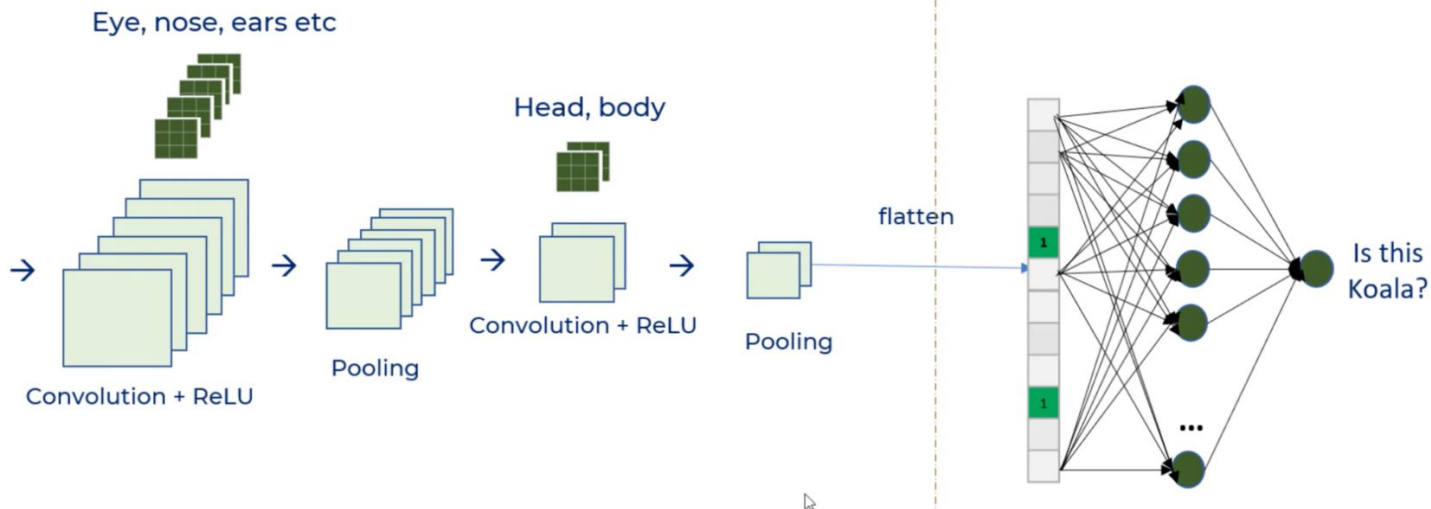
5	1	3	4
8	2	9	2
1	3	0	1
2	2	2	0

4	4.5
2	0.75



Shifted 9 at different position





Feature Extraction

Classification