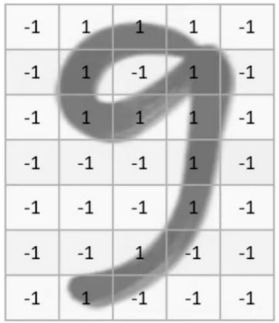
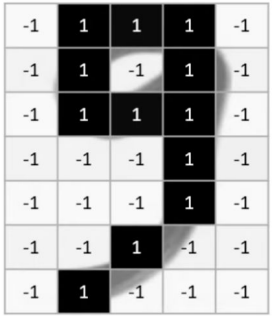
MIDS W207
Applied Machine Learning

Summer Week 10
Live Session Slides





Location shifted

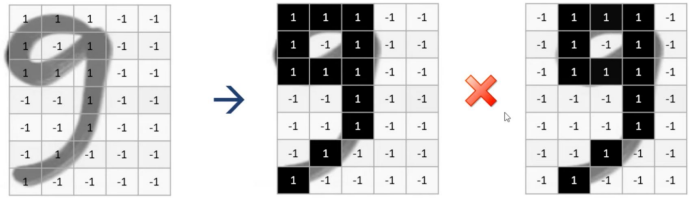
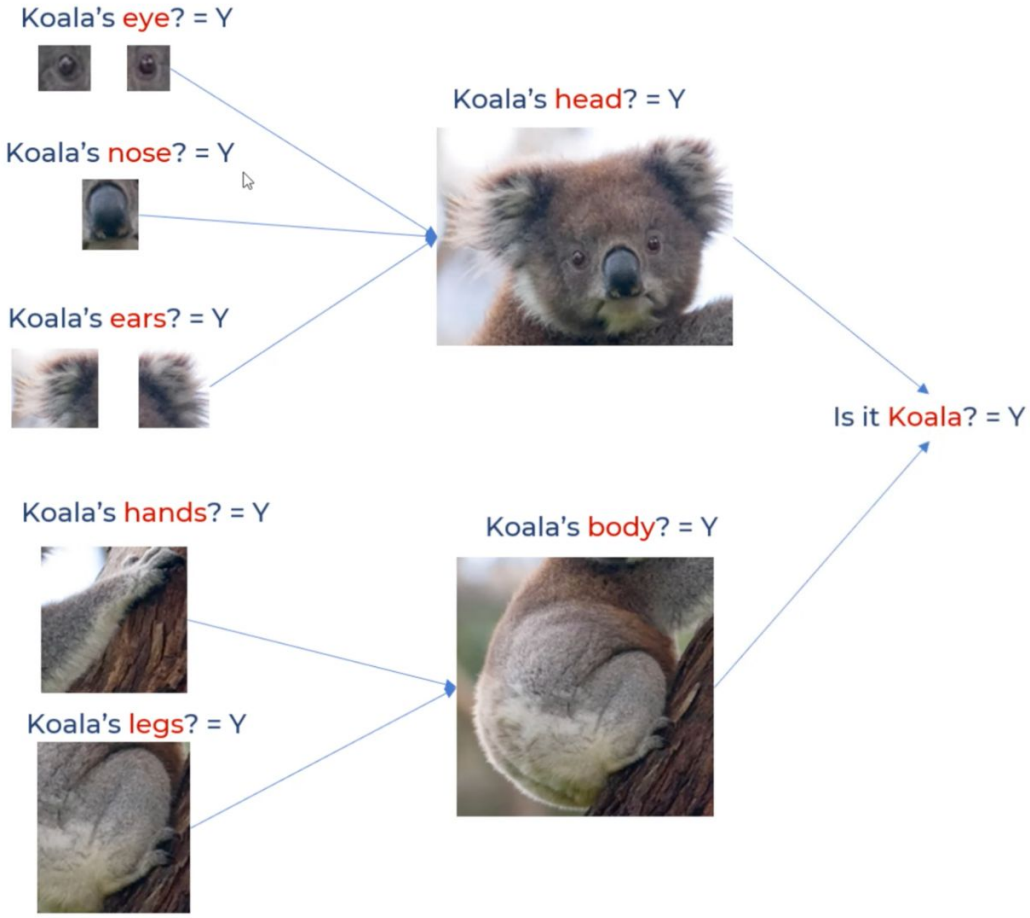


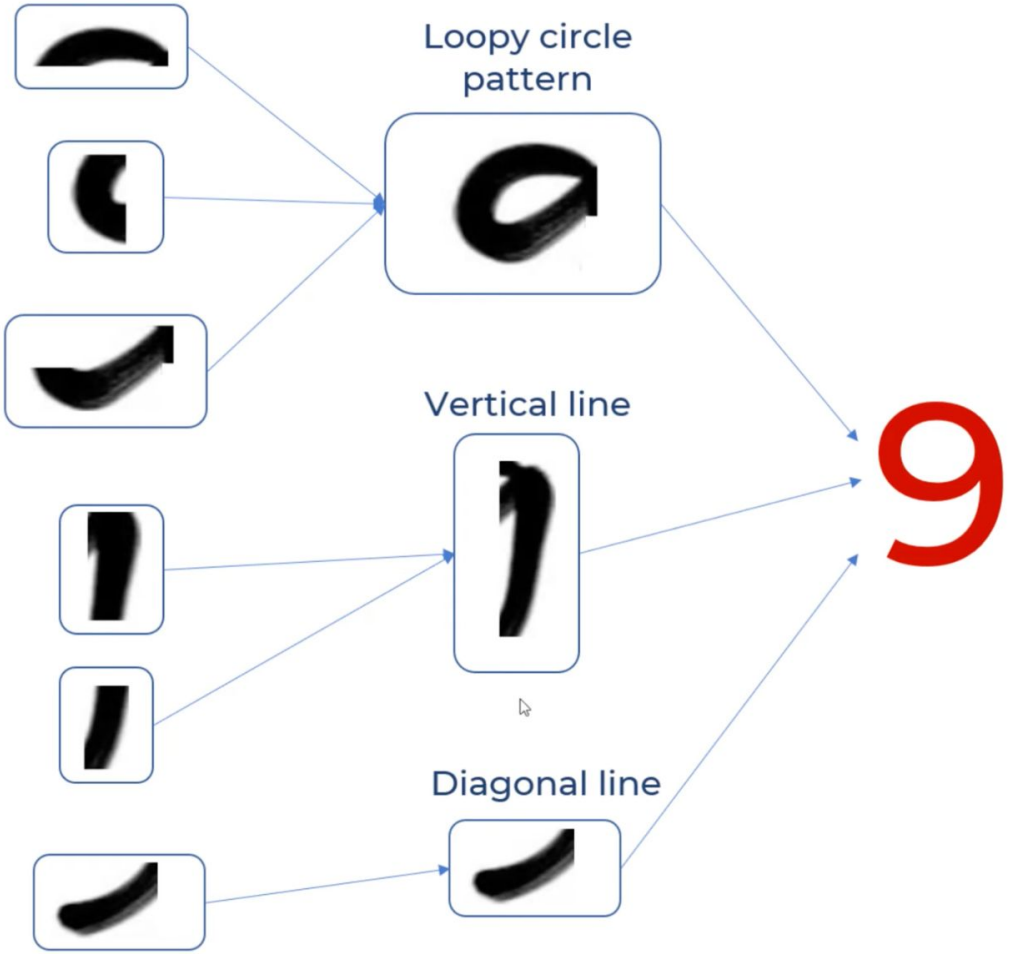
Image size = 1920 x 1080 X 3

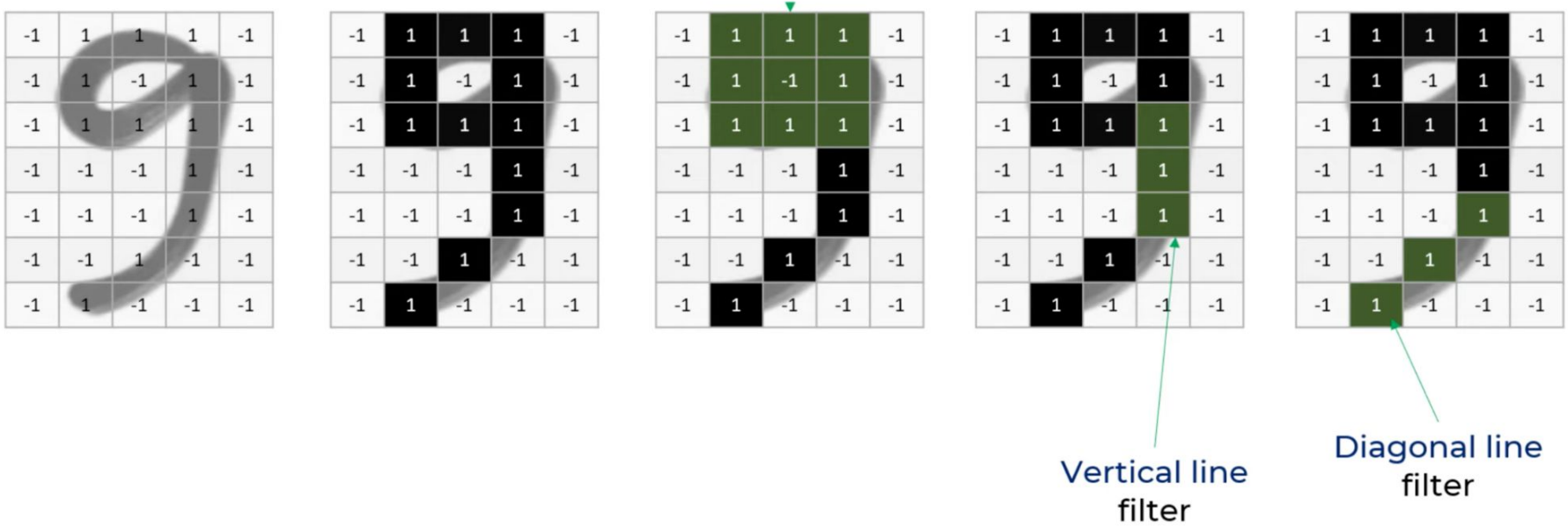
First layer neurons = 1920 x 1080 X 3 ~ 6 million

Hidden layer neurons = Let's say you keep it ~ 4 million

Weights between input and hidden layer = 6 mil * 4 mil
= 24 million


Koala's eye? = Y
Koala's nose? = Y
Koala's ears? = Y
Koala's head? = Y
Is it Koala? = Y
Koala's hands? = Y
Koala's legs? = Y
Koala's body? = Y


Loopy circle pattern
Vertical line
Diagonal line
9


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	**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

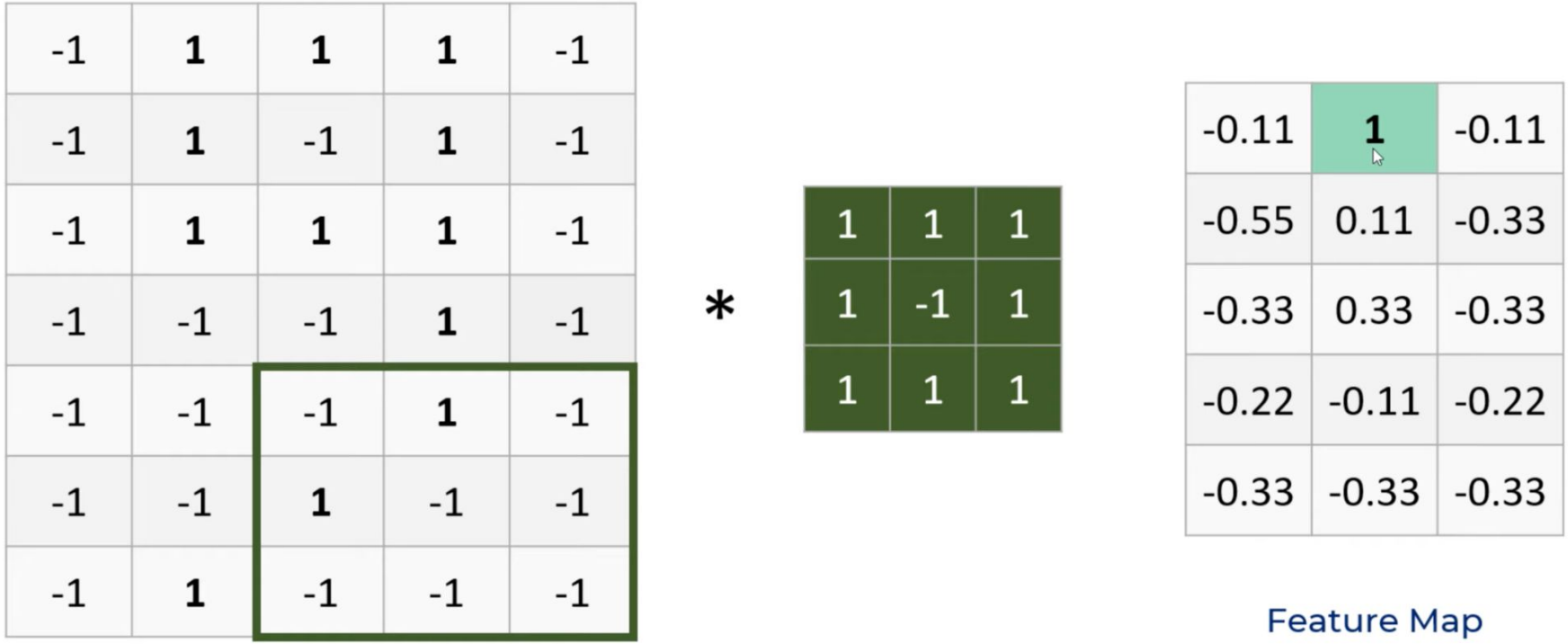
-0.11		

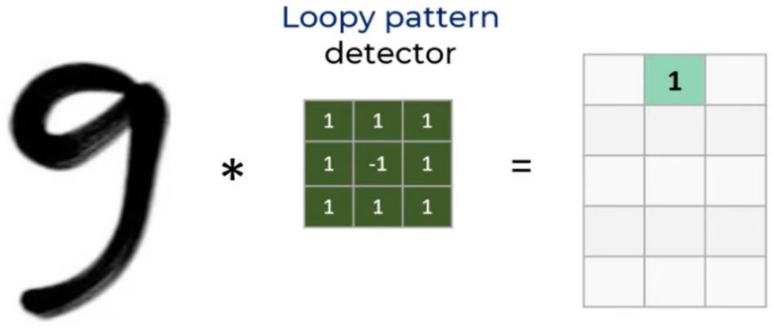
-1	**1**	**1**	**1**	-1
-1	**1**	-1	**1**	-1
-1	**1**	**1**	**1**	-1
-1	-1	-1	**1**	-1
-1	-1	-1	**1**	-1
-1	-1	**1**	-1	-1
-1	**1**	-1	-1	-1

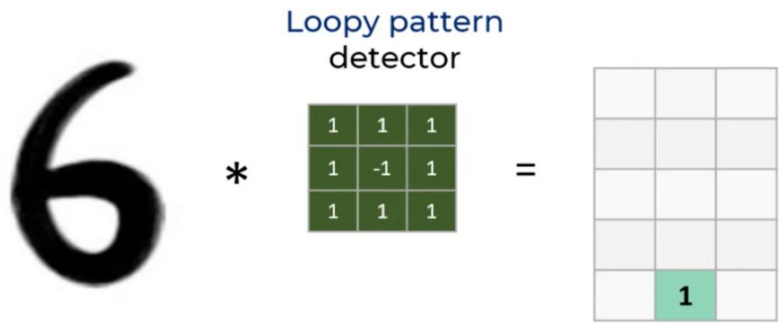
*

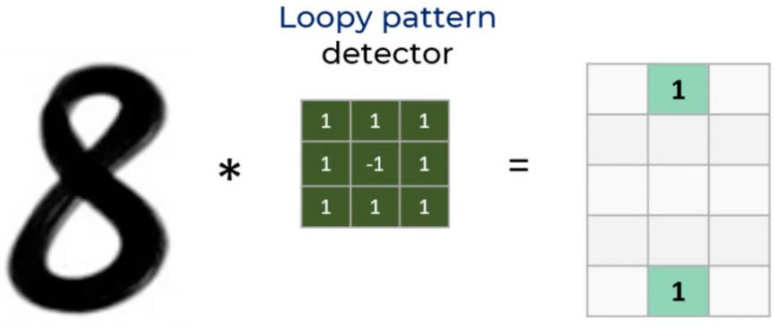
1	1	1
1	-1	1
1	1	1

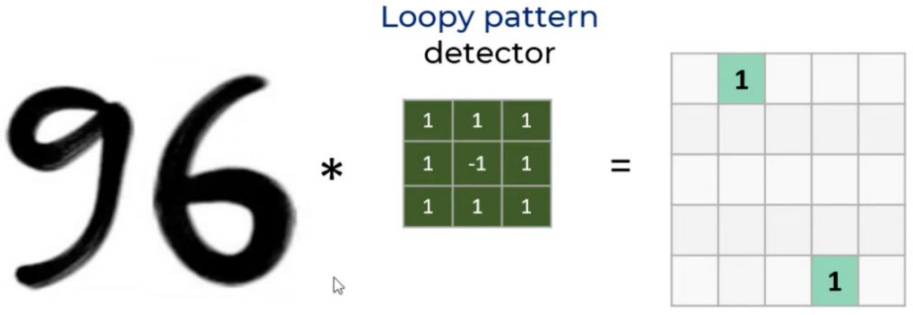
-0.11	1	-0.11
-0.55	0.11	-0.33


-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
-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
Feature Map


Loopy pattern
detector
1 1 1
1 -1 1
1 1 1
1


Loopy pattern
detector
1 1 1
1 -1 1
1 1 1
1


Loopy pattern
detector
1 1 1
1 -1 1
1 1 1
1
1

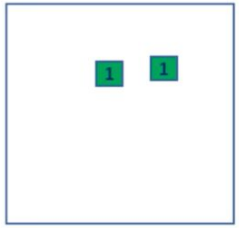

Loopy pattern
detector
1 1 1
1 -1 1
1 1 1
1
1

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

*

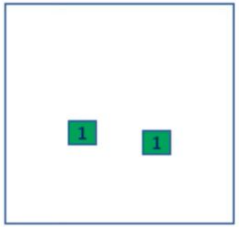
eye
detector

=



eye
detector

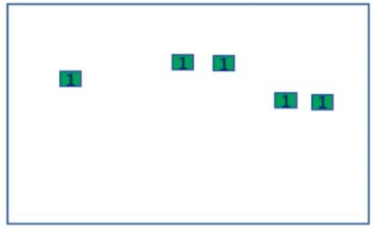
=

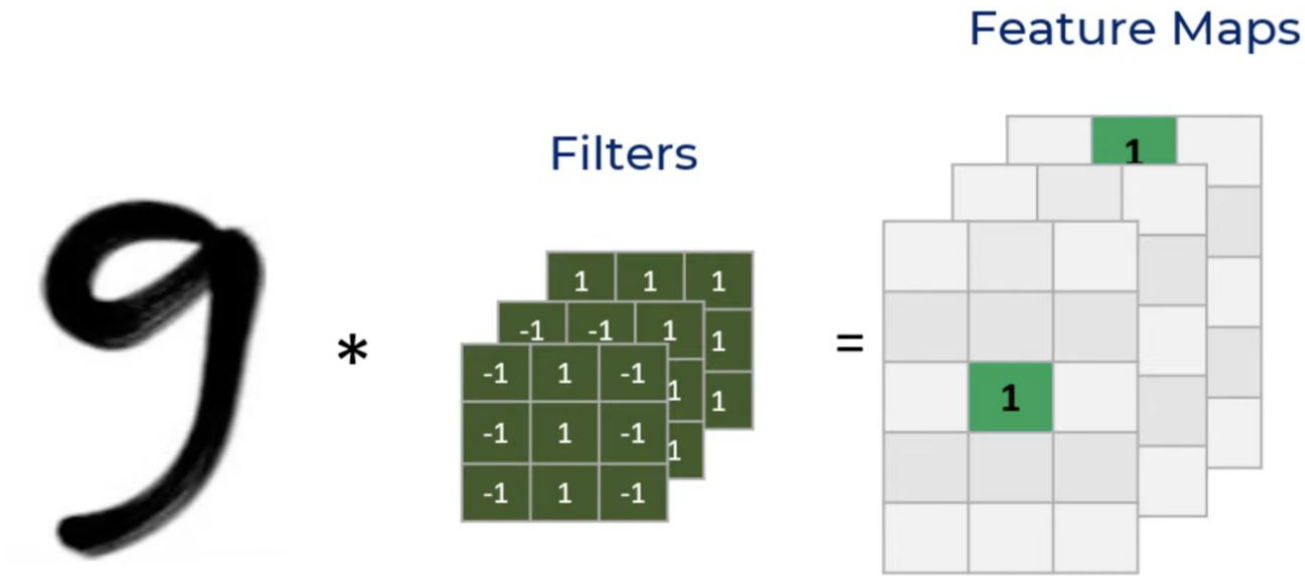


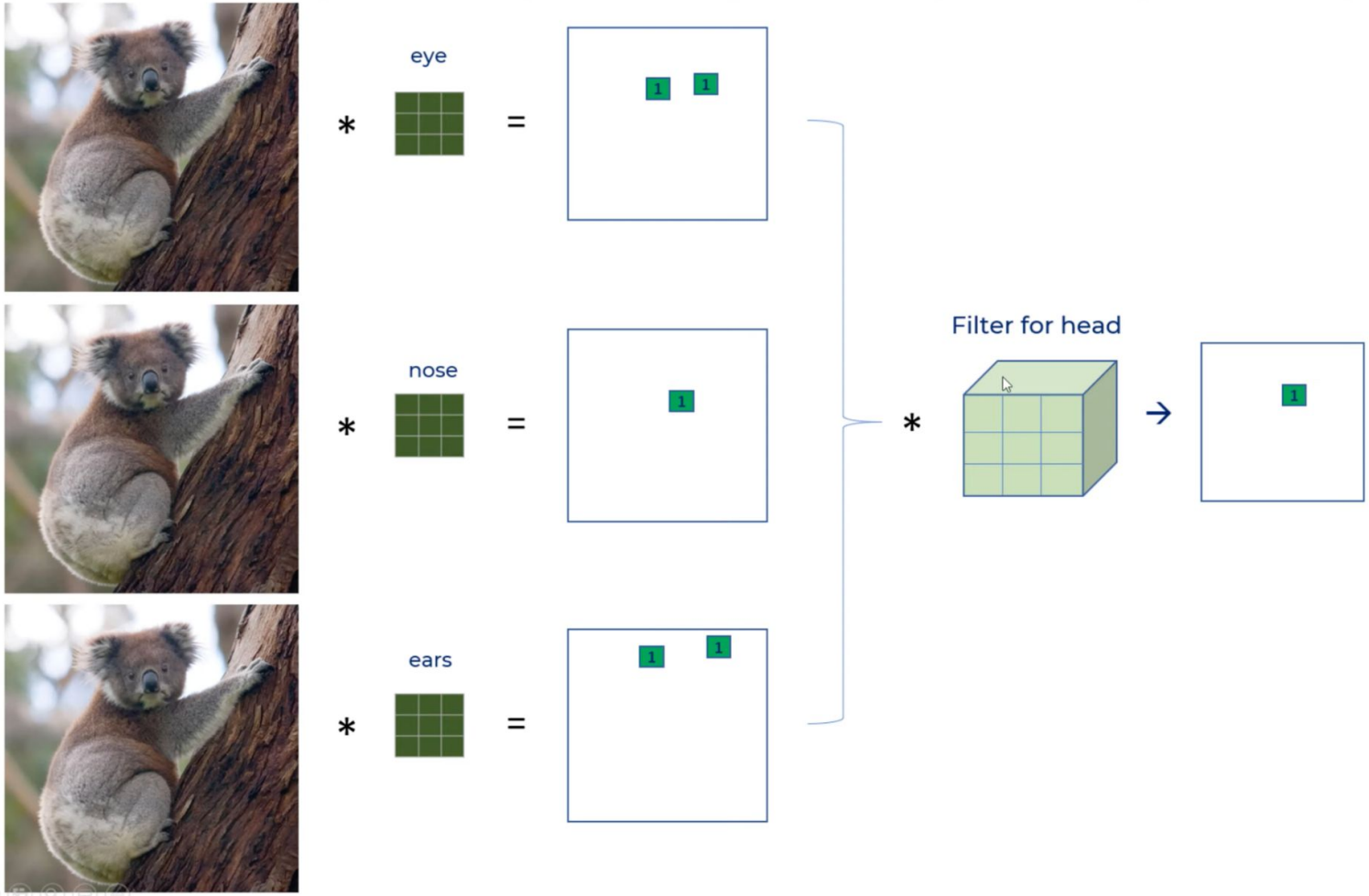
eye
detector

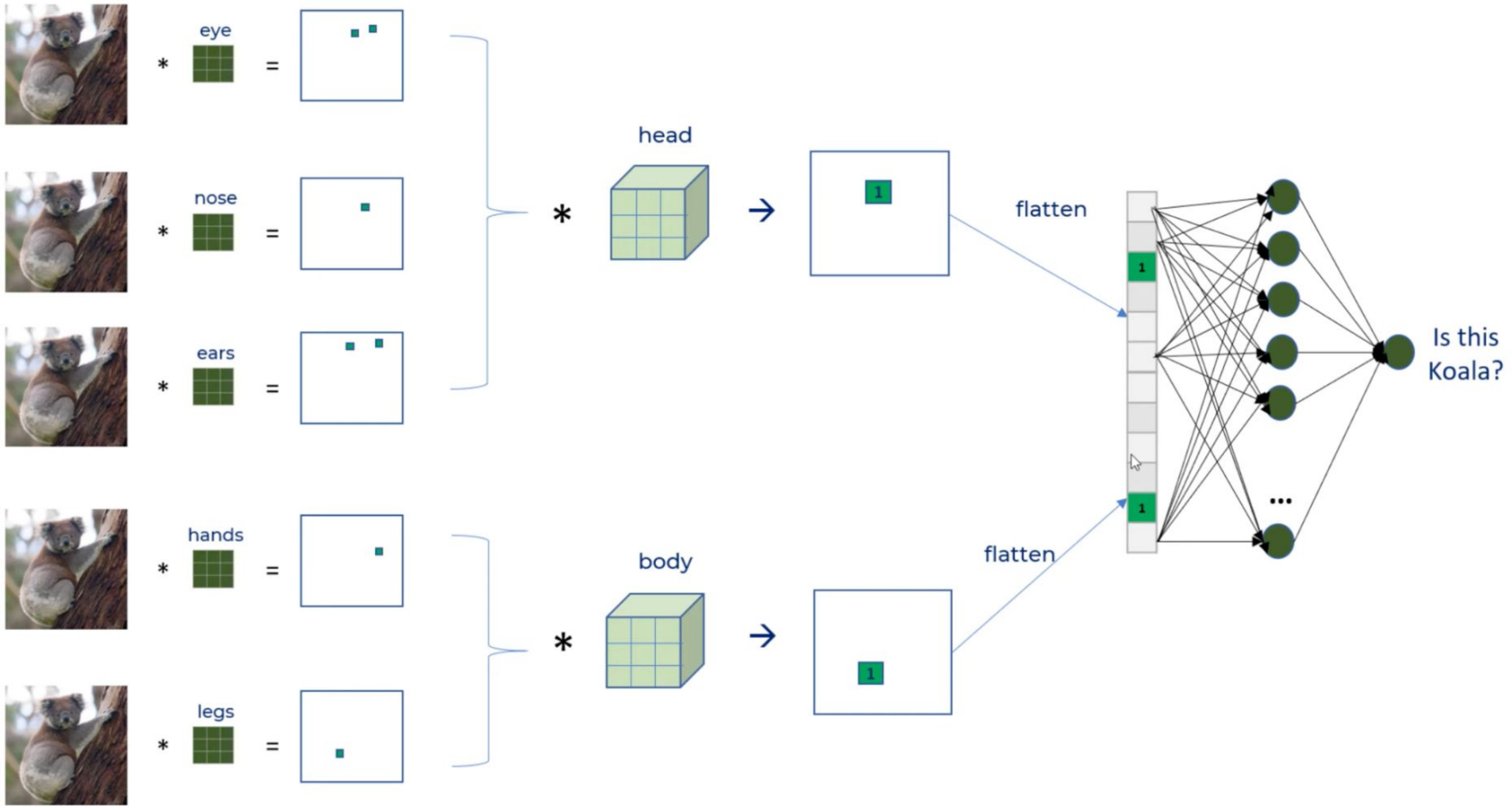
*

=




Feature Maps
Filters
1 1 1
-1 -1 1
-1 1 -1
-1 1 -1
-1 1 -1
1
1
1
1
1
1
1


eye
nose
ears
Filter for head
1
1
1
1
1
1
1


eye
nose
ears
hands
legs
head
body
flatten
flatten
1
1
1
Is this Koala?

eye

nose

ears

hands

legs

head

body

1

flatten

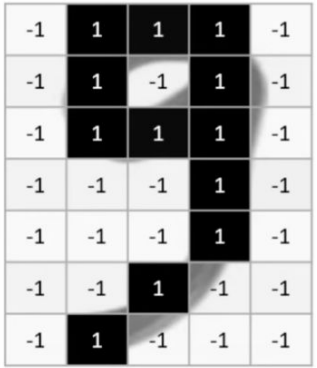
flatten

1

1

...

Is this Koala?



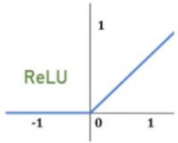
*

Loopy pattern
filter

1	1	1
1	-1	1
1	1	1

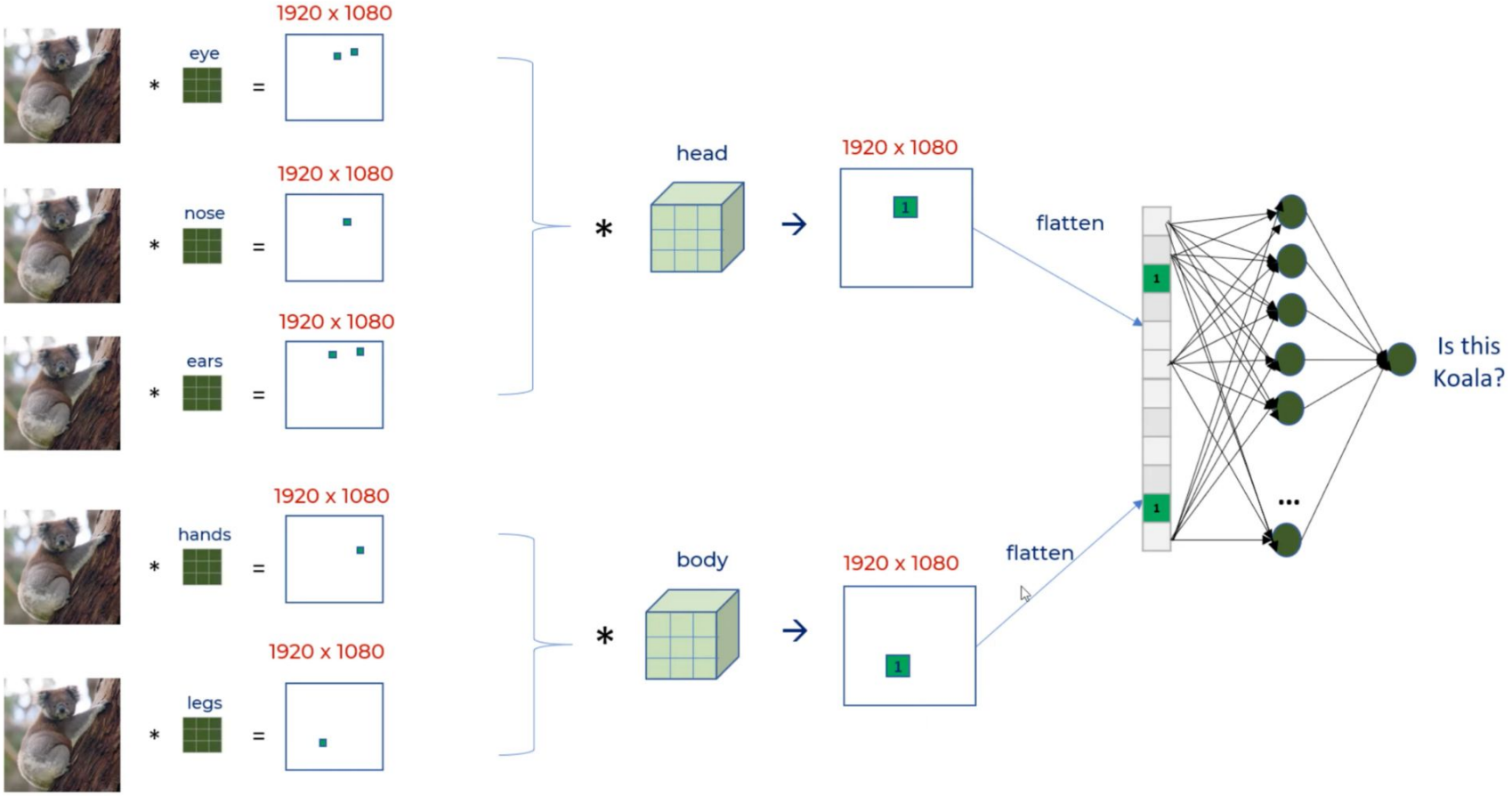
→

-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


1920 x 1080
eye
1920 x 1080
nose
1920 x 1080
ears
1920 x 1080
hands
1920 x 1080
legs
head
1920 x 1080
1
flatten
body
1920 x 1080
1
flatten
1
1
...
Is this Koala?

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

8	**9**
3	2

2 by 2 filter with stride = 2

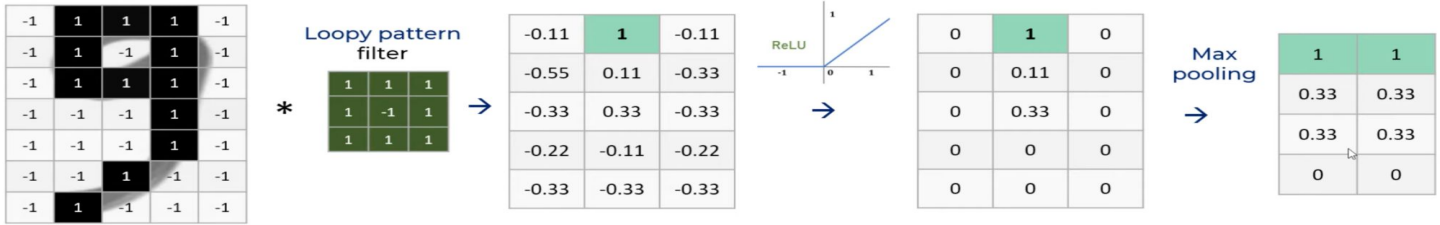
5	1	3	4
8	2	9	2
1	3	0	1
2	2	2	0

4	4.5
2	0.75

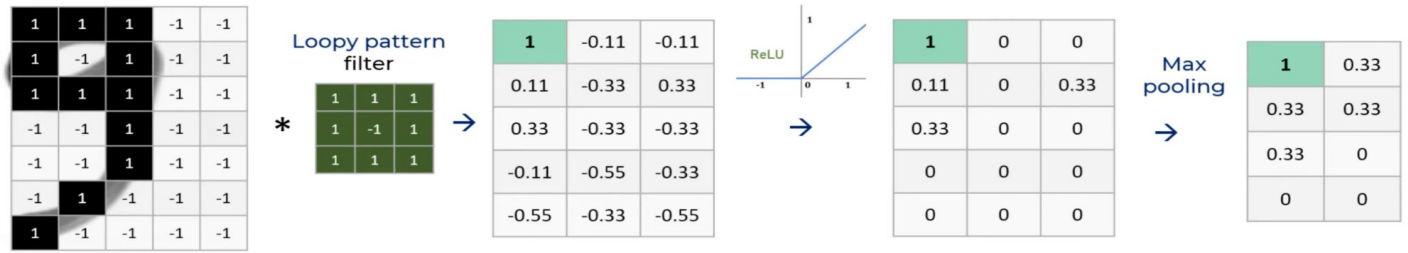
0	**1**	0
0	0.11	0
0	0.33	0
0	0	0
0	0	0

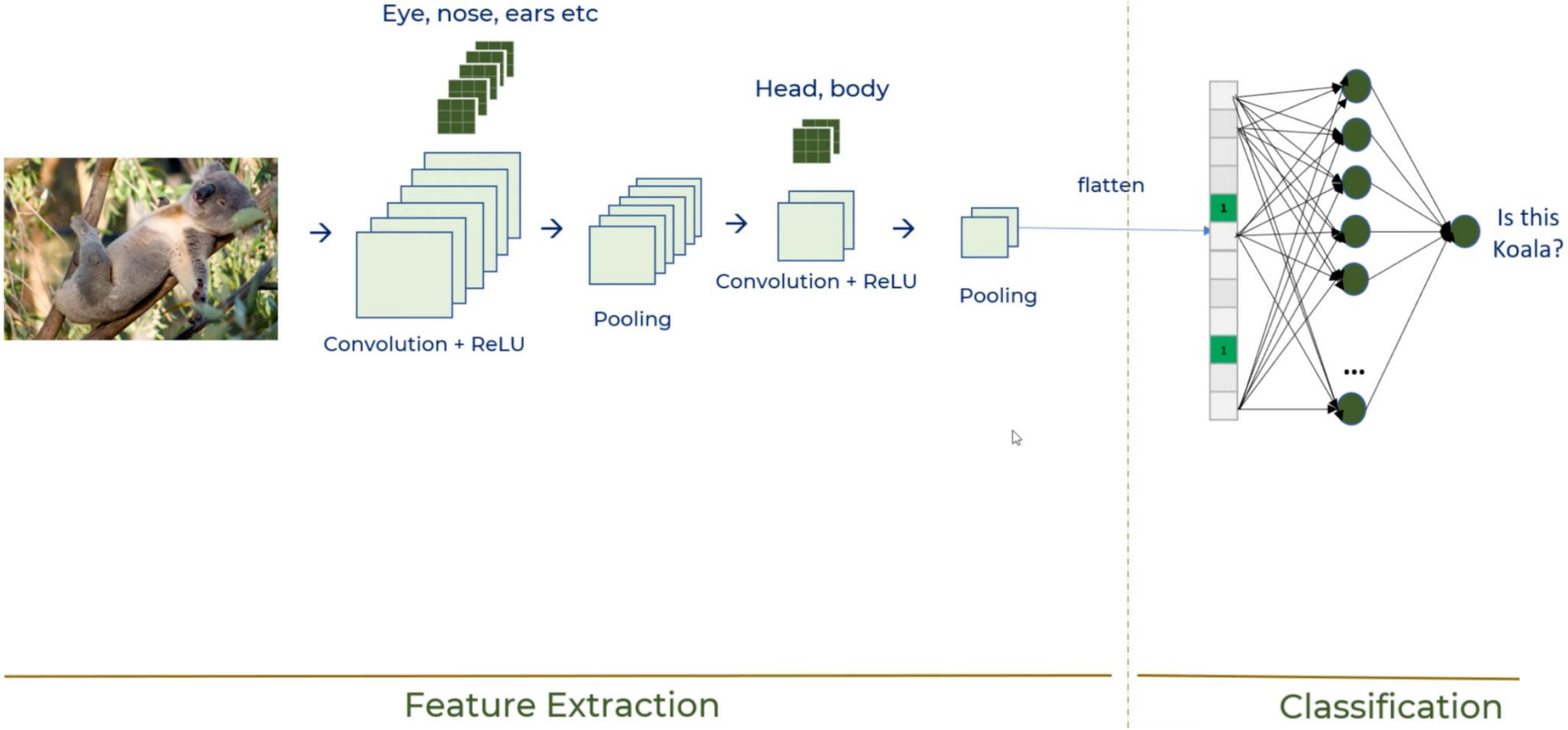
1	

2 by 2 filter with stride = 1



Shifted 9 at different position




Eye, nose, ears etc
Head, body
Convolution + ReLU
Pooling
Convolution + ReLU
Pooling
flatten
1
1
...
Is this Koala?
Feature Extraction
Classification