IESTI01 - TinyML

Introducing Convolutions

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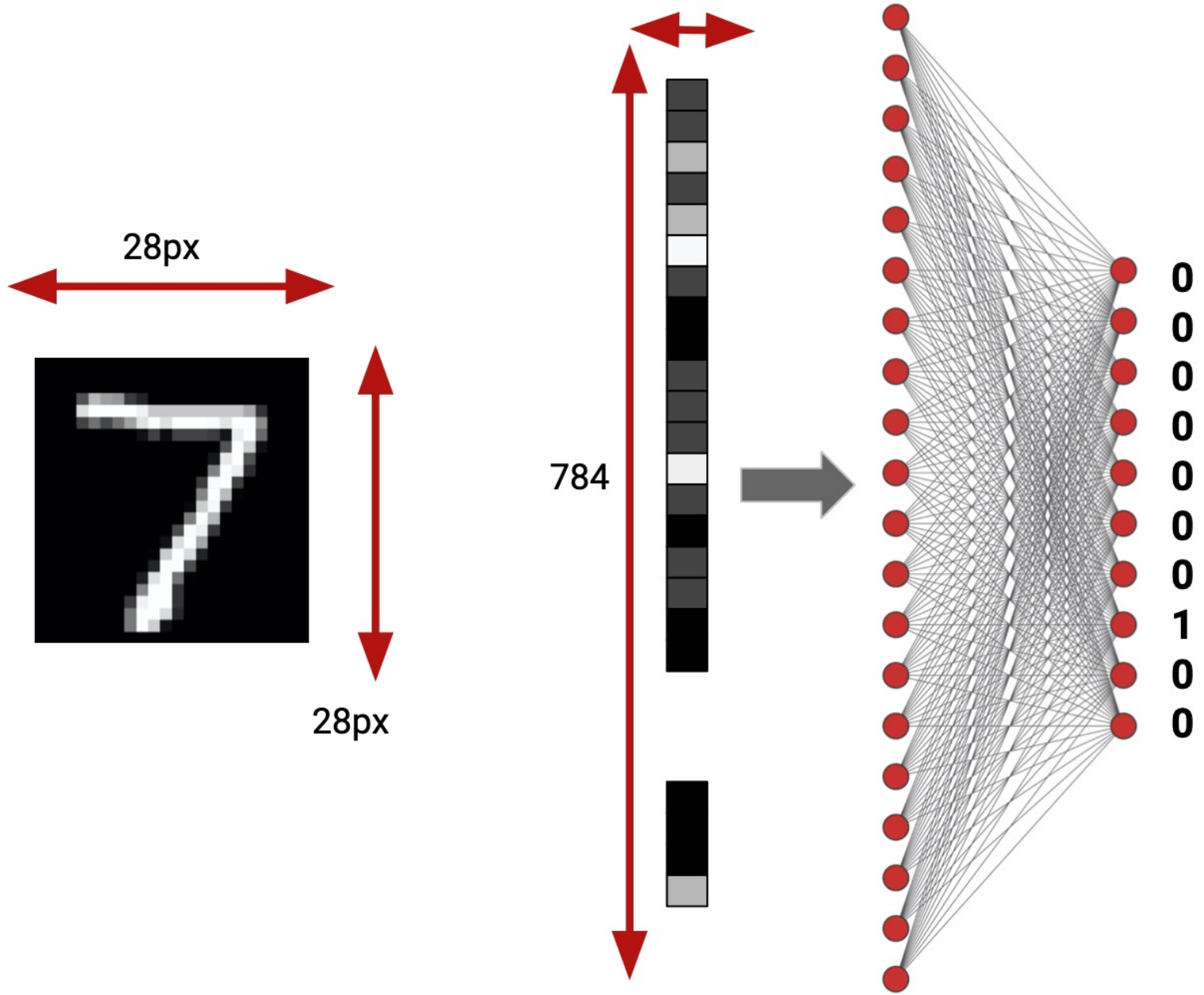
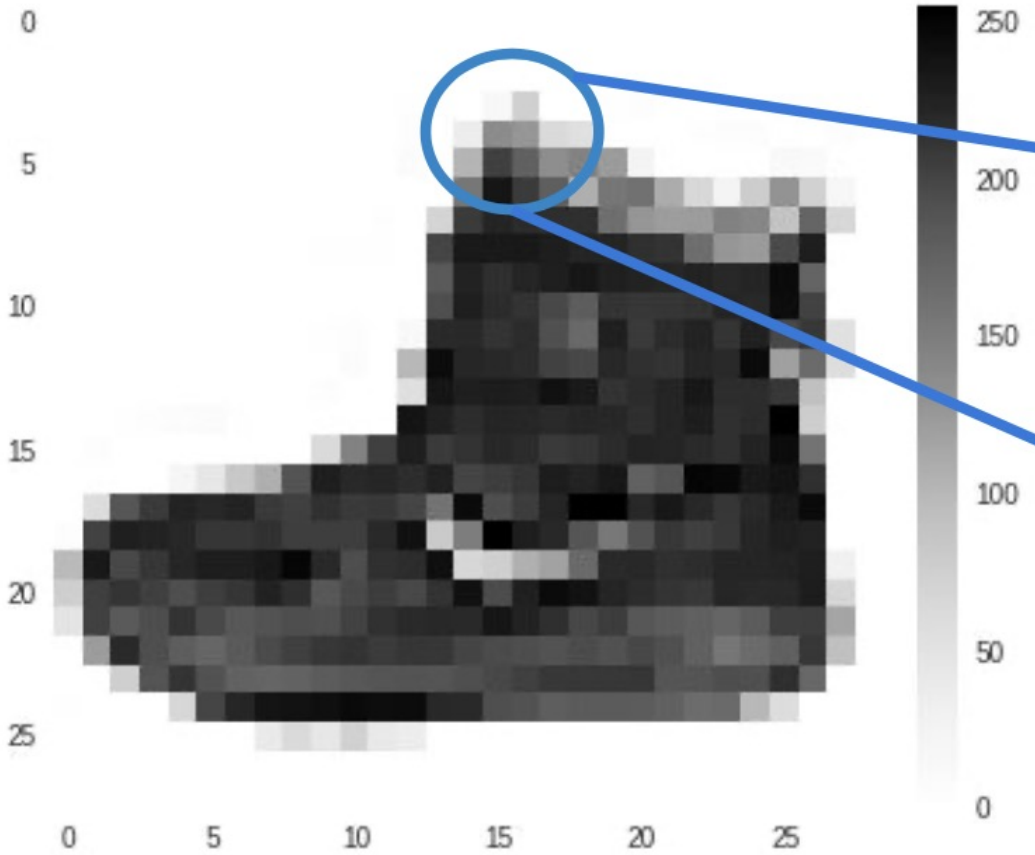
May 26th, 2021

Introducing Convolutions

Beyond weights and biases…


28px
28px
784
0
0
0
0
0
0
1
0
0



0	64	128
48	192	144
142	226	168

Current Pixel Value is 192

Consider neighbor Values

-1	0	-2
.5	4.5	-1.5
1.5	2	-3

Filter Definition

```
CURRENT_PIXEL_VALUE = 192
NEW_PIXEL_VALUE = (-1 * 0) + (0 * 64) + (-2 * 128) +
                  (.5 * 48) + (4.5 * 192) + (-1.5 * 144) +
                  (1.5 * 42) + (2 * 226) + (-3 * 168)
```

Image Kernels

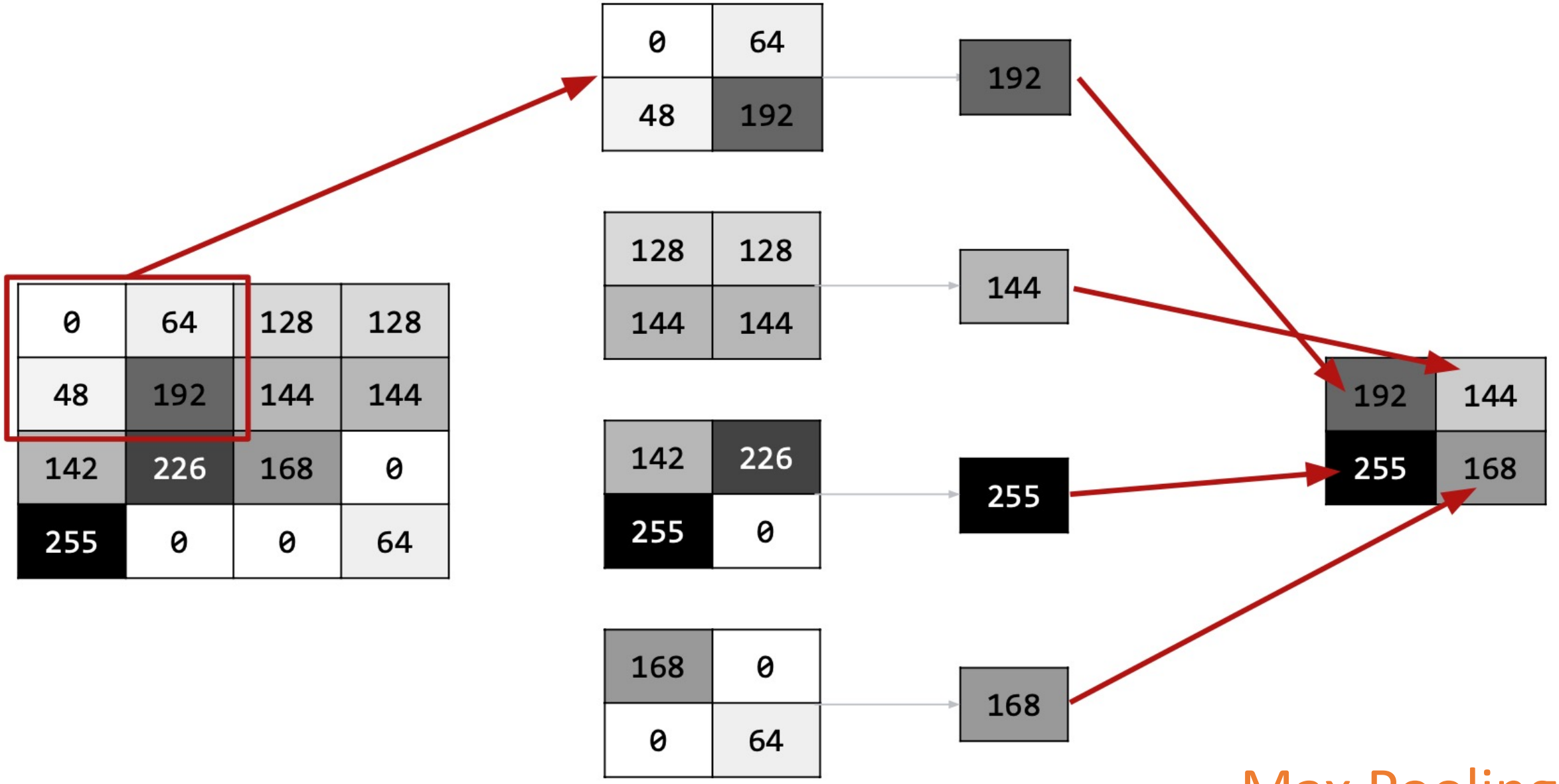
-1	0	1
-2	0	2
-1	0	1

custom

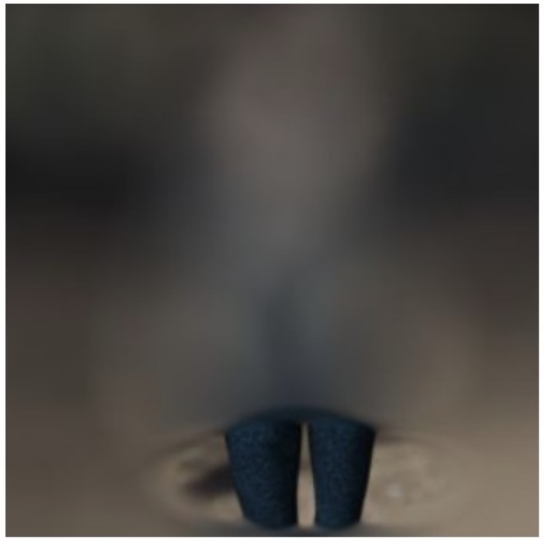
-1	-2	-1
0	0	0
1	2	1

custom

https://setosa.io/ev/image-kernels/


0 64 128 128
48 192 144 144
142 226 168 0
255 0 0 64
0 64
48 192
128 128
144 144
142 226
255 0
168 0
0 64
192
144
255
168
192 144
255 168

Max Pooling



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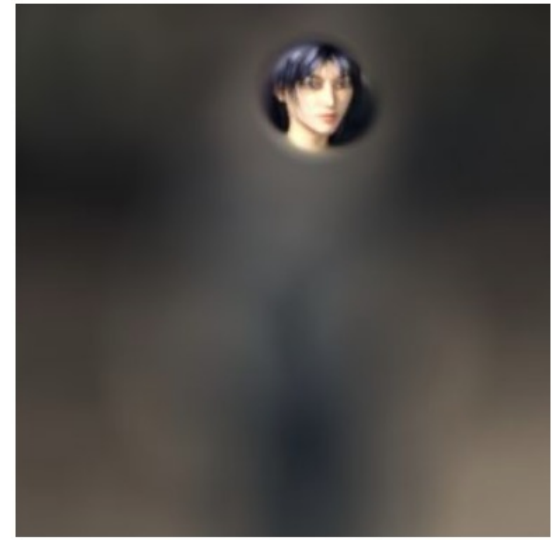

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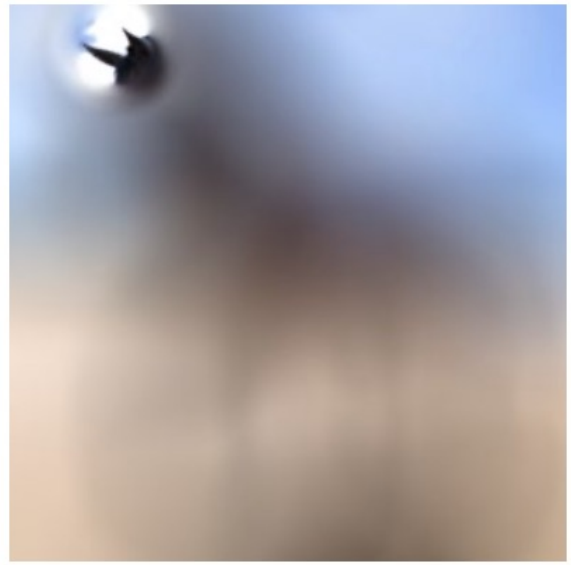

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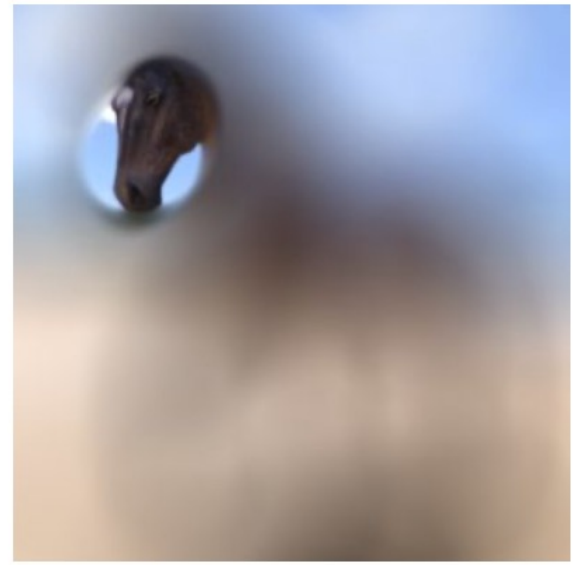

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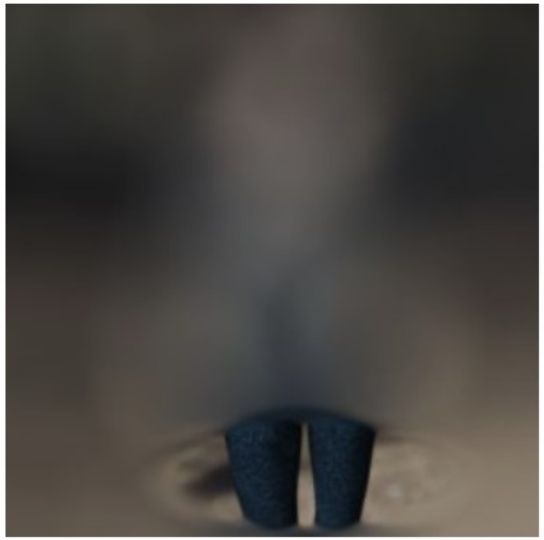

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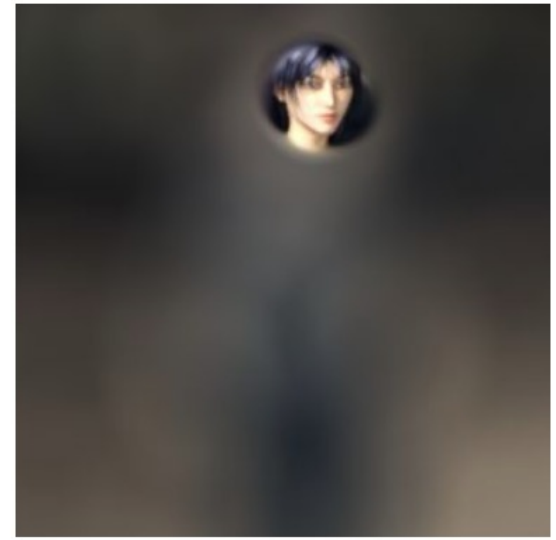

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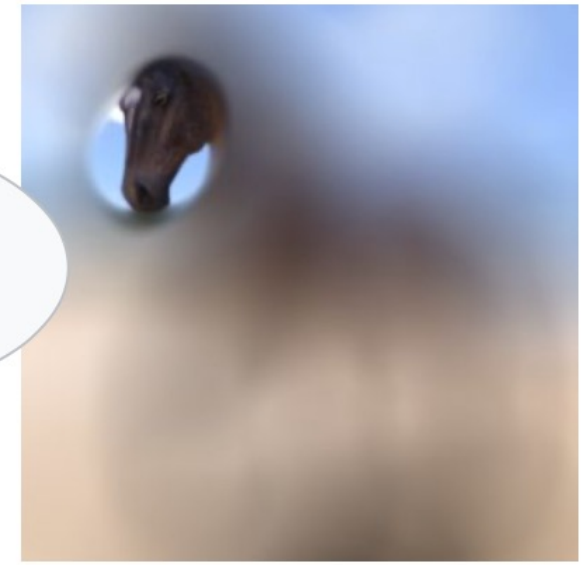

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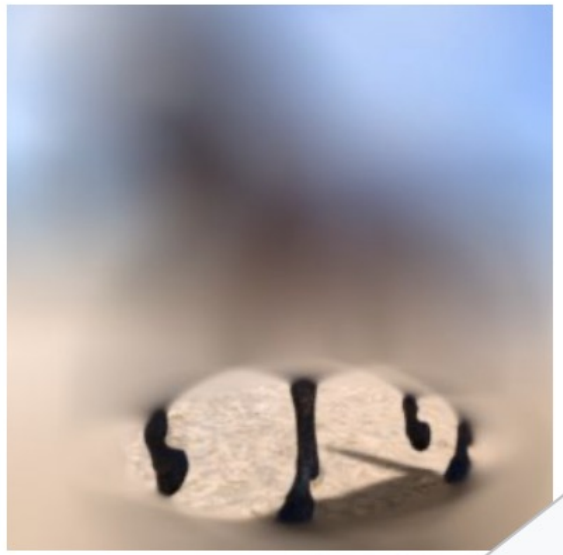

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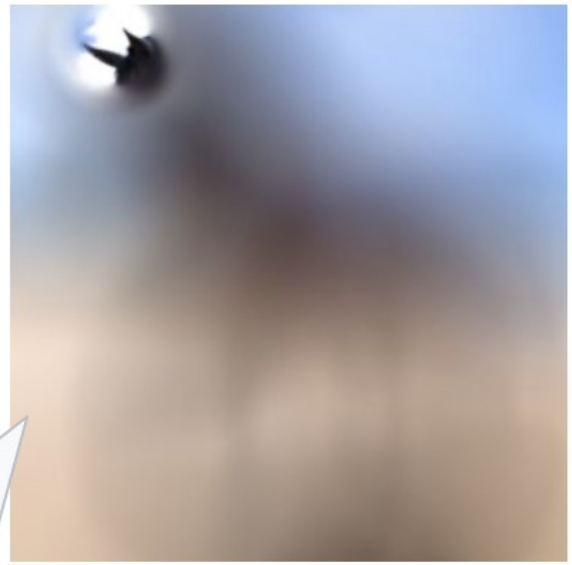

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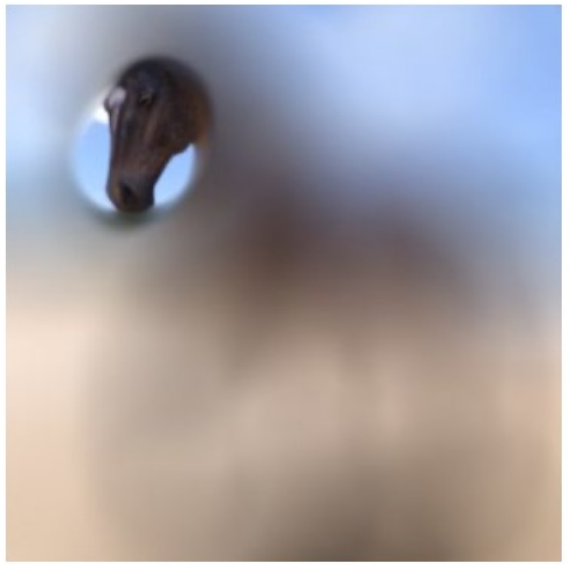

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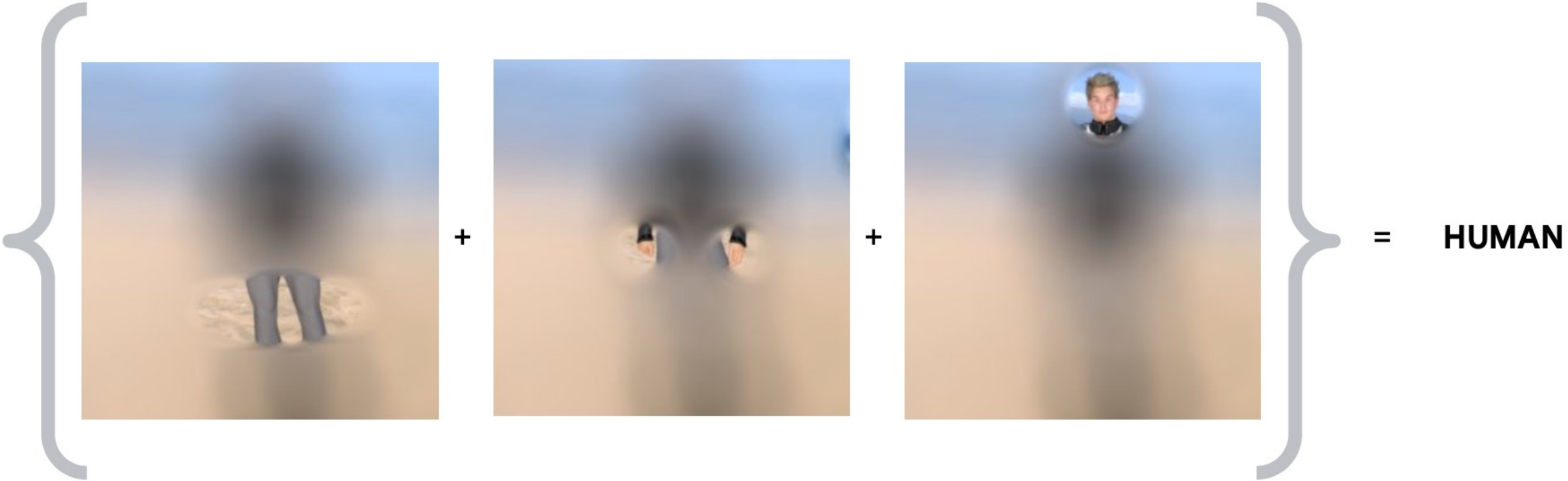
Filters can then be combined with **labels** to make a **prediction** of the image contents...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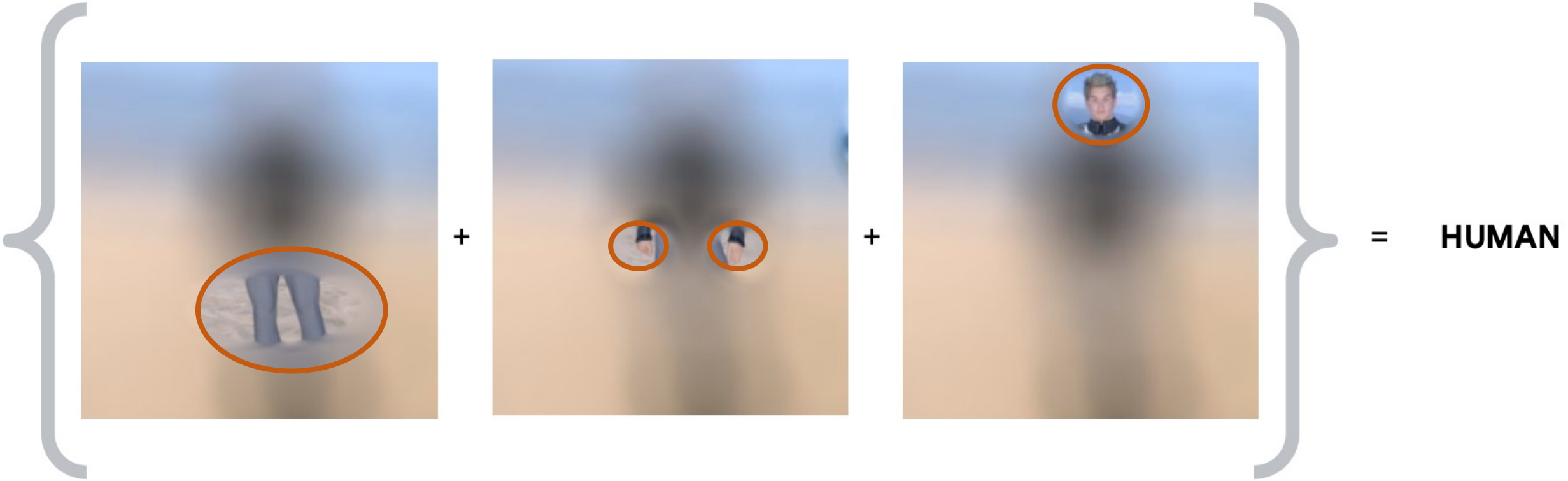

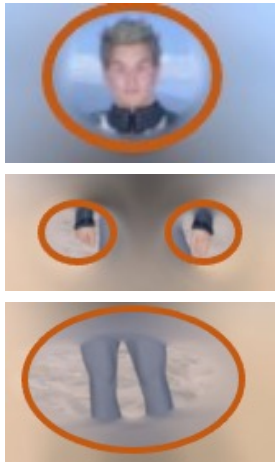

Data

Model

Inferences

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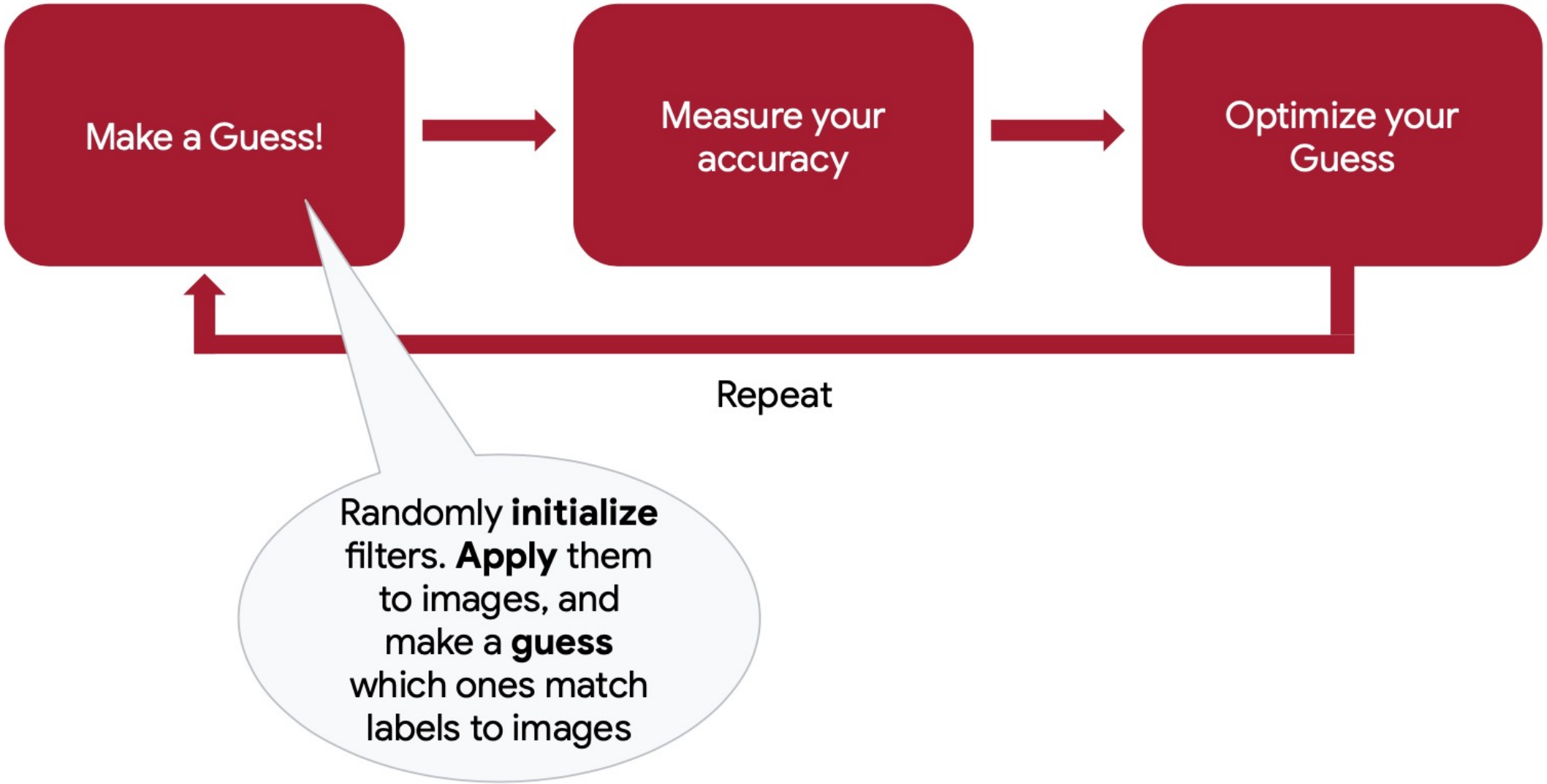
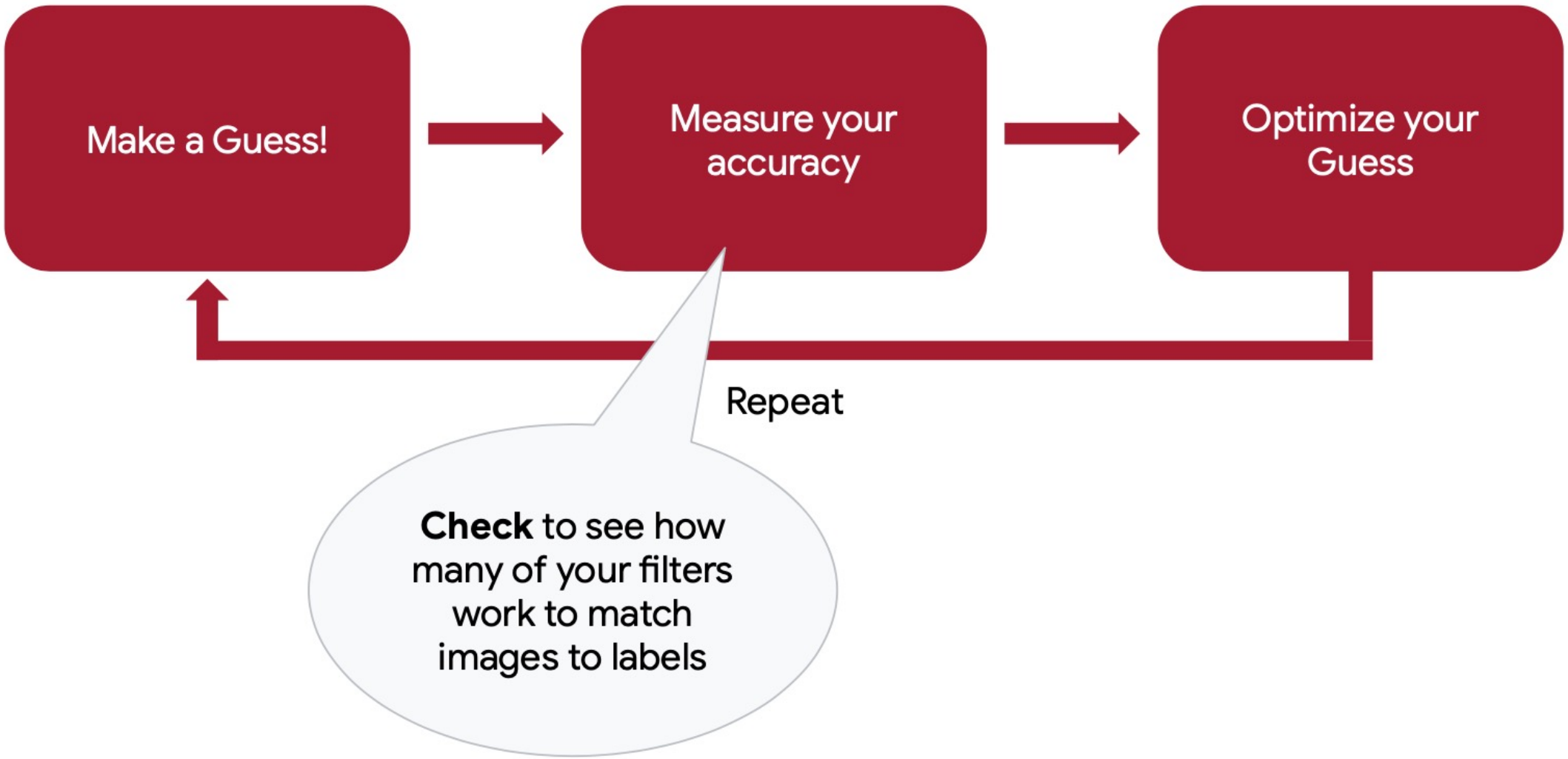
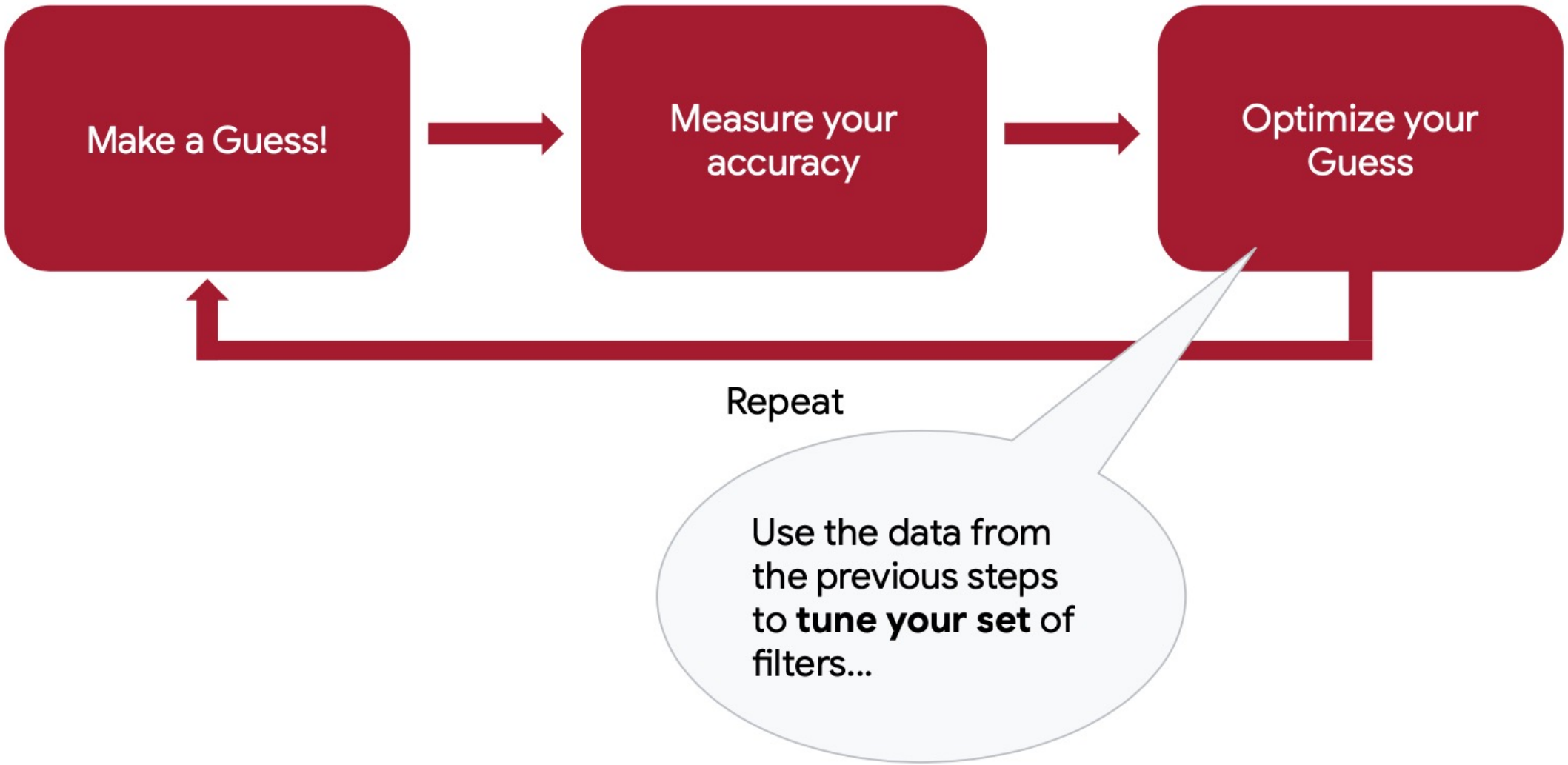
The Machine Learning Paradigm



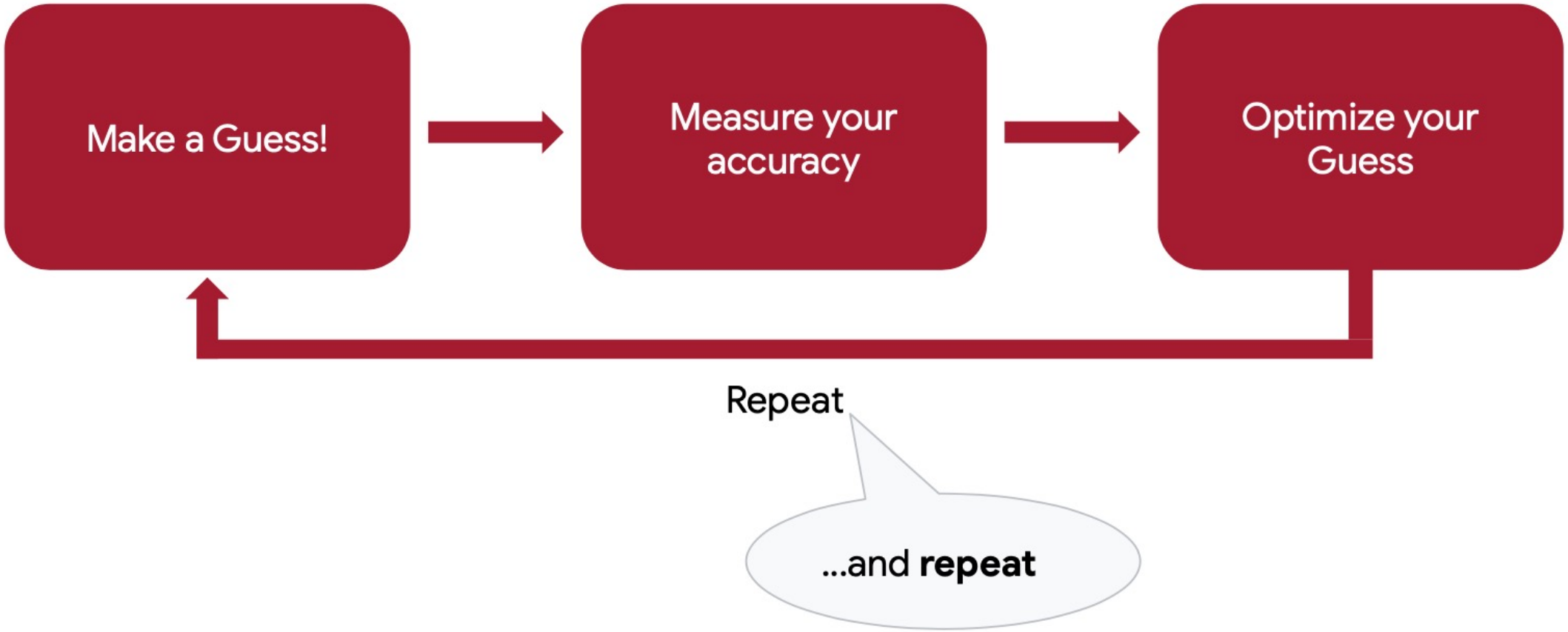
The Machine Learning Paradigm



The Machine Learning Paradigm



The Machine Learning Paradigm

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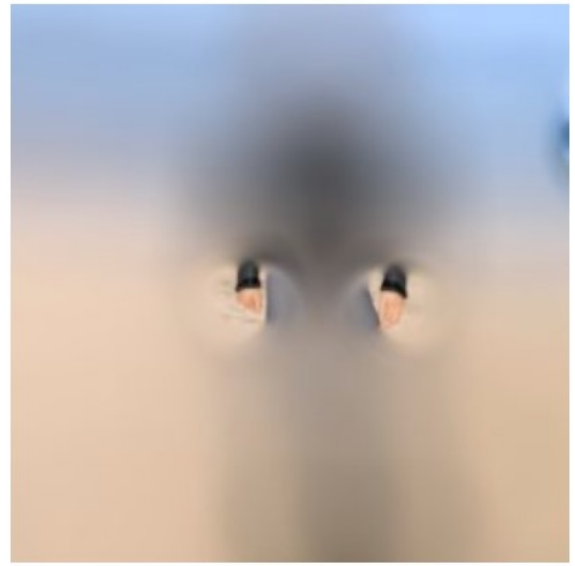
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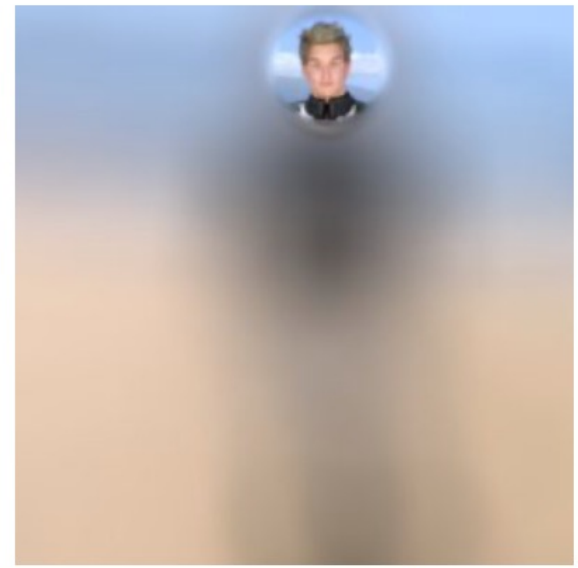
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Image Classification using CNN

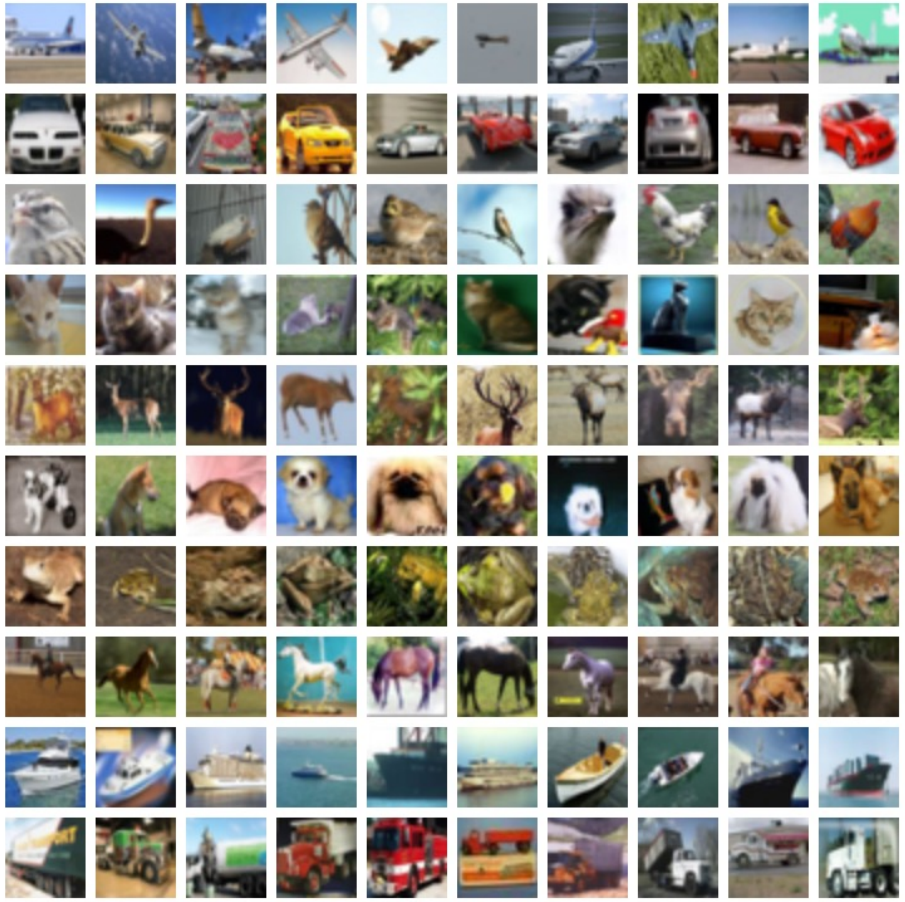
Code Time!

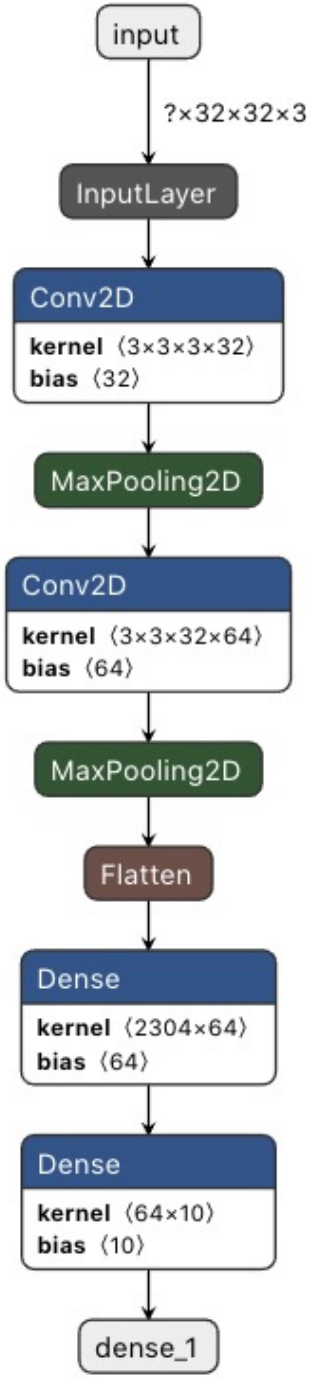
CNN_Cifar-10.ipynb

Image Classification using CNN

Cifar-10

0 airplane
1 automobile
2 bird
3 cat
4 deer
5 dog
6 frog
7 horse
8 ship
9 truck





https://www.tensorflow.org/datasets/catalog/cifar10

Reading Material

Main references

- Harvard School of Engineering and Applied Sciences - CS249r: Tiny Machine Learning
- Professional Certificate in Tiny Machine Learning (TinyML) – edX/Harvard
- Introduction to Embedded Machine Learning (Coursera)
- Text Book: "TinyML" by Pete Warden, Daniel Situnayake

I want to thank Laurence Moroney from Google, Harvard professor Vijay Janapa Reddi, Ph.D. student Brian Plancher and their staff for preparing the excellent material on TinyML that is the basis of this course at UNIFEI.

The IESTI01 course is part of the TinyML4D, an initiative to make TinyML education available to everyone globally.

Thanks

And stay safe!