WALC 2023
Applied AI

Introduction to Convolutions

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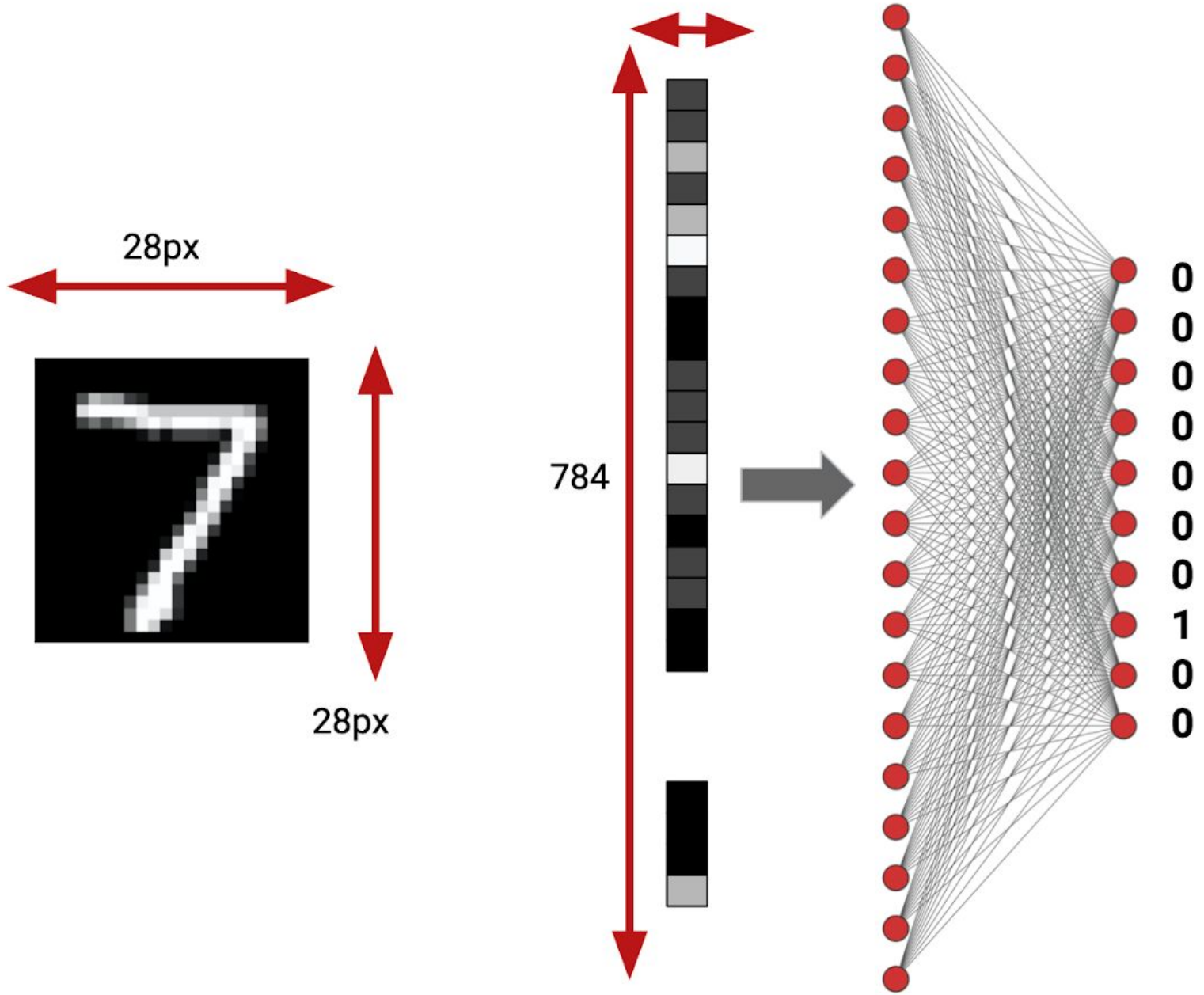
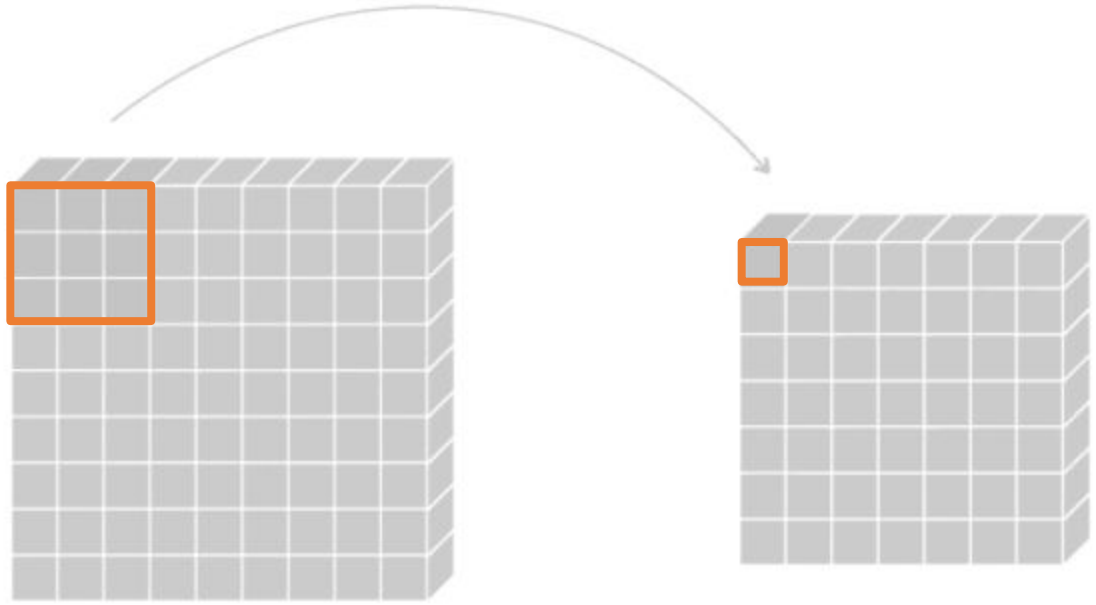
TinyML4D Academic Network Co-Chair

Introducing Convolutions

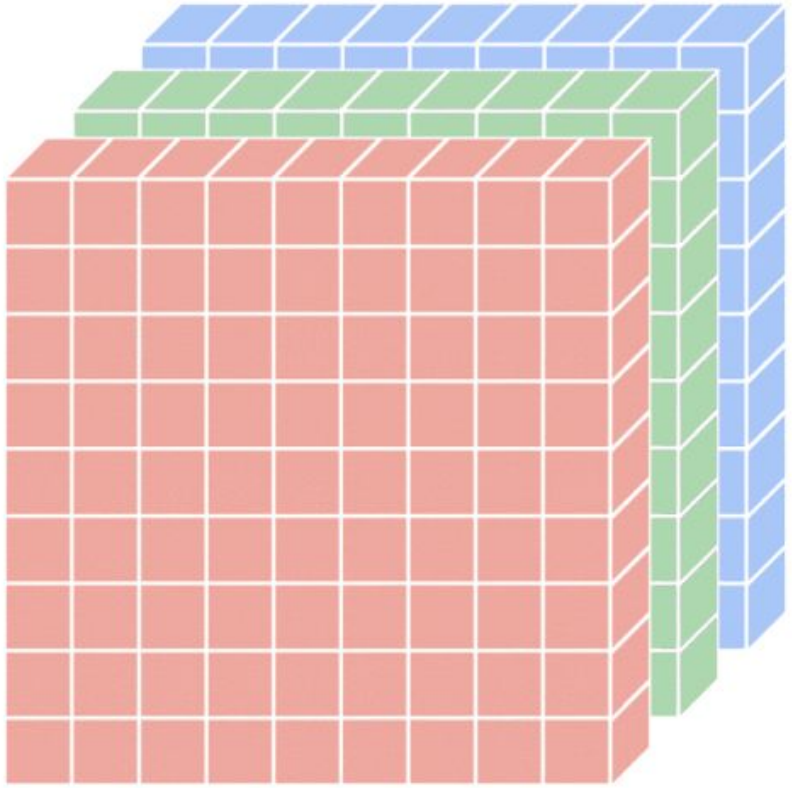
Beyond weights and biases…

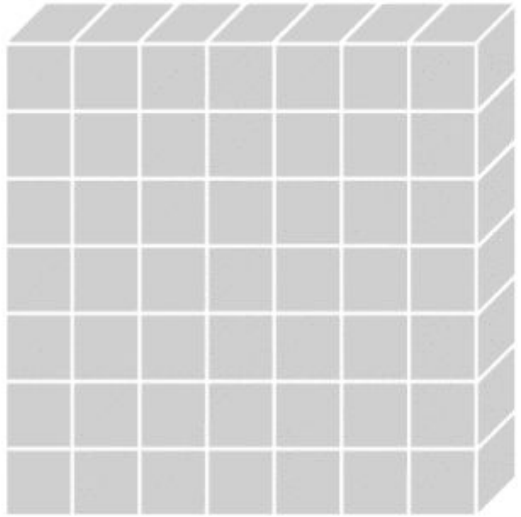

28px
28px
784
0
0
0
0
0
0
0
1
0
0

Standard Convolution (1 Channel)



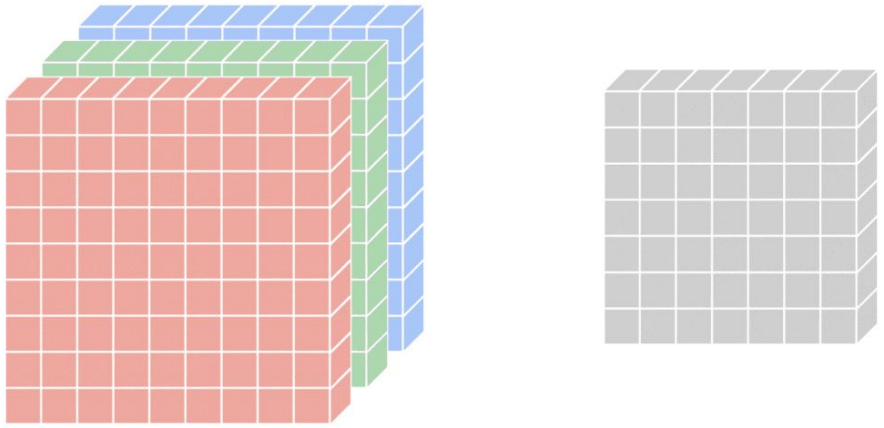
Standard Convolution ***(3 Channel**—e.g., RGB)*

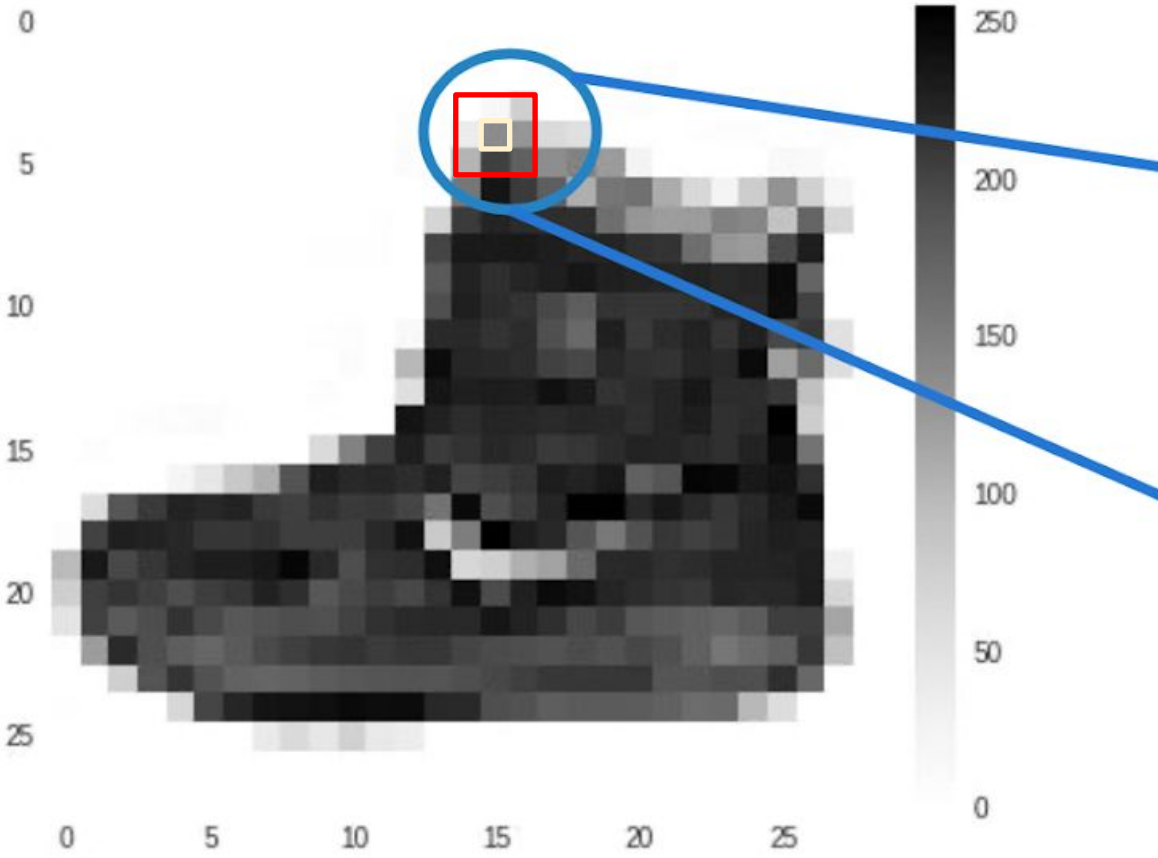




Standard Convolution ***(3 Channel**—e.g., RGB)*

- Input Feature Map
  - $8 \times 8 \times 3$
  - Width $\times$ Height $\times$ Channels
- Kernel (*1 Filter*)
  - $3 \times 3 \times 3$





0	64	128
48	192	144
142	226	168

Current Pixel Value is 192

Consider neighbor Values

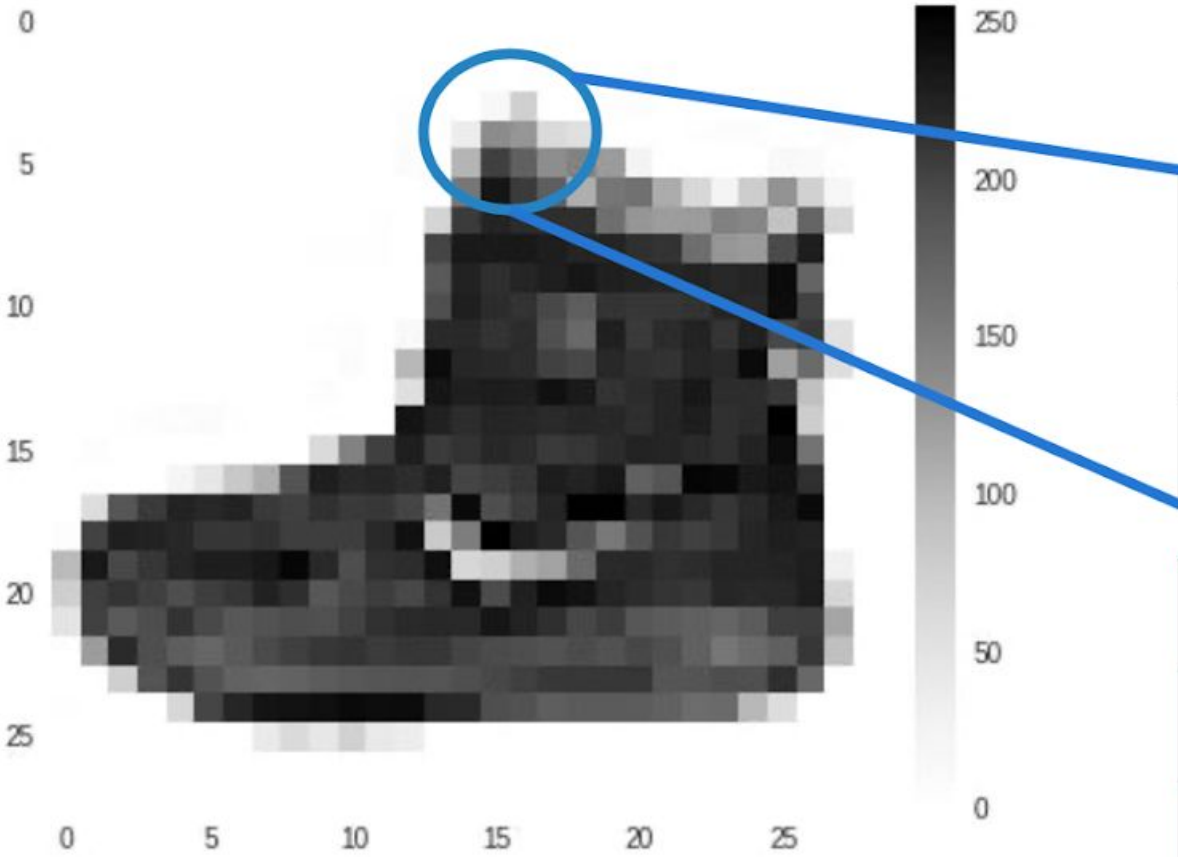
-1	0	-2
.5	4.5	-1.5
1.5	2	-3

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)
```

-256
672
11

427 ← New Pixel Value



Kernels = Filters

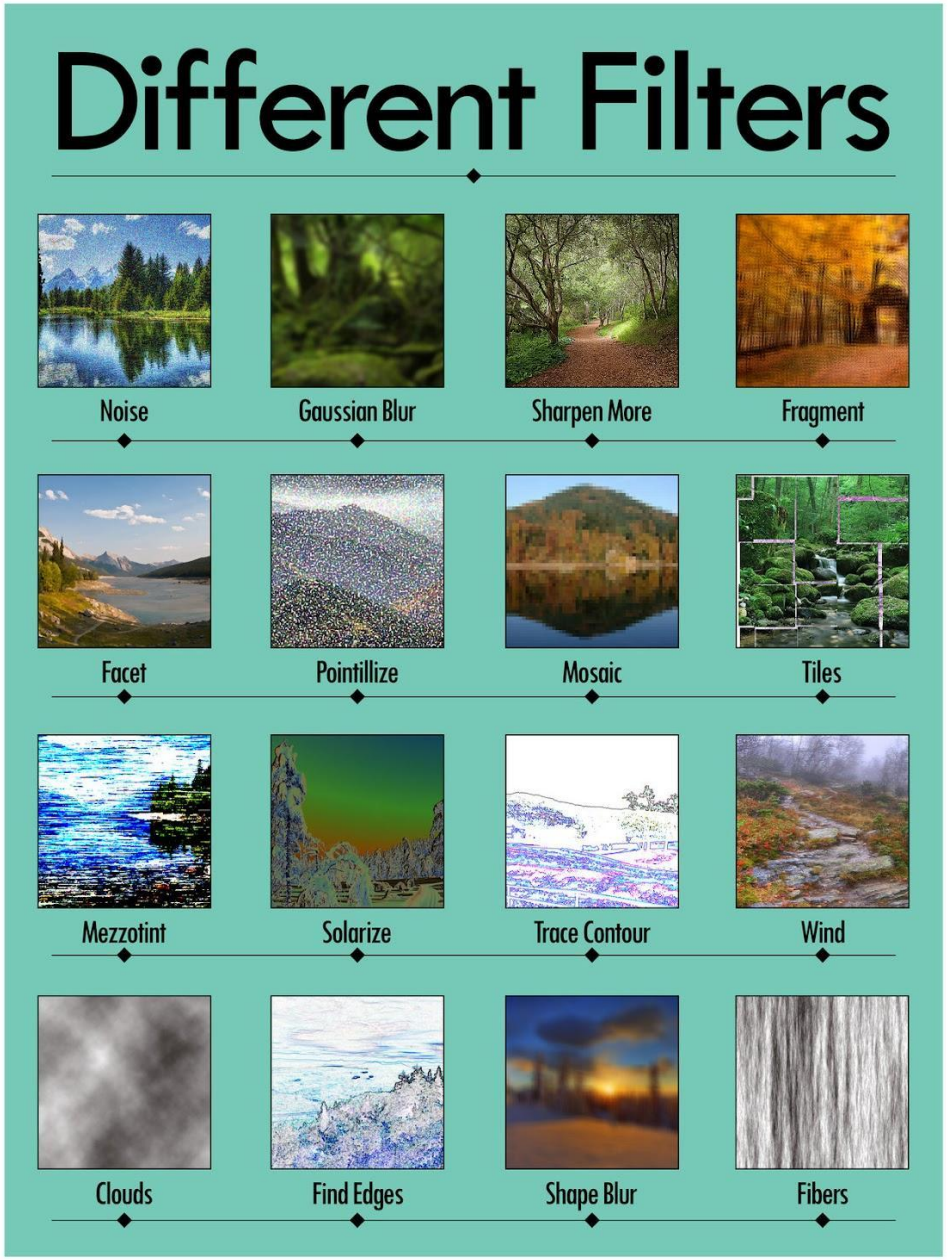


Image Kernels

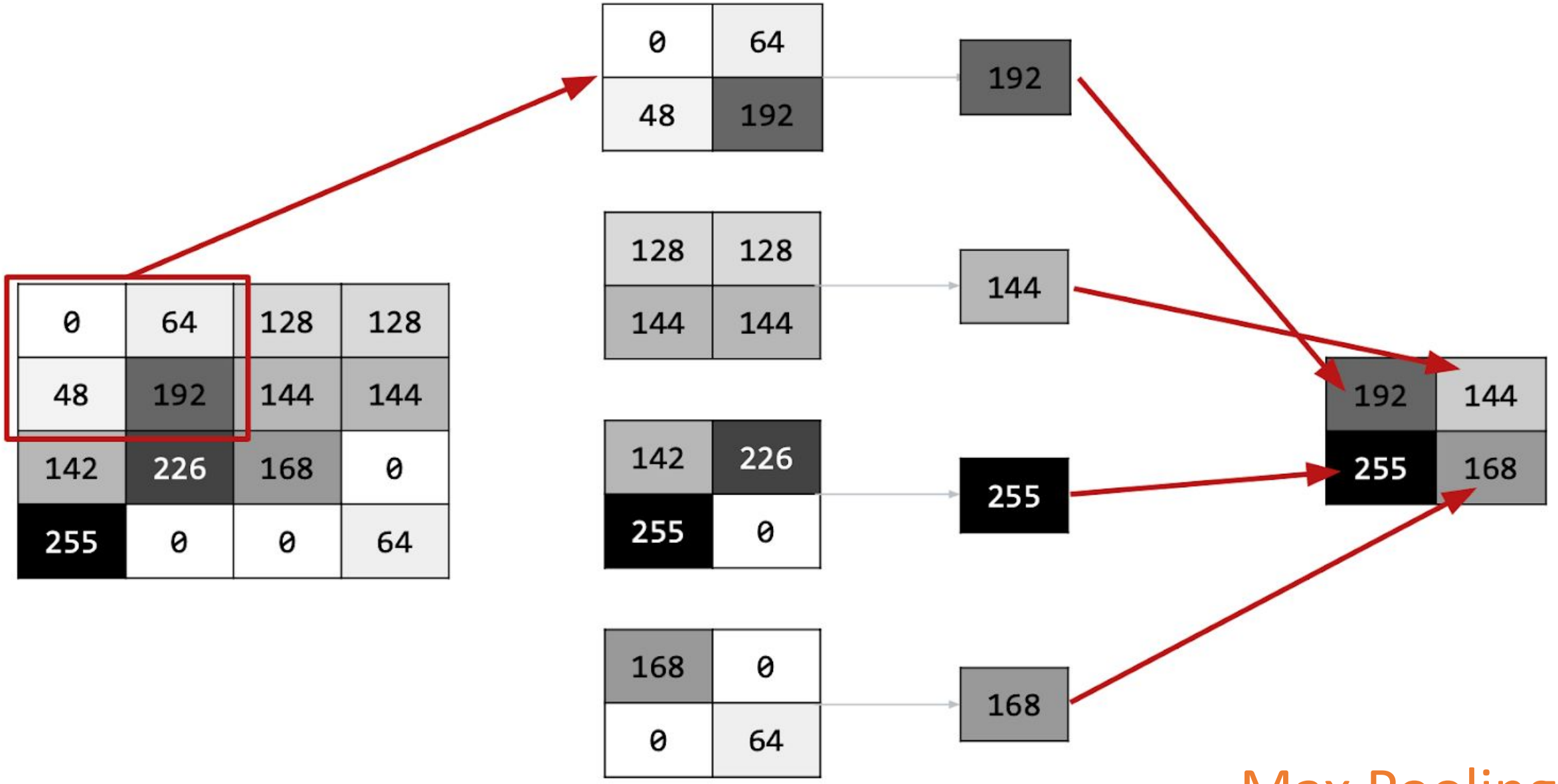
-1	0	1
-2	0	2
-1	0	1

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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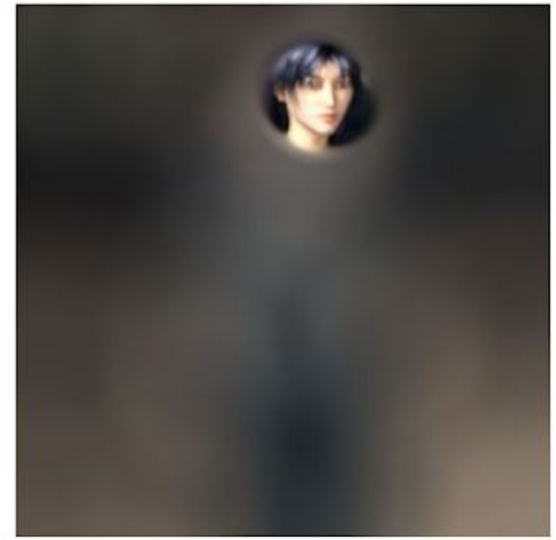

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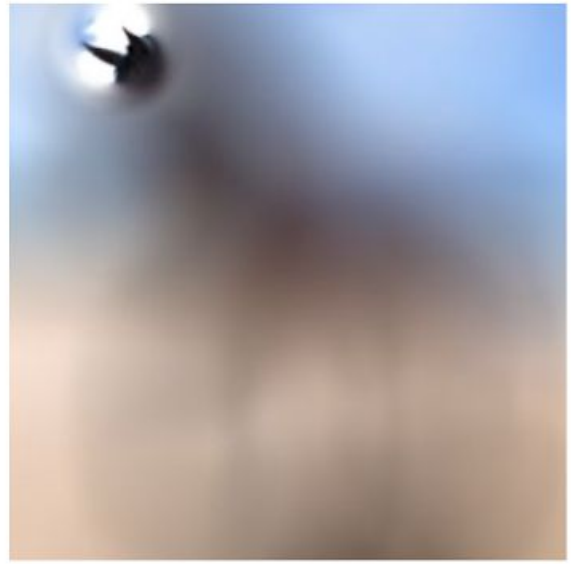

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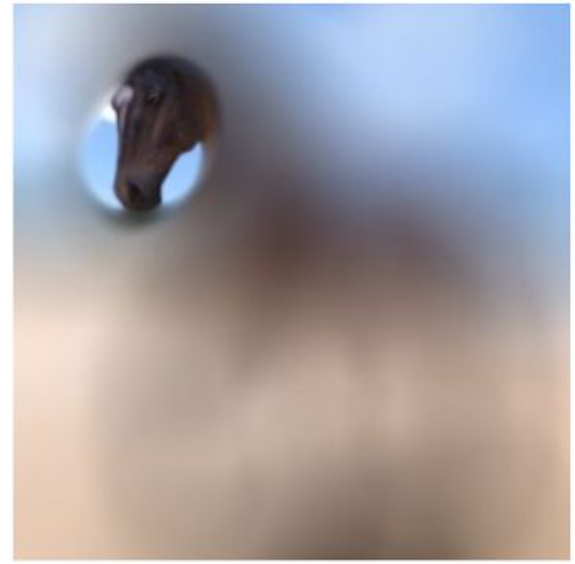

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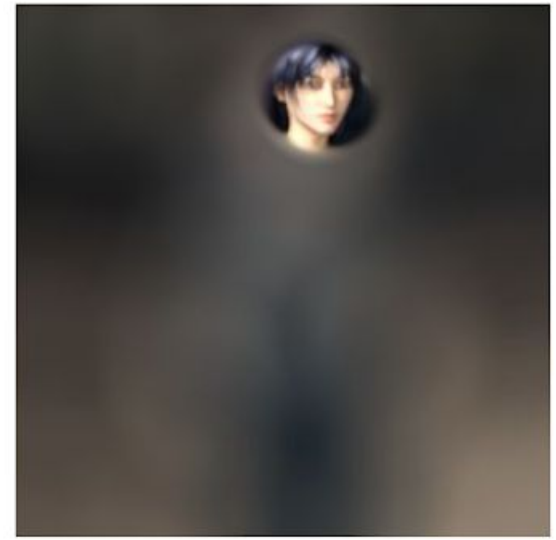

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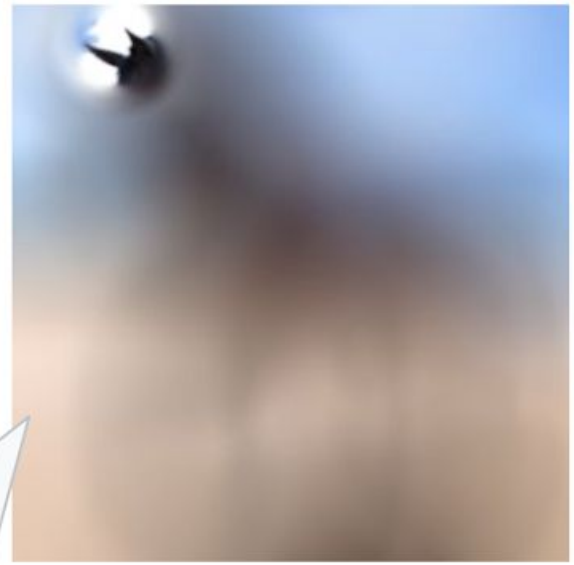

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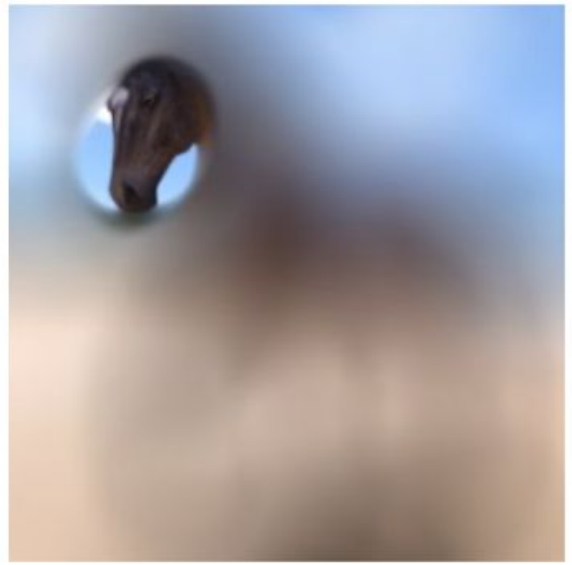

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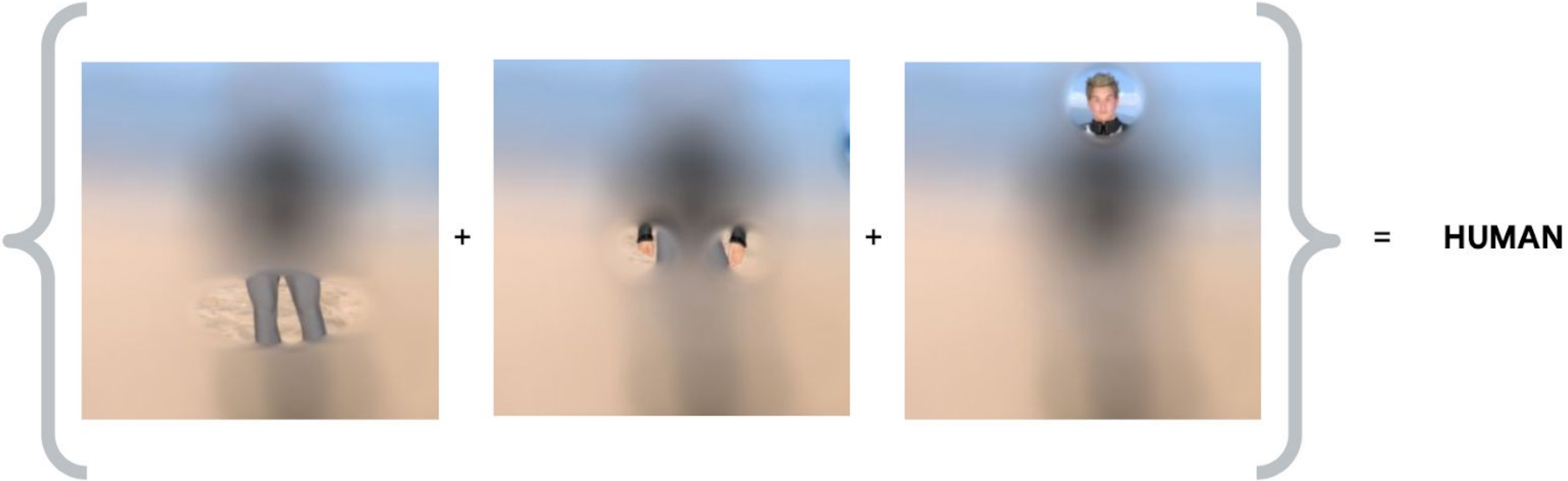
Filters can then be combined with **labels** to make a **prediction** of the image contents...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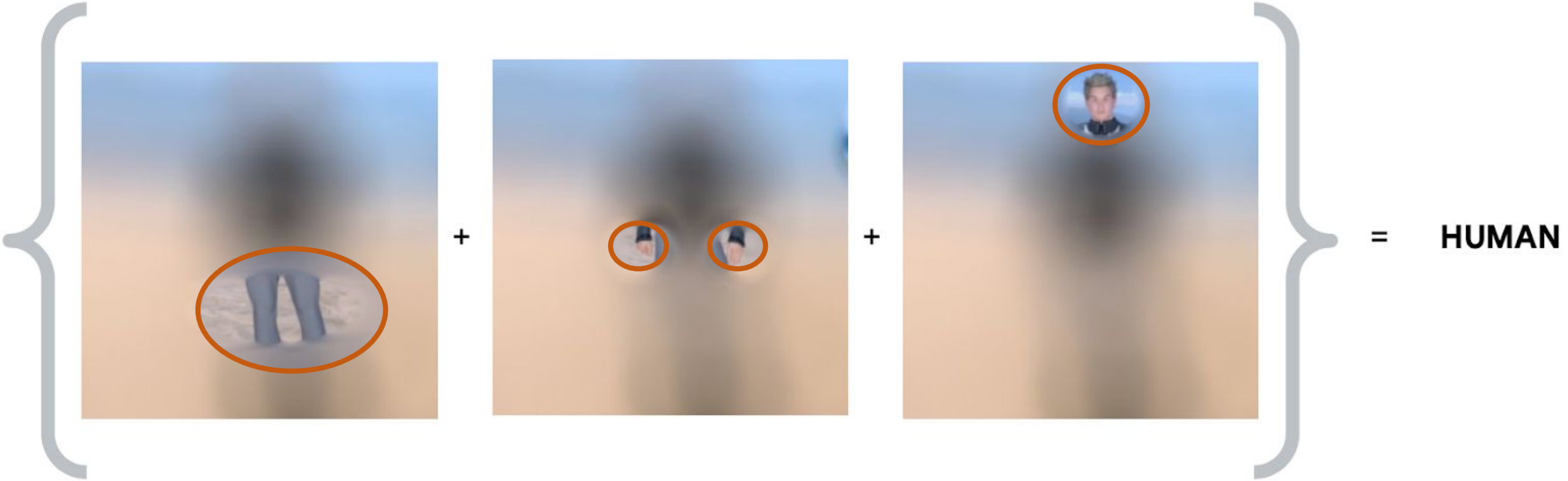

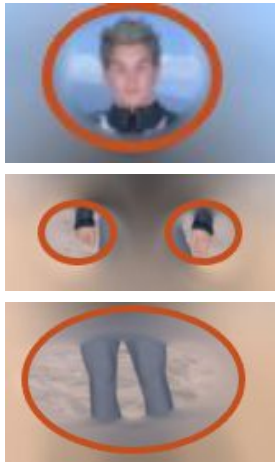

Data

Model

Inferences

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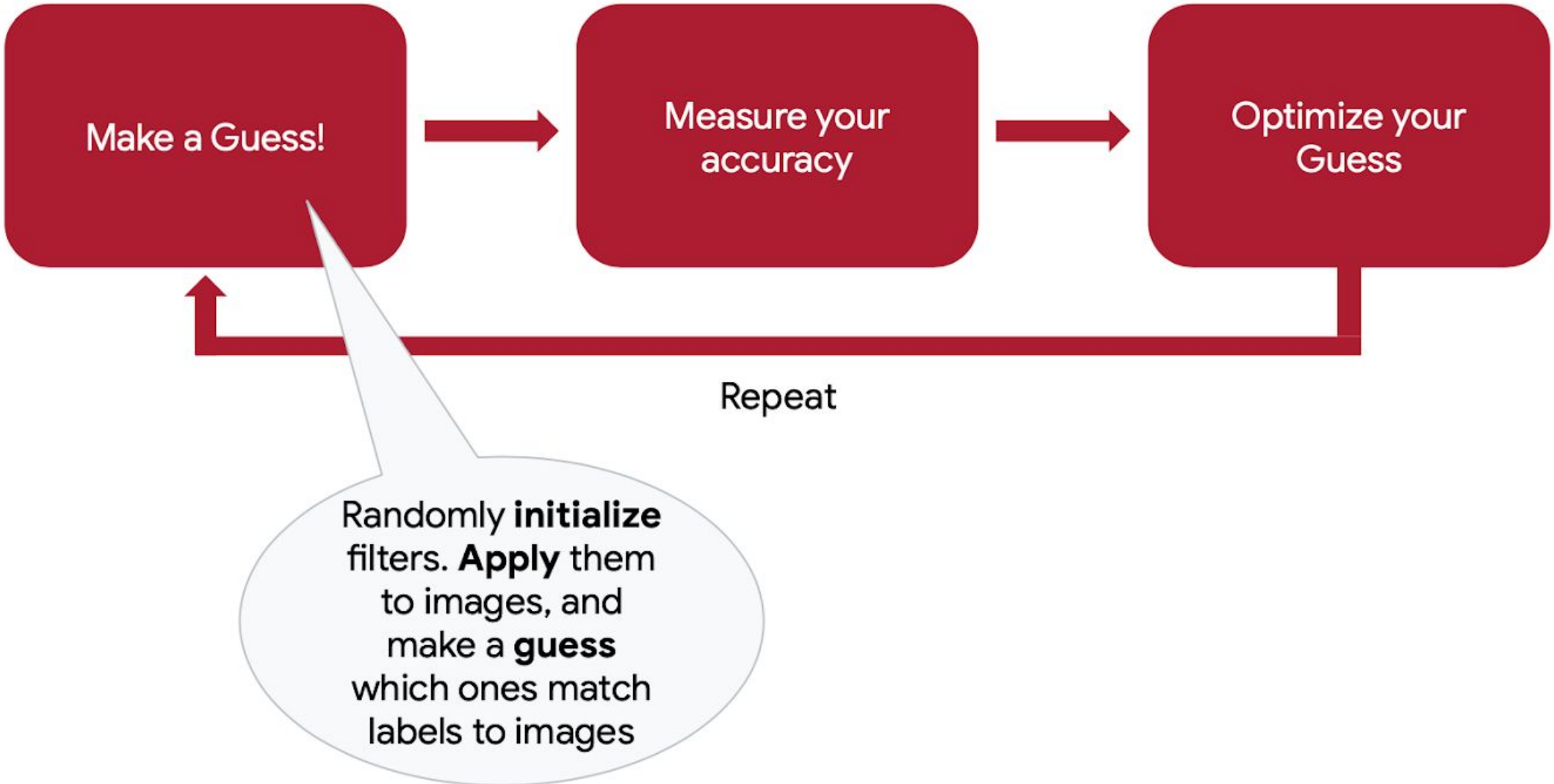
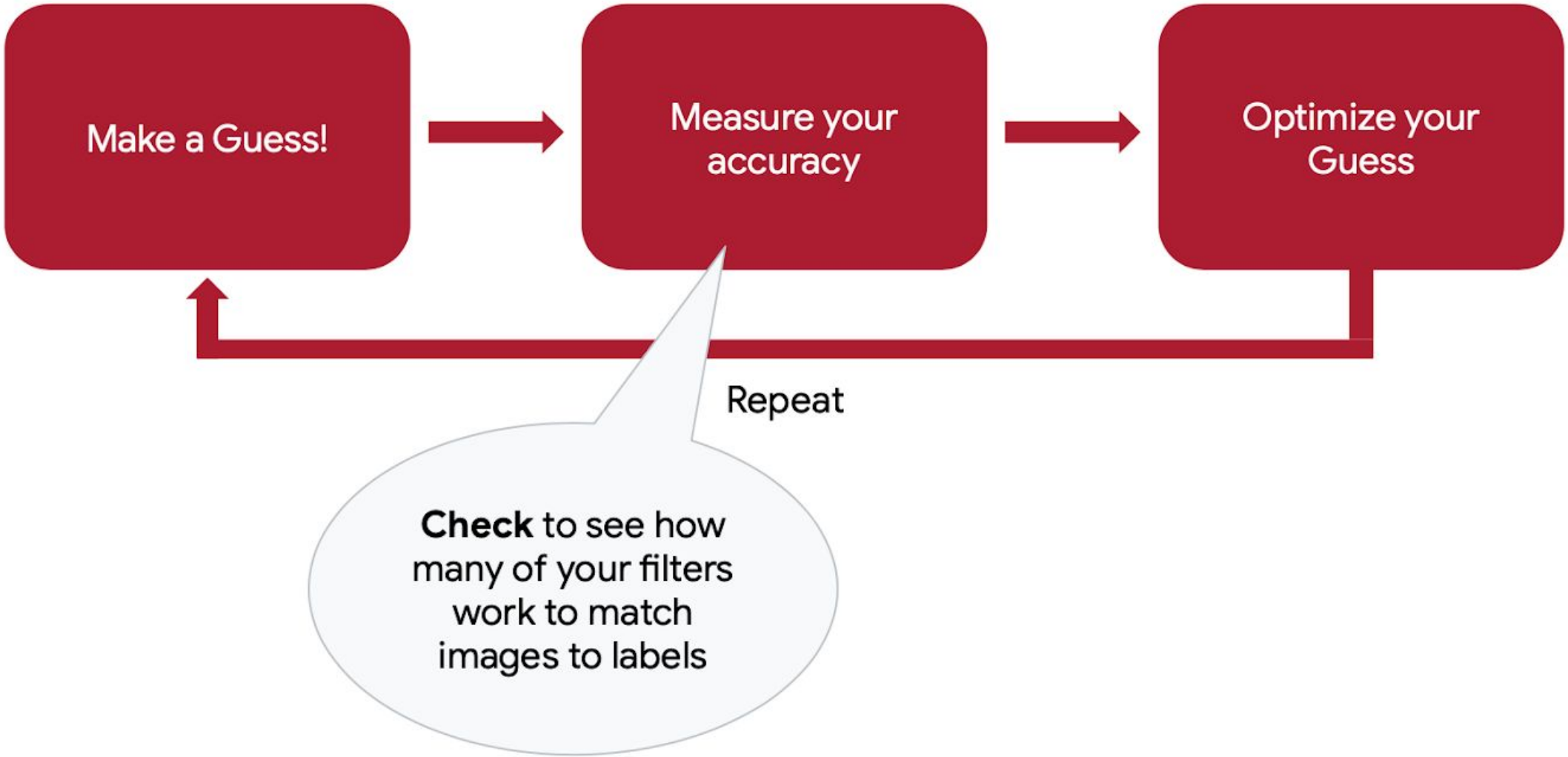
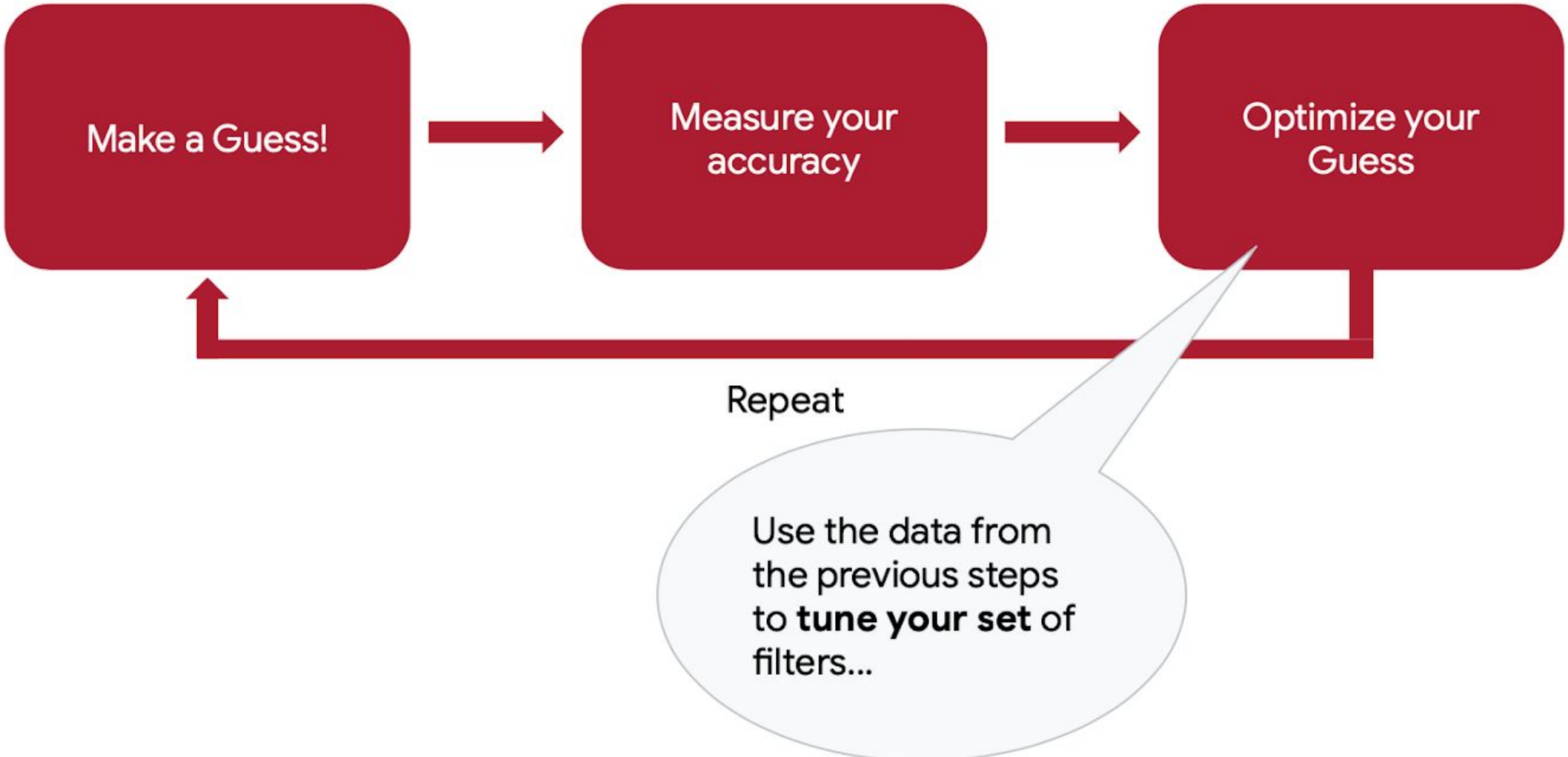
The Machine Learning Paradigm



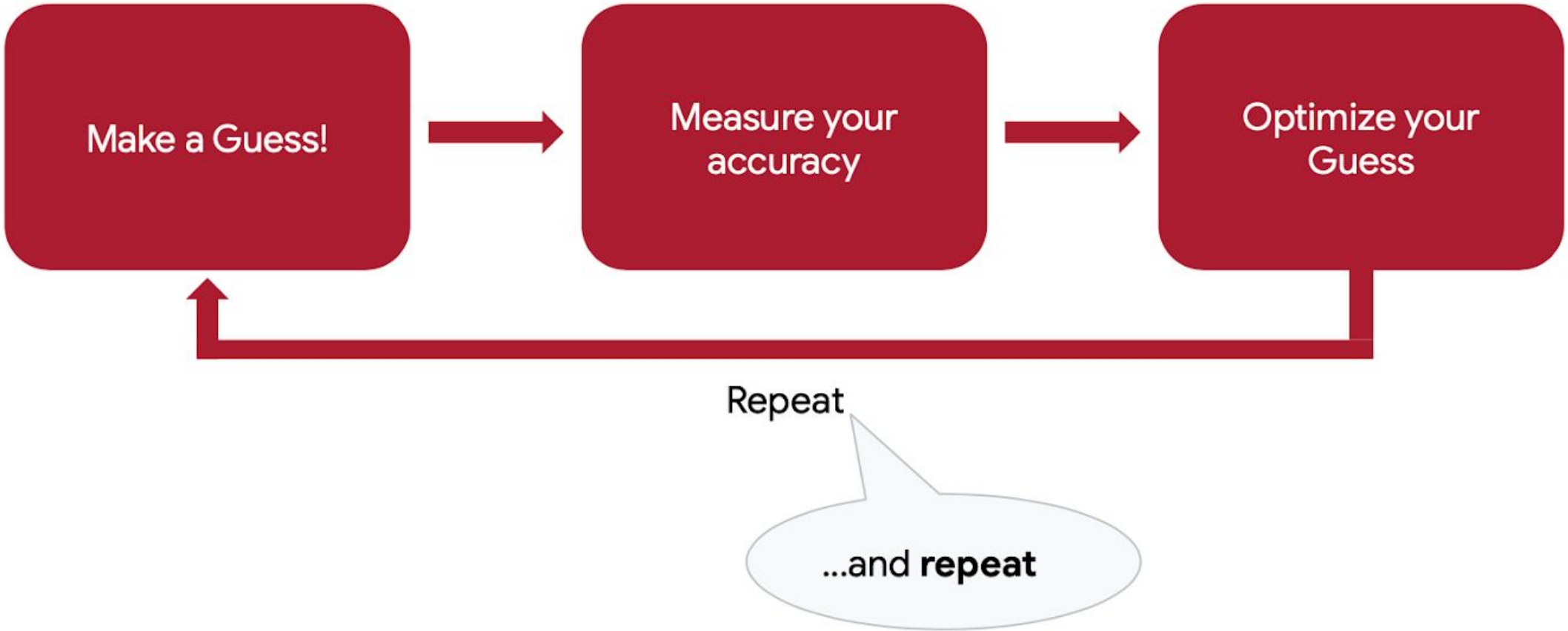
The Machine Learning Paradigm



The Machine Learning Paradigm



The Machine Learning Paradigm

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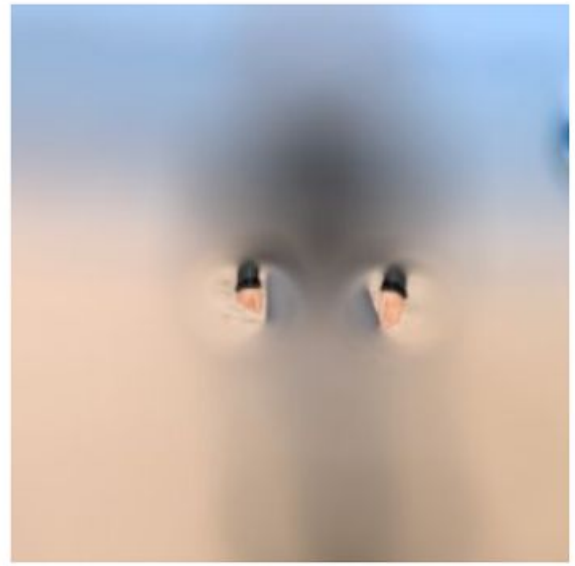
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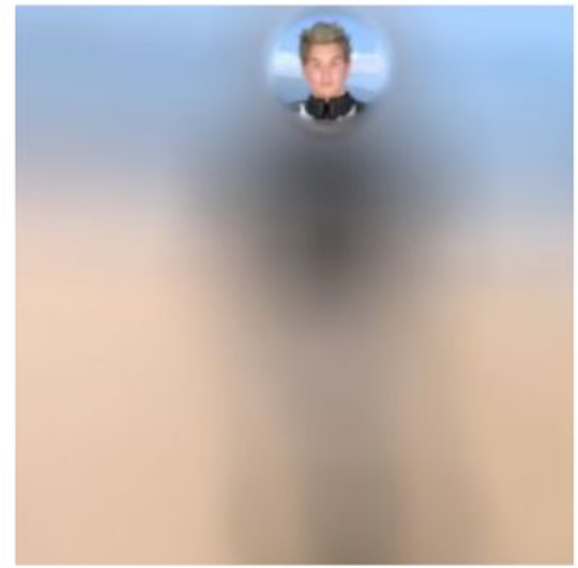
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Exploring CNN

CNN Explainer

https://poloclub.github.io/cnn-explainer/

ConvNetJS MNIST demo

https://cs.stanford.edu/people/karpathy/convnetjs/demo/mnist.html

ConvNetJS CIFAR-10 demo

https://cs.stanford.edu/people/karpathy/convnetjs/demo/cifar10.html

Thanks


WALC 2023
Guayaquil, Ecuador
13 al 17 de Noviembre
26°
Taller sobre
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para América Latina y el Caribe
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