



DEEP LEARNING IN JAVASCRIPT

ASK WHAT AI CAN DO FOR YOU

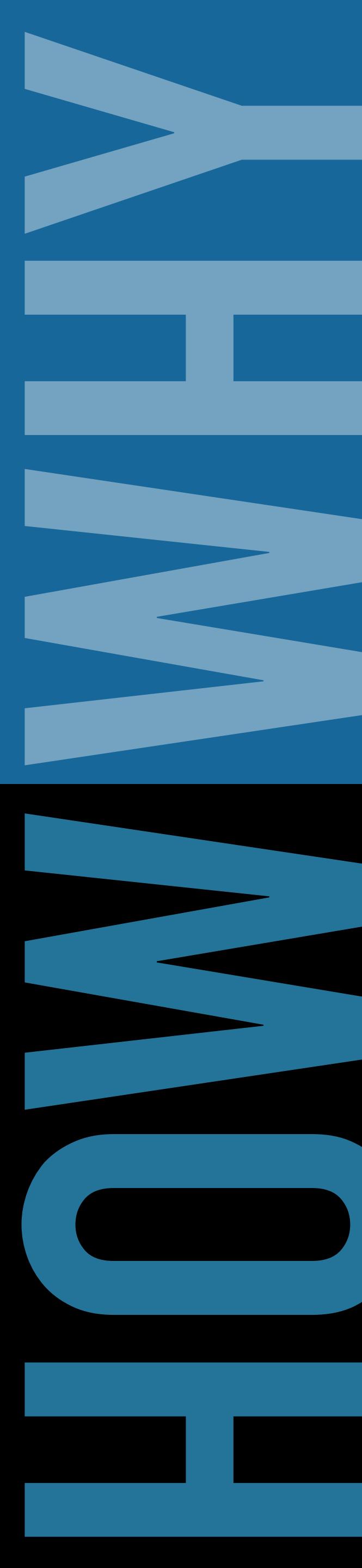
Kevin Scott | 5.17.19



DEEP LEARNING IN JAVASCRIPT

ASK WHAT AI CAN DO FOR YOU

Kevin Scott | 5.17.19

- 
1. Why Deep Learning
 2. Edge Intelligence
 3. A Simple Neural Network
 4. Transfer Learning for Images

-
- ▶ Designer & Developer
 - ▶ Software Consultant
 - ▶ Laser Aficionado

@thekevinscott



DEEP LEARNING IN JAVASCRIPT

A Hacker's Guide To Getting Started With Neural Networks

Contents

Foreword	i
1. What is Deep Learning	1
Inference	
2. Making Predictions	12
3. Data and Tensors	17
4. How To Prepare Image Data	25
Training	
5. Training Your Neural Network	32
6. Training from Scratch	38
7. Working With Non-Linear Data	47
8. Structured Data	60
9. Recognizing Images	72
10. Transfer Learning with ImageNet	85
Conclusion	104
Resources	105

Foreword

```
function login(username, password) {
  const user = User.get(username)
  if (!user) {
    throw new Error('Bad login attempt')
  } else if (!user.checkPassword(password)) {
    throw new Error('Bad login attempt')
  } else if (user.expired) {
    throw new Error('Your subscription has expired')
  }
  return user
}
```

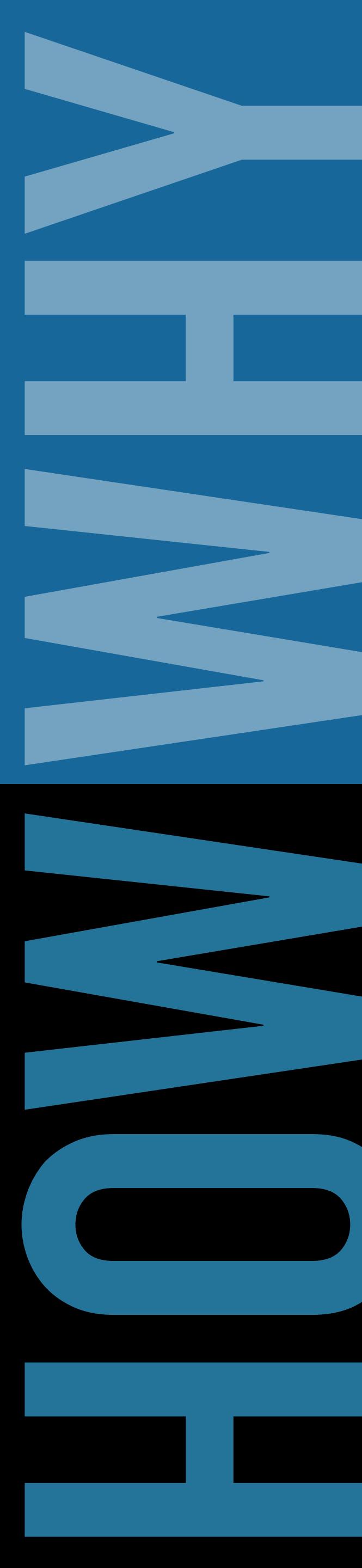
You've probably seen code like this before.

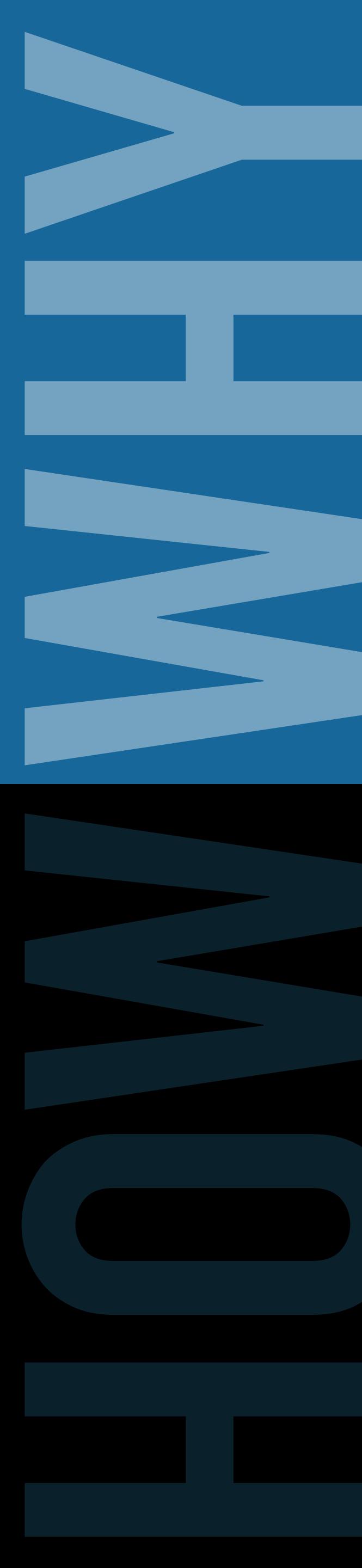
This is how most software gets written today. Manually and line by line. You, the programmer, specify everything about how a program should operate, from how a user interacts to the way data is stored and retrieved.

Some have called this approach to code [explicit programming](#), though a more straight forward description would simply be "programming".

When you're building a login form, or any sort of system where you want this action to cause that outcome, explicitly programming software makes a lot of sense. You can reason through code like this. There's little danger that the software wakes up one day on the wrong side of the bed and decides it's tired of this whole "login business" and why don't we try logging users *out* for a change? Your code will always do exactly what you've told it to.



- 
1. Why Deep Learning Matters
 2. Edge Intelligence
 3. A Simple Neural Network
 4. Transfer Learning for Images

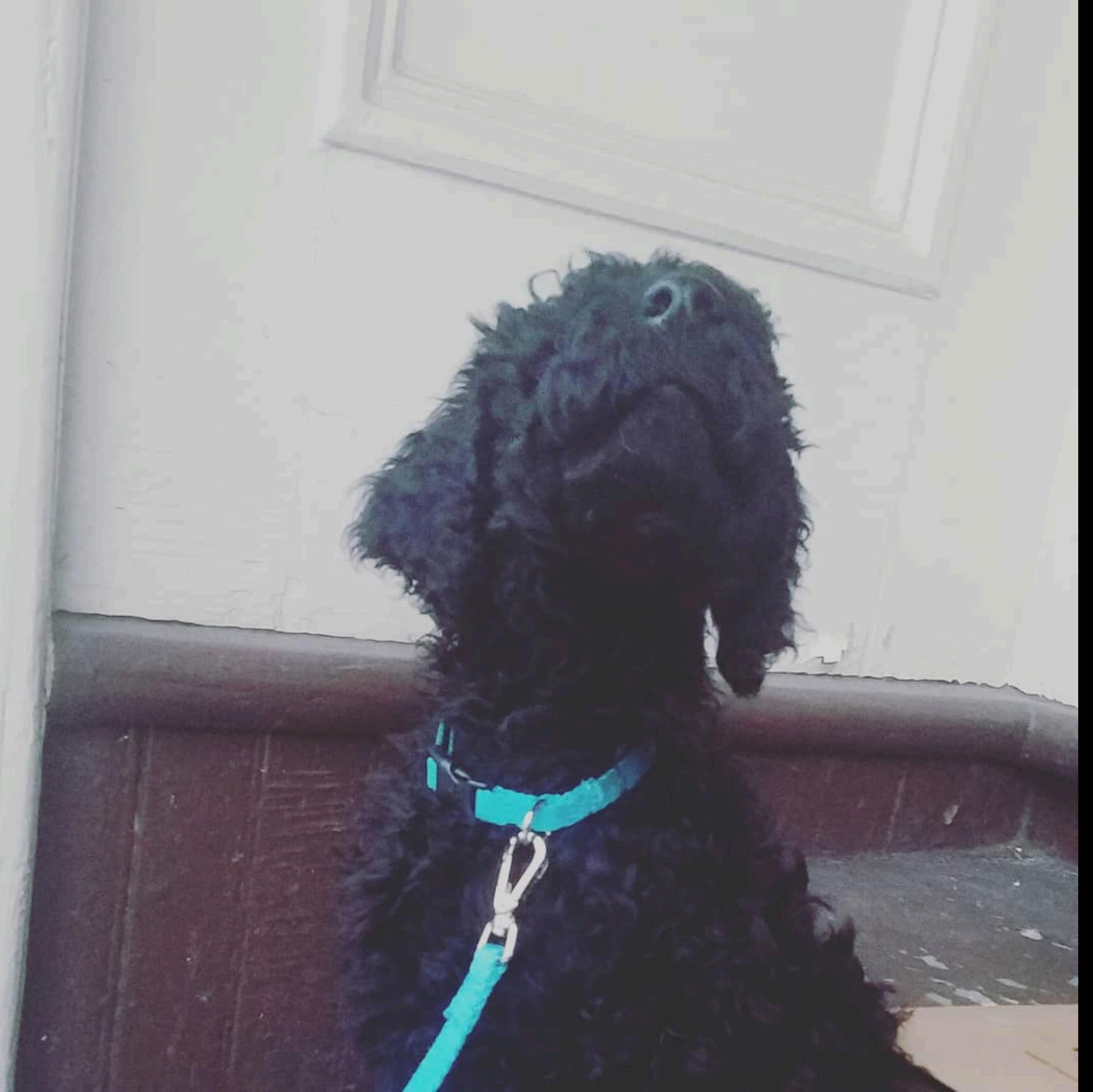
- 
1. Why Deep Learning Matters
 2. Edge Intelligence
 3. A Simple Neural Network
 4. Transfer Learning for Images

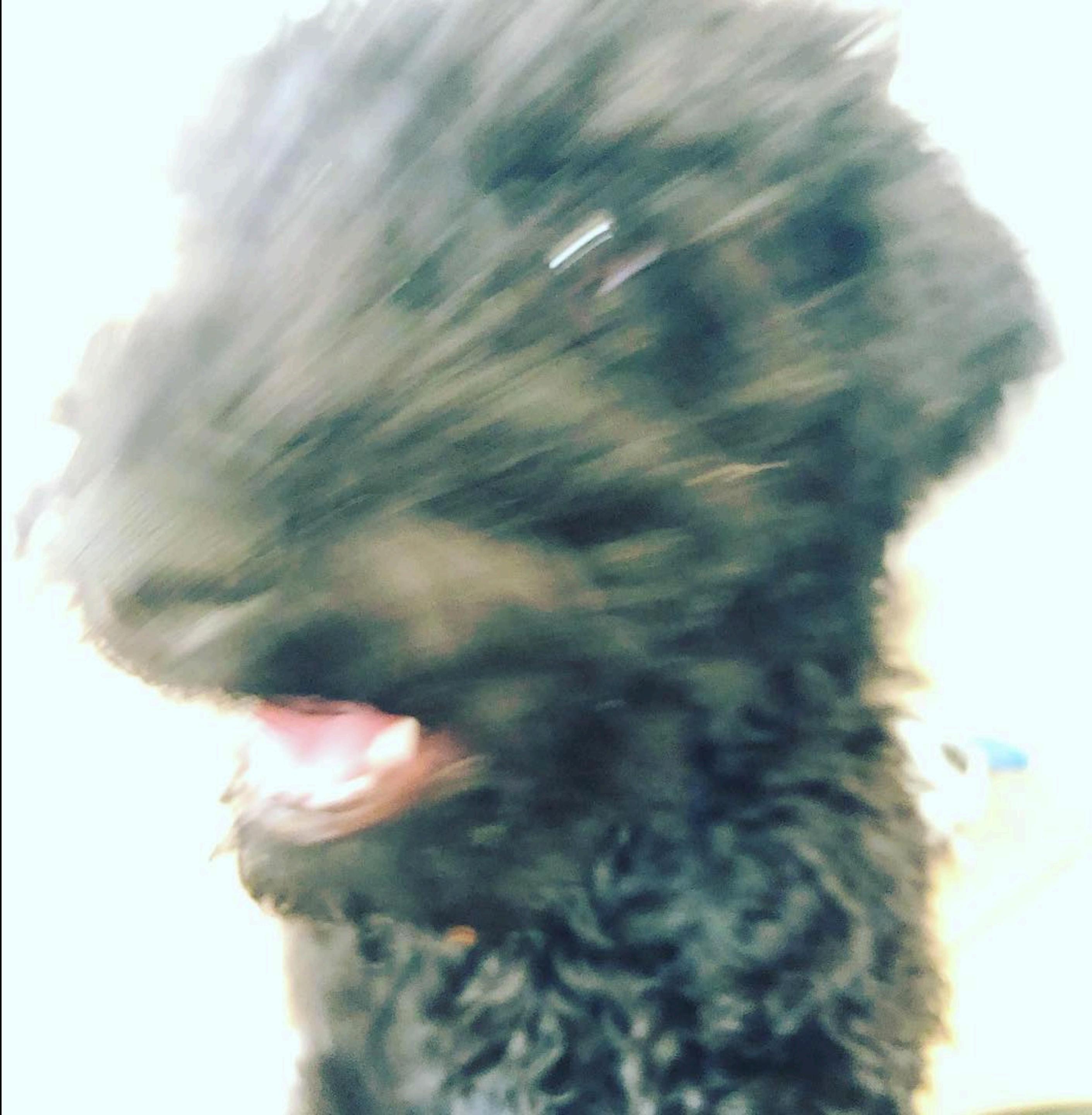
1

WHY DEEP LEARNING MATTERS

```
function login(username, password) {  
  const user = User.get(username)  
  
  if (!user) {  
    throw new Error('Bad login attempt')  
  } else if (!user.checkPassword(password)) {  
    throw new Error('Bad login attempt')  
  } else if (user.expired) {  
    throw new Error('Your subscription has expired')  
  }  
  
  return user  
}
```









I sometimes see people refer to neural networks as just “another tool in your machine learning toolbox” ... this interpretation completely misses the forest for the trees.

Neural networks are not just another classifier, they represent the beginning of a fundamental shift in how we write software.

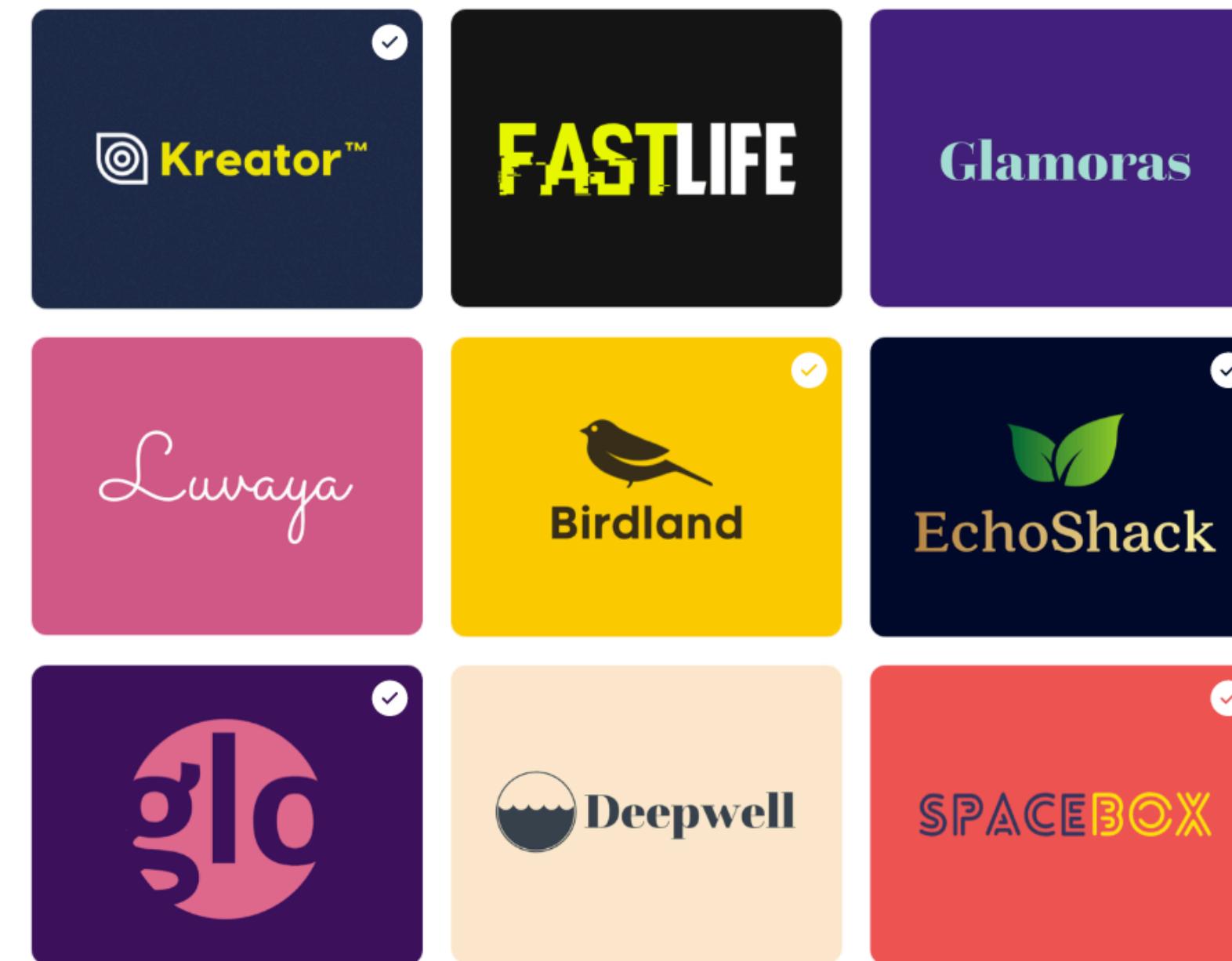
They are Software 2.0.

Andrej Karpathy
Director of AI at Tesla

They are Software 2.0.

How it works

Looka combines your design preferences with AI to create a custom logo you'll love. You can then get marketing assets, build a website, and launch your business!

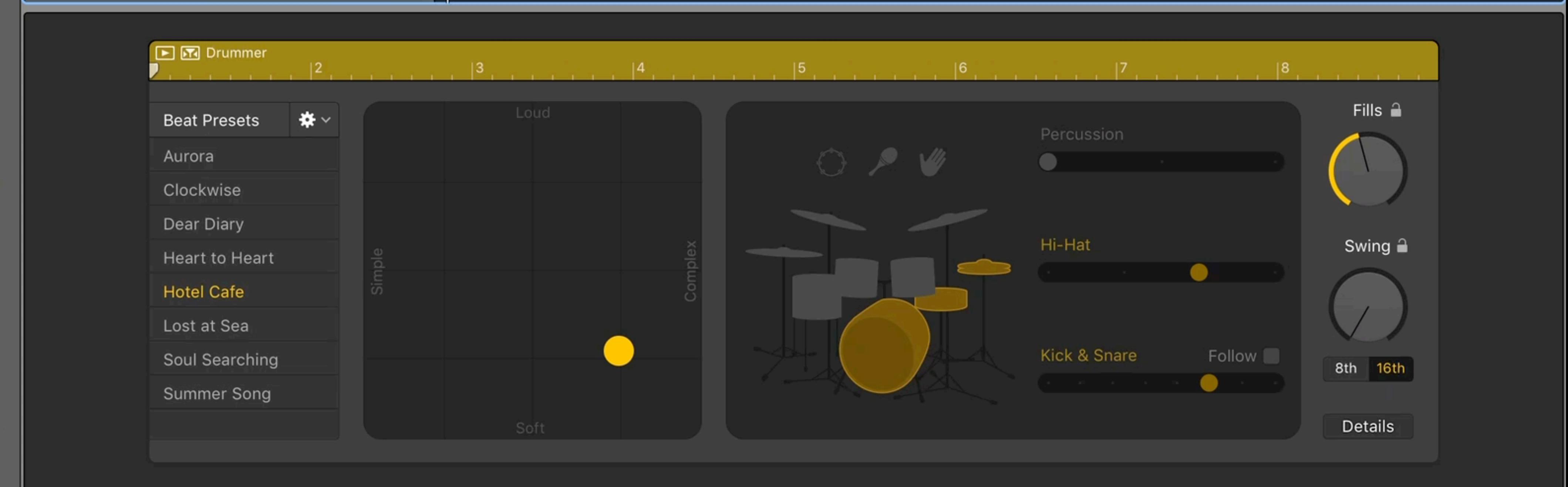
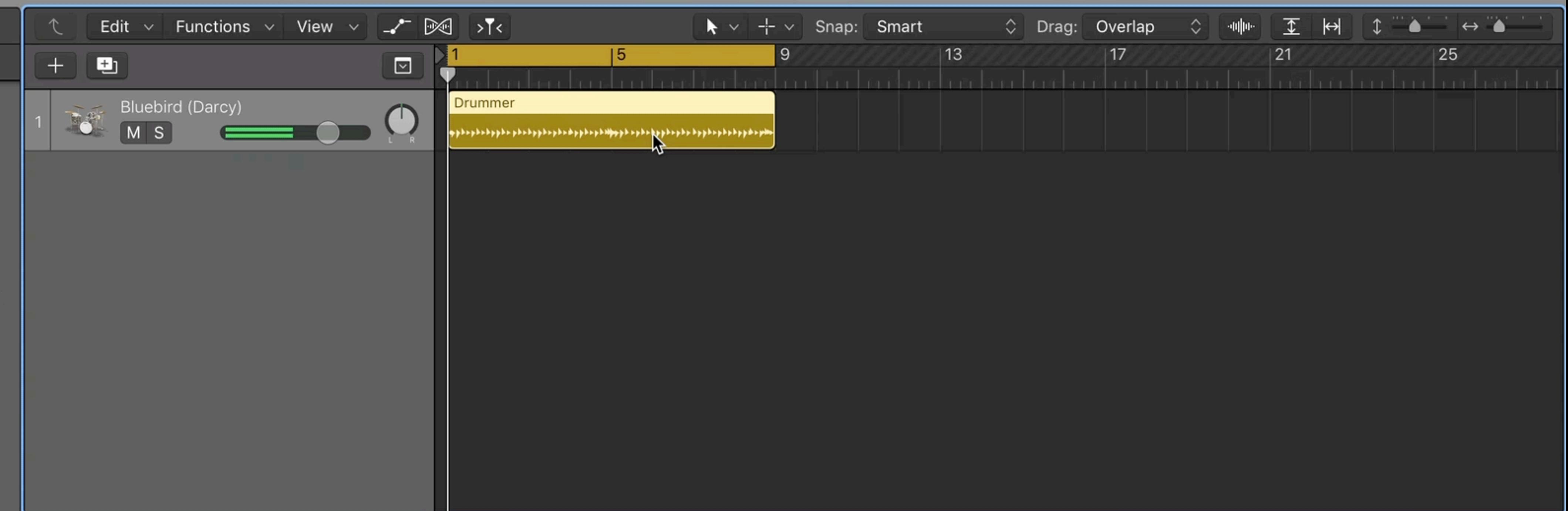


01. Start with design inspiration

Enter your company name and select the logo styles, colors, and symbols you like. Looka's AI-powered platform will use these as inspiration when generating your logo designs.

01:00:00:00.40 | 44.1 | Speed Only ±0.00% | 100.0000 | No In
0001 1 1 033 | KHZ | Keep Tempo | No Out

► Region: Drummer
► Track: Bluebird



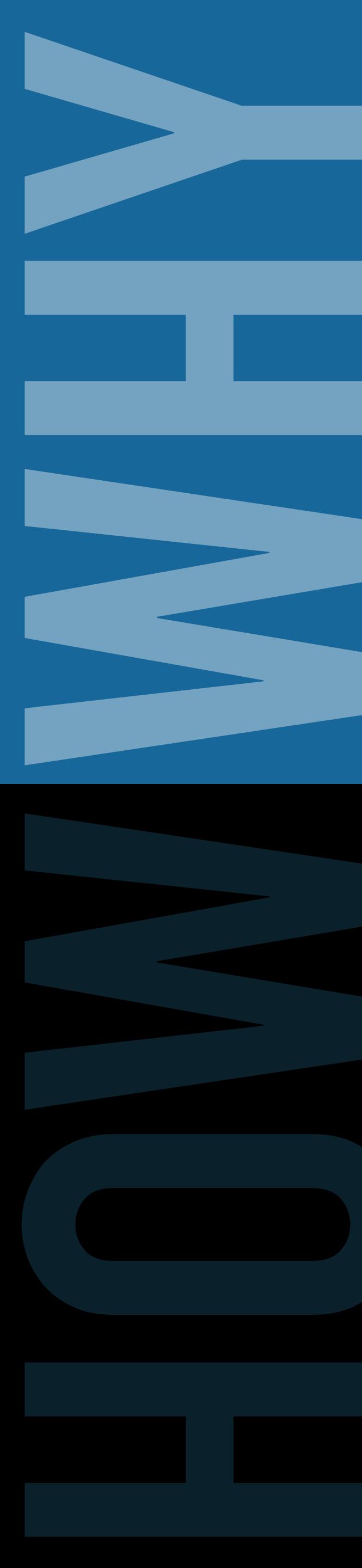
A portrait photograph of Fei-Fei Li, a woman with dark hair, wearing a blue ribbed sweater, smiling at the camera.

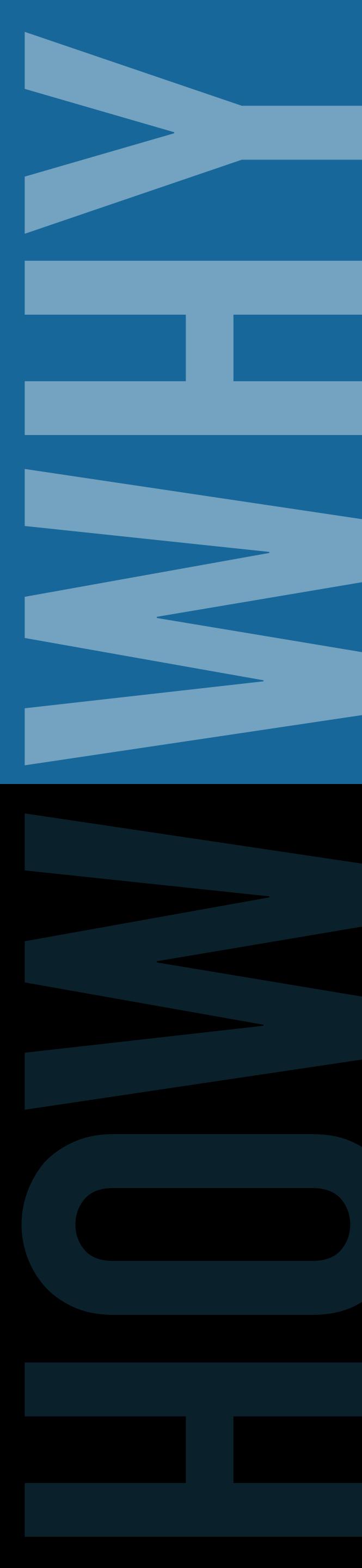
“Even a cat has
things it can do
that AI can not.”

Fei-Fei Li
Stanford’s AI Institute

CHALLENGES

- ▶ Mindshare
- ▶ Data
- ▶ UX

- 
1. Why Deep Learning Matters
 2. Edge Intelligence
 3. A Simple Neural Network
 4. Transfer Learning for Images

- 
1. Why Deep Learning Matters
 2. Edge Intelligence
 3. A Simple Neural Network
 4. Transfer Learning for Images

2

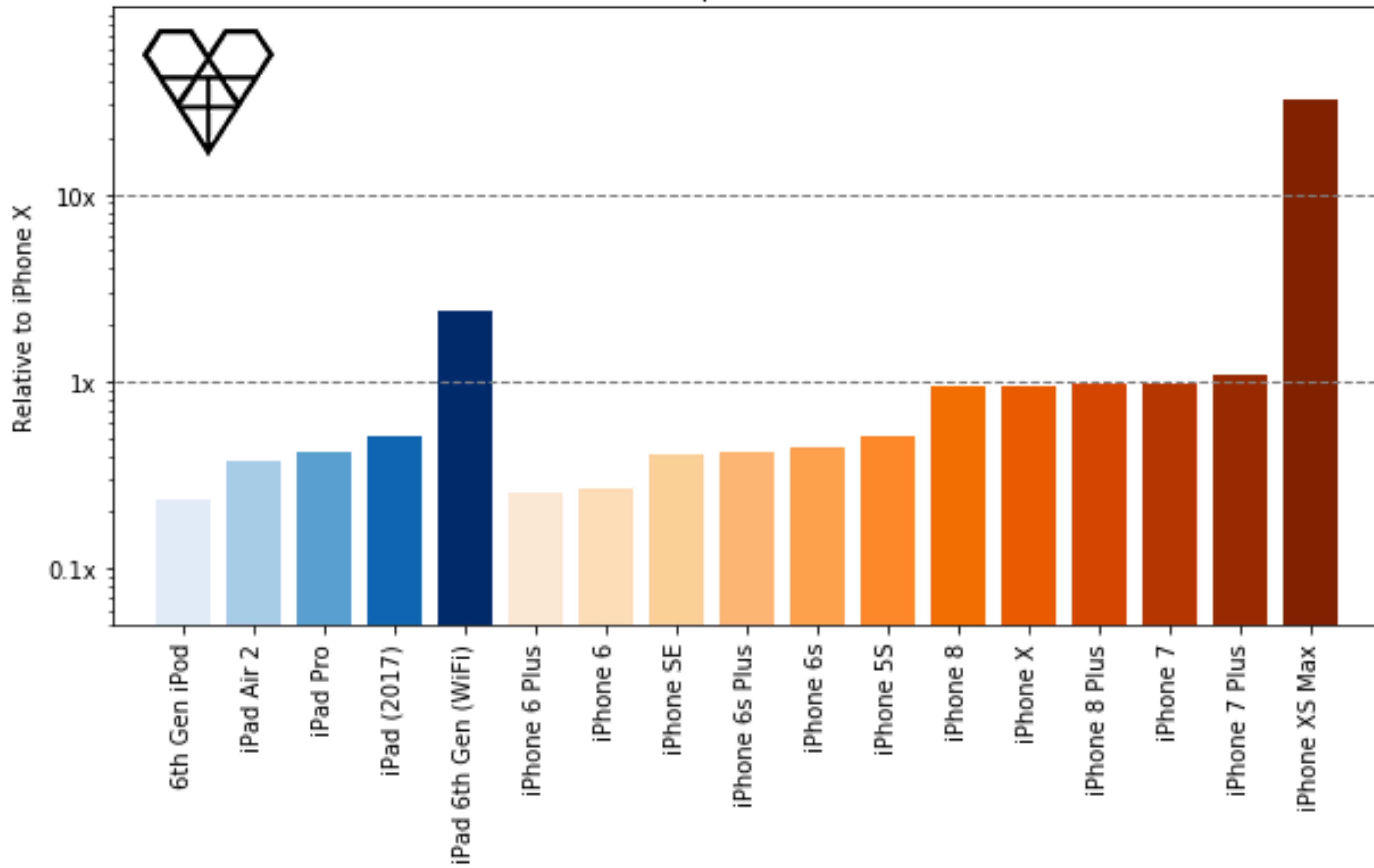
EDGE INTELLIGENCE

**Reboot and Select proper Boot device
or Insert Boot Media in selected Boot device and press a key**





Core ML Runtime Speed Relative to iPhone X

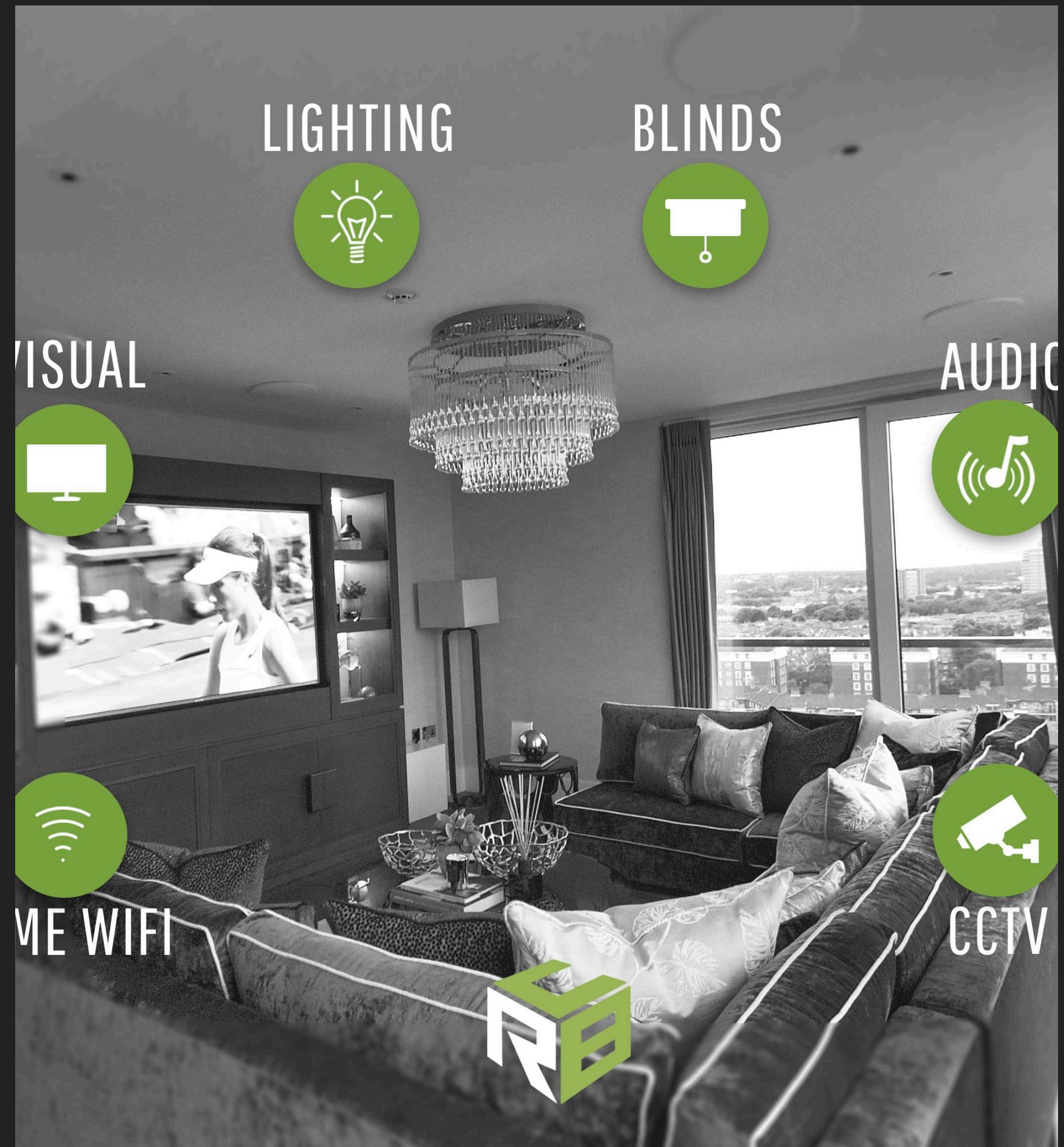


EDGE INTELLIGENCE

‘Running Inference and
Training of Neural Networks
on Consumer Devices’

EDGE INTELLIGENCE

- ▶ Privacy
- ▶ Latency
- ▶ Offline
- ▶ Speed
- ▶ Bandwidth



EDGE INTELLIGENCE

- ▶ Privacy
- ▶ Latency
- ▶ Offline
- ▶ Speed
- ▶ Bandwidth



EDGE INTELLIGENCE

- ▶ Privacy
- ▶ Latency
- ▶ Offline
- ▶ Speed
- ▶ Bandwidth



EDGE INTELLIGENCE

- ▶ Privacy
- ▶ Latency
- ▶ Offline
- ▶ Speed
- ▶ Bandwidth



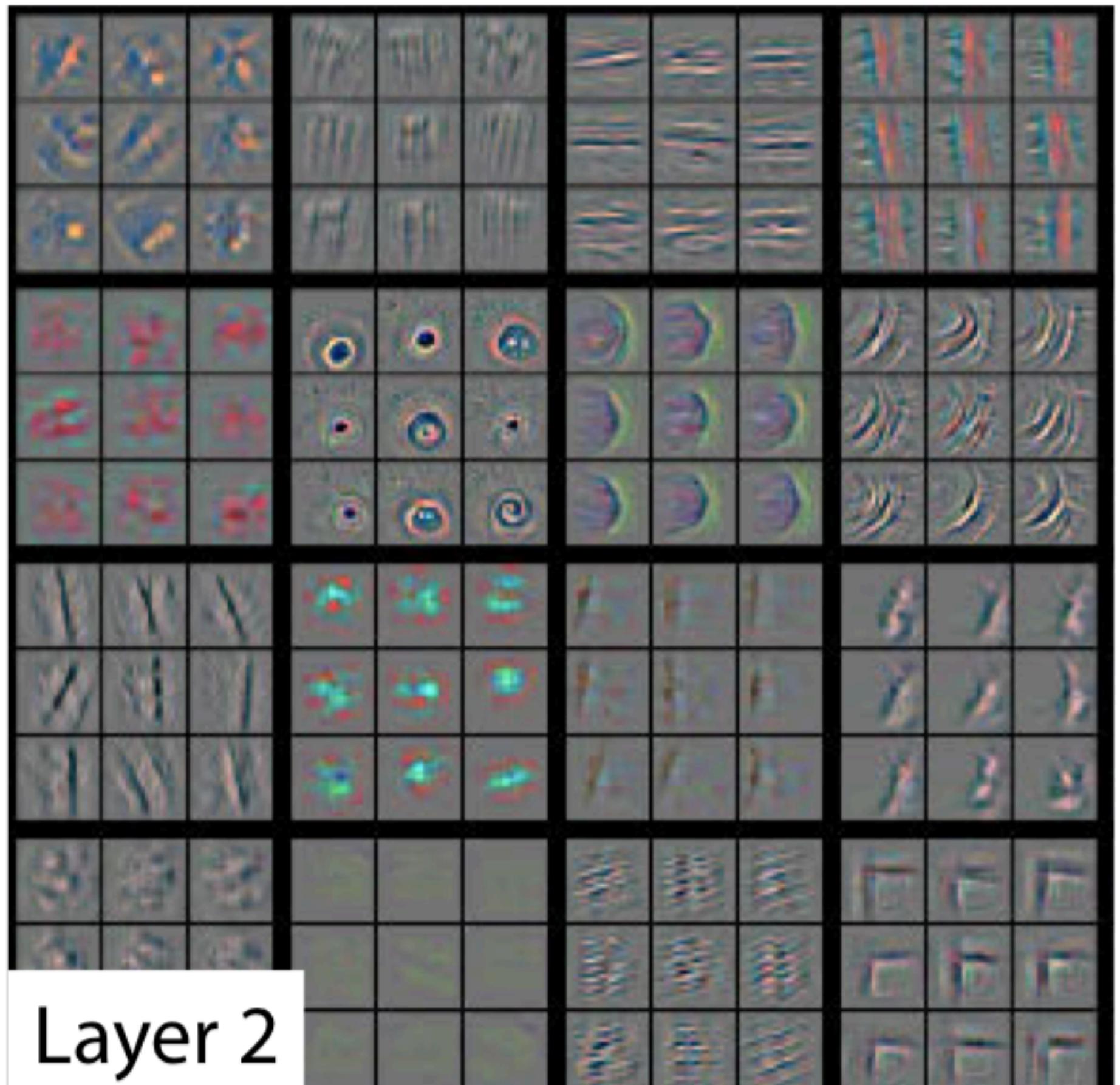
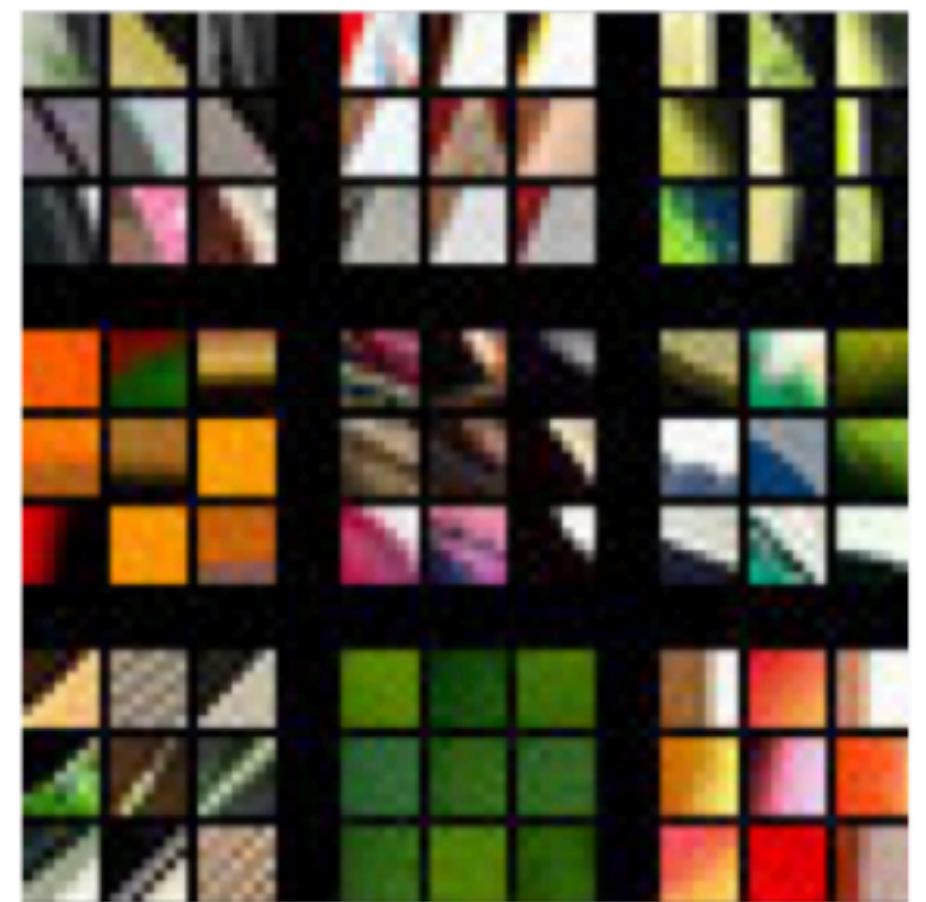
TRANSFER LEARNING

A machine learning method where a model developed for a task is reused as the starting point for a model on a second task.

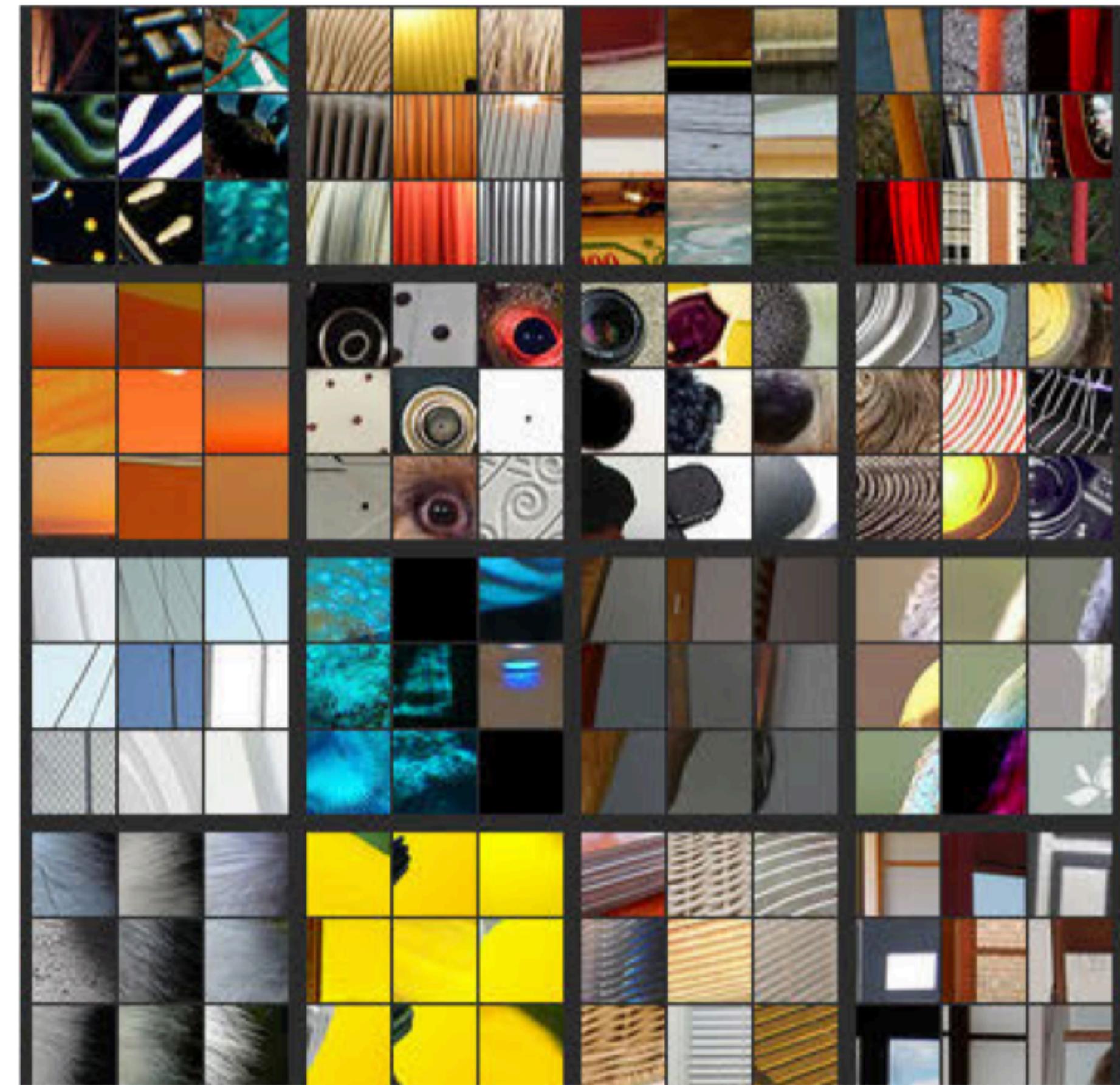
– Jason Brownlee



Layer 1

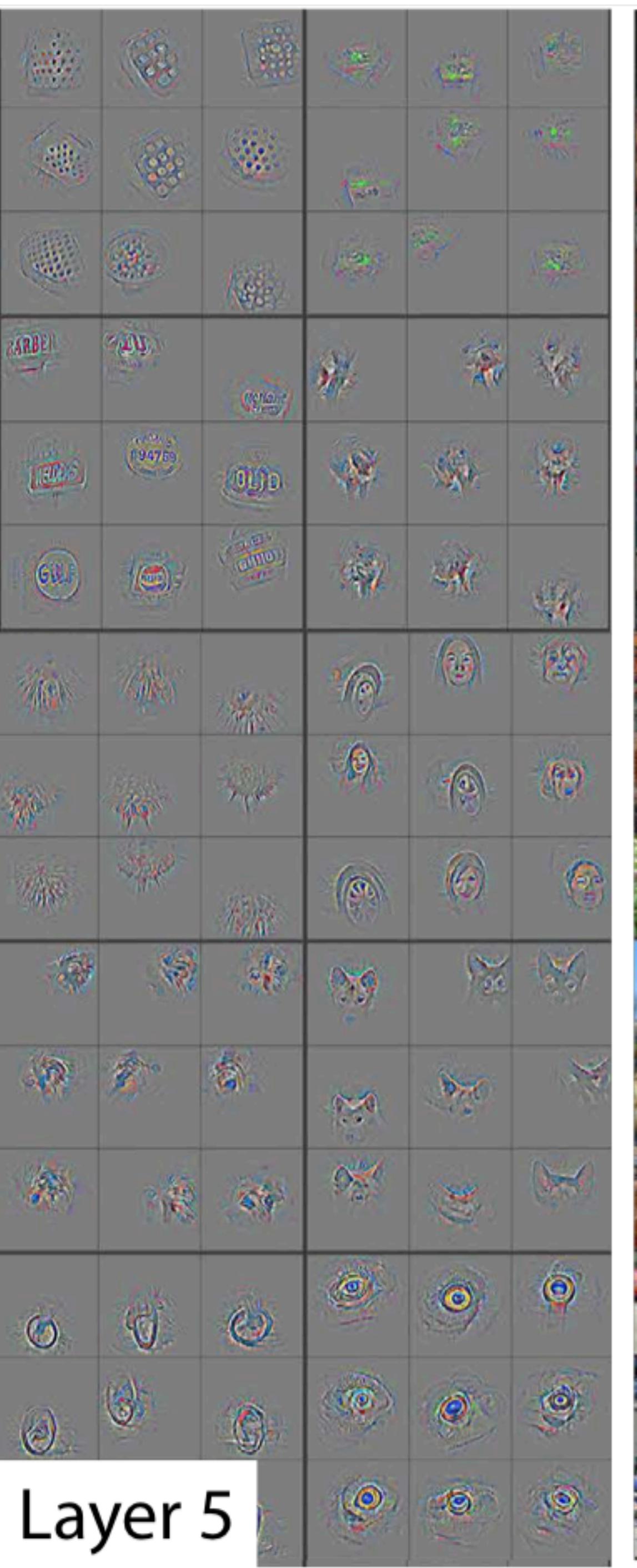
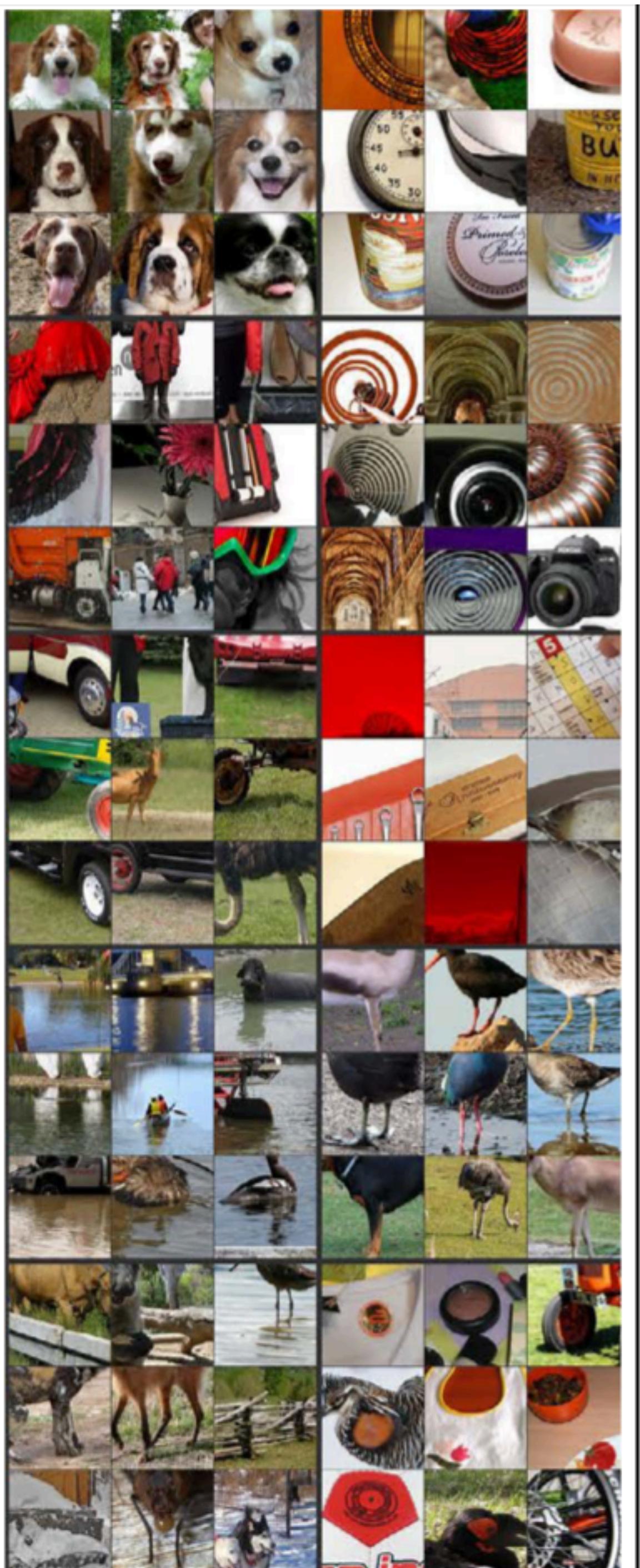


Layer 2

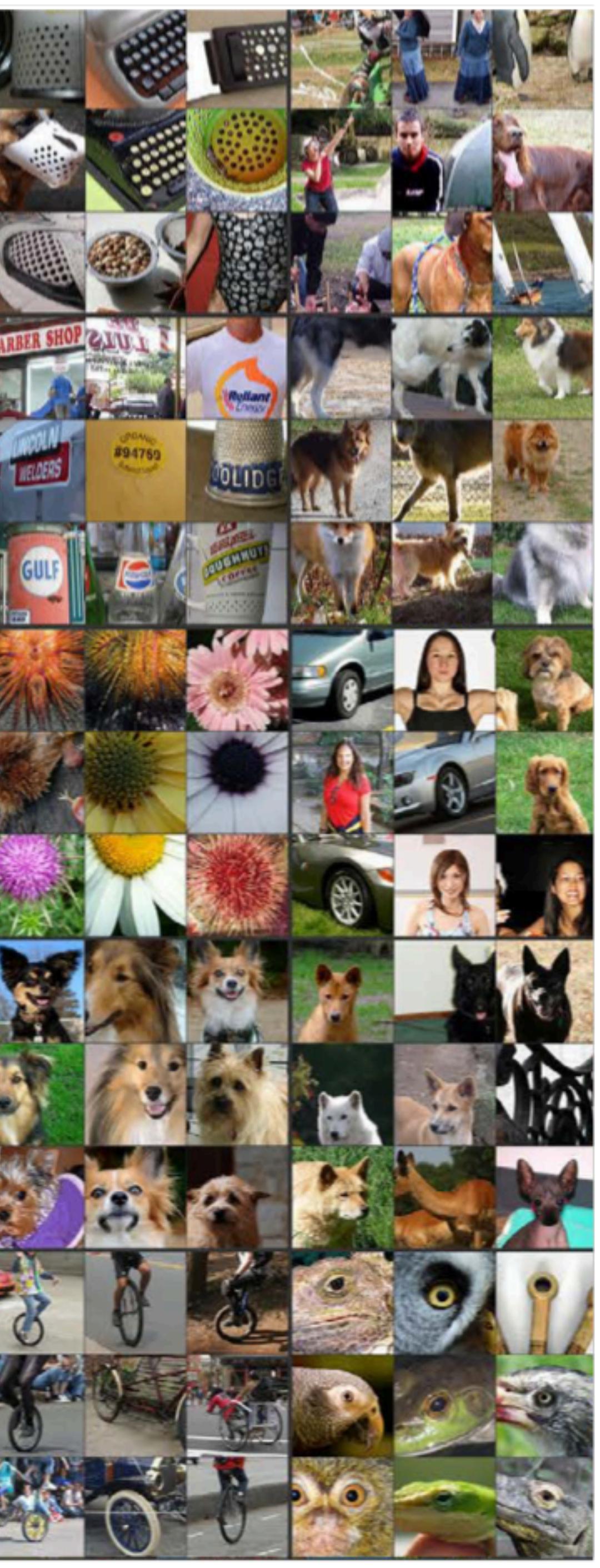




Layer 4

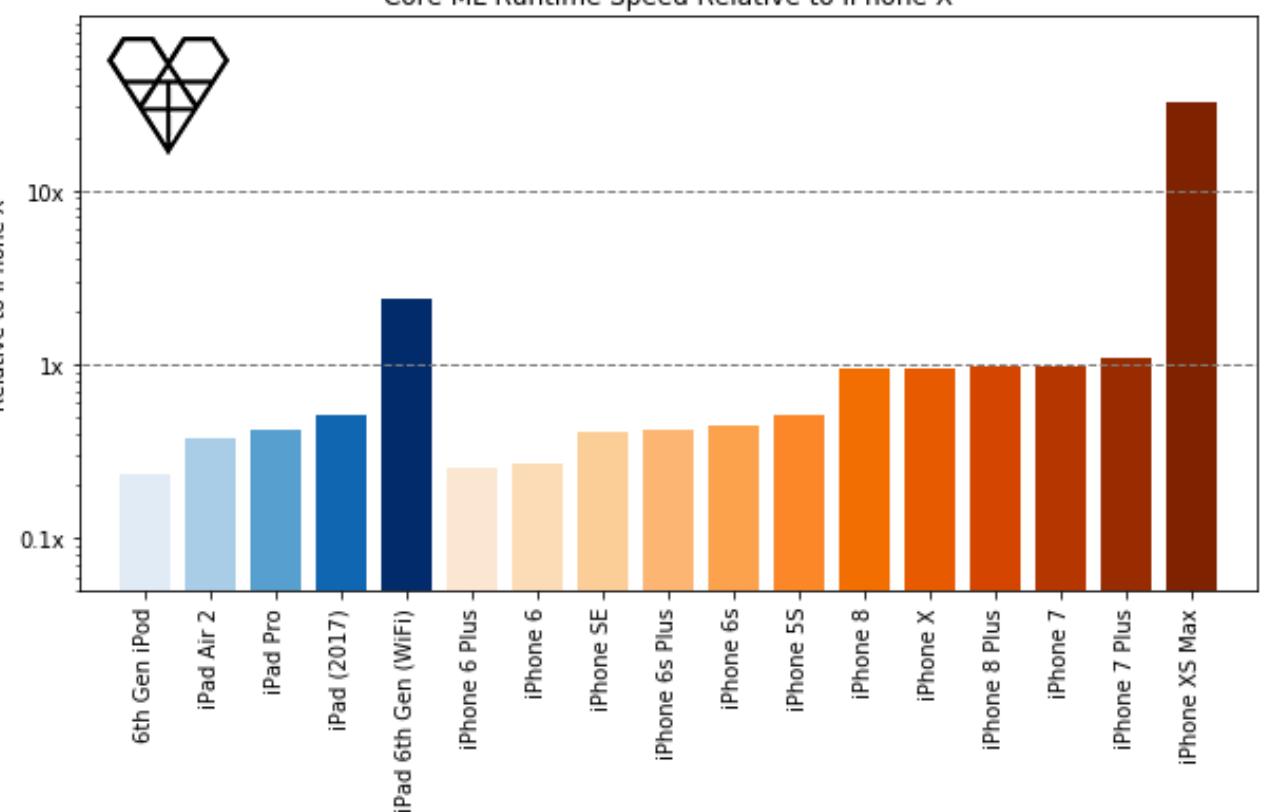


Layer 5



1

Hardware Support for on-device Neural Networks



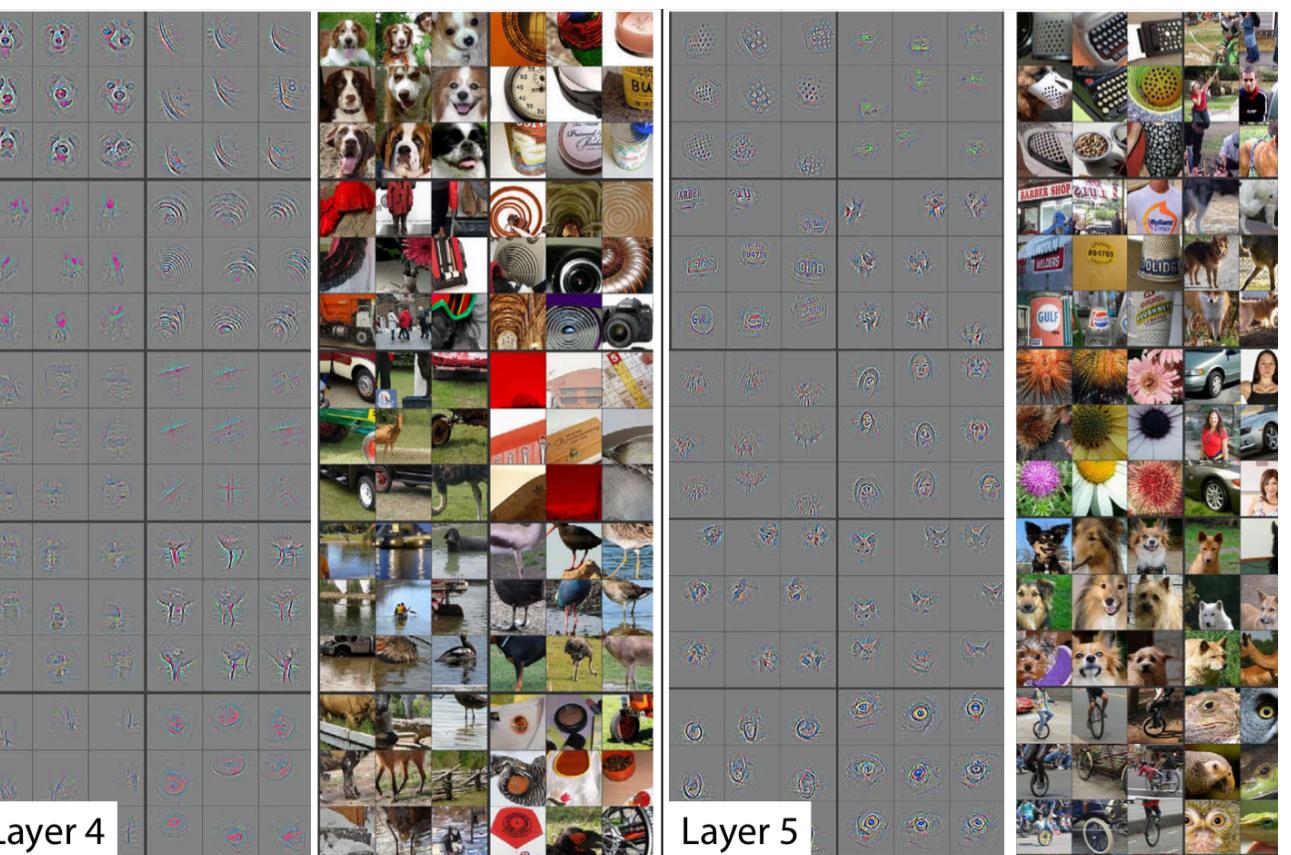
2

Privacy and Latency Concerns



3

Research Advancements



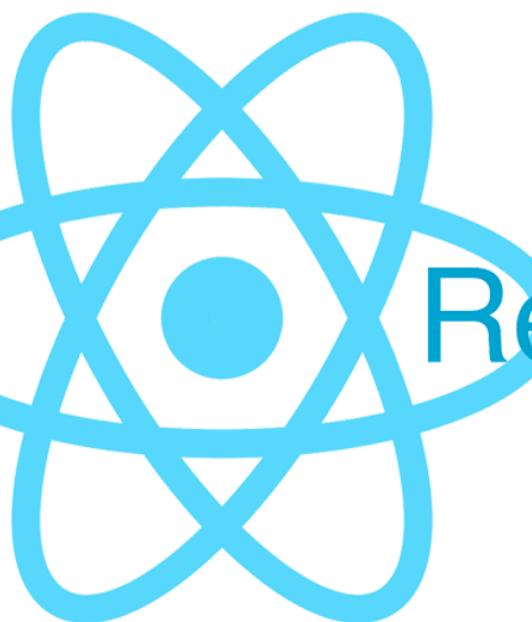


Atwood's Law

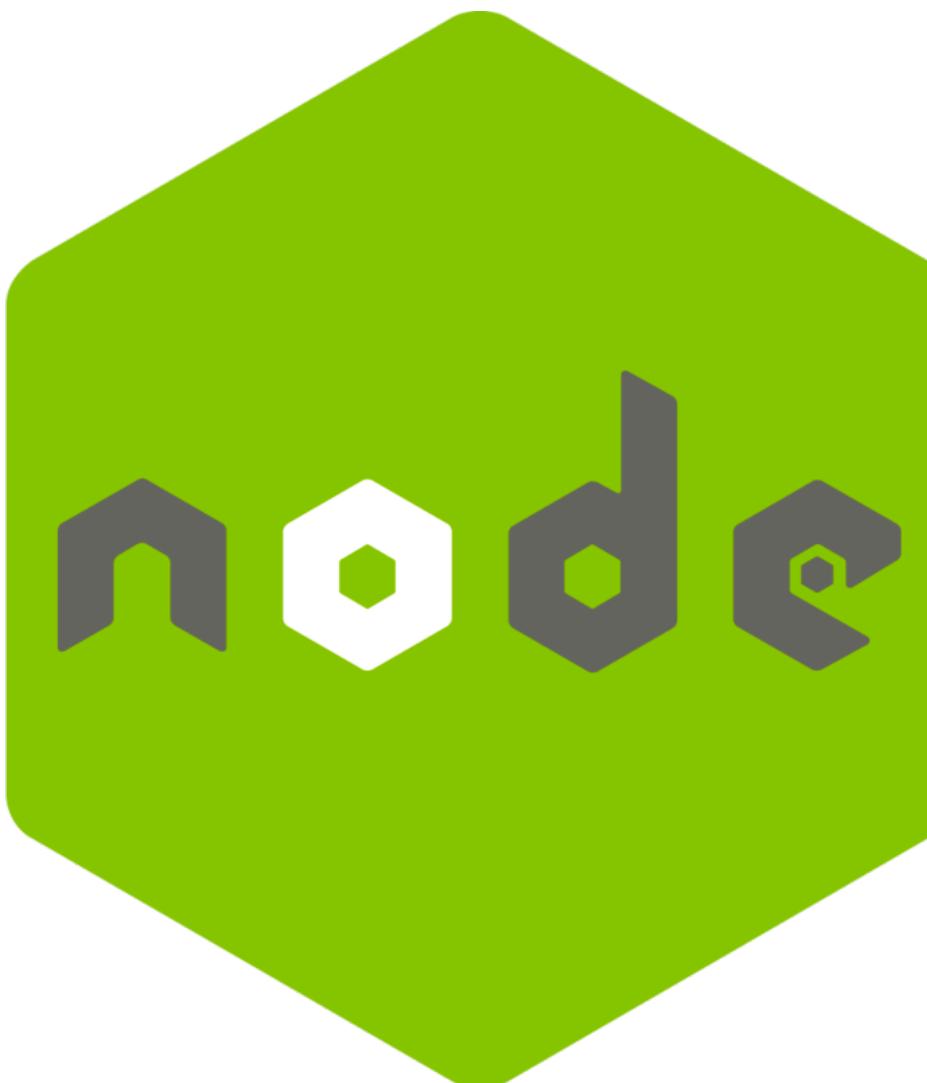
"Any application that can
be written in JavaScript,
will eventually be written
in JavaScript."

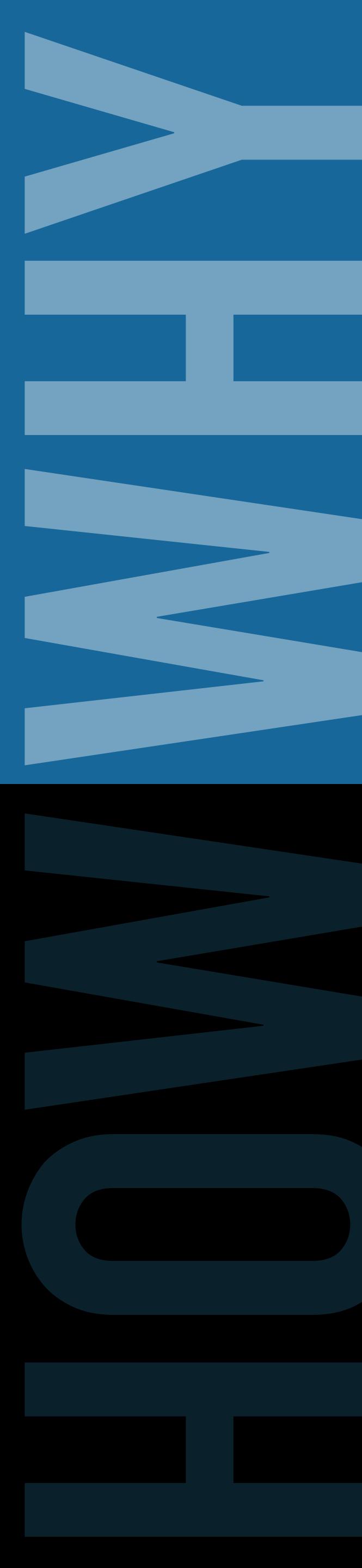
Jeff Atwood
Founder of Stack Overflow

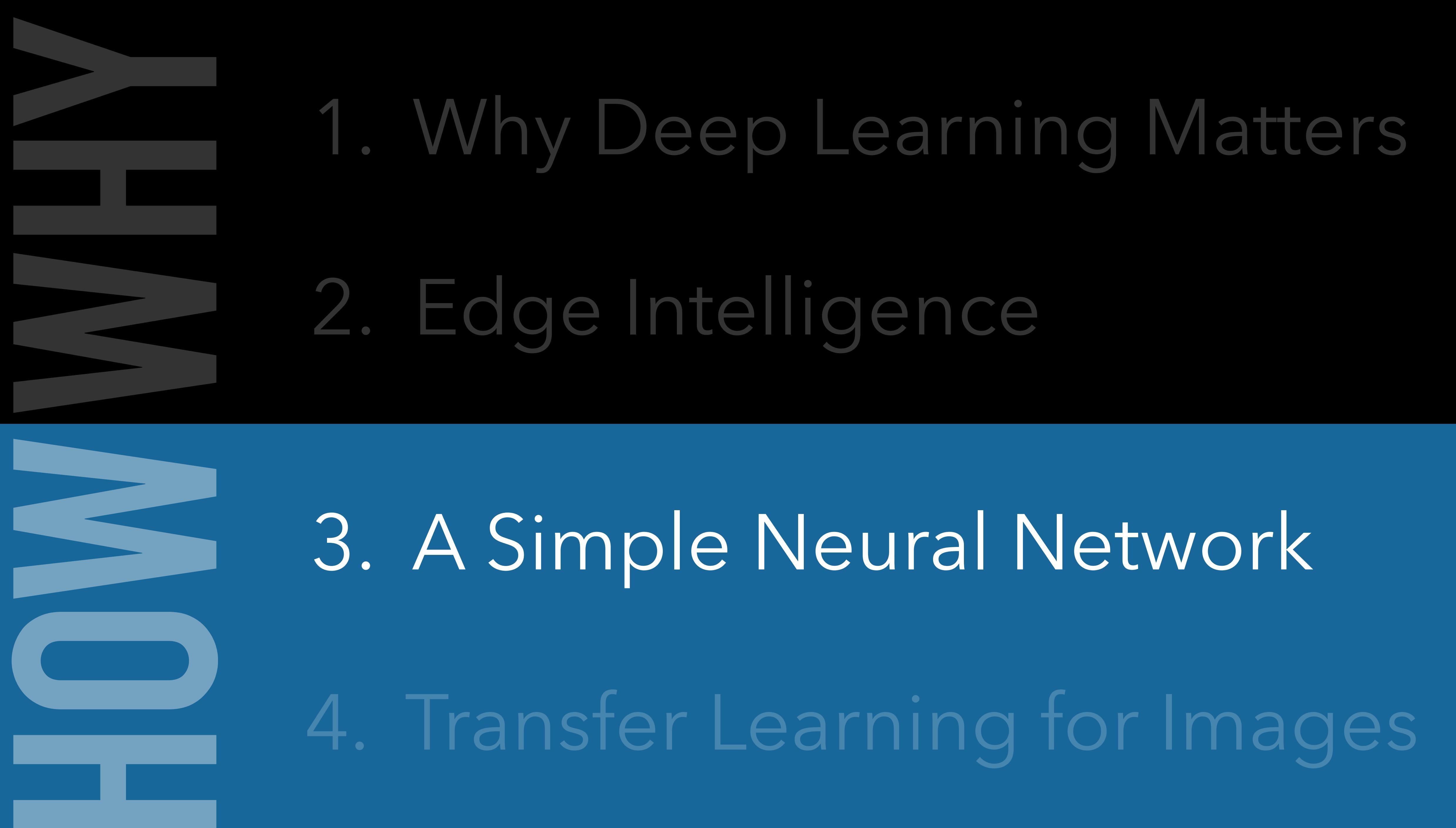
JAVASCRIPT IS EVERYWHERE



React Native



- 
1. Why Deep Learning Matters
 2. Edge Intelligence
 3. A Simple Neural Network
 4. Transfer Learning for Images



1. Why Deep Learning Matters
2. Edge Intelligence
3. A Simple Neural Network
4. Transfer Learning for Images

3

A SIMPLE NEURAL NETWORK

(live demo)

The image shows a browser window with three tabs open: HTML, CSS, and JS. Below the tabs is a live demo of a chart.

HTML:

```
<script>
src="https://cdns.cloudflare.com/cdn-cgi/charts/chart.js/2.7.3/Chart.min.js"></script>
<script>
src="https://cdn.jsdelivr.net/npm/PhaserFlow@7
June-13-2020/dist/phaser-flow.min.js"></script>
<script>
src="https://cdn.jsdelivr.net/npm/PhaserFlow@7
June-13-2020/dist/phaser-flow.min.js"></script>
<div id="container">
<button id="train">Train</button>
<div id="chart"></div>
</div>
</div>
```

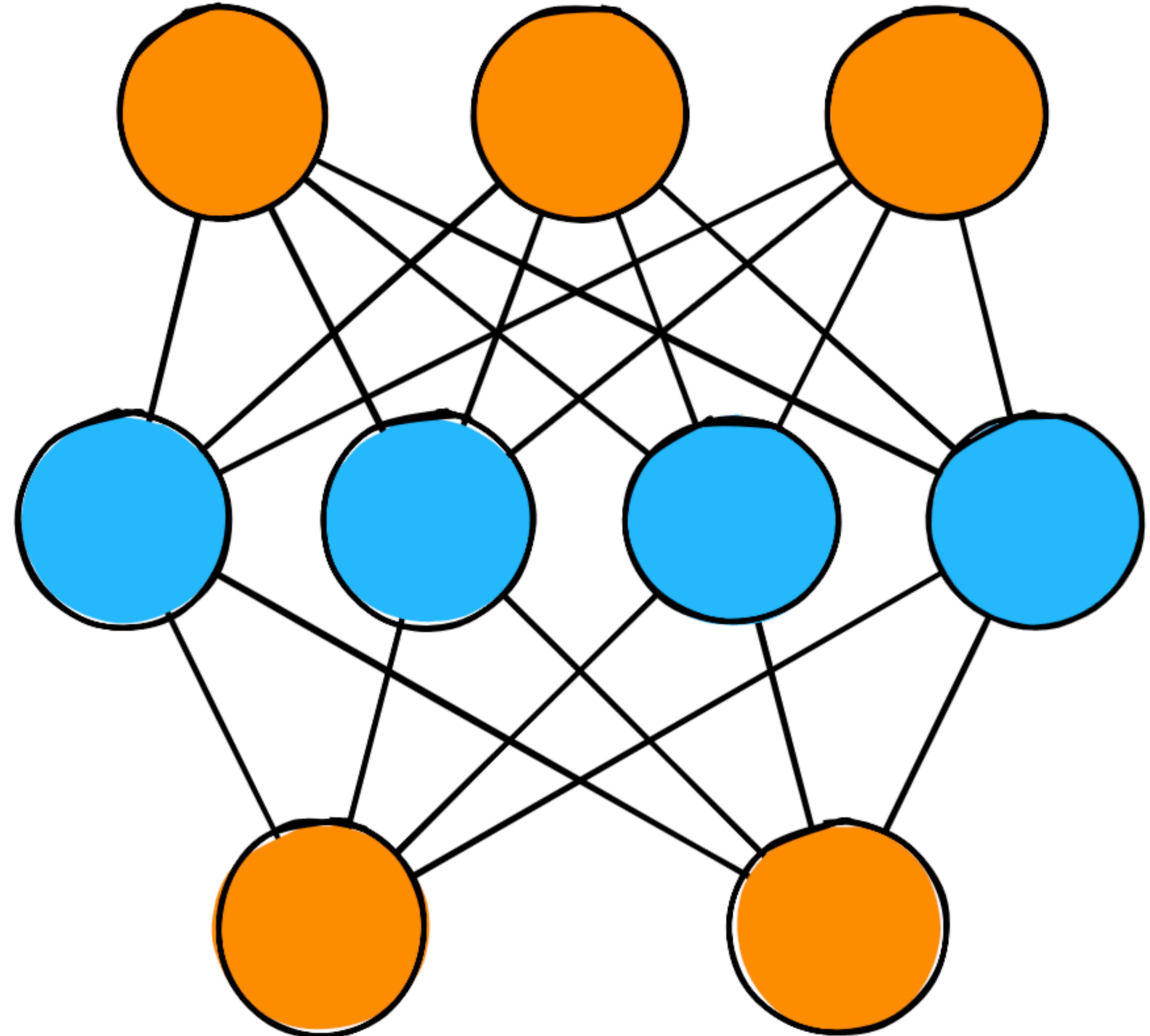
CSS:

```
html, body {
padding: 0;
margin: 0;
height: 100%;
width: 100%
}
body {
background-color: #f0f0f0;
font-family: sans-serif;
}
#container {
width: 100px;
}
#chart {
width: 100px;
}
```

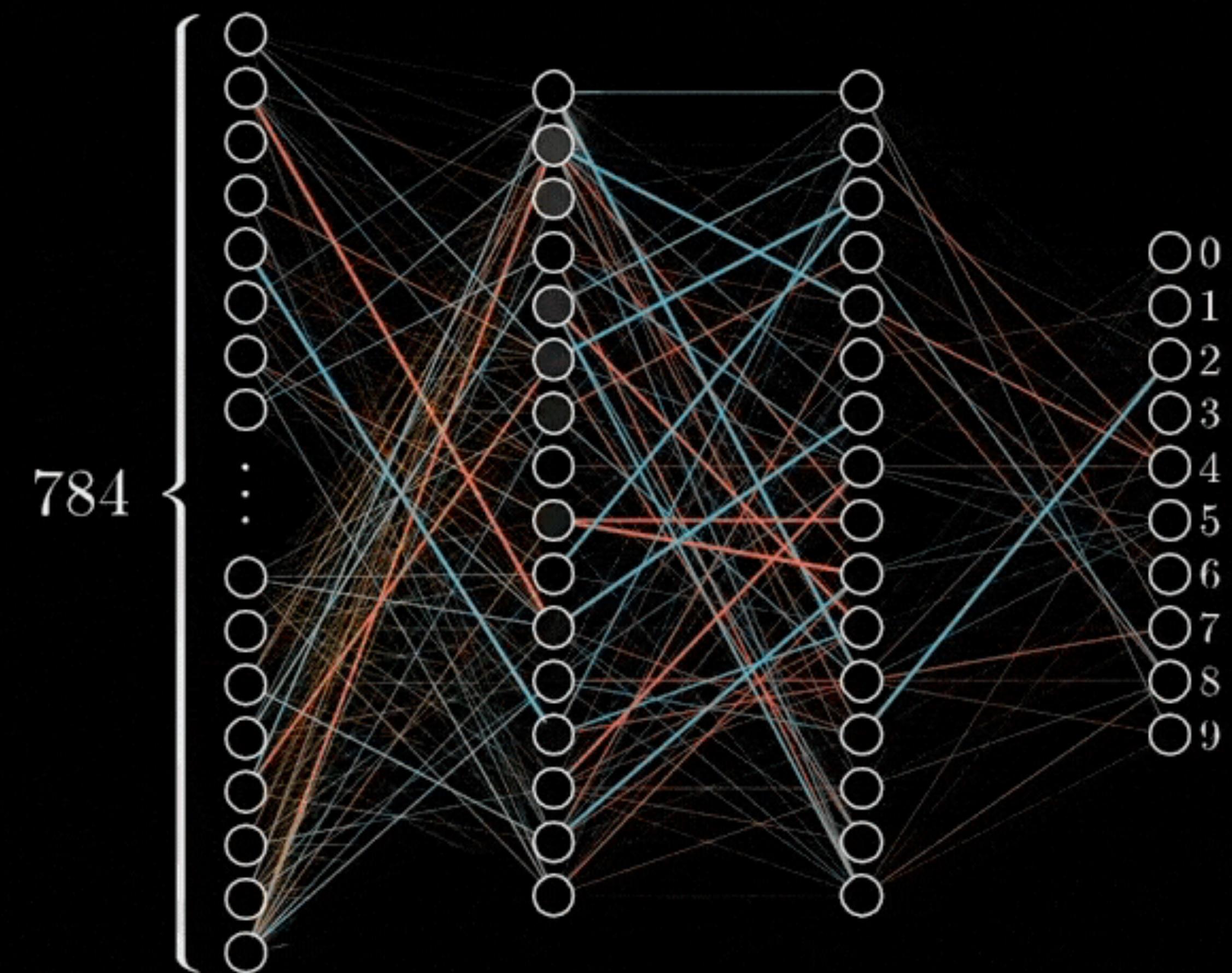
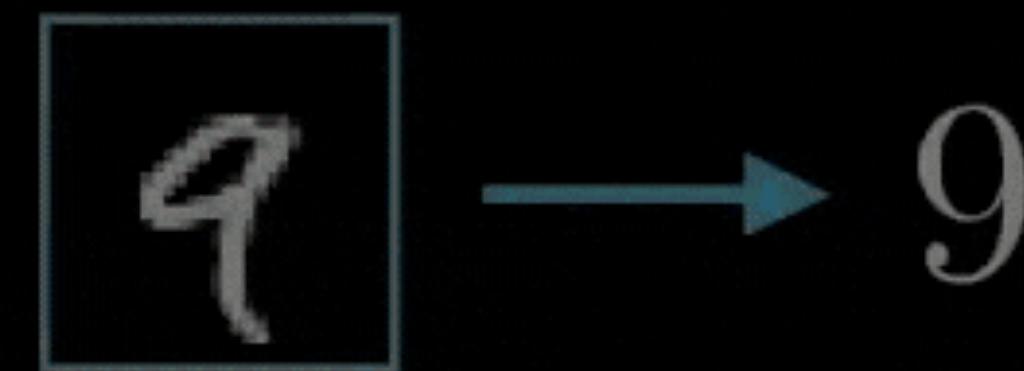
JS:

```
const data = [
{x: 1,
y: 1},
{x: 2,
y: 2},
{x: 3,
y: 3},
{x: 4,
y: 4},
{x: 5,
y: 5},
{x: 6,
y: 6},
{x: 7,
y: 7},
{x: 8,
y: 8},
{x: 9,
y: 9}
]
```

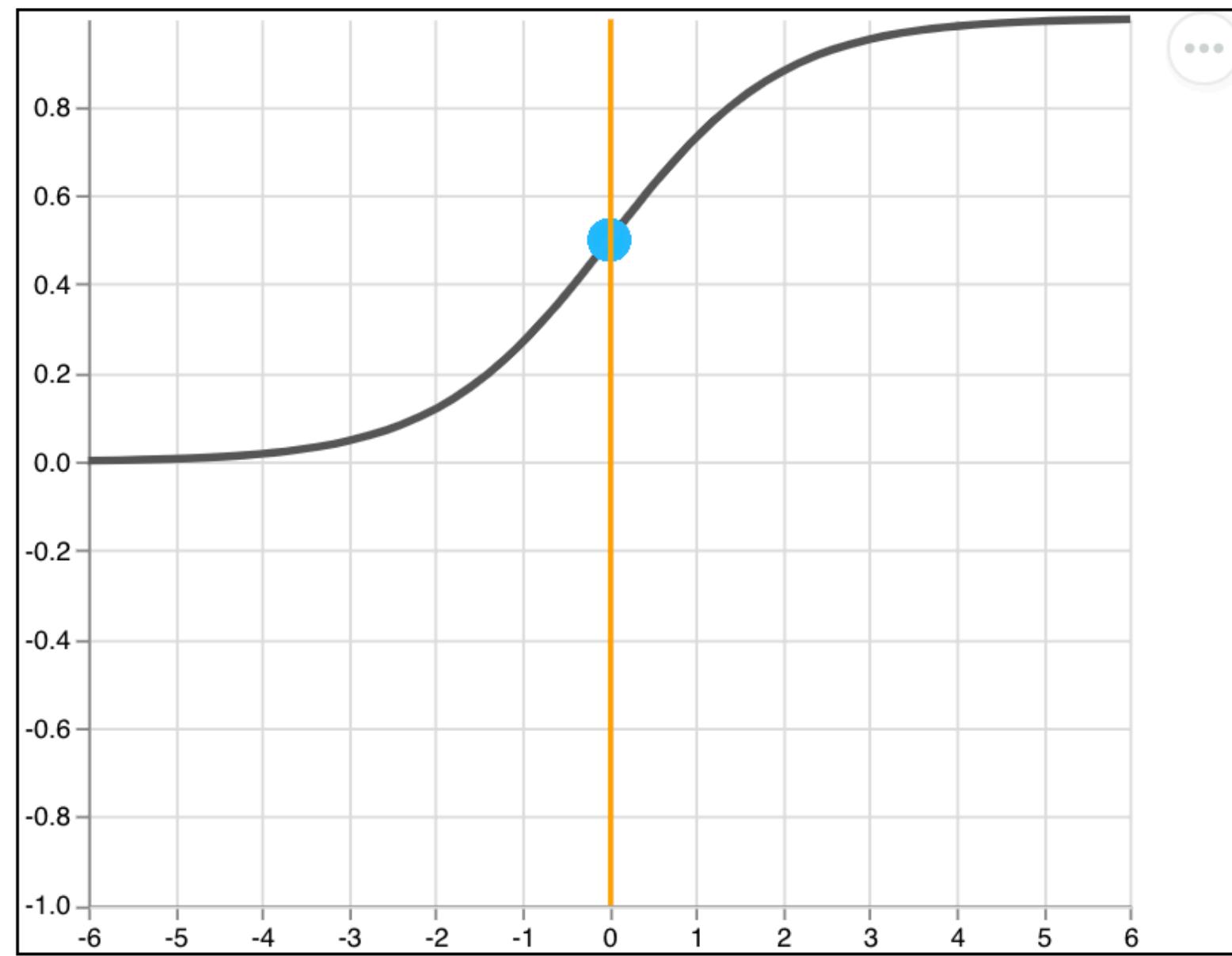
The live demo shows a grid with a red line connecting points (1,1) through (9,9). A red arrow points from the bottom-left corner towards the line.



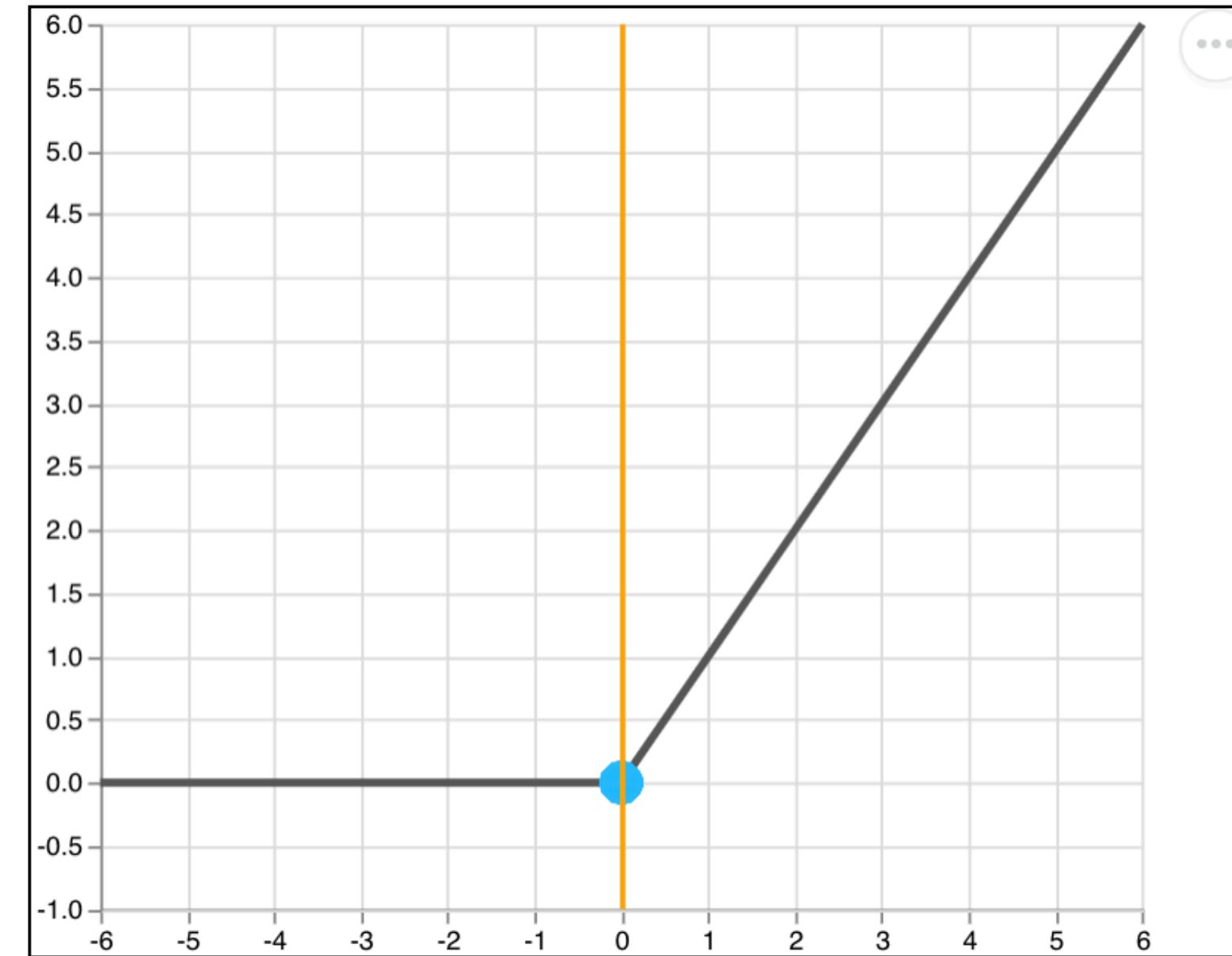
Training in
progress. . .



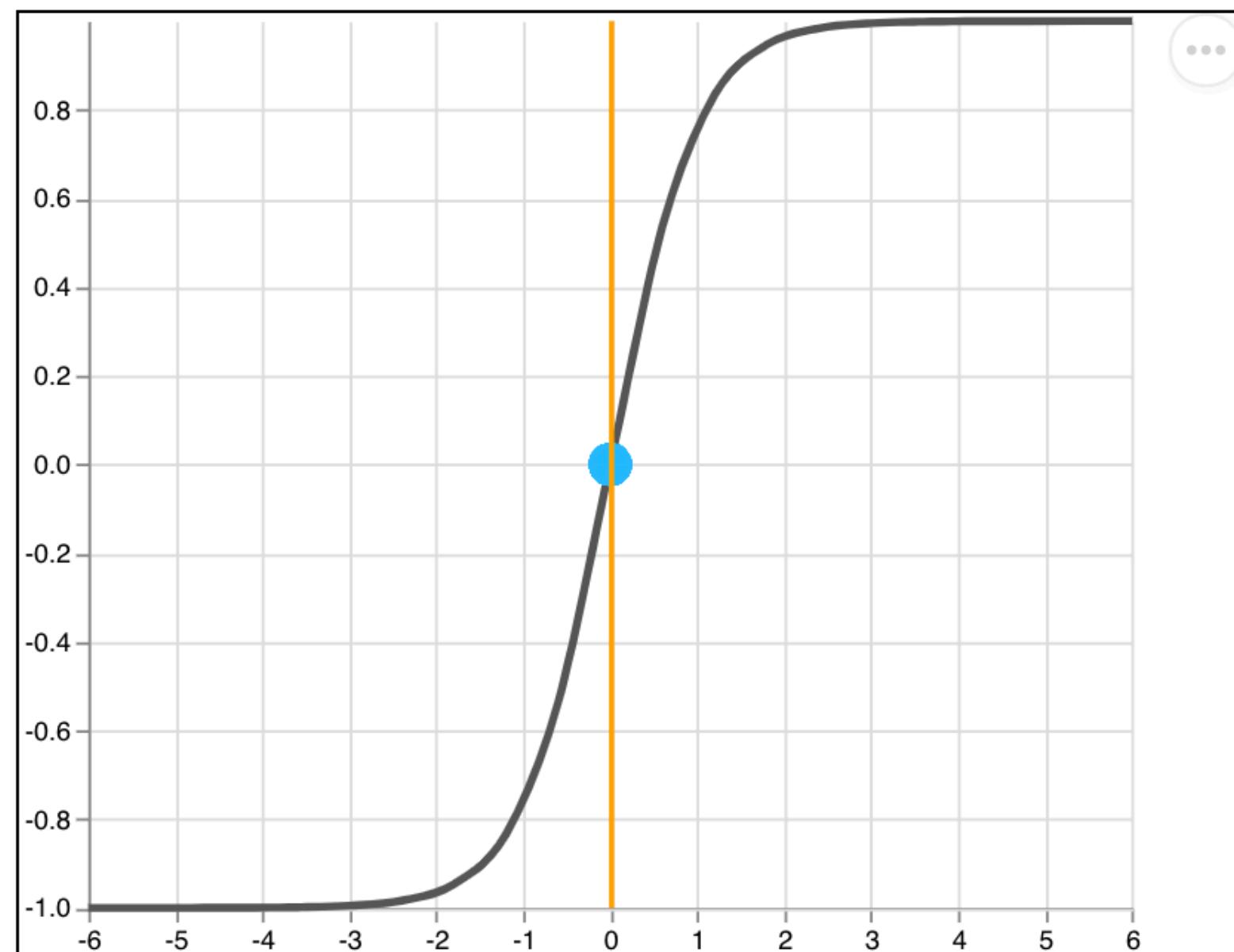
Sigmoid



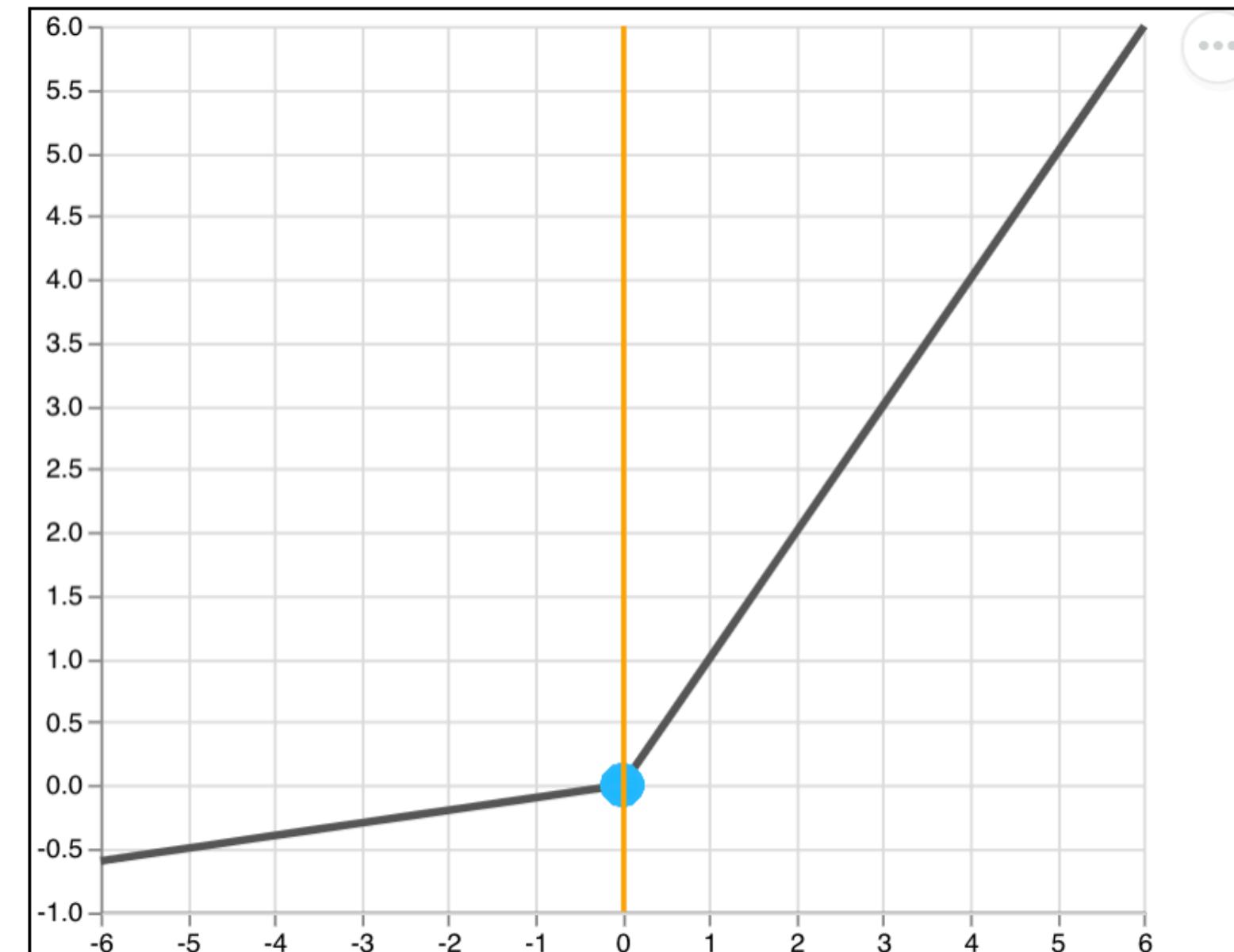
ReLU



TanH



Leaky ReLU





“There's the joke that 80 percent of data science is cleaning the data and 20 percent is complaining about cleaning the data ... Actually training models is typically a relatively small proportion of what a machine learner or data scientist does.”

**Anthony Goldbloom
Founder of Kaggle**



1. Why Deep Learning Matters
2. Edge Intelligence
3. A Simple Neural Network
4. Transfer Learning for Images

- 
1. Why Deep Learning Matters
 2. Edge Intelligence
 3. A Simple Neural Network
 4. Transfer Learning for Images

4

TRANSFER LEARNING FOR IMAGES

(live demo)

The screenshot shows a code editor window with a dark theme. On the left is a sidebar listing files: 'map.js', 'dataset.js', 'index.html', 'styles.css', 'dataset.json', 'the-meat-and-potatoes.js', and 'ui.js'. The main area displays the following code:

```
copy function() {
    // Define the number of classes in our model
    const NUM_CLASSES = 7;

    // Load the pretrained model
    // https://github.com/kodakai/kodakai-koala-examples/tree/main/models/mnist_v1.mdl
    const TensorFlowModel = "https://storage.googleapis.com/kodakai-koala-examples/25_224/model.json";
};

// Return a model that outputs an internal activation
```

Below the code editor is a large black rectangular placeholder. To the right of the editor are two buttons: 'KOALA' and 'examples'.

CHALLENGES

- ▶ Mindshare
- ▶ Data
- ▶ UX



THANKS!

Buy the book

dljsbook.com

Slides: dljsbook.com/fullstack

[@thekevinscott](https://twitter.com/thekevinscott)