

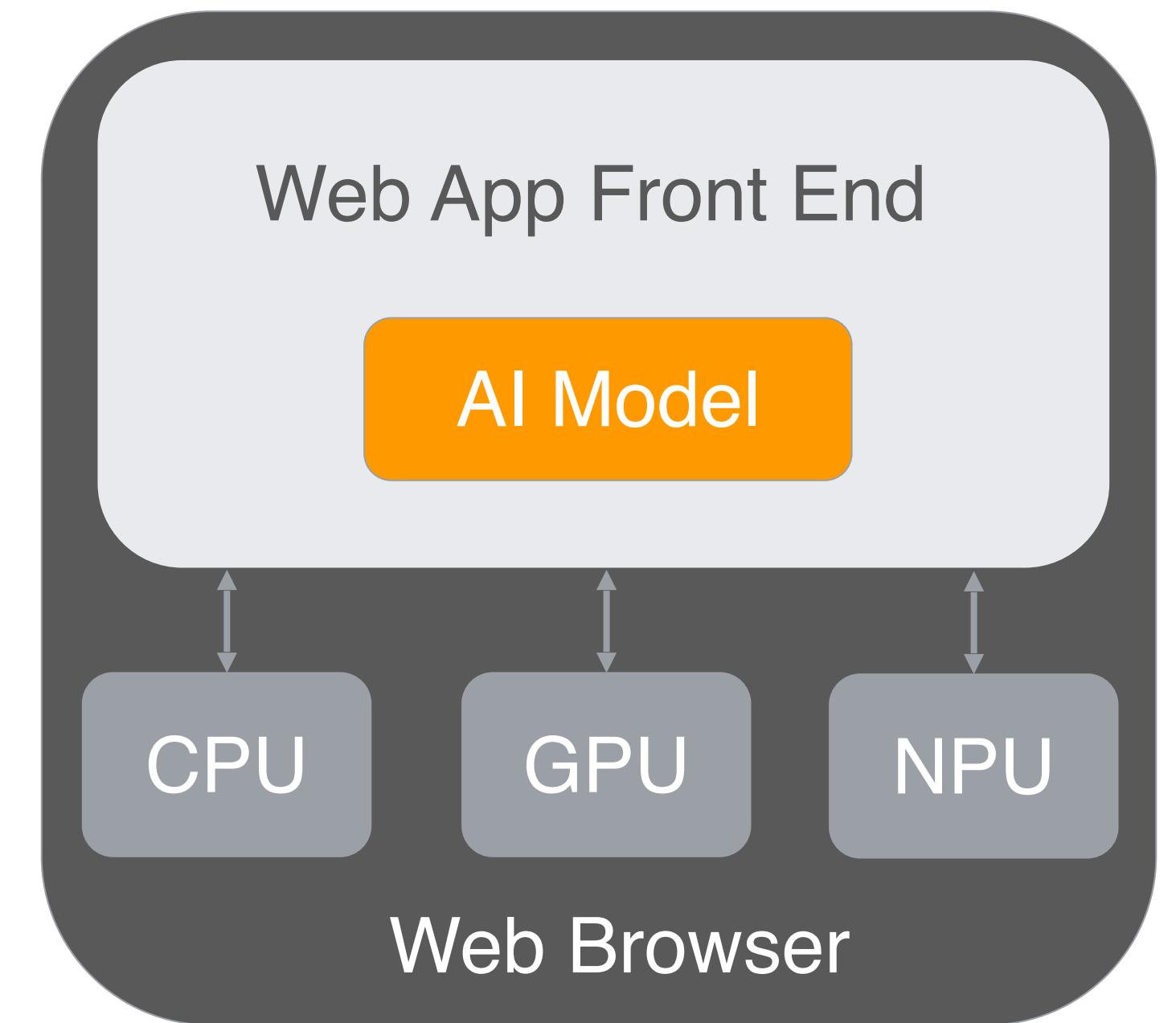
# Web Apps of the future with Web AI

**Jason Mayes**  
Web AI Lead, Google

[linkedin.com/in/WebAI](https://linkedin.com/in/WebAI)  
@jason\_mayes

# Web AI != Cloud AI

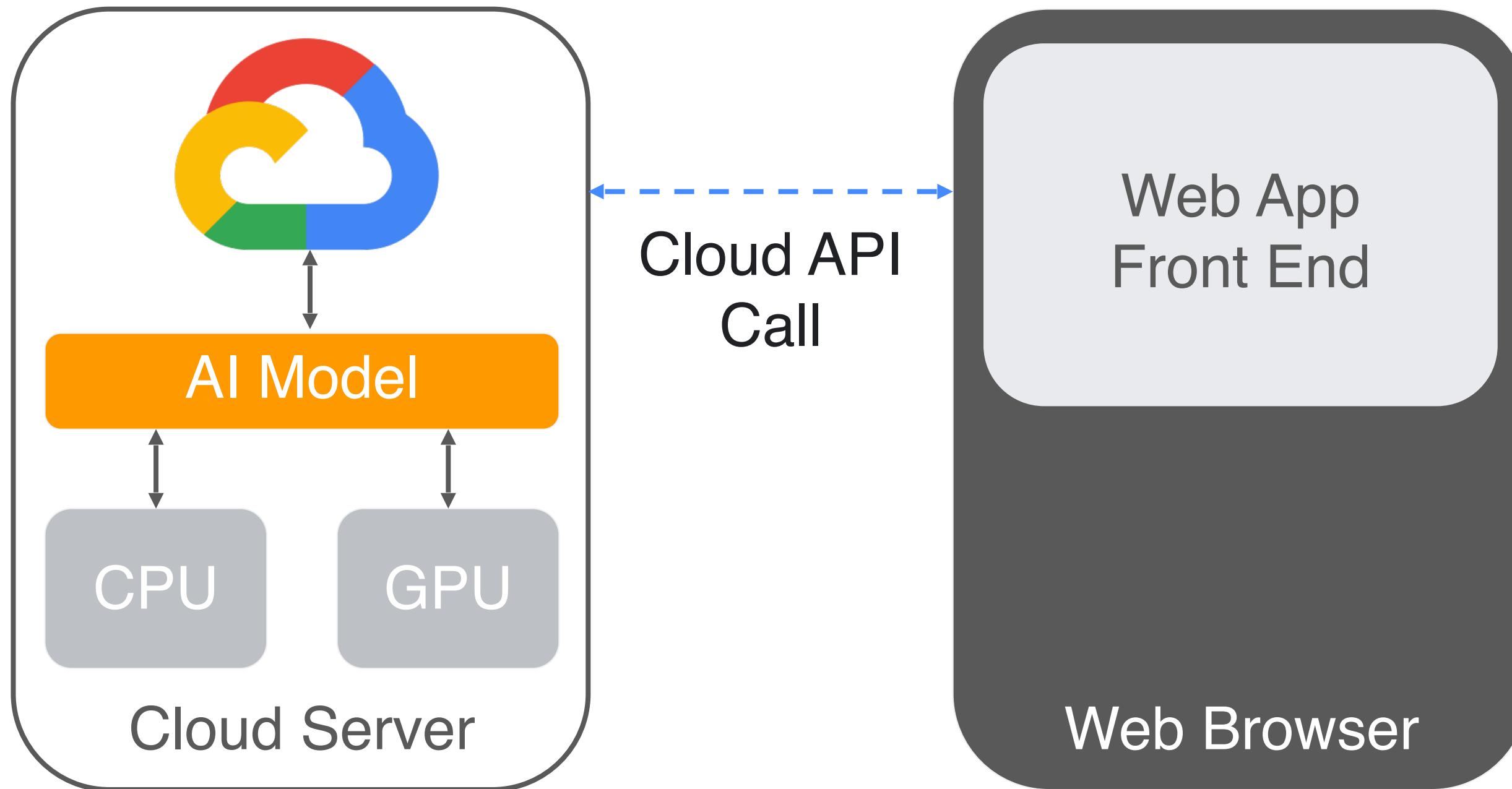
Client vs Server



WebNN

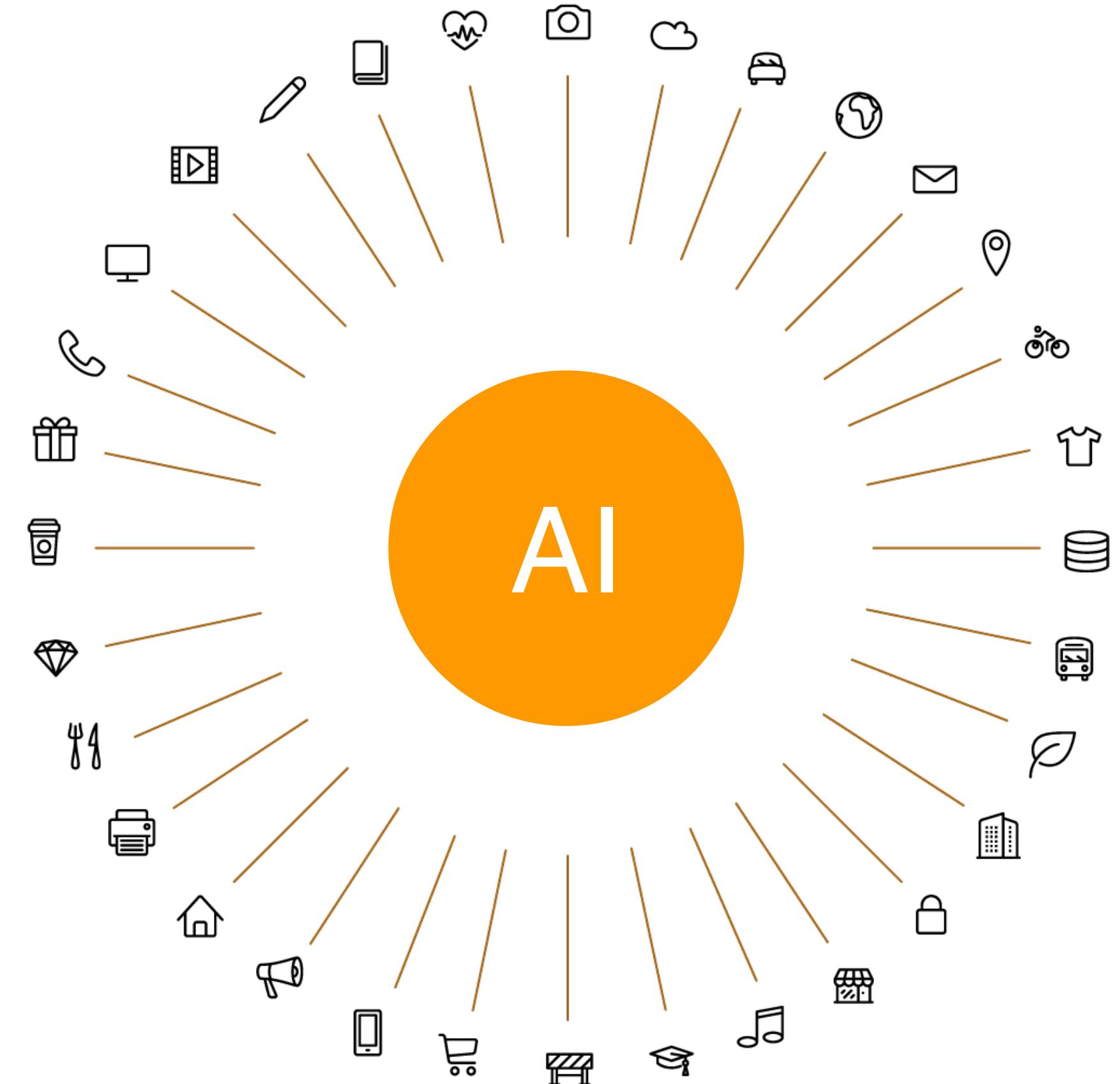


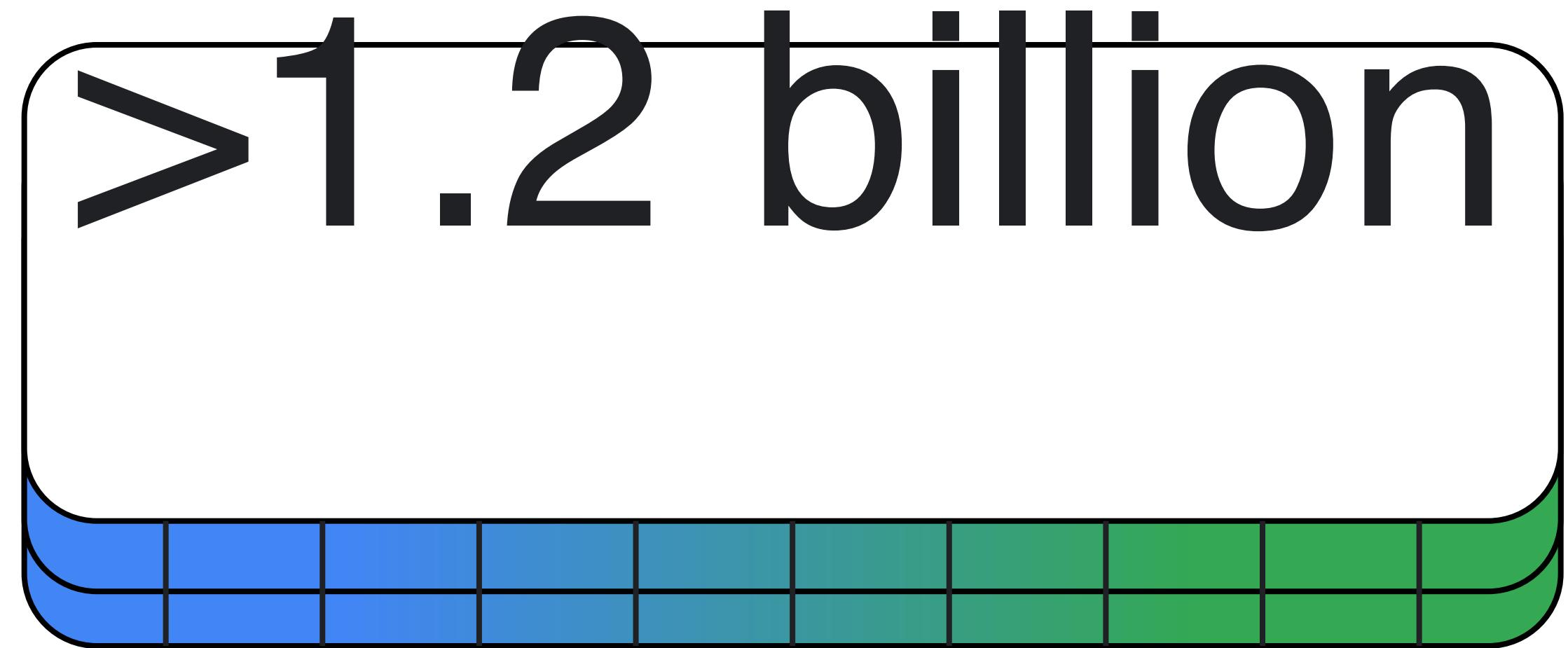
Built in JS APIs for common AI powered tasks



AI will touch every industry.

Time to learn in JavaScript too!





Cumulative CDN downloads of MediaPipe Web /  
TensorFlow.js libraries or models in 2022 and 2023.

Sources: 2023 + 2022 Public JSDeliver CDN statistics: [234M TFJS Library](#), [80M tfjs-tflite Library](#), [285M MP Face Detection](#), [292M MP Face Mesh](#), [60M MP Pose](#), [12M MP vision](#), [141M MP Selfie Segmentation](#), [52M MP Hands](#), [54M TFJS BodyPix](#), [18M TFJS MobileNet](#)

# Why Client Side AI?

## JavaScript on-device AI wins

### Privacy

**Sensor data from camera, microphone, or other connected sensors stays on device. No cloud based inference protecting user privacy.**

### Cost

As no server side hiring of expensive GPUs / CPUs and RAM, along with the bandwidth of sending data to and from server, cost can reduce significantly.

### Offline

After initial page load the model and logic can run entirely offline which is particularly suitable for folk working in remote locations or areas with poor connectivity.

### Zero install

Unlike native apps, no installation required, so not blocked by company policies to run the web app.

### Latency

As no cloud involved there is no round trip time to server and back again. Instead of 100ms models can run in real time

### Reach & Scale of Web

Anyone, anywhere, can go to the link the web app is hosted on and it just works. No need to install dependencies or setup Linux / CUDA etc. High shareability.

## Total Body

3 exercises, 1 round

1



Single Foot  
Balance

10 sec

2



Full Body  
Squat

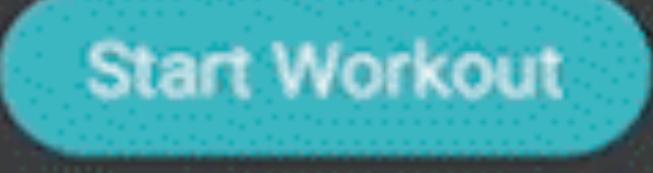
5 reps

3



Shoulder  
Abduction

6 reps



Start Workout

Learn More:

<https://goo.gle/IncludeHealth>

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3 exercises, 1 round

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# Consumer Goods Detection

Created by Hugo Zanini

**Learn More:**

<https://goo.gle/WebAI-Goods>



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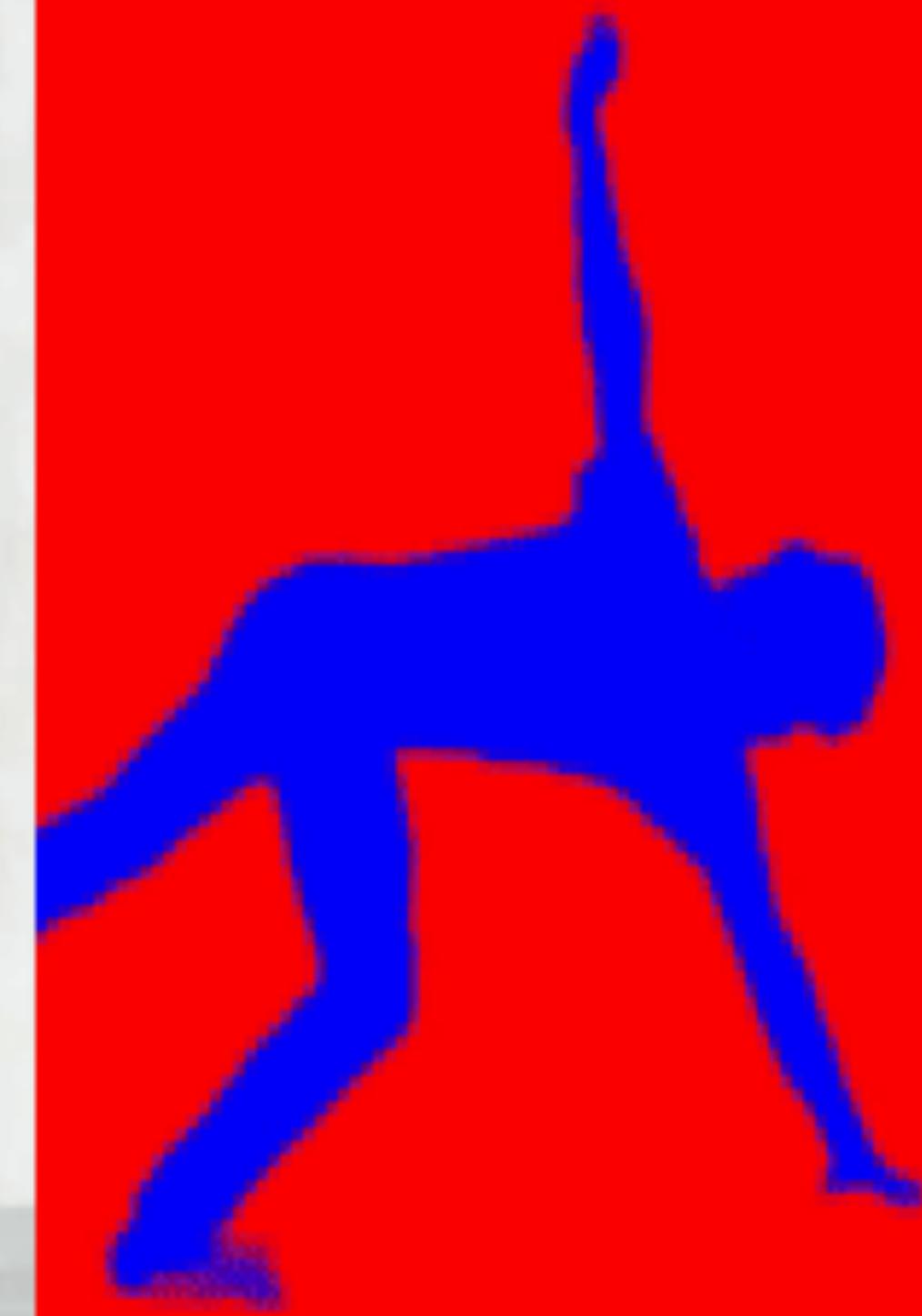
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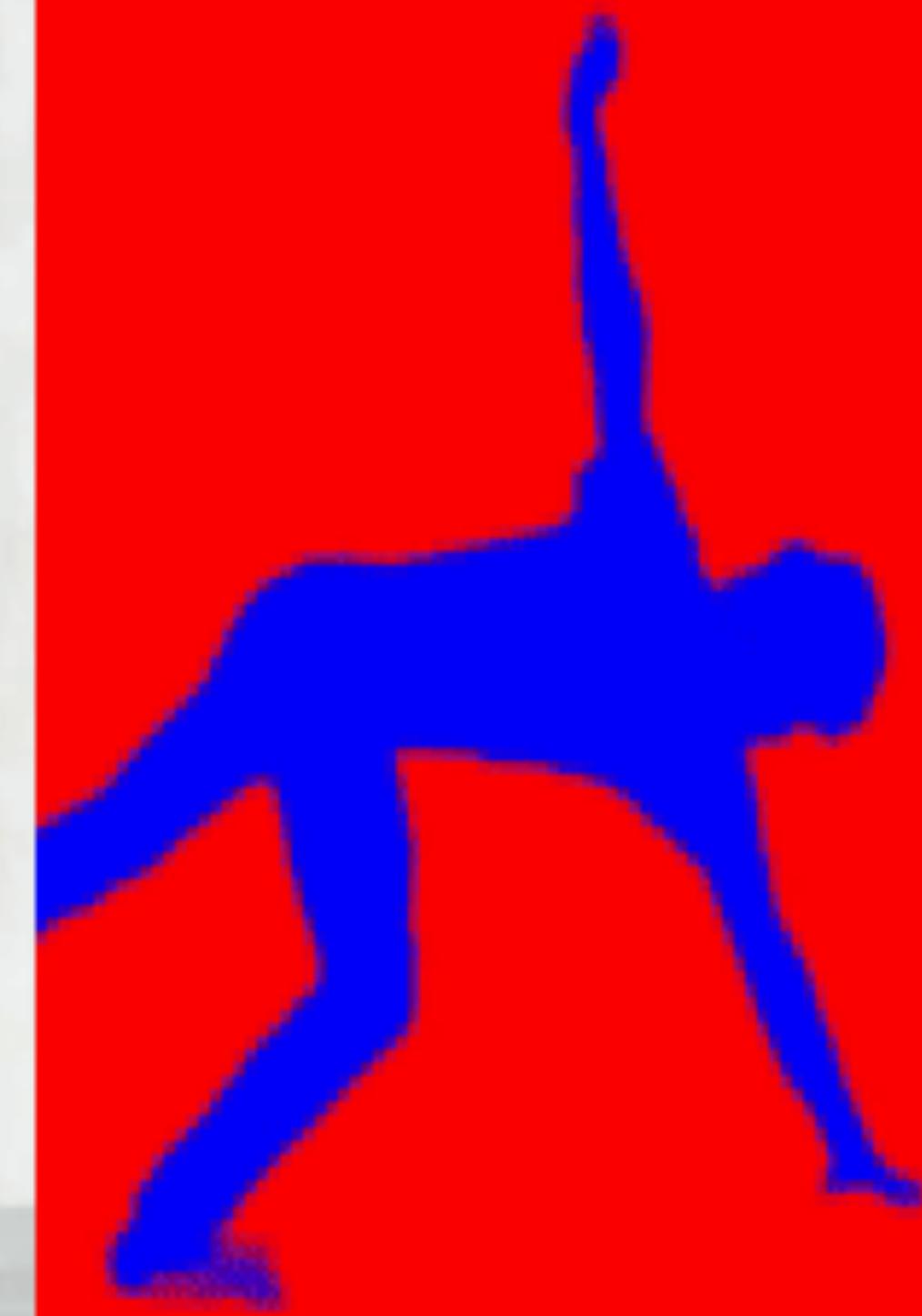
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 MediaPipe



 MediaPipe

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# Cost savings for both end users and companies

**LLM Inference**

Run large language models (LLMs) completely in-browser for text-to-text generation. You can use LLM Inference to perform a wide range of tasks, such as question answering, email drafting, and document summarization.

Download [Gemma 2B](#) (TensorFlow Lite 2b-it-gpu-int4) from Kaggle Models and select the model file in the picker below to get started. For more information on models, see the [documentation](#).

This demo specifically uses [Gemma prompt formatting](#). See the [LLM Inference API documentation](#) for the full web SDK documentation and generic web sample code.

Code examples  
[Android](#) | [iOS](#) | [Web](#)

Model selections: gemma-2b-it-gpu-int4.bin ▾

Reset conversation

Enter some text...



Chat with state of the art LLMs client side at incredible speeds without API usage caps

Web apps like video conferencing are even more cost effective to business when providing users with advanced features

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Ps (Beta) AdobeStock\_371221521 33% Open in desktop app Download Share

Select

Select subject

Object selection

Mode: Rectangle

Advanced settings

Quick selection

Magic wand

Lasso

Rectangular marquee

Elliptical marquee

Layers

fx

Layer 0

Properties

Layer 0

Appearance

Blend: Normal

Opacity: 100%

Effects

Add effect

Try adding a stroke, color overlay, outer glow or drop shadow

Dimensions

W: 3848 X: 0

H: 3848 Y: 0

C C M M Y Y



Learn More:  
<https://goo.gle/AdobeWebAI>

Select subject Remove background

Adobe offerings and trademarks belong to Adobe Inc and are not associated with Google.

Ps (Beta) AdobeStock\_371221521 33% Open in desktop app Download Share

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Select subject

Object selection

Mode: Rectangle

Advanced settings

Quick selection

Magic wand

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Rectangular marquee

Elliptical marquee

3D View

Layers

fx

Layer 0

Properties

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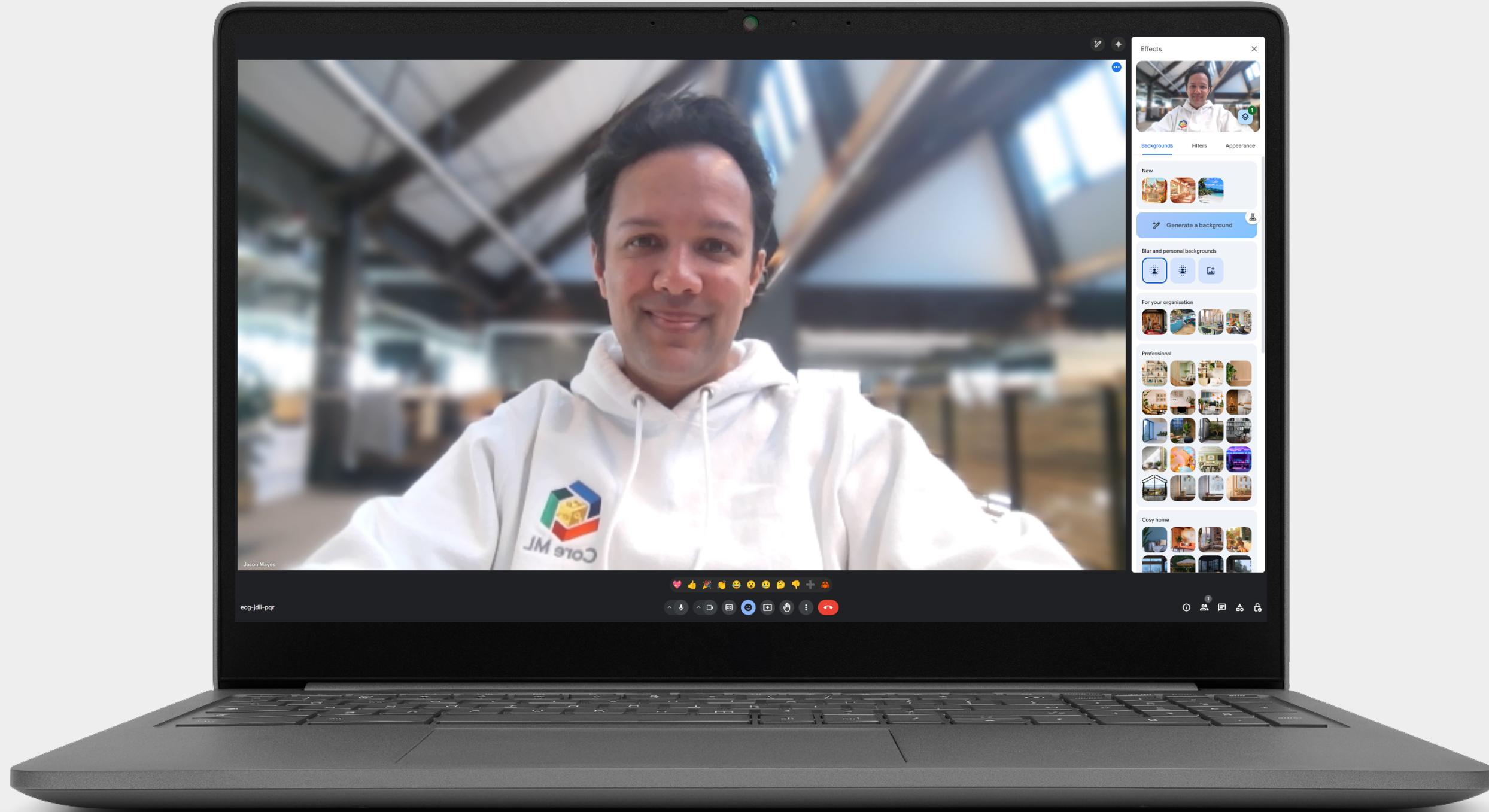
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**54K**

Images per 30 minute meeting\*

\*Assuming 30 frames per second for video

**54B**

Images per day\*

\*Assuming 1M meetings per day

# \$2B

Estimated yearly  
savings by using  
client side Web AI\*



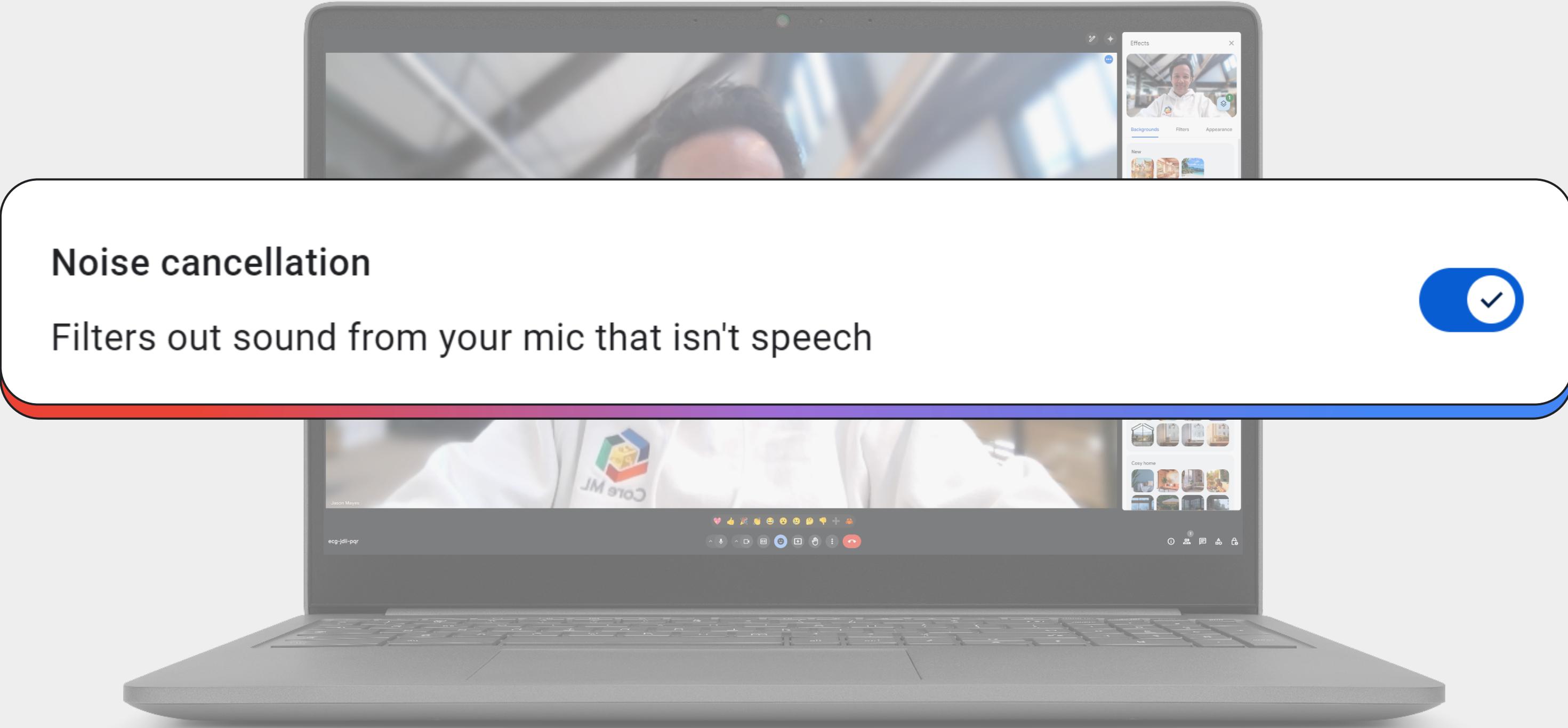
\*Assuming 0.0001 cents per inference for segmentation when using server side compute

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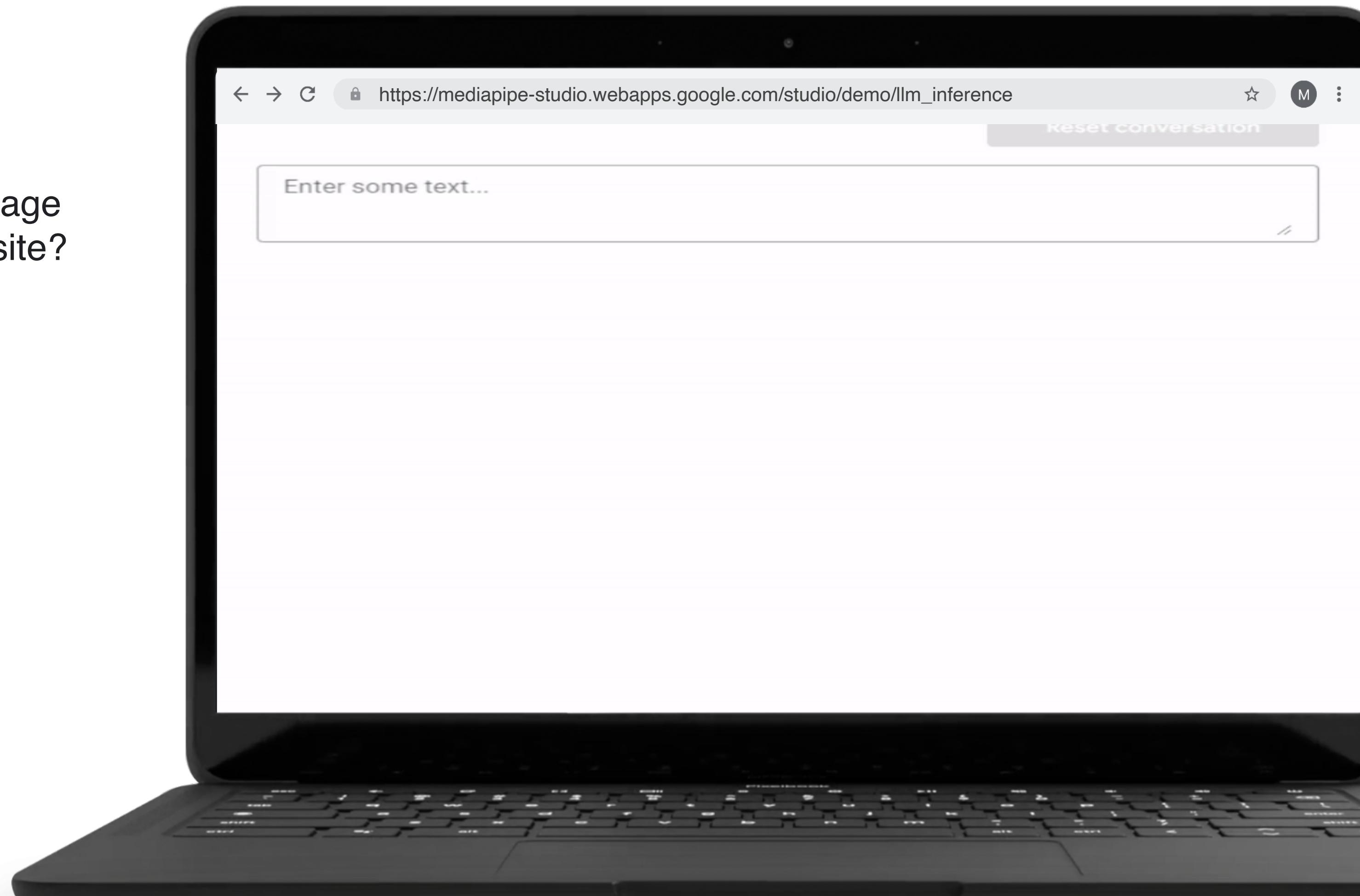
Noise cancellation

Filters out sound from your mic that isn't speech



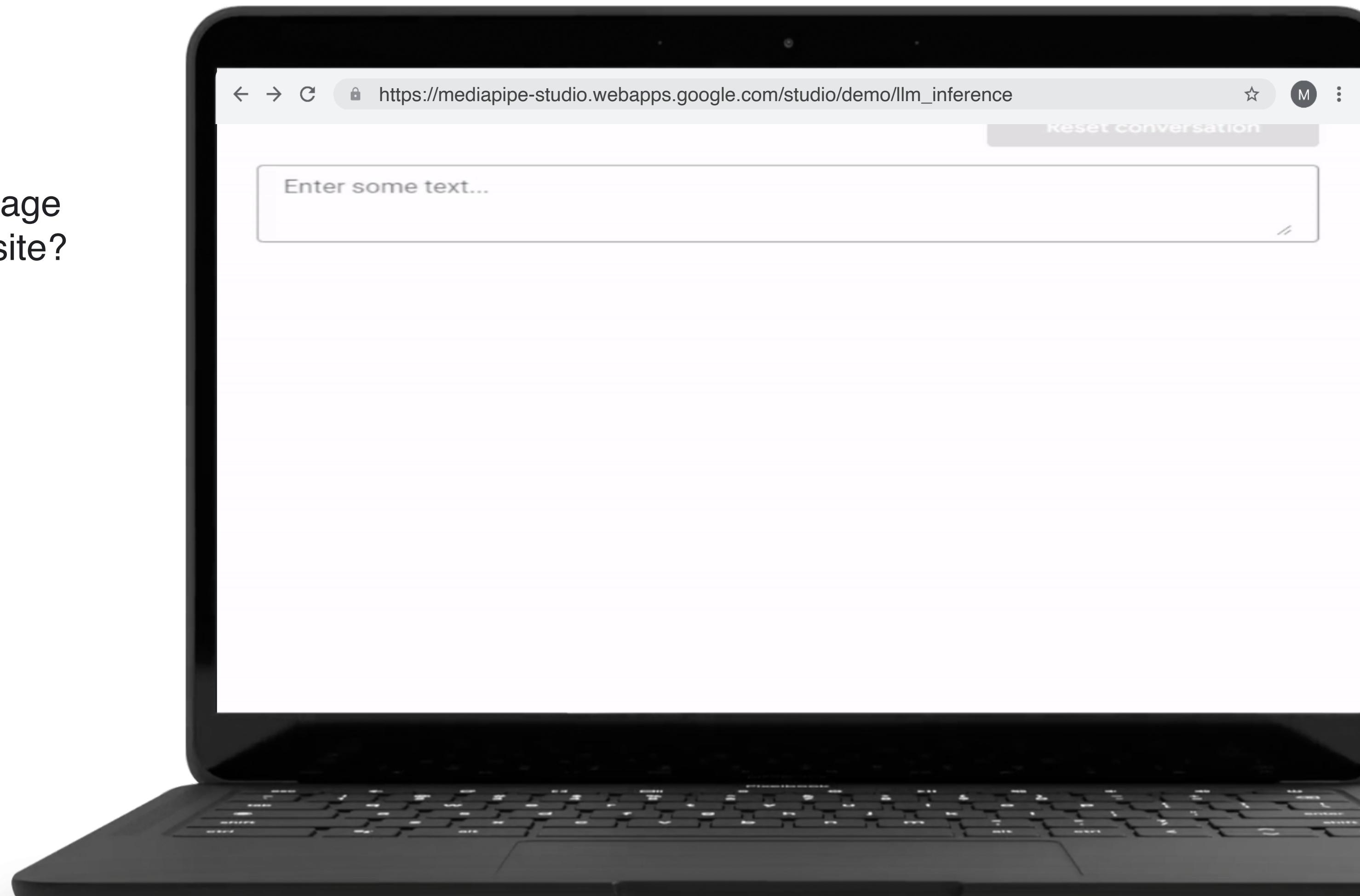
# LLMs in the browser

How could you leverage an LLM in your website?



# LLMs in the browser

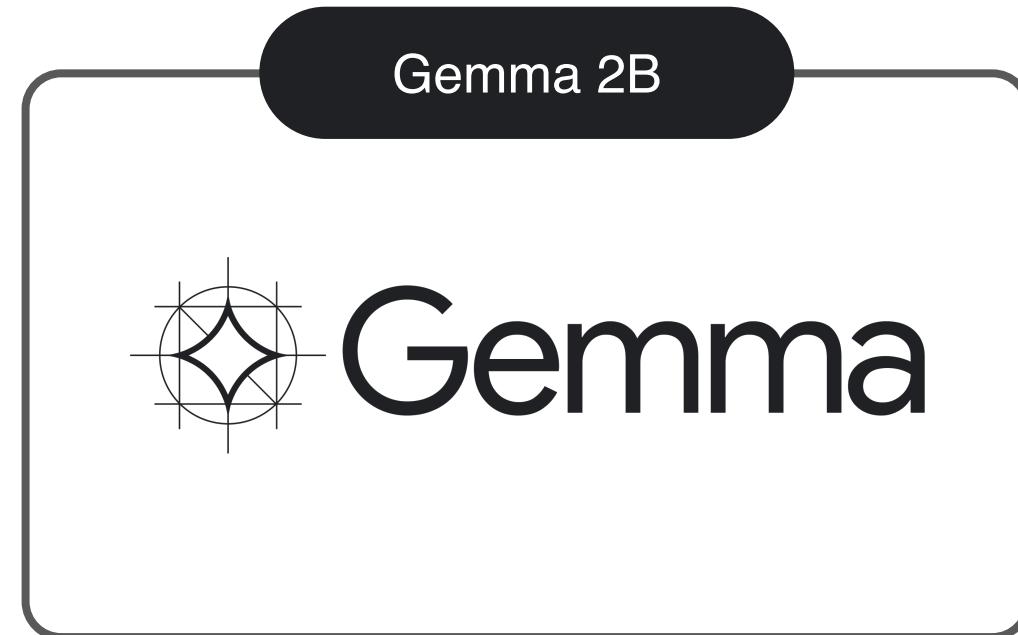
How could you leverage an LLM in your website?



# LLM Task API

Load and run our 4 supported LLM architectures in the browser with ease.

**Learn More:**  
<https://goo.gle/MPWebLLMDocs>



```
import {FilesetResolver, LlmInference as LlmTask} from 'https://cdn.jsdelivr.net/npm/@mediapipe/tasks-genai';

const modelURL = 'https://YOUR_LLM_MODEL_URL_HERE';

async function initLLM() {
  const filesetURL = 'https://cdn.jsdelivr.net/npm/@mediapipe/tasks-genai/wasm';
  const genAiFileset = await FilesetResolver.forGenAiTasks(filesetURL);

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# Endless possibilities

A prototype made in just a few hours to explore how LLMs could enhance your web browsing productivity.

Real-time capture taken in Chrome.

Model is accelerated via WebGPU running on an NVIDIA 1070 GPU entirely in the web browser.

**Try it yourself:**  
<https://goo.gle/WebAIGemma>



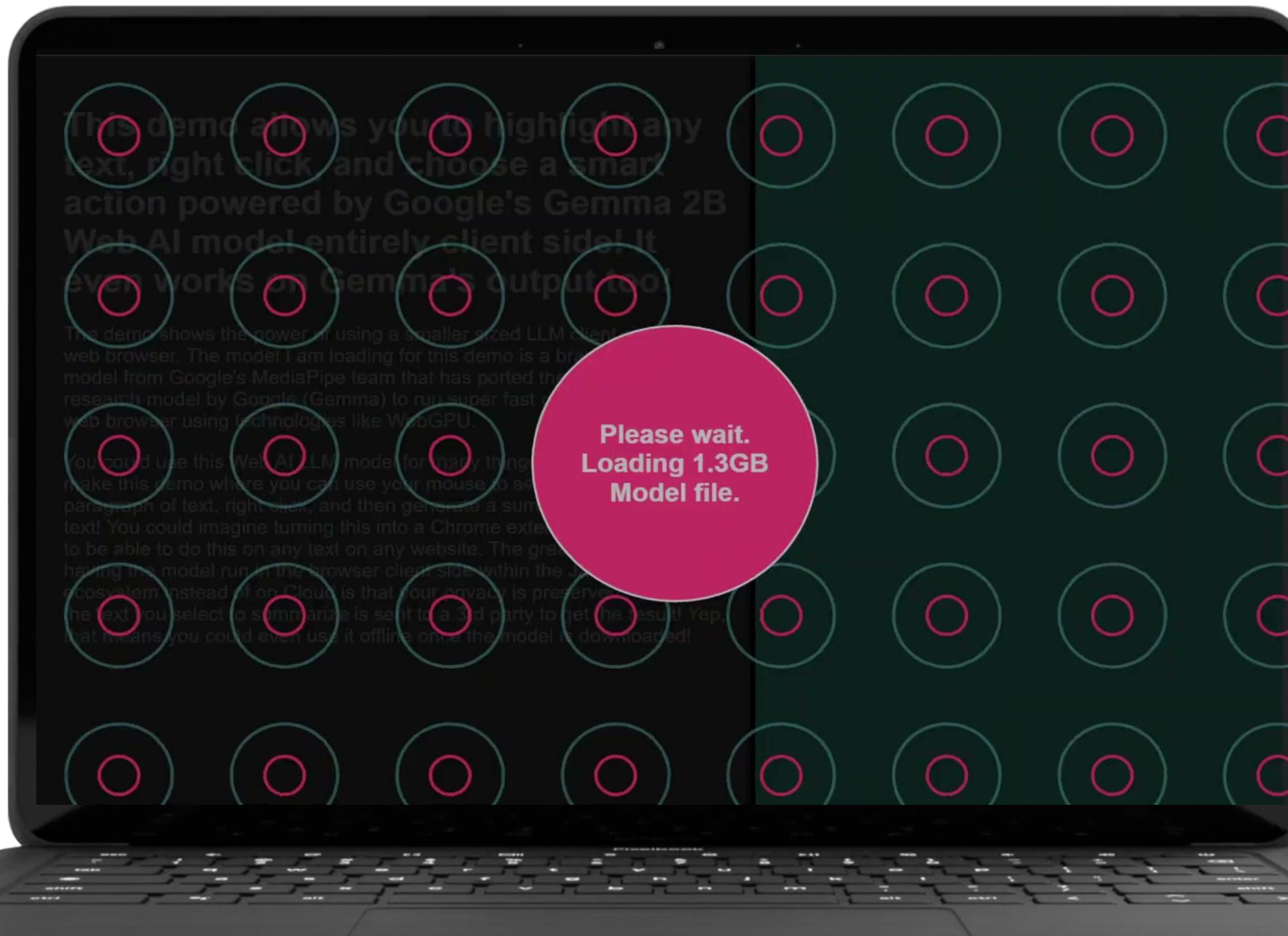
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# Talk with PDFs

Created by Nico Martin

**Try it yourself:**  
<https://pdf.nico.dev/>



Read PDF

Please add a document for  
which you have questions.



# Talk with PDFs

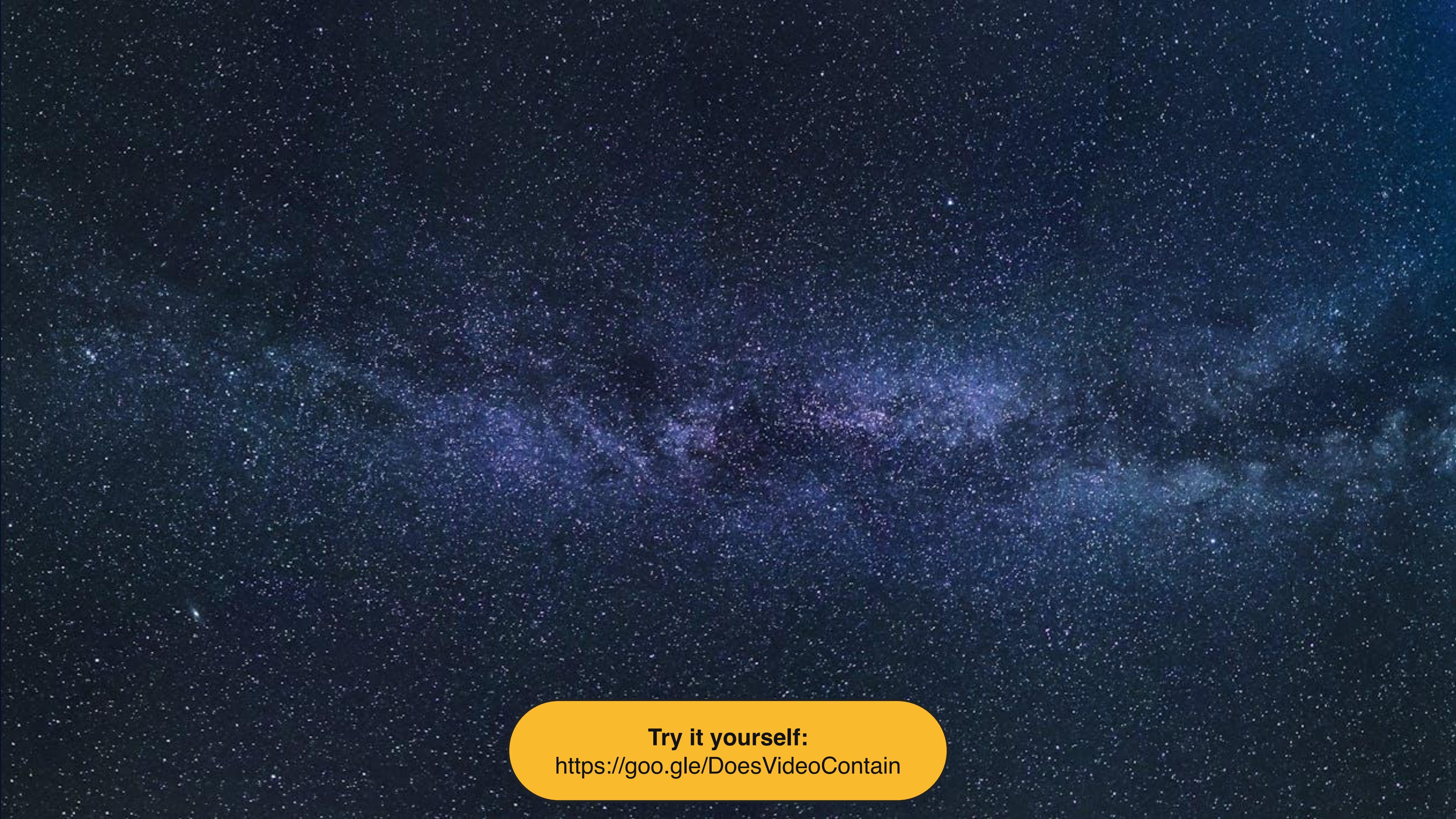
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**Try it yourself:**  
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Step 1: When does your video find while you're watching? Does your video contain:

The word "AI" or "Machine learning" or "Deep learning" or "Neural network".

Step 2: Take a video from your local computer to which you do not have access so that you can test it.



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# The start of a new era: AI enabled web apps

Get creative!

# Hardware will evolve over time

Allowing even more powerful models to run on device in the future...



**2-8B**

Smaller LLMs ❤️ Web AI

Hybrid Web AI  
could be a good starting  
point today

Progressive enhancement

[web.dev/explore/ai](https://web.dev/explore/ai)

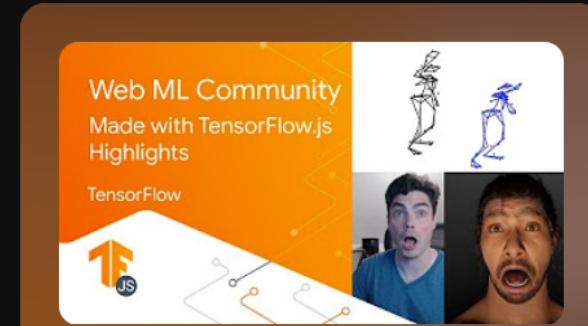
AI and the Web ecosystem

## Web AI Community

# Community show & tell demos

See them all in full at:

<https://goo.gle/made-with-tfjs>



### Made with TensorFlow.js

TensorFlow

43 videos 39,033 views Last updated on 3 Apr 2023



▶ Play all

🔀 Shuffle

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If you would like a chance to be featured in future interviews, use #MadeWithTFJS on social media so we can find your amazing work!

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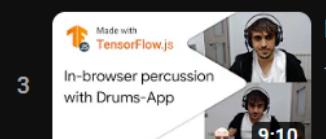
#### Made with TensorFlow.js highlights

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#### Radiological image segmentation with Medseg - Made with TensorFlow.js

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#### In-browser percussion instruments with Drums-App - Made with TensorFlow.js

TensorFlow • 2.3K views • 3 months ago



#### Reinforcement learning with Snake-RL - Made with TensorFlow.js

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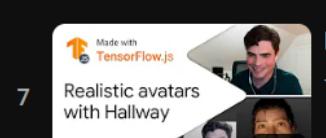
#### Motion interactive AR with Rotoflo - Made with TensorFlow.js

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#### Faster dataset annotation and model evaluation with Roboflow - Made with TensorFlow.js

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#### Realistic avatars with Hallway face motion capture - Made with TensorFlow.js

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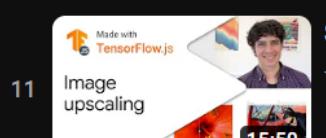
#### Remote physiotherapy at scale with IncludeHealth - Made with TensorFlow.js

TensorFlow • 6.3K views • 6 months ago



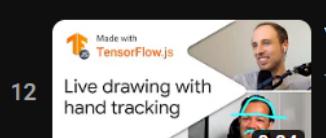
#### Grocery store recommendation systems with HarperDB and Web ML - Made with TensorFlow.js

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#### Super resolution with UpscalerJS - Made with TensorFlow.js

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#### Yoha: Write in thin air with custom hand tracking - Made with TensorFlow.js

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#### Autoencoders that can dance with you - Made with TensorFlow.js





# Web ML Community

Made with TensorFlow.js Highlights

The background image shows a 3D animated character with short, light blue hair styled in a spiky, layered cut. She has large, expressive blue eyes and is wearing a black leather jacket over a dark top. Her right hand is resting on her hip, and she is looking slightly to the left. The setting appears to be an indoor room with wooden floors and walls.

# 3D Character Animation

Created by Richard Yee

**Learn More:**  
<https://goo.gle/37FtC2g>

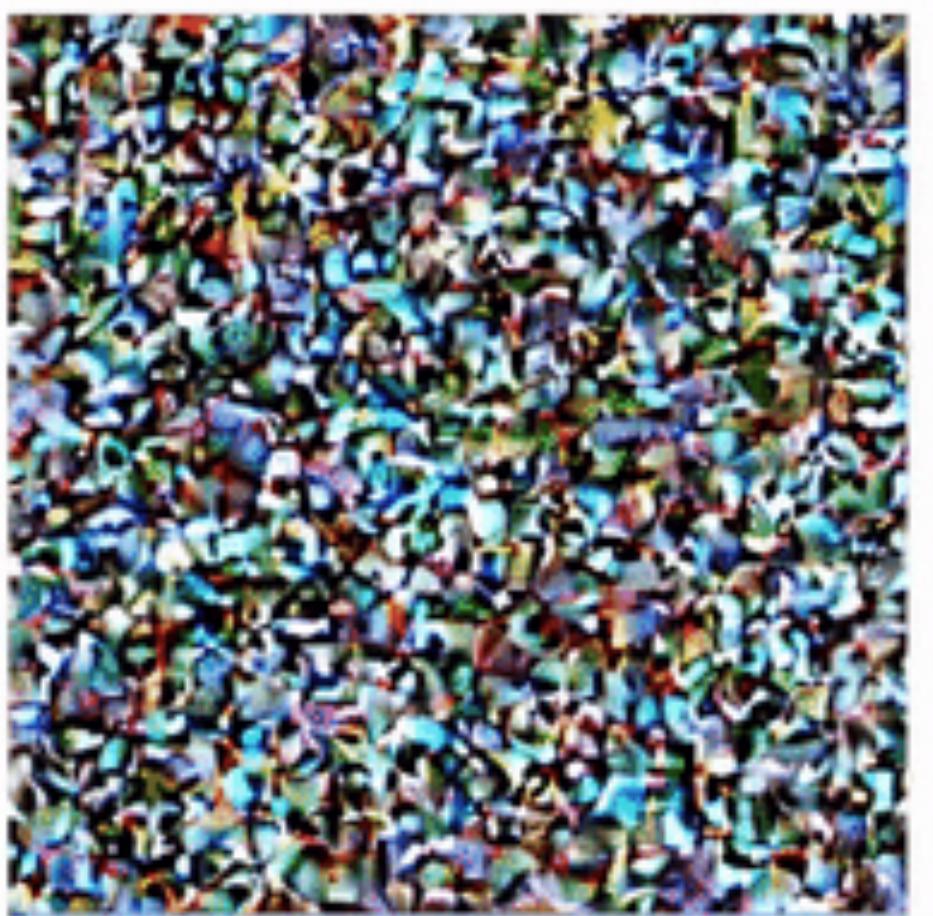
A 3D rendered character with short, light blue hair styled in a spiky, layered cut. She has large, expressive blue eyes and a neutral expression. She is wearing a dark, zippered leather jacket over a black top. Her hands are tucked into her pockets. The background is a dimly lit room with wooden floors and walls.

# 3D Character Animation

Created by Richard Yee

**Learn More:**  
<https://goo.gle/37FtC2g>

# WebGL



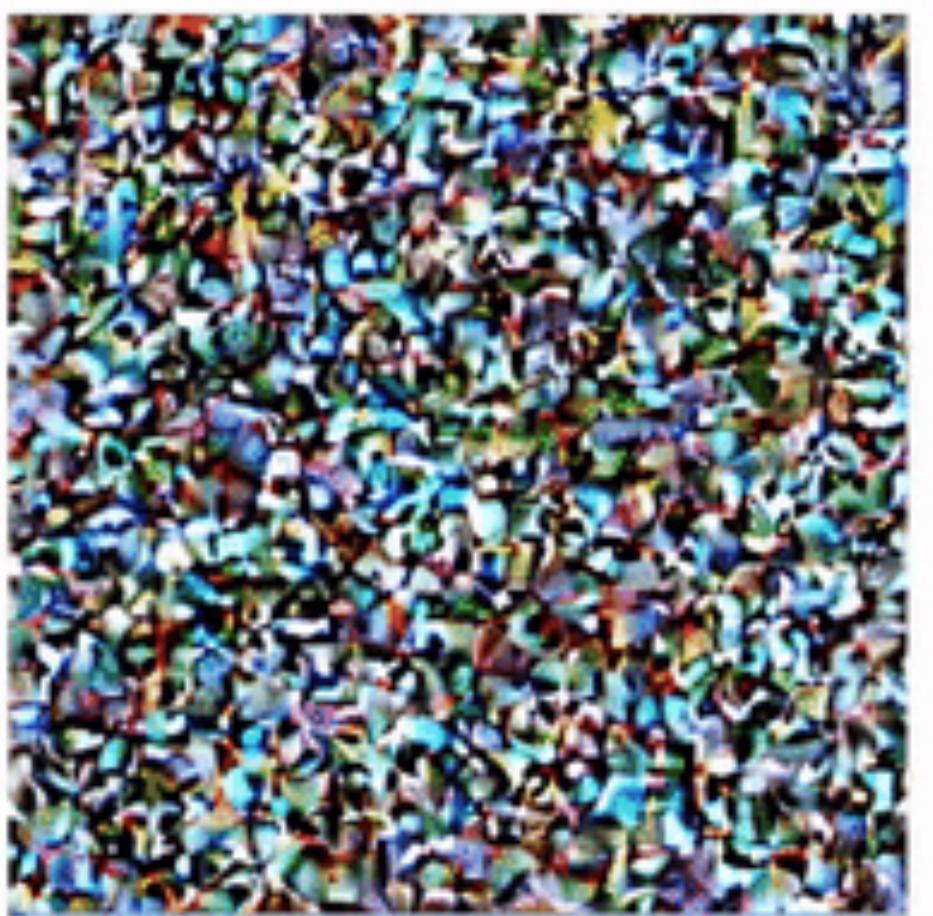
Prompt:  
A cat next to a window with sunlight streaming in

# WebGPU



Prompt:  
A cat next to a window with sunlight streaming in

# WebGL



Prompt:  
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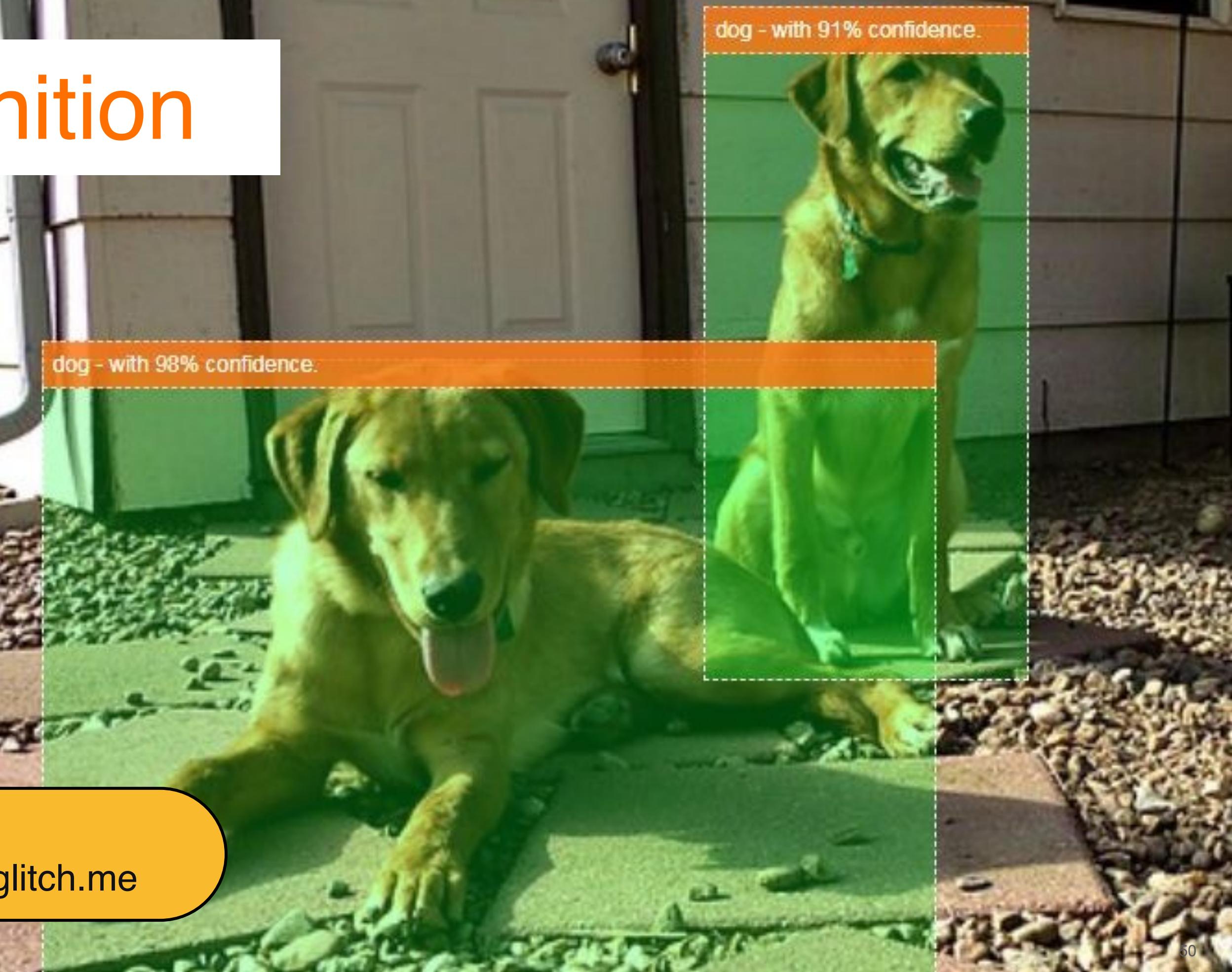
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Prompt:  
A cat next to a window with sunlight streaming in

object detection, image recognition, speech  
recognition, token extraction, natural language  
processing, large language models, diffusion  
models, generative ai, translation, pose  
estimation, face keypoint estimation, hand pose  
estimation, body segmentation, semantic  
segmentation, decision trees, decision forests,  
multi layer perceptron, depth estimation, text  
toxicity detection, spam classification, universal  
sentence encoder, gesture recognition, gans,

# Object Recognition



**Demo:**  
[tensorflow-js-object-detection.glitch.me](http://tensorflow-js-object-detection.glitch.me)



Pet Cam  
Client

Welcome, to start, allow access to your camera once the button becomes enabled below.



Great! Now select what pet you want to recognize:

Dog

Alert me when when pet is near:

Food bowl



Enable Detection



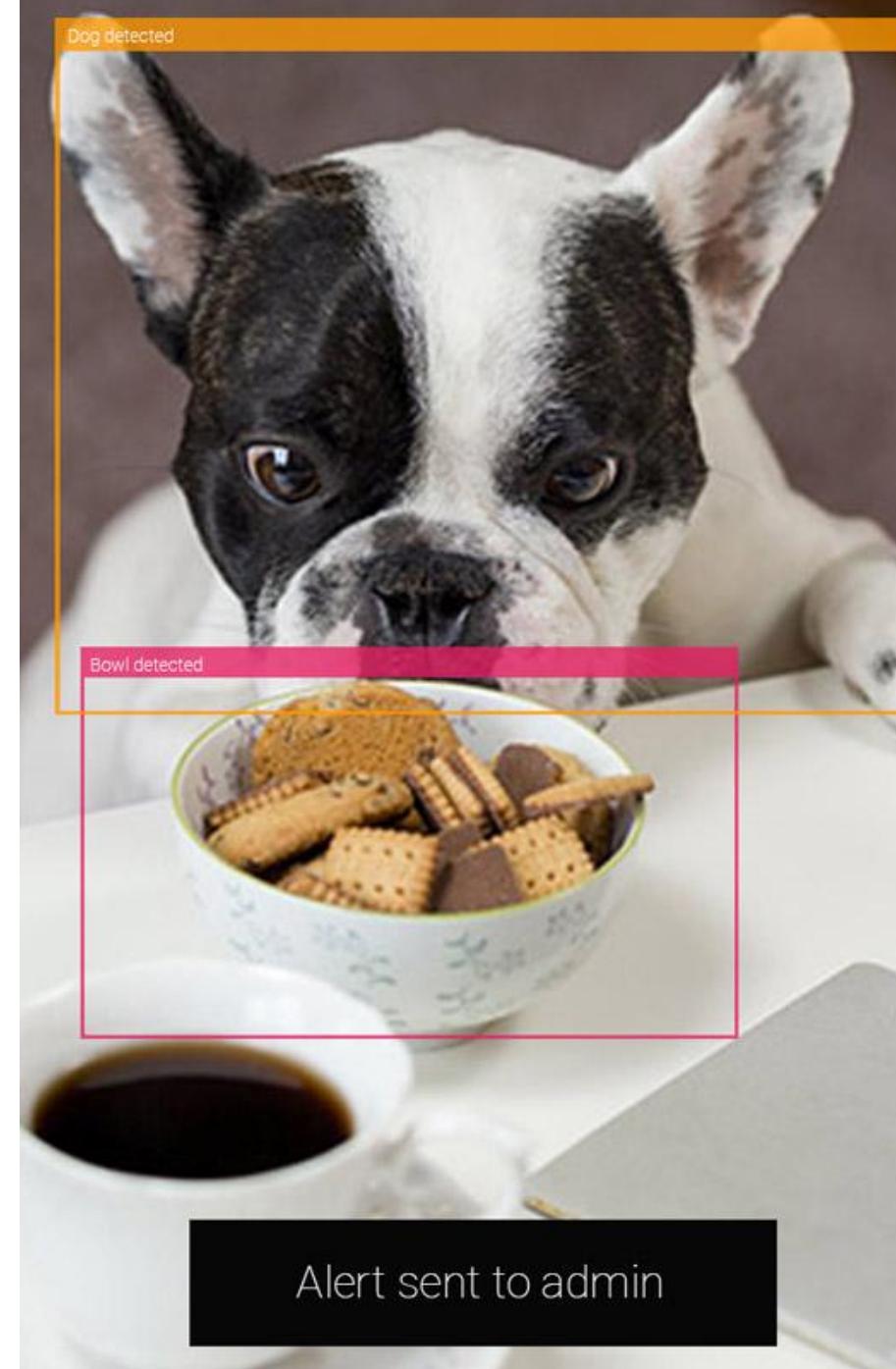
monitoring



Great! Now open the **admin view** on your mobile device to receive alerts when away



monitoring



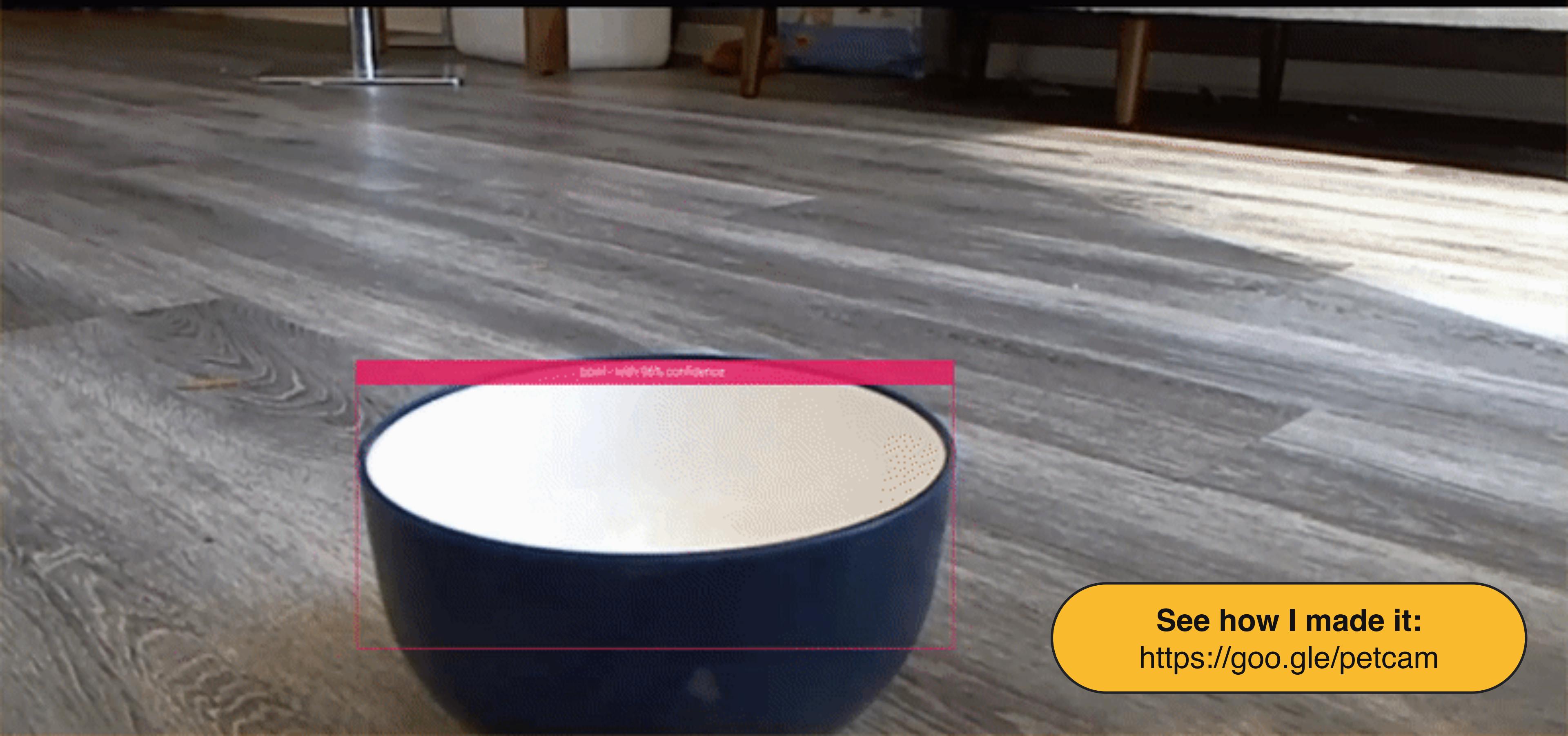
Alert sent to admin

Use this knowledge to bring any creative idea to life, like this pet cam, for when you are out.



Pet Cam  
Client

monitoring

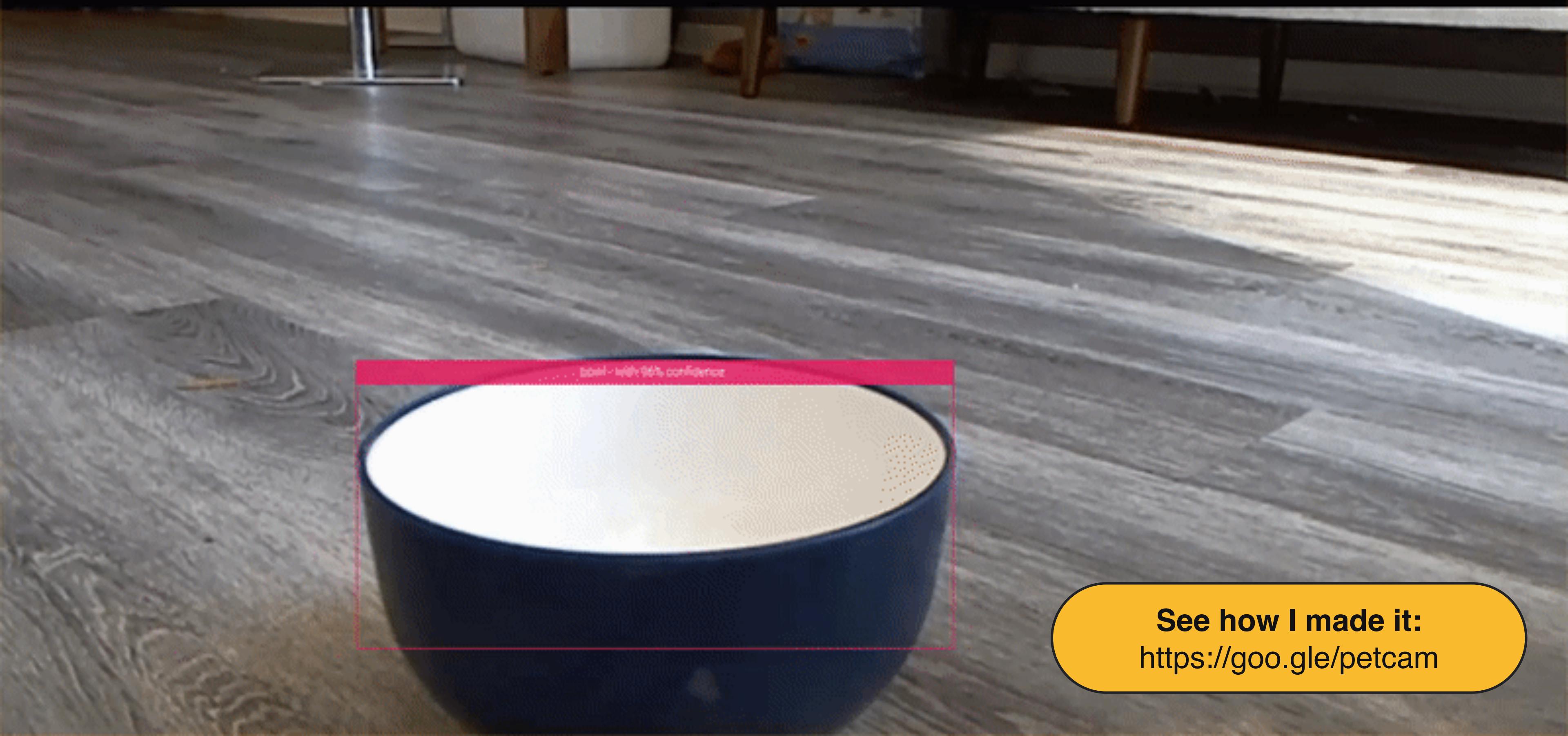


**See how I made it:**  
<https://google/petcam>



Pet Cam  
Client

monitoring



**See how I made it:**  
<https://google/petcam>

# Text Toxicity Detection

Is a comment toxic or not?

	text	identity attack	insult	obscene	severe toxicity	sexual explicit	threat	toxicity
Automatically filter out comments before they are even posted. Or maybe you could hide offensive things via a chrome extension if a paragraph on page is deemed toxic. <b>What would you make?</b>	We're dudes on computers, moron. You are quite astonishingly stupid.	false	true	false	false	false	false	true
	Please stop. If you continue to vandalize Wikipedia, as you did to Kmart, you will be blocked from editing.	false	false	false	false	false	false	false
	I respect your point of view, and when this discussion originated on 8th April I would have tended to agree with you.	false	false	false	false	false	false	false

Enter text below and click 'Classify' to add it to the table.

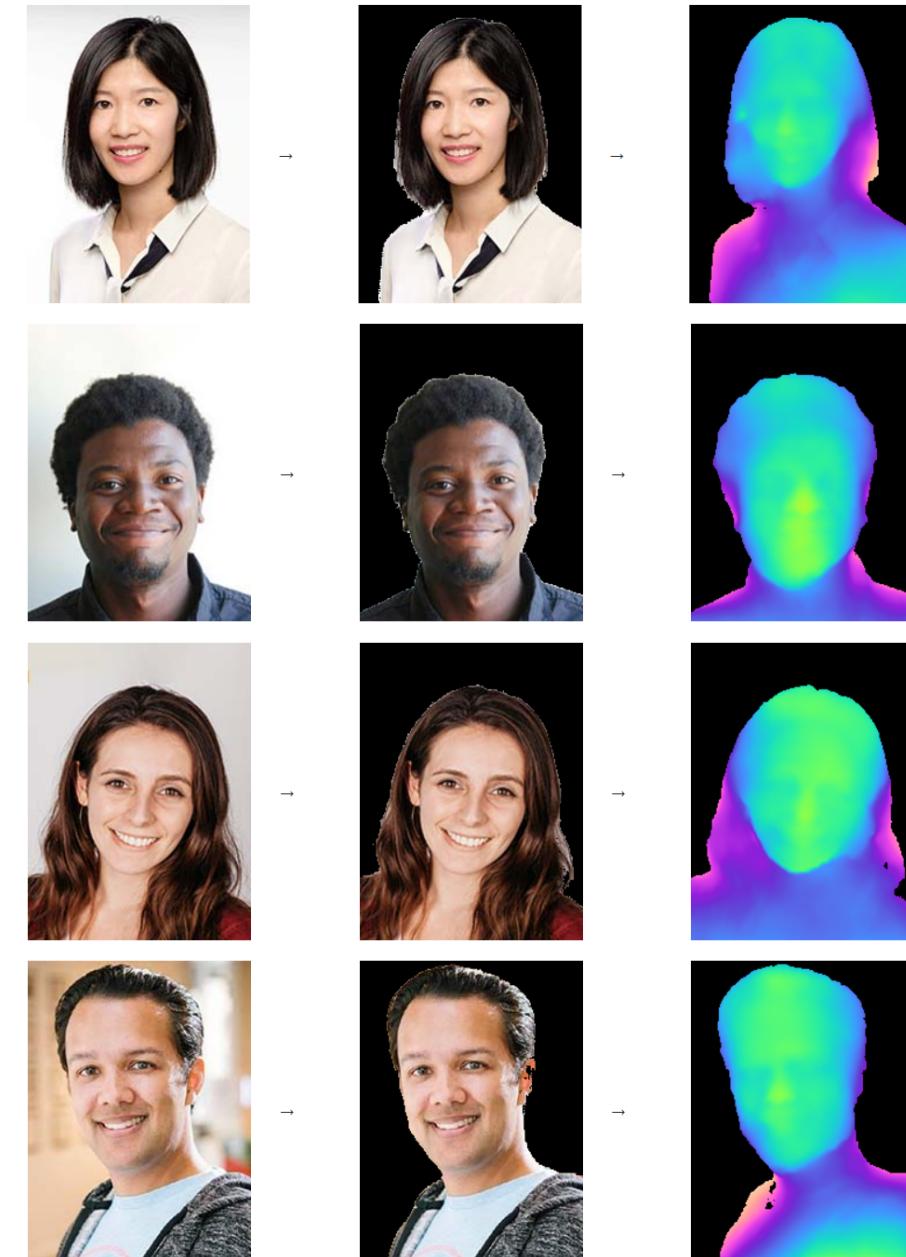
i.e. 'you suck'

CLASSIFY

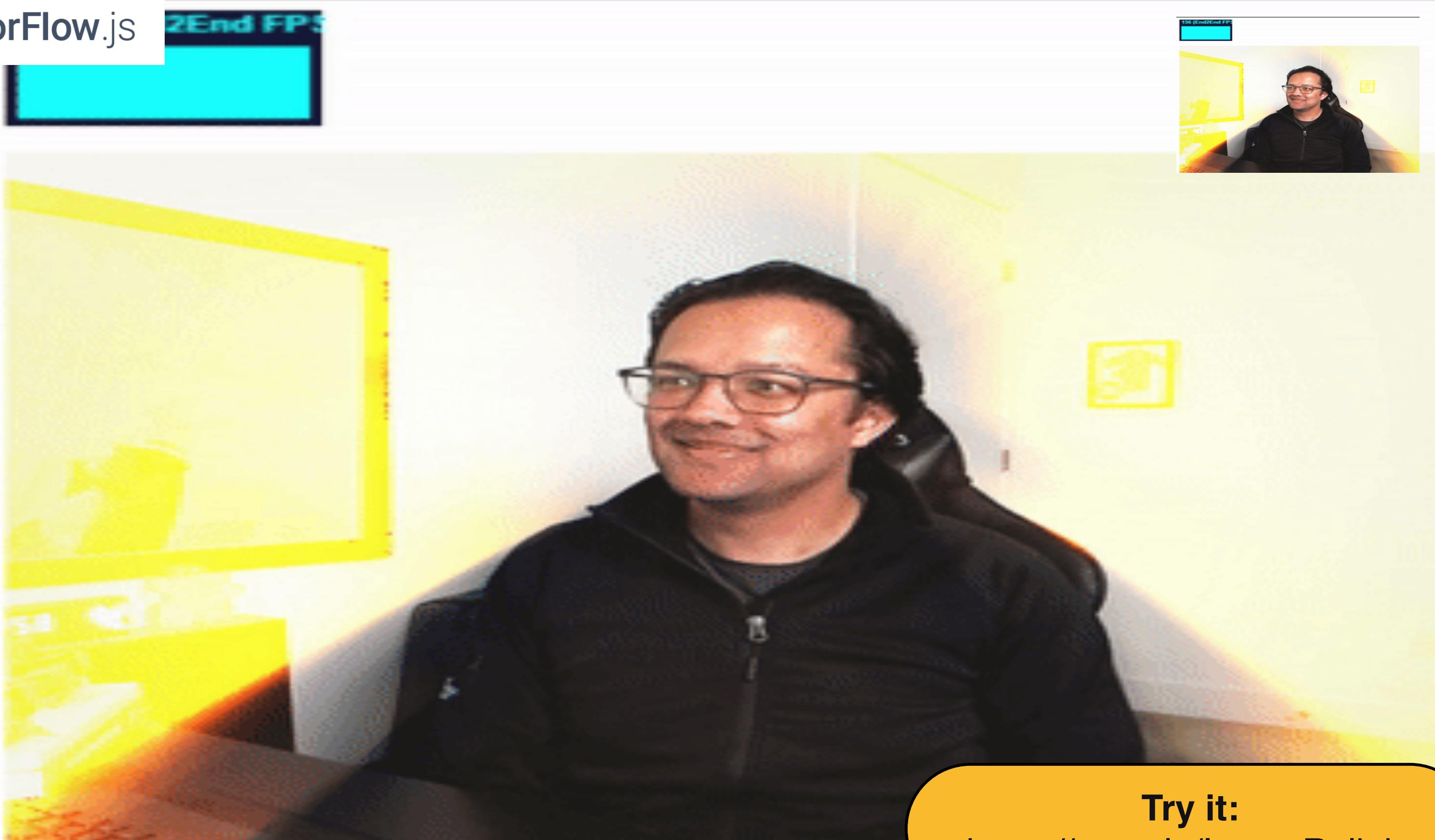
**Learn More:**  
<https://goo.gle/toxicity>

# Selfie Depth Estimation

We have also produced a brand new model type for depth estimation of selfie photos.



**Try it:**  
<https://goo.gle/selfiedepth>



# Image relighting

Try it:  
<https://goo.gle/ImageRelight>



# Image relighting

Try it:  
<https://goo.gle/ImageRelight>

117 FPS (1-127)



# Face Mesh

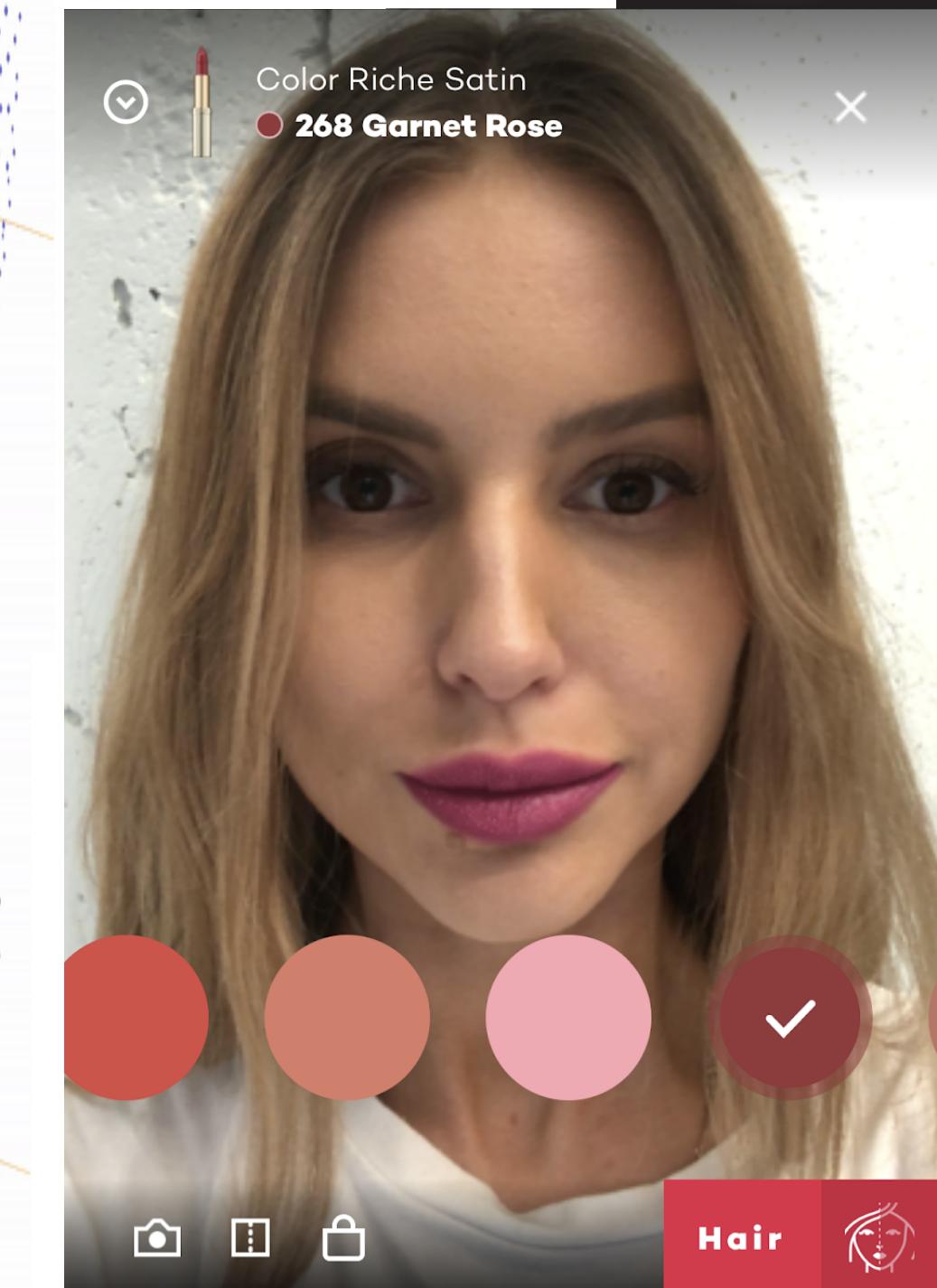
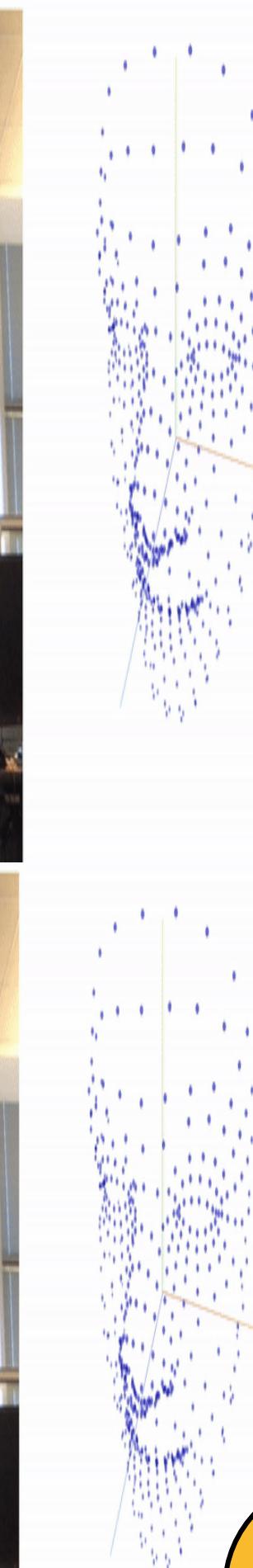
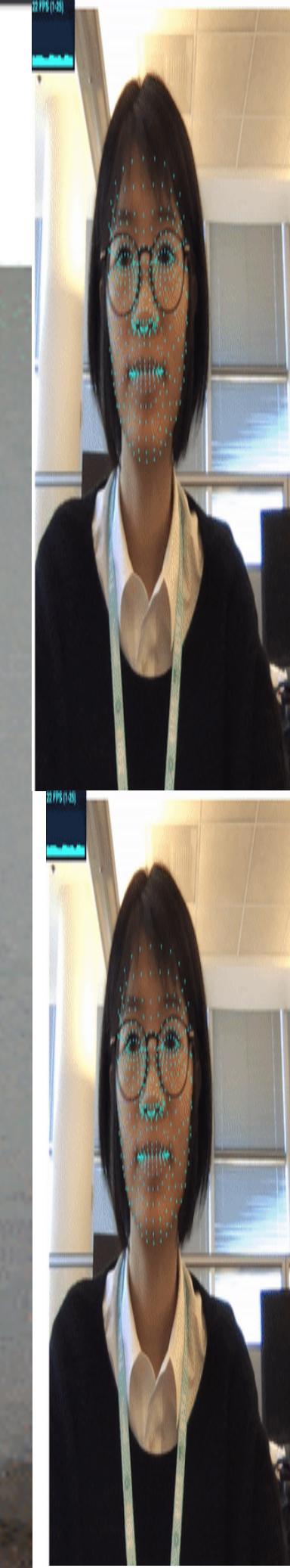
117 FPS (1-127)



Just 3MB in size

Recognize 468

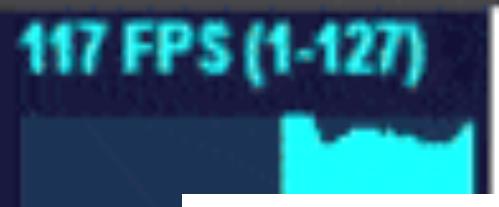
facial landmarks



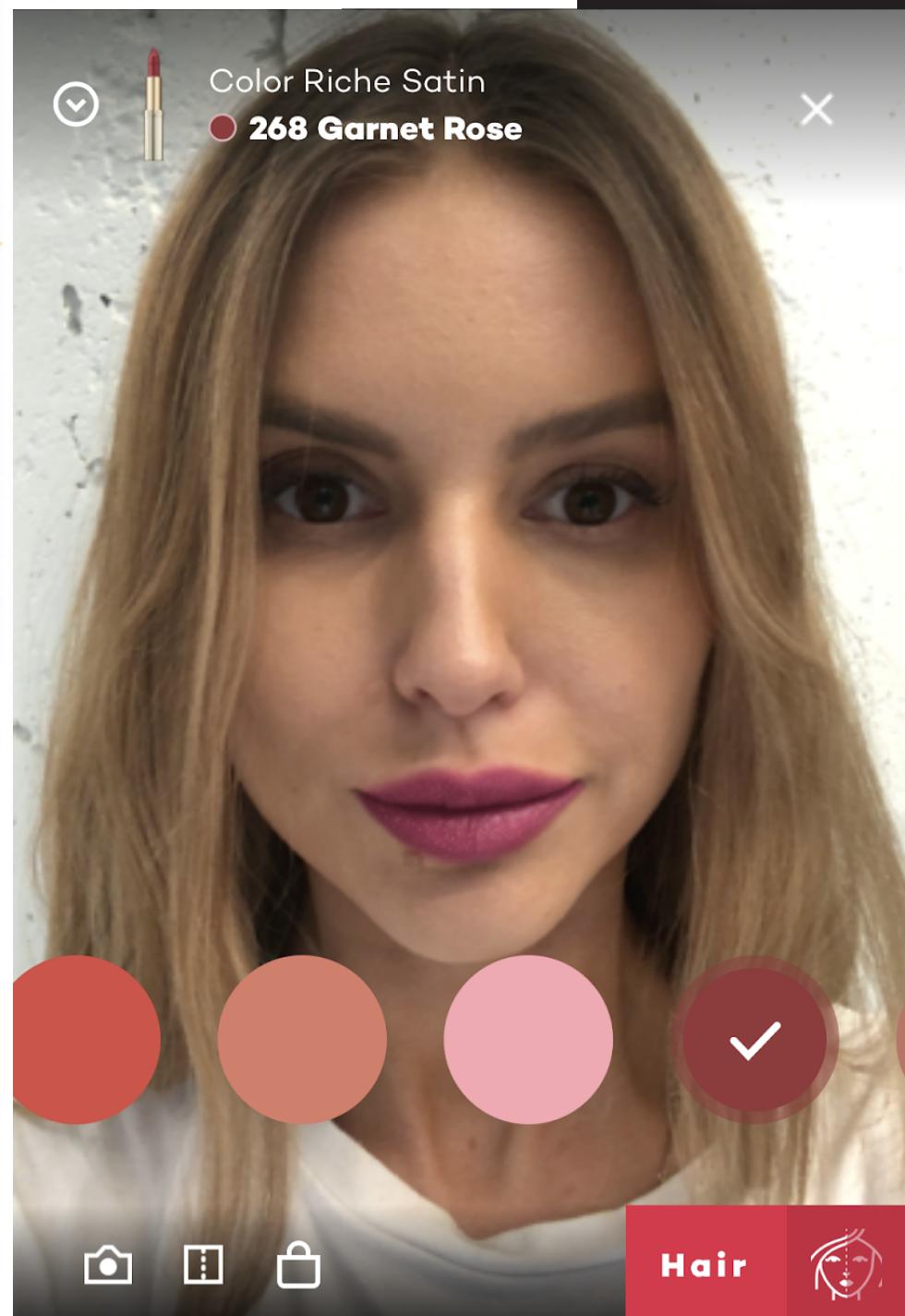
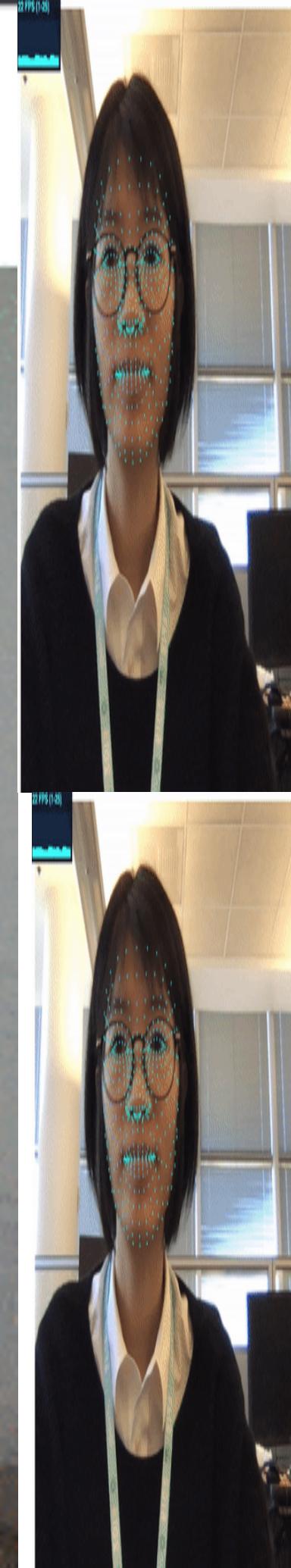
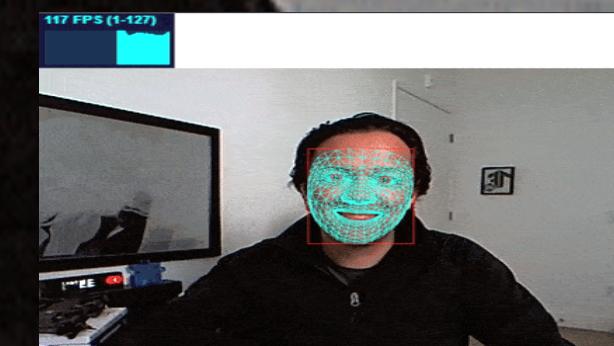
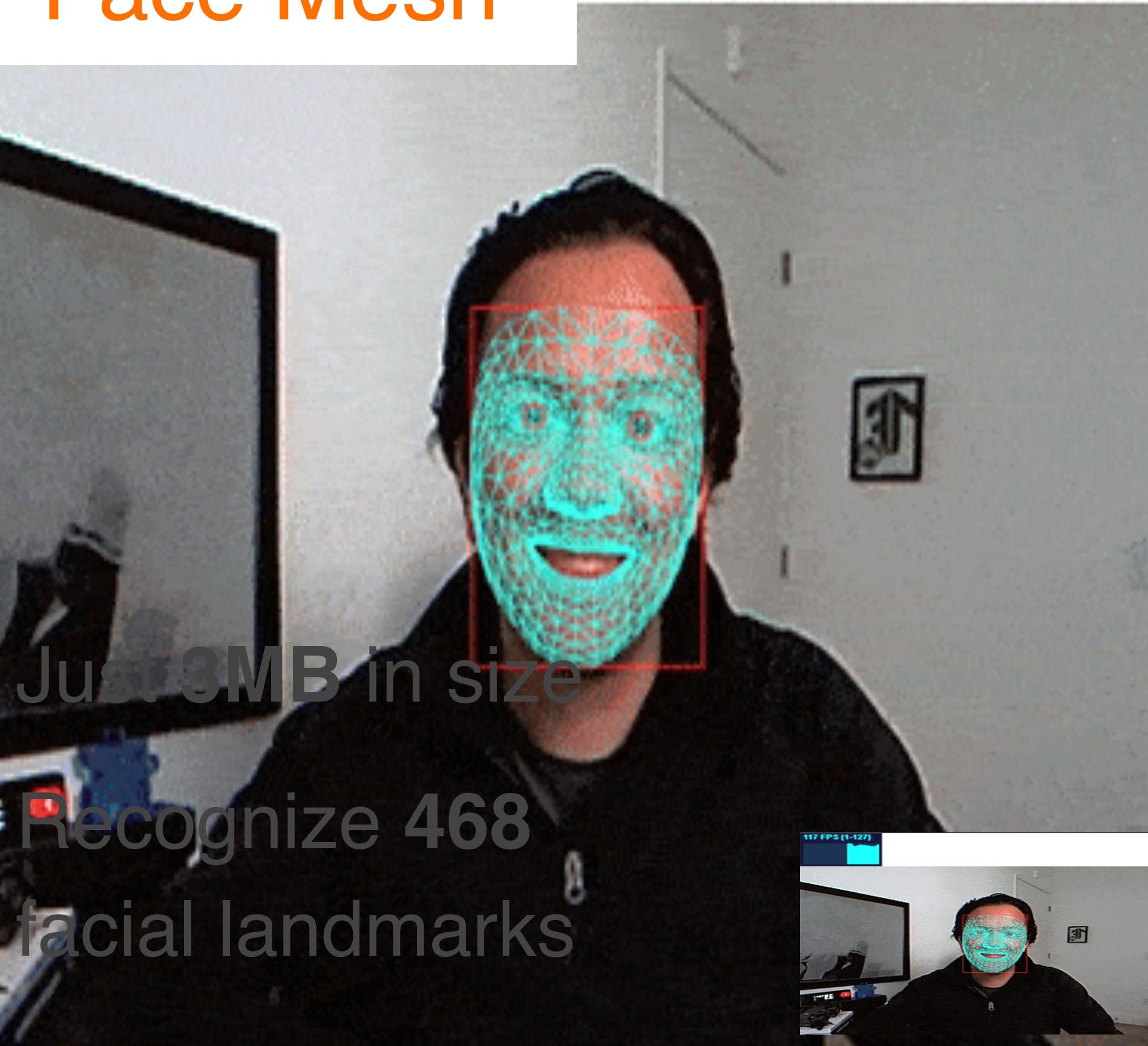
Try it:  
<https://goo.gle/FaceMesh>

L'ORÉAL

MODI  
FACE



# Face Mesh

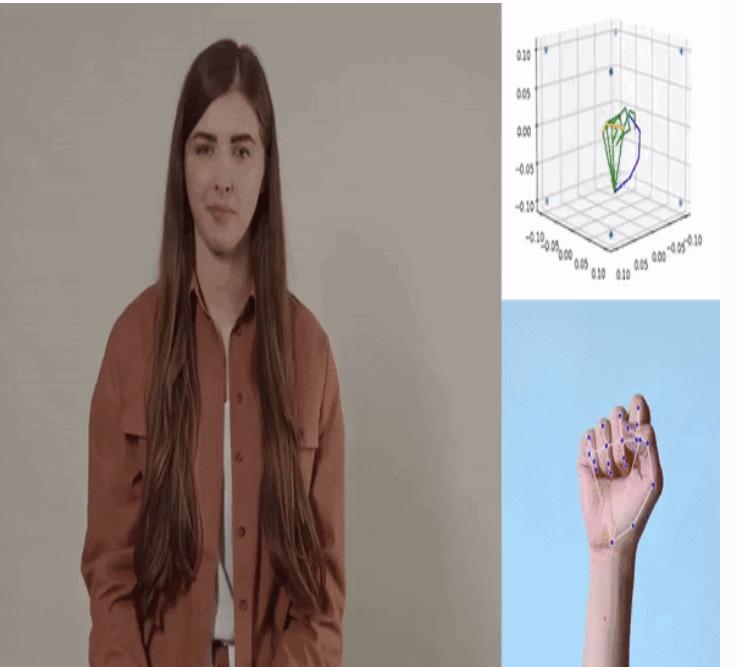
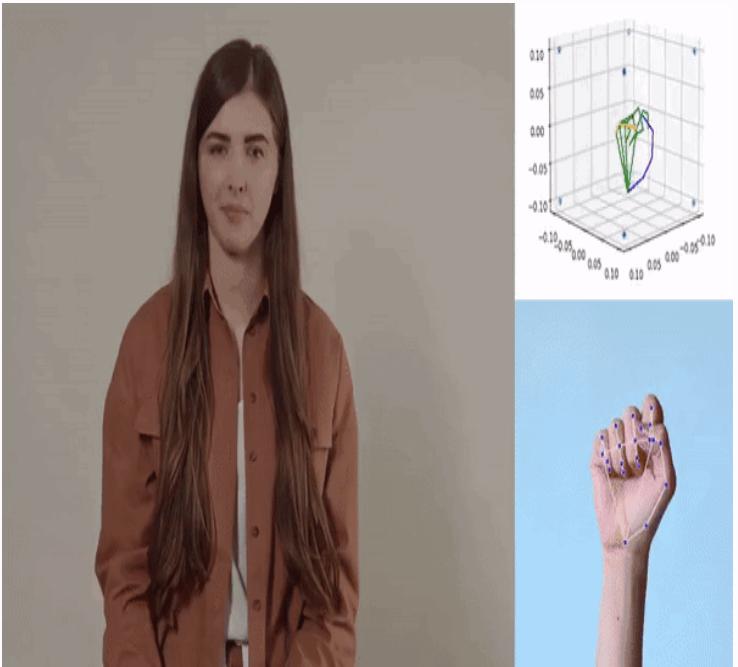
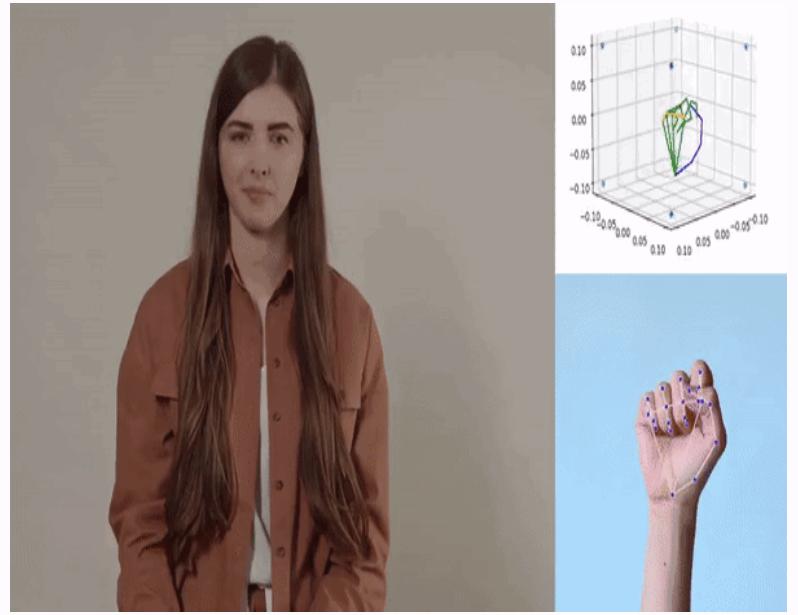


Try it:  
<https://goo.gle/FaceMesh>

MODI  
FACE

# Hand Pose Estimation

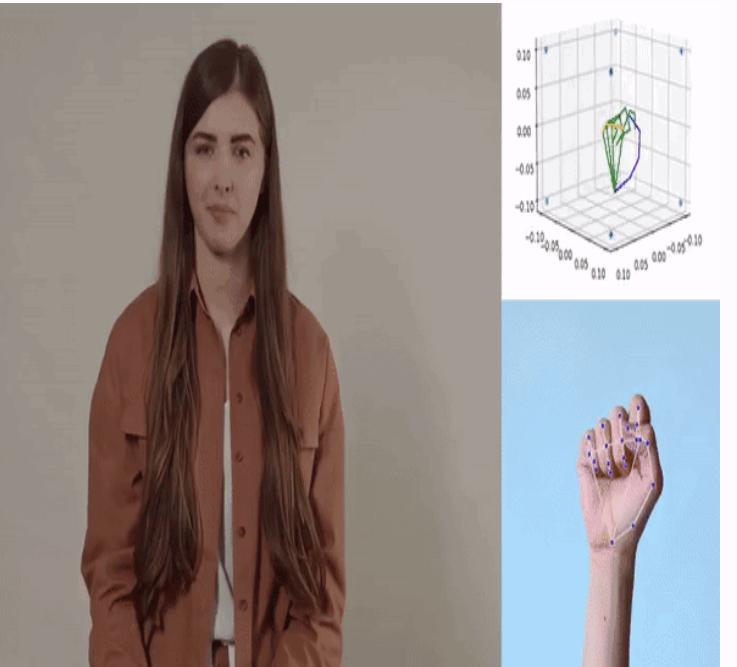
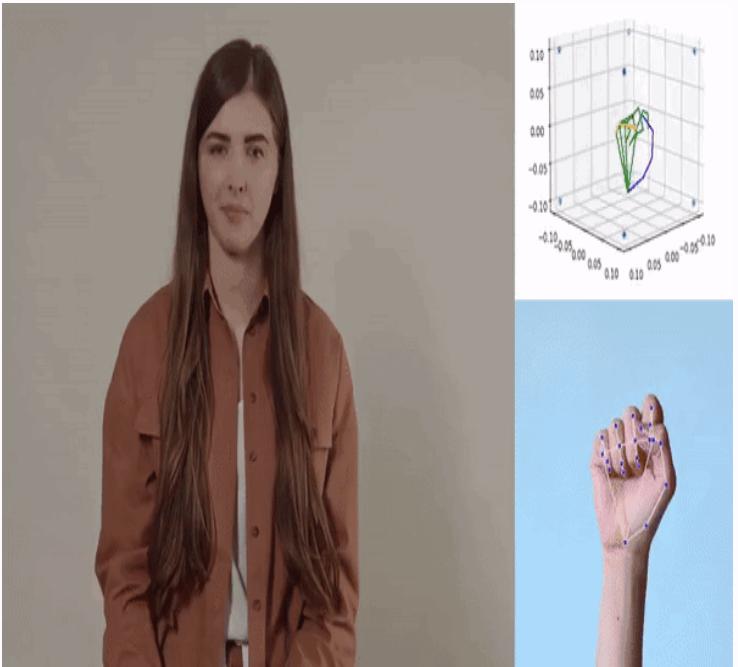
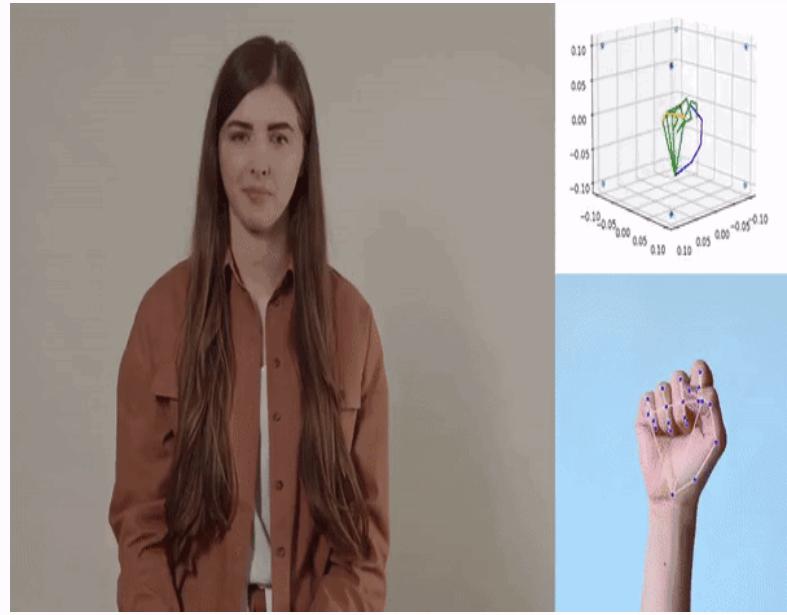
Track multiple hands in 3D or 2D and with higher precision than before.



**Try it:**  
<https://goo.gle/HandPose>

# Hand Pose Estimation

Track multiple hands in 3D or 2D and with higher precision than before.



**Try it:**  
<https://goo.gle/HandPose>

## 2D / 3D Pose

BlazePose GHUM 3D model is now available through TensorFlow.js recognizing 33 key points. Can run at 150 FPS for real time results.

Learn more:  
<https://goo.gle/pose>

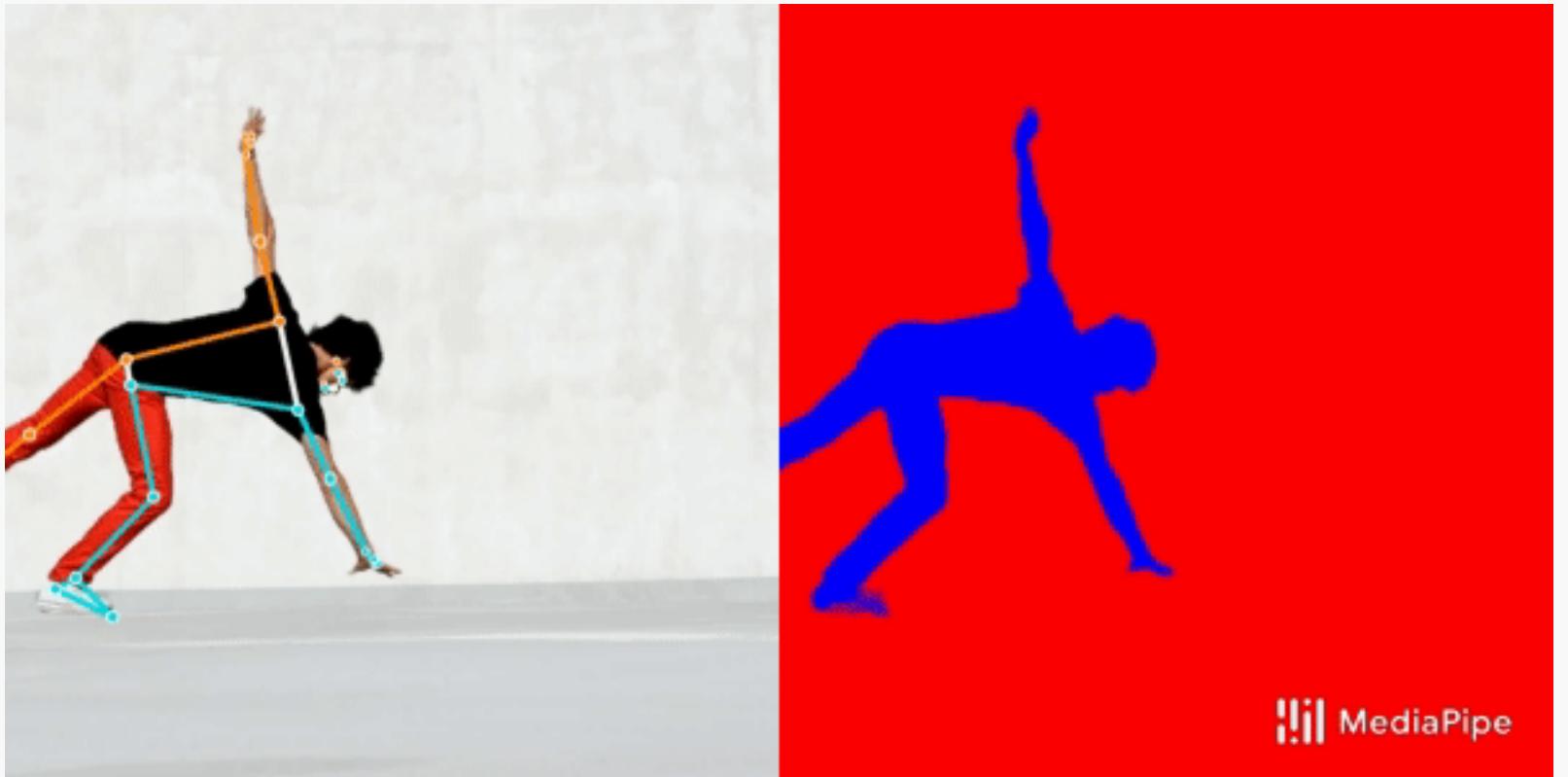
## 2D / 3D Pose

BlazePose GHUM 3D model is now available through TensorFlow.js recognizing 33 key points. Can run at 150 FPS for real time results.

Learn more:  
<https://goo.gle/poke>

# Full Body Segmentation

Builds upon the pose model you just saw allowing you to get both pose and segmentation returned simultaneously.

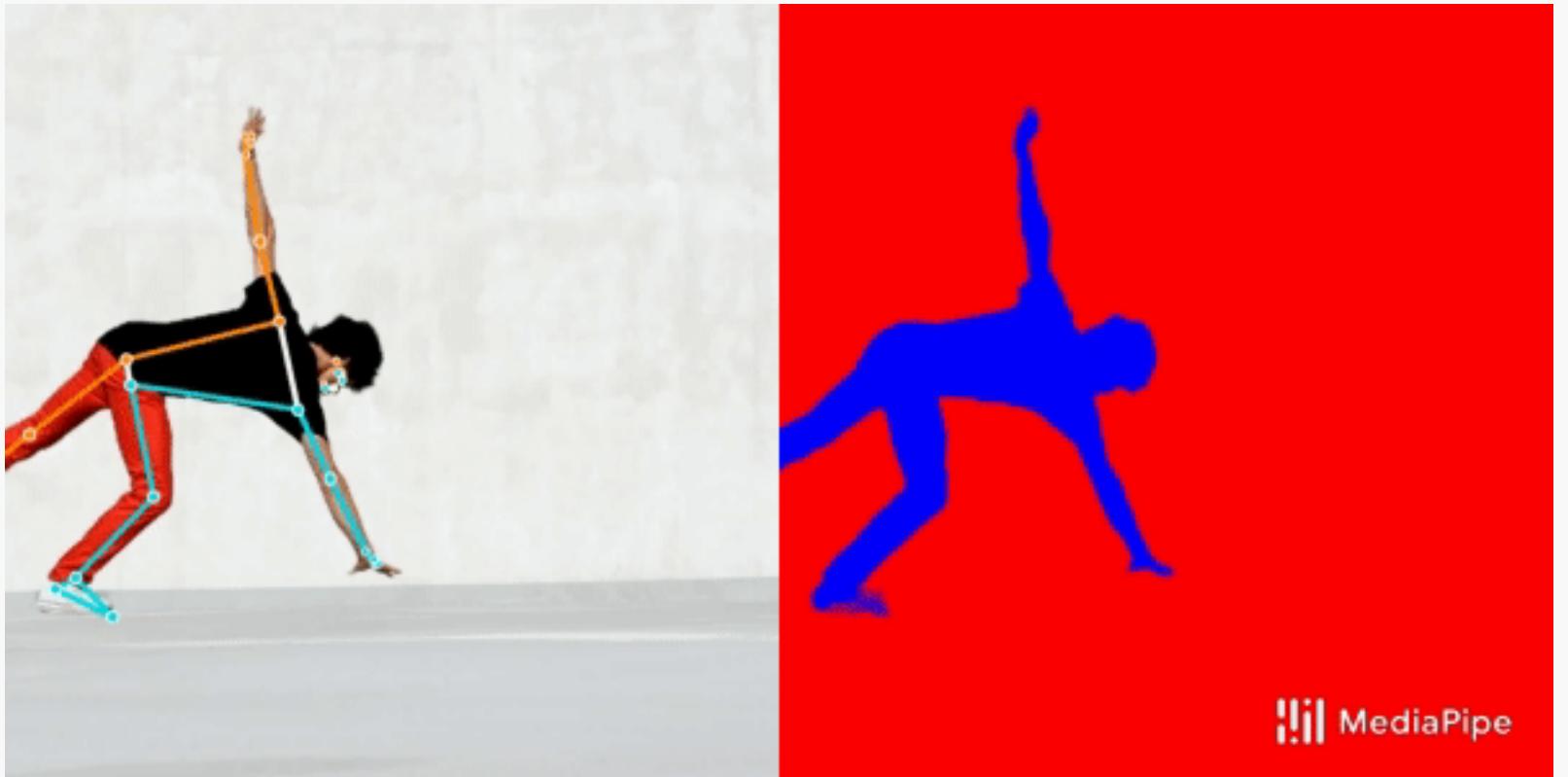


Pose + Segmentation

Learn more:  
<https://goo.gl/PoseSeg>

# Full Body Segmentation

Builds upon the pose model you just saw allowing you to get both pose and segmentation returned simultaneously.



Pose + Segmentation

Learn more:  
<https://goo.gl/PoseSeg>

# Selfie Segmentation

**Learn More:**  
<https://goo.gle/SelfieSeg>

**!il MediaPipe**

# Selfie Segmentation

**Learn More:**  
<https://goo.gle/SelfieSeg>

**!il MediaPipe**



A photograph of two students in a classroom. One student in the foreground is pointing at a laptop screen displaying a video conference interface. Another student in the background is also looking at a laptop screen. A large yellow speech bubble in the bottom left corner contains the text.

**Try it yourself:**  
<https://goo.gle/VisualBlocks>

A photograph of two students in a classroom. One student in the foreground is pointing at a laptop screen displaying a video conference interface. Another student in the background is also looking at a laptop screen. A large yellow speech bubble in the bottom left corner contains the text.

**Try it yourself:**  
<https://goo.gle/VisualBlocks>



Learn how to use:  
<https://goo.gle/LearnVisualBlocks>

Search nodes

Input

- Input Image
- Input Text
- Live camera

Effect

Model

Output

Tensor

Misc

Input image

Image

Urls Manage

Grid columns 3

Allow user upload

Hide preview

Note: Capture is in real time but edited to highlight key stages of creation.



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Manage

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# Create advanced web apps to prototype faster

The screenshot shows the "Depth Estimation (client)" application interface. On the left, there's a "Image input" component displaying a grid of sample images. In the center, a "Depth Estimation Viewer" shows a tiger standing on a rock, with a small callout "View the depth estimation result." At the bottom, a visual block diagram shows the flow from "Image input" to "Depth Estimation" (with options like "Model ID: Xeno/na/deq" and "Device: webgpu") and finally to "Depth Estimation Viewer". The entire application has a "Made with #VisualBlocks" watermark.

The screenshot shows the "Token Classification (client)" application interface. It features a "Text input" field containing a sentence about travel, followed by a "Token Classification Viewer" which displays the same sentence with tokens highlighted in different colors. Below this is a visual block diagram showing the flow from "Text input" to "Token Classification" (with options like "Model ID: Xeno/na/distilbert" and "Device: webgpu") and finally to "Token Classification Viewer". The entire application has a "Made with #VisualBlocks" watermark.

The screenshot shows the "Translation (client)" application interface. It has a "Text input" field with the text "Hello! I do not speak this language." and a "Markdown viewer" field showing the translated text "Hola, no hablo este idioma.". Below this is a visual block diagram showing the flow from "Text input" to "Translation" (with options like "Model ID: Xeno/na/distilbert" and "Device: webgpu") and finally to "Markdown viewer". The entire application has a "Made with #VisualBlocks" watermark.

Bring AI ideas to life with this Hugging Face and Visual Blocks collaboration.

Make 2D images 3D, find key tokens in sentences to make smarter choices, or translate between languages locally!

Try them today:  
<https://goo.gle/hf-visualblocks>

# Create advanced web apps to prototype faster

The screenshot shows the "Depth Estimation (client)" interface. On the left, there's a "Image input" block with a grid of sample images. In the center, a "Depth Estimation Viewer" block displays a tiger standing on a rock, with a small text overlay "View the depth estimation result." Below the viewer is a "Depth Estimation" block. A flow diagram at the bottom shows the connection from the "Image input" block to the "Depth Estimation" block, and then to the "Depth Estimation Viewer" block. The "Depth Estimation" block has settings like "Model ID: Xeno/na/deq", "Device: webgpu", and "Quantized Model: Quantized Model". The "Depth Estimation Viewer" block shows "Depth Data" and "Image Displacement: 0.167". The sidebar on the left contains a search bar and a list of node categories: Input, Processor, Model, Output, Tensor, and Advanced.

The screenshot shows the "Token Classification (client)" interface. On the left, there's a "Text input" block with the sentence "I was in Berlin, dining at Lego World, then I went to Italy to see Pisa." In the center, a "Token Classification Viewer" block displays the same sentence with tokens highlighted in colors (LOC, ORG, etc.). Below the viewer is a "Token Classification" block. A flow diagram at the bottom shows the connection from the "Text input" block to the "Token Classification" block, and then to the "Token Classification Viewer" block. The "Token Classification" block has settings like "Model ID: Xeno/na/distilbert", "Device: webgpu", and "Quantized Model: Quantized Model". The "Token Classification Viewer" block shows "Text" and "Results". The sidebar on the left contains a search bar and a list of node categories: Input, Processor, Model, Output, Tensor, and Advanced.

The screenshot shows the "Translation (client)" interface. On the left, there's a "Text input" block with the sentence "Hello! I do not speak this language.". In the center, a "Markdown viewer" block displays the translated sentence "Hola, no hablo este idioma." Below the viewer is a "Translation" block. A flow diagram at the bottom shows the connection from the "Text input" block to the "Translation" block, and then to the "Markdown viewer" block. The "Translation" block has settings like "Model ID: Xeno/na/distilbert", "Device: webgpu", and "Quantized Model: Quantized Model". The "Markdown viewer" block shows "Text" and "Results". The sidebar on the left contains a search bar and a list of node categories: Input, Processor, Model, Output, Tensor, and Advanced.

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Visual Blocks Demo

Export Import Share

**Input Image**

**Input text**

Describe the image:

**Text processor**

Join Separator: 'n'

**Output:**

Add "in the Picasso style" to the image:  
The image shows two dogs running down a dirt road. One dog is a Pembroke Welsh Corgi and the other dog is a Yorkshire Terrier. The dogs are both brown and white in color. They are running side by side and they look like they are having fun.

**Input text**

Add "in the Picasso style" to the image:

**Speech to text**

**Media gen**

Add "in the Picasso style" to the image: The image shows two dogs running down a dirt road. One dog is a Pembroke Welsh Corgi and the other dog is a Yorkshire Terrier. The dogs are both brown and white in color. They are running side by side and they look like they are having fun.

**Image viewer**

**Fetch**

Made with #VisualBlocks

Search nodes

Input

- Input Image
- Input text
- Live camera
- Sheet reader

Effect

Model

Output

Tensor

Misc

**Input Image**

Image

Urls Manage

Grid columns: 3

Allow user upload

Hide preview

**Prompt**

Image Answer

**Text processor**

Texts Recorder

Text Hide preview

**Media gen**

Text

Signal Name: imagen:v2

Immediate mode

Hide preview

**Image viewer**

Images

Urls

Max columns: 2

Hide preview

**Learn More:**  
<https://goo.gl/InstructPipe>

Visual Blocks Demo

Export Import Share

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**Input text**

Describe the image:

**Text processor**

Join Separator: 'n'

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Signal Name: imagen:v2

Immediate mode

Hide preview

**Image viewer**

Images

Urls

Max columns: 2

Hide preview

**Learn More:**  
<https://goo.gl/InstructPipe>







# Flights

⇄ Round trip • ⏚ 1 • Economy

○ San Francisco

Where to?

Fri, 1 Nov



Sat, 9 Nov



Explore

Find cheap flights from San Francisco to anywhere ⓘ

San Francisco

Oakland

San Jose

Sacramento

Explore destinations



# Flights

⇄ Round trip • ⏚ 1 • Economy

O San Francisco

Where to?

Fri, 1 Nov



Sat, 9 Nov



Explore

Find cheap flights from San Francisco to anywhere ⓘ

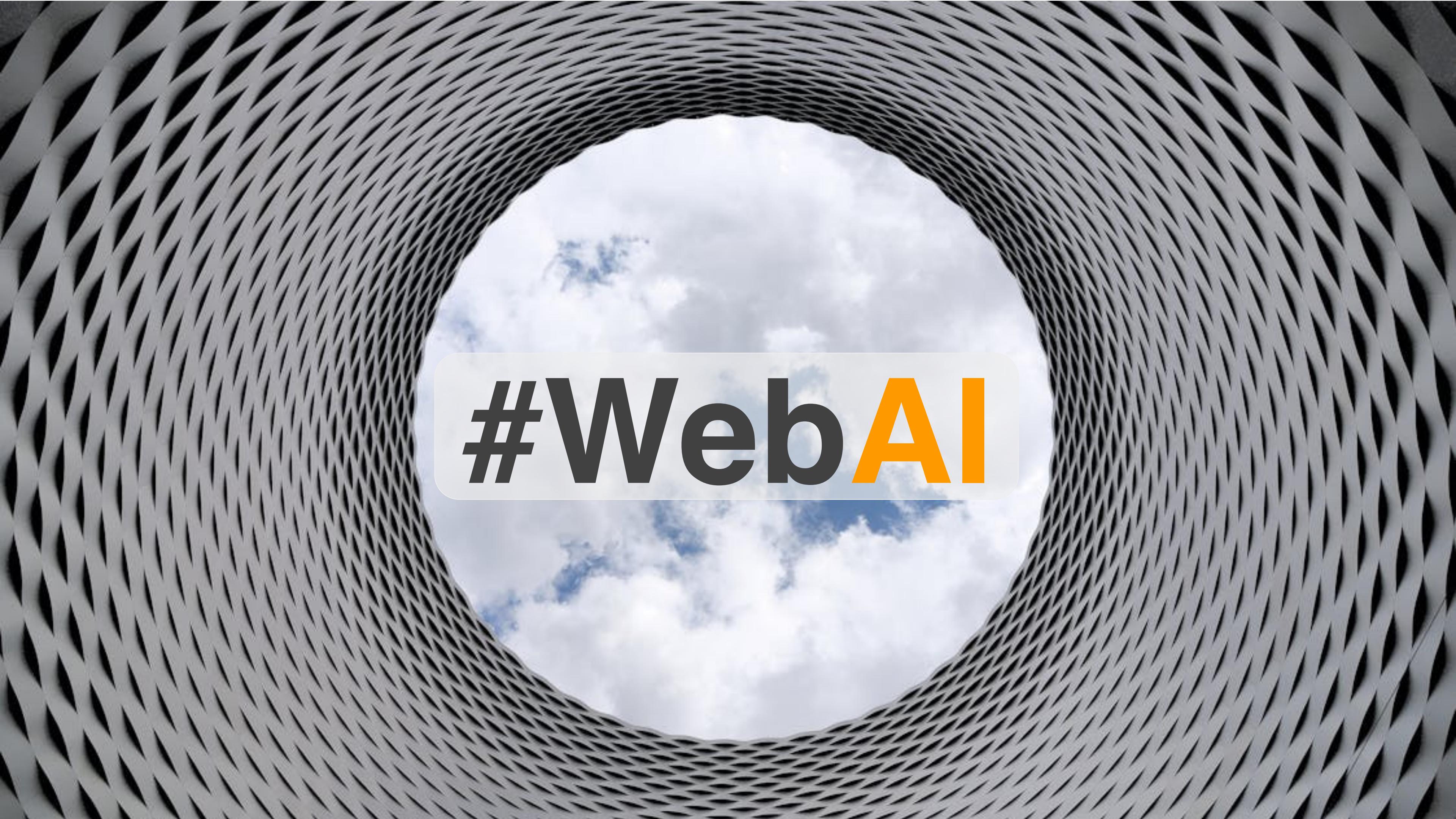
San Francisco

Oakland

San Jose

Sacramento

Explore destinations



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Learn:  
<https://goo.gle/Learn-WebAI>

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or got thoughts for the future?  
Share using:

# Thank you

**Jason Mayes**  
Web AI Lead, Google

[@jason\\_mayes](https://linkedin.com/in/WebAI)

#WebAI

# Feedback

**Jason Mayes**  
Web AI Lead, Google

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@jason\_mayes

