

Generative AI

Kevin Nørby Andersen, October 2024

Motivation

- Always curious about new materials
- New “material” able to generate text, images, etc.
- Unprecedented speed, quality, style
- Ability to be used as both a tool and a material
- Non-deterministic, mystical, magical
- Material aesthetics are influenced by applications

But where to
start?

Intelligence in computing

17th century

Leibniz develops binary number system and thinks entire universe can be understood this way.

Descartes defines mind–body dualism, separating the mind from the body.

Programming
Rules

1950s-1960s

Birth of "Artificial Intelligence". Machines that could simulate human intelligence / Symbolic AI

Orange fruit:

- Has orange color
- Has bumpy skin
- Has soft, fleshy inside
- Has green bump

1980s

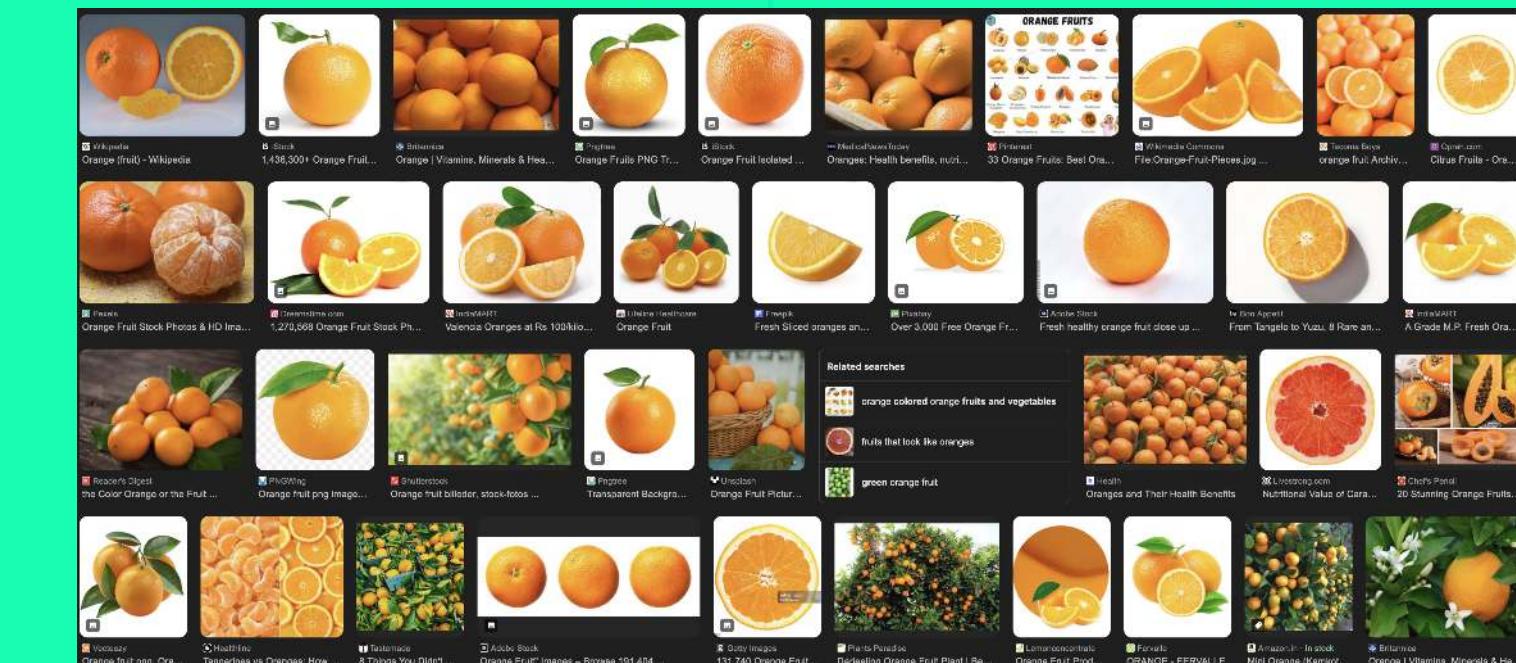
Expert systems

Symbolic AI

1980s-1990s

Rise of Machine Learning, shift from programming and rules to data and patterns.

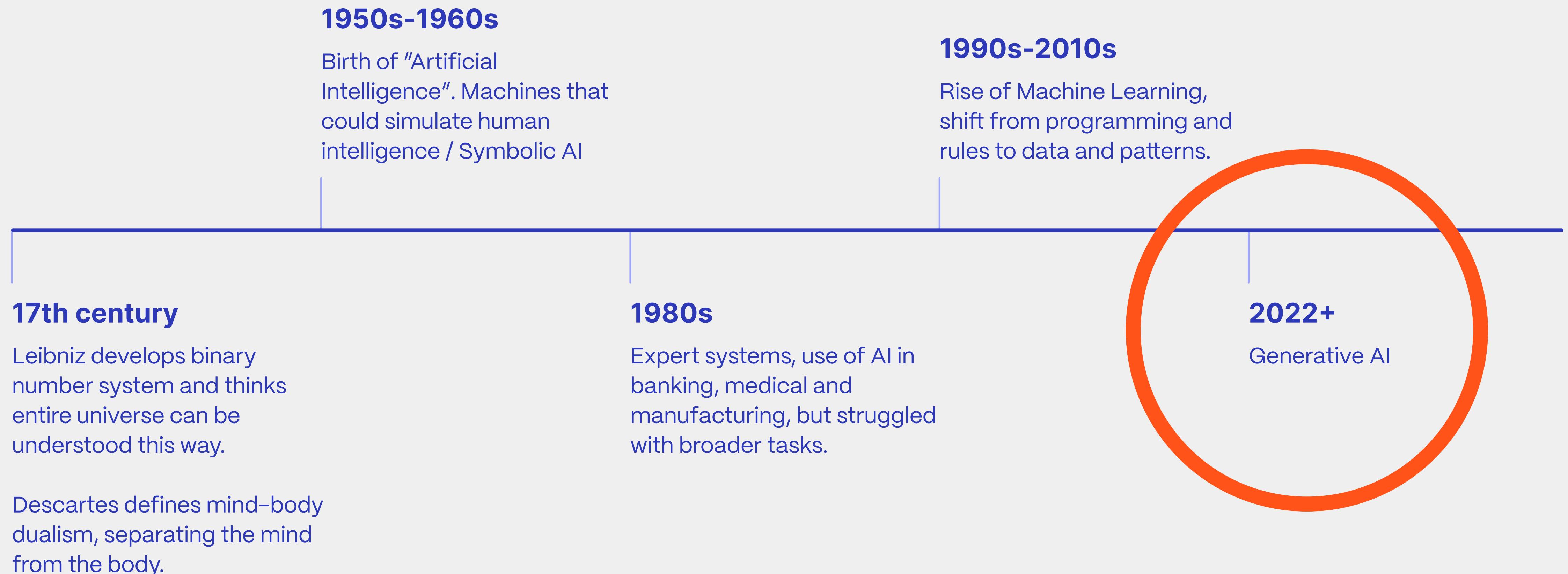
Orange fruit:



Screenshot of searching for "orange fruit" on Google Images

Training
Data

Intelligence in computing



Generative AI is a
growing and
emerging field

2017

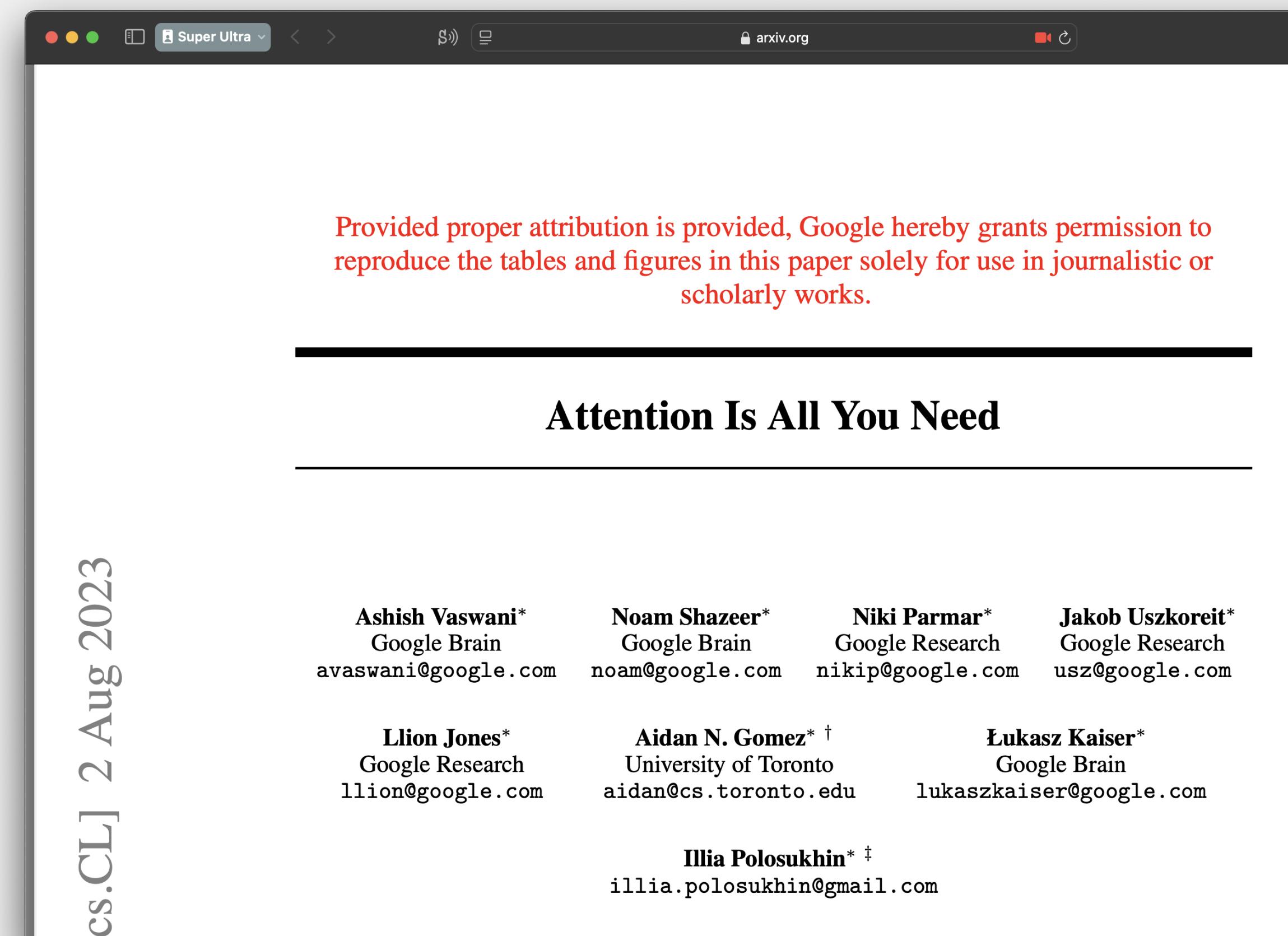
Transformers

Deep learning algorithm developed by researchers at Google and University of Toronto.

Instead of processing information step by step (like older models), it uses a method called "attention" to focus on different parts of the data all at once.

This makes it faster and more efficient, allowing it to handle larger tasks and understand context better.

This model is the foundation for today's most powerful AI systems, like ChatGPT, that can write, translate, and even create images.



Text

Images

Videos

Sound

Data

Let's talk
about text

Then
images

Text

2019

GPT-2

Generative Pre-trained Transformer 2 (GPT-2) is a large language model by OpenAI and the second in their foundational series of GPT models.

GPT-2 was pre-trained on a dataset of 8 million web pages.

The writing it produces is usually easily identifiable as non-human. Although its grammar and spelling are generally correct, it tends to stray off topic, and the text it produces lacks overall coherence. But what's really impressive about GPT-2 is not its fluency but its flexibility.

Give it a fake headline, and it'll write the rest of the article, complete with fake quotations and statistics. Feed it the first line of a short story, and it'll tell you what happens to your character next. It can even write fan fiction, given the right prompt.

James Vincent

The Verge: OpenAI's new multitalented AI writes, translates, and slanders, 2019

<https://en.wikipedia.org/wiki/GPT-2>

2022 (December)

ChatGPT

ChatGPT is a generative artificial intelligence chatbot[2][3] developed by OpenAI.

Gained 100M users in two months, becoming the fastest-growing consumer software application in history.

Great example of S-curve. The underlying GPT-3 model was available in 2020, but didn't take off until the release of ChatGPT in 2022

ChatGPT			
			
Examples	Capabilities	Limitations	
"Explain quantum computing in simple terms"	Remembers what user said earlier in the conversation	May occasionally generate incorrect information	
"Got any creative ideas for a 10 year old's birthday?"	Allows user to provide follow-up corrections	May occasionally produce harmful instructions or biased content	
"How do I make an HTTP request in Javascript?"	Trained to decline inappropriate requests	Limited knowledge of world and events after 2021	

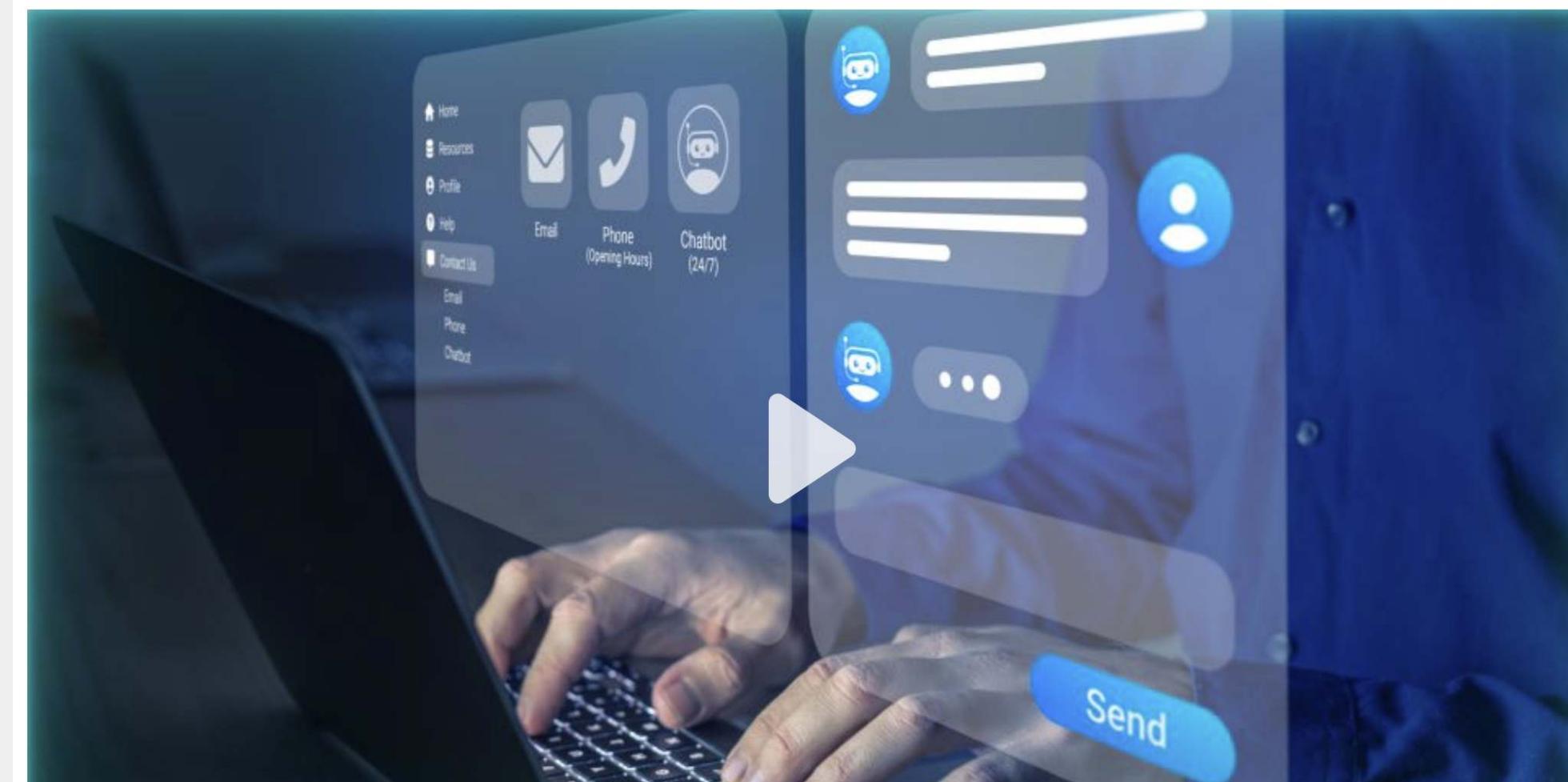
: ChatGPT is optimized for dialogue. Our goal is to make AI systems more natural to interact with, and your feedback will help us improve our system.

ChatGPT

The CNN Business homepage features a dark header with navigation links for Markets, Tech, Media, Calculators, and Videos. Below the header, there's a section for 'Markets →' showing DOW at 42,920.89 (0.42% ▲), S&P 500 at 5,827.63 (0.21% ▲), and NASDAQ at 18,325.83 (0.06% ▲). A 'Fear & Greed Index' meter shows a reading of 69, with the needle pointing towards 'Greed'. To the right, there's a 'Latest Market News' section with headlines about Fox anchors, Tostitos and Ruffles, and Bed Bath & Beyond.

ChatGPT passes exams from law and business schools

By Samantha Murphy Kelly, CNN Business
① 4 minute read · Updated 1:35 PM EST, Thu January 26, 2023



MORE FROM CNN

-  What this high school senior wants adults to know about classroom ...
-  The ultimate guide to earning and redeeming Bilt Rewards points ...
-  Kremlin confirms Trump sent Russia Covid-19 tests, after former ...



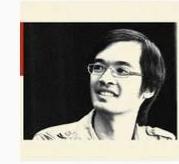
The Atlantic

MORE FROM ARTIFICIAL INTELLIGENCE

AI's Penicillin and X-Ray Moment
MATTEO WONG



We're Entering Uncharted Territory for Math
MATTEO WONG



It's Time to Stop Taking Sam Altman at His Word
DAVID KARPFF



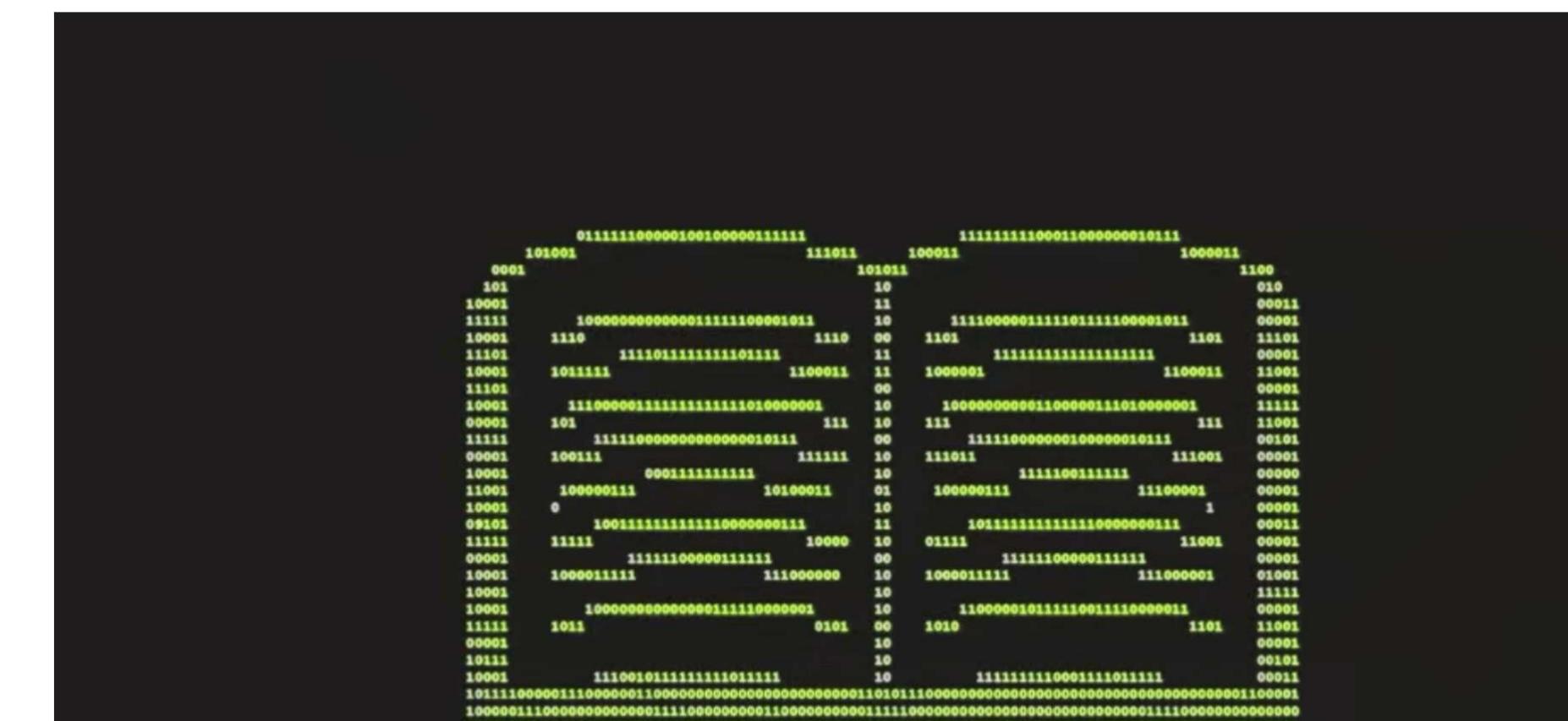
My Deeper Signed, Ch

TECHNOLOGY

The End of High-School English

I've been teaching English for 12 years, and I'm astounded by what ChatGPT can produce.

By Daniel Herman



New solutions, new problems

 Harvard Business Review

Intellectual Property | Generative AI Has an Intellectual Property Problem

Intellectual Property

Generative AI Has an Intellectual Property Problem

by Gil Appel, Juliana Neelbauer and David A. Schweidel

April 7, 2023



Pitchfork

NEWS REVIEWS BEST NEW MUSIC FEATURES LISTS THE PITCH VIDEO BEST OF THE 2020S

← Ads by Google Send feedback Why this ad? ▶

NEWS

Grimes Unveils Software to Mimic Her Voice, Offering 50-50 Royalties for Commercial Use

She has also announced a pair of new songs, "Music for Machines" and "I Wanna Be Software"

By Jazz Monroe
May 2, 2023



Material Properties

Non-deterministic

LLMs use different sampling techniques (rather than just selecting the most likely word every time), complex probabilistic interactions and unique seeds.

Hallucination

Models will make up facts in order to satisfy your prompt.

Can be "hacked"

Any LLM is prone to a technique called "Prompt Injection", where you can effectively cancel any previous prompt.

Trained on us

LLMs can appear to have human traits, since they are trained on data made by us.

An LLM is more likely to give you what you want if you coerce it, eg by threats.



An LLM is not an LLM

It's a bit sad and confusing that LLMs ("Large Language Models") have little to do with language; It's just historical.

They are highly general purpose technology for statistical modeling of token streams. A better name would be Autoregressive Transformers or something.

They don't care if the tokens happen to represent little text chunks. It could just as well be little image patches, audio chunks, action choices, molecules, or whatever. If you can reduce your problem to that of modeling token streams (for any arbitrary vocabulary of some set of discrete tokens), you can "throw an LLM at it".

– [Andrej Karpathy](#)

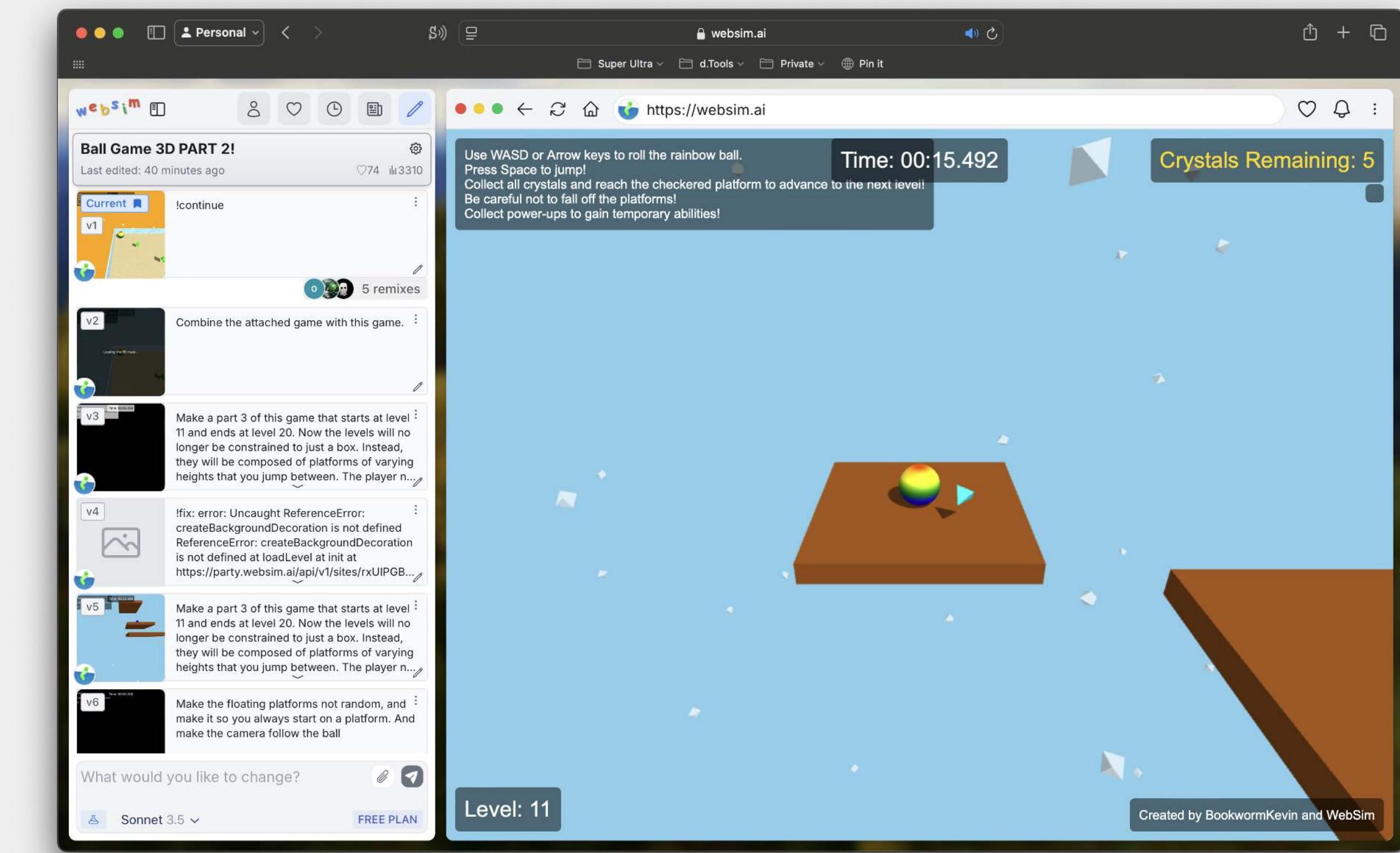
Andrej doesn't
work in marketing
:)



New Materials
New Products

WebSim

the browser for our imagination



websim.ai example: Ball Game 3D PART 2!

https://websim.ai/p/k4vke2obejb55_5caa23/21

Poem/1



A screenshot of a Kickstarter project page titled "Poem/1: AI rhyming clock".

The page features a search bar, navigation links for categories like Art, Comics, Crafts, and Technology, and buttons for "Start a project" and "Log in".

The main image shows a white e-paper device displaying a poem:

```
Colors mingle, brush takes flight / Three fifty-seven, a palette of light.
```

The device is connected to a power source via a USB cable. In the background, there are books on a shelf, including one titled "Letters NICHOLAS" and another from "FREE PRESS".

The project description reads:

This clock on your shelf, with e-paper display / Spins poems profound, in a whimsical way

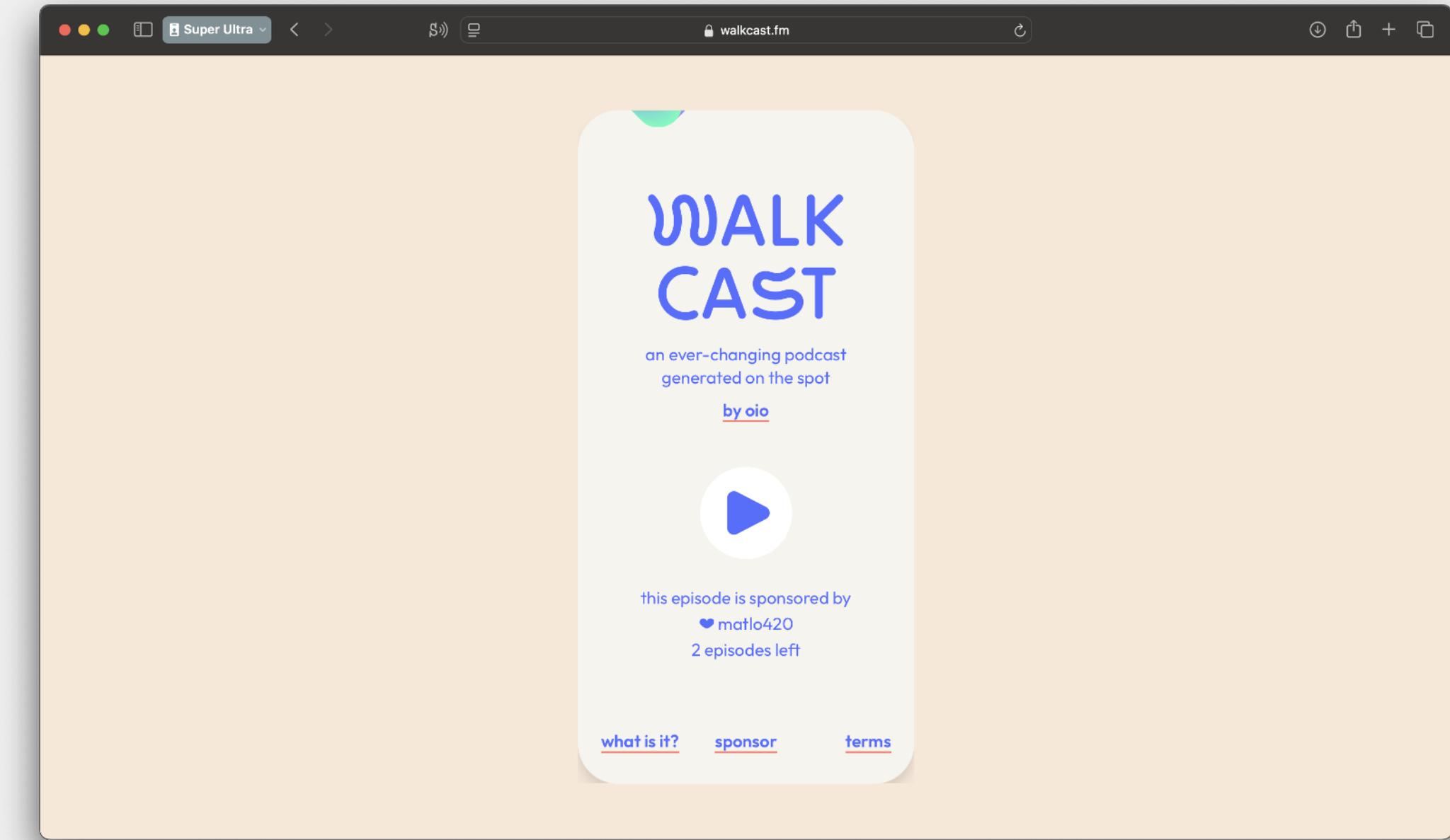
There is a "Join the newsletter" button and a "Created by Matt Webb" section. It also mentions 844 backers pledged £95,326 and was last updated on August 19, 2024.

At the bottom, there are links for Campaign, Rewards, FAQ, Updates, Comments, and Community.

walkcast.fm

A project by oio.studio, walkcast is “an ever-changing podcast generated as you walk, revealing the hidden layers that surround you”

<https://www.walkcast.fm>

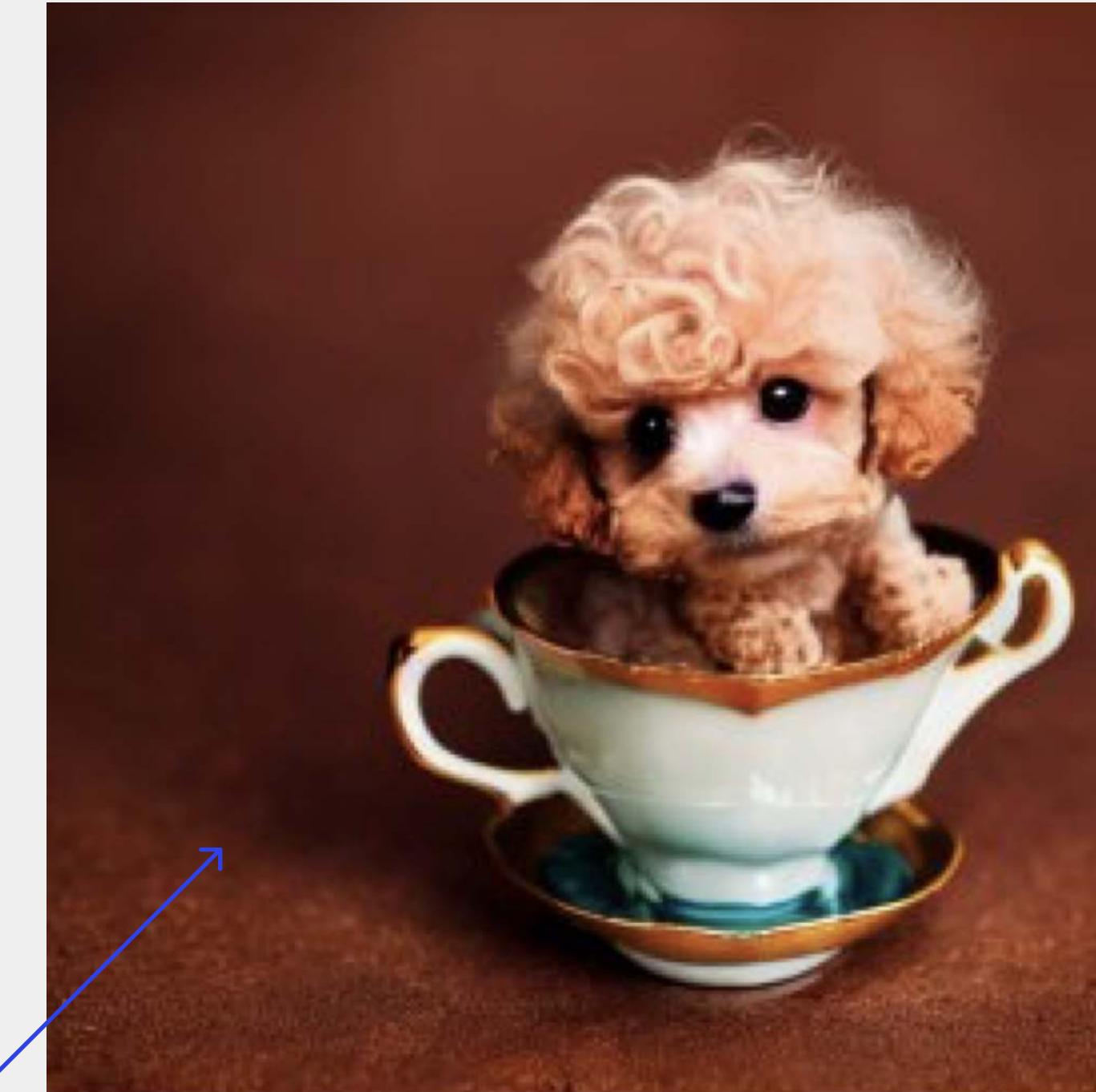


Images

2022 (August)

Stable Diffusion

"Tiny poodle puppy sitting inside a teacup on a felt tablecloth"



<https://stability.ai/news/stable-diffusion-announcement>

previously required complex photoshoot
or computer modelling/rendering

previously required complex character/
scene modelling and rendering

How a diffusion model is born

Trained through forward diffusion to learn reverse diffusion
Noise is gradually added to images



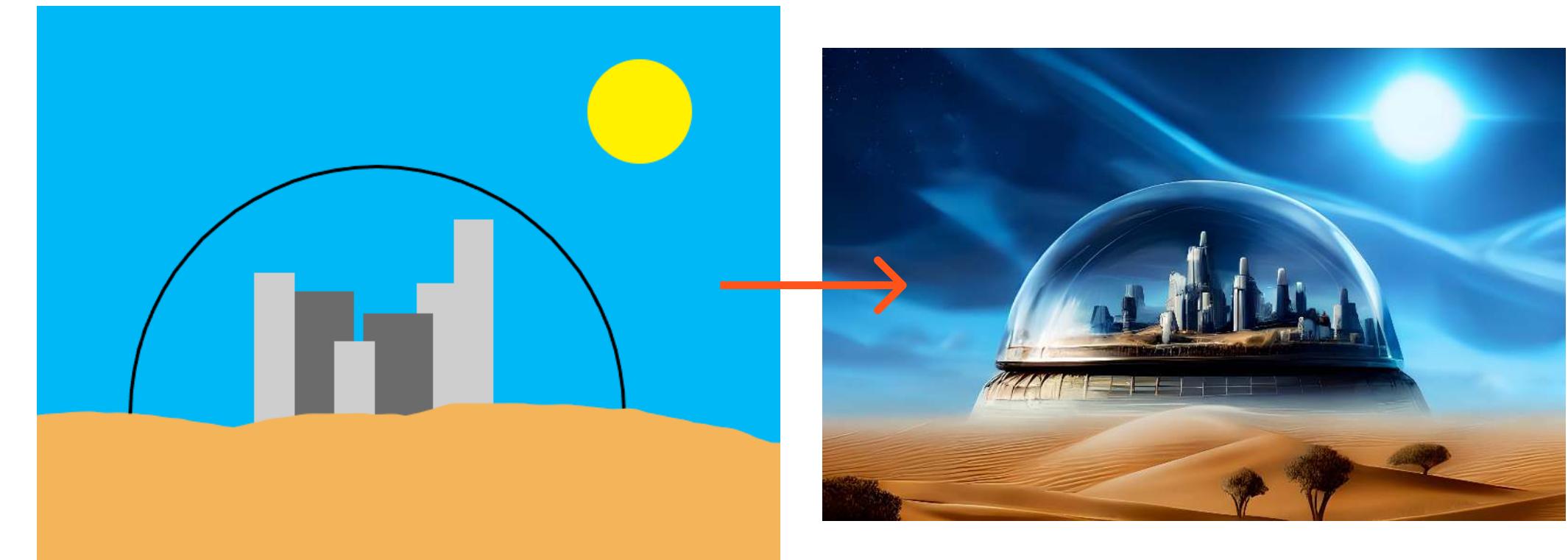
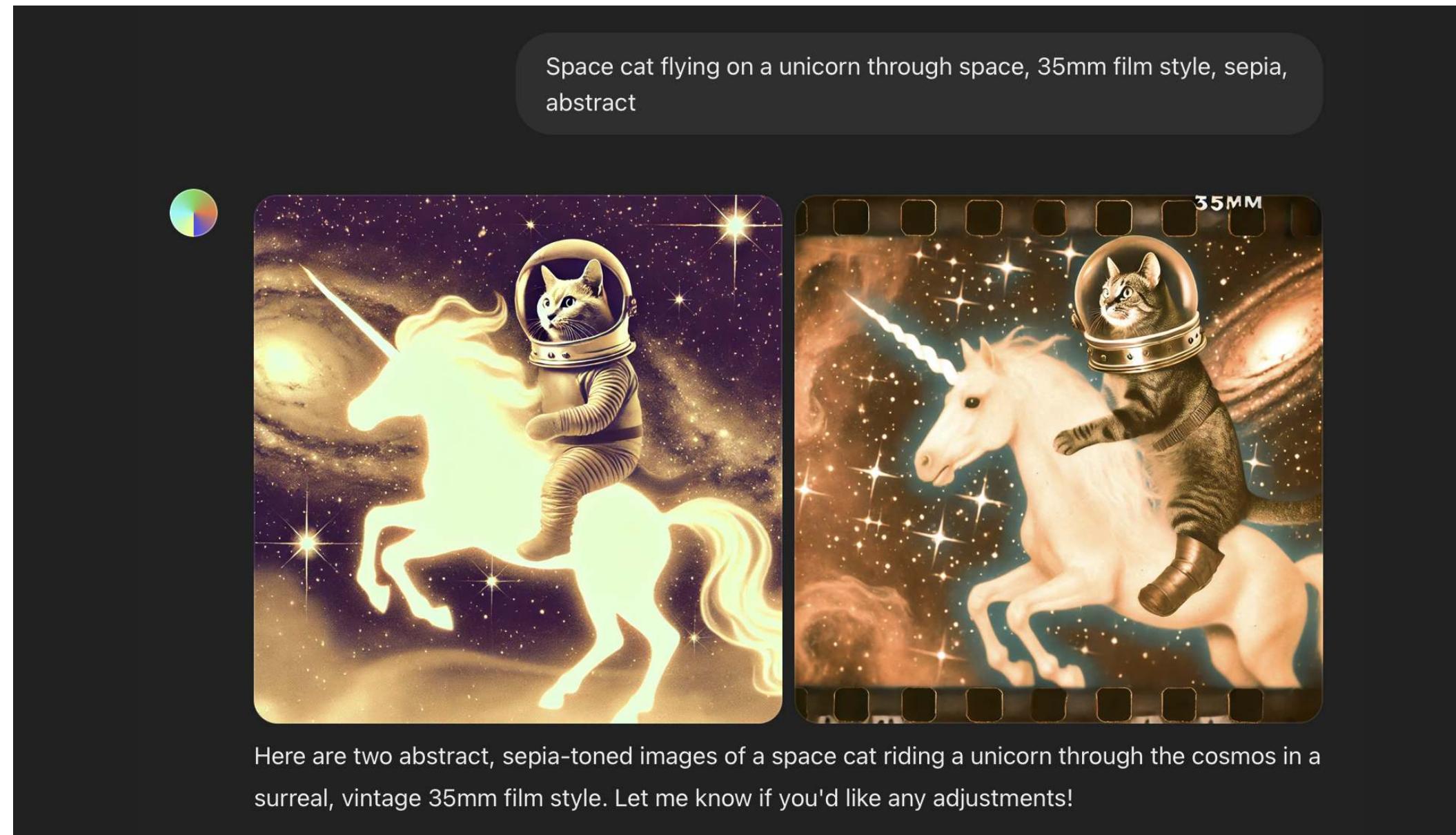
<https://developer.nvidia.com/blog/improving-diffusion-models-as-an-alternative-to-gans-part-1/>

Used through reverse diffusion
Random noise gradually denoises to become an image

Training a model how to form an image from noise

Remember
Gene's video
about "features"
in Image
Classification?

Different inputs



Text-to-Image

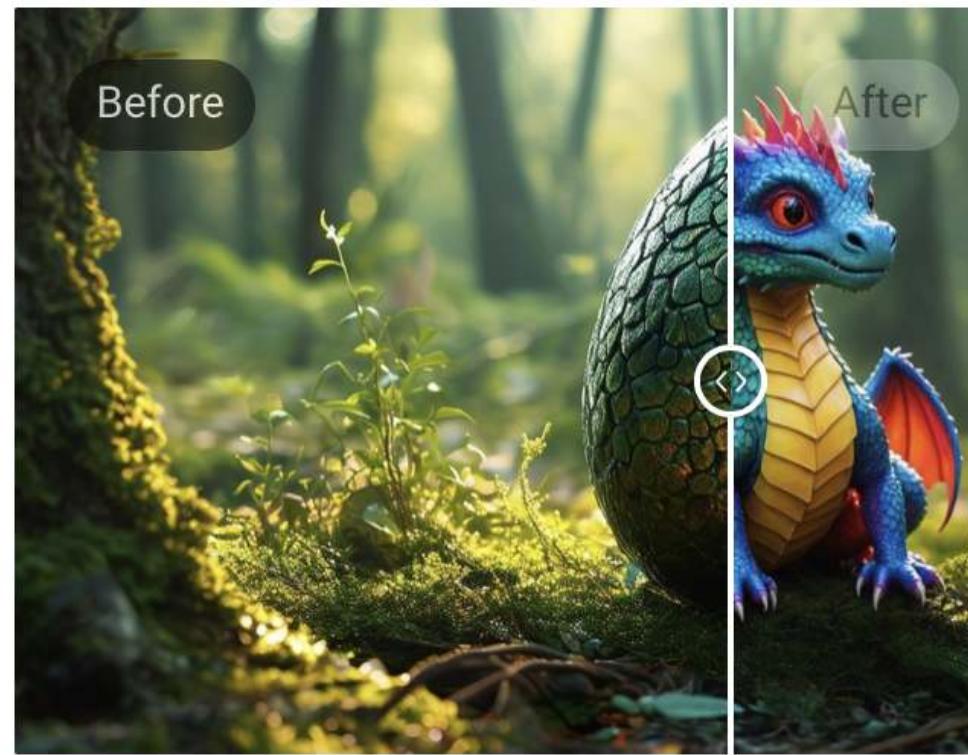
Textual descriptions are interpreted by an image model to create a corresponding image

Image-to-Image

An existing input image is transformed or modified based on additional input (eg style transfer, inpainting, etc)

<https://simonwillison.net/2022/Aug/29/stable-diffusion/>

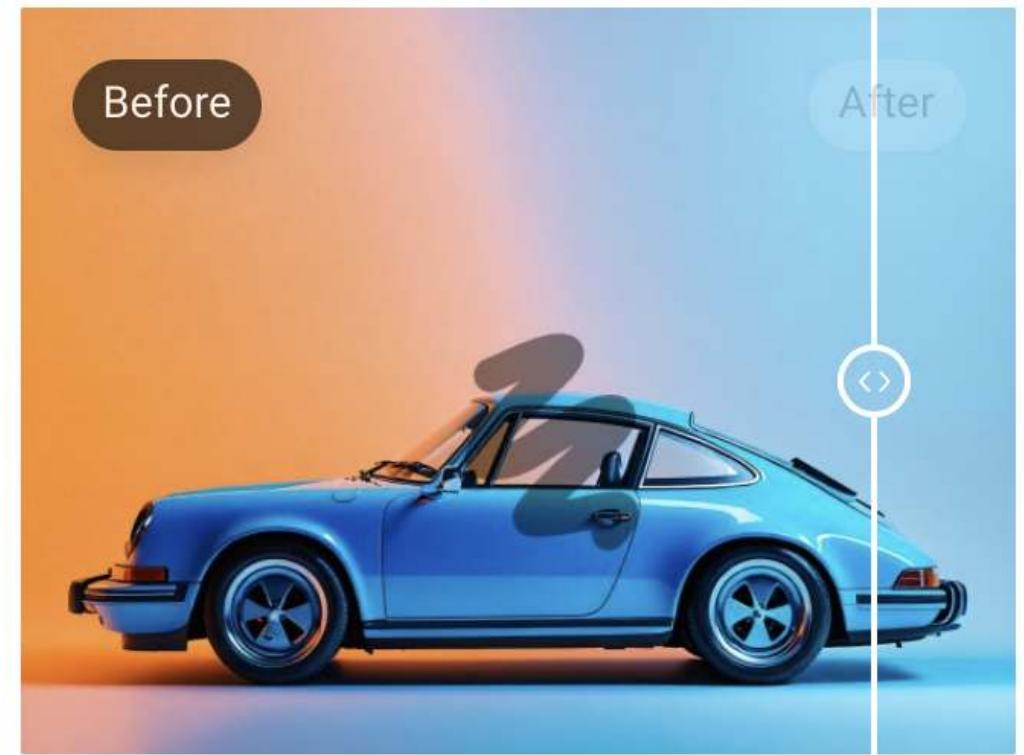
<https://blog.segmind.com/the-a-z-of-stable-diffusion-essential-concepts-and-terms-demystified/>



Search and Replace



Erase



Inpaint

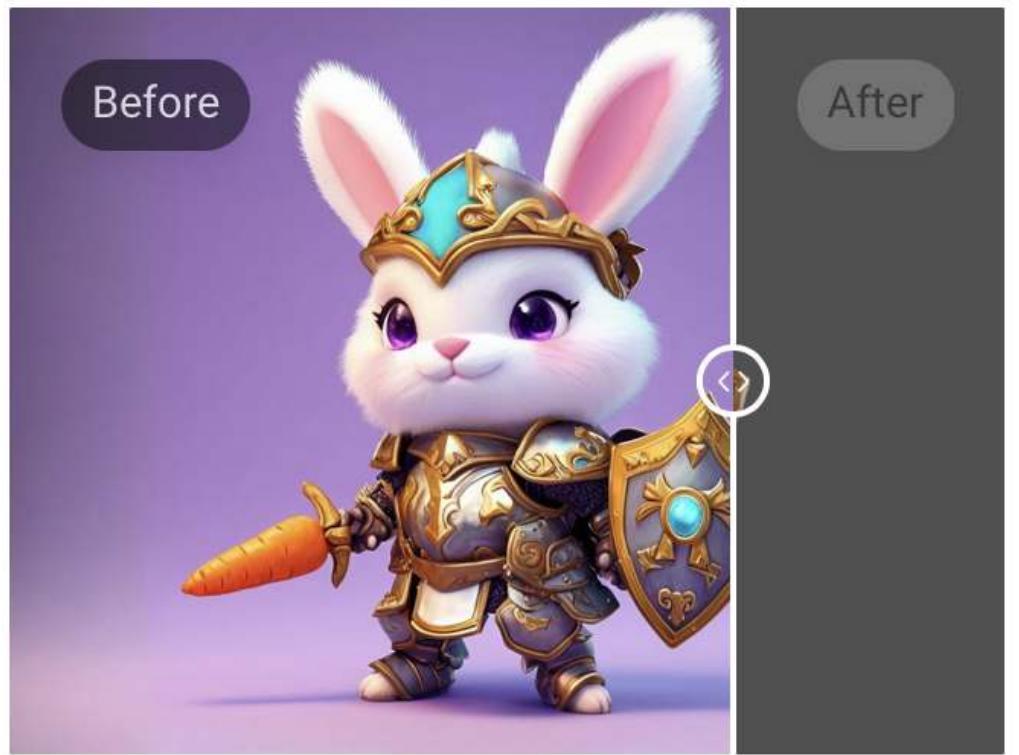
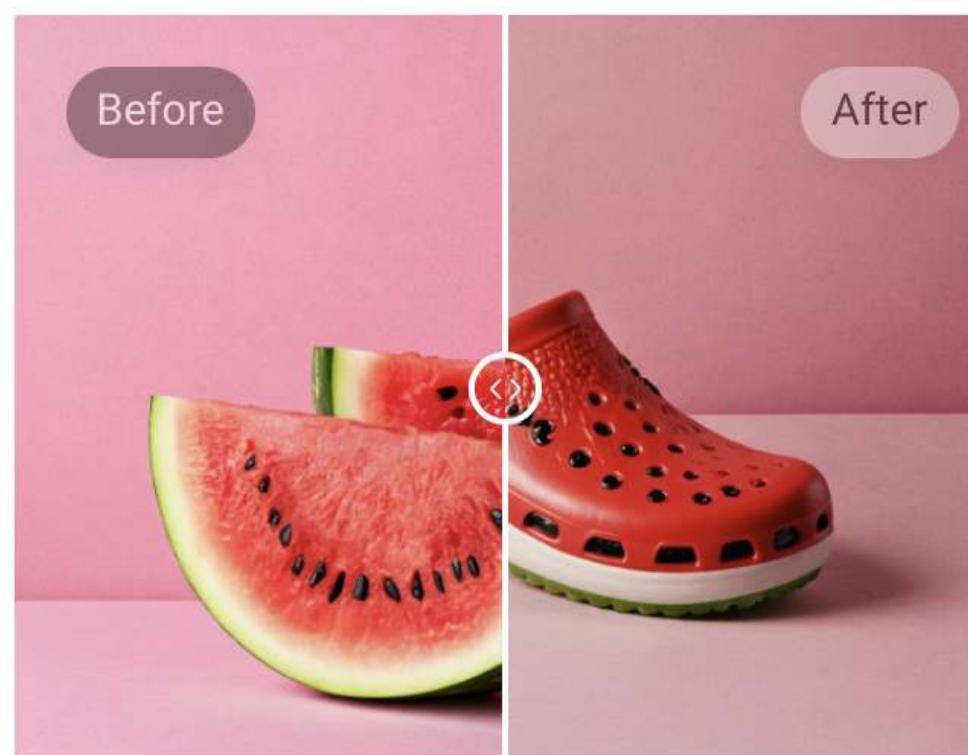
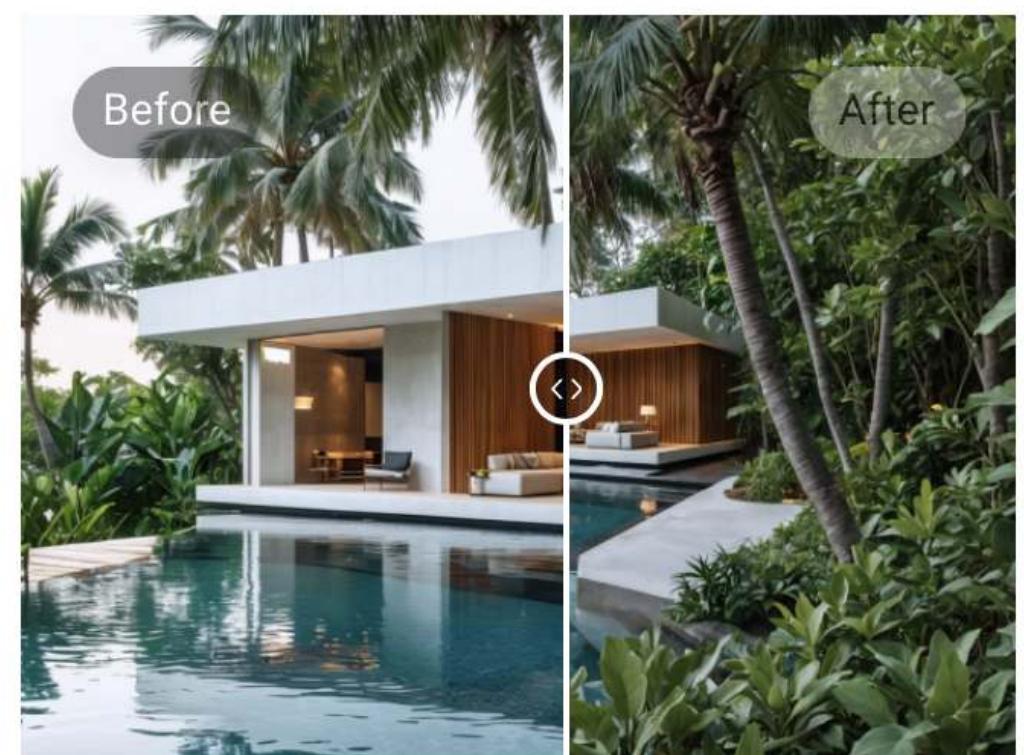


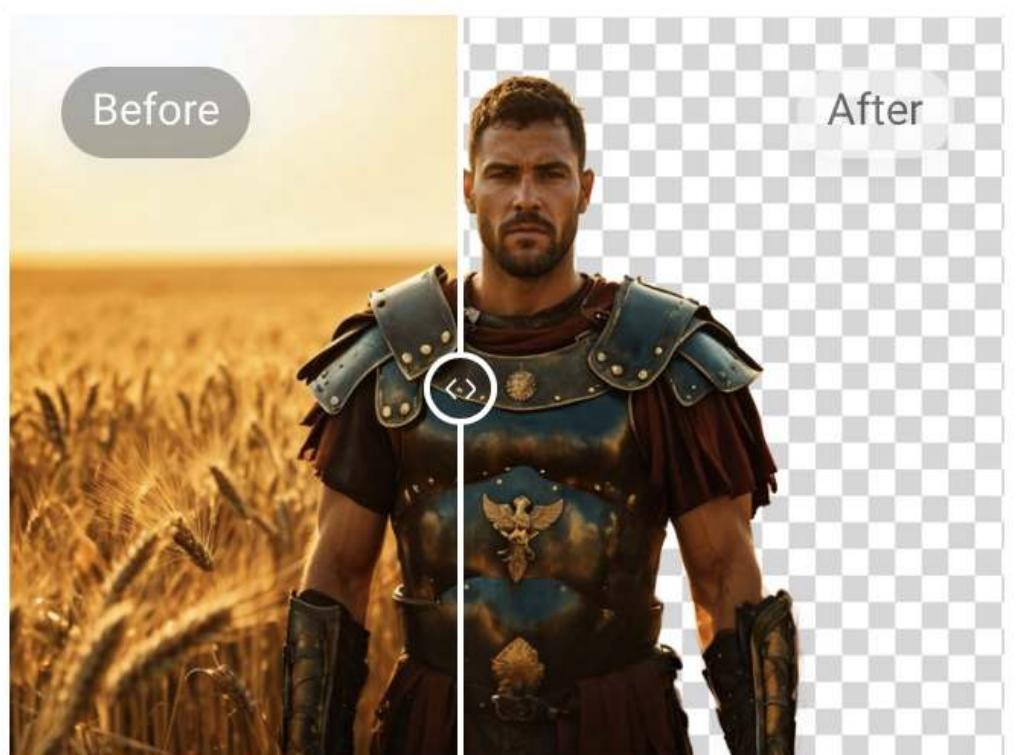
Image to 3D



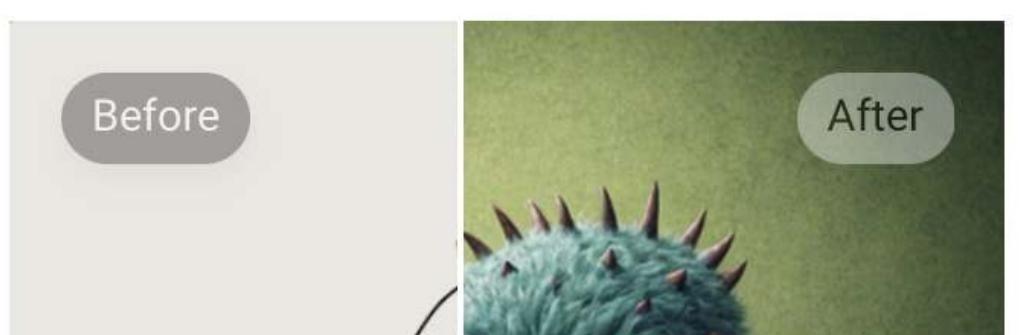
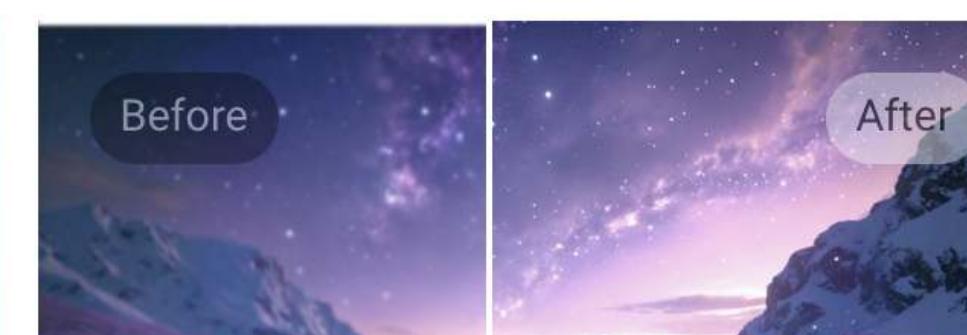
New Image with the Same Structure

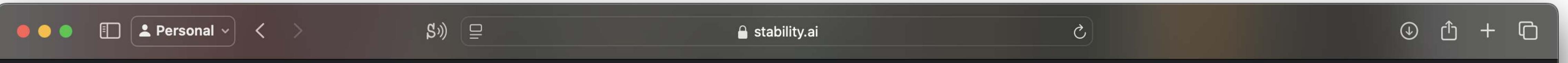


Zoom Out



Remove Background

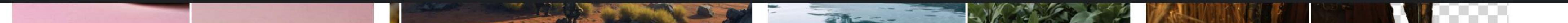




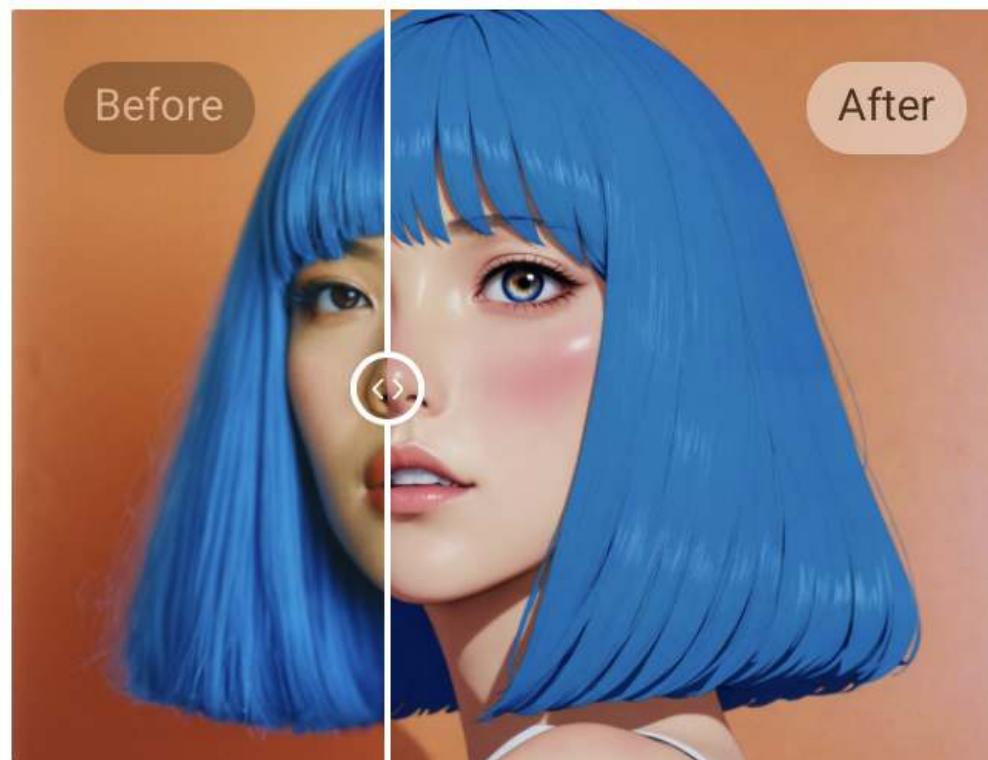
stability.ai

Models ▾ Applications ▾ Deployment ▾ Company ▾ News Resources ▾ 日本語

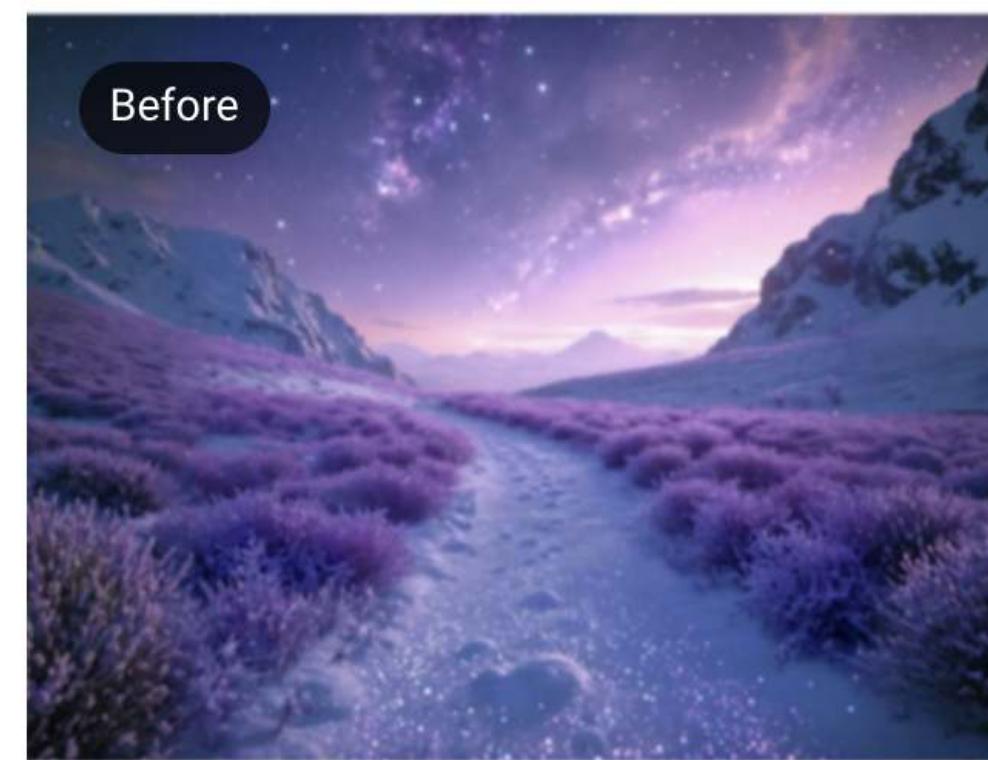
Contact Us



New Image with the Same Style



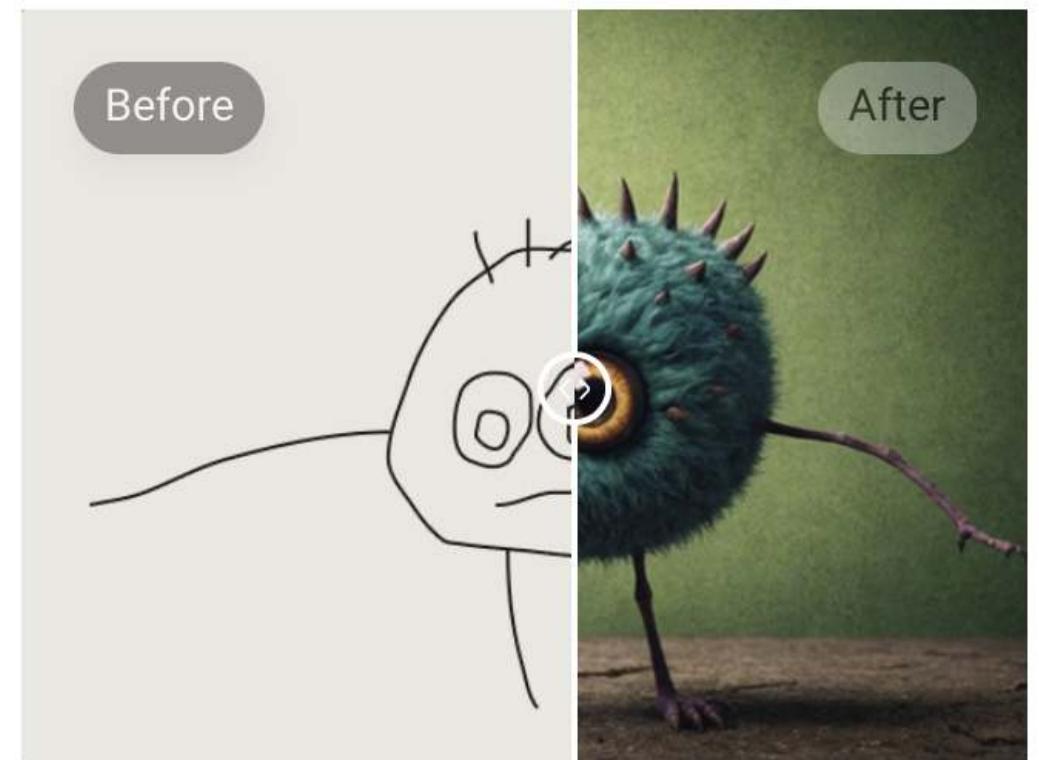
New Image with the Same Structure



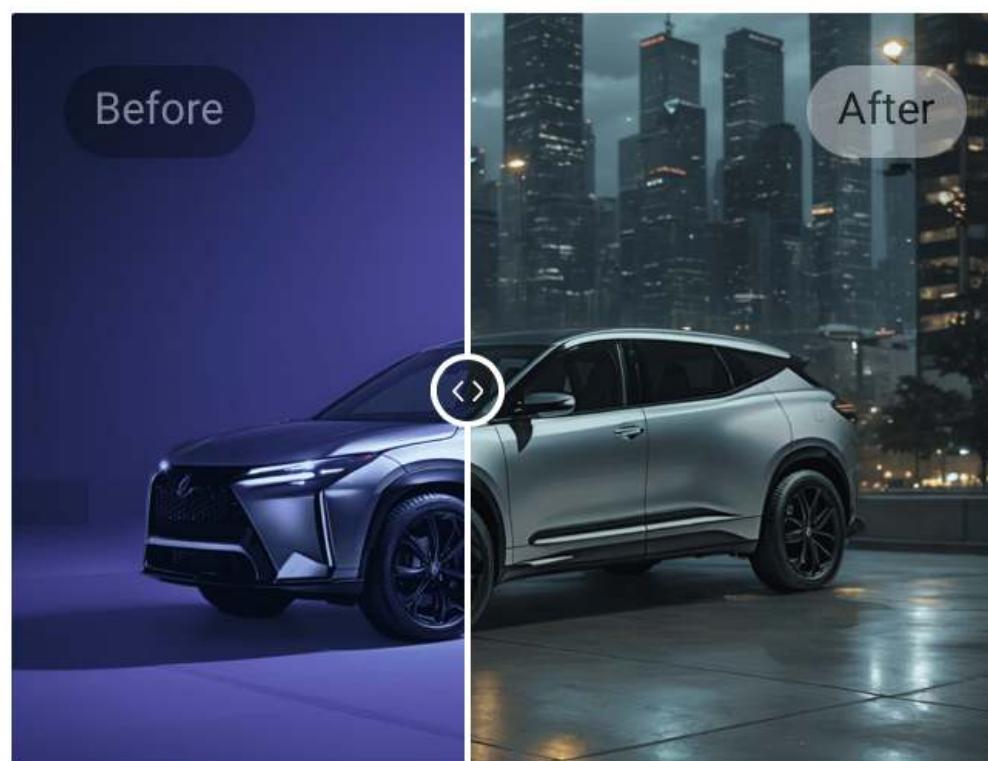
Zoom Out



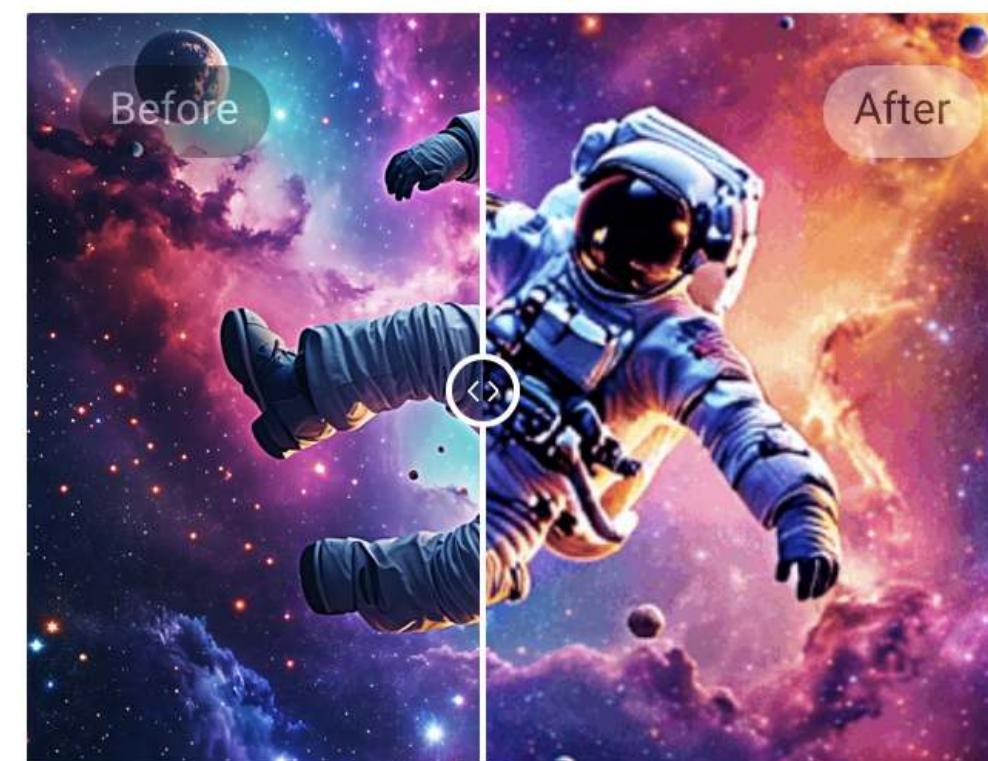
Remove Background



Enhance



Upscale



Search and Recolor



Sketch to Image

Replace Background

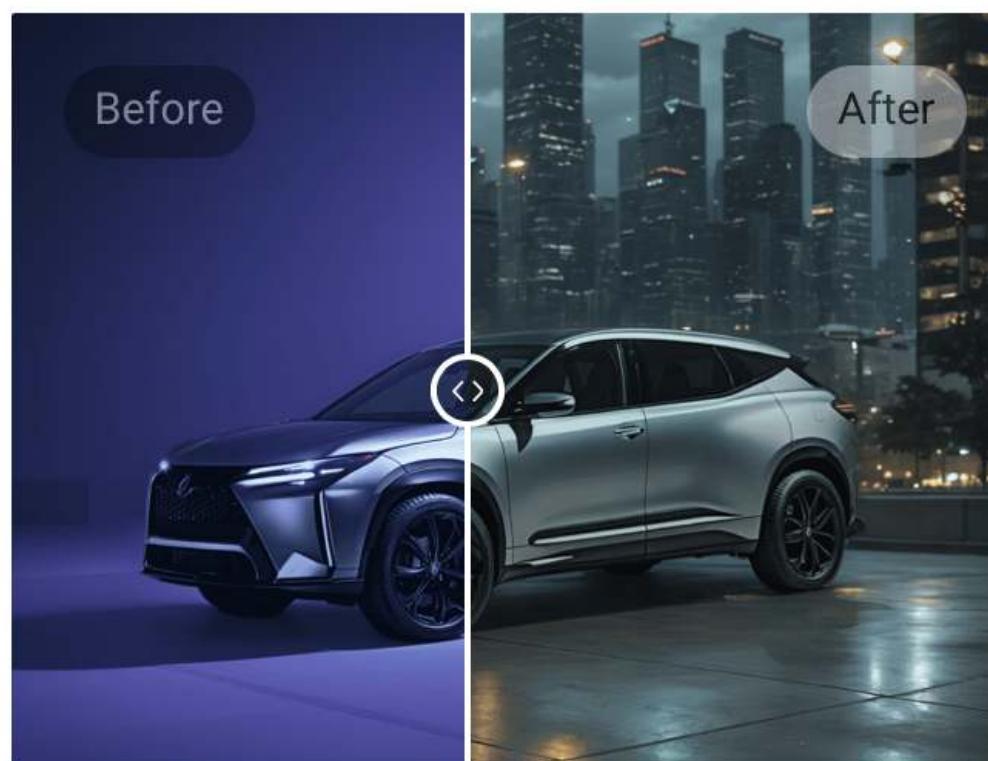
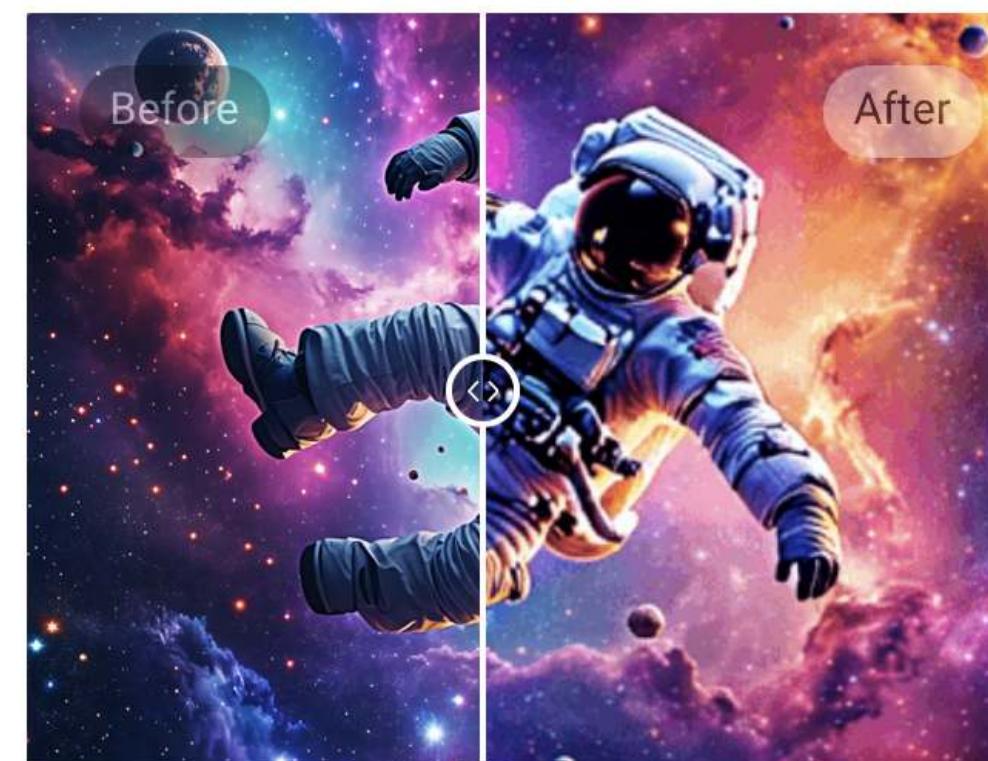
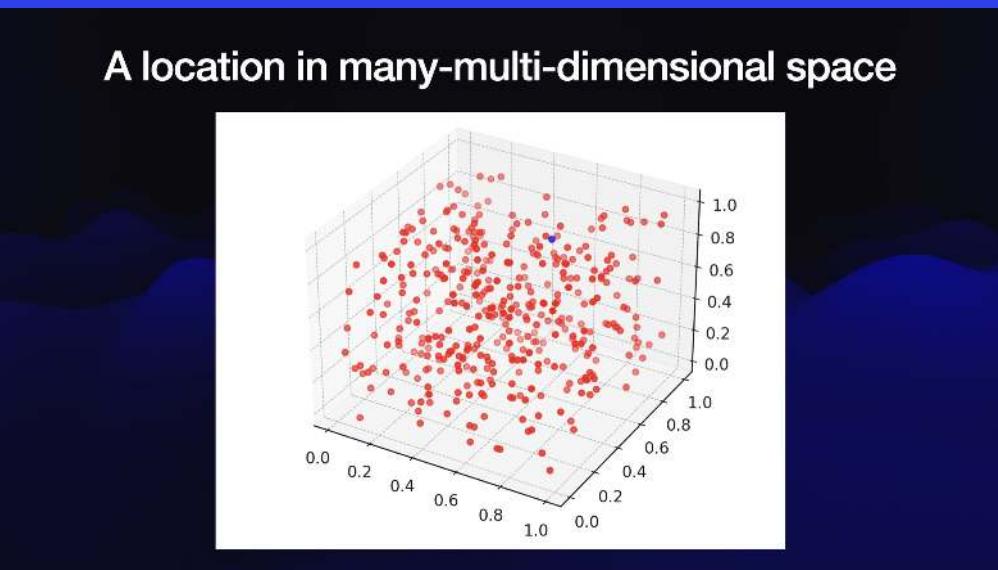


Image to Video



How It Works

Large Language Models



Predicts
Token/Word

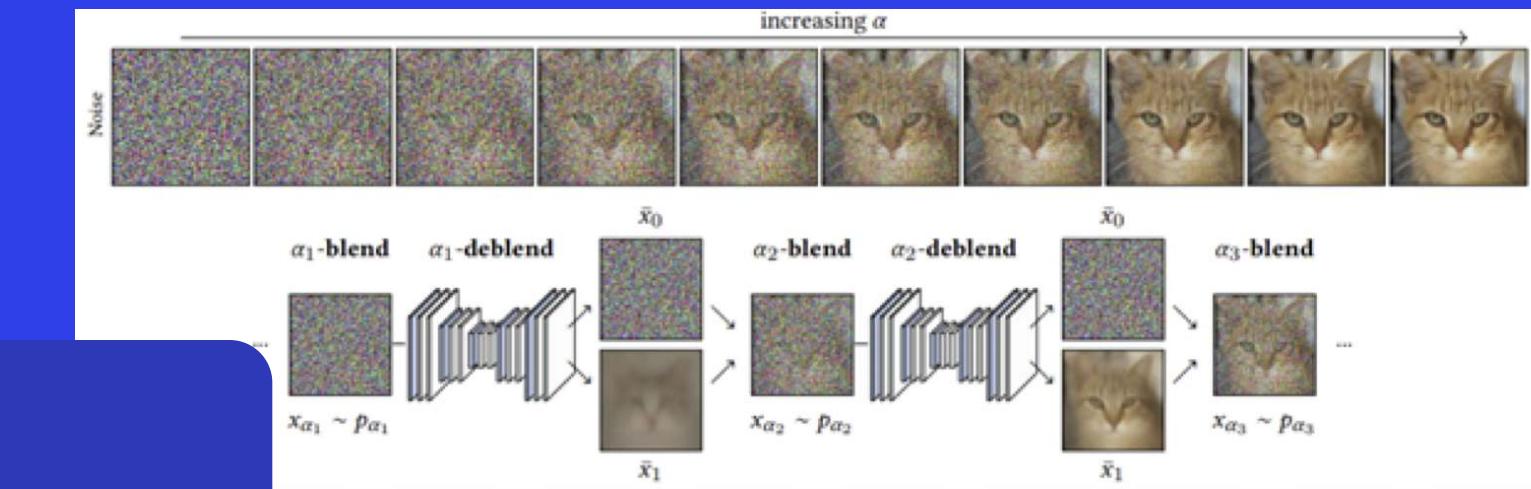
Large Datasets

Generative Models

Transformers

Neural Networks

Image models



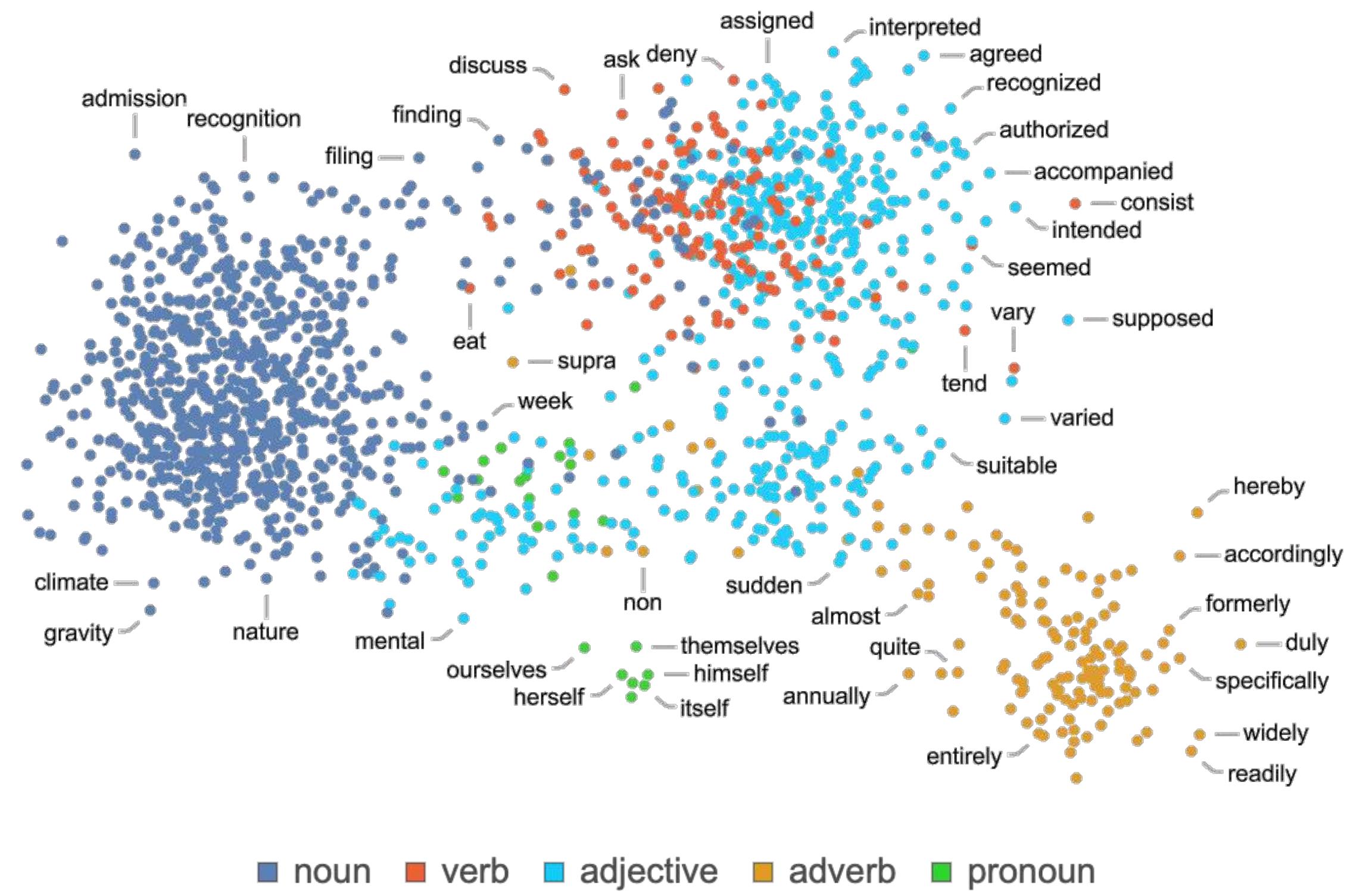
Denoises
Pixels

How a Large Language Model works

A Large Language Model learns statistical relationships between words, based on self-supervised and semi-supervised training on very large datasets (from billions to trillions of parameters).

To an LLM, a word (or token) is just a number in a space, and has relationships with other numbers in space.

When you input a sentence into an LLM, it simply tries to find the next statistically optimal word for you.



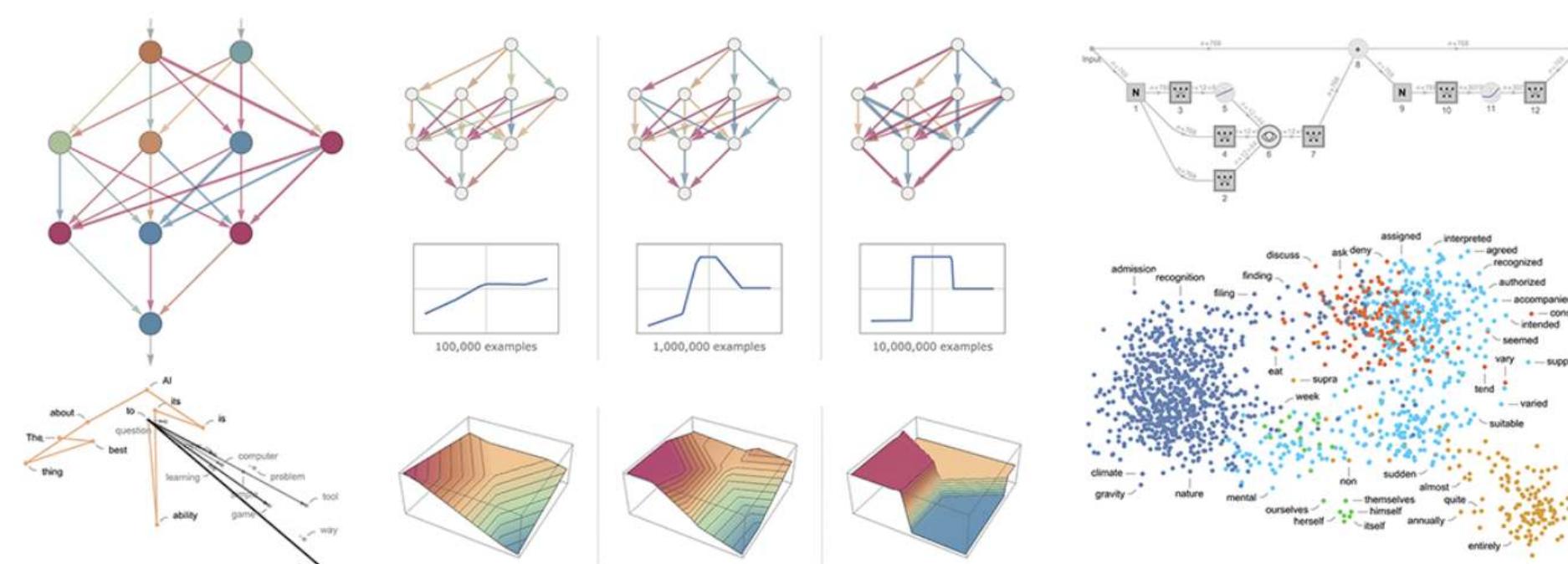
<https://writings.stephenwolfram.com/2023/02/what-is-chatgpt-doing-and-why-does-it-work/>

https://en.wikipedia.org/wiki/Large_language_model

Content

What Is ChatGPT Doing .. and Why Does It Work?

February 14, 202



It's Just Adding One Word at a Time

That ChatGPT can automatically generate something that reads even superficially like human-written text is remarkable, and unexpected. But how does it do it? And why does it work? My purpose here is to give a rough outline of what's going on inside ChatGPT—and then to explore why it is that it can do so well in producing what we might consider to be meaningful text. I should say at the outset that I'm going to focus on the big picture of what's going on—and while I'll mention some engineering details, I won't get deeply into them. (And the essence of what I'll say applies just as well to other current “large language models” [LLMs] as to ChatGPT.)

A standard black and white QR code is centered on the page, designed to be scanned by a mobile device or computer to access the document.

Search Writings 

Recent Writings



On the Nature of Time
October 8, 2024



Nestedly Recursive Functions

September 27, 2024



Five Most Productive Years: What Happened and What's Next



What's Really Going On in Machine Learning? Some Minimal Models



Yet More New Ideas and New Functions: Launching Version 14.1 of Wolfram Language & Mathematica

All by date >

Popular Categories

- Artificial Intelligence
 - Big Picture
 - Companies & Business

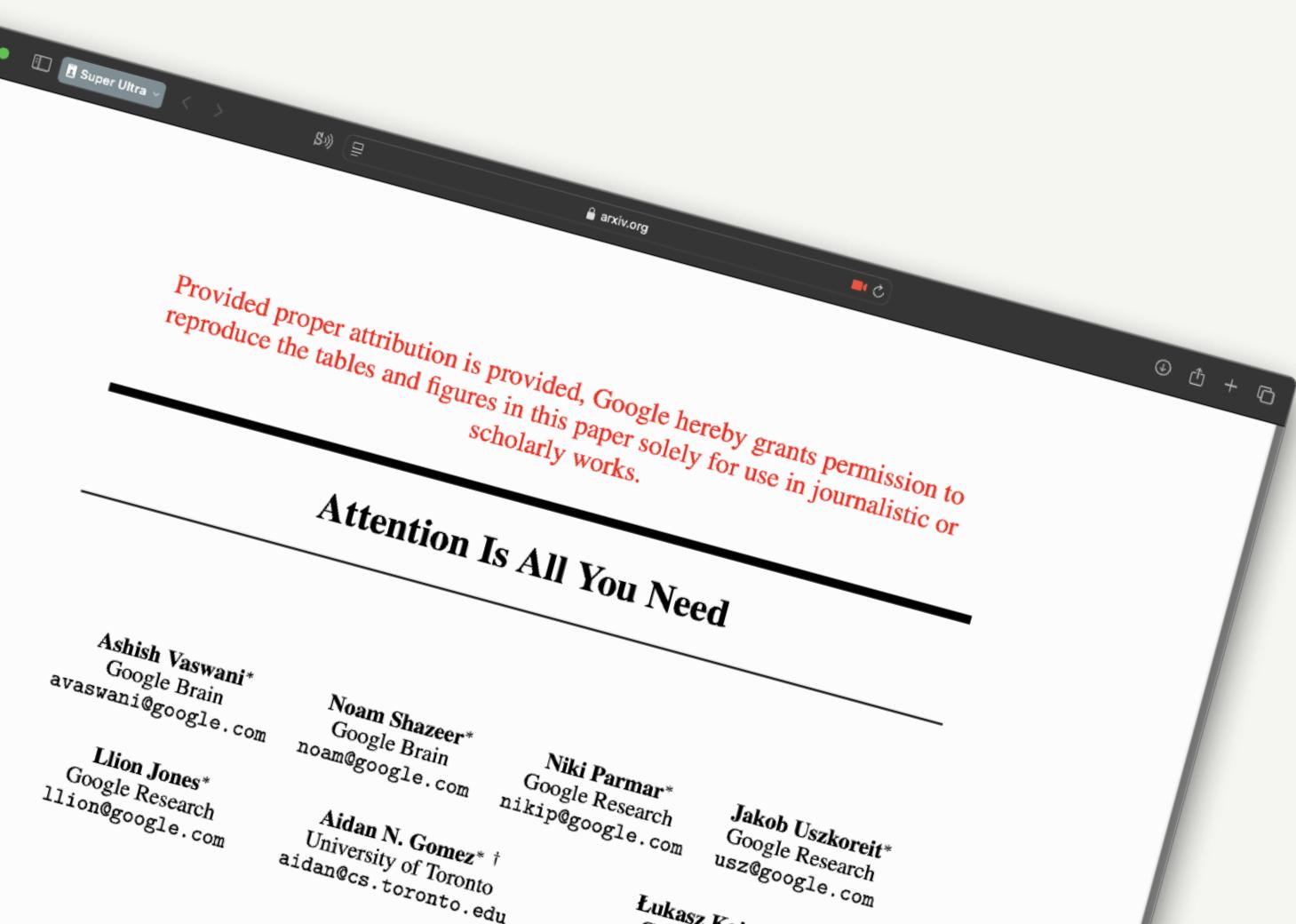
Prompt Engineering is just you
directing statistical
relationships between words in
a database.

In the end, everything is just
numbers with really complex
relationships.

Zooming Back
Out

Model are moving at
hyperspeed, and its
an arms race.

Turns out attention isn't all they need

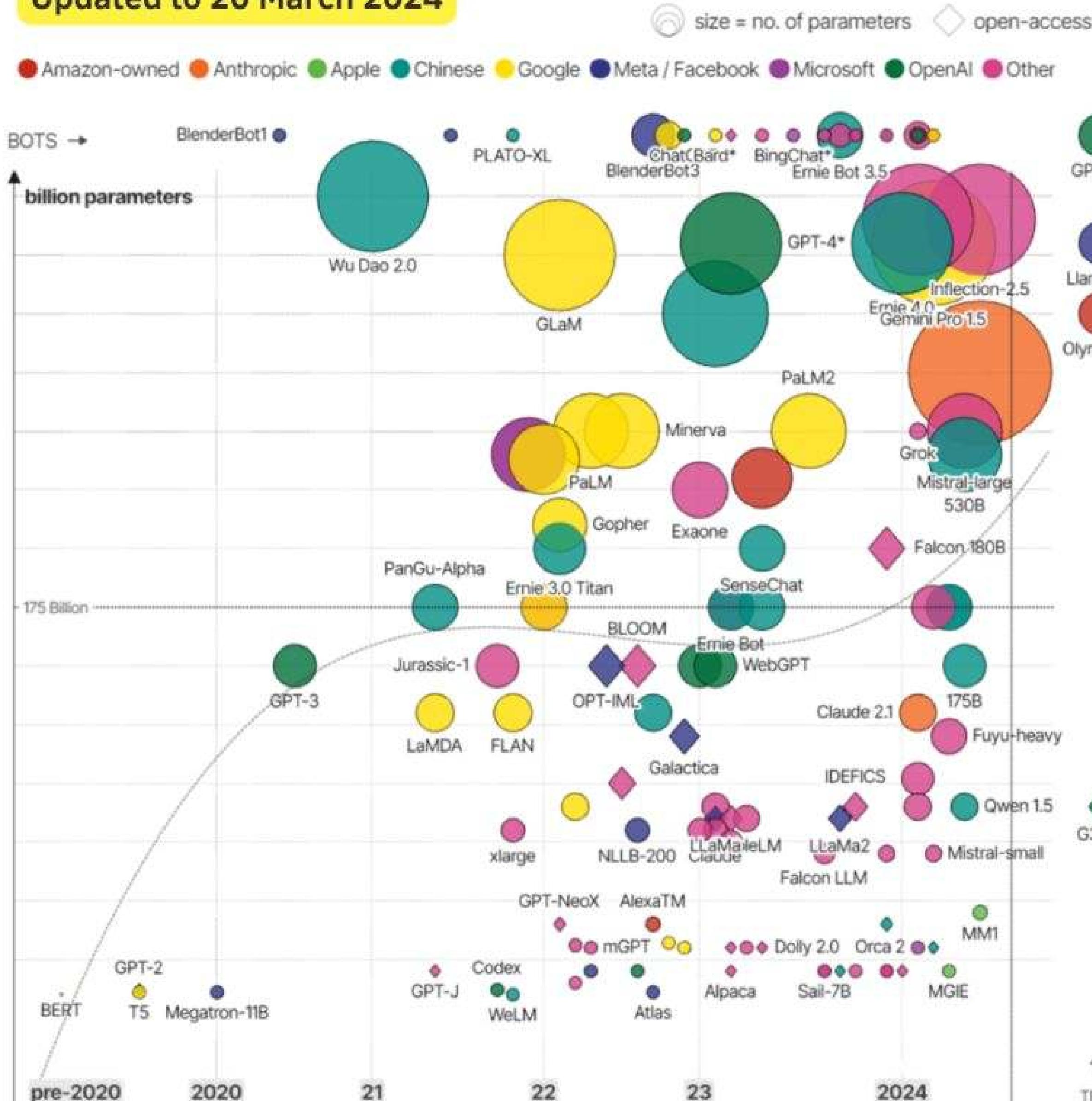


A screenshot of a Google search results page. The search bar at the top contains the query 'openai bleeding money'. Below the search bar, there are tabs for 'All', 'News', 'Images', 'Videos', 'Web', 'Books', and 'Finance'. The 'News' tab is selected. The first result is from 'Futurism' with the title 'OpenAI Is Putting Profits First, Yet It's Bleeding an Astronomical Amount of Money'. The second result is from 'The New York Times' with the title 'OpenAI Is Growing Fast and Burning Through Piles of Money'. The third result is from 'Cointelegraph' with the title 'OpenAI could lose \$5B this year and run out of cash in 12 months: Report'. Each news item includes a small thumbnail image and a timestamp indicating it was posted '3 weeks ago'.

A screenshot of a The Verge article titled 'OpenAI wants to be the App Store of AI /'. The article features a large, stylized black and white logo of a brain composed of interconnected loops in the center. The text of the article discusses OpenAI's financial challenges and its plans to create an AI app store. The author's name, Alex Heath, is mentioned, along with the date of publication, Nov 8, 2023, at 3:24 AM GMT-1. The article is categorized under 'COMMAND LINE / ARTIFICIAL INTELLIGENCE / CREATORS'.

LLMs Landscape

Updated to 20 March 2024



Geopolitical

Next big economy, potential for cyber warfare

Product and innovation

Many companies want to be the next Apple, for invention and for money

Openness and safety

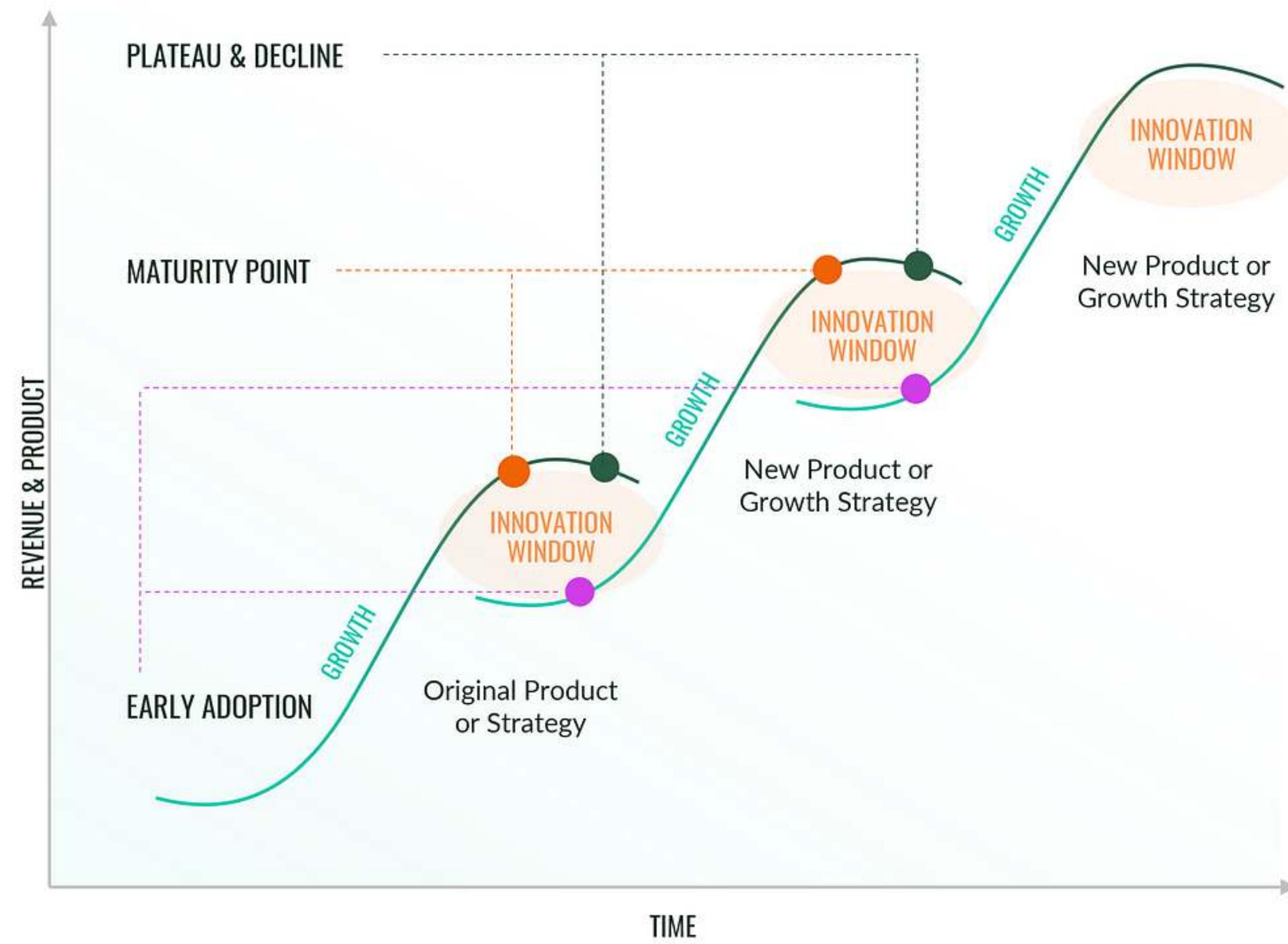
These technologies are too powerful to gatekeep (or maybe should have been?) and there are concerns about the kind of threats of these models to society.



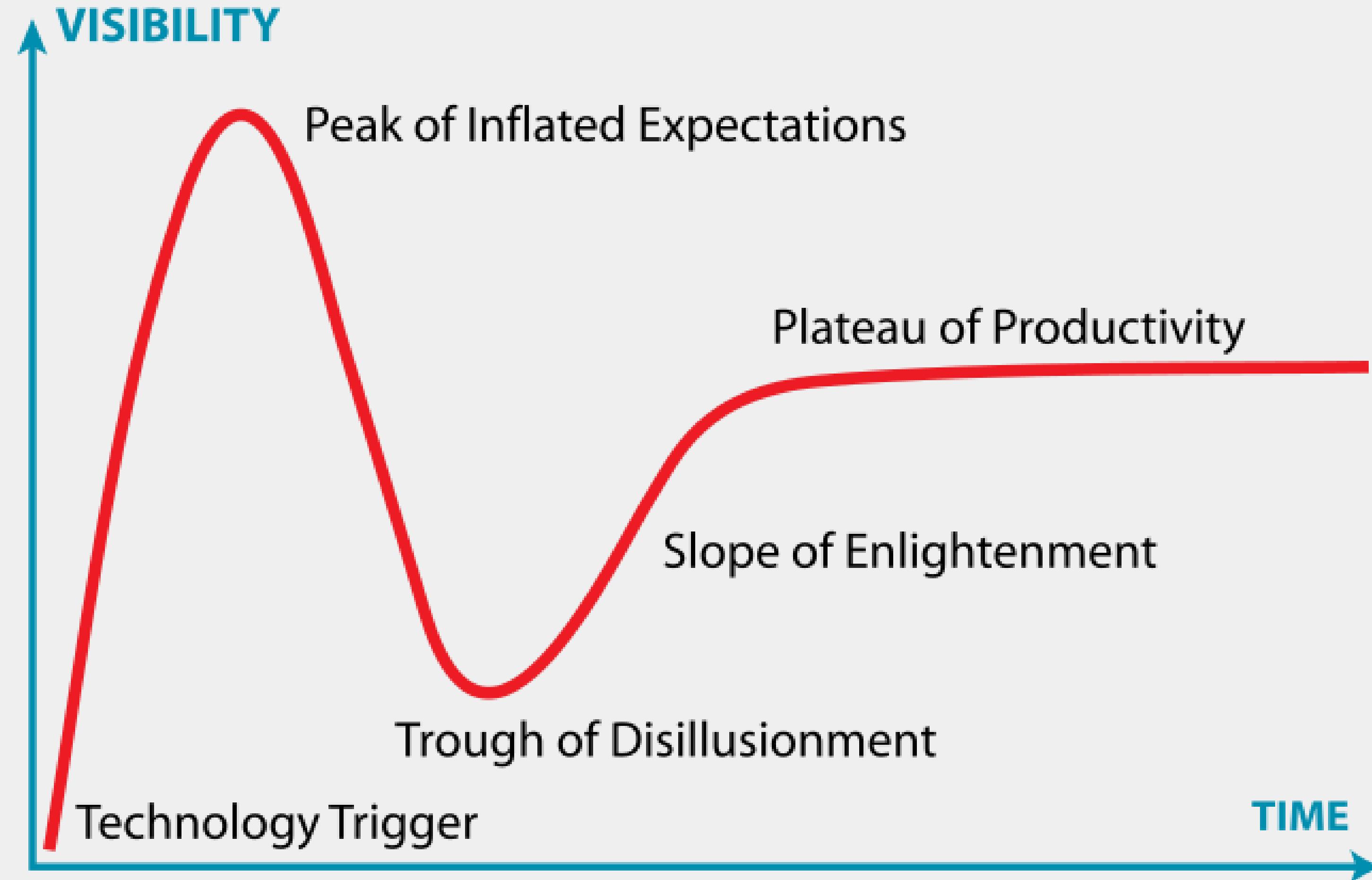
“All numbers are generated from 1 and 0, just as God made everything from nothing.”



“A.I. will probably most likely lead to the end of the world, but in the meantime, there'll be great companies.”



Technology S-curve



Gartner hype curve

Tech

ChatGPT boss says he's created human-level AI, then says he's 'just memeing'

'AGI has been achieved internally' at OpenAI, Sam Altman writes on Reddit, before backtracking

Anthony Cuthbertson • Wednesday 27 September 2023 14:45 BST • 0 Comments



.ITY

Peak of Inflated Expectations

Trough

ChatGPT

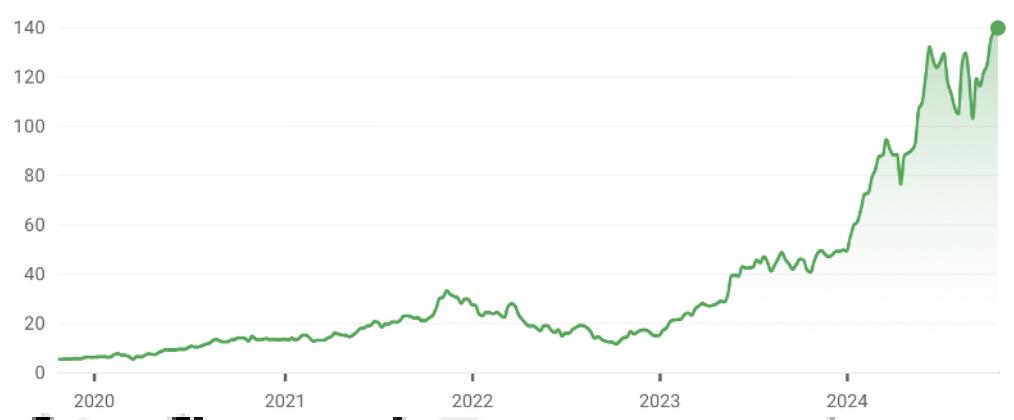
Technology Trigger

NVIDIA Corp

\$139.56 ↑ 2,631.12% +134.45 5 Y

After hours: \$140.21 (↑ 0.47%) +0.65
Closed: 23 Oct, 19:59:56 UTC-4 · USD · NASDAQ · Disclaimer

1D 5 D 1M 6 M YTD 1Y 5Y MAX



Plateau of Productivity

Slope of Enlightenment

Gartner hype curve

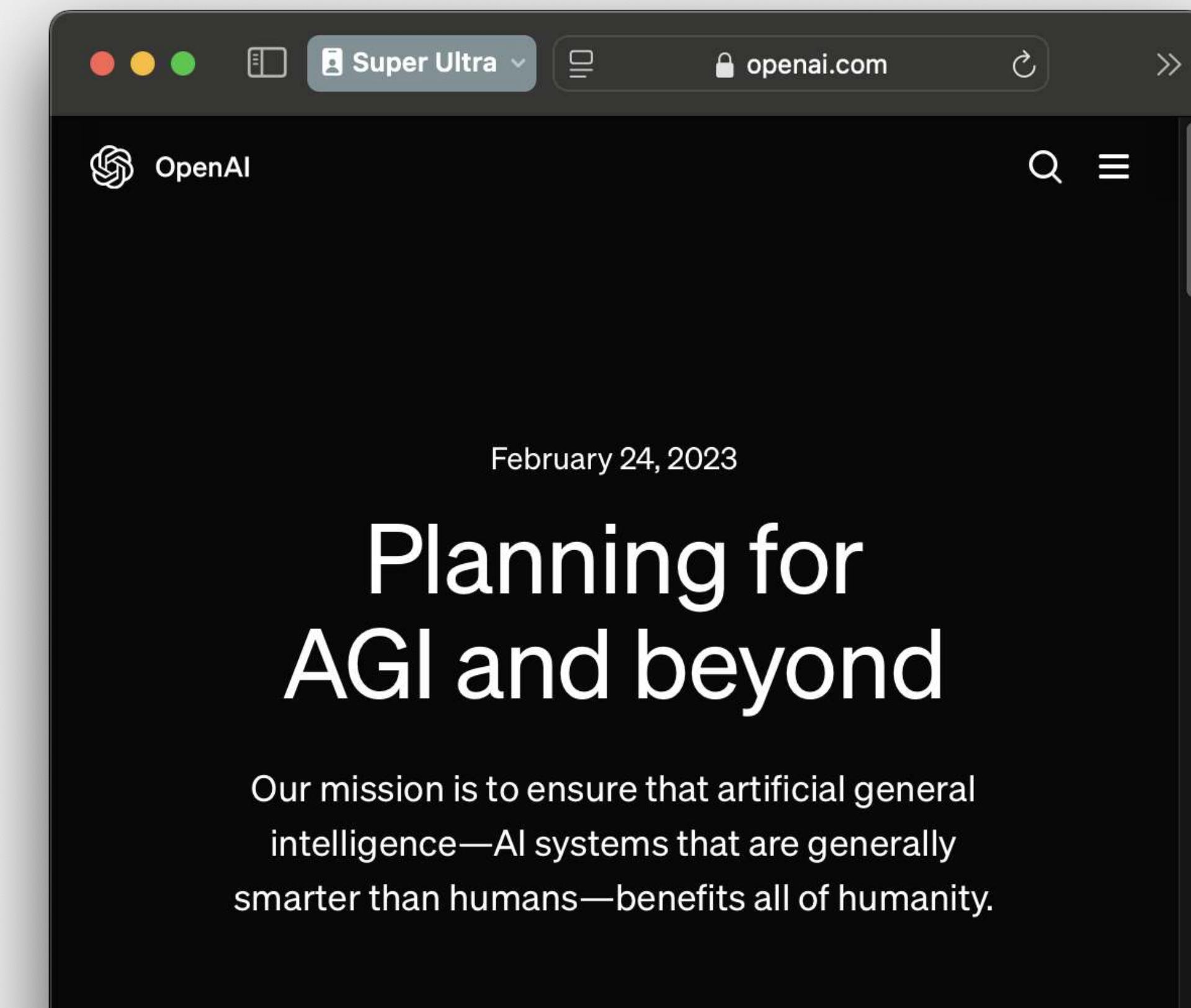
TECHNOLOGY

ChatGPT Is Dumber Than You Think

Treat it like a toy, not a tool.

By Ian Bogost

People can invent great things while working towards the wrong goal



<https://openai.com/index/planning-for-agi-and-beyond/>

Concerns

Sustainability

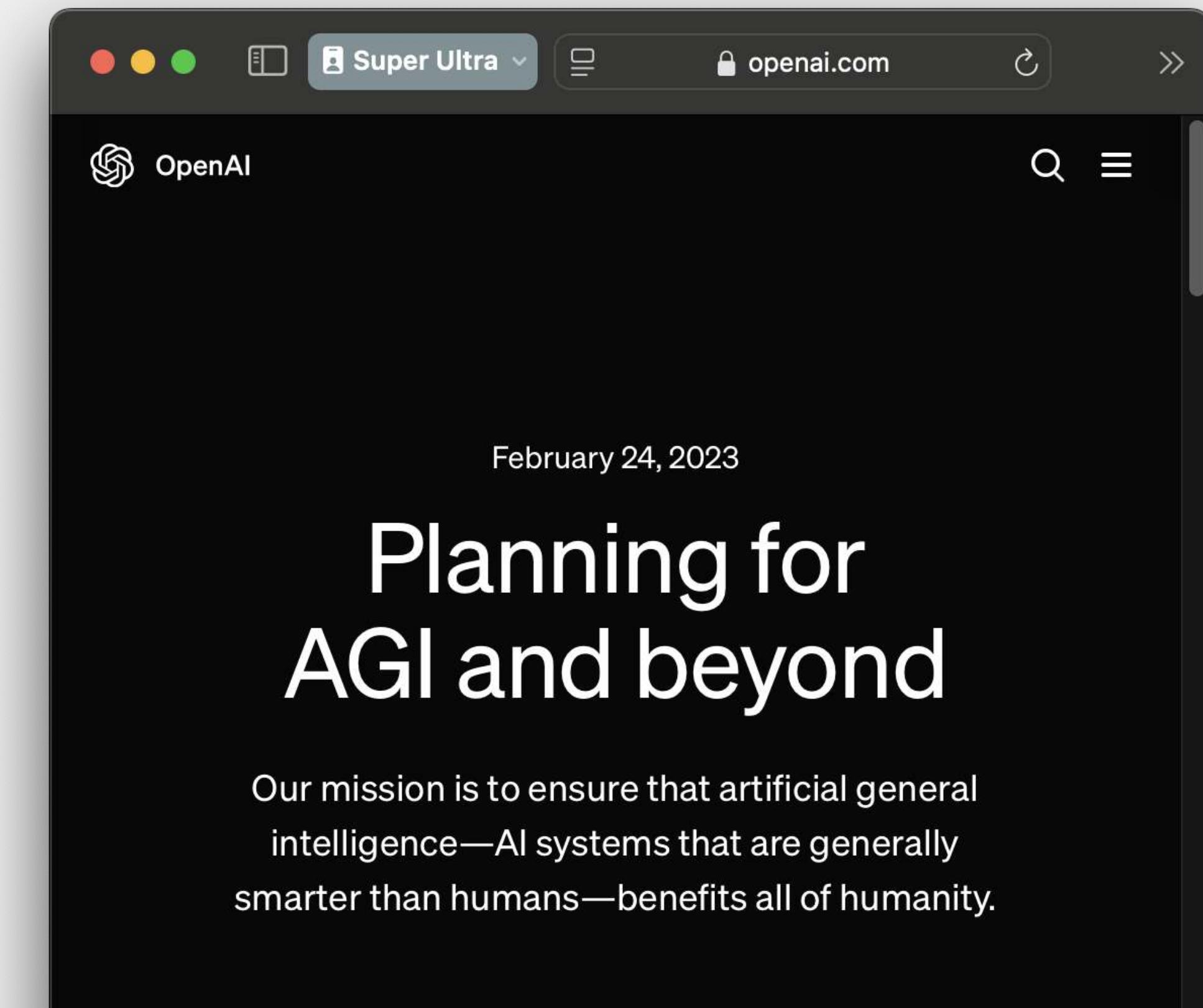
Training and using these models consume extraordinary large amounts of power, but some can be run locally.

Data and Ethics

What are these models trained on and what value systems power these choices? Some models are being developed for openness.

Artificial General Intelligence

<https://openai.com/index/planning-foragi-and-beyond/>



If there are people on this planet whose language doesn't include number or time...

... and we want to base a general intelligence on language...

... how general can our intelligence be? general to who?

<https://www.spiegel.de/international/spiegel/brazil-s-piraha-tribe-living-without-numbers-or-time-a-414291.html>

The screenshot shows a web browser window with the SPIEGEL International website. The URL in the address bar is spiegel.de. The page title is "SPIEGEL International". On the right side, there are links for "Abonnement" and "Anmelden". The main navigation menu includes "Menü", "Startseite", "International", "Zeitgeist", "Brazil", and "Brazil's Pirahã Tribe: Living without Numbers". A search icon is also present. The main content area features a dark background with white text. The headline reads "Brazil's Pirahã Tribe" and "Living without Numbers or Time". Below the headline, a text snippet states: "The Pirahã people have no history, no descriptive words and no subordinate clauses. That makes their language one of the strangest in the world -- and also one of the most hotly debated by linguists." At the bottom left, it says "Von Rafaela von Bredow" and the date "03.05.2006, 16.11 Uhr". A small note at the bottom right says "Dieser Beitrag stammt aus dem SPIEGEL-Archiv. Warum ist das wichtig?"

Remember our
chat about biases
in algorithms?

Can a computer have
a bad day?



The people who are most confident
AI can replace writers are the ones
who think writing is typing.

Andrew Ti



*When humanity ends, there will
be nobody to pay attention to
time*

Hiroshi Sugimoto

Our focus

We will learn to work
with GenAI as a tool
and material

To understand and
shape our mental
model of what it can
do

Module 2: Generative AI

(Chat)GPT

Learn to use ChatGPT to accomplish various tasks and work with the GPT API directly

Assistants

Learn how to use specific materials like books and documents to create specific GPT Assistants

Image Generation

Learn how to generate and modify bitmap images

That's it

Questions? Comments? Thoughts?

