

Modern Powerhouses of AI

Part 1: The Major Areas of AI in Modern Life

Question:

*What uses of AI have you
encountered today?*

What We'll Cover

- Natural Language Processing (NLP)
- Large Language Models (LLMs)
- Computer vision and image processing
- Forecasting and prediction
- Autonomy and robots
- Creative AI and "the algorithm"

Natural Language Processing (NLP)

Natural Language Processing (NLP)

- Computers understanding, interpreting, and generating human language
- "*Teaching computers to read between the lines*"
- Written text is split into paragraphs, sentences, parts of speech, etc. and then converted to numerical form that computers can interpret
- Has its foundations in early "chat bots" in the 1960s
- ELIZA chat bot developed in 1966 by Joseph Weizenbaum at MIT*

* <https://en.wikipedia.org/wiki/ELIZA>



Image adapted from <https://www.oldcomputr.com/digital-vt100-1978/>

Developments in NLP

Early foundations (in the 1960s) used basic **pattern-matching** techniques and simple rules

In the 1990s, more advanced statistical methods were developed for **spam filters** and early **language translation** techniques

The explosion of **deep learning** methods in the 2010s, enabled by more powerful CPUs and GPUs, dramatically improved NLP leading to fast and accurate language interpretation and translation

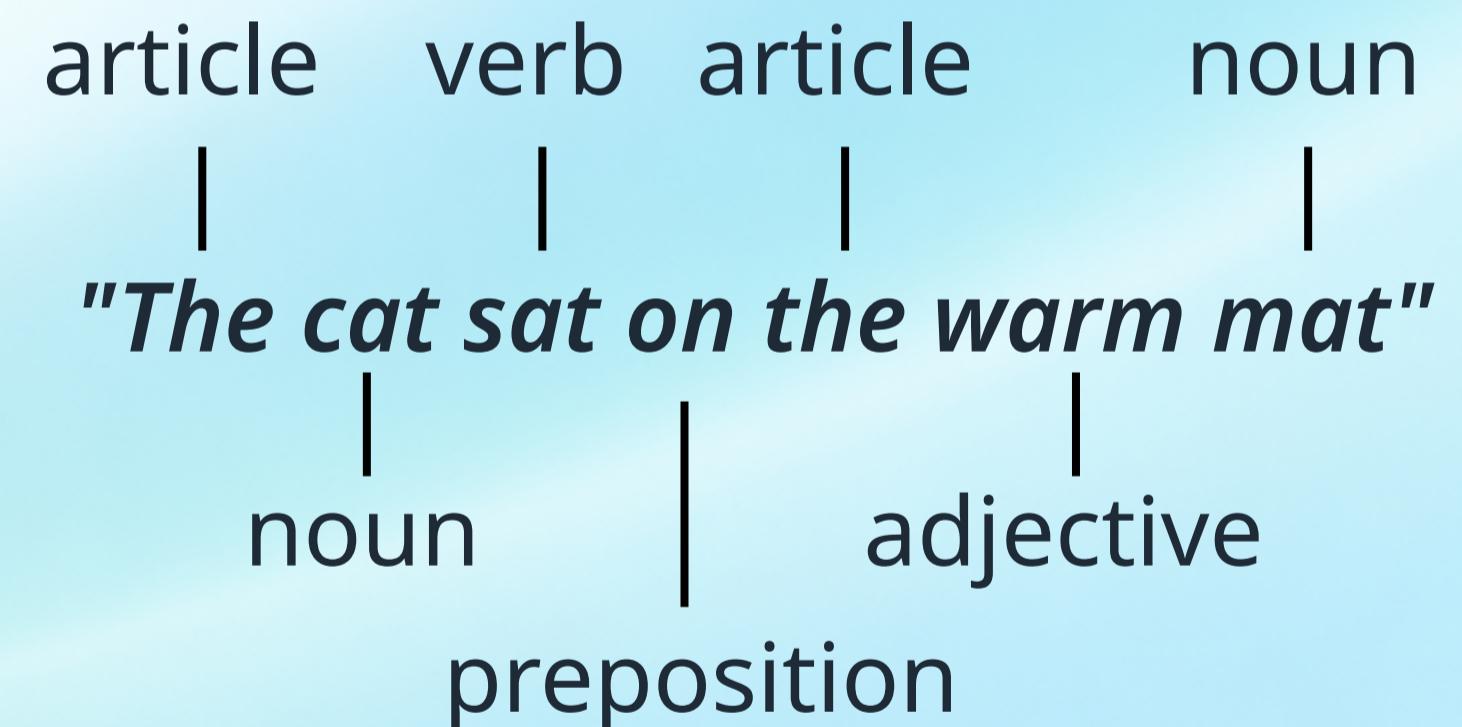
LLMs are the ultimate evolution (for now) of Natural Language Processing

How NLP Works

Tokenisation: breaking sentences up into smaller chunks, often words

Parts of speech: labelling words with grammatical rules

Similar process to how humans learn languages and grammar



How NLP Works

Named entities: categorising nouns

Sentiment analysis: the sentiment of the first sentence is neutral, the second is positive

Word embeddings: similar words live closer in mathematical space, e.g. "king" and "queen" are close together, like coordinates on a map

person place day

| | |

*"Sarah flew to Paris on Monday.
She had an amazing time*

|

positive
sentiment

NLP in Action

Early Google Translate was not perfect.
The translation here reads "*An alligator follows you, run idiot!*" in a Lebanese dialect

It can now understand context, nuance, idioms - all complex language features

LLMs are now able to translate too

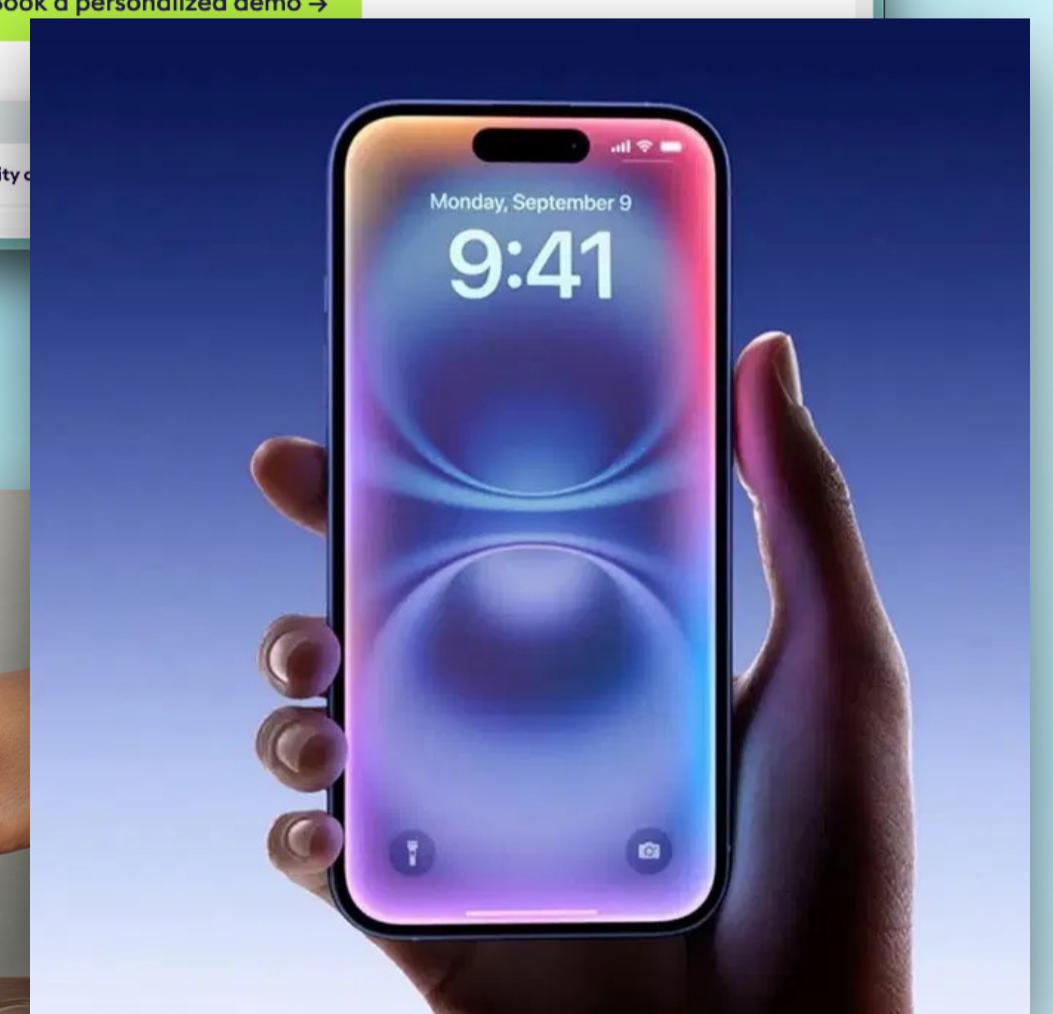
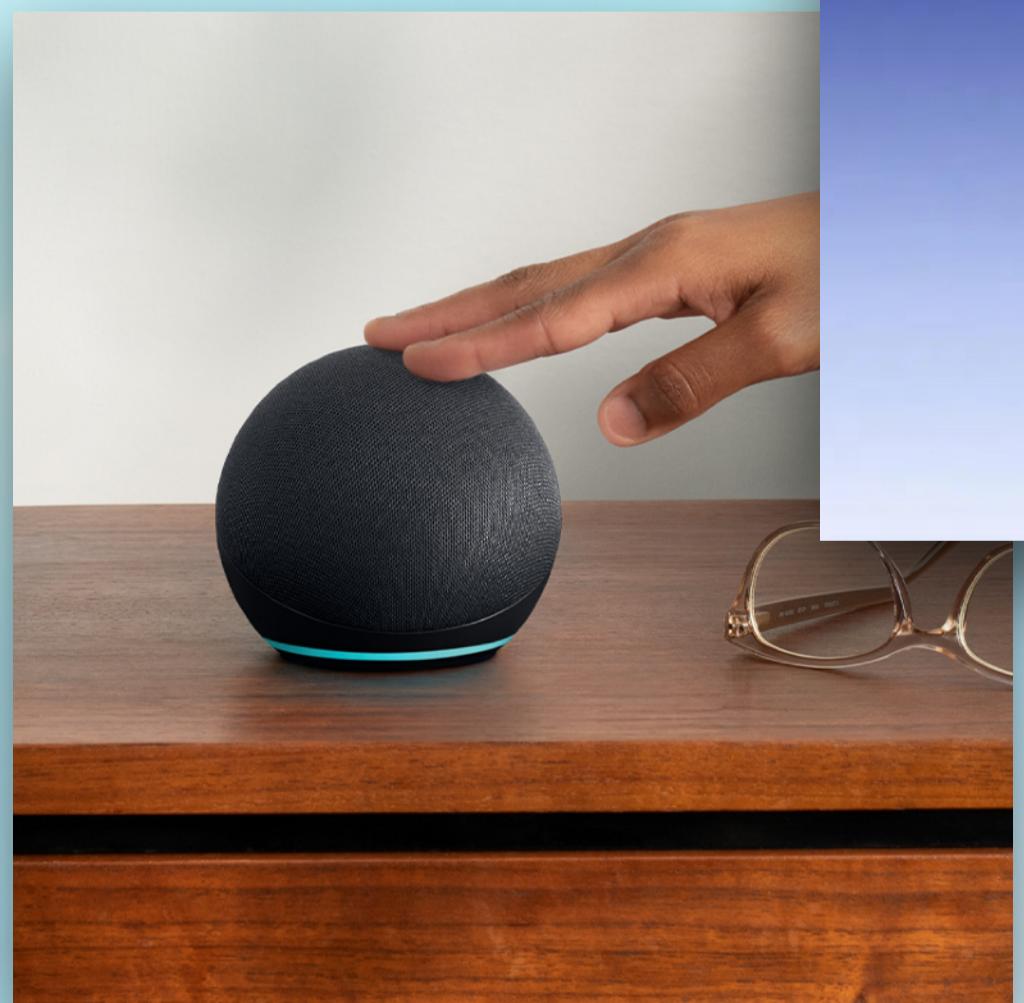


NLP in Action

Sentiment analysis: often used to analyse positive/negative social media or customer feedback/reviews

Voice assistants: services like Siri and Alexa use speech-to-text, then NLP, then text-to-speech

The screenshot shows the Chattermill website homepage. At the top, there's a navigation bar with links for 'Platform', 'Solutions', 'Plans', 'Customer Stories', 'Resources', 'Sign in', and a prominent green 'Book a demo' button. Below the navigation, a banner reads 'Voice of Customer and Text Feedback Analysis Platform'. The main headline says 'Transform all your customer feedback into decision-ready insights'. A subtext explains that Chattermill is the CX intelligence platform that unifies fragmented feedback and turns it into precise AI-powered insights. There's also a smaller inset image showing a laptop screen with a Chattermill interface.

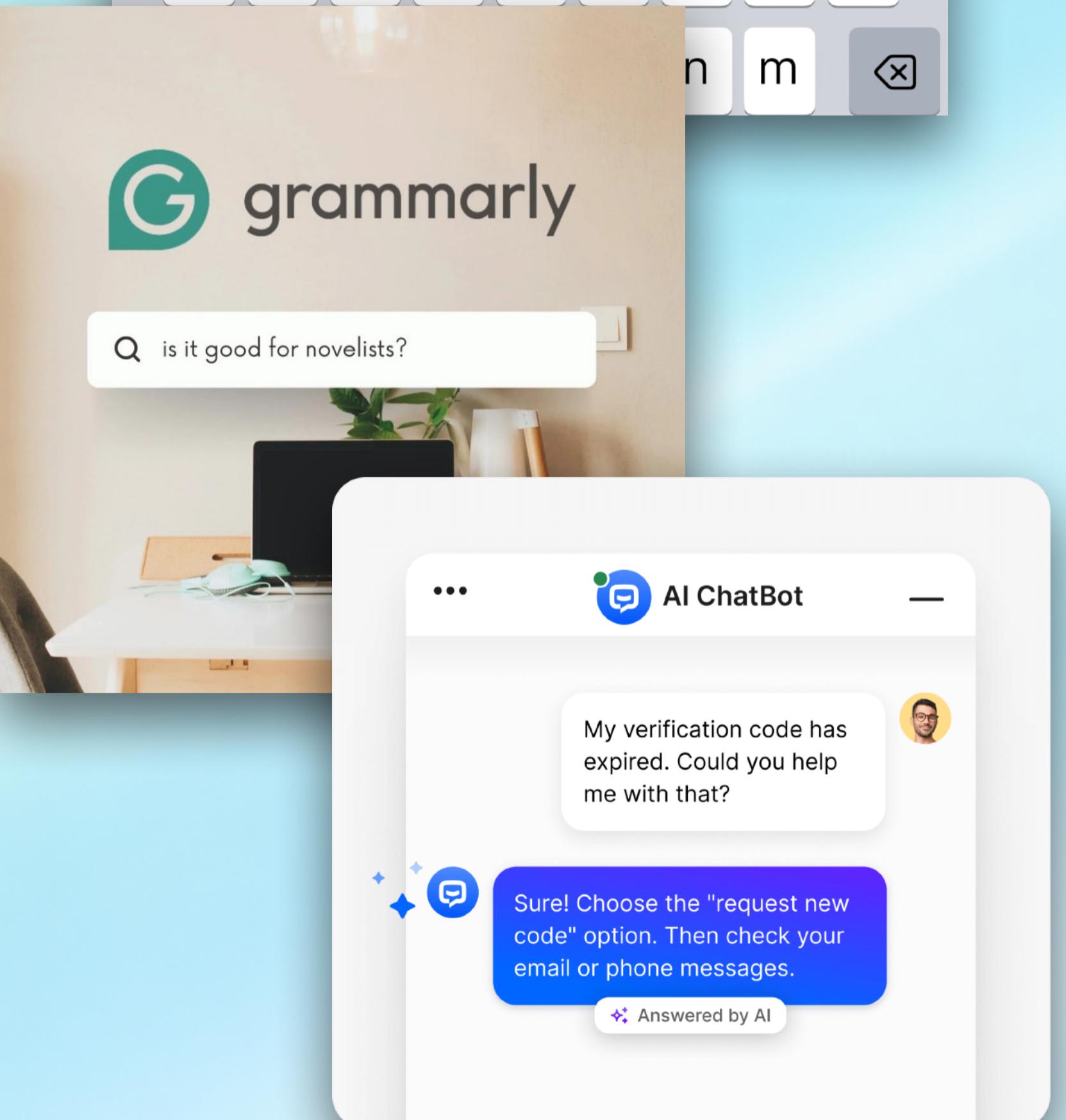
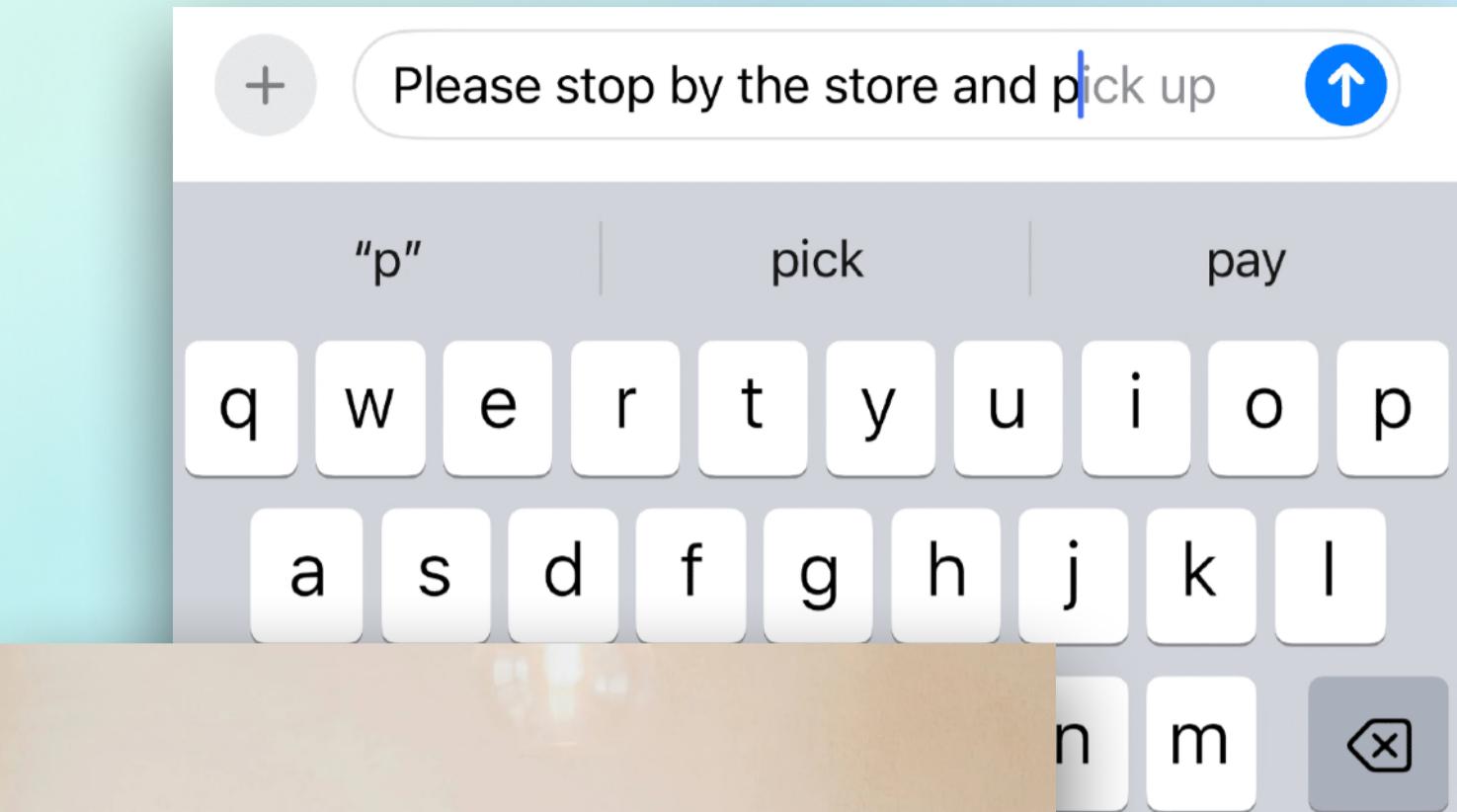


NLP in Action

Autocomplete/predictive text: your phone uses word context to predict the next word, or to complete words

Grammar/writing tools: these tools can rewrite or re-style your written text

Customer service chatbots: many companies use these in place of human customer support



Large Language Models (LLMs)



* Back at it, Sandy

How can I help you today?



Opus 4.5



</> Code

Create

Learn

Write

Life stuff

openai.com

Research

Safety

For Business

For Developers

ChatGPT

Sora

Stories

Company

News

Introducing ChatGPT Go, now available worldwide
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The new ChatGPT Images is here
Product 7 min read

Introducing GPT-5.2-Codex
Product 5 min read

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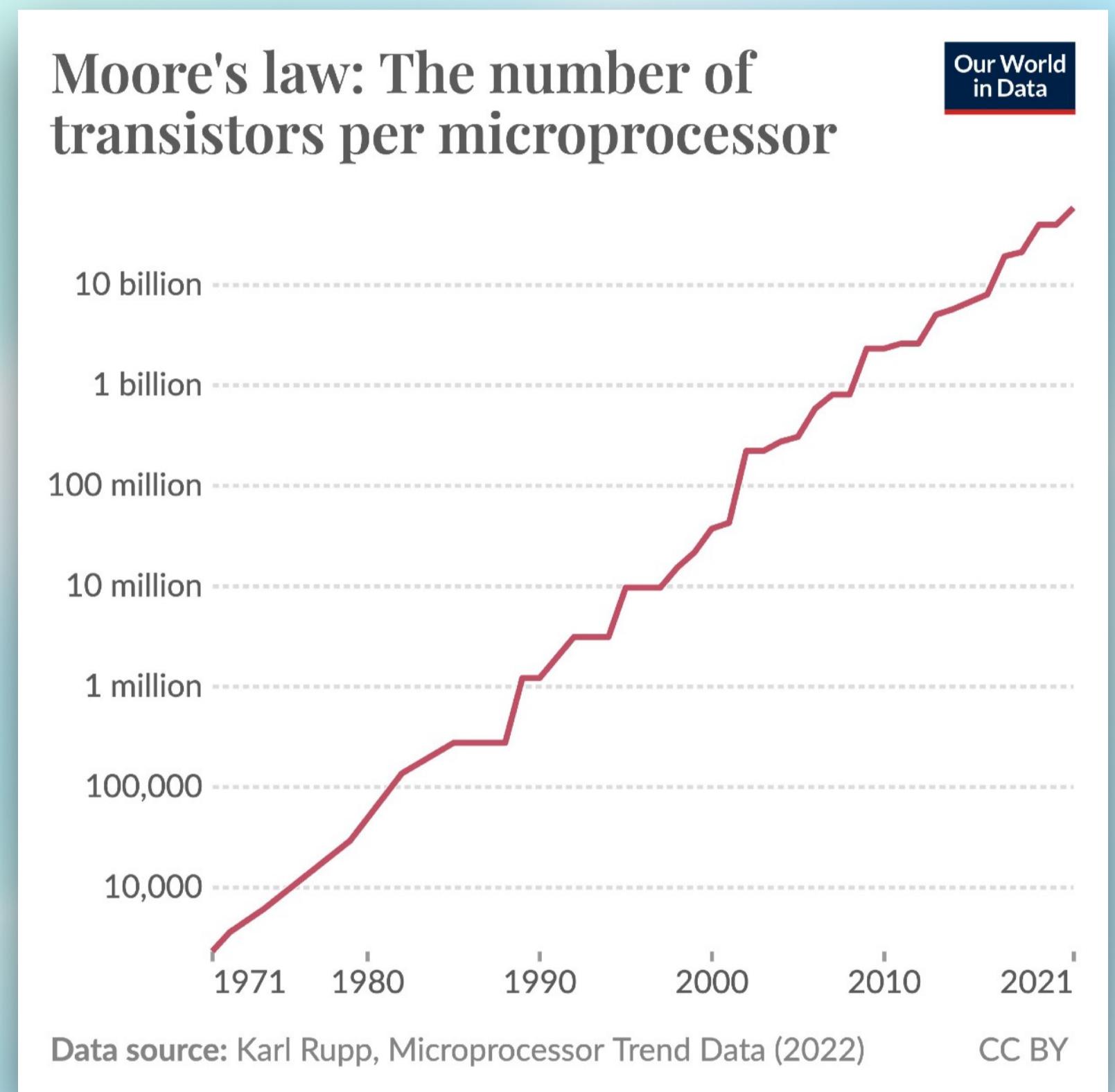
Create a custom quiz from audio input

Transform a sketch into a realistic image

NLP to LLMs

The dramatic increase in transistor density has enabled LLMs to operate at huge scale and replace traditional smaller-scale NLP methods

They operate very similarly, interpreting and generating human language, but are dramatically more "clever"



What is an LLM?

An **LLM (Large Language Model)** is a neural network that takes some text as input (called a **prompt**) and successively generates words as output

The models are trained on vast amounts of text to learn patterns

Analogy is someone reading *all* of the internet, and then being able to recall parts of it in seconds

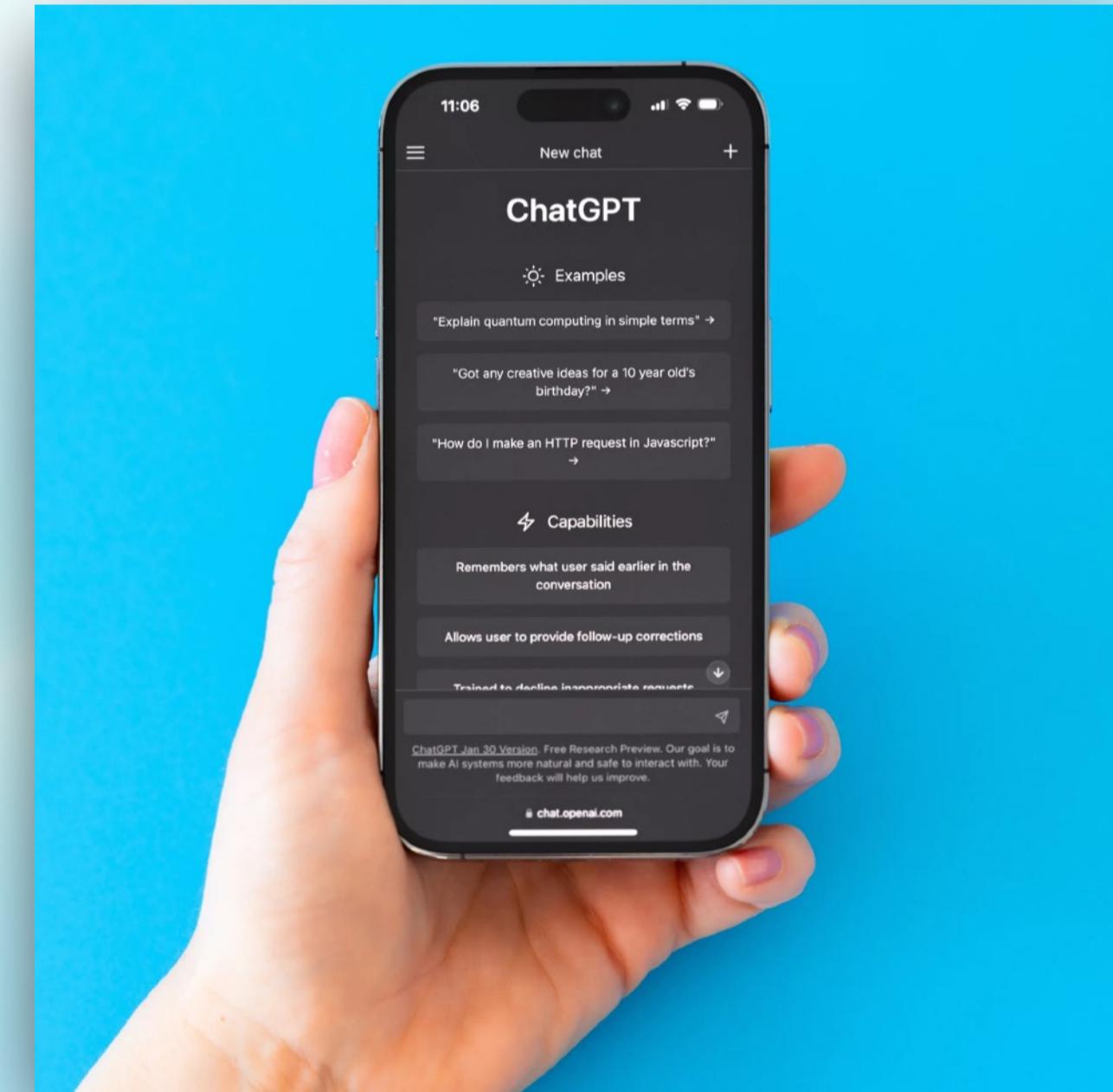
We'll go into more detail on LLMs tomorrow...

Why LLMs Matter

LLMs like **ChatGPT** and **Claude** have democratised using AI, because they generalise so well

This is in contrast to more specific models that have specific use cases

LLMs can do many more things, and do almost all of them as well as specific AI models/techniques



Computer Vision & Image Analysis

What Do We Mean By "Computer Vision"?

Teaching computers to "see" and interpret images and video, usually by showing them *lots* (millions) of training images

Analogy is babies learning to recognise specific faces and other objects

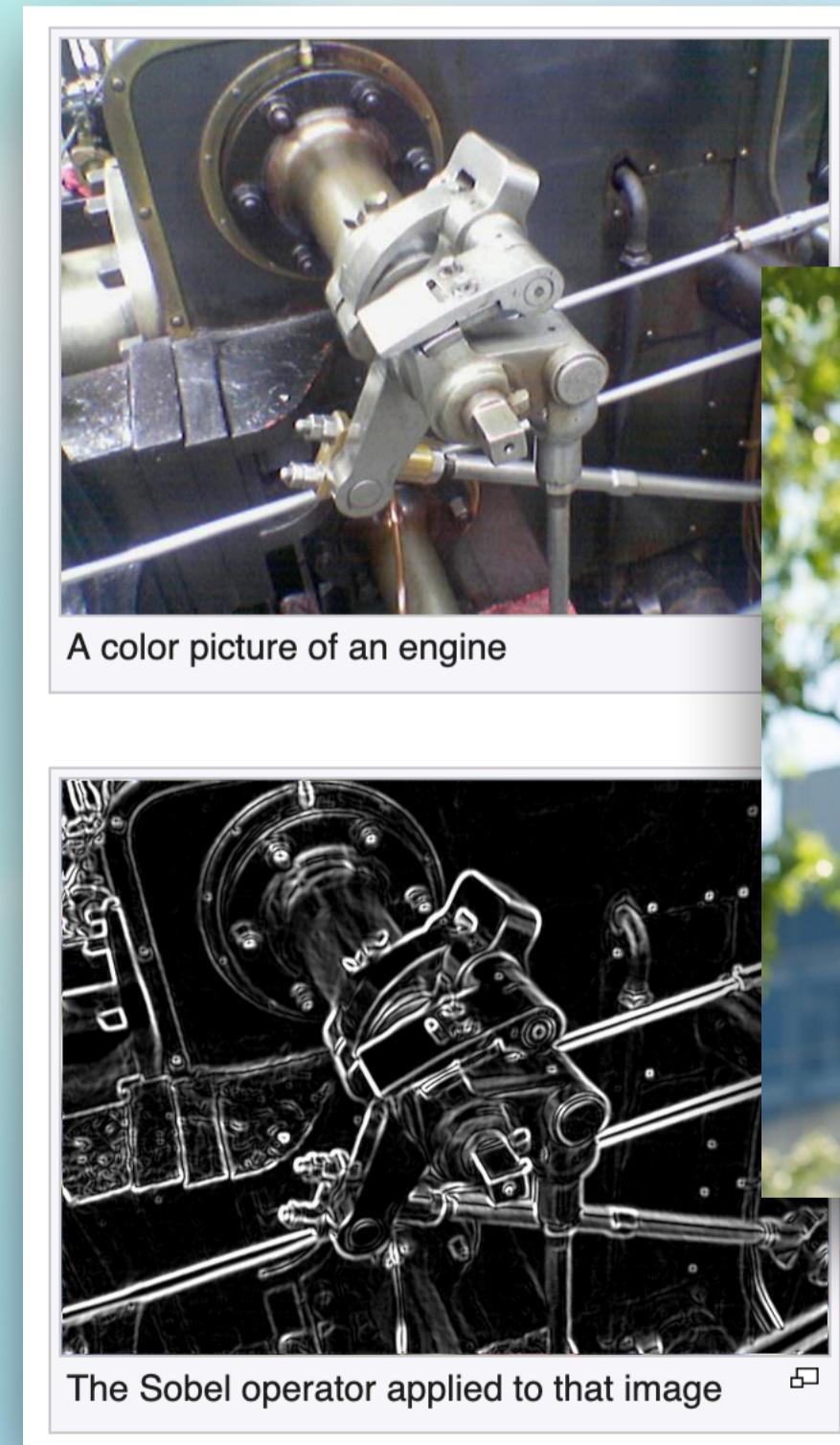


A Brief History of Computer Vision

Early edge detection methods (Sobel operator*) and shape recognition in the 1960s

AlexNet deep convolutional neural network wins ImageNet competition in 2012. **Geoffrey Hinton** is involved.

Arguably the start of the AI explosion



* https://en.wikipedia.org/wiki/Sobel_operator

How it Works

- Images converted into grids of numbers (pixels to matrices)
- Convolutional neural networks look for patterns in the numbers
- Edges detected, then shapes, then specific objects
- Similar to making a painting: pencil sketch first, block in colours, add detail
- Done at huge scale on millions of training images

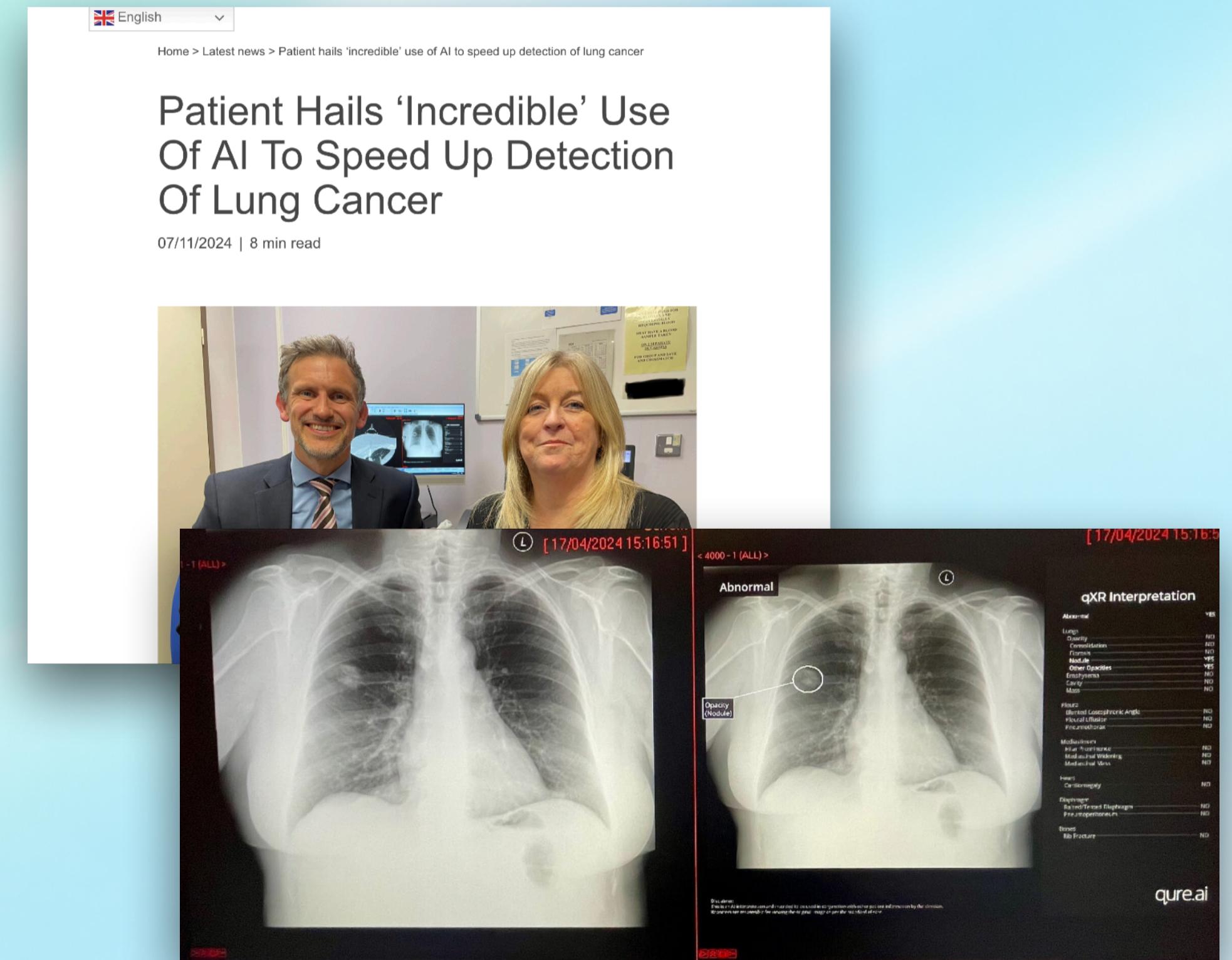
Computer Vision in Action

Being used increasingly in medical imaging and diagnosis, esp. for detecting cancer from scans

qXR software from Qure.ai

Can triage query cases for consultants to speed up diagnosis and treatment

Diabetic retinopathy screening



* <https://www.nhsggc.scot/patient-hails-incredible-use-of-ai-to-speed-up-detection-of-lung-cancer/>

Computer Vision in Action

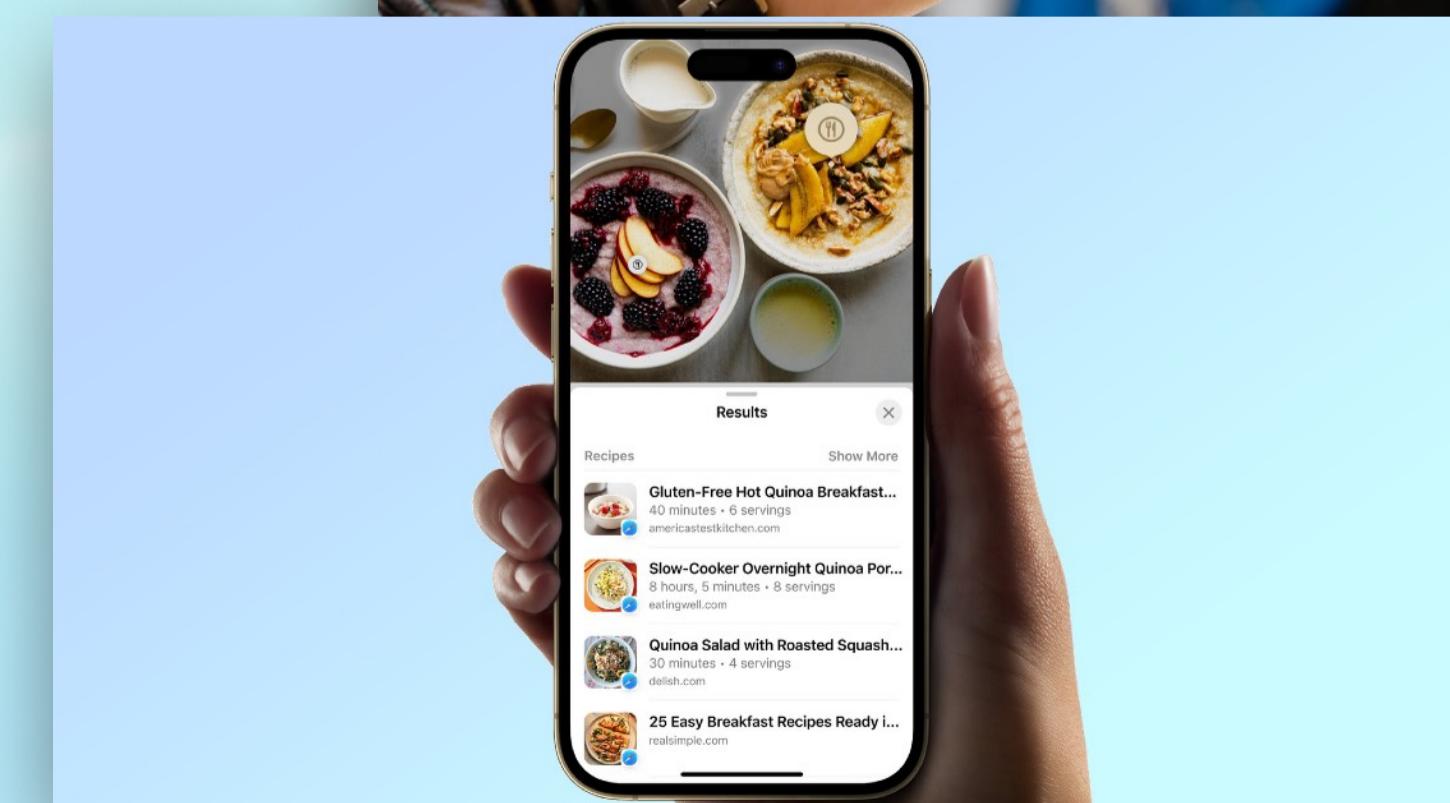
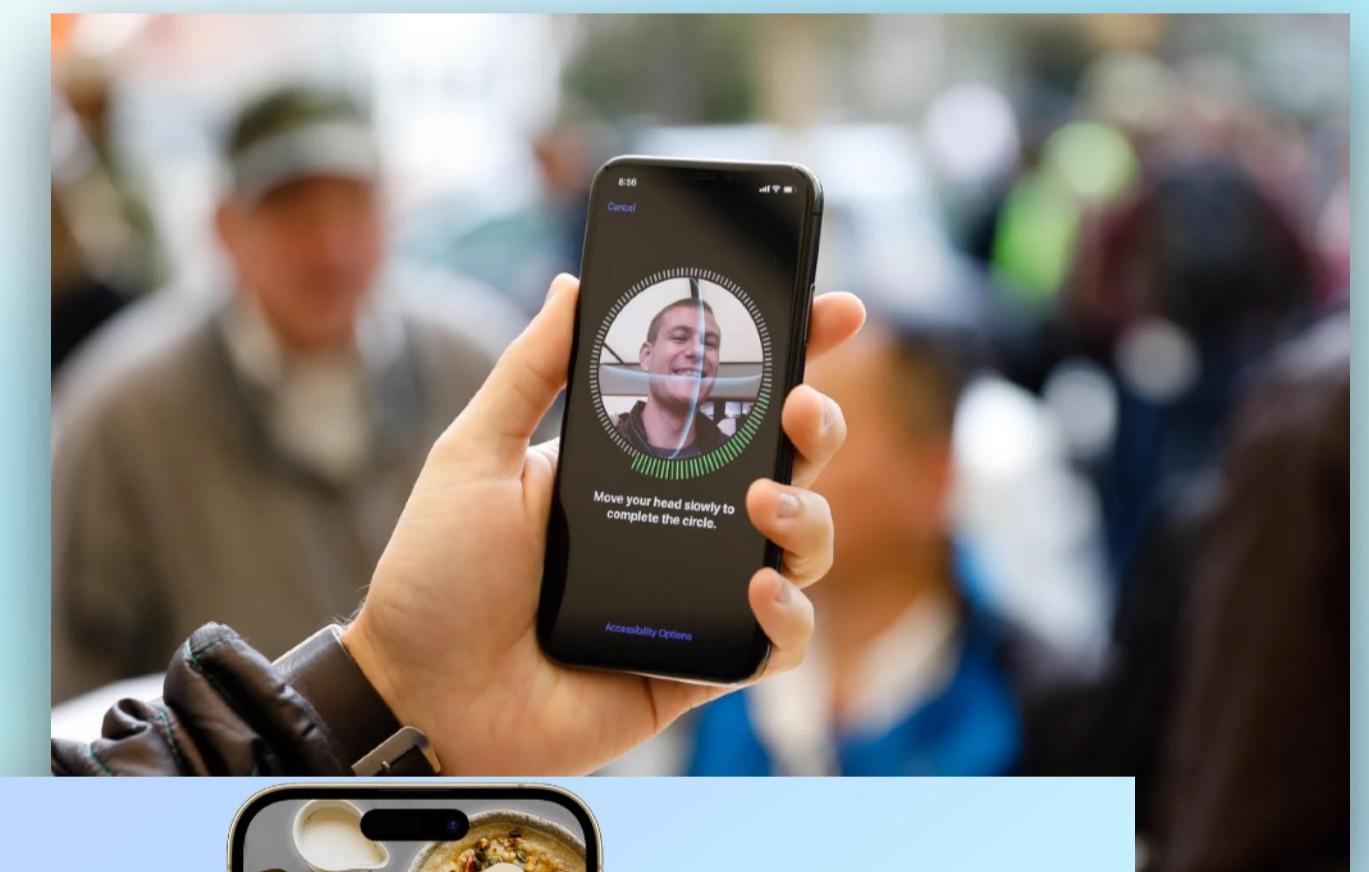
Used frequently in our everyday lives

Face ID/unlock on our phones

Photo categorisation/search on our phones

"Visual lookup" on our phones

Accessibility: object descriptions, door detection



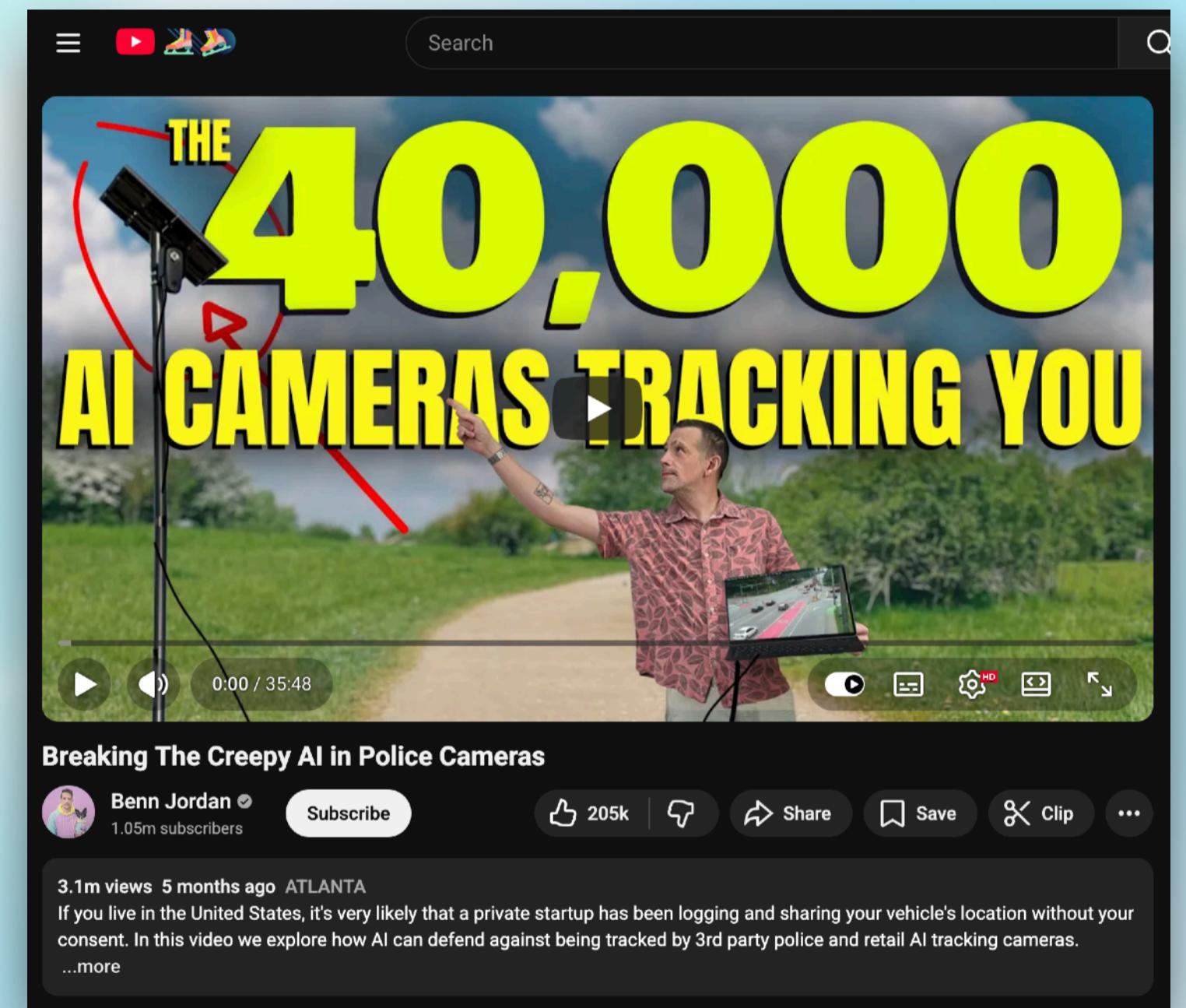
Computer Vision in Action

CCTV/surveillance analysis

Automated number plate recognition
(ANPR) camera systems

Significant privacy implications, data collection concerns

e.g. Flock Safety cameras in US (see Benn Jordan's excellent videos on YouTube*)



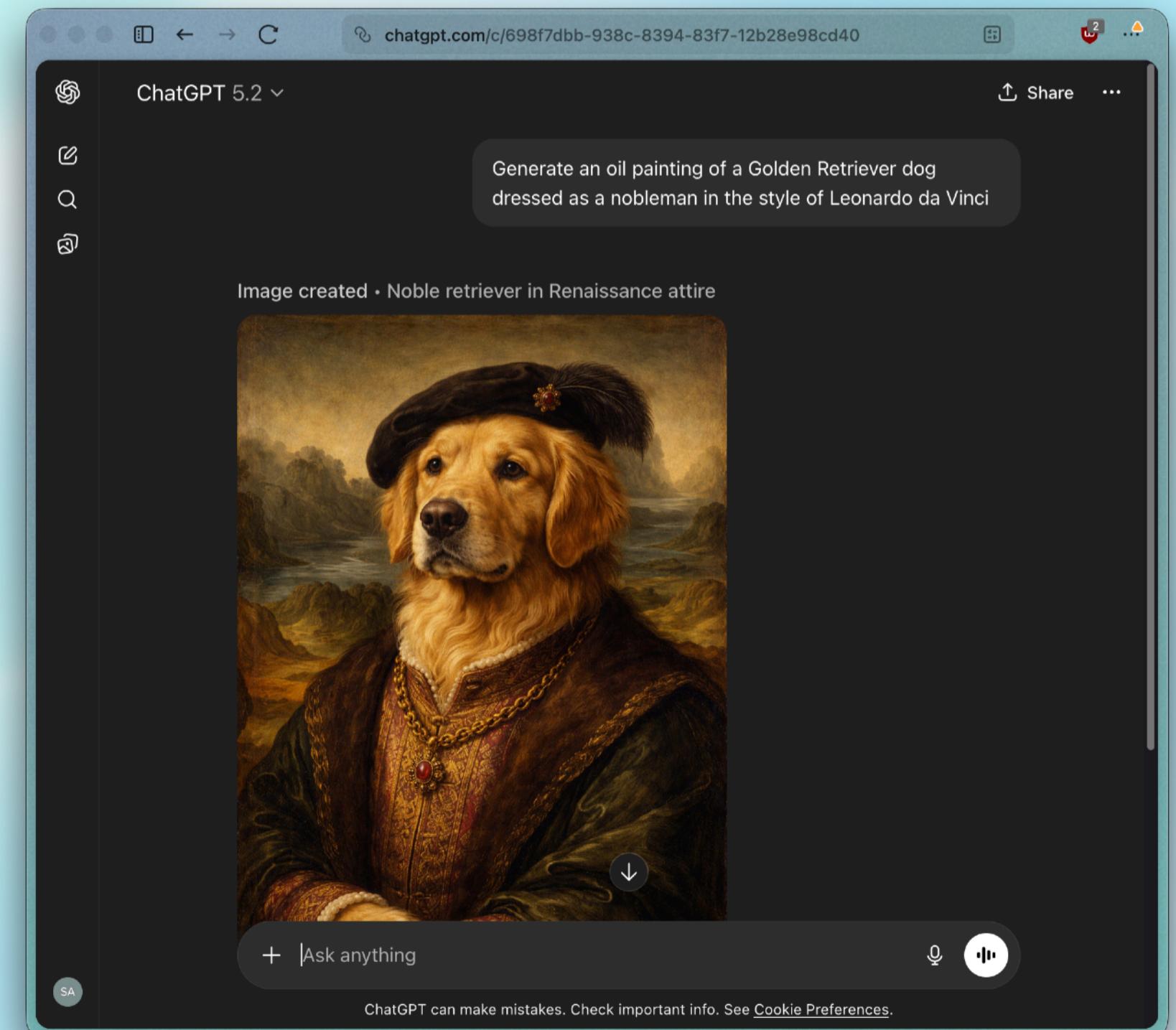
* <https://www.youtube.com/watch?v=Pp9MwZkHiMQ>

Computer Vision in Action

As well as recognising images, AI can now generate images using LLMs

DALL-E/Nano Banana (Google), ChatGPT (OpenAI) and Sora for video, Midjourney

Ethical concerns around training data, intellectual property right, "AI slop" versus human art



Forecasting & Prediction

AI as a Crystal Ball

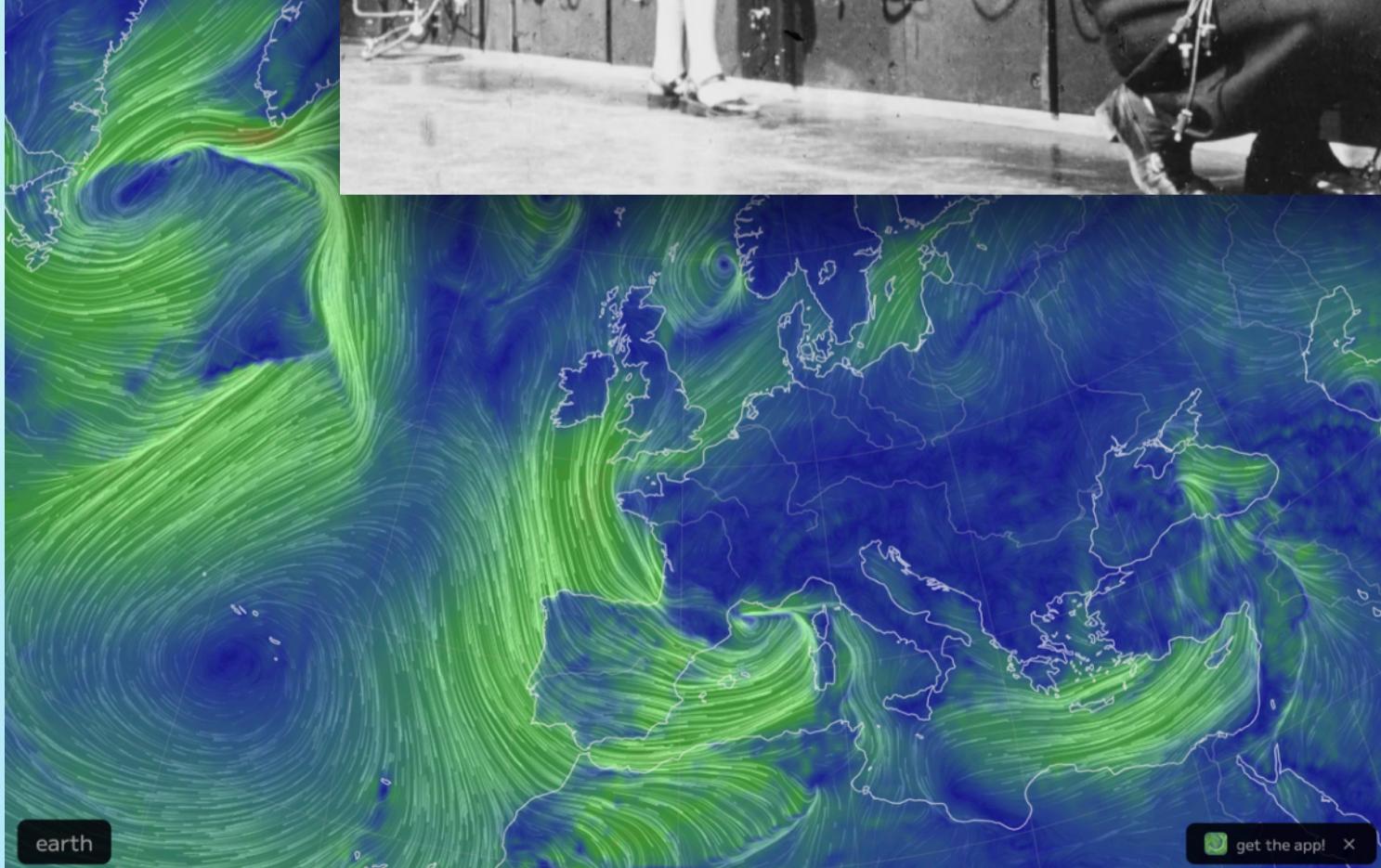
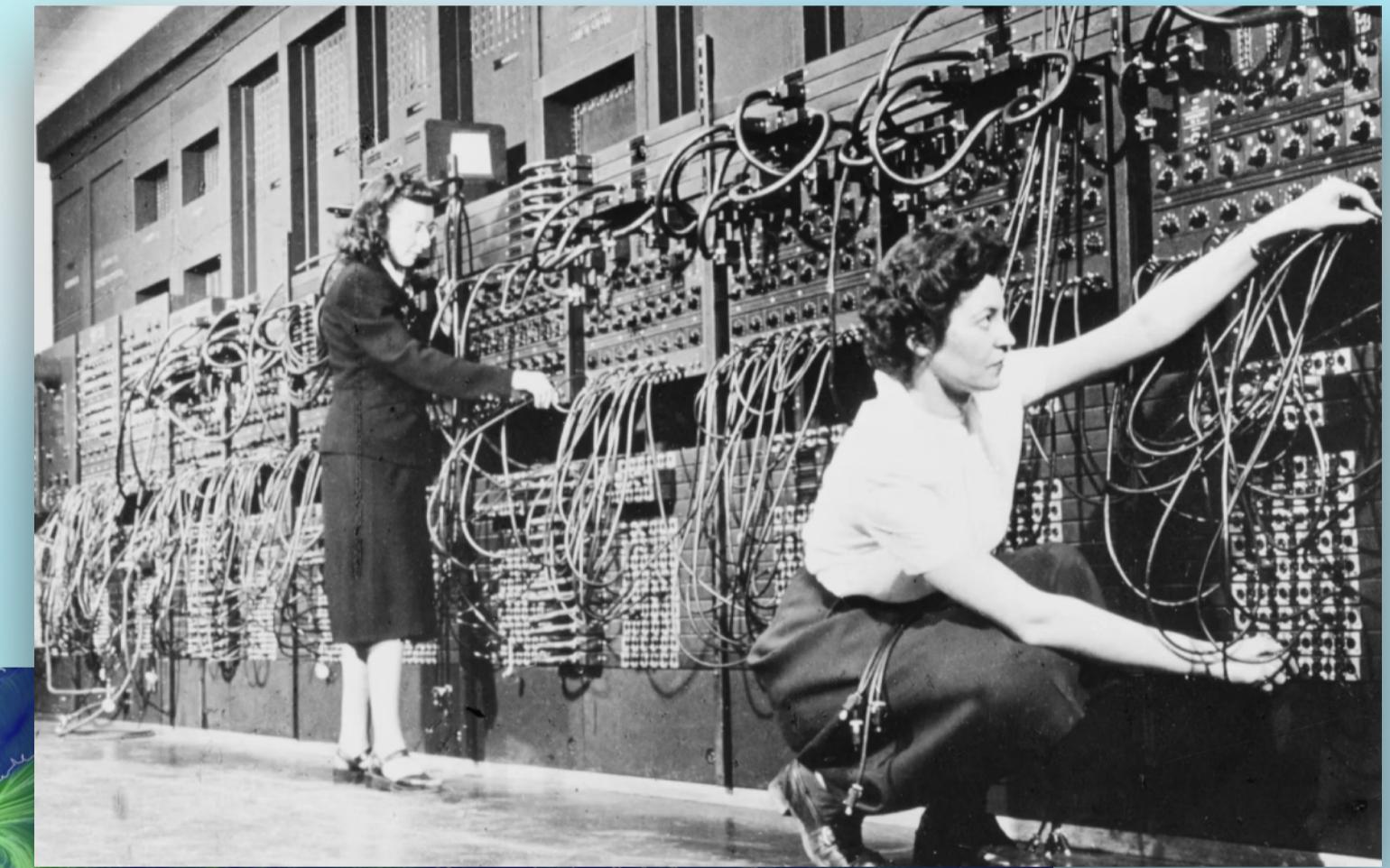
Early economic models used moving averages and regression models

Early computers were used for weather and economic forecasts from the 1950s to the 1970s (e.g. ENIAC*)

In the 1980s and 90s, neural networks were used for credit scoring and fraud detection

In the 2000s, machine learning takes over, dramatically improving forecasting

Now, deep learning and LLMs are used everywhere for prediction of energy grid demand, traffic management, weather forecasting, and more



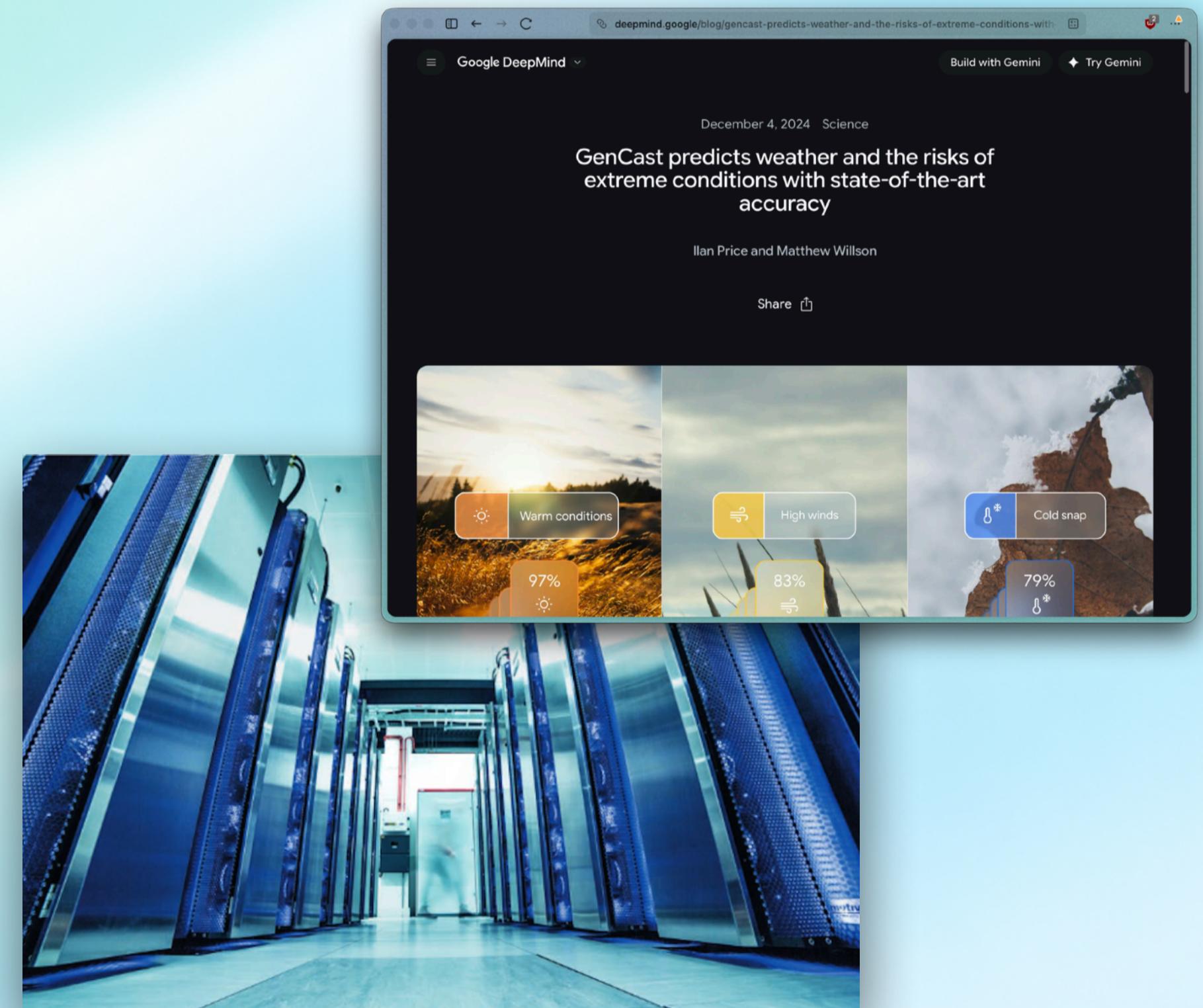
* <https://www.aps.org/apsnews/2022/11/eniac-first-top-secret-program>

Forecasting in Action

Traditional weather forecasts used physics-based models and were computationally intensive to simulate, running on supercomputers like the Cray XC40*

Now, AI models like **Google GraphCast**, **DeepMind GenCast**, and **WeatherNext 2** can run on fairly modest hardware and low resolution models can run on consumer machines

GraphCast and GenCast are open source and open weight models



* <https://archivesit.org.uk/supercomputers-and-the-met-office-at-the-forefront-of-weather-and-climate-science/>

Forecasting in Action

In business, AI enables stock predictions, fraud detection, forecasting supply chain demand

Difficulty here is the human factor, which can be hard to predict and model

Up to 60-75% of trading is now "algorithmic" and automated high-frequency trading*

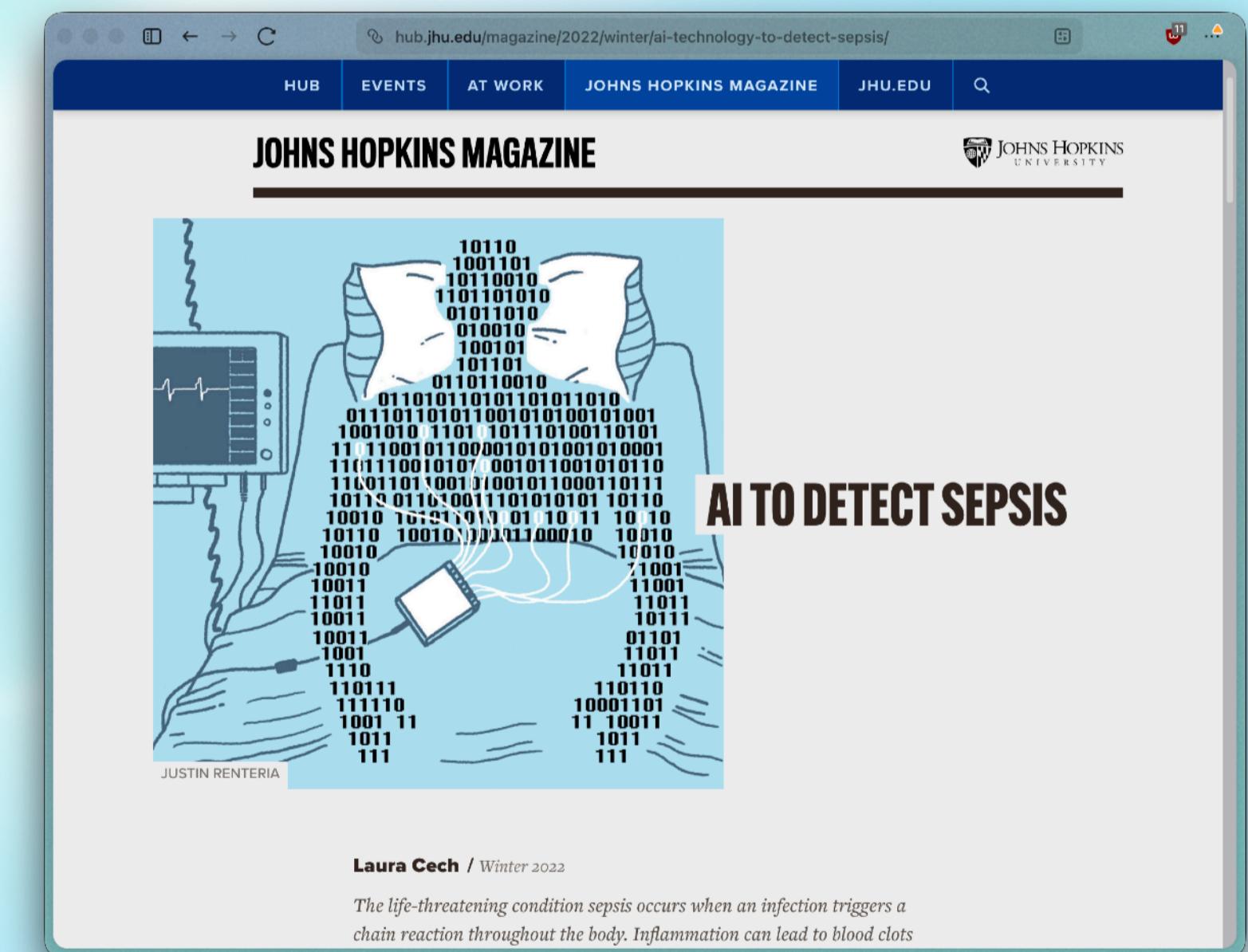


* <https://www.quantifiedstrategies.com/what-percentage-of-trading-is-algorithmic/>

Forecasting in Action

In healthcare, AI-based algorithms that monitor changes in dozens of variables are being used to grade risk of developing sepsis*

These are reducing the risk of death from sepsis by 20%, by identifying cases more quickly



* <https://hub.jhu.edu/magazine/2022/winter/ai-technology-to-detect-sepsis/>

How it Works

- Time series analysis: measurements taken through time, and historical data used to detect patterns that can predict future behaviour
- Imagine measuring sea water heights over a day, and then you would have a fairly good idea of the pattern of the tides for the following day
- The combination of the wealth of data collection we have now, and the scale at which AI can operate, allows high confidence predictions
- Human factors and freak events (e.g. the COVID pandemic) can throw models off

Autonomy & Robotics

Key Events in Autonomy & Robotics

In the 1960s, "Shakey" the robot* was developed at Stanford University, which could interpret commands rather than being given individual steps to perform

DARPA was a competition in which autonomous vehicles tried to cross the desert. In 2004, no cars finished; in 2005, five did.

From the 2010s, autonomous vehicles advanced hugely. Now we have fully autonomous taxis, like Waymo (from Alphabet/Google) in the US.



* https://en.wikipedia.org/wiki/Shakey_the_robot

Autonomy in Action

Fully or partially autonomous vehicles are one of the most recognisable uses of autonomy now

They use cameras with object detection, GPS, LIDAR and many more sensors, along with deep learning, to navigate routes

Many consumer cars now have partially autonomous features like adaptive cruise control

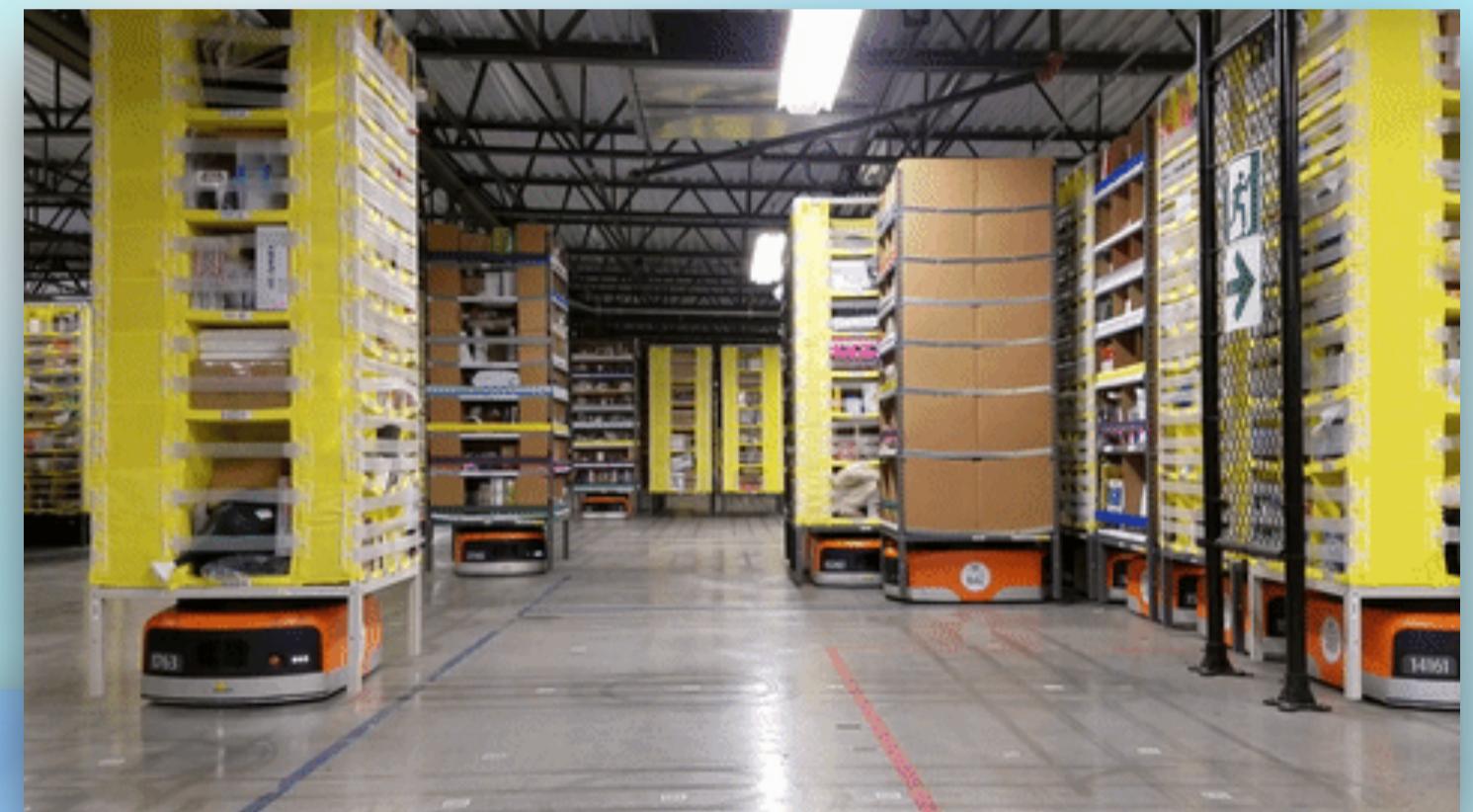


* <https://bernardmarr.com/how-tesla-is-using-artificial-intelligence-to-create-the-autonomous-cars-of-the-future/>

Autonomy in Action

Amazon fulfilment warehouses uses robots to move products around the warehouse

In agriculture, robots are being used increasingly: for planting seeds, harvesting, and monitoring fields with drones



* <https://www.escatec.com/blog/the-rise-of-the-farming-robots-10-agtech-innovations>

Autonomy in Action

Autonomous delivery drones are still not widely-used, but Zipline* delivering medication and vaccines in remote areas of Africa is a headline story

Military drones are a highly controversial use of autonomous drones, with Palantir and Anduril Industries being high-profile names



The Future
of Drone
Navigation:
INTRODUCING VNS
Palantir's
Visual Naviga



* [https://en.wikipedia.org/wiki/Zipline_\(drone_delivery_company\)](https://en.wikipedia.org/wiki/Zipline_(drone_delivery_company))

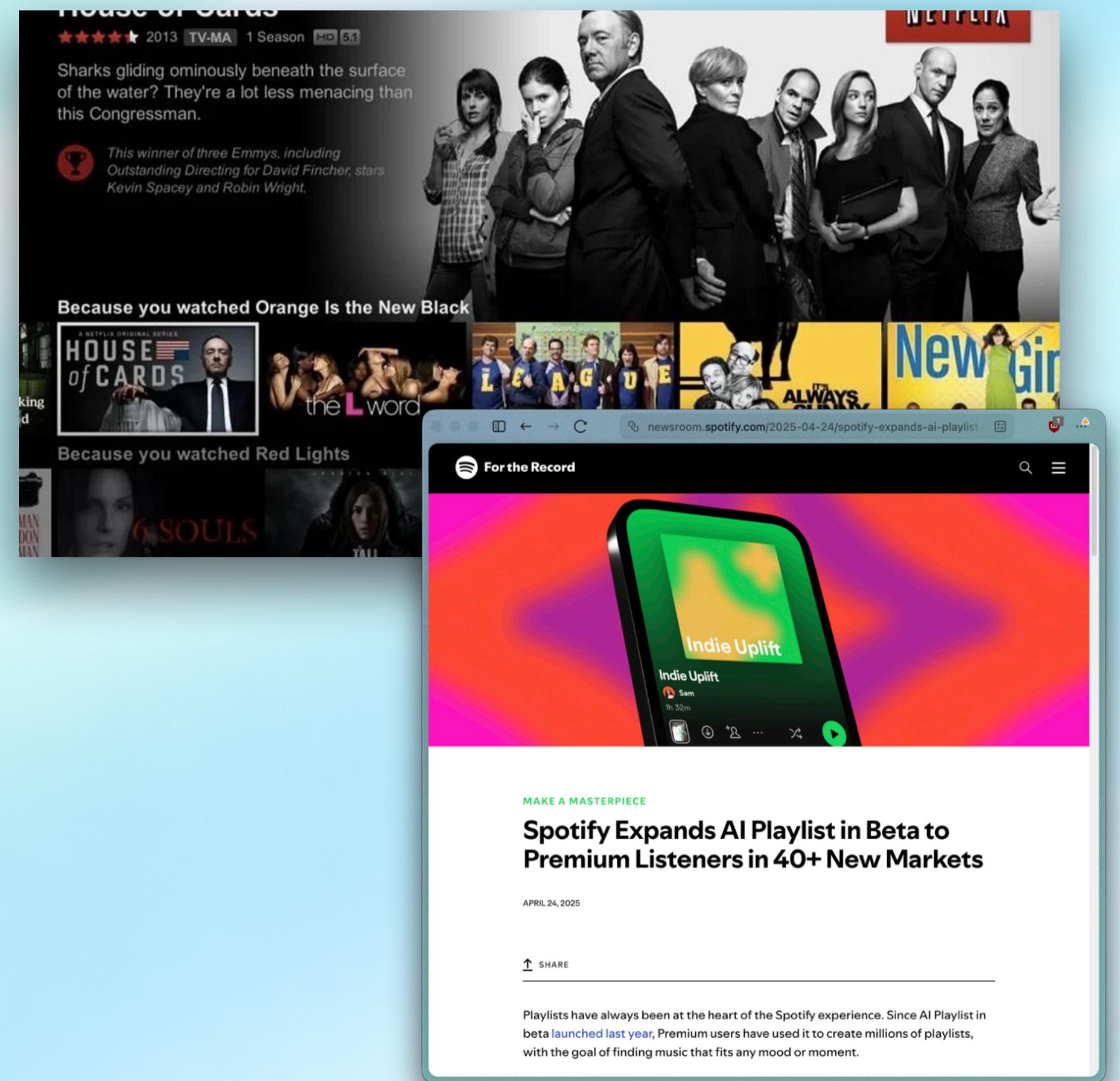
"The Algorithm"

"The Algorithm"

Recommendation algorithms are one of our most frequently-encountered uses of AI: your Facebook feed posts, Netflix recommendations, Spotify playlists, etc.

These use your data to determine what other things may interest you

Ethical concerns over data collection



Question:

*What other everyday uses of AI can
you think of?*

The Common Thread

- The common thread is that all these methods involve pattern-matching
- Patterns in language, pixels, time series, sensors, and more
- Humans are very good at recognising patterns, computers and AI excel at it
- The volumes of data that feed into models now far exceeds what humans could process and make sense of
- Developments in transistors on CPUs and GPUs has enabled this

Rate of Change

- Since the 2010s, AI and especially deep learning has exploded and advanced exponentially, especially with LLMs
- Questions remain over whether it is a bubble that will burst imminently
- No doubt over the impact of it already, e.g. AlphaFold
- What next?!