Artificial Intelligence

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SYSTEM STATUS
OPTIMAL
SYNC
ONLINE DRF-1
ONLINE NEF-2
ONLINE VIS-4
ONLINE MOT-6


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Founding Partner Brain Analytics Technologies
SYSTEM STATUS
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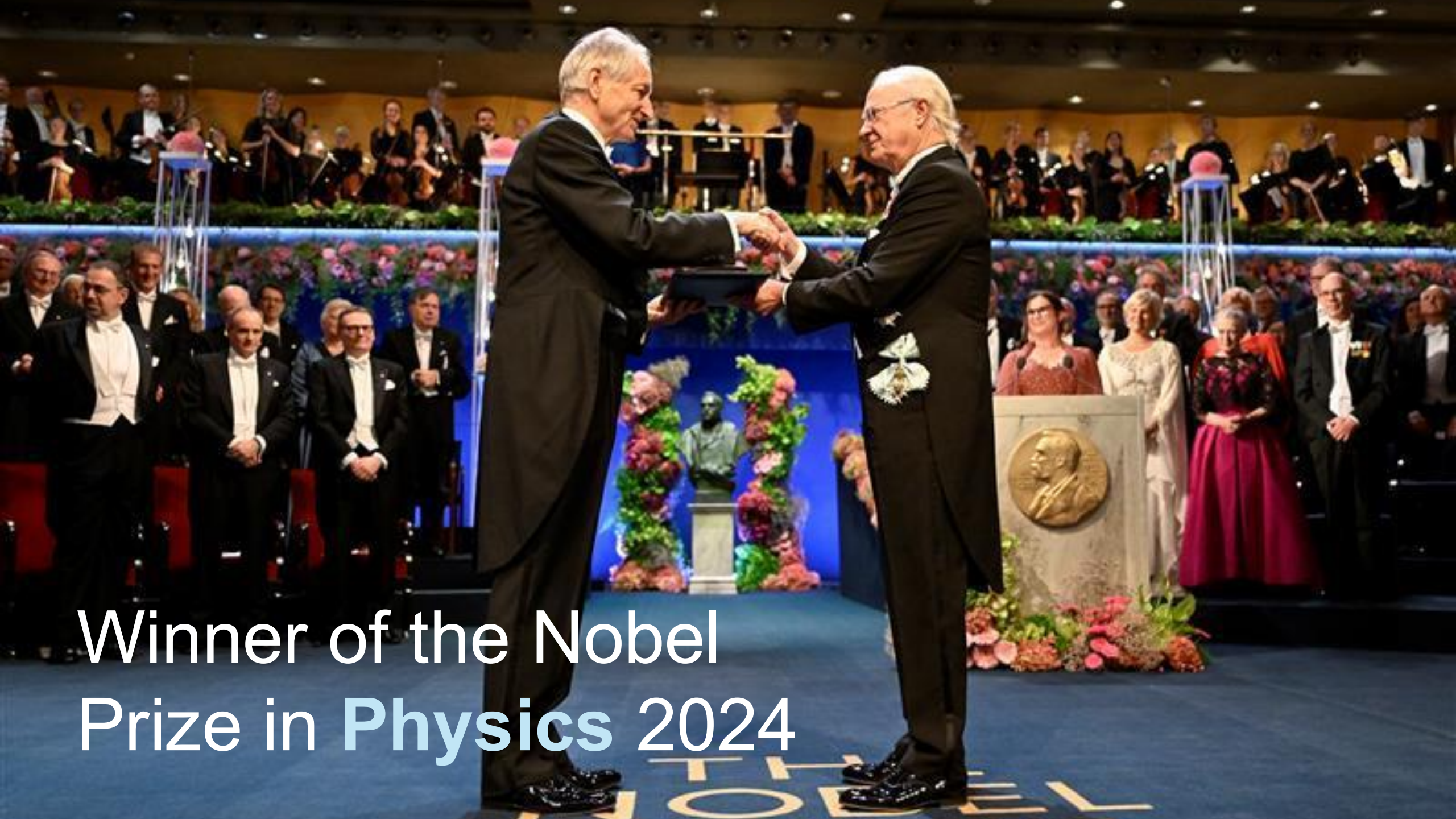
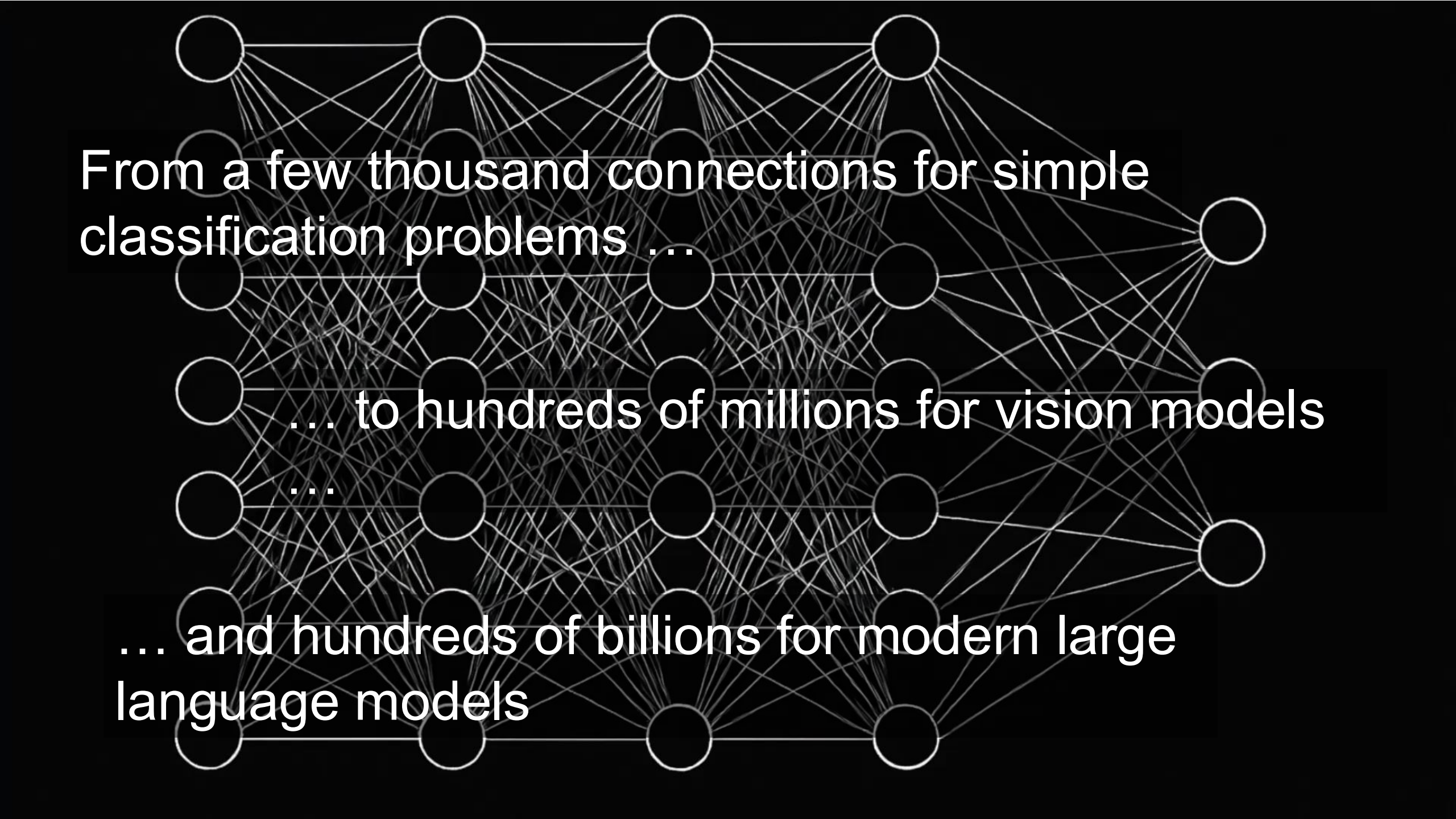
Disruptions?


Geoffrey Hinton
University of Toronto


Winner of the Nobel
Prize in Physics 2024

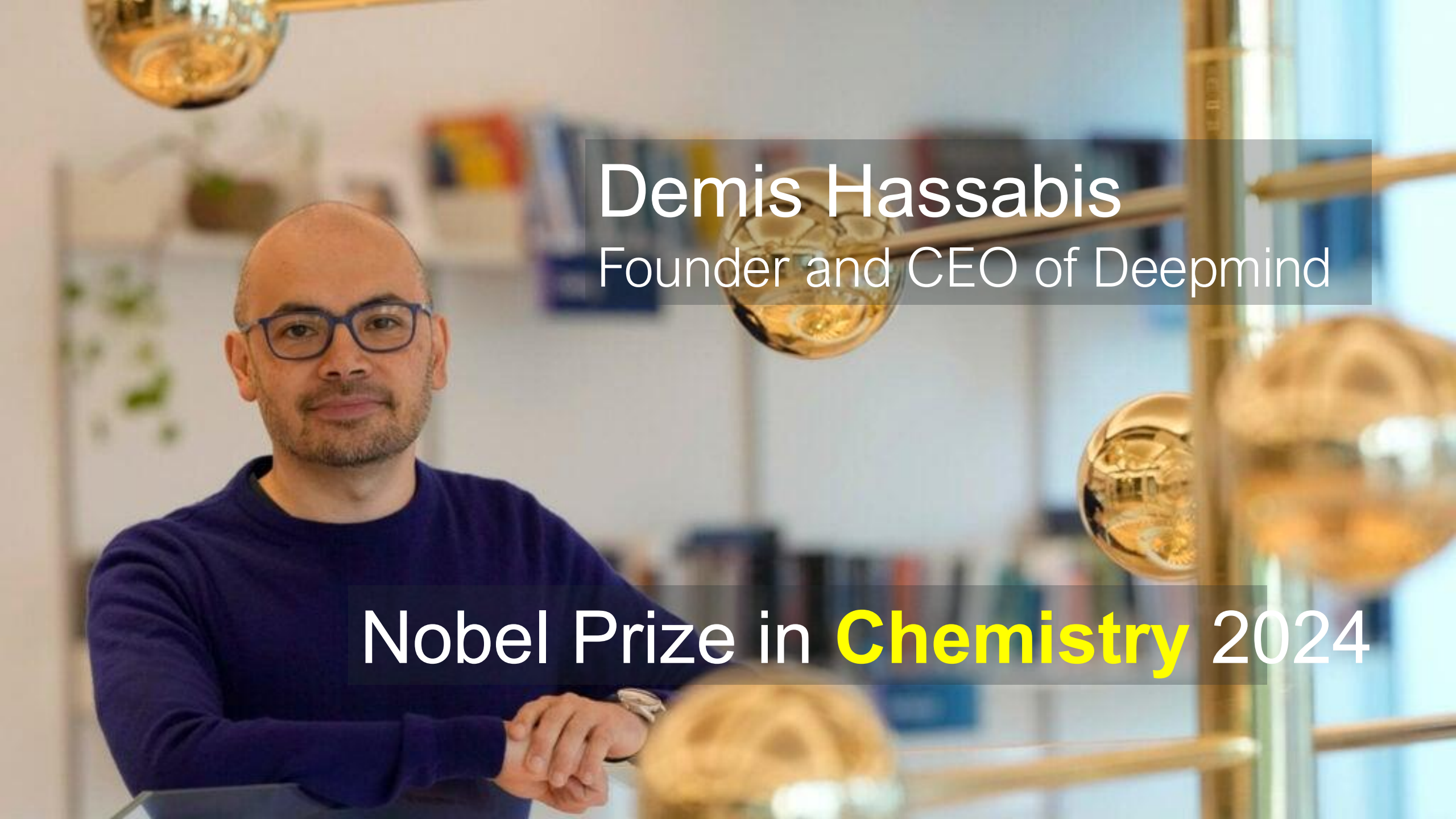


From a few thousand connections for simple classification problems …

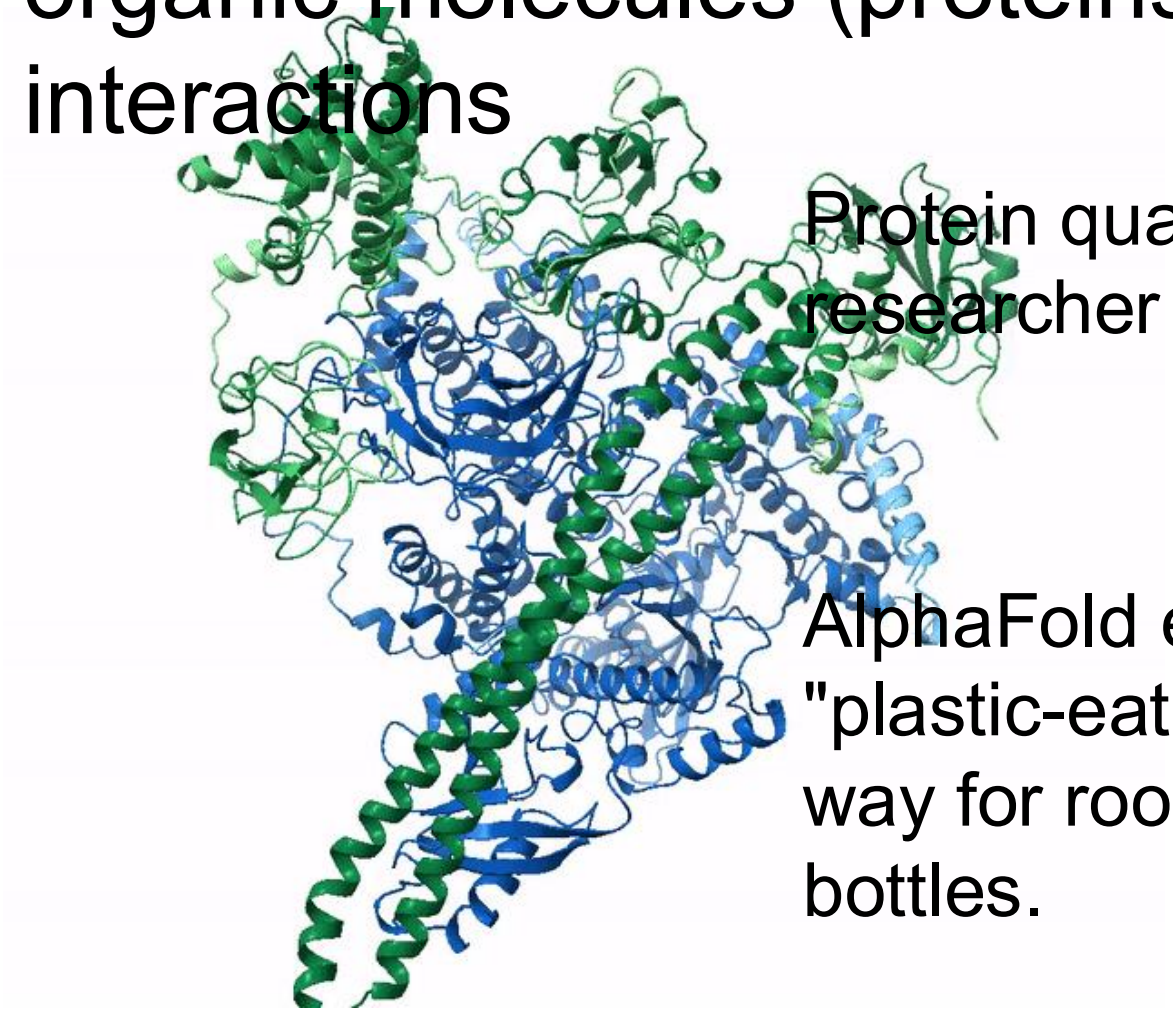
… to hundreds of millions for vision models

…

… and hundreds of billions for modern large language models


Demis Hassabis
Founder and CEO of Deepmind
Nobel Prize in Chemistry 2024

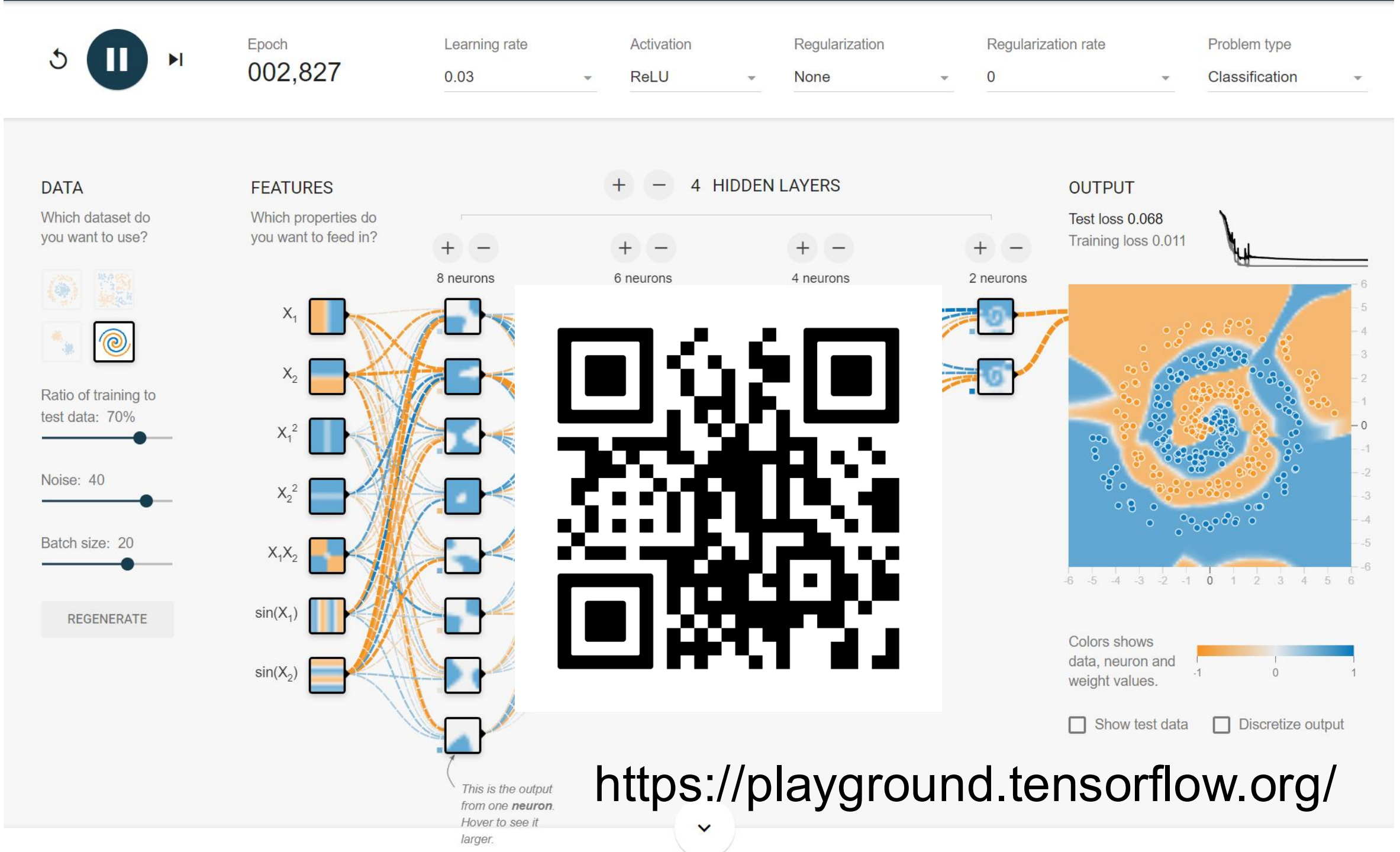
Alphafold 3 predicts the spatial structure of organic molecules (proteins, …) and their interactions



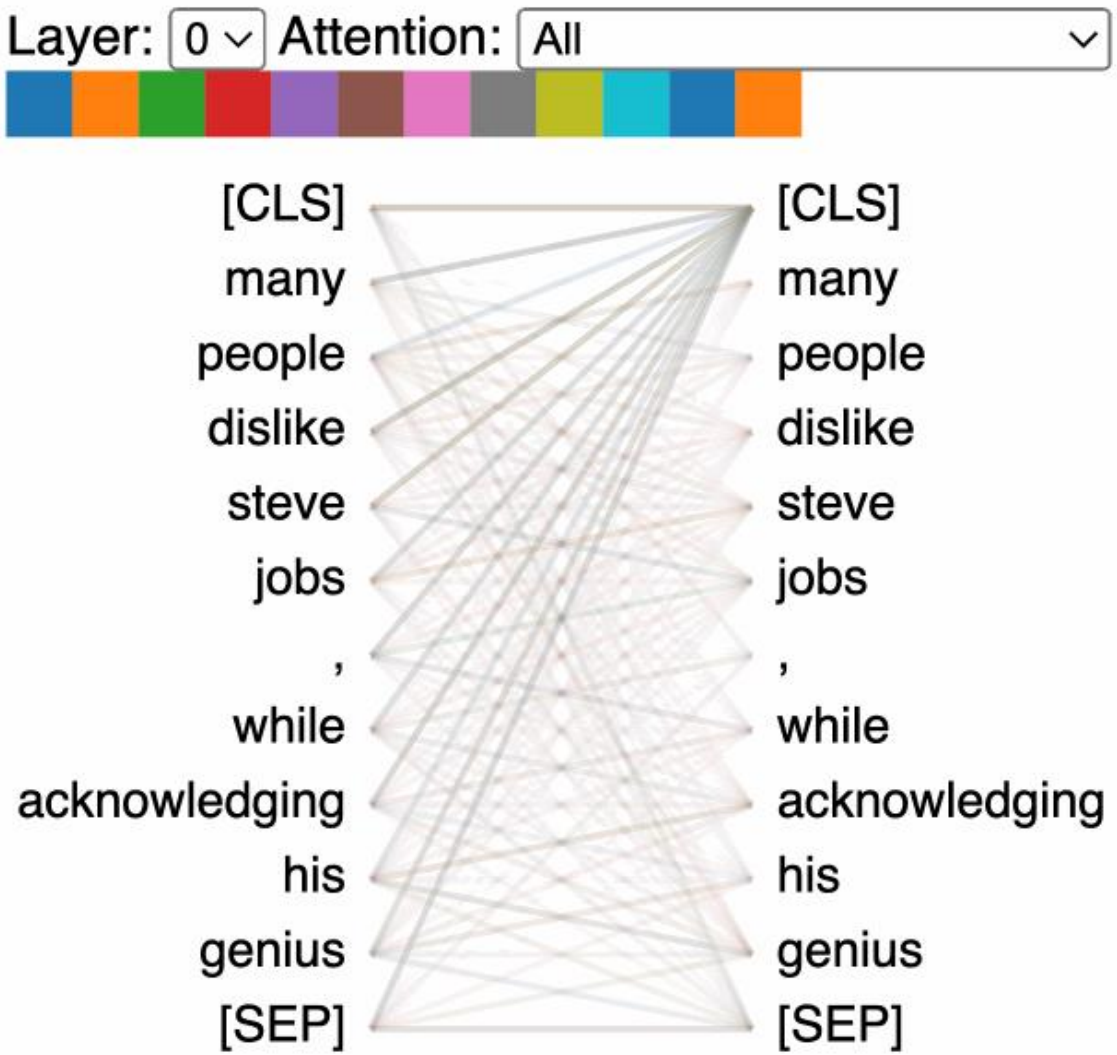
Protein qualification that could take a researcher years can be done in minutes

AlphaFold enabled a UK team to screen 100 "plastic-eating" enzymes in 48h, paving the way for room-temperature recycling of PET bottles.

How does it work?


Epoch
002,827
Learning rate
0.03
Activation
ReLU
Regularization
None
Regularization rate
0
Problem type
Classification
DATA
Which dataset do you want to use?
Ratio of training to test data: 70%
Noise: 40
Batch size: 20
REGENERATE
FEATURES
Which properties do you want to feed in?
4 HIDDEN LAYERS
8 neurons
6 neurons
4 neurons
2 neurons
X1
X2
X1²
X2²
X1X2
sin(X1)
sin(X2)
This is the output from one neuron. Hover to see it larger.
OUTPUT
Test loss 0.068
Training loss 0.011
Colors shows data, neuron and weight values.
Show test data
Discretize output
https://playground.tensorflow.org/

Transformers

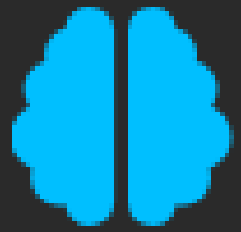


https://colab.research.google.com/drive/1hXIQ77A4TYS4y3UthWF-Ci7V7vVUoxmQ?usp=sharing#scrollTo=twSVFOM9SopW

Foundation Model

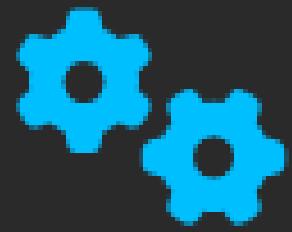
1. Massive Data

Training on a very large amount of data



2. Foundation Model

Building a large 'generalist' model with several hundreds of billions of connections



3. Adaptation (Fine-tuning)

Fast specialization of the model for specific tasks: translate, summarize, code, draw.

Current trends

Multimodal foundation models

RAG (Retrieval-Augmented Generation)

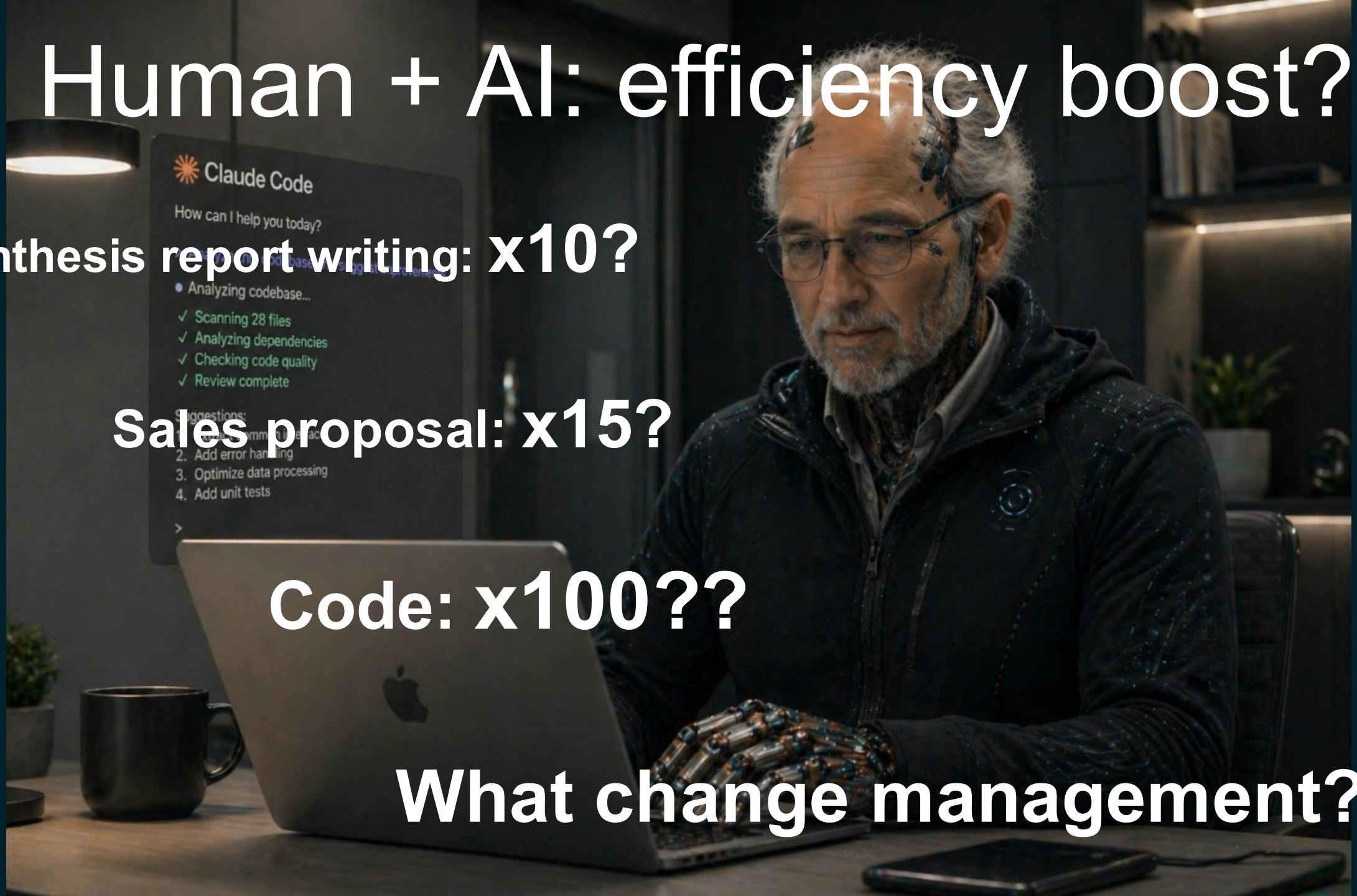
Local models

AI Agents

Digital twins and "world models"

Changes

Human + AI: efficiency boost?



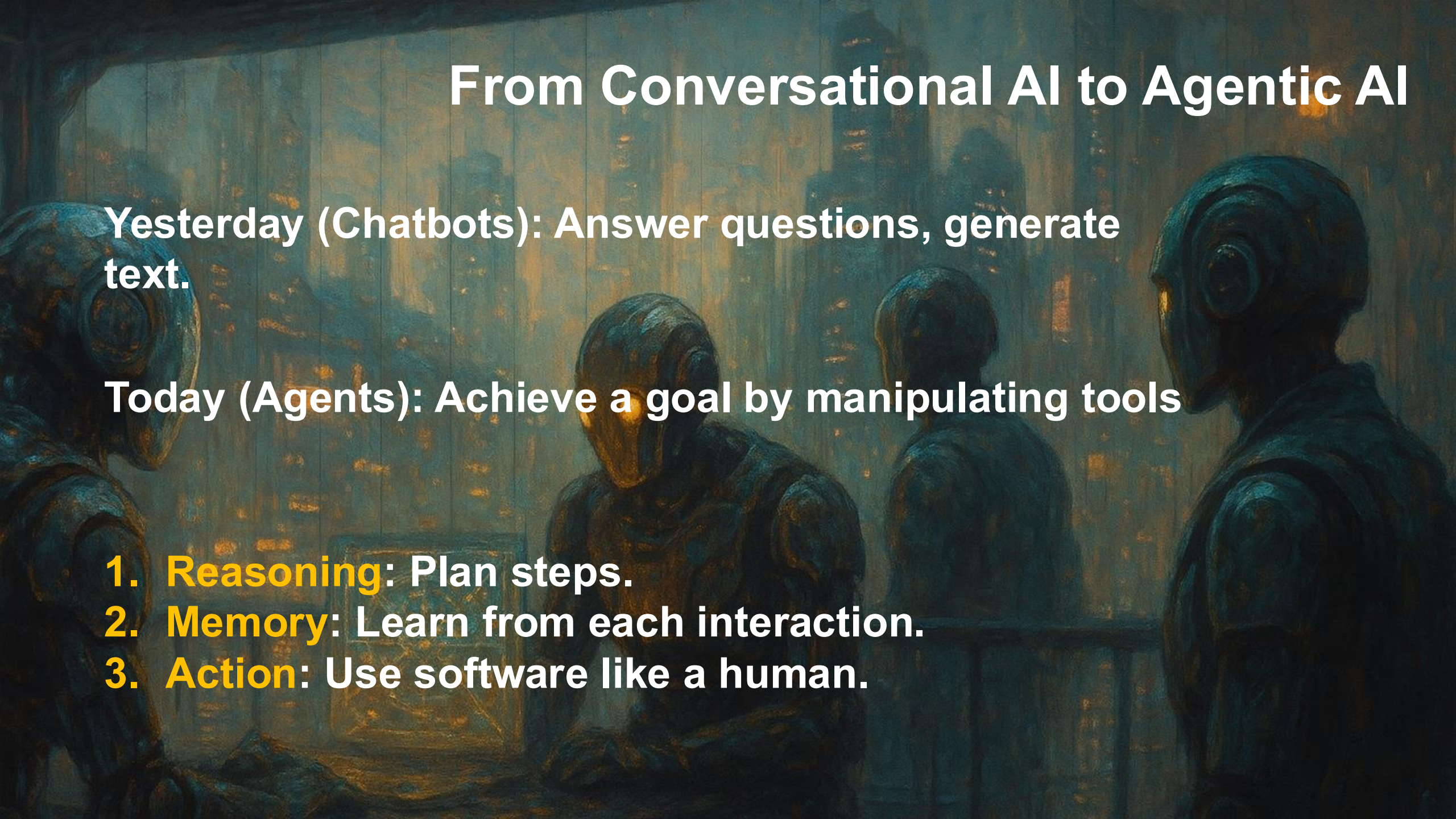
Synthesis report writing: x10?

Sales proposal: x15?

Code: x100??

What change management?

Next steps:
AI agents

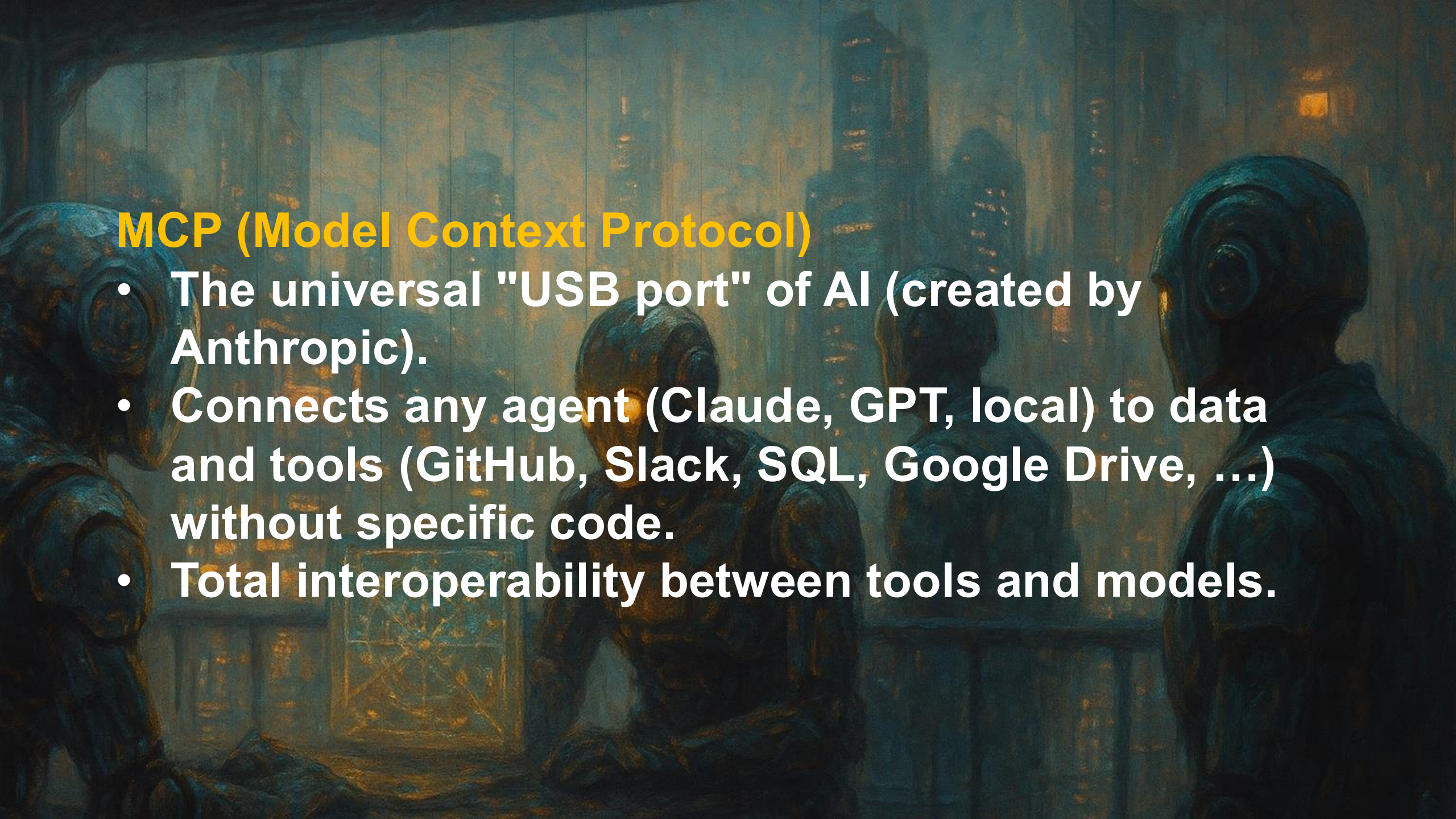


From Conversational AI to Agentic AI

Yesterday (Chatbots): Answer questions, generate text.

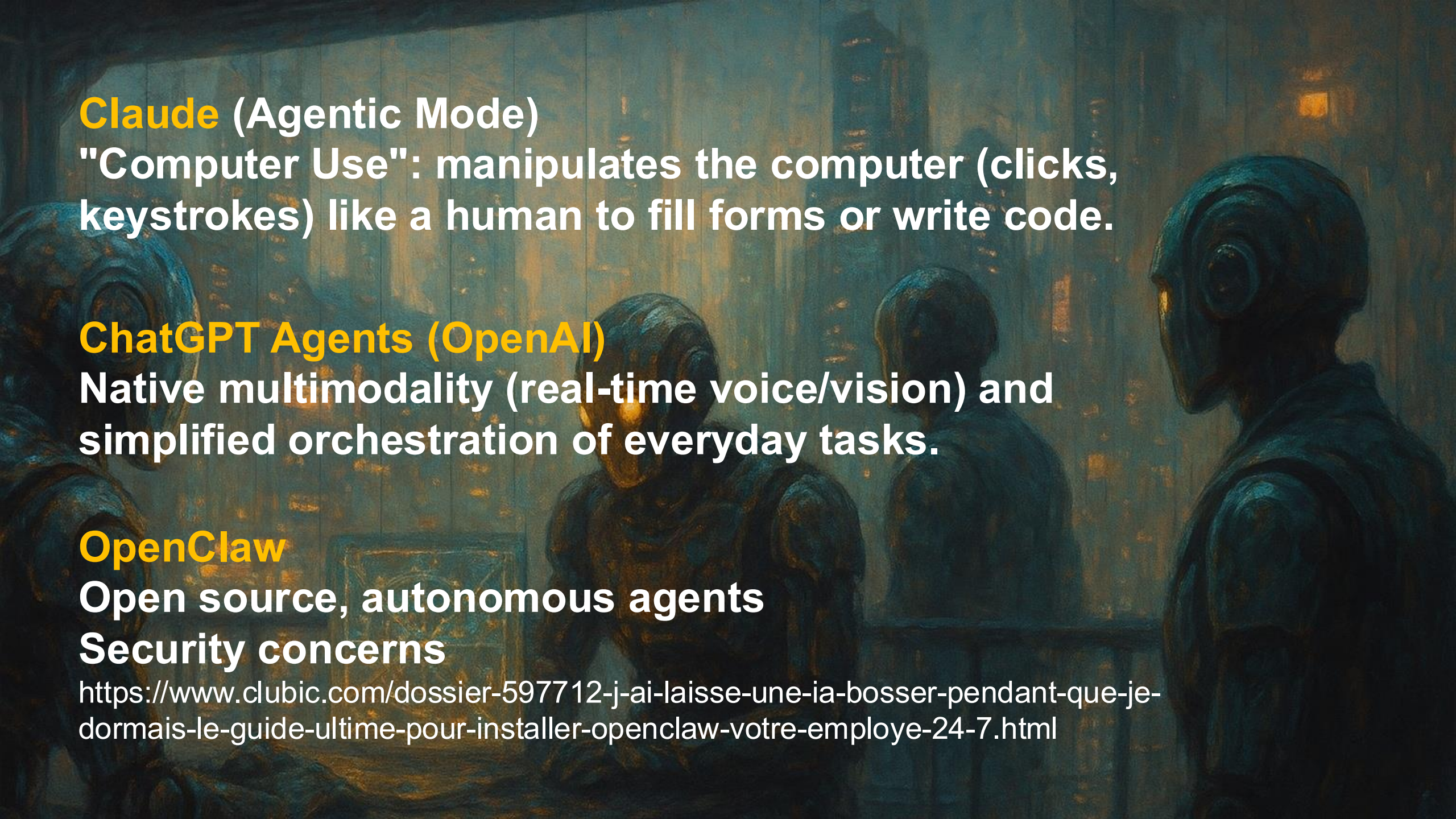
Today (Agents): Achieve a goal by manipulating tools

1. **Reasoning**: Plan steps.
2. **Memory**: Learn from each interaction.
3. **Action**: Use software like a human.



MCP (Model Context Protocol)

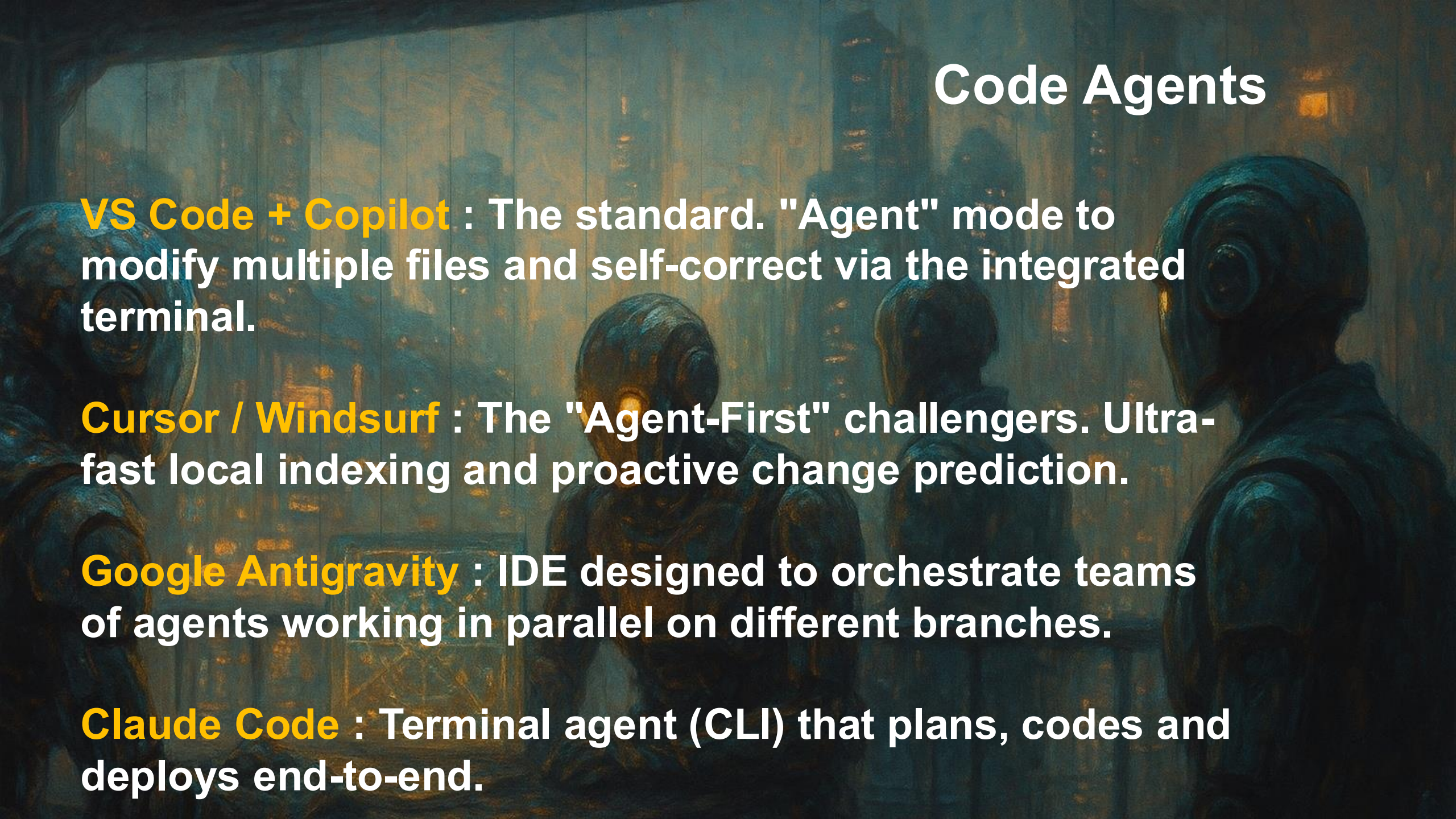
- The universal "USB port" of AI (created by Anthropic).
- Connects any agent (Claude, GPT, local) to data and tools (GitHub, Slack, SQL, Google Drive, …) without specific code.
- Total interoperability between tools and models.



Claude (Agentic Mode)
"Computer Use": manipulates the computer (clicks, keystrokes) like a human to fill forms or write code.

ChatGPT Agents (OpenAI)
Native multimodality (real-time voice/vision) and simplified orchestration of everyday tasks.

OpenClaw
Open source, autonomous agents
Security concerns
https://www.clubic.com/dossier-597712-j-ai-laisse-une-ia-bosser-pendant-que-je-dormais-le-guide-ultime-pour-installer-openclaw-votre-employe-24-7.html



Code Agents

VS Code + Copilot : The standard. "Agent" mode to modify multiple files and self-correct via the integrated terminal.

Cursor / Windsurf : The "Agent-First" challengers. Ultra-fast local indexing and proactive change prediction.

Google Antigravity : IDE designed to orchestrate teams of agents working in parallel on different branches.

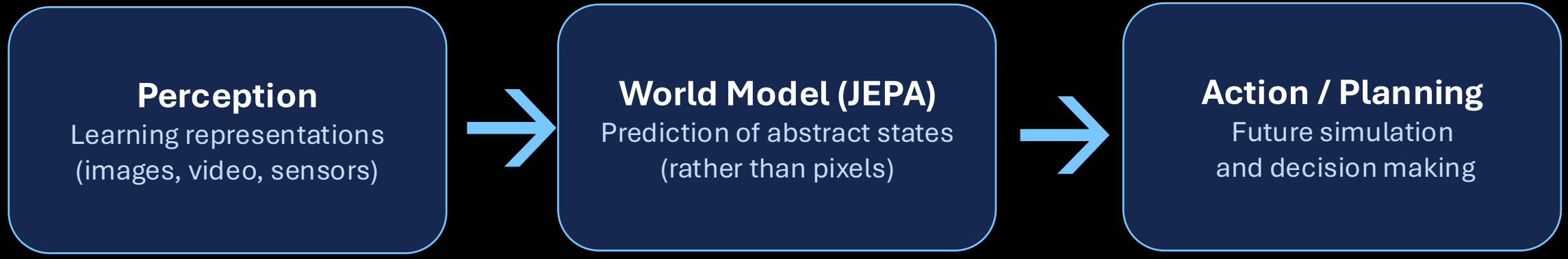
Claude Code : Terminal agent (CLI) that plans, codes and deploys end-to-end.

Next steps:
World models

Yann LeCun

Founder and CEO of AMI

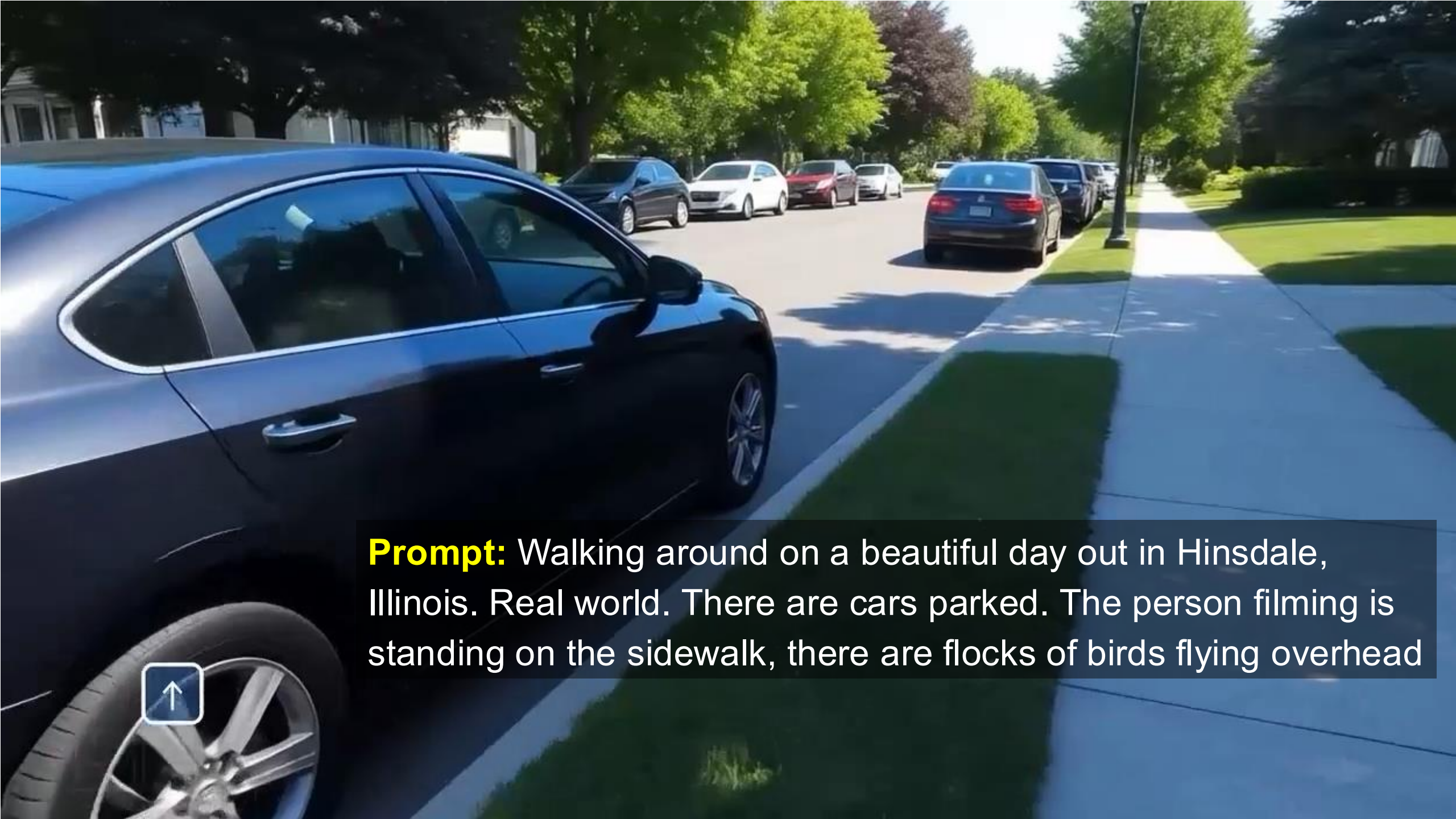
World Models: Yann LeCun's vision



Genie 3 (Deepmind)

Prompt: First-person view drone video. High speed flight into and along a narrow canyon in Iceland with a river at the bottom and moss on the rocks, golden hour, realworld

https://deepmind.google/discover/blog/genie-3-a-new-frontier-for-world-models/


Prompt: Walking around on a beautiful day out in Hinsdale, Illinois. Real world. There are cars parked. The person filming is standing on the sidewalk, there are flocks of birds flying overhead


Prompt: POV action camera of a tan house being painted by a first person agent with a paint roller

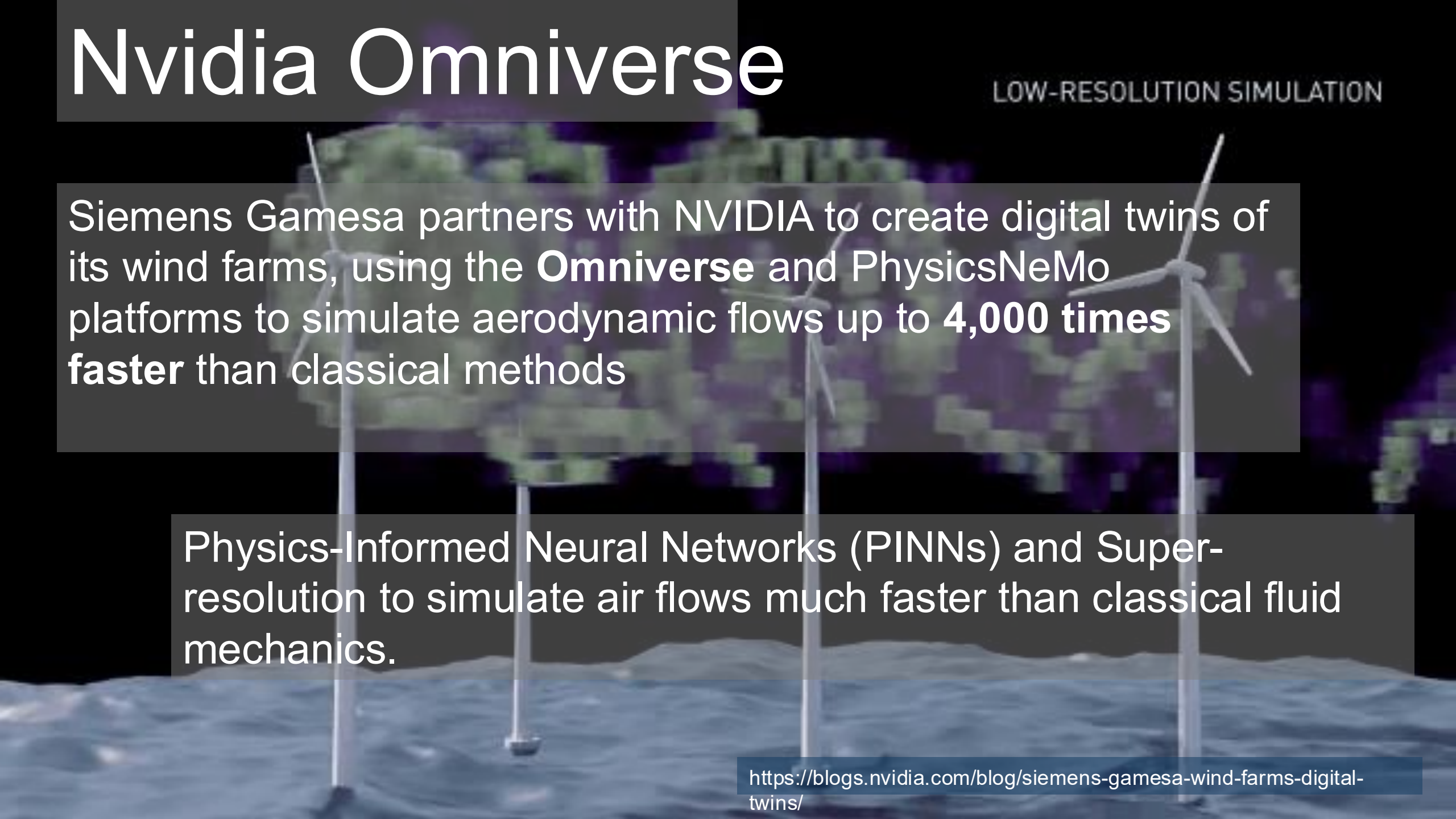
Digital twins

A **digital twin** (digital twin) is a dynamic virtual replica of a system, a physical object, a process or even an organization.

It is not just a static model, but a simulation continuously fed by real data from sensors, IoT, databases or operational streams.

The goal is to monitor, predict and optimize the behavior of the real entity, leveraging AI, modeling and analysis techniques.

Nvidia Omniverse



Siemens Gamesa partners with NVIDIA to create digital twins of its wind farms, using the **Omniverse** and PhysicsNeMo platforms to simulate aerodynamic flows up to **4,000 times faster** than classical methods

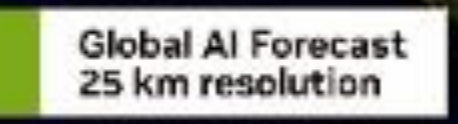
Physics-Informed Neural Networks (PINNs) and Super-resolution to simulate air flows much faster than classical fluid mechanics.

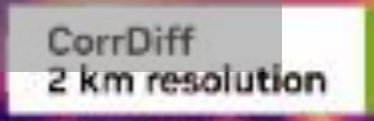
https://blogs.nvidia.com/blog/siemens-gamesa-wind-farms-digital-twins/

Weather and clim

GraphCast (DeepMind) : global 10-day weather forecasts, ultra-fast (~1 min) without compute clusters, open source, very accurate

Earth-2 (NVIDIA) : global climate digital twin (*Climate in a bootle*) at high resolution (~5 km), super-resolution, ultra-fast and energy-efficient interactive forecasts





https://deepmind.google/discover/blog/graphcast-ai-model-for-faster-and-more-accurate-global-weather-forecasting/?utm_source=chatgpt.com
https://blogs.nvidia.com/blog/earth2-generative-ai-foundation-model-global-climate-kilometer-scale-resolution/?utm_source=chatgpt.com

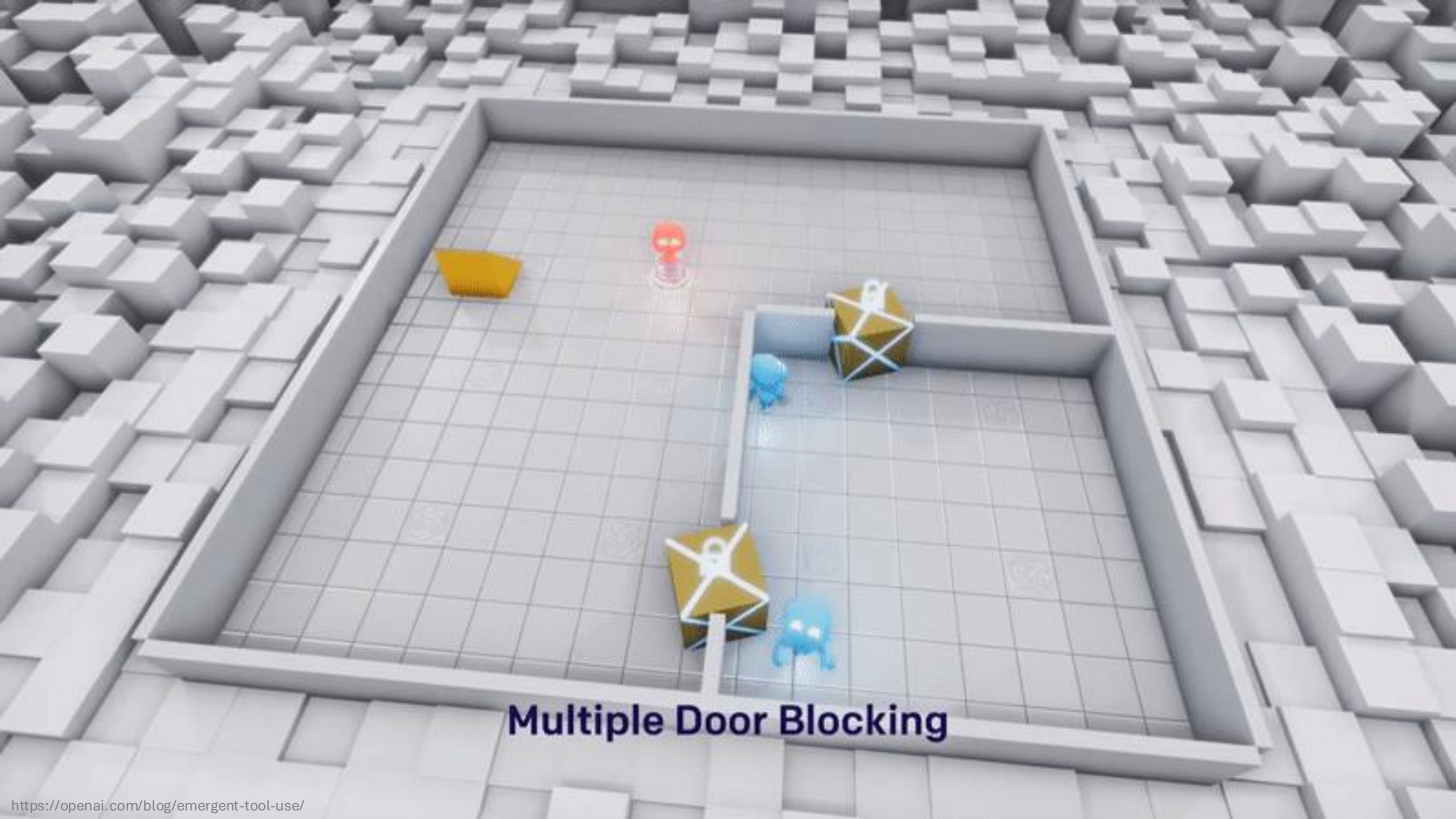
Towards general AI?

Hide and seek (OpenAI)

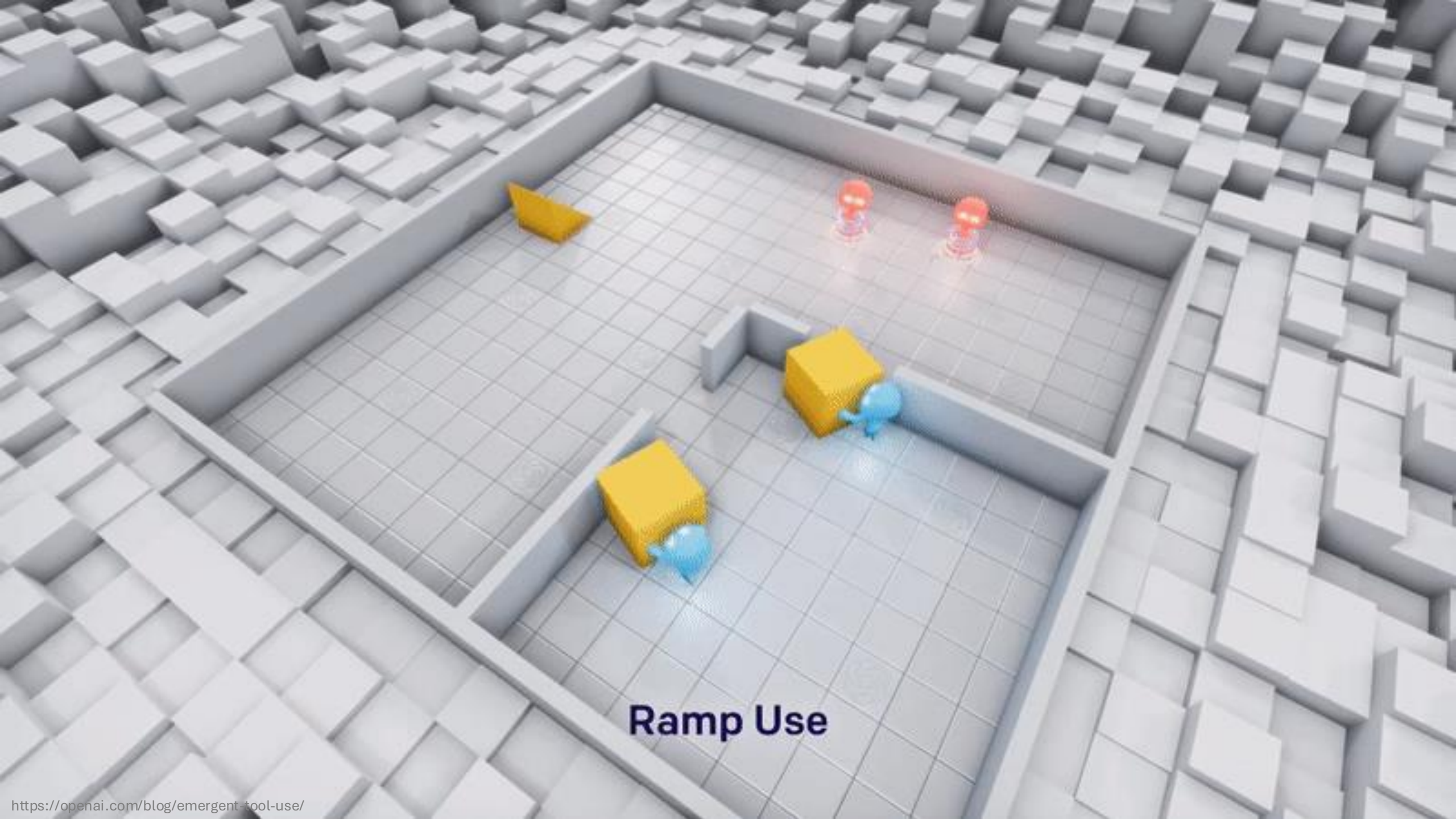
Deep reinforcement learning: agents learn to make decisions through trial and error/errors with a reward function

https://openai.com/blog/emergent-tool-use/

https://openai.com/blog/emergent-tool-use/



https://openai.com/blog/emergent-tool-use/



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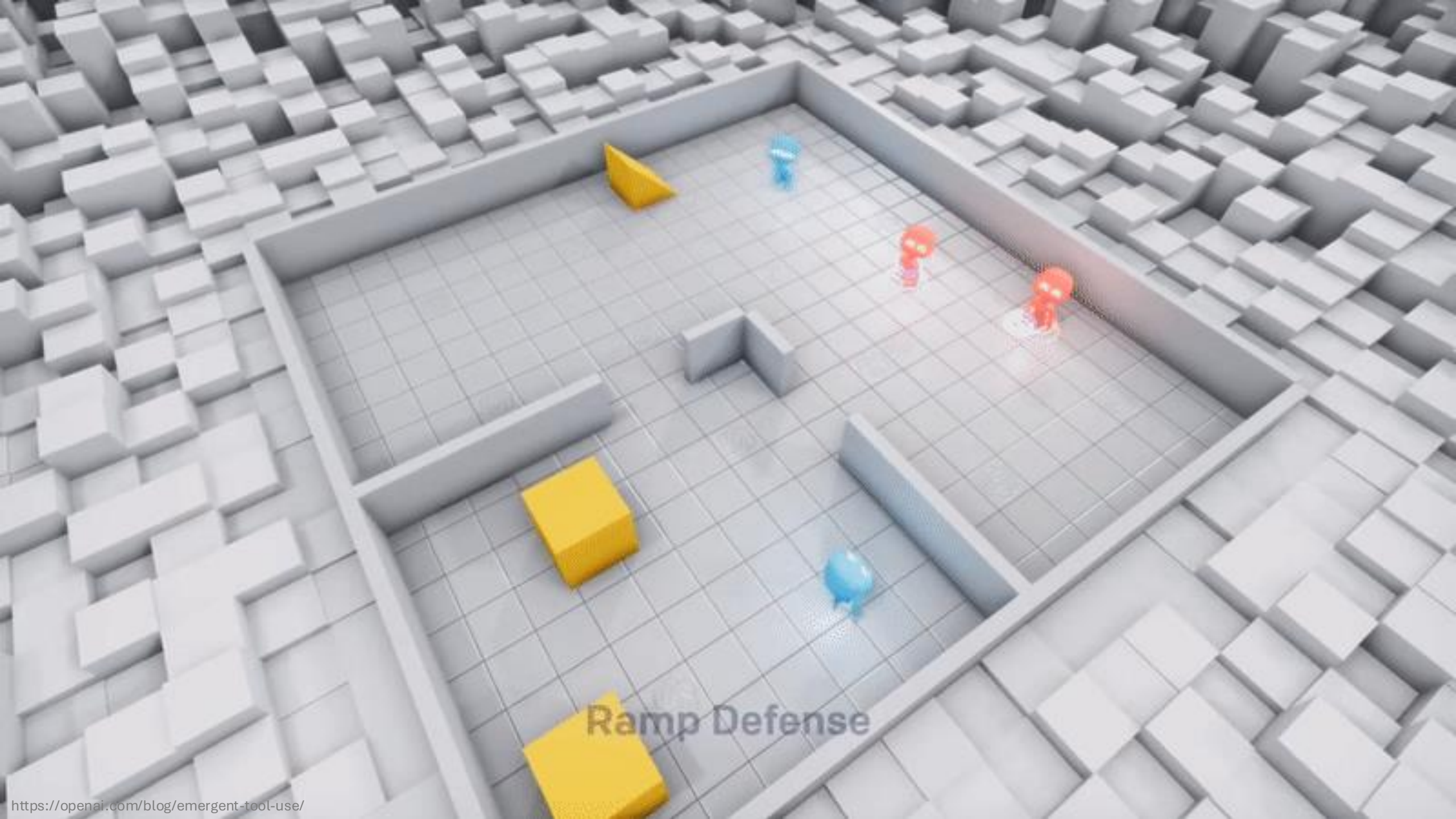


https://openai.com/blog/emergent-tool-use/

Deepmind AlphaGo

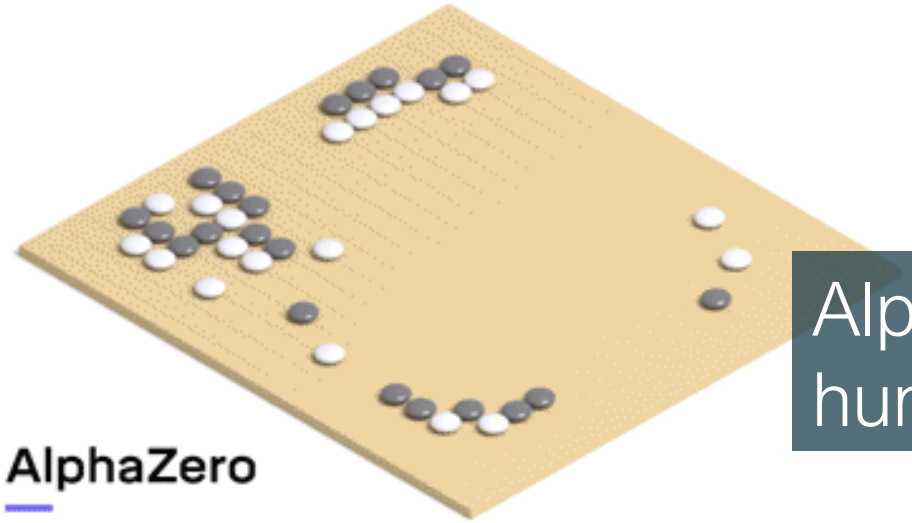
AlphaGo beats Go champion Lee Sedol in 2016

10^{600} moves to explore

"I thought AlphaGo was based on probability calculation and that it was merely a machine. But when I saw this move, I changed my mind. ***Surely, AlphaGo is creative****."* Lee Sedol

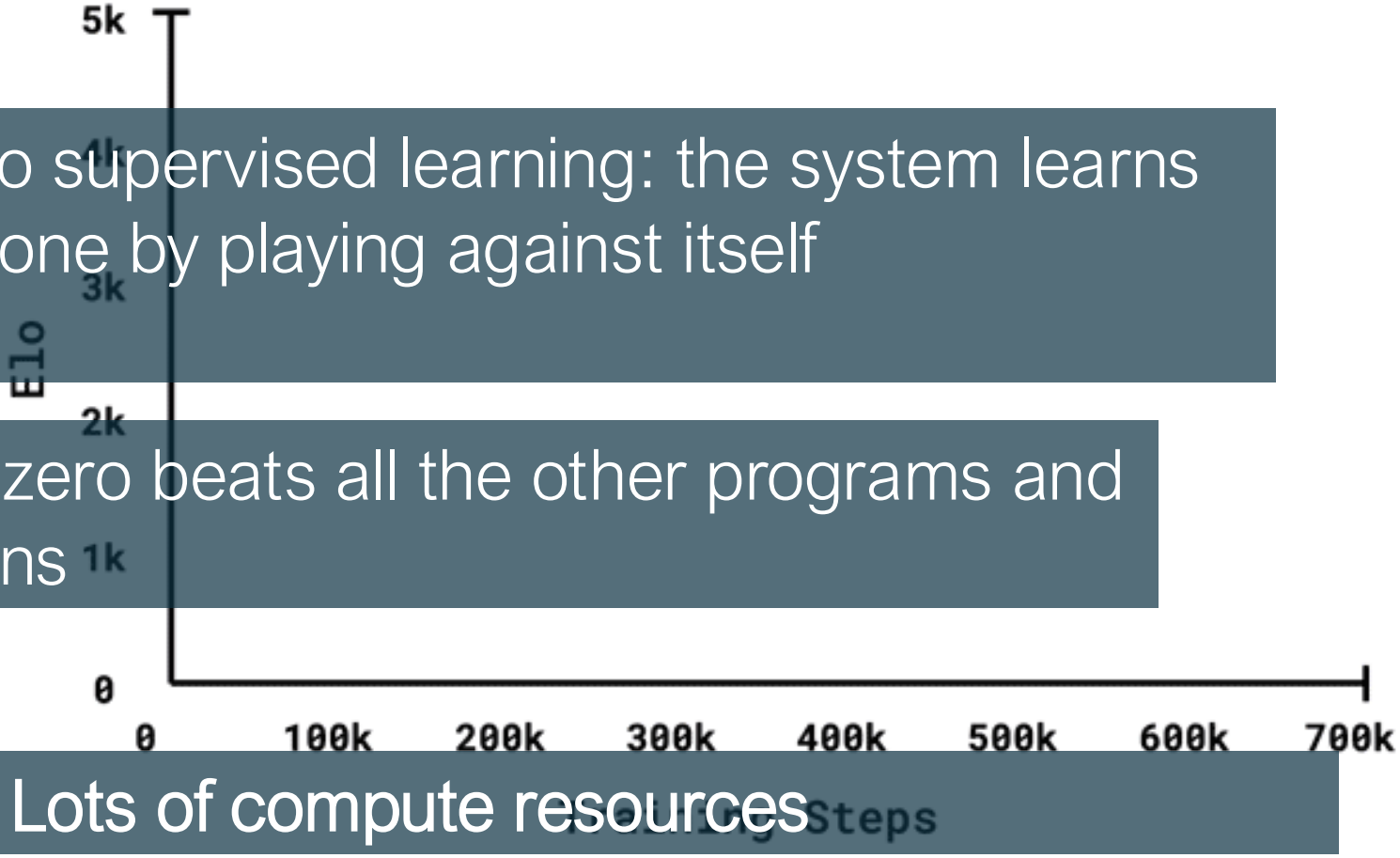
https://www.youtube.com/watch?v=WXuK6gekU1Y&t=4146s

Deepmind AlphaZero



No supervised learning: the system learns alone by playing against itself

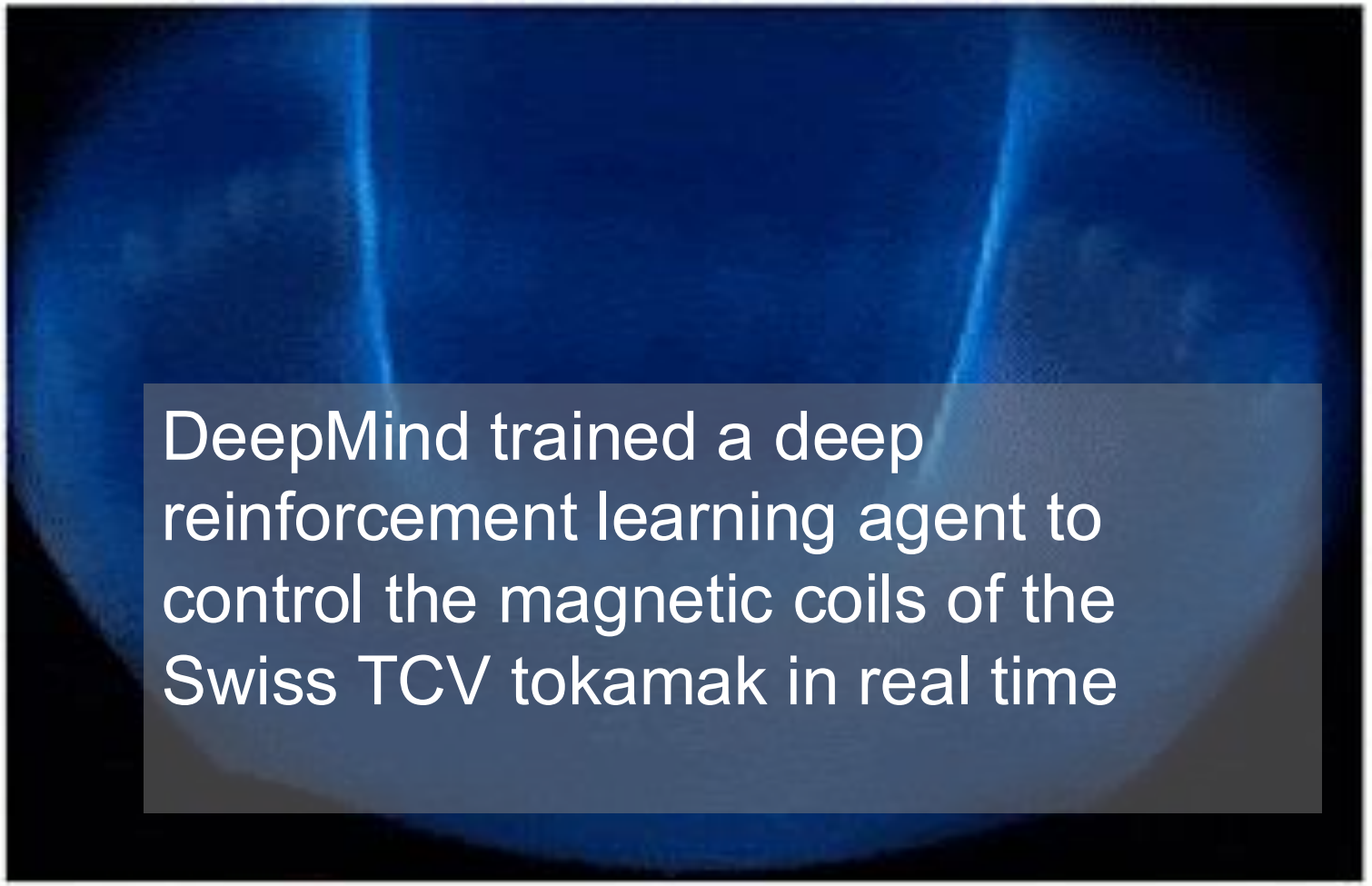
Alphazero beats all the other programs and humans



Lots of compute resources

https://www.chess.com/fr/news/view/alphazero-le-programme-de-google-bat-stockfish-a-plates-coutures-4961
https://deepmind.com/blog/alphazero-shedding-new-light-grand-games-chess-shogi-and-go/
https://deepmind.com/documents/260/alphazero_preprint.pdf

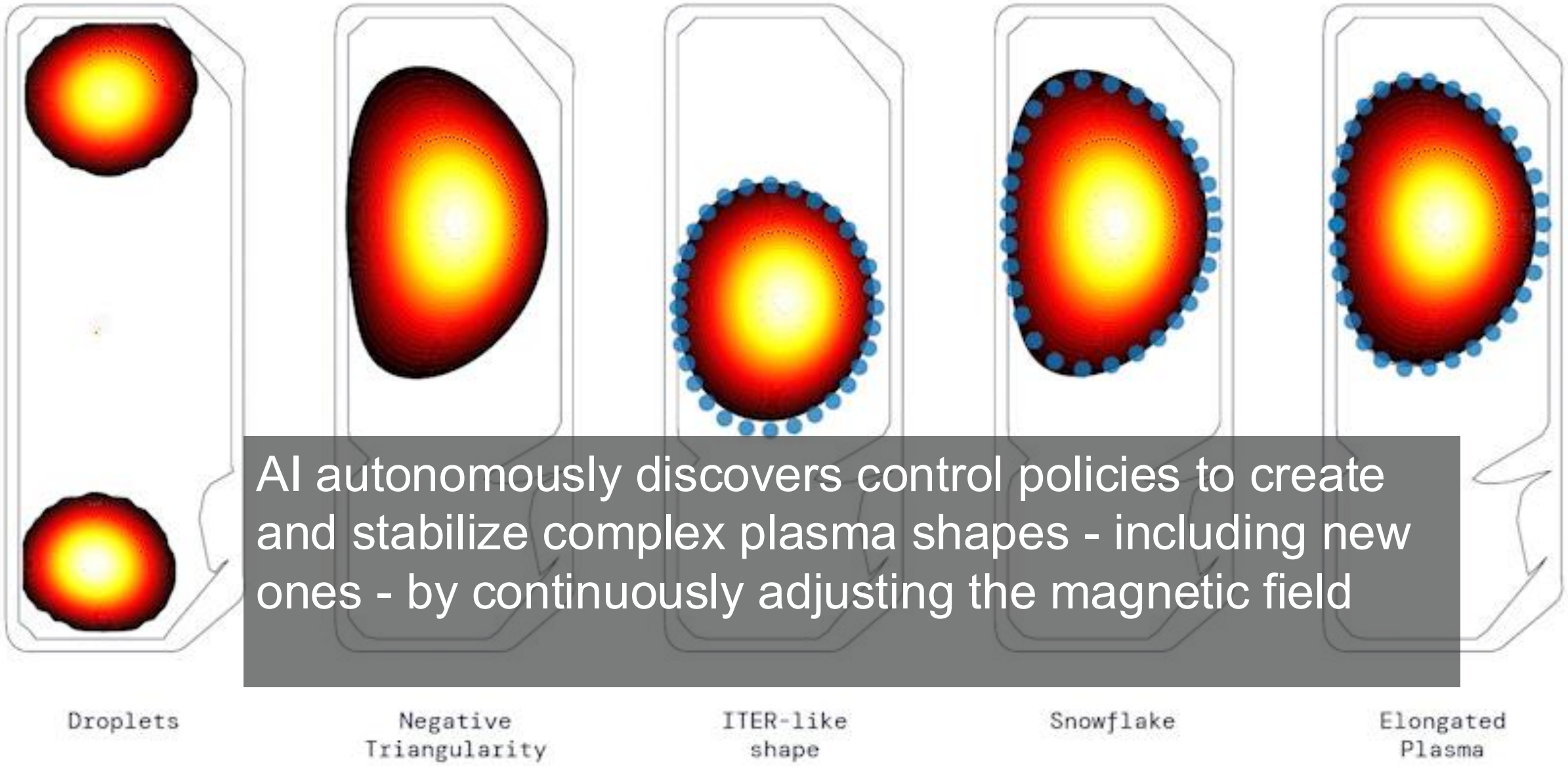
AI tames a mini sun



View from inside the tokamak

Plasma state reconstruction

https://deepmind.google/discover/blog/accelerating-fusion-science-through-learned-plasma-control/



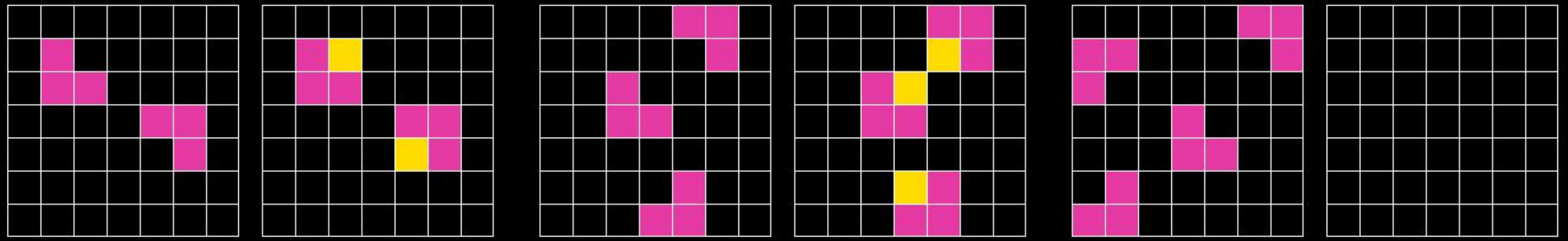
AI autonomously discovers control policies to create and stabilize complex plasma shapes - including new ones - by continuously adjusting the magnetic field

Vision Language Action

Helix (Figure AI): VLA (Vision-Language-Action)
Perception + language + continuous motor control (including fingers) and multi-robot collaboration demos without dedicated scripts

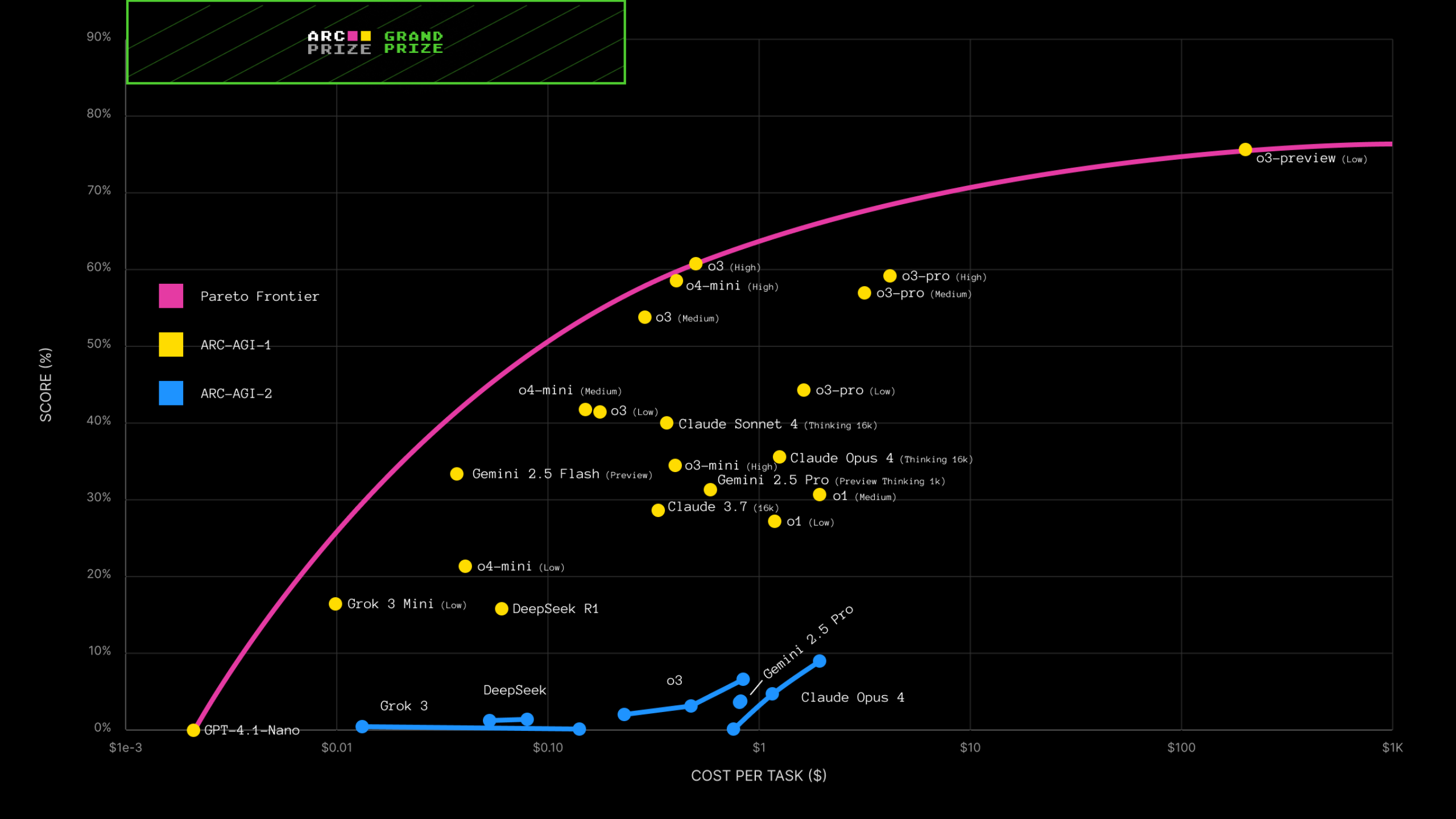
NVIDIA Isaac GR00T : foundation model for humanoid robots coupled with Isaac simulation, learning tasks via demonstration/simulation and transferring them across different robots, from planning to execution

Reasoning: ARC-AGI test

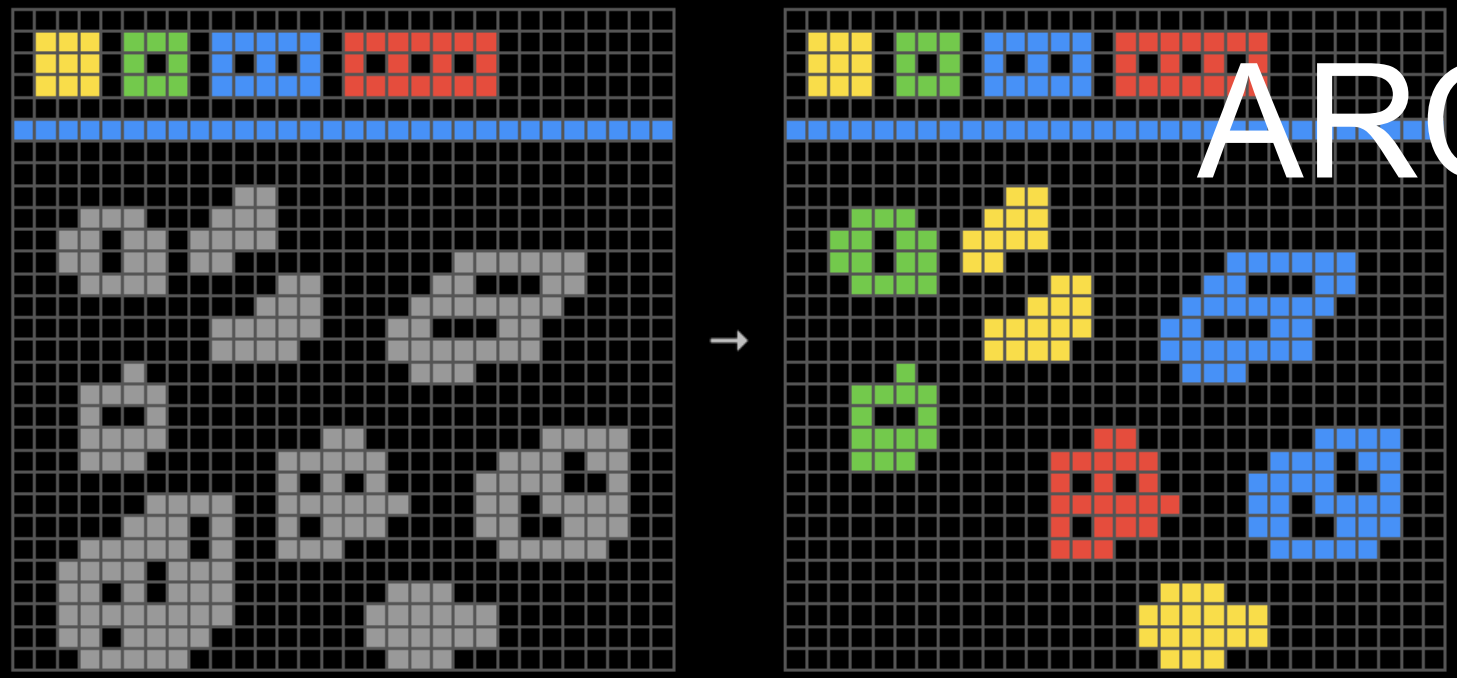


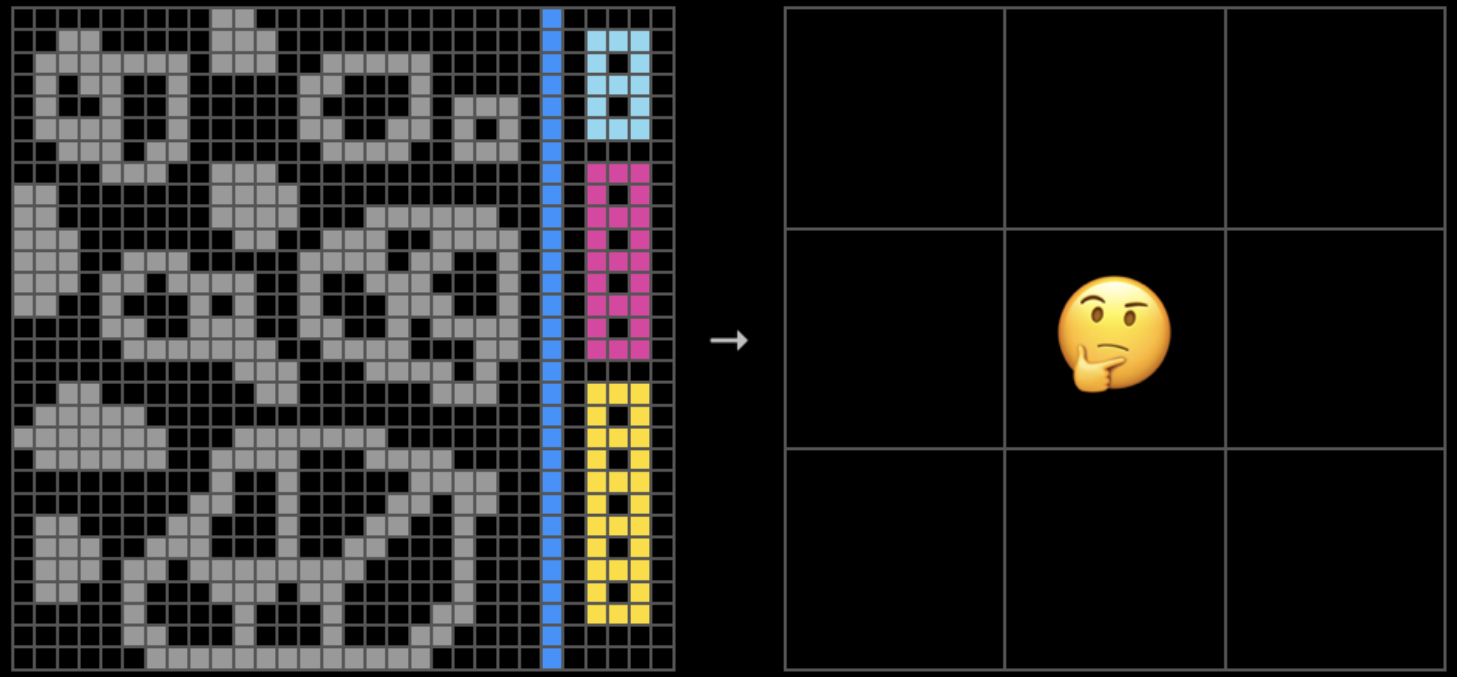
ARC-AGI is a benchmark created by François Chollet that proposes abstract visual puzzles on small grids, easy for humans but designed to test the ability of AI to generalize from a small number of examples

https://arcprize.org/


ARC PRIZE GRAND PRIZE
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
SCORE (%)
Pareto Frontier
ARC-AGI-1
ARC-AGI-2
o3-preview (Low)
o3 (High)
o4-mini (High)
o3-pro (High)
o3-pro (Medium)
o3 (Medium)
o4-mini (Medium)
o3-pro (Low)
o3 (Low)
Claude Sonnet 4 (Thinking 16k)
Claude Opus 4 (Thinking 16k)
o3-mini (High)
Gemini 2.5 Flash (Preview)
Gemini 2.5 Pro (Preview Thinking 1k)
o1 (Medium)
Claude 3.7 (16k)
o1 (Low)
o4-mini (Low)
Grok 3 Mini (Low)
DeepSeek R1
Gemini 2.5 Pro
o3
Claude Opus 4
DeepSeek
Grok 3
GPT-4.1-Nano
$1e-3
$0.01
$0.10
$1
$10
$100
$1K
COST PER TASK ($)

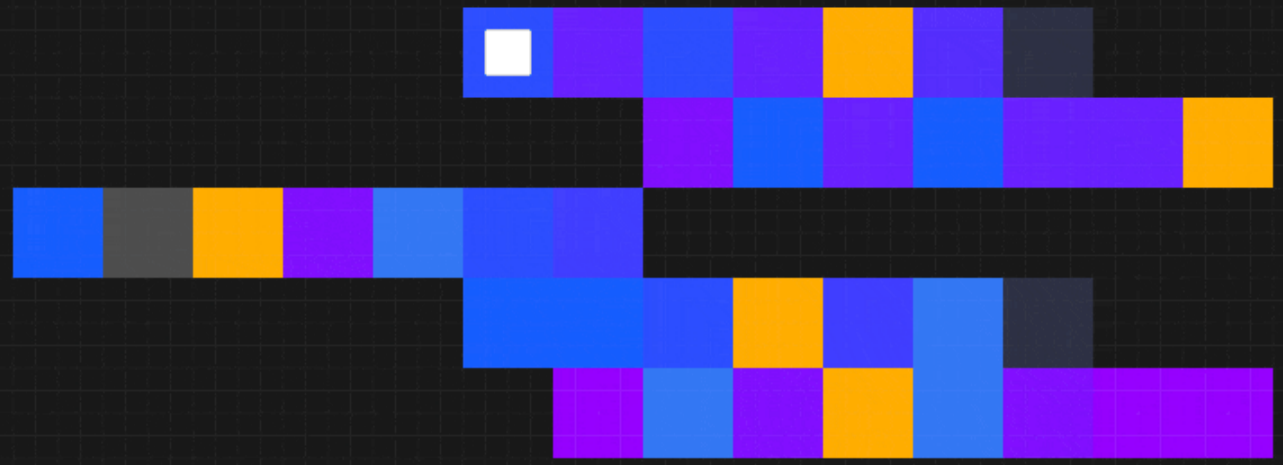
ARC-AGI 2

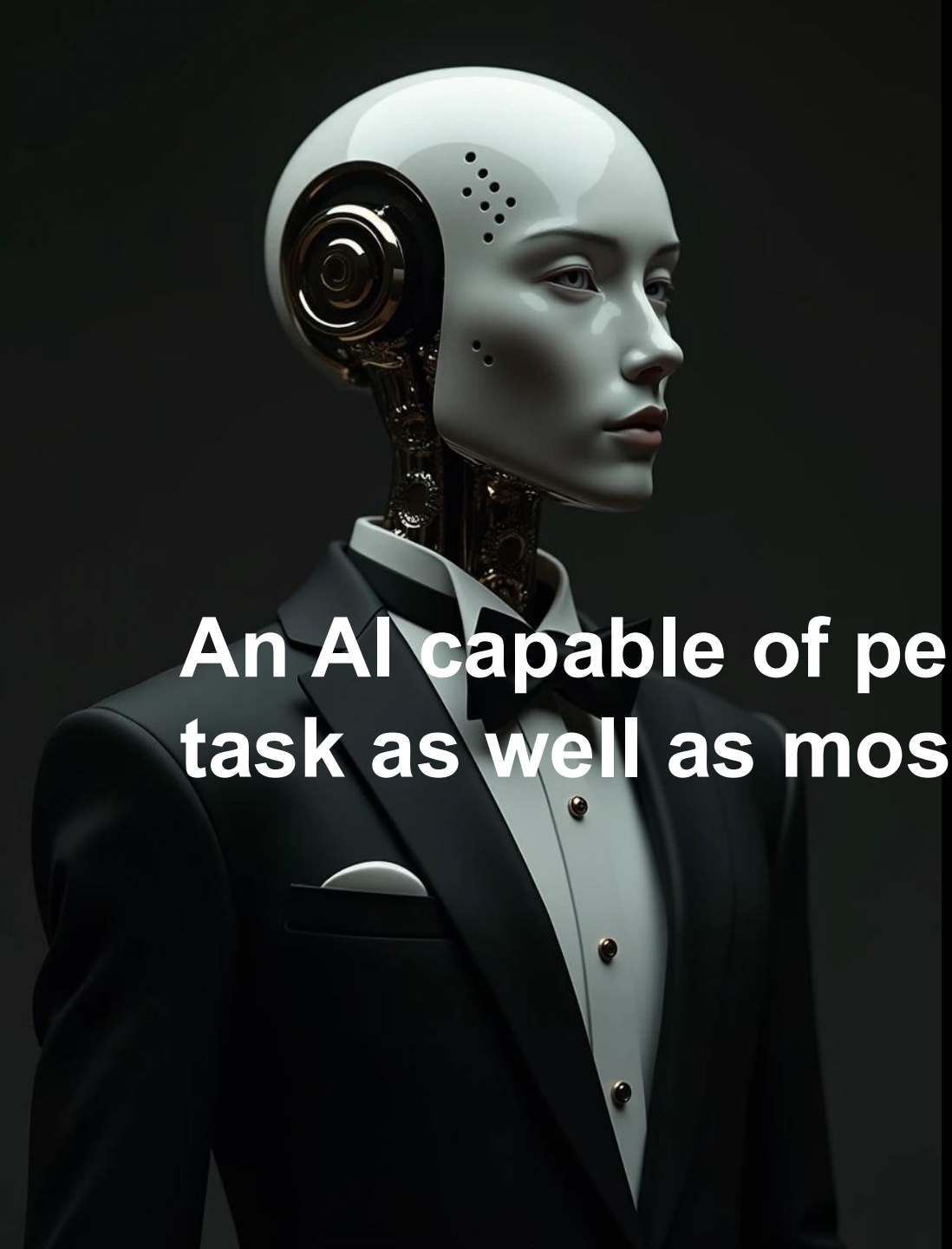




Test Level Start
Test Win
Test Lose
Reset

ARC-AGI 3

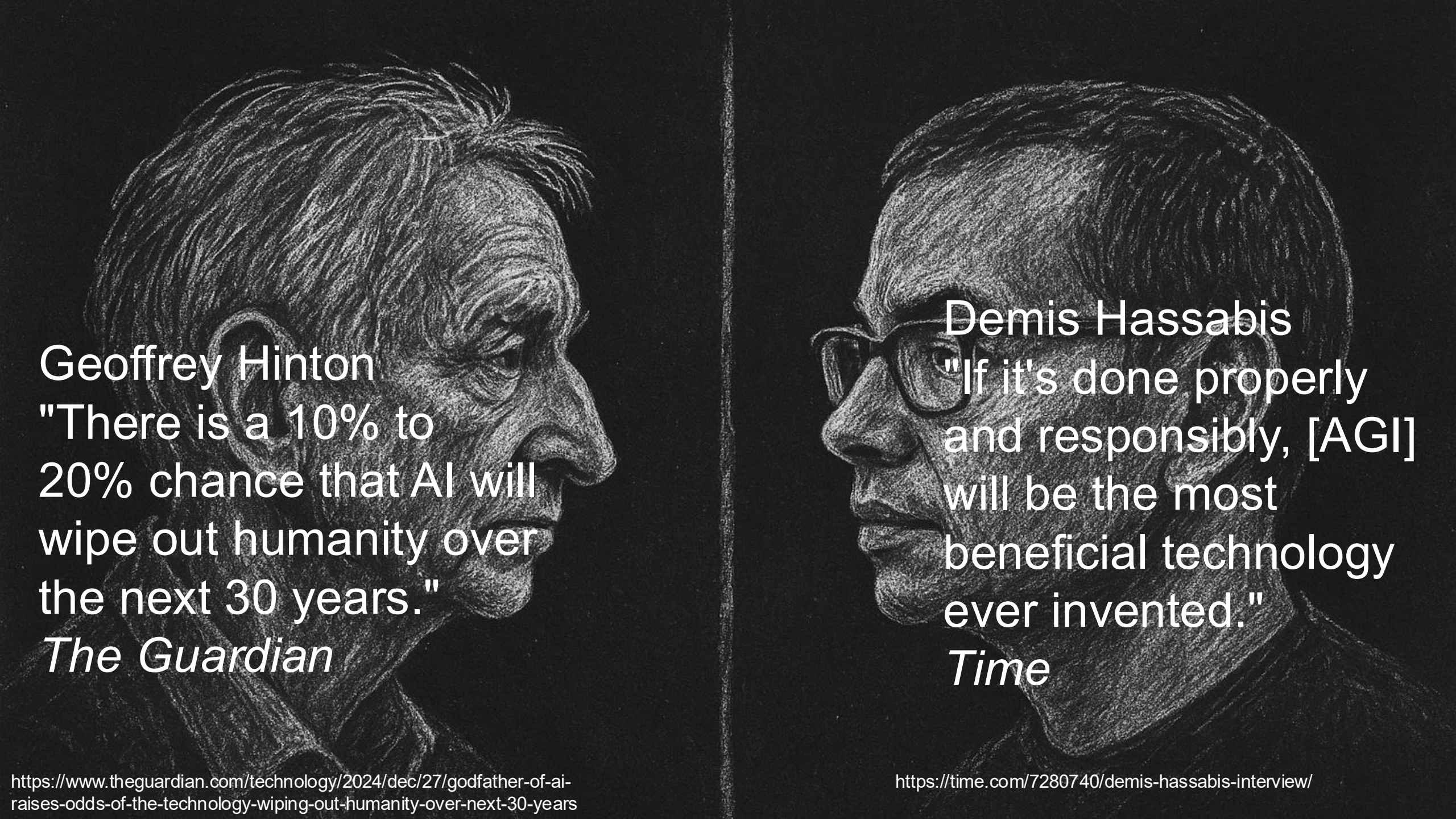




General AI?

An AI capable of performing any (immaterial) task as well as most humans

2030?



Geoffrey Hinton
"There is a 10% to 20% chance that AI will wipe out humanity over the next 30 years."
The Guardian

https://www.theguardian.com/technology/2024/dec/27/godfather-of-ai-raises-odds-of-the-technology-wiping-out-humanity-over-next-30-years

Demis Hassabis
"If it's done properly and responsibly, [AGI] will be the most beneficial technology ever invented."
Time

https://time.com/7280740/demis-hassabis-interview/