

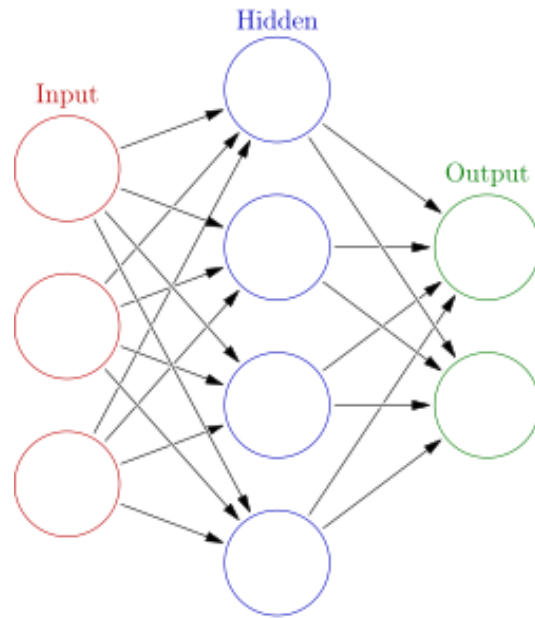
Generative AI

Introduction

Generative AI

How do Artificial Neural Networks work?

- Inspired by human brain's neural connections
- Composed of interconnected nodes (called neurons)
- Each connection has a weight corresponding to its importance
- Hidden Layer(s)
 - Perform calculations on inputs using weighted connections
 - Each neuron applies activation function
 - Multiple hidden layers capture complex patterns
- Training process adjusts connection weights based on data



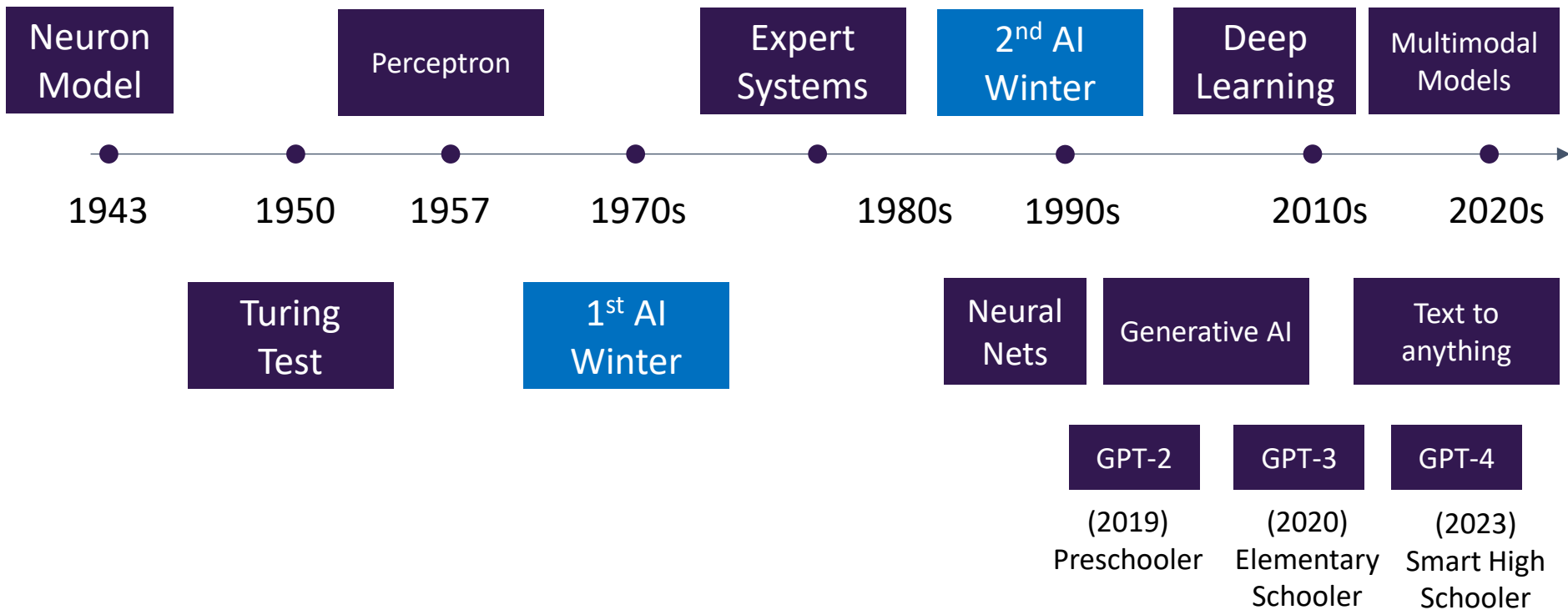
Receives
input data

Has neurons and
connections

Returns
outputs

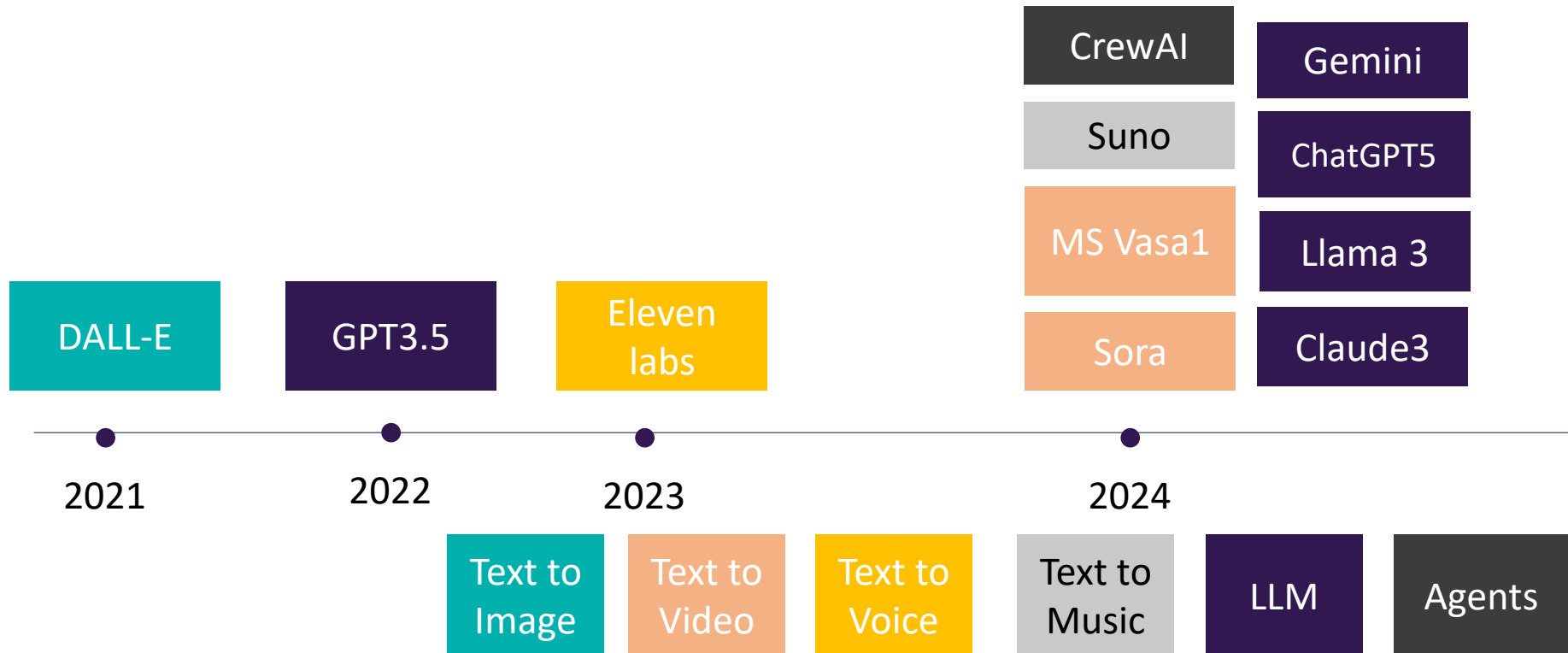
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Artificial Intelligence over Time: Past and Present



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Recent Developments in AI-Tools



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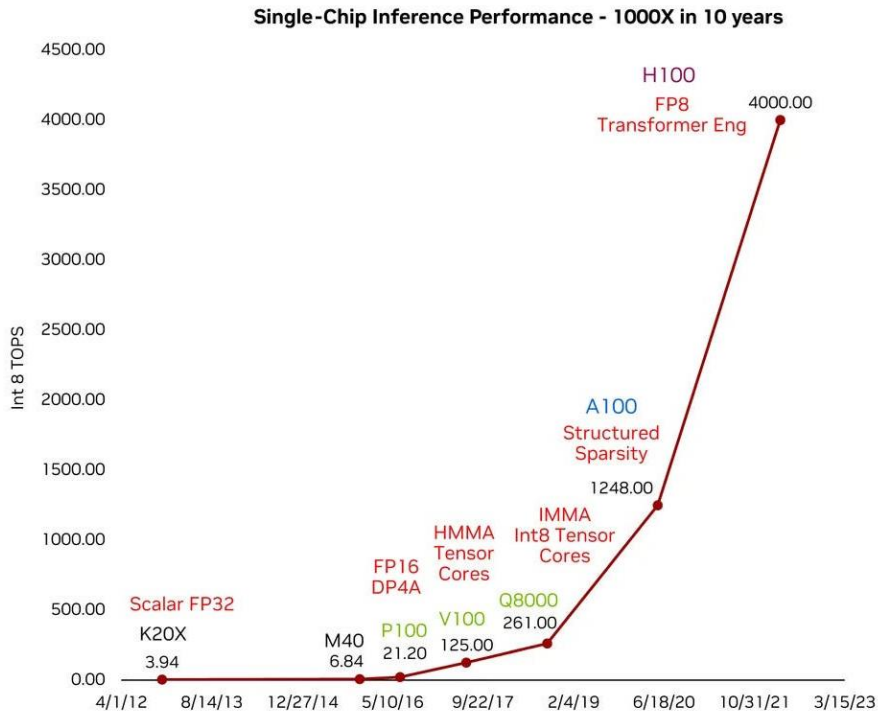
What is GenAI?

- Artificial Intelligence, that can create new content
- Trained on large datasets
- Typically based on Transformer architecture
- Applications
 - Text generation
 - Image/Music/Video generation
- Challenges
 - Ethics and Biases
 - Copyright/Ownership

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Larger models require more computational power

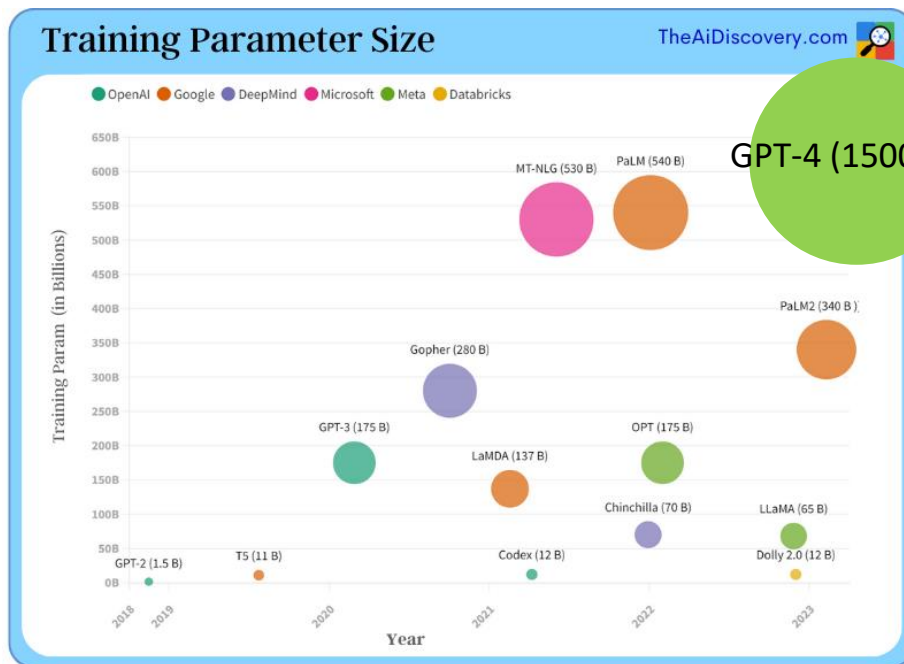
- Moore's law is still active in chip performance



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Model Sizes increase exponentially

- Based on larger computational power
- Larger datasets



GPT-4 (1500B)

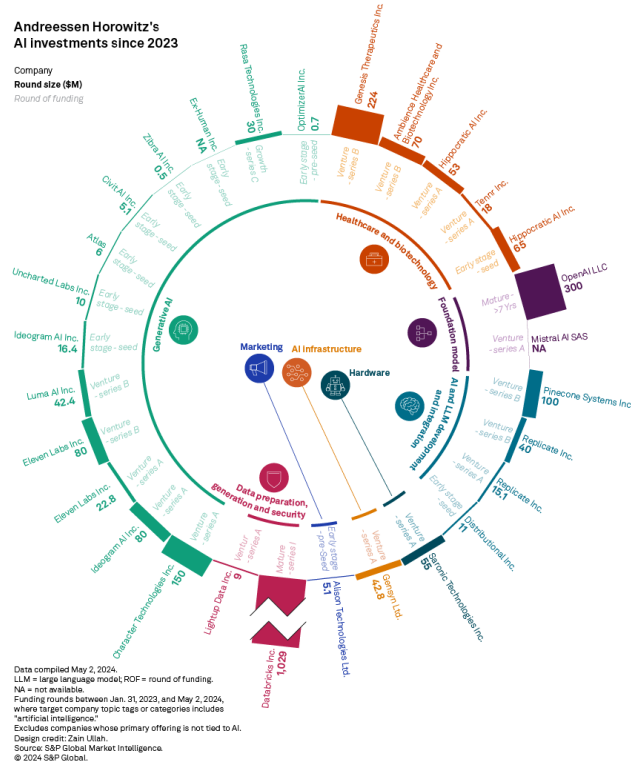
GPT-5 (10x GPT4??)

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Investments

Andreessen Horowitz's AI Investments since 2023

Company
Round size (\$M)
Round of funding



Source: <https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/how-top-vcs-are-placing-their-growing-ai-bets-81722741>

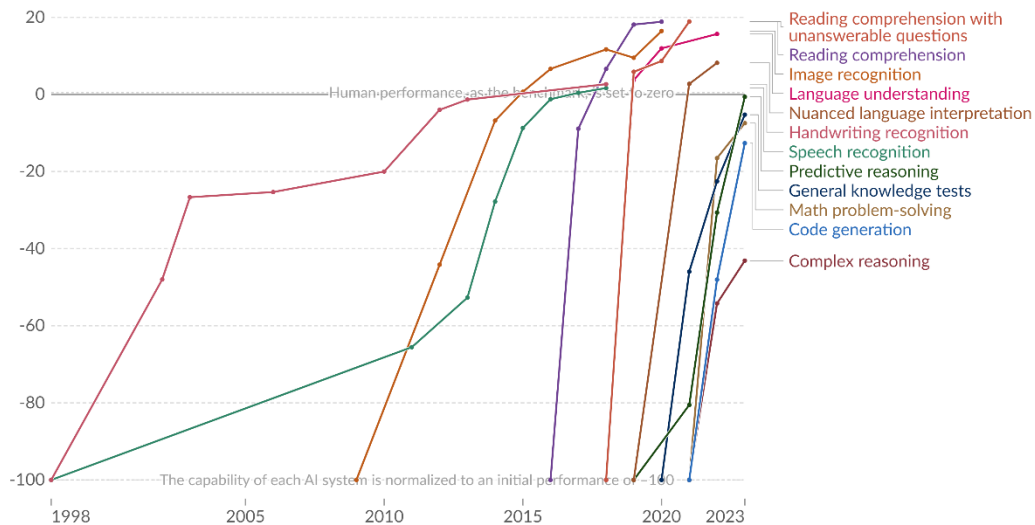
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Current State: Exceeding human capabilities

Test scores of AI systems on various capabilities relative to human performance

Our World
in Data

Within each domain, the initial performance of the AI is set to -100. Human performance is used as a baseline, set to zero. When the AI's performance crosses the zero line, it scored more points than humans.



Data source: Kiela et al. (2023)

OurWorldInData.org/artificial-intelligence | CC BY

Note: For each capability, the first year always shows a baseline of -100, even if better performance was recorded later that year.

Source: <https://ourworldindata.org/artificial-intelligence>

AI already exceeds human performance in nearly all tasks.

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Current State: LLMs get exponentially better

Rank★ (UB)	Model	Arena Score	95% CI	Votes	Organization	License	Knowledge Cutoff
1	ChatGPT-4o-latest (2024-08-08)	1316	+4/-4	24358	OpenAI	Proprietary	2023/10
2	Gemini-1.5-Pro-Exp-0827	1301	+5/-5	19976	Google	Proprietary	2023/11
2	Gemini-1.5-Pro-Exp-0801	1298	+4/-3	25471	Google	Proprietary	2023/11
2	Grok-2-08-13	1295	+4/-6	10170	xAI	Proprietary	2024/3
5	GPT-4o-2024-05-13	1286	+3/-3	83181	OpenAI	Proprietary	2023/10
6	GPT-4o-mini-2024-07-18	1274	+4/-4	23318	OpenAI	Proprietary	2023/10
6	Gemini-1.5-Flash-Exp-0827	1270	+7/-6	6610	Google	Proprietary	2023/11
6	Claude-3.5-Sonnet	1270	+3/-3	53610	Anthropic	Proprietary	2024/4
6	Gemini-Advanced-App (2024-05-14)	1266	+3/-3	52225	Google	Proprietary	Online
6	Grok-2-Mini-08-13	1266	+6/-6	10939	xAI	Proprietary	2024/3
7	Meta-Llama-3.1-405b-Instruct	1266	+3/-4	24855	Meta	Llama 3.1 Community	2023/12
7	GPT-4o-2024-08-06	1262	+7/-5	14960	OpenAI	Proprietary	2023/10
10	Gemini-1.5-Pro-001	1259	+3/-3	74909	Google	Proprietary	2023/11

Source: <https://lmarena.ai/?leaderboard>

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Current State: Math - 07/2024: Silver Medal in International Mathematical Olympiad

February 9, 2024

TIPS AND TRICKS

Why is ChatGPT bad at even basic math?

Two things ChatGPT can get wrong: math and facts. Why?

How is one of the biggest AI Tools in the world making mistakes that even a normal person can figure out?



Sunny K. Tuladhar · Follow
4 min read · Feb 3, 2024



You

$1+1+1+3+1+1+1-3+2+1+2+3$

< 2 / 2 >



ChatGPT

Let's simplify the expression:

$1 + 1 + 1 + 3 + 1 + 1 + 1 - 3 + 2 + 1 + 2 + 3.$

Combine the like terms:

$1 + 1 + 1 + 3 + 1 + 1 + 1 - 3 + 2 + 1 + 2 + 3 = 18.$

So, the result is 18.

📄 🗨️ 🔄 🌐

PROF SIR TIMOTHY GOWERS,
IMO GOLD MEDALIST AND FIELDS MEDAL WINNER

The fact that the program can come up with a non-obvious construction like this is very impressive, and well beyond what I thought was state of the art.



On June 30, 2022, what will be the state-of-the-art accuracy of a machine-learning model on the MATH Dataset?

Forecast: 12.7 %



83 forecasters
Start: 2021-07-16
End: 2021-09-29

Crowd Forecast

Forecast History

More Info

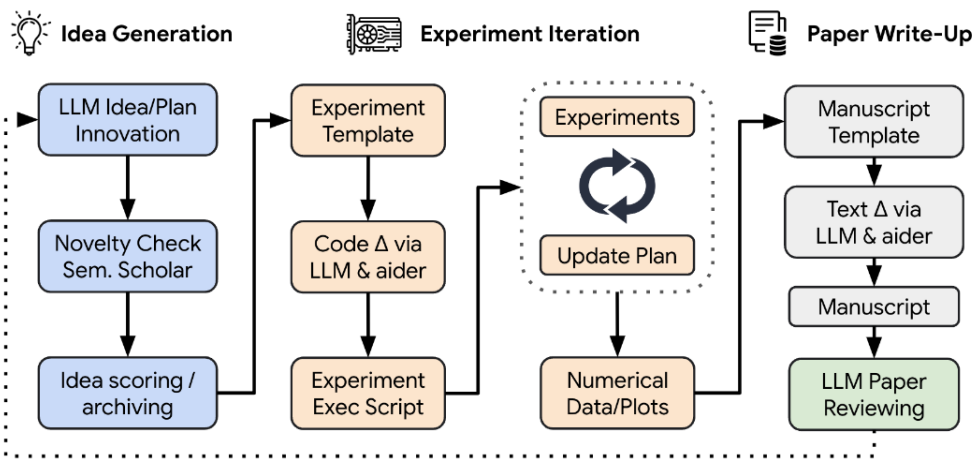
News

Source: <https://lmarena.ai/?leaderboard>

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Current State: AI Scientist (2024-08)

- AI system can write research papers fully automated
- full-paper cost of \$15

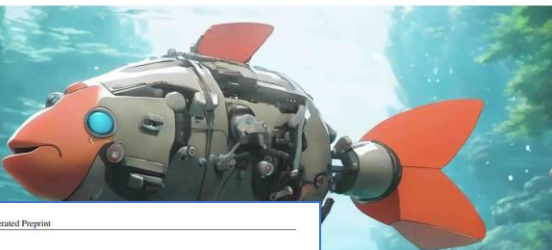


Source: <https://sakana.ai/ai-scientist/>

sakana.ai

The AI Scientist: Towards Fully Automated Open-Ended Scientific Discovery

August 13, 2024



AI-Scientist Generated Preprint

DUALSCALE DIFFUSION: ADAPTIVE FEATURE BALANCING FOR LOW-DIMENSIONAL GENERATIVE MODELS

Anonymous authors
Paper under double-blind review

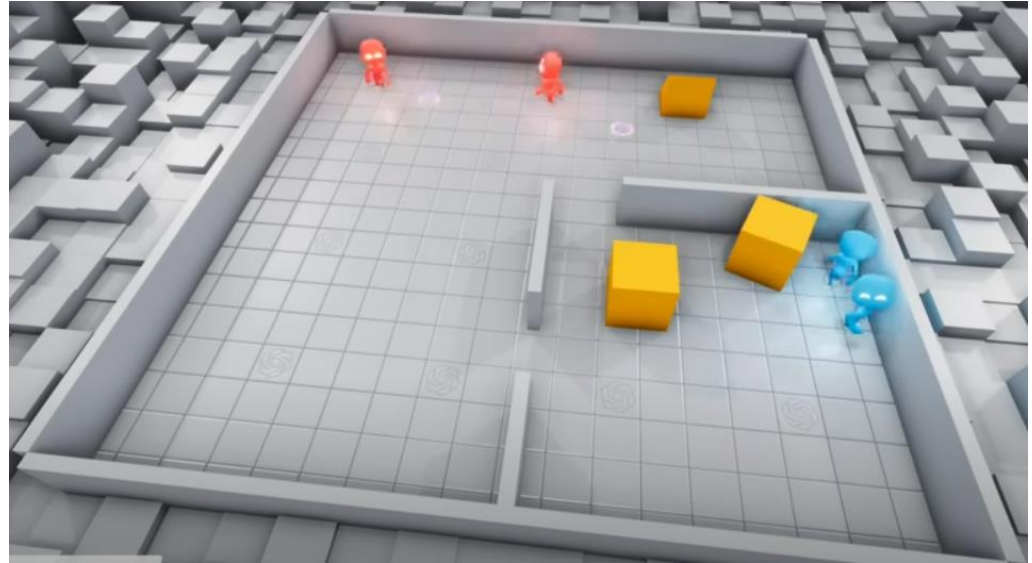
ABSTRACT

This paper introduces an adaptive dual-scale denoising approach for low-dimensional diffusion models, addressing the challenge of balancing global structure and local detail in generated samples. While diffusion models have shown remarkable success in high-dimensional spaces, their application to low-dimensional data remains crucial for understanding fundamental model behaviors and addressing real-world applications with inherently low-dimensional data. However, in these spaces, traditional models often struggle to simultaneously capture both macro-level patterns and fine-grained features, leading to suboptimal sample quality. We propose a novel architecture incorporating two parallel branches: a global branch processing the original input and a local branch handling an upsampled version, with a learnable, timestep-conditioned weighting mechanism dynamically balancing their contributions. We evaluate our method on four diverse 2D datasets: circle, digit, line, and moon. Our results demonstrate significant improvements in sample quality, with KL divergence reductions of up to 12.8% compared to the baseline model. The adaptive weighting successfully adjusts the focus between global and local features across different datasets and denoising stages, as evidenced by our weight evolution analysis. This work not only enhances low-dimensional diffusion models but also provides insights that could inform improvements in higher-dimensional domains, opening new avenues for advancing generative modeling across various applications.

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Current State: AI agents collaboration

- AI teams play hide-and-seek
- two hiders vs. two seekers
- develop novel solutions
- find glitches in programming
- unexpected behavior



Source: <https://www.youtube.com/watch?v=Lu56xVlZ40M&t=5s>