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Gemini is a family of multimodal large language models (LLMs) developed by Google DeepMind , and the successor to LaMDA and PaLM 2 . Comprising Gemini Ultra, Gemini Pro, Gemini Flash, and Gemini Nano, it was announced on December 6, 2023. It powers the chatbot of the same name .

History

Development

Google announced Gemini, a large language model (LLM) developed by subsidiary Google DeepMind , during the Google I/O keynote on May 10, 2023. It was positioned as a more powerful successor to PaLM 2 , which was also unveiled at the event, with Google CEO Sundar Pichai stating that Gemini was still in its early developmental stages. [1] [2] Unlike other LLMs, Gemini was said to be unique in that it was not trained on a text corpus alone and was designed to be multimodal , meaning it could process multiple types of data simultaneously, including text, images, audio, video, and computer code . [3] It had been developed as a collaboration between DeepMind and Google Brain , two branches of Google that had been merged as Google DeepMind the previous month. [4] In an interview with Wired , DeepMind CEO Demis Hassabis touted Gemini's advanced capabilities, which he believed would allow the algorithm to trump OpenAI 's ChatGPT , which runs on GPT-4 and whose growing popularity had been aggressively challenged by Google with LaMDA and Bard . Hassabis highlighted the strengths of DeepMind's AlphaGo program, which gained worldwide attention in 2016 when it defeated Go champion Lee Sedol , saying that Gemini would combine the power of AlphaGo and other Google–DeepMind LLMs. [5]

In August 2023, The Information published a report outlining Google's roadmap for Gemini, revealing that the company was targeting a launch date of late 2023. According to the report, Google hoped to surpass OpenAI and other competitors by combining conversational text capabilities present in most LLMs with artificial intelligence –powered image generation, allowing it to create contextual images and be adapted for a wider range of use cases . [6] Like Bard, [7] Google co-founder Sergey Brin was summoned out of retirement to assist in the development of Gemini, along with hundreds of other engineers from Google Brain and DeepMind; [6] [8] he was later credited as a "core contributor" to Gemini. [9] Because Gemini was being trained on transcripts of YouTube videos, lawyers were brought in to filter out any potentially copyrighted materials. [6]

With news of Gemini's impending launch, OpenAI hastened its work on integrating GPT-4 with multimodal features similar to those of Gemini. [10] The Information reported in September that several companies had been granted early access to "an early version" of the LLM, which Google intended to make available to clients through Google Cloud 's Vertex AI service. The publication also stated that Google was arming Gemini to compete with both GPT-4 and Microsoft 's GitHub Copilot . [11] [12]

Launch

On December 6, 2023, Pichai and Hassabis announced "Gemini 1.0" at a virtual press conference. [13] [14] It comprised three models: Gemini Ultra, designed for "highly complex tasks"; Gemini Pro, designed for "a wide range of tasks"; and Gemini Nano, designed for "on-device tasks". At launch, Gemini Pro and Nano were integrated into Bard and the Pixel 8 Pro smartphone,

respectively, while Gemini Ultra was set to power "Bard Advanced" and become available to software developers in early 2024. Other products that Google intended to incorporate Gemini into included Search , Ads , Chrome , Duet AI on Google Workspace , and AlphaCode 2 . [15] [14] It was made available only in English. [14] [16] Touted as Google's "largest and most capable AI model" and designed to emulate human behavior, [17] [14] [18] the company stated that Gemini would not be made widely available until the following year due to the need for "extensive safety testing". [13] Gemini was trained on and powered by Google's Tensor Processing Units (TPUs), [13] [16] and the name is in reference to the DeepMind–Google Brain merger as well as NASA 's Project Gemini . [19]

Gemini Ultra was said to have outperformed GPT-4, Anthropic 's Claude 2 , Inflection AI 's Inflection-2, Meta 's LLaMA 2 , and xAI 's Grok 1 on a variety of industry benchmarks, [20] [13] while Gemini Pro was said to have outperformed GPT-3.5 . [3] Gemini Ultra was also the first language model to outperform human experts on the 57-subject Massive Multitask Language Understanding (MMLU) test, obtaining a score of 90%. [3] [19] Gemini Pro was made available to Google Cloud customers on AI Studio and Vertex AI on December 13, while Gemini Nano will be made available to Android developers as well. [21] [22] [23] Hassabis further revealed that DeepMind was exploring how Gemini could be "combined with robotics to physically interact with the world". [24] In accordance with an executive order signed by U.S. President Joe Biden in October, Google stated that it would share testing results of Gemini Ultra with the federal government of the United States . Similarly, the company was engaged in discussions with the government of the United Kingdom to comply with the principles laid out at the AI Safety Summit at Bletchley Park in November. [3]

In June, 2025 Google introduced Gemini CLI, an open-source AI agent that brings the capabilities of Gemini directly to the terminal, offering advanced coding, automation, and problem-solving features with generous free usage limits for individual developers. [25]

Updates

Google partnered with Samsung to integrate Gemini Nano and Gemini Pro into its Galaxy S24 smartphone lineup in January 2024. [26] [27] The following month, Bard and Duet AI were unified under the Gemini brand, [28] [29] with "Gemini Advanced with Ultra 1.0" debuting via a new "AI Premium" tier of the Google One subscription service. [30] Gemini Pro also received a global launch. [31]

In February, 2024, Google launched Gemini 1.5 in a limited capacity, positioned as a more powerful and capable model than 1.0 Ultra. [32] [33] [34] This "step change" was achieved through various technical advancements, including a new architecture, a mixture-of-experts approach, and a larger one-million-token context window , which equates to roughly an hour of silent video, 11 hours of audio, 30,000 lines of code, or 700,000 words. [35] The same month, Google debuted Gemma, a family of free and open-source LLMs that serve as a lightweight version of Gemini. They came in two sizes, with a neural network with two and seven billion parameters, respectively. Multiple publications viewed this as a response to Meta and others open-sourcing their AI models, and a stark reversal from Google's longstanding practice of keeping its AI proprietary. [36] [37] [38] Google announced an additional model, Gemini 1.5 Flash, on May 14th at the 2024 I/O keynote. [39]

Two updated Gemini models, Gemini-1.5-Pro-002 and Gemini-1.5-Flash-002, were released on September 24, 2024. [40]

On December 11, 2024, Google announced Gemini 2.0 Flash Experimental, [41] a significant update to its Gemini AI model. This iteration boasts improved speed and performance over its predecessor, Gemini 1.5 Flash. Key features include a Multimodal Live API for real-time audio and video interactions, enhanced spatial understanding, native image and controllable text-to-speech generation (with watermarking), and integrated tool use, including Google Search. [42] It also introduces improved agentic capabilities, a new Google Gen AI SDK, [43] and "Jules," an experimental AI coding agent for GitHub. Additionally, Google Colab is integrating Gemini 2.0 to generate data science notebooks from natural language. Gemini 2.0 was available through the Gemini chat interface for all users as "Gemini 2.0 Flash experimental".

On January 30, 2025, Google released Gemini 2.0 Flash as the new default model, with Gemini 1.5 Flash still available for usage. This was followed by the release of Gemini 2.0 Pro on February 5, 2025. Additionally, Google released Gemini 2.0 Flash Thinking Experimental, which details the language model's thinking process when responding to prompts. [44]

On March 12, 2025, Google also announced Gemini Robotics , a vision-language-action model based on the Gemini 2.0 family of models. [45]

The next day, Google announced that Gemini in Android Studio would be able to understand simple UI mockups and transform them into working Jetpack Compose code. [46]

Gemini 2.5 Pro Experimental was released on March 25, 2025, described by Google as its most intelligent AI model yet, featuring enhanced reasoning and coding capabilities, [47] [48] [49] and a "thinking model" capable of reasoning through steps before responding, using techniques like chain-of-thought prompting , [47] [49] [50] whilst maintaining native multimodality and launching with a 1 million token context window. [47] [49]

At Google I/O 2025, Google announced significant updates to its Gemini core models. [51] [52] Gemini 2.5 Flash became the default model, delivering faster responses. [51] [52] Gemini 2.5 Pro was introduced as the most advanced Gemini model, featuring reasoning, coding capabilities, and the new Deep Think mode for complex tasks. [53] Both 2.5 Pro and Flash support native audio output and improved security.

On June 17, 2025, Google announced general availability for 2.5 Pro and Flash. They also introduced Gemini 2.5 Flash-Lite that same day, a model optimized for speed and cost-efficiency. [54]

Model versions

The following table lists the main model versions of Gemini, describing the significant changes included with each version: [55] [56]

Technical specifications

As Gemini is multimodal, each context window can contain multiple forms of input. The different modes can be interleaved and do not have to be presented in a fixed order, allowing for a multimodal conversation. For example, the user might open the conversation with a mix of text, picture, video, and audio, presented in any order, and Gemini might reply with the same free ordering. Input images may be of different resolutions , while video is inputted as a sequence of images. Audio is sampled at 16 kHz and then converted into a sequence of tokens by the Universal Speech Model. Gemini's dataset is multimodal and multilingual, consisting of "web documents, books, and code, and includ[ing] image, audio, and video data". [64]

Gemini and Gemma models are decoder-only transformers , with modifications to allow efficient training and inference on TPUs. The 1.0 generation uses multi-query attention . [64]

No whitepapers were published for Gemini 2.0 and Gemini 2.5.

Reception

Gemini's launch was preceded by months of intense speculation and anticipation, which MIT Technology Review described as "peak AI hype". [67] [20] In August 2023, Dylan Patel and Daniel Nishball of research firm SemiAnalysis penned a blog post declaring that the release of Gemini would "eat the world" and outclass GPT-4, prompting OpenAI CEO Sam Altman to ridicule the duo on X (formerly Twitter). [68] [69] Business magnate Elon Musk , who co-founded OpenAI, weighed in, asking, "Are the numbers wrong?" [70] Hugh Langley of Business Insider remarked that Gemini would be a make-or-break moment for Google, writing: "If Gemini dazzles, it will help Google change the narrative that it was blindsided by Microsoft and OpenAI. If it disappoints, it will embolden critics who say Google has fallen behind." [71]

Reacting to its unveiling in December 2023, University of Washington professor emeritus Oren Etzioni predicted a "tit-for-tat arms race " between Google and OpenAI . Professor Alexei Efros of the University of California, Berkeley praised the potential of Gemini's multimodal approach, [19] while scientist Melanie Mitchell of the Santa Fe Institute called Gemini "very sophisticated".

Professor Chirag Shah of the University of Washington was less impressed, likening Gemini's launch to the routineness of Apple 's annual introduction of a new iPhone . Similarly, Stanford University 's Percy Liang, the University of Washington's Emily Bender , and the University of Galway 's Michael Madden cautioned that it was difficult to interpret benchmark scores without insight into the training data used. [67] [72] Writing for Fast Company , Mark Sullivan opined that Google had the opportunity to challenge the iPhone's dominant market share, believing that Apple was unlikely to have the capacity to develop functionality similar to Gemini with its Siri virtual assistant . [73] Google shares spiked by 5.3 percent the day after Gemini's launch. [74] [75]

Google faced criticism for a demonstrative video of Gemini, which was not conducted in real time. [76]

Gemini 2.5 Pro Experimental debuted at the top position on the LMArena leaderboard, a benchmark measuring human preference, indicating strong performance and output quality. [47] [49] The model achieved state-of-the-art or highly competitive results across various benchmarks evaluating reasoning, knowledge, science, math, coding, and long-context performance, such as Humanity's Last Exam , GPQA, AIME 2025, SWE-bench and MRCR. [47] [77] [49] [48] Initial reviews highlighted its improved reasoning capabilities and performance gains compared to previous versions. [48] [50] Published benchmarks also showed areas where contemporary models from competitors like Anthropic , xAI , or OpenAI held advantages. [77] [49]

See also

Gato , a multimodal neural network developed by DeepMind

Gemini Robotics

List of large language models

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White paper for 1.0 and 1.5

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Google

Google Brain

Google DeepMind

AlphaGo (2015)

Master (2016)

AlphaGo Zero (2017)

AlphaZero (2017)

MuZero (2019)

Fan Hui (2015)

Lee Sedol (2016)

Ke Jie (2017)

AlphaGo (2017)

The MANIAC (2023)

AlphaFold (2018)

AlphaStar (2019)

AlphaDev (2023)

AlphaGeometry (2024)

AlphaGenome (2025)

Inception (2014)

WaveNet (2016)

MobileNet (2017)

Transformer (2017)

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Tensor Processing Unit

Assistant (2016)

Sparrow (2022)

Gemini (2023)

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XLNet (2019)

T5 (2019)

LaMDA (2021)

Chinchilla (2022)

PaLM (2022)

Imagen (2023)

Gemini (2023)

VideoPoet (2024)

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NotebookLM (2023)

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Gemini Robotics (2025)

" Attention Is All You Need "

Future of Go Summit
Generative pre-trained transformer
Google Labs
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Google.org Crisis Response
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Contact Lens

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Digital Garage
Digital News Initiative
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Get Your Business Online
Google for Education
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Made with Code
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Solve for X
Street View Trusted
Student Ambassador Program
Vevo
YouTube BrandConnect
YouTube Creator Awards
YouTube Select
YouTube Original Channel Initiative
Year in Search

YouTube Rewind 2018 2019

2018

2019

AlphaGo versus Fan Hui

AlphaGo versus Lee Sedol

AlphaGo versus Ke Jie

Android Developer Challenge

Android Developer Day

Android Developer Lab

CNN/YouTube presidential debates

Code-in

Code Jam

Developer Day

Developers Live

Doodle4Google

Future of Go Summit

G-Day

Hash Code

I/O

Lunar X Prize

Mapathon

Science Fair

Summer of Code

World Chess Championship 2024

YouTube Awards

YouTube Comedy Week

YouTube Live

YouTube Music Awards 2013 2015

2013

2015

YouTube Space Lab

YouTube Symphony Orchestra

111 Eighth Avenue

Android lawn statues

Androidland

Barges

Binoculars Building

Central Saint Giles

Chelsea Market
Chrome Zone
Data centers
GeoEye-1
Googleplex
Ivanpah Solar Power Facility
James R. Thompson Center
King's Cross
Mayfield Mall
Pier 57
Sidewalk Toronto
St. John's Terminal
Submarine cables Dunant Grace Hopper Unity
Dunant
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Susan Wojcicki
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Alphabet Workers Union
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Blocking of YouTube videos in Germany
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Doodle Champion Island Games

Magic Cat Academy

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ALTS

American Fuzzy Lop

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Android Debug Bridge

Android NDK

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Android SDK

Android Studio

Angular

AngularJS

Apache Beam

APIs

App Engine

App Inventor

App Maker

App Runtime for Chrome

AppJet

Apps Script

AppSheet

ARCore

Base

Bazel
BeyondCorp
Bigtable
BigQuery
Bionic
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Chart API
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Cloud Connect
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Cloud Shell
Cloud Storage
Code Search
Compute Engine
Cpplint
Dalvik
Data Protocol
Dialogflow
Exposure Notification
Fast Pair
Fastboot
Federated Learning of Cohorts
File System
Firebase
Firebase Studio
Firebase Cloud Messaging
FlatBuffers
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Keyhole Markup Language
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Looker Studio
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Mashup Editor
Matter
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Nomulus
Open Location Code
OpenRefine
OpenSocial
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OR-Tools
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Plugin for Eclipse

Polymer

Programmable Search Engine

Project Shield

Public DNS

reCAPTCHA

RenderScript

SafetyNet

SageTV

Schema.org

Search Console

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Skia Graphics Engine

Spanner

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V8

VirusTotal

VisBug

Wave Federation Protocol

Weave

Web Accelerator

Web Designer

Web Server

Web Toolkit

Webdriver Torso

WebRTC

Android Cupcake Donut Eclair Froyo Gingerbread Honeycomb Ice Cream Sandwich Jelly Bean KitKat Lollipop Marshmallow Nougat Oreo Pie 10 11 12 13 14 15 16 version history smartphones

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Chrome Experiments
Chrome Remote Desktop
Chrome Web Store
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Cloud Print
Cloud Search

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Quick, Draw!
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Pixelbook Go (2019)

Pixel Buds (2017–present)
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Play Edition
Project Ara
OnHub
Pixel Visual Core
Project Iris
Search Appliance

Sycamore processor

Tensor

Tensor Processing Unit

Titan Security Key

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Authors Guild, Inc. v. Google, Inc. (2015)

Field v. Google, Inc. (2016)

Google LLC v. Oracle America, Inc. (2021)

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Rocky Mountain Bank v. Google, Inc. (2009)

Hibnick v. Google, Inc. (2010)

United States v. Google Inc. (2012)

Judgement of the German Federal Court of Justice on Google's autocomplete function (2013)

Joffe v. Google, Inc. (2013)

Mosley v SARL Google (2013)

Google Spain v AEPD and Mario Costeja González (2014)

Frank v. Gaos (2019)

Garcia v. Google, Inc. (2015)

Google LLC v Defteros (2020)

Epic Games v. Google (2021)

Gonzalez v. Google LLC (2022)

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Colombia

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Most-liked videos

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Arabic music videos

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AlphaGo

Google: Behind the Screen

Google Maps Road Trip

Google and the World Brain

The Creepy Line

Google Hacks

The Google Story

Googled: The End of the World as We Know It

How Google Works

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In the Plex
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Google Feud
Google Me (film)
" Google Me " (Kim Zolciak song)
" Google Me " (Teyana Taylor song)
Is Google Making Us Stupid?
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Synthetic data
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Devstral
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Kimi-Dev
Qwen3-Coder
Replit
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Flux
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Suno AI
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Agentforce

AutoGLM
AutoGPT
ChatGPT Agent
Devin AI
Manus
OpenAI Codex
Operator
Replit Agent
01.AI
Aleph Alpha
Anthropic
Baichuan
Canva
Cognition AI
Cohere
Contextual AI
DeepSeek
ElevenLabs
Google DeepMind
HeyGen
Hugging Face
Inflection AI
Krikey AI
Kuaishou
Luma Labs
Meta AI
MiniMax
Mistral AI
Moonshot AI
OpenAI
Perplexity AI
Runway
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Salesforce
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Bias–variance tradeoff

Double descent

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Quasi-Newton method

Conjugate gradient method

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Batchnorm

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Softmax

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Q-learning

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Imitation

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In-context learning

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Deep learning

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Large language model

NMT

Reasoning language model

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Intelligent agent

Artificial human companion

Humanity's Last Exam

Artificial general intelligence (AGI)

AlexNet

WaveNet

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HWR

OCR

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Speech synthesis 15.ai ElevenLabs

15.ai

ElevenLabs

Speech recognition Whisper

Whisper

Facial recognition

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Aurora

DALL-E

Firefly

Flux

Ideogram

Imagen

Midjourney

Recraft

Stable Diffusion

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Dream Machine

Runway Gen

Hailuo AI

Kling

Sora

Veo

Music generation Riffusion Suno AI Udio

Riffusion

Suno AI

Udio

Word2vec

Seq2seq

GloVe

BERT

T5

Llama

Chinchilla AI

PaLM

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2

3

J

ChatGPT

4

4o

o1

o3

4.5

4.1

o4-mini

5

Claude

Gemini Gemini (language model) Gemma

Gemini (language model)

Gemma

Grok

LaMDA

BLOOM

DBRX

Project Debater

IBM Watson

IBM Watsonx

Granite

PanGu-Σ

DeepSeek

Qwen

AlphaGo

AlphaZero

OpenAI Five

Self-driving car

MuZero

Action selection AutoGPT

AutoGPT

Robot control

Alan Turing

Warren Sturgis McCulloch

Walter Pitts
John von Neumann
Claude Shannon
Shun'ichi Amari
Kunihiko Fukushima
Takeo Kanade
Marvin Minsky
John McCarthy
Nathaniel Rochester
Allen Newell
Cliff Shaw
Herbert A. Simon
Oliver Selfridge
Frank Rosenblatt
Bernard Widrow
Joseph Weizenbaum
Seymour Papert
Seppo Linnainmaa
Paul Werbos
Geoffrey Hinton
John Hopfield
Jürgen Schmidhuber
Yann LeCun
Yoshua Bengio
Lotfi A. Zadeh
Stephen Grossberg
Alex Graves
James Goodnight
Andrew Ng
Fei-Fei Li
Alex Krizhevsky
Ilya Sutskever
Oriol Vinyals
Quoc V. Le
Ian Goodfellow
Demis Hassabis
David Silver
Andrej Karpathy

Ashish Vaswani

Noam Shazeer

Aidan Gomez

John Schulman

Mustafa Suleyman

Jan Leike

Daniel Kokotajlo

François Chollet

Neural Turing machine

Differentiable neural computer

Transformer Vision transformer (ViT)

Vision transformer (ViT)

Recurrent neural network (RNN)

Long short-term memory (LSTM)

Gated recurrent unit (GRU)

Echo state network

Multilayer perceptron (MLP)

Convolutional neural network (CNN)

Residual neural network (RNN)

Highway network

Mamba

Autoencoder

Variational autoencoder (VAE)

Generative adversarial network (GAN)

Graph neural network (GNN)

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