

Artificial Intelligence & Generative AI

Large Language Models (LLMs): PART I

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Artificial Intelligence & Generative AI: LLMs



AI Deep learning (Source: mindovermachines.com)

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Artificial Intelligence: Generative AI

What is It?



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Artificial Intelligence: Generative AI

What is It?

Generative AI: A category of artificial intelligence focused on using AI deep learning models to generate new contents, including text, images, audio, video, and more. The contents are novel but look realistic and may be indistinguishable from human-created ones.

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Artificial Intelligence: Generative AI

What is It?

Generative AI: A subfield of artificial intelligence based on AI neural networks that are trained on massive datasets of text, code, images, or other media. These algorithms learn the underlying patterns and relationships within the data to create novel outputs mimicking the style and characteristics of the training data.

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Artificial Intelligence: Generative AI

What is It?

Generative AI: Artificial intelligence techniques that are used to generate new data or contents such as text, images, audio, and video. The new contents can be indistinguishable from those created by humans.

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Generative AI: Large Language Model

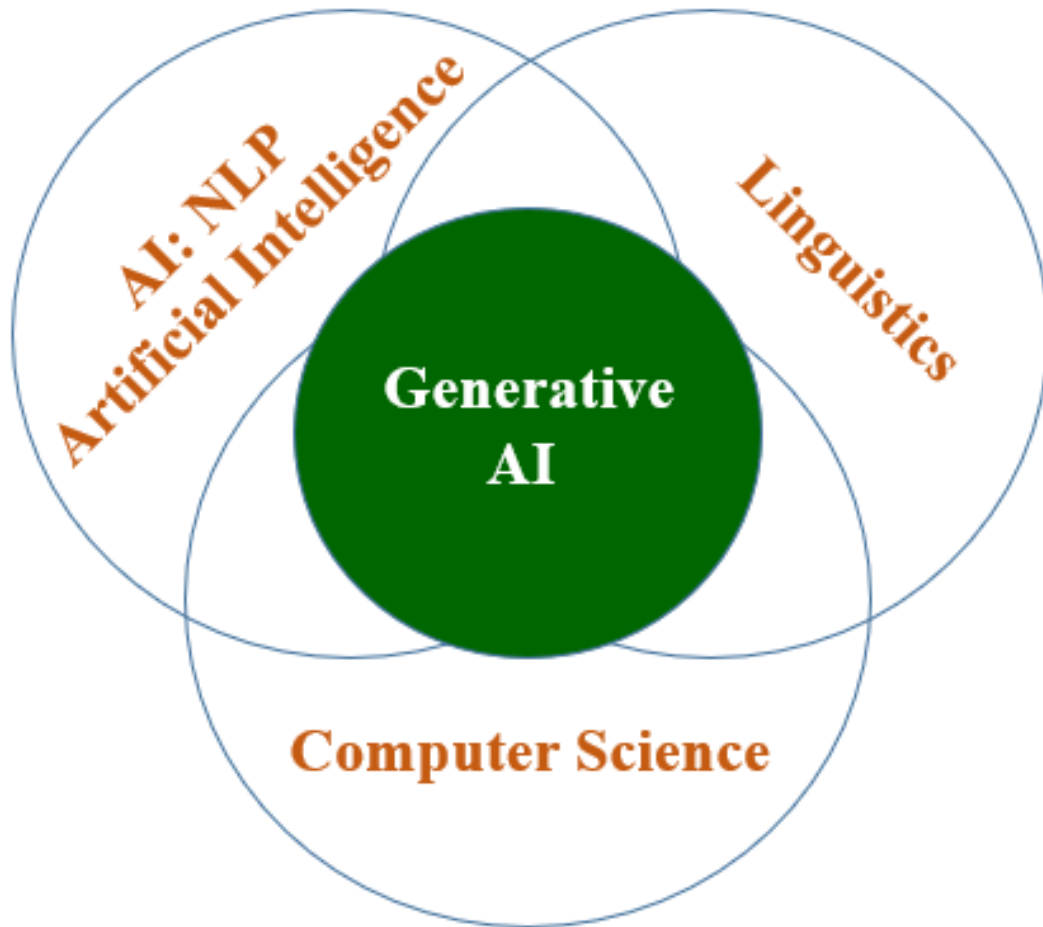
What is It?

Generative AI – LLM: A virtual digital artist that meticulously studies the brushstrokes of a master, then uses the knowledge and skills to paint his/her own unique masterpiece.

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Artificial Intelligence: Generative AI: LLM

What is It?



Generative AI is based on the NLP technologies such as Natural Language Understanding (NLU) and Conversational AI (AI Dialogues) - Those among the most challenging tasks AI needs to solve.

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Artificial Intelligence: Generative AI

A Brief History

Early Seeds (1900s – 1960s):

Very early in the 20th Century, **1906**, Andrey Markov published the first paper on **Markov chains**, a theory that could be used to offer first glimpses of statistical text generation. Then, in the **1940s**, Warren McCulloch and Walter Pitts published the seminal research paper, “A Logical Calculus of the Ideas Immanent in Nervous Activity.” The two AI genius pioneers proposed the **McCulloch-Pitts model**, a.k.a. the **artificial neuron**, a foundational mathematical model representing the biological neuron. The artificial neuron is the basic building blocks of an artificial neural network (ANN). It is not exaggerated to state that these two researchers **started the AI deep learning** field, if not the entire AI kingdom, the foundation of the **Generative AI**.

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A Brief History

Early Seeds (1960s – 1980s):

In the **1970s Harold Cohen**, an artist, developed and released **AARON**, a collection of computer programs that could generate abstract art. The program demonstrates the potential of AI for artistic expression.

In the **1980s**, Geoffrey Hinton and Terry Sejnowski proposed the **Boltzmann machine**, a type of **neural network** capable of **learning complex patterns from data**. The Boltzmann machine **could perform unsupervised learning tasks, including generative modeling** that can create new data resembling the training data, like generating realistic images or music. Although the Boltzmann machine was very limited in its capabilities, the model **laid the groundwork** for future developments in **generative AI**.

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A Brief History

The Growth of AI Deep Learning Neural Networks (1990s – 2016):

In the **1990s**, **many types of neural networks** with complex algorithms resembling the human brain structure were proposed. Models like **Pixie (1992)** that could generate artistic images and **ELIZA (1966)** that could **simulate basic conversation** did **pave the way for chatbots and natural language generation**, which ushered AI researchers and practitioners into a golden age of experimentation.

Importantly, in **2014**, Ilya Sutskever, Oriol Vinyals, and Quoc V. Le introduced **Sequence to Sequence** (Seq2Seq) model, laid the groundwork for the explosion of NLP advancements to come, including the revolutionary neural network, Transformers. **Seq2Seq bridges the gap between sequences – transforming one sequence of data (text, code, music) into another.**

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A Brief History

The Growth of AI Deep Learning Neural Networks (1990s – 2016):

By the end of the **2010s**, more advancements in AI deep learning further propelled AI subfields, including generative AI.

In **2014**, Ian Goodfellow, Yoshua Bengio, and Aaron Courville proposed **Generative Adversarial Networks (GANs)**, consisting of two convolutional neural networks pitting against each other – one generating, the other critiquing, that can be used to **generate photorealistic images**. One of these pictures was auctioned and sold over \$432,000.00 by the powerhouse Christie's.

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A Brief History

Revolutionary Advent of Transformers (2017):

Transformers, introduced in 2017, revolutionized Natural Language Processing (NLP) and Generative AI.

- Understand language differently, using "self-attention" to connect every word in a sentence, unlike old, sequential models.
- Understand complex sentences and generate impressive human-quality text, translate languages, and even write creatively.
- Power intelligent assistants, chatbots, and even video captioning.

Blossom of Generative AI (2017 - ...):

- BERT, GPT, GPT-2, GPT-3, LaMDA, GPT-4, GEMINI, ...

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Types of Deep Learning Neural Networks

Generative AI Models

Prominent types of generative AI neural networks:

- Generative Adversarial Networks (GAN)
 - Autoregressive Models
 - Variational Autoencoders (VAEs)
- Diffusion Models: Stable Diffusion Models
 - Transformer-based Models

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Types of Deep Learning Neural Networks

Generative AI Models

Generative Adversarial Networks (GAN):

GANs pit neural networks against each other to yield increasingly realistic synthetic outputs. One, the "generator," tries to create realistic data, while the other, the "discriminator," tries to distinguish real from fake. This constant competition pushes both models to improve, resulting in incredibly realistic outputs.

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Types of Deep Learning Neural Networks

**Generative
AI
Models**

Autoregressive Models:

Autoregressive models generate content step-by-step, predicting the next token (e.g. word or pixel) based on the previously generated sequence.

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Types of Deep Learning Neural Networks

Generative AI Models

Variational Autoencoders (VAE):

VAEs encode inputs into a latent space and then decode random points in that space into outputs. It can be thought of as compressing a complex image into a smaller code, then using that code to recreate the image or even generate new variations. The model is very good for image and text generation.

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Types of Deep Learning Neural Networks

Generative AI Models

Diffusion Models – Stable Diffusion:

“Diffusion” means “adding noise to an image.” Diffusion models blend image diffusion, some latent space, i.e., a hidden representation of the image, and text inputs to create images. Generally, diffusion models add noise to data and then train models to reverse that process as a creativity technique

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Types of Deep Learning Neural Networks

Generative AI Models

Transformer-Based Models:

The Transformer Neural Network is a revolutionary architecture that aims to solve sequence-to-sequence tasks with long-range dependencies. It was proposed in the paper “Attention Is All You Need” by Alphabet/Google AI researchers in 2017. All the prominent generative AI models such as GPT, GPT 2, 3, and 4, BERT, LaMDA, PaLM, and Gemini are based on this novel AI technology.