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Generative AI (Artificial Intelligence): What is it? & What are its Inter- and Transdisciplinary Applications?

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ABSTRACT

Generative AI can generate new contents in many types of outputs: images, videos, text or music. ChatGPT is web application that uses Generative AI. Many industries such as financial, health care, manufacturing, and marketing and sales use Generative AI.

This article discusses:

(1.) Literature review on the development for Large Language Models (LLM), Deep Learning, and Generative AI and recent research in these areas with a focus on Artificial Intelligence.

(2.) What are multidisciplinary, interdisciplinary and transdisciplinary applications of Artificial Intelligence and other applications for Generative AI such as those for vision, speech, language, decision, Open AI Service.

(3.) The concept of Trans-AI/DS (Data Science) as the transformative, transdisciplinary and translational artificial intelligence and data science.

A bibliography of current research in Generative AI is also presented and its relationship to Artificial Intelligence (AI), Machine Learning, and Deep Learning. Illustrative figures are also provided to visually enhance the differences and applications of each of these.

Keywords: Generative Artificial Intelligence (AI), Transformative, Transdisciplinary, Translational, Data Science, Trans-AI, Trans-AI/DS.

1. INTRODUCTION

The purpose of this paper is that based on my 2025 Plenary Keynote address that was presented virtuallyat the 29th World Multi-Conference on Systemics, Cybernetics and Informatics (WMSCI 2025) that was held September 9-12, 2025 as a Virtual Conference. This Plenary Keynote explained how the field of AI is often visualized in layers that include that of Machine learning (ML), Deep Learning, and Large Language Models (LLMs), and the relationships of Multidisciplinary, Interdisciplinaryand Transdisciplinary artificial intelligence.

2. ARTIFICIAL INTELLIGENCE(AI) WHAT IS IT?

According to Sterling & Sterling (2024) the terminology of AI "represents the broader discipline with computer science focused on creating systems capable of performing tasks that typically require human intelligence that encompasses various capabilities such as understanding natural language, recognizing patterns and images, making decisions and solving complex problems" (p. 17). In short, AI refers to a set of techniques that enable computers to mimic human behavior.

According to Stoffelbauer (2023), the field of AI is often visualized in layers such as illustrated in Figure 1. The layers of AI (Artificial Intelligence) include 3 subsets or layers that are as shown in Figure 1 (1.) Machine Learning that includes (2.) Neural Networks that include (3.) Deep Learning. Artificial Intelligence (AI) generally deals with intelligence machines, while Machine Learning (ML) is a subfield of AI and focuses on pattern recognition in data, and Deep Learning that is a subfield of ML that utilizes multi-layered neural networks and is capable of using unstructured data that includes text and images.

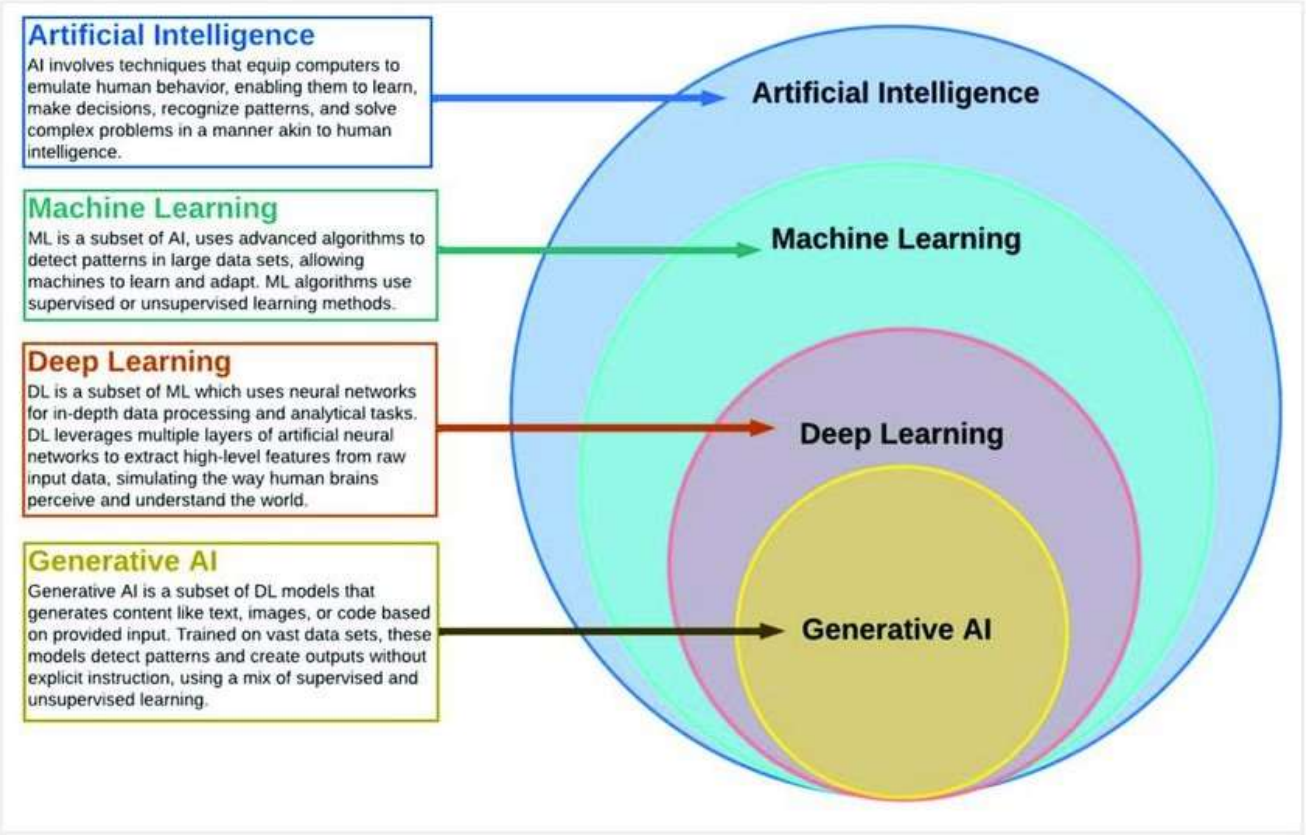

Figure 1: Relationship of Generative AI with Artificial Intelligence, Machine Learning and Deep Learning (Source: https://blog.pwskills.com/wp-content/uploads/2024/09/Generative-AI-Vs-Machine-Learning.png)

3. WHAT IS TRANS-AI/DS?

According to Cao (2023) a new generation of Artificial Intelligence (AI) and Data Science (DS) has inspired a new concept named Trans-AI/DS that features "transformative, transdisciplinary and translational" Artificial Intelligence and Data Science" in terms of thinking, paradigms, methodologies, technologies, engineering, and practices" as illustrated in Figure 2 below as the intersection of Translational AI/DS with Transformative AI/DS with Transformative AI/DS and Transdisciplinary AI/DS.

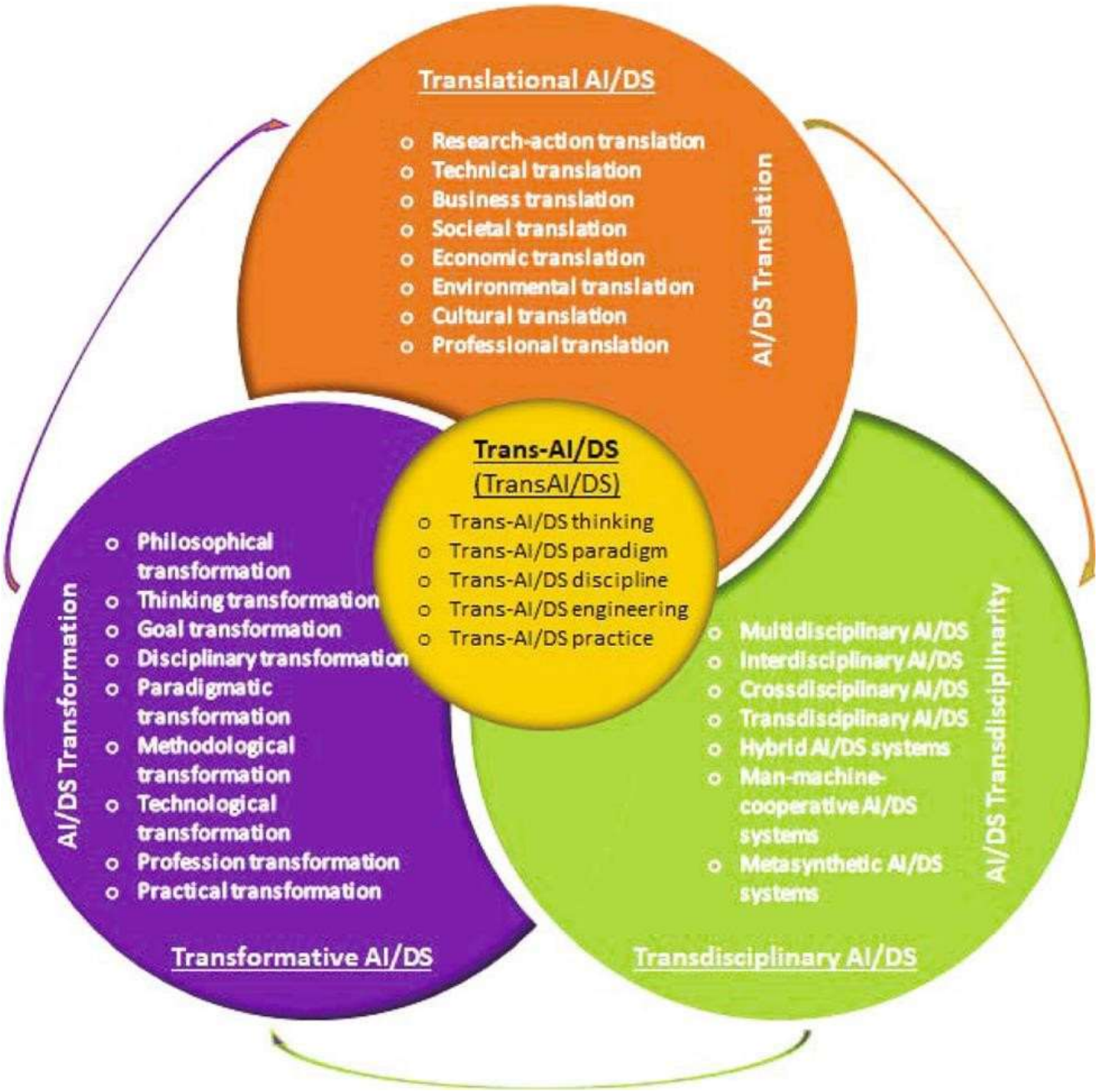

Figure 2: Trans-AI/DS: transformative, transdisciplinary and translational artificial intelligence (AI) and data science (DS) (Source: Cao (2023) [18.])

Source: https://media.springernature.com/lw1200/springer-static/image/art%3A10.1007%2Fs41060-023-00383-y/MediaObjects/41060_2023_383_Fig1_HTML.png

Figure 3 below illustrates the distinctions between and among four different levels of the term "Disciplinary" with the lowest level to be composed of individual silos for disjoint disciplines; followed by the next level of additive disjoint silos to form "Multi-disciplinary"; followed by interaction between selected silos to form "Inter-Disciplinary"; followed by the supreme combining together of each of the disciplines to form a "higher level synthesis" named "Trans-Disciplinary.

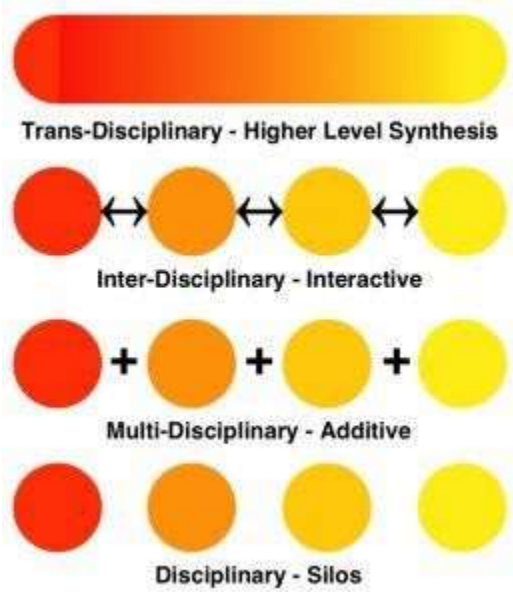

Figure 3: Relationship between Transdisciplinary, Inter-Disciplinary, Multi-Disciplinary and Disciplinary

Source: https://www.violence-lab.eu/wp-content/uploads/2019/05/transdisciplinarity-258x300.jpeg

Figure 4 from Cao (2024) illustrates the formation and mechanisms of multidisciplinary, interdisciplinary and transdisciplinary AI/DS (Artificial Intelligence/Data Science). According to Bryon (2017) "in reality, multidisciplinary, cross-disciplinary, interdisciplinary and transdisciplinary AI/DS are often interrelated, mixed or combined to address complex problems."

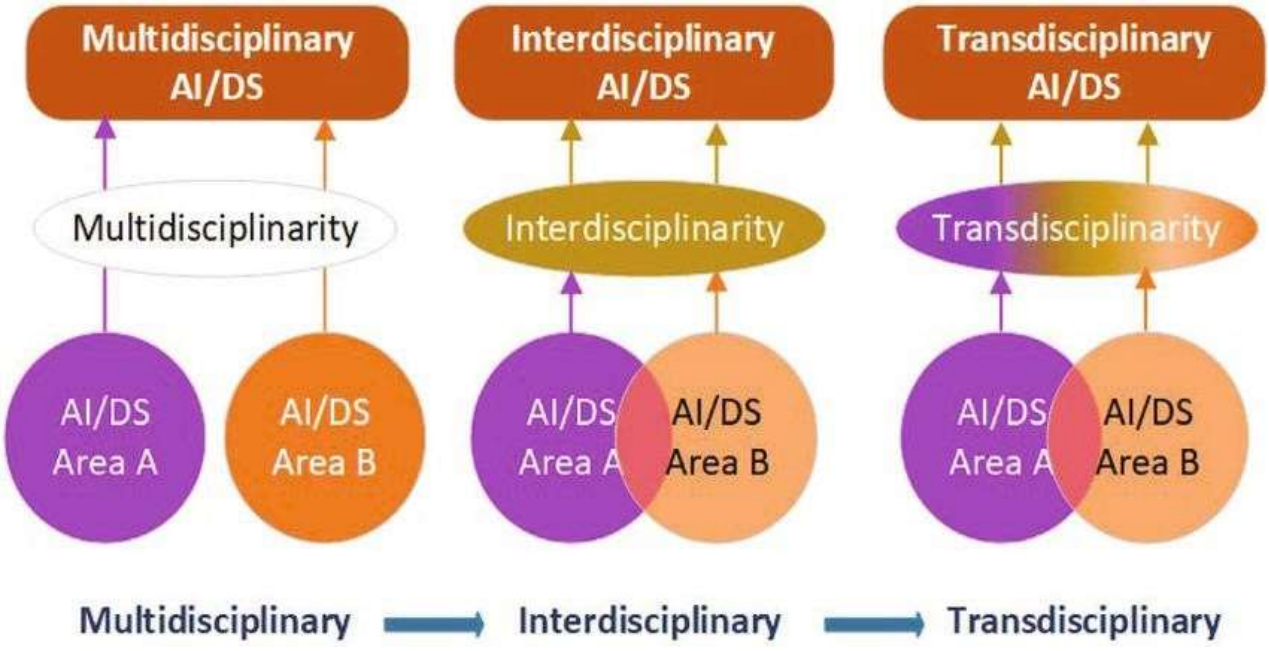

Figure 4: Multidisciplinary, interdisciplinary and transdisciplinary AI and data scienceource (Cao (2023) [18.])

Source: https://www.researchgate.net/publication/368689094/figure/fig2/AS:11431281126177407@1678590671958/Multidisciplinary-interdisciplinary-and-transdisciplinary-AI-and-data-science.png

4. WHAT IS GENERATIVE AI?

According to Sterling & Sterling (2024), Generative AI is a subset of Artificial Intelligence that specifically focuses on generating new content whether it be text, images or other (p.17).

Nguyen (2024) stated that "generative artificial intelligence (AI) refers to algorithms that can generate new data that is similar to the data they were trained on. Unlike traditional AI, which is often designed to recognize patterns and make decisions based on existing data, generative AI creates new content. This capability opens up a world of possibilities to create realistic images and videos, compose music, and write text."

Singh (2024) discussed transforming business with Generative AI with conclusions that "GenAI enhances operational efficiency, facilitates product and service innovation, and creates new revenue streams, positioning it as a powerful catalyst for substantial shifts in business structures and strategies." Singh (2024) also points out that GenAI present significant challenges that includes ethical concerns, regulatory demands, and risk of job displacement.

Figure 5 below illustrates ten Gnerative AI applications that encompasses those to art and design, music composition, content creation, virtual words, fashion and product design, financial forecasting, customer behavior analysis, demand forecasting, healthcare diagnosis and prognosis, and fraud detection.

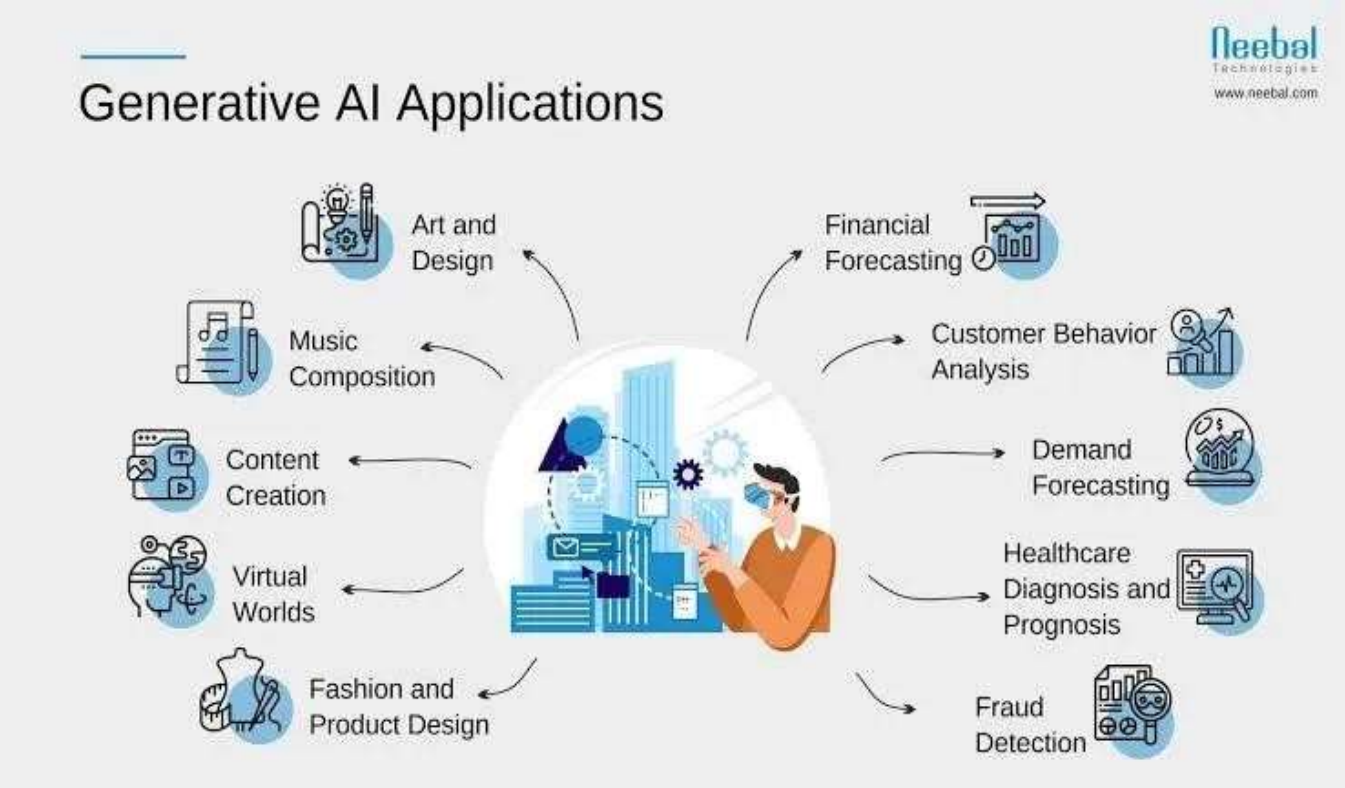

Figure 5: Generative AI Applications

Source: https://www.aegissofttech.com/insights/wp-content/uploads/2025/01/image-1.png

As shown in Figure 5 above, Generative AI applications range from music composition, fashion and product design to healthcare diagnosis and prognosis to customer behavior analysis and fraud detection., and Figure 6 below shows Generative AI applications specific to fields of software engineering that includes code generation, business that includes portfolio management, medicine that includes medical advice, and education that includes personalized feedback.

Coursea (2025) provides twenty generative AI applications across six industries, including health care, advertising and marketing, manufacturing, software development, financial services, and entertainment.

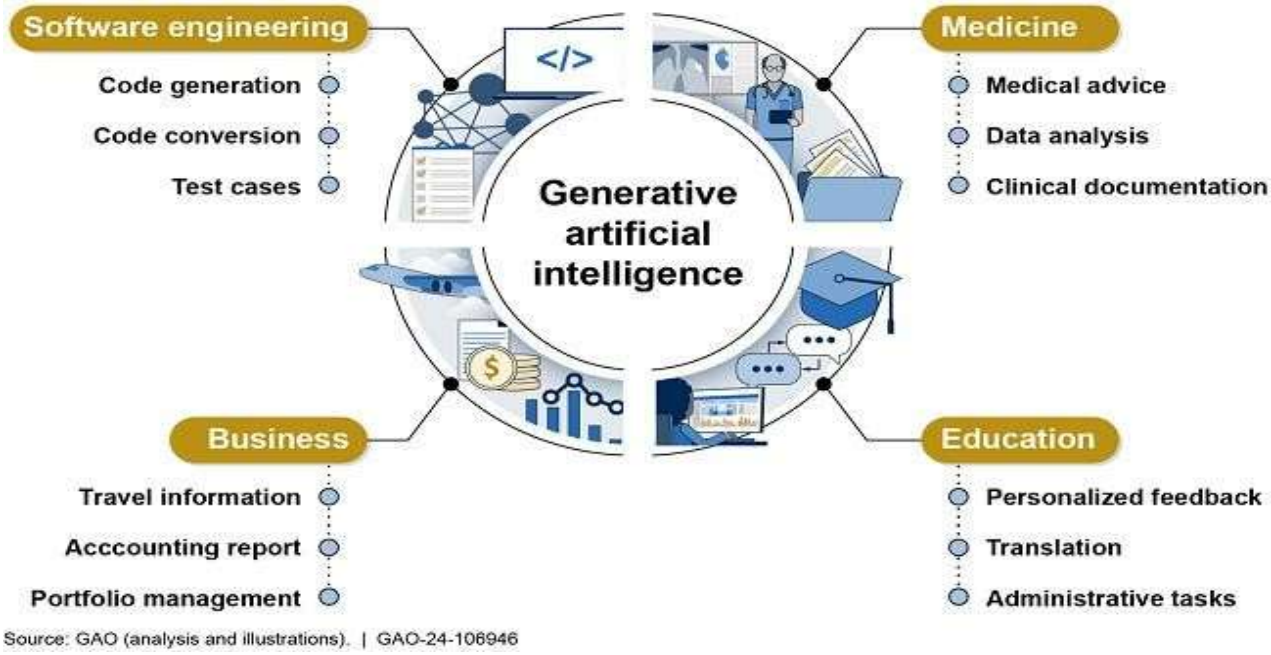

Figure 6: Generative AI applications to software engineering, business, medicine & education

Source: https://www.gao.gov/assets/870/869230.png

The below figure shown in video of Gupta & Ramaskrishnan (2025) of MIT Sloan School of Management provides guidance of which Artificial Intelligence (AI) tool you should use and why, and states that when resources are limited Generative AI does not require as much expertise to use.

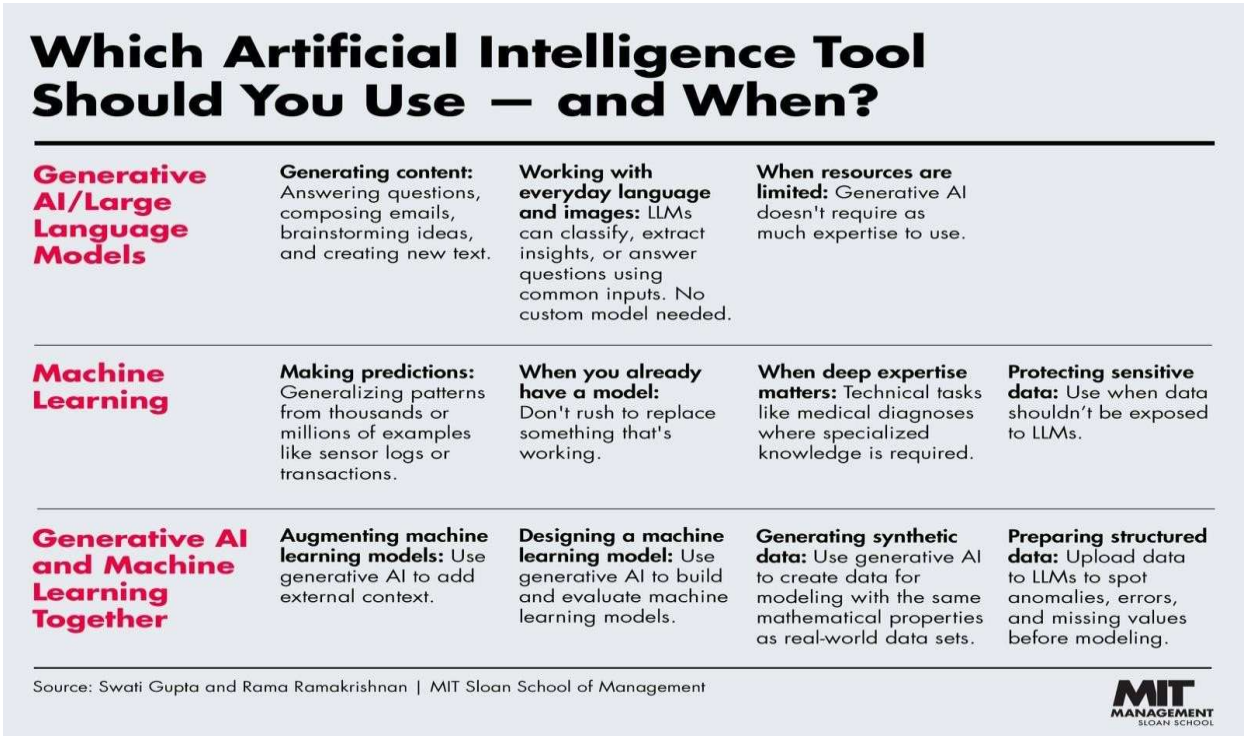

Figure 7: Which Artificial Tool Should You Use – and When?

[Source: Gupta & Ramakrishnan (2025)] https://images.jifo.co/122297491_1748836799127.jpg

5. WHAT ARE TYPES OF GENERATIVE AI MODELS?

Patel (2025) discussed eight types of Generative AI and provided examples of each as shown in Table 1 below.

According to Nguyen (2024) there are seven types of Generative AI Models that include Generative Adversarial Networks (GANs), Transformers based models, and others as shown in Figure 7 and cited below in seven sections.

Type of Generative AI	Example
Text-to-Text (T2T)	GPT-4, Google Bard, Claude
Text-to-Audio (T2A)	Google Tacotron, Amazon Poly
Text-to-Image (T2I)	OpenAI DALL-E & MidJourney
Text-to-Video (T2V)	FlikiAI & InvideoAI
Text-to-Music (T2M)	Suno & Udio
Audio-To-Text (A2T)	Amazon Alexa
Text-to-code (T2C)	GitHub Copilot
Image-to-Video (I2V)	RunwayML

Table 1: The Types of Generative AI [Source: Patel (2025)]

These explanatory paragraphs below Figure 8 correspond directly to the list of names for Generative AI models in Figure 8 created by Nguyen (2025) and this list differs from lists of Types of Generative AI Models created by other authors such as those in Sweenor & Mulkers (2024).

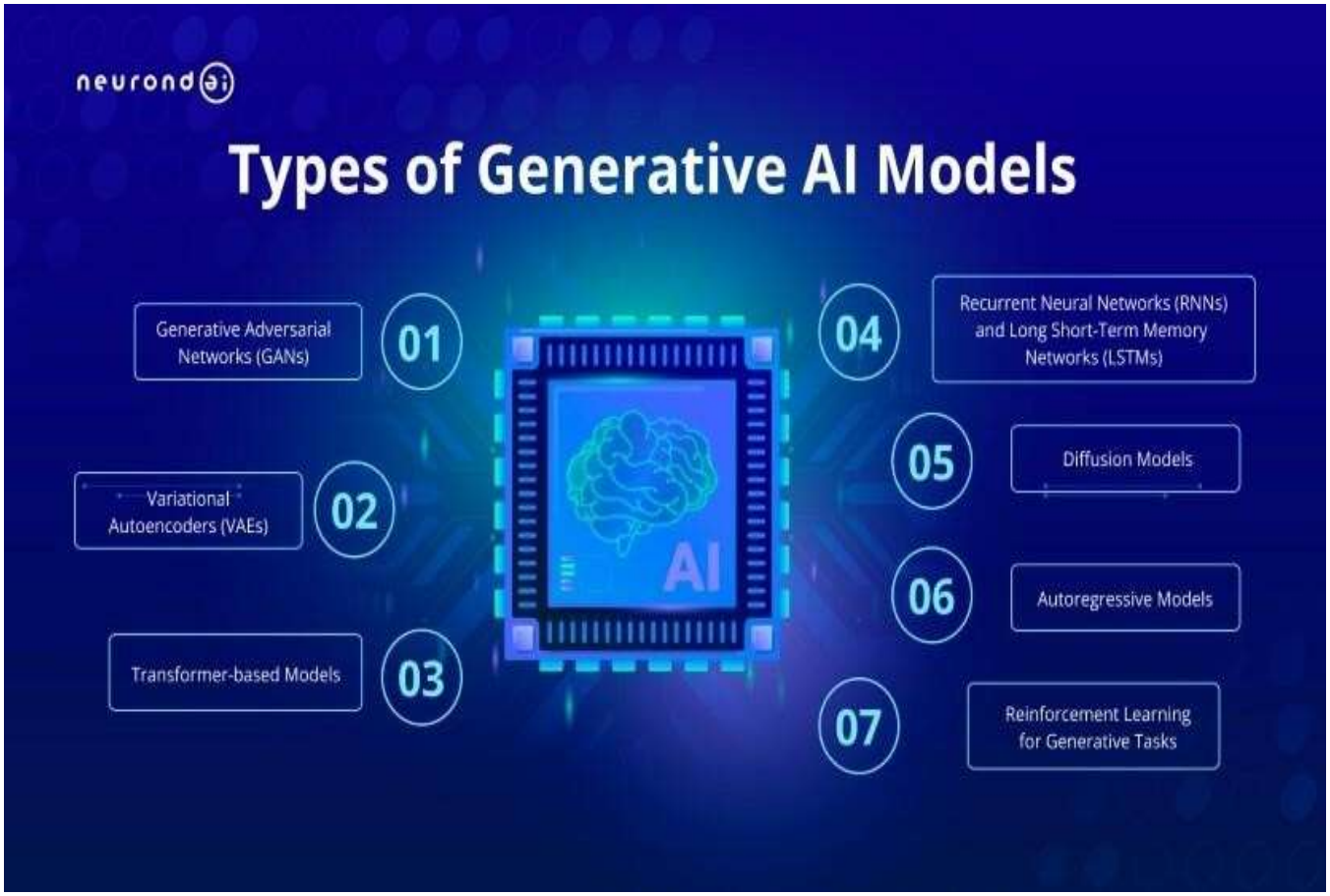

Figure 8 Types of Generative AI Models [Source: Nguyen (2024)]

Source: https://www.neurond.com/static/ee21649db716ea19134f604796a6b3e7/56731/types-of-generative-ai-models-1.jpg

#1 Generative Adversarial Networks (GANs)

"GANs prove to be one of the most popular types of generative models. Introduced by Ian Goodfellow and his colleagues in 2014, GANs consist of two neural networks: a generator and a discriminator. These two networks are trained simultaneously in a process that can be likened to a game. A few applications of GANs include image generation, such as creating realistic photos of non-existent people, art and design, and data augmentation, e.g., creating synthetic data for training other models." [Nguyen (2024)]

#2 Variational Autoencoders (VAEs)

"VAEs generative model is particularly useful for generating new data points that are similar to a given dataset. It's a type of autoencoder, a neural network architecture used for unsupervised learning." [Nguyen (2024)]

#3 Transformer-based Models

"Introduced in the 2017 paper "Attention is All You Need" by Vaswani et al., transformer models have become the foundation models for many state-of-the-art NLP models. They use a mechanism called self-attention to process input data in parallel, making them highly efficient and effective." [Nguyen (2024)]

#4 Recurrent Neural Networks (RNNs) and Long Short-Term Memory Networks (LSTMs)

"Recurrent Neural Networks and their advanced variant, Long Short-Term Memory Networks (LSTMs), are generative models particularly suited for sequential data. They are widely used in natural language processing tasks." [Nguyen (2024)]

#5 Diffusion Models

"As a class of generative models, diffusion models produce data by iteratively refining a noisy initial input. These models are inspired by the physical process of diffusion, where particles spread out over time." [Nguyen (2024)]

#6 Autoregressive Models

"Autoregressive models generate data one step at a time, predicting the next element based on the previously generated elements. Each prediction is conditioned on the previous elements, allowing the model to capture dependencies and patterns in the data. The model is trained to maximize the likelihood of the observed data, given the previous elements in the sequence." [Nguyen (2024)]

#7 Reinforcement Learning for Generative Tasks

"Reinforcement Learning (RL) is a type of machine learning in which an agent learns to make decisions by interacting with an environment and receiving feedback in the form of rewards or penalties. While traditionally used for game-playing and robotic tasks, RL can also be applied to generative tasks.

Art and Music Generation: RL can be applied to generative art and music, where the agent learns to create aesthetically pleasing or musically harmonious pieces based on human feedback.

Game Content Generation: RL can be used to generate game levels, characters, and narratives that provide an engaging and balanced experience for players." [Nguyen (2024)]

6. CONCLUSIONS

Generative AI is concluding its experimental phase and entering mainstream adoption, driven by rapid advancements in capabilities, the democratization of tools, and a shift toward task-specific autonomous agents. While it offers significant potential for productivity, efficiency, and innovation, its increasing integration into daily life also brings challenges related to bias, security, and regulation. The ultimate conclusion for generative AI's impact will be shaped by the strategic decisions of leaders, the adaptation of the workforce, and the effectiveness of governance.

As you can see from the list of over forty references provided in section 7, there have been an abundance of literature, books, and other works in 2025 that pertain to Generative AI. Each of these references are included for additional. readings on topic of Generative AI and its transdisciplinary applications.

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