

Applications of Generative Artificial Intelligence

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ABSTRACT

Generative Artificial Intelligence is already changing industries with the ability of creating human content such as text, image, video, and code. Deep learning models like GANs, VAEs, and Transformers make these creative outputs possible, differing from the classical AI which leans on classification and prediction. The authors will cover the wide range of Gen AI in healthcare, education, and business software development with entertainment research. In healthcare, the application of generative models is used for drug discovery, medical image synthesis, and personalized treatments. Organizations use Gen AI for product prototyping, marketing, and augmentation. Software engineering benefits from automatically generated and tested code. While these transformative benefits may exist, the responsible implementation and oversight of Gen AI is critical and will present serious ethical, legal, and societal implications.

INTRODUCTION

Generative Artificial Intelligence (Generative AI or GenAI) refers to a class of AI models capable of autonomously producing novel content—ranging from text, images, and audio to video, computer code, and even molecular structures—by learning patterns and relationships from large datasets. These

DOI: 10.4018/407613

models are powered by sophisticated machine learning architectures such as Generative Adversarial Networks (GANs), Variational Autoencoders (VAEs), and Large Language Models (LLMs) (Goodfellow et al., 2014; Kingma & Welling, 2013; Brown et al., 2020). Rather than simply analyzing or classifying data, GenAI systems generate new, coherent outputs that often mirror or extend the creativity typically associated with human intelligence.

Beyond content generation, GenAI is driving transformative change across industries by enhancing creative workflows, accelerating research and development, automating routine tasks, and enabling new forms of human–machine interaction. From generating realistic visual media and automating software development to revolutionizing drug discovery and redefining personalized education, the applications of generative AI are as diverse as they are impactful.

This chapter delves into the practical applications of generative AI across various sectors—including media and content creation, software engineering, healthcare, business intelligence, education, and scientific research. It also addresses the ethical, legal, and societal challenges that accompany its rapid adoption, underscoring the importance of responsible development and deployment as we navigate the future of generative technologies. (Yao, J. 2024).

Stanford, CA. Generative Artificial Intelligence (GenAI) refers to a class of AI models that can learn patterns from large datasets and generate new content examples in text, images, audio, video, computer code or molecular structures. Instead of generating the real-world labels like you typically see in an AI model, these types explore creating brand new human-like solutions to problems. GenAI relies primarily on state-of-the-art machine learning architectures such as Generative Adversarial Networks (GANs) (Goodfellow et al., 2014), Variational Autoencoders (VAEs) (Kingma & Welling, 2013) and Transformer-based models (Brown et al., 2020)

GANs work by training a generator-discriminator pair, in which the discriminator evaluates some synthetic samples (here: images) and the generator tries to trick the discriminator. The adversarial training procedure eventually produces more and more convincing outputs.

Variational autoencoders are an example that marries deep learning with translate learnings, as they encode input data into a latent space from which samples can be generated. They are therefore very powerful tools when it comes to data compression, anomaly detection, and generative outputs of all sorts.

Attention mechanism, used in Transformers and their successors such as GPT-3/4 or LLaMA, enabled models to interact over long distances in data. It has since been a core idea behind these large language models (LLMs) and multimodal generative systems.

CONTENT CREATION AND MEDIA

Generative AI has become a transformative force in content creation, enabling individuals and organizations to produce high-quality, engaging materials at scale. By leveraging powerful large language models (LLMs) like OpenAI's GPT-4, Google's Gemini, and Meta's LLaMA, users can automate a wide range of text-based tasks. These include writing articles and blog posts, crafting social media content, summarizing long documents, and generating personalized email or chatbot responses (OpenAI, 2023). News agencies, in particular, have adopted these tools to streamline repetitive reporting tasks such as

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