

# Comparison of Generative AI and Artificial Intelligence

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**Abstract** - Generative AI represents a transformative branch of artificial intelligence focused on creating new data, such as images, text, or audio, based on patterns learned from existing data. Unlike traditional AI, which primarily focuses on classification, prediction, or optimization tasks, generative AI models, such as Generative Adversarial Networks (GANs) and Variational Autoencoders (VAEs), aim to simulate creative processes by generating outputs that resemble real-world data. This paper reviews the current state of generative AI technologies, exploring the underlying architectures, including deep learning techniques that power models like GPT and DALL·E. It also examines applications across various fields, such as healthcare, art, entertainment, and natural language processing. Moreover, the ethical considerations surrounding AI-generated content, including issues of bias, authenticity, and misuse, are critically analyzed. By synthesizing current research and advancements, this paper highlights both the opportunities and challenges that generative AI presents for the future of AI development and its societal impact. In recent years, the study of artificial intelligence (AI) has undergone a paradigm shift. This has been propelled by the groundbreaking capabilities of generative models both in supervised and unsupervised learning scenarios. Generative AI has shown state-of-the-art performance in solving perplexing real-world conundrums in fields such as image translation, medical diagnostics, textual imagery fusion, natural language processing, and beyond. This paper documents the systematic review and analysis of recent advancements and techniques in Generative AI with a detailed discussion of their applications including application-specific models. Indeed, the major impact that generative AI has made to date, has been in language generation with the development of large language models, in the field of image translation and several other interdisciplinary applications of generative AI. Moreover, the primary contribution of this paper lies in its coherent synthesis of the latest advancements in these areas, seamlessly weaving together contemporary breakthroughs in the field. Particularly, how it shares an exploration of the future trajectory for generative AI. In conclusion, the paper ends with a discussion of Responsible AI principles, and the necessary ethical considerations for the sustainability and growth of these generative models.

**Keywords:** Artificial Intelligence, Generative AI, Natural Language Processing, Generative Adversarial Networks, AI Ethics, Creative AI, Automated Content Generation, AI in Art and Design, AI and Human Collaboration.

## I. Introduction

The recent advancement in Artificial Intelligence has been mainly the result of Generative Artificial Intelligence (often referred to as Generative AI or GenAI) being introduced. Generative AI encompasses artificial intelligence systems with the ability to create text, images, or various forms of media through the utilization of generative models. These models acquire an understanding of the underlying patterns and structures within their training data, subsequently producing fresh data that share similar traits and characteristics. The motivation of this systematic review is to gather, evaluate, and synthesize existing research on a GenAI.[1] This paper presents a systematic review that highlights key applications and variations of the architecture of Generative Artificial Intelligence models and their performance.

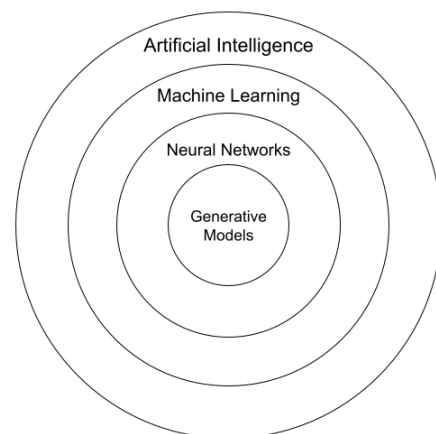


Figure 1: Overview of Artificial Intelligence

We conducted this review to (a) understand the state-of-the-art generative AI techniques including summarizing key methodologies, algorithms, and findings across a range of studies (b) systematically review a large body of literature, which includes emerging trends, common challenges, and recurring patterns in the development and application of generative AI techniques (c) compare and contrast different generative AI approaches, such as Autoencoders, Generative

Adversarial Networks, Transformers, and Diffusion models (d) explore successful applications of generative AI such as image translation, video synthesis and generation, natural language processing, knowledge graph generation, etc. (e) identify ethical challenges and propose solutions for responsible AI development. In this research, we outline the most recent research and advancement in the field of Generative Artificial Intelligence. It details the approach used to navigate and analyze cutting-edge developments, ensuring a comprehensive and insightful review of the current landscape in Generative AI. The following criteria were applied for searching the used research papers. Time Period: This paper presents a comprehensive overview of the advancements and applications of Generative AI, focusing on significant developments between 2018 and 2023. Additionally, it offers a concise historical perspective, tracing the evolution of foundational models from 2012 to 2018, which laid the groundwork for the current state of Generative AI techniques. This historical context enriches the understanding of the field's rapid progression and its burgeoning applications. Keywords: This paper employs a targeted keyword search strategy, incorporating specific terms such as 'Generative Adversarial Networks', 'Transformers', 'Variational Autoencoders', and 'Diffusion Models'. This approach also includes searching for advancements in 'image translation', 'video synthesis', and various applications of Generative AI in 'natural language processing' and 'knowledge graph generation'. This methodology ensures a focused and comprehensive review of the latest developments in the field of Generative AI. Databases: The work primarily sources relevant literature from Google Scholar, focusing on the specified timeframe.[2] It selectively includes research that showcases advancements in generative models. The criteria ensure the inclusion of studies where developed models were rigorously tested on well-recognized datasets, and where results are communicated effectively and clearly. This approach guarantees that the paper presents a detailed and credible overview of significant developments in the field of Generative AI. 2 Inclusion Criteria: This work exclusively incorporates peer-reviewed papers, conference, and journal papers that are written in English. It emphasizes studies that highlight either significant advancements or innovative applications in the realm of Generative AI, ensuring that the focus remains on cutting-edge and impactful developments within this field. Exclusion Criteria: This paper meticulously filters its sources, excluding non-peer reviewed materials, papers not written in English, and studies that fall outside the 2012-2023 timeframe.

## II. What is Artificial Intelligence?

Artificial intelligence (AI), in its broadest sense, is intelligence exhibited by machines, particularly computer

systems. It is a field of research in computer science that develops and studies methods and software that enable machines to perceive their environment and use learning and intelligence to take actions that maximize their chances of achieving defined goals. Such machines may be called AIs. Some high-profile applications of AI include advanced web search engines (e.g., Google Search) recommendation systems (used by YouTube, Amazon, and Netflix) interacting via human speech (e.g., Google Assistant, Siri, and Alexa) autonomous vehicles (e.g., Waymo); generative and creativetools (e.g., ChatGPT, and AI art); and superhuman play and analysis in strategy games (e.g., chess and Go). However, many AI applications are not perceived as AI: "A lot of cutting edge AI has filtered into general applications, often without being called AI because once something becomes useful enough and common enough it's not labeled AI anymore.[3]

The various subfields of AI research are centered around particular goals and the use of particular tools. The traditional goals of AI research include reasoning, knowledge representation, planning, learning, natural language processing, perception, and support for robotics. General intelligence—the ability to complete any task performable by a human on an at least equal level—is among the field's long-term goals. To reach these goals, AI researchers have adapted and integrated a wide range of techniques, including search and mathematical optimization, formal logic, artificial neural networks, and methods based on statistics, operations research, and economics. AI also draws upon psychology, linguistics, philosophy, neuroscience, and other fields.

Artificial intelligence was founded as an academic discipline in 1956, and the field went through multiple cycles of optimism, followed by periods of disappointment and loss of funding, known as AI winter. Funding and interest vastly increased after 2012 when deep learning outperformed previous AI techniques. This growth accelerated further after 2017 with the transformer architecture, and by the early 2020s hundreds of billions of dollars were being invested in AI (known as the "AI boom"). The widespread use of AI in the 21st century exposed several unintended consequences and harms in the present and raised concerns about its risks and long-term effects in the future, prompting discussions about regulatory policies to ensure the safety and benefits of the technology.

Artificial Intelligence (AI) has emerged as one of the most transformative technologies of the 21st century, reshaping industries, enhancing human capabilities, and redefining our interactions with machines. At its core, AI refers to the development of algorithms and systems that enable computers to perform tasks typically requiring human

intelligence, such as reasoning, learning, perception, and decision-making. The field encompasses a wide range of sub-disciplines, including machine learning, natural language processing (NLP), computer vision, and robotics.

### III. What is the Generative Artificial Intelligence?

**Generative artificial intelligence (GenAI, GAI)** is artificial intelligence capable of generating text, images, videos, or other data using generative models, often in response to prompts. Generative AI models learn the patterns and structure of their input training data and then generate new data that has similar characteristics. Improvements in transformer-based deep neural networks, particularly large language models (LLMs), enabled an AI boom of generative AI systems in the early 2020s. These include chatbots such as ChatGPT, Copilot, Gemini and LLaMA, text-to-image artificial intelligence image generation systems such as Stable Diffusion, Midjourney and DALL-E, and text-to-video AI generators such as Sora. Companies such as OpenAI, Anthropic, Microsoft, Google, and Baidu as well as numerous smaller firms have developed generative AI models.

Generative AI has uses across a wide range of industries, including software development, healthcare, finance, entertainment, customer service, sales and marketing, art, writing, fashion, and product design. However, concerns have been raised about the potential misuse of generative AI such as cybercrime, the use of fake news or deepfakes to deceive or manipulate people, and the mass replacement of human jobs. Intellectual property law concerns also exist, around generative models that are trained on and emulate copyrighted works of art.

Generative Artificial Intelligence (Generative AI) represents a significant frontier in the field of artificial intelligence, characterized by its ability to create original content and solutions across various modalities, including text, images, audio, and video. Unlike traditional AI, which primarily focuses on classification and prediction tasks, Generative AI leverages advanced algorithms to generate new data that closely resembles existing datasets, thus enabling creative applications that were previously unimaginable.

### IV. Conceptualization of generative AI and Artificial Intelligence:

#### 1. Definition

Artificial Intelligence (AI) refers to the simulation of human intelligence in machines designed to perform tasks that typically require human cognitive functions, such as learning,

reasoning, problem-solving, perception, and language understanding.

Generative AI, a subset of AI, specifically focuses on creating new content or data rather than merely analyzing or categorizing existing information. AI encompasses a wide range of technologies and methods designed to enable machines to perform tasks that typically require human intelligence.[3] This includes understanding natural language, recognizing patterns, solving problems, and making decisions.

#### 2. Mechanisms and Techniques

The conceptual foundation of AI is built on various methodologies, including:

- **Machine Learning (ML):** A method that allows systems to learn from data and improve their performance over time without being explicitly programmed. ML algorithms identify patterns in data to make predictions or decisions.
- **Deep Learning:** A subset of ML that employs neural networks with many layers (deep neural networks) to process and learn from vast amounts of unstructured data. Deep learning is particularly effective in tasks such as image and speech recognition.
- **Natural Language Processing (NLP):** This field focuses on enabling machines to understand, interpret, and generate human language. It combines linguistics and AI techniques to facilitate communication between humans and computers.

#### 3. Applications

The applications of AI and Generative AI are vast and varied:

- **AI Applications:**
  - Autonomous vehicles
  - Medical diagnosis and treatment recommendation
  - Predictive analytics in finance and marketing
  - Chatbots and virtual assistants
- **Generative AI Applications:**
  - Content creation, including articles, poetry, and storytelling
  - Artistic generation, such as paintings and music composition
  - Video game design and virtual environments
  - Drug discovery and simulation of molecular structures

**V. Comparative study between Generative AI and AI:**

| Technology                                | Scope   | Mechanism  | Tools   | Limitation   | Memory  |
|---|---|--|---|--|---|
| <b>Generative Artificial Intelligence</b> | Refers to the broad field of computer science focused on creating systems that can perform tasks requiring human-like intelligence. | Generative Adversarial Networks (GANs)<br>Transformers                 | Image Generation Tools<br>Text Generation Tools<br>Audio Generation Tools<br>video Generation Tools | Quality and Coherence<br>Data Dependency<br>Resource Intensive<br>Lack of Understanding                        | Contextual Memory<br>Training Memory<br>Limitations of Memory |
| <b>Artificial Intelligence</b>            | A specialized subset of AI focused on generating new content rather than merely analyzing or processing existing data.              | Supervised Learning<br>Unsupervised Learning<br>Reinforcement Learning | Machine Learning Frameworks<br>Computer Vision Tools<br>Data Processing and Analysis Tools          | Generalization Challenges<br>Data Limitations<br>Dependence on Quality Data<br>Automation and Job Displacement | Working Memory<br>Long-Term Memory                            |

**VI. Applications of Generative AI and Artificial Intelligence**

**Applications of Generative AI**

**1. Content Creation:**

- **Text Generation:** Used for writing articles, marketing copy, and social media posts. Examples include news generation and automated reporting.
- **Creative Writing:** Assists authors in generating story ideas, dialogue, and poetry.

**2. Media and Entertainment:**

- **Music Composition:** Creates original music tracks or assists musicians with songwriting and arrangement.
- **Video Game Development:** Generates game assets, environments, and storylines, enhancing creativity and reducing development time.

**3. Personalization:**

- **Recommendation Systems:** Generates personalized content recommendations based on user preferences and behaviors (e.g., Netflix, Spotify).
- **Chatbots and Virtual Assistants:** Provides personalized customer interactions and support through conversational agents.

**4. Healthcare:**

- **Drug Discovery:** Generates molecular structures and simulates their interactions, speeding up the drug development process.
- **Medical Imaging:** Enhances and synthesizes medical images, aiding in diagnosis and analysis.

**5. Education:**

- **Personalized Learning Materials:** Creates tailored educational content based on individual learning styles and progress.
- **Tutoring Systems:** Provides real-time assistance and feedback to students in various subjects.

**Applications of Artificial Intelligence**

**1. Automation and Robotics:**

- **Industrial Automation:** AI-driven robots automate manufacturing processes, improving efficiency and precision.
- **Supply Chain Optimization:** AI models predict demand, optimize inventory, and enhance logistics management.

**2. Natural Language Processing (NLP):**

- **Sentiment Analysis:** Analyzes customer feedback and social media to gauge public sentiment and brand perception.
- **Translation Services:** Provides real-time translation and transcription services (e.g., Google Translate).

**3. Computer Vision:**

- **Facial Recognition:** Used in security systems, social media tagging, and user authentication.
- **Object Detection:** Applied in autonomous vehicles and surveillance systems to identify and track objects.

#### 4. Finance:

- **Fraud Detection:** Analyzes transaction patterns to detect anomalies and prevent fraudulent activities.
- **Algorithmic Trading:** Uses AI to analyze market data and make trading decisions in real-time.

#### 5. Healthcare:

- **Predictive Analytics:** Analyzes patient data to predict health outcomes and support early intervention strategies.
- **Robotic Surgery:** AI assists surgeons in performing precise and minimally invasive procedures.

### VII. Advantages of GAI and AI

#### Advantages of Generative AI

##### 1. Creativity and Innovation:

- **Content Generation:** Automates the creation of text, images, music, and other forms of media, enabling artists and creators to explore new ideas and styles.
- **Rapid Prototyping:** Facilitates quick iteration on design concepts, helping designers and developers visualize ideas faster.

##### 2. Personalization:

- **Tailored Content:** Generates customized recommendations and content based on user preferences, enhancing user engagement and satisfaction.

##### 3. Efficiency:

- **Time-Saving:** Automates repetitive tasks, allowing professionals to focus on more complex and strategic work.
- **Cost Reduction:** Reduces the need for extensive human labor in content creation and data analysis, potentially lowering costs.

##### 4. Enhanced Collaboration:

- **Assistance in Creative Processes:** Acts as a collaborative partner, providing suggestions and inspiration for writers, artists, and developers.

##### 5. Data Augmentation:

- **Synthetic Data Generation:** Produces additional training data for machine learning models, helping improve model accuracy, especially in cases with limited data.

#### Advantages of Artificial Intelligence:

##### 1. Automation:

- **Increased Productivity:** Automates routine tasks, allowing businesses to operate more efficiently and with fewer errors.
- **24/7 Availability:** AI systems can work continuously without fatigue, improving service delivery and operational uptime.

##### 2. Improved Decision-Making:

- **Data-Driven Insights:** Analyzes vast amounts of data to identify trends, patterns, and anomalies, supporting informed decision-making.
- **Predictive Analytics:** Uses historical data to forecast future outcomes, aiding in planning and strategy development.

##### 3. Enhanced Customer Experience:

- **Personalized Interactions:** AI can tailor responses and recommendations based on individual user behavior, improving customer satisfaction.
- **Rapid Response:** Provides immediate answers to customer inquiries through chatbots and virtual assistants.

##### 4. Scalability:

- **Handling Large Volumes of Data:** AI systems can process and analyze large datasets quickly, enabling businesses to scale operations efficiently.

##### 5. Innovation in Healthcare:

- **Improved Diagnostics:** AI algorithms assist in diagnosing diseases and analyzing medical images, leading to better patient outcomes.
- **Drug Discovery:** Speeds up the process of discovering new drugs and treatments through data analysis and simulation.

##### 6. Risk Management:

- **Fraud Detection:** Analyzes transaction patterns to detect and mitigate fraudulent activities in real-time.
- **Predictive Maintenance:** Anticipates equipment failures in industrial settings, reducing downtime and maintenance costs.

## VIII. Disadvantages of GAI and AI

### Disadvantages of Generative AI

#### 1. Quality and Coherence Issues:

- **Inconsistent Outputs:** Generated content may vary in quality, with some outputs being nonsensical or lacking coherence.
- **Repetition:** Models can produce repetitive content, leading to a lack of diversity and creativity in generated outputs.

#### 2. Data Dependence:

- **Training Data Quality:** Generative models are only as good as the data they are trained on. Poor or biased data can lead to biased or flawed outputs.
- **Overfitting:** Models may memorize training data rather than generalize, which can limit their effectiveness in new situations.

#### 3. Ethical and Legal Concerns:

- **Misuse of Technology:** Generative AI can be used to create deepfakes, misleading content, or propaganda, raising ethical concerns.
- **Intellectual Property Issues:** Generated content may unintentionally infringe on copyrights or trademarks, leading to legal challenges.

#### 4. Resource Intensive:

- **High Computational Costs:** Training and running large generative models require significant computational resources, which can be expensive and environmentally taxing.
- **Limited Real-Time Learning:** Most generative models cannot learn from new data in real time, making them less adaptable to changing contexts.

#### 5. Lack of Understanding:

- **Black Box Nature:** Many generative models operate without transparency, making it difficult to understand how they arrive at specific outputs.

### Disadvantages of Artificial Intelligence

#### 1. Bias and Fairness Issues:

- **Inherent Biases:** AI systems can perpetuate and amplify biases present in their training data, leading to unfair outcomes in applications like hiring, lending, and law enforcement.

- **Discrimination Risks:** Biased algorithms can result in discriminatory practices, negatively impacting marginalized groups.

#### 2. Dependence on Data:

- **Quality and Quantity of Data:** AI models require large amounts of high-quality data to perform well. Insufficient or poor-quality data can lead to inaccurate predictions.
- **Data Privacy Concerns:** Collecting and processing data can raise privacy issues, especially when sensitive information is involved.

#### 3. Job Displacement:

- **Automation Concerns:** AI can replace human jobs in certain sectors, leading to economic displacement and requiring workforce retraining.
- **Economic Inequality:** The benefits of AI may not be evenly distributed, potentially widening the gap between different socioeconomic groups.

#### 4. Interpretability Challenges:

- **Complex Models:** Many AI systems, especially deep learning models, are difficult to interpret, making it hard for users to trust their outputs.
- **Accountability Issues:** When AI systems make mistakes, it can be challenging to determine responsibility and accountability.

#### 5. Security Vulnerabilities:

- **Adversarial Attacks:** AI systems can be susceptible to adversarial attacks, where small, deceptive modifications to input data lead to incorrect outputs.
- **Manipulation Risks:** AI technologies can be exploited to create misinformation or automate cyberattacks.

## IX. Result and Discussion of Generative AI and AI

### Results of Generative AI

#### 1. Creative Content Generation:

- **Art and Music:** Generative AI tools like DALL-E and Jukedeck can create original art and music, expanding creative possibilities for artists and composers.
- **Writing and Storytelling:** Models like ChatGPT generate human-like text, aiding writers in brainstorming and drafting narratives.

## 2. Data Augmentation:

- **Synthetic Data Creation:** Generative AI can produce synthetic datasets that enhance machine learning models, especially in fields where real data is scarce or sensitive (e.g., healthcare).

## 3. Personalization:

- **Customized User Experiences:** Businesses leverage generative models to offer personalized content recommendations, improving customer engagement and satisfaction.

## 4. Prototyping and Design:

- **Rapid Prototyping:** Designers can quickly generate and iterate on concepts, leading to faster innovation cycles and reduced time-to-market.

### Discussion

The creative capabilities of Generative AI raise questions about authorship and originality. As these tools become more advanced, the distinction between human-generated and machine-generated content may blur, leading to debates over intellectual property rights. Additionally, the potential for misuse—such as creating deepfakes or misleading content—highlights the need for ethical guidelines and regulation.

### Results of Artificial Intelligence

#### 1. Operational Efficiency:

- **Automation of Tasks:** AI has automated routine processes in industries like manufacturing, logistics, and customer service, leading to cost savings and enhanced productivity.

#### 2. Improved Decision-Making:

- **Data Analysis and Insights:** AI systems analyze large datasets, providing actionable insights that inform strategic decisions, particularly in sectors like finance and healthcare.

#### 3. Enhanced Customer Engagement:

- **Chatbots and Virtual Assistants:** These tools improve customer service by providing immediate responses to inquiries, thus increasing customer satisfaction.

## 4. Healthcare Innovations:

- **Diagnostics and Treatment Personalization:** AI aids in diagnosing diseases and tailoring treatment plans, significantly improving patient outcomes.

### Discussion

The widespread implementation of AI raises concerns about job displacement, particularly in sectors prone to automation. While AI increases efficiency, it may also lead to economic inequality if certain jobs are rendered obsolete without adequate retraining programs for affected workers. Moreover, issues of bias in AI algorithms can result in unfair outcomes, emphasizing the need for transparency and fairness in AI development.

### **X. Conclusion**

In comparing Generative AI and Artificial Intelligence (AI), it is evident that both play pivotal roles in advancing technology, yet they serve distinct purposes and exhibit unique characteristics. Generative AI focuses primarily on creating new content—whether it be text, images, or music—leveraging its ability to understand patterns in data and produce outputs that mimic human creativity. This specialization allows for innovative applications in art, media, and personalization, pushing the boundaries of creativity and efficiency. On the other hand, AI encompasses a broader spectrum of capabilities, including machine learning, natural language processing, and computer vision. Its primary strength lies in analyzing vast amounts of data to make informed decisions, automate tasks, and enhance operational efficiency across various industries. AI's applications in areas like healthcare, finance, and customer service demonstrate its transformative potential in improving processes and outcomes. While both technologies offer substantial benefits, they also present challenges, such as ethical considerations, data bias, and implications for employment. Addressing these challenges requires a collaborative approach that involves stakeholders from technology, ethics, and policy to ensure responsible development and deployment.

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