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Make Technology Work

Generative AI: The Next Frontier

A Whitepaper

Artificial Intelligence has enabled businesses to break barriers by automating many manual and complex processes, which has resulted in lowering costs and improving efficiency. As a result, it has enabled organizations to utilize their resources better and improve their productivity. As a result, the adoption of AI has been growing fast globally, with the artificial intelligence market generating revenues of USD 62.35 billion in 2020, with the compound annual growth rate (CAGR) expected to increase at 40.2% between 2021 to 2028.

A Gartner report on emerging technology roadmap points to the growing popularity of emerging, advanced technologies such as generative AI, composite AI, and knowledge graphs that are driving AI use further for innovation, improvements, and expansion.

Generative AI, especially, is being widely used across applications such as identity protection, controlling robotics better, and even in healthcare for early identification of potential diseases and implementing effective preventive and treatment protocols.

Generative AI–An Overview

Generative modeling is unsupervised machine learning that uses AI, statistics, and probability for predicting probabilities and identify the underlying patterns in the input image, text, and audio to generate new content. Also called deepfake, this is being used to extensively in:

- Creating photographs of people, scenes, and objects that look real
- Generating images of popular figures
- Translating one image to another, such as black and white to color or transforming a photo into a painting and sketches to photos
- Restoring films by upscaling old images and movies to 4K and improving them
- Transforming semantic images to photos that look realistic
- Creating emojis using photos
- Transforming a young face to show how it will look when older

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How Did We Get Here?

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Generative adversarial networks (GANs): Generator and Discriminator are the two neural networks that GANs work with. The generator network creates new content similar to the source data. The discriminator network compares the new content with the source to identify the one that best resembles the original content.

Transformers: Transformer Networks transform one sequence of elements into another. There are two types of models used, Seq2Seq for language translation and LSTM-based models for data that is sequence-dependent. Seq2Seq models have an Encoder and a Decoder that work together to effect the transformation. While the Encoder maps the input sequence into a higher-dimensional space, the Decoder generates the output sequence. This also can be used for generating images.

Variational Auto-Encoders: The input data is encoded by the encoder into a compressed code. The initial information is reproduced by the decoder. If chosen and trained correctly, this compressed representation stores the input data distribution in a much smaller dimensional representation.

GPT-3: GPT-3 (Generative Pre-trained Transformer 3) is a transformer language model. A transformer model has sequence-to-sequence deep learning capability and when fed with an input sequence, can produce a human-like text sequence. GPT-3 is a 175-billion parameter deep learning model that was trained using text datasets containing several billions of words. It is capable of answering questions, summarizing text, and doing machine translation.

DALLE-2: DALL·E 2 is an AI-based system to generate realistic images and art using a test description in natural language. It combines concepts, styles, and attributes, using the relationship between images and text description using a process called diffusion. It begins as a pattern of random dots and gradually transforms into an image on recognizing specific details of that image.

Use Cases of Generative AI

Generative AI or deepfake has a potentially wide use.

- In healthcare, for instance, it can be used to predict antibody structures that would be able to neutralize antigens and viruses, new or hitherto unknown. The National Institutes of Health's Director's Transformative Research program is investing in pathbreaking research in risky and untested projects using GANs to uncover the relationship between an antigen-binding site and the antibody's variable chain features.
- Another use for GAN in healthcare is in improving the quality of images to meet the requirement of high resolution. High-quality images are essential for the right treatment but may be difficult in some cases. GANs can be used to reduce the noise without distorting the image.
- GANs can recreate 3D models from fragmentary images of objects and photos from astronomical observations to enable training film or animation personnel. Graphics designers can create 3D models by converting 2D facial images for developing video games or animation.
- GANs is also gaining currency in developing entertainment tools such FaceApp and ZAO where users can edit their features or swap a celebrity's face with theirs in a video or a photo.
- Advertising and marketing are two other areas where GAN adoption rate is the highest as it can be used to create unique and repetitive content such as using photo models for different promotional activities.
- Like the autocomplete feature for text in social media and even when typing in Word, suggestion for coding is also being made possible with solutions such as GitHub Copilot. It is trained using billions of lines of code to provide natural language prompts for coding suggestions across several languages.
- GAN is being used to generate data from random noise. It involves letting two neural networks contest with each other instead of training one with millions of data points.

Alexa, Siri, and Echo are familiar household names today. These virtual assistants provide human-like assistance for various functions by relying on GAN.

- AutoEncoder is yet another use case of GAN where high - dimensional input data is reconstructed using a neural network with a narrow bottleneck layer in the middle where the input data is represented in the latent form. This is used for a variety of purposes, including anomaly detection, recommendation engines, image recognition and generation, and so on.

Some of the other areas include aerospace, automotive, defense, energy, manufacturing, and material science. It is expected to disrupt software coding by automating as much as 70% of the development work. It can be used for detecting fraud, malware, and preventing the spread of disinformation to cause social unrest.

Though currently, its adoption has been small, it is expected to pick up pace especially to reduce data acquisition costs and improve the analytics development cycle.

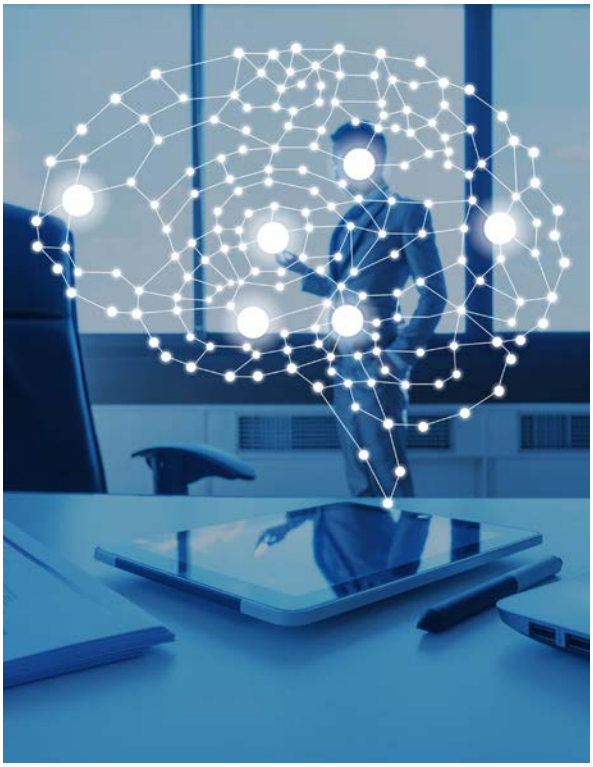
Challenges

The biggest challenge is that it is unstable, hard to train, and needs a lot of data to be able to generate the required images with artifacts. Broadly, generative AI challenges include:

- **Breach of Security:** Generative AI lends itself to fraud for scamming people by generating fake images, news, phone calls, and so on.
- **Limitations:** Large amounts of training data are required for Generative AI algorithms to perform the expected tasks. They also need input files to generate outputs and cannot create completely new texts or images.

  Unexpected Outcomes: It is also hard to predict how some
- Generative AI models like GANs will behave. As of now, their performance can be unstable and the outcome, unexpected.
- **Heavy Infrastructure Needed:** In addition to being data-hungry, these technologies need heavy infrastructure to train such large models, which only large tech companies can afford. Also, the models learn the biases of the dataset and even perpetuate it.

Leverage Generative AI with Indium Software: Benefit from time, cost, and resource effectiveness by adopting Generative AI for some of your automation, data acquisition, and security needs. Indium Software, a software solution company that works with varied technologies such as AI, machine learning, security, data, and analytics, can help you with the transformation process. Our team of experts with cross-domain experience can understand your requirements and develop solutions to meet your unique needs.



Indium can develop AI & ML self-learning algorithms for improving accuracy and reducing errors by examining data and learning anew without human intervention for quicker insights.

We facilitate AI innovation by identifying AI opportunities specific to your organization and automating repetitive tasks to free up your resources.

Some of our AI solutions include:

Cognitive Analytics: Using computer vision techniques, we help room-type classification, room object type classification, text analytics, speech recognition, facial recognition, image, and video analytics.

AI, ML & NLP: We facilitate deep learning, advanced analytics, human-machine, and machine-human solutions, and smart technologies by harnessing AI, ML, and NLP technologies to create a data-driven business.

IoT Analytics: Optimize your digital transformation efforts by creating analytics solutions for your IoT data, enabling predictive maintenance, people-process optimization, and performance optimization.

To know more about Indium's AI capabilities and how we can help you leverage Generative AI, contact us now.

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