Government College of Engineering (GCOEJ), Jalgaon

(An Autonomous Institute of Government of Maharashtra)

DEPARTMENT OF COMPUTER ENGINEERING

INDUSTRIAL LECTURE REPORT ON

GENERATIVE AI

(Academic Year 2023-24)

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CERTIFICATE

This is to certify that the ***Industrial Lecture*** report**, "Generative AI"**, which is being submitted here with for the award of ***LY Computer Engineering (7th Semester)*** is the result of the work completed by ***Bhargav Gurav (2041009)*** under my supervision and guidance within offline mode of classes of the institute, in the academic year 2023-24.

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Head of Department

Dr. D. V. Chaudhari

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ABSTRACT

The term "generative AI" refers to computational techniques that are capable of generating seemingly new, meaningful content such as text, images, or audio from training data. The widespread diffusion of this technology with examples such as Dall-E 2, GPT-4, and Copilot is currently revolutionizing the way we work and communicate with each other. In this article, we provide a conceptualization of generative AI as an entity in socio-technical systems and provide examples of models, systems, and applications. Based on that, we introduce limitations of current generative AI and provide an agenda for Business & Information Systems Engineering (BISE) research. Different from previous works, we focus on generative AI in the context of information systems, and, to this end, we discuss several opportunities and challenges that are unique to the BISE community and make suggestions for impactful directions for BISE research.

INTRODUCTION

Generative AI is a type of artificial intelligence technology that can produce various types of content, including text, imagery, audio and synthetic data. The recent buzz around generative AI has been driven by the simplicity of new user interfaces for creating high-quality text, graphics and videos in a matter of seconds.

The technology, it should be noted, is not brand-new. Generative AI was introduced in the 1960s in chatbots. But it was not until 2014, with the introduction of generative adversarial networks, or GANs -- a type of machine learning algorithm -- that generative AI could create convincingly authentic images, videos and audio of real people.

On the one hand, this newfound capability has opened up opportunities that include better movie dubbing and rich educational content. It also unlocked concerns about deepfakes -- digitally forged images or videos -- and harmful cybersecurity attacks on businesses, including nefarious requests that realistically mimic an employee's boss.

Two additional recent advances that will be discussed in more detail below have played a critical part in generative AI going mainstream: transformers and the breakthrough language models they enabled. Transformers are a type of machine learning that made it possible for researchers to train ever-larger models without having to label all of the data in advance. New models could thus be trained on billions of pages of text, resulting in answers with more depth. In addition, transformers unlocked a new notion called attention that enabled models to track the connections between words across pages, chapters and books rather than just in individual sentences. And not just words: Transformers could also use their ability to track connections to analyze code, proteins, chemicals and DNA.

The rapid advances in so-called large language models (LLMs) -- i.e., models with billions or even trillions of parameters -- have opened a new era in which generative AI models can write engaging text, paint photorealistic images and even create somewhat entertaining sitcoms on the fly. Moreover, innovations in multimodal AI enable teams to generate content across multiple types of media, including text, graphics and video. This is the basis for tools like Dall-E that automatically create images from a text description or generate text captions from images.

These breakthroughs notwithstanding, we are still in the early days of using generative AI to create readable text and photorealistic stylized graphics. Early implementations have had issues with accuracy and bias, as well as being prone to hallucinations and spitting back weird answers. Still, progress thus far indicates that the inherent capabilities of this generative AI could fundamentally change enterprise technology how businesses operate. Going forward, this technology could help write code, design new drugs, develop products, redesign business processes and transform supply chains.

HOW DOES GENERATIVE AI WORK?

Generative AI starts with a prompt that could be in the form of a text, an image, a video, a design, musical notes, or any input that the AI system can process. Various AI algorithms then return new content in response to the prompt. Content can include essays, solutions to problems, or realistic fakes created from pictures or audio of a person.

Early versions of generative AI required submitting data via an API or an otherwise complicated process. Developers had to familiarize themselves with special tools and write applications using languages such as Python.
Now, pioneers in generative AI are developing better user experiences that let you describe a request in plain language. After an initial response, you can also customize the results with feedback about the style, tone and other elements you want the generated content to reflect.

Generative AI models
Generative AI models combine various AI algorithms to represent and process content. For example, to generate text, various natural language processing techniques transform raw characters (e.g., letters, punctuation and words) into sentences, parts of speech, entities and actions, which are represented as vectors using multiple encoding techniques. Similarly, images are transformed into various visual elements, also expressed as vectors. One caution is that these techniques can also encode the biases, racism, deception and puffery contained in the training data.
Once developers settle on a way to represent the world, they apply a particular neural network to generate new content in response to a query or prompt. Techniques such as GANs and variational autoencoders (VAEs) -- neural networks with a decoder and encoder -- are suitable for generating realistic human faces, synthetic data for AI training or even facsimiles of particular humans.
Recent progress in transformers such as Google's Bidirectional Encoder Representations from Transformers (BERT), OpenAI's GPT and Google AlphaFold have also resulted in neural networks that can not only encode language, images and proteins but also generate new content.

How neural networks are transforming generative AI
Researchers have been creating AI and other tools for programmatically generating content since the early days of AI. The earliest approaches, known as rule-based systems and later as "expert systems," used explicitly crafted rules for generating responses or data sets.
Neural networks, which form the basis of much of the AI and machine learning applications today, flipped the problem around. Designed to mimic how the human brain works, neural networks "learn" the rules from finding patterns in existing data sets. Developed in the 1950s and 1960s, the first neural networks were limited by a lack of computational power and small data sets. It was not until the advent of big data in the mid-2000s and improvements in computer hardware that neural networks became practical for generating content.
The field accelerated when researchers found a way to get neural networks to run in parallel across the graphics processing units (GPUs) that were being used in the computer gaming industry to render video games. New machine learning techniques developed in the past decade, including the aforementioned generative adversarial networks and transformers, have set the stage for the recent remarkable advances in AI-generated content.

What are Dall-E, ChatGPT and Bard?
ChatGPT, Dall-E and Bard are popular generative AI interfaces.

Dall-E : Trained on a large data set of images and their associated text descriptions, Dall-E is an example of a multimodal AI application that identifies connections across multiple media, such as vision, text and audio. In this case, it connects the meaning of words to visual elements. It was

built using OpenAI's GPT implementation in 2021. Dall-E 2, a second, more capable version, was released in 2022. It enables users to generate imagery in multiple styles driven by user prompts.

ChatGPT : The AI-powered chatbot that took the world by storm in November 2022 was built on OpenAI's GPT-3.5 implementation. OpenAI has provided a way to interact and fine-tune text responses via a chat interface with interactive feedback. Earlier versions of GPT were only accessible via an API. GPT-4 was released March 14, 2023. ChatGPT incorporates the history of its conversation with a user into its results, simulating a real conversation. After the incredible popularity of the new GPT interface, Microsoft announced a significant new investment into OpenAI and integrated a version of GPT into its Bing search engine.

Bard : Google was another early leader in pioneering transformer AI techniques for processing language, proteins and other types of content. It open sourced some of these models for researchers. However, it never released a public interface for these models. Microsoft's decision to implement GPT into Bing drove Google to rush to market a public-facing chatbot, Google Bard, built on a lightweight version of its LaMDA family of large language models. Google suffered a significant loss in stock price following Bard's rushed debut after the language model incorrectly said the Webb telescope was the first to discover a planet in a foreign solar system. Meanwhile, Microsoft and ChatGPT implementations also lost face in their early outings due to inaccurate results and erratic behavior. Google has since unveiled a new version of Bard built on its most advanced LLM, PaLM 2, which allows Bard to be more efficient and visual in its response to user queries.

WHAT ARE USE CASES FOR GENERATIVE AI?

Generative AI can be applied in various use cases to generate virtually any kind of content. The technology is becoming more accessible to users of all kinds thanks to cutting edge breakthroughs like GPT that can be tuned for different applications.

Some of the use cases for generative AI include the following:

- Implementing chatbots for customer service and technical support.
- Deploying deepfakes for mimicking people or even specific individuals.
- Improving dubbing for movies and educational content in different languages.

- Writing email responses, dating profiles, resumes and term papers.
- Creating photorealistic art in a particular style.
- Improving product demonstration videos.
- Suggesting new drug compounds to test.
- Designing physical products and buildings.
- Optimizing new chip designs.
- Writing music in a specific style or tone.

WHAT ARE THE BENEFITS OF GENERATIVE AI?

Generative AI can be applied extensively across many areas of the business. It can make it easier to interpret and understand existing content and automatically create new content. Developers are exploring ways that generative AI can improve existing workflows, with an eye to adapting workflows entirely to take advantage of the technology.

Some of the potential benefits of implementing generative AI include the following:

- Automating the manual process of writing content.
- Reducing the effort of responding to emails.
- Improving the response to specific technical queries.
- Creating realistic representations of people.
- Summarizing complex information into a coherent narrative.
- Simplifying the process of creating content in a particular style.

WHAT ARE THE LIMITATIONS OF GENERATIVE AI?

Early implementations of generative AI vividly illustrate its many limitations. Some of the challenges generative AI presents result from the specific approaches used to implement particular use cases. For example, a summary of a complex topic is easier to read than an explanation that includes various sources supporting key points. The readability of the summary, however, comes at the expense of a user being able to vet where the information comes from.

Here are some of the limitations to consider when implementing or using a generative AI app:

- It does not always identify the source of content.
- It can be challenging to assess the bias of original sources.

- Realistic-sounding content makes it harder to identify inaccurate information.
- It can be difficult to understand how to tune for new circumstances.
- Results can gloss over bias, prejudice and hatred.

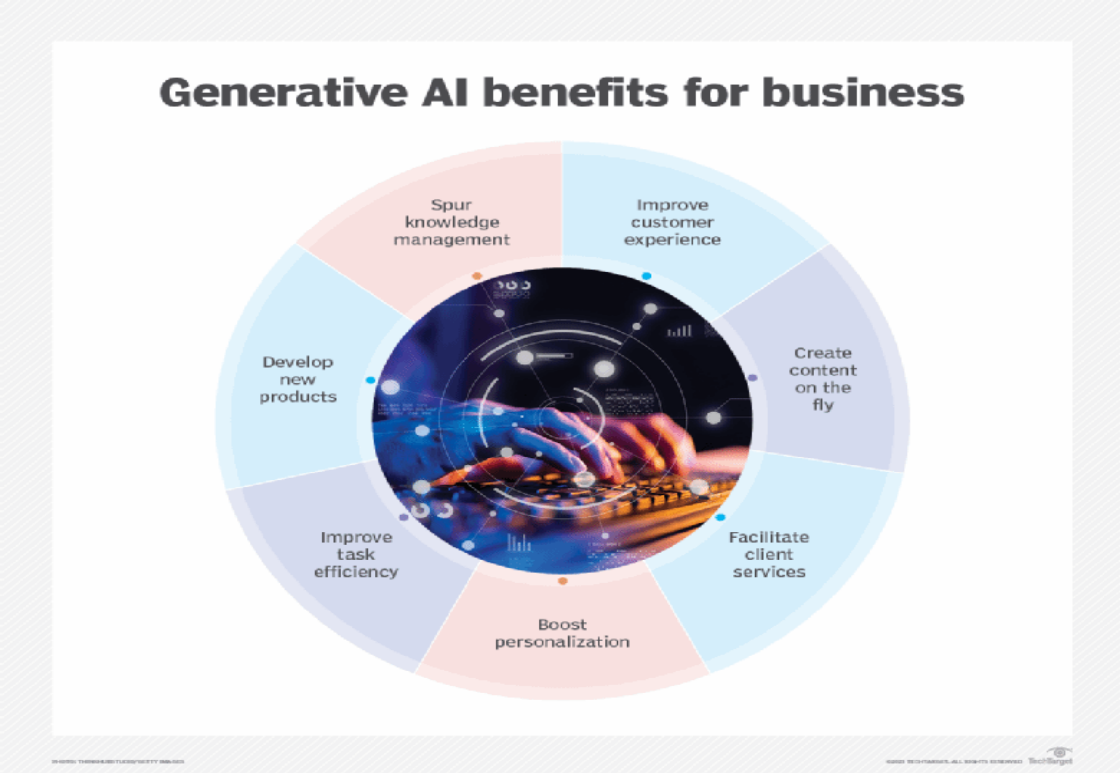
THE FUTURE OF GENERATIVE AI

The incredible depth and ease of ChatGPT spurred widespread adoption of generative AI. To be sure, the speedy adoption of generative AI applications has also demonstrated some of the difficulties in rolling out this technology safely and responsibly. But these early implementation issues have inspired research into better tools for detecting AI-generated text, images and video.

Indeed, the popularity of generative AI tools such as ChatGPT, Midjourney, Stable Diffusion and Bard has also fueled an endless variety of training courses at all levels of expertise. Many are aimed at helping developers create AI applications. Others focus more on business users looking to apply the new technology across the enterprise. At some point, industry and society will also build better tools for tracking the provenance of information to create more trustworthy AI.

Generative AI will continue to evolve, making advancements in translation, drug discovery, anomaly detection and the generation of new content, from text and video to fashion design and music. As good as these new one-off tools are, the most significant impact of generative AI in the future will come from integrating these capabilities directly into the tools we already use. Grammar checkers, for example, will get better. Design tools will seamlessly embed more useful recommendations directly into our workflows. Training tools will be able to automatically identify best practices in one part of an organization to help train other employees more efficiently. These are just a fraction of the ways generative AI will change what we do in the near-term.

What the impact of generative AI will be in the future is hard to say. But as we continue to harness these tools to automate and augment human tasks, we will inevitably find ourselves having to reevaluate the nature and value of human expertise.



CONCLUSION

Generative AI represents a transformative technology with immense potential across diverse domains. However, its responsible development and deployment necessitate addressing ethical challenges, ensuring transparency, fairness, and accountability in its use.

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