EXP 1 : Comprehensive Report on the Fundamentals of Generative AI and Large Language Models (LLMs)

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Topic 1: Introduction to Generative AI and Large Language Models

Aim:

To introduce the concept of Generative AI, explain how it works, and discuss its applications and challenges.

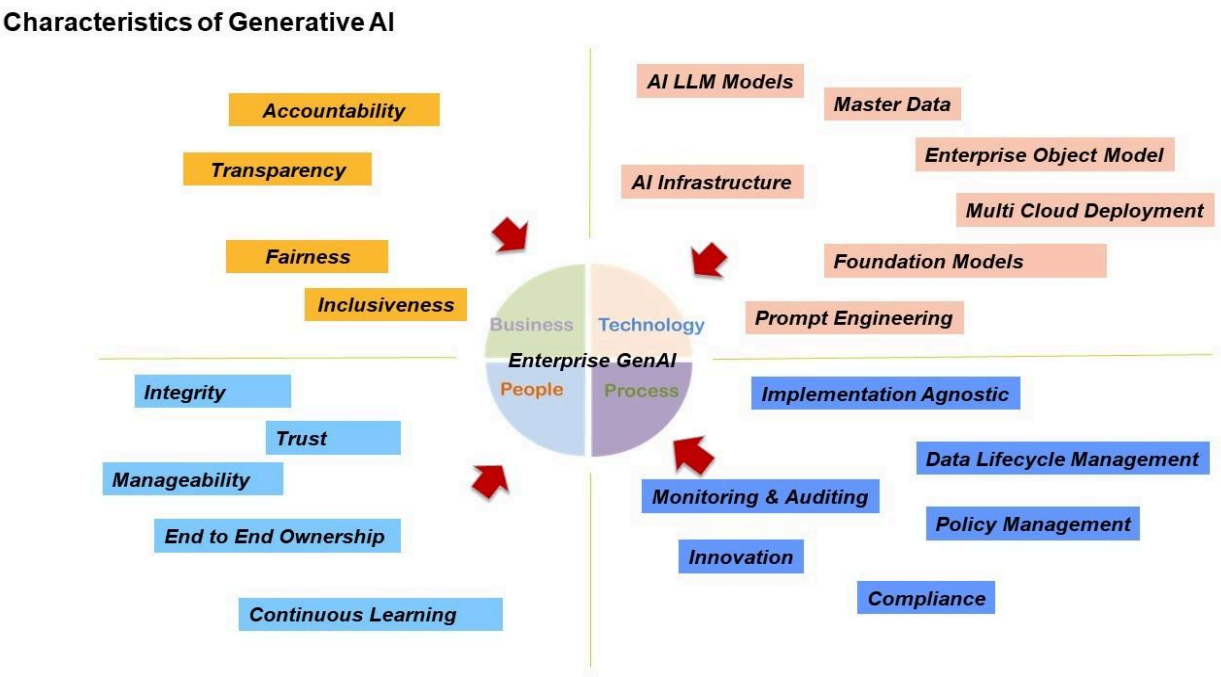
Procedure:

1.What is Generative AI and its Key characteristics?

Generative AI is a set of models that describe what we want, visualising and generating content to match prompts. Generative AI accelerates ideation, brings vision to life and frees up to spend more time on being creative. It creates a wide variety of data such as images, videos, audio, text and 3D models. Typically uses large language models, example: ChatGPT, OpenAI.

The below diagram depicts the major characteristics of Generative AI which are classified as,

- Business
- Technology
- Process
- People



2.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 familiarise 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 customise 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.

3. Real-world applications of Generative AI:

New generative AI technologies have sometimes been described as general-purpose technologies akin to steam power, electricity and computing because they can profoundly affect many industries and use cases. It's essential to keep in mind that, like previous general-purpose technologies, it often took decades for people to find the best way to organize workflows to take advantage of the new approach rather than speeding up small portions of existing workflows. Here are some ways generative AI applications could impact different industries:

- Finance can watch transactions in the context of an individual's history to build better fraud detection systems.
- Legal firms can use generative AI to design and interpret contracts, analyze evidence and suggest arguments.
- Manufacturers can use generative AI to combine data from cameras, X-ray and other metrics to identify defective parts and the root causes more accurately and economically.

- Film and media companies can use generative AI to produce content more economically and translate it into other languages with the actors' own voices.
- The medical industry can use generative AI to identify promising drug candidates more efficiently.
- Architectural firms can use generative AI to design and adapt prototypes more quickly.
- Gaming companies can use generative AI to design game content and levels.

4.Advantages and Challenges of Generative AI:

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.

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.

5. Ethics and bias in generative AI:

- Despite their promise, the new generative AI tools open a can of worms regarding accuracy, trustworthiness, bias, hallucination and plagiarism -- ethical issues that likely will take years to sort out. None of the issues are particularly new to AI. Microsoft's first foray into chatbots in 2016, called Tay, for example, had to be turned off after it started spewing inflammatory rhetoric on Twitter.
- What *is* new is that the latest crop of generative AI apps sounds more coherent on the surface. But this combination of humanlike language and coherence is not synonymous with human intelligence, and there currently is great debate about whether generative AI models can be trained to have reasoning ability. One Google engineer was even fired after publicly declaring the company's generative AI app, Language Models for Dialog Applications (LaMDA), was sentient.
- The convincing realism of generative AI content introduces a new set of AI risks. It makes it harder to detect AI-generated content and, more importantly, makes it more difficult to detect when things are wrong. This can be a big problem when we rely on generative AI results to write code or provide medical advice. Many results of generative AI are not transparent, so it is hard to determine if, for example, they infringe on copyrights or if there is problem with the original sources from which they draw results. If you don't know how the AI came to a conclusion, you cannot reason about why it might be wrong.

Referred websites:

1. https://www.techtarget.com/searchenterpriseai/definition/generative-AI
2. https://www.investopedia.com/generative-ai-7497939#toc-the-pros-and-cons-of-generative-ai

Conclusion:

Generative AI is still a relatively new technology with the potential to transform many of the ways we work and live. Traditionally, AI has been the realm of data scientists, engineers, and experts, but the ability to prompt software in plain language and generate new content in seconds has opened up AI to a much broader user base. However, there are wide-ranging concerns and issues to be cautious of its applications. Many implications, ranging from legal, ethical, and political to ecological, social, and economic, have been and will continue to be raised as generative AI continues to be adopted and developed.