SESSION 2

Introduction to Generative AI

- What is Generative AI ?
- Generative AI vs Conventional AI
- How Generative AI Works ?
- Generative AI Tools
- Ethical Considerations of Using Generative AI

2.1 INTRODUCTION

You all are aware that AI, *Artificial Intelligence*, has taken the world by storm. Everyone is aware of it and everyone is using and benefitting from it directly or indirectly. There are different types of AI that work in different ways for different purposes.

AI belongs to one of these *three* main types :

(*i*) **Narrow AI.** This AI can only perform specific, narrow tasks *like image recognition/ creation or language/text processing*. Virtual assistants like *Siri* or *Alexa* are forms of narrow AI focused on understanding voice commands.

(*ii*) **Reactive Machines.** These AI systems can only react to current situations and stimuli, without learning or building memories. Examples include *spam filters* and *recommendation systems* that suggest content based on your current behavior.

(*iii*) **Limited Memory AI.** This AI can store knowledge, learn from it, and then use that learning to perform new tasks and make predictions. It's used in applications like *chatbots*, *self-driving cars* etc. This is one of the most common types of AI today.

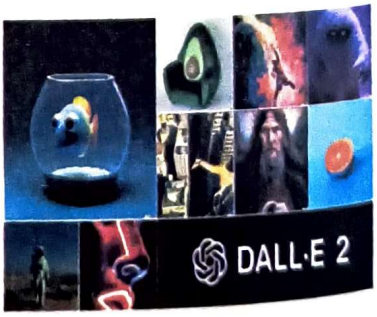
Generative AI is a type of narrow AI. In this session, we shall discuss what Generative AI is, its types, tools, benefits and limitations of generative AI, and ethical considerations of using generative AI.

Note

Generative AI is a type of narrow AI, that can only perform specific, narrow tasks.

2.2 WHAT IS GENERATIVE AI ?

Generative AI is a type of artificial intelligence that can create new content of different types, such as ***images***, ***music***, ***text***, or even ***videos***. Imagine you have a robot that can paint pictures, write stories, or compose songs. That's what Generative AI can do! It does this by learning patterns from a large amount of existing data using special algorithms and then create something new that is similar.



Another example use of generative AI could be this. For example, if you train a generative AI on millions of pictures of cats, it can then generate brand new images of cats that look real but have never existed before. It essentially learns what a cat looks like by studying the training data.

Note

Popular tools like **ChatGPT** and **DALL-E** are based on generative AI.

Generative AI

Generative AI is a type of artificial intelligence that can create new content of different types, such as ***images***, ***music***, ***text***, or even ***videos***.

2.3 GENERATIVE AI vs CONVENTIONAL AI

Regular AI or *conventional AI* is good at classifying and predicting based on existing data. But it can't create brand new data from scratch. However, generative AI is creative and can create new things. It can take what it has learned and use that to make something totally new and original, much like an artist paints a new picture.

Conventional AI follows rules to perform tasks. For example, a calculator uses math rules to solve problems. In contrast, Generative AI creates new things, *e.g.*, DALL-E creating an image. Generative AI doesn't just follow rules; it learns patterns from data and uses these patterns to generate new content.

Following table lists some differences in Generative AI and Conventional AI.

Table 2.1 *Generative AI vs. Conventional AI*

S.No.	Conventional AI	Generative AI
1.	It is good at classifying and predicting based on existing data.	It is good at creating new content of different types.
2.	It cannot create brand new data from scratch.	It can create brand new data from scratch.
3.	It follows rules to perform tasks.	It doesn't just follow rules; it learns patterns from data and uses these patterns to generate new content.
4.	It is limited to doing already planned jobs and tasks.	It is more creative and flexible and can create new things.
5.	It is suitable task-specific responses, *e.g.*, real-time response in automation, or vehicles etc.	It can create innovative and creative content, and it can create a variety of things.
6.	It requires clear rules and standards.	It can create content without preset clear rules.

Note

Regular AI is good at classifying and predicting based on existing data, but can't create new data or things. However, generative AI is creative and can create new things.

2.3.1 How Generative AI Works ?

Generative AI works by learning from data. Generative models work by first being trained on a large dataset, like millions of images or billions of words of text data. During training, the model learns the patterns and characteristics of the data. For images, it might learn features like shapes, textures, colours etc.

Then when you provide the trained model with a text prompt or seed data, it uses what it learned to generate brand new content that matches the patterns in a realistic way. It's like the model has absorbed and understood the ***rules*** *or* ***statistics*** behind what a real image or text should look like. So its generated output matches those learned patterns.

Thus, we can summarise that generative AI works by following these steps :

(*i*) **Training with Data.** The AI looks at lots of examples (*e.g., pictures of cats*).

(*ii*) **Learning Patterns.** It learns the patterns in these examples (*e.g., fur, eyes, and whiskers*).

(*iii*) **Generating.** It uses these patterns to create new images (*e.g,,* of cats that look realistic).

2.4 TYPES OF GENERATIVE AI

Generative AI comes in different types. Few main types of generative AI models are being listed below :

1. Generative Adversarial Networks (GANs)

GANs are like a game between two AI systems (two competing AI-based *neural networks*) : *the Generator* and *the Discriminator*. The *Generator* creates new content, and the *Discriminator* tries to guess if the content is real or fake. They learn from each other until the Generator becomes very good at creating realistic content.

2. Variational Autoencoders (VAEs)

VAEs learn to compress data into smaller bits and then reconstruct it. This helps them understand the data's underlying patterns and generate new, similar content.

3. Transformers

Transformers are used in language models like ChatGPT. They learn from lots of text data and can generate new text that looks like a human's work.

4. Diffusion Models

Diffusion models learn data distributions to generate things like photorealistic images from text descriptions.

2.5 EXAMPLES OF GENERATIVE AI

Generative AI is used these days in many fields. Some real-life examples of how Generative AI is used are :

(*i*) **Image Generation.** AI can create realistic images of people who don't exist. This is useful in movies and video games.

(*ii*) **Music Composition.** AI can compose new music pieces by learning from existing songs.

(*iii*) **Text Generation.** AI can write stories, articles, and even chat with you like a human.

(*iv*) **Video Creation.** AI can generate new videos or enhance existing ones by adding details.

Following figure 2.1 shows some common use cases of generative AI.

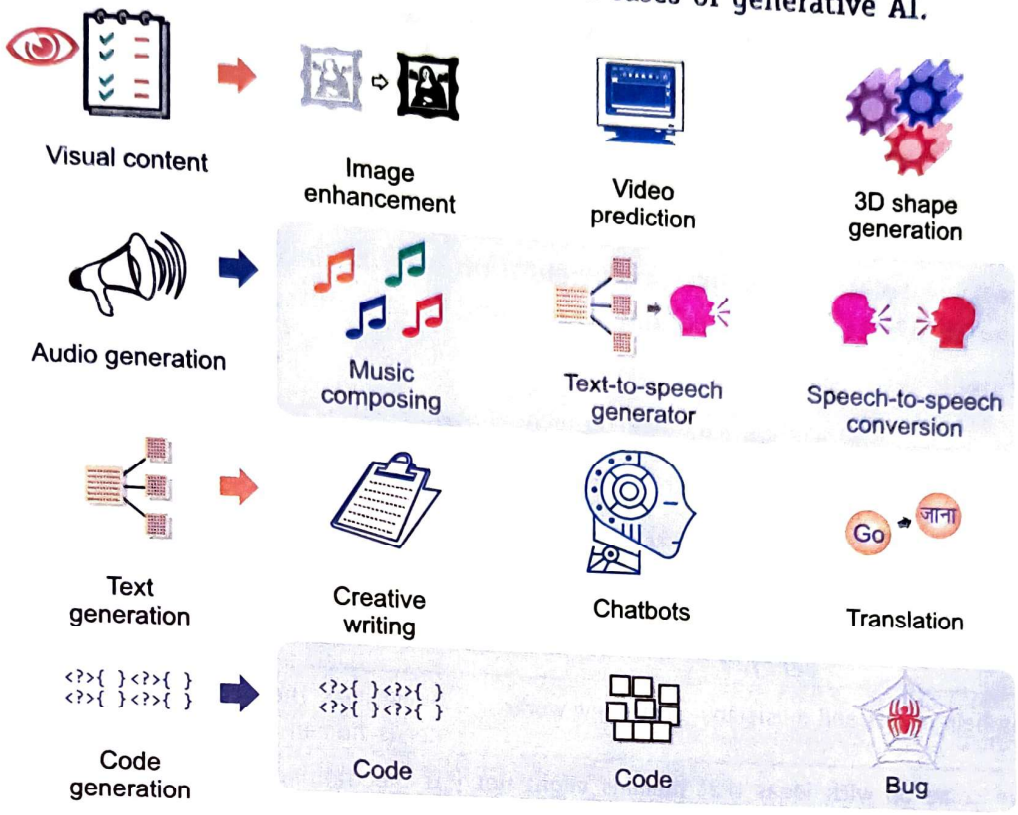


Figure 2.1 Generative AI use cases

2.6 BENEFITS AND LIMITATIONS OF USING GENERATIVE AI

Generative AI has made fast inroads in our daily work and activities. There are many benefits of using generative AI models, but there are certain limitations too.

For example, generative AI offers these **benefits** :

- **Creativity.** It can aid creativity and automate content creation for things like marketing materials, artwork, code generation and more.
- **Efficiency.** It can save time by automating routine tasks like generating product descriptions or design mockups.
- **Innovation.** Generative AI can explore new ideas and concepts that humans may not think of.
- **Data Generation.** It allows companies to quickly create synthetic data like images to train other AI systems.

Note

In science and research, generative models can boost discovery by generating new molecular structures or nano-patterns.

However, Generative AI also has some limitations :

- **Quality.** The output can be nonsensical, biased, or contain mistakes since the model just learns patterns.

- **Bias.** Models can unintentionally learn societal biases present in their training data, which will impact their outcomes (which will be then biased outcomes).
- **Ethics.** There are potential ethical issues around things like deepfakes or impersonating real people/data.
- **Quality.** AI-generated content may not always be high quality or factual. So users must check facts and ensure the correctness of data before using it, *e.g.*, if you got an article related to *policy implementation related to SDG in your area*, then you must verify the produced content's facts and correctness.

Note

So while it's a powerful technology, generative AI needs careful monitoring to ensure responsible use.

Following table lists the benefits and limitations of Generative AI.

Table 2.2 *The Benefits and Limitations of Generative AI*

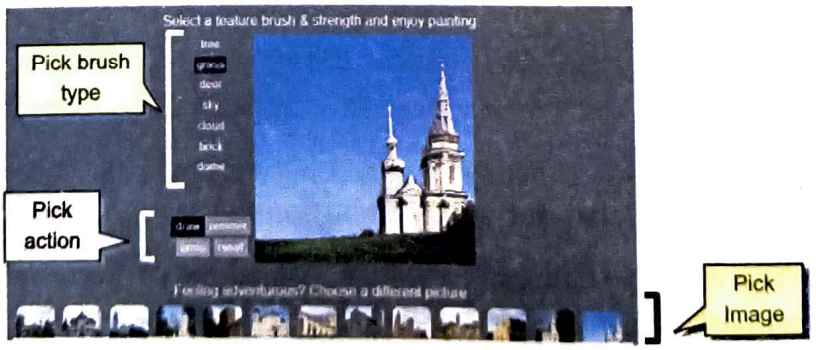
S.No.	Benefits	Limitations
1.	It can help artists and musicians create new works.	Sometimes the generated content isn't perfect and needs human improvement.
2.	It can come up with ideas that humans might not think of.	If the training data has biases, the AI will also be biased.
3.	It can generate content quickly, saving time and effort.	There are ethical concerns about using AI to create fake content.
4.	Generative AI can create synthetic data in bulk, which proves useful in situations where bulk data is required, such as training AI systems.	AI-generated content may not always be high quality or factual.

PART B

Activity 1 Use AI to Generate Real Looking Image using GAN Paint

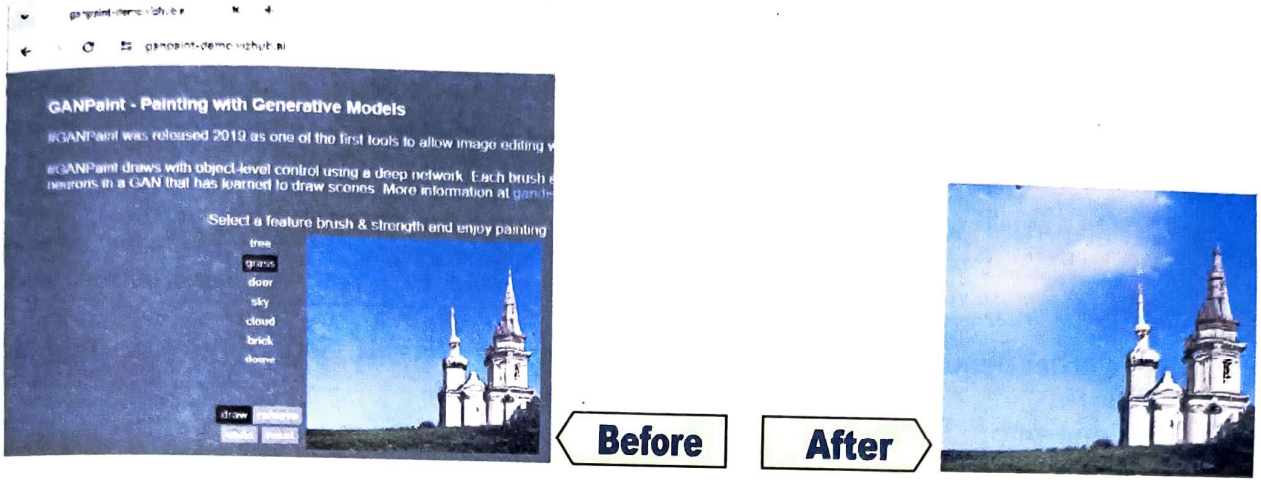
Try using *GAN Paint*, a tool that lets you modify images with AI. You can add *trees, buildings*, and more to a picture just by clicking! Use URL : ganpaint.io

1. Go to **ganpaint.io** in a web browser.
2. It will show a list of images in the lower side and some predefined paint tools/brushes on the left of image such as to paint *grass, trees, clouds* etc. (*see* below)



3. Explore with various tools, actions and images.

Following images show the *before* and *after* using cloud brush.



2.7 GENERATIVE AI TOOLS

Generative AI tools leverage machine learning models like *GANs, VAEs, transformers,* and *diffusion models* to create new synthetic data outputs like *images, text, audio,* and more. These tools have a wide range of potential applications.

Various Generative AI tools are given below :

1. Image Generation Tools

These tools provide features (realistic digital brushes) or use prompts to generate photorealistic images and artworks. Some examples of Generative AI image generation tools are being listed in the table below.

Table 2.3 *Generative AI Image Generation Tools*

	Tool	Description	Application	Example
1.	GAN Paint	*GAN Paint* is a tool that allows users to modify images by adding or removing objects like trees, buildings, or clouds.	It is useful for artists/ designers to quickly prototype changes in images without manually editing.	An architect can use GAN Paint to visualize how adding trees might change the look of a building's surroundings.
2.	DeepArt	*DeepArt* uses AI to turn photos into artworks by applying styles of famous artists.	It helps artists / hobbyists create unique art pieces from ordinary photographs.	A user can transform a vacation photo into an artwork that looks like it was painted by a greater artist.

Some other Generative AI image generation tools are : *DALL-E , MidJourney, Stable Diffusion, Jasper Art, Prompt Hunt, NightCafe, AutoDraw, Designs.ai,* and many more.

2. Text Generation Tools

Generative text generation tools can write human-like text on almost any topic. Examples of Generative AI text generation tools are being listed in the table below.

Table 2.4 *Generative AI Text Generation Tools*

	Tool	Description	Application	Example
1.	ChatGPT, Claude.ai, GEMINI, CopySmith	These are examples of conversational AI that generates human-like text based on the input (prompt) it receives.	These are used for creating content, customer service chatbots, and even for educational purposes.	Businesses use them to provide 24/7 customer support through chatbots, answering common queries from customers.
2.	AI Dungeon	AI Dungeon is a text-based game that uses AI to generate interactive stories based on the player's choices.	It provides an interactive and engaging storytelling experience for entertainment and education.	Players can create and explore their own unique adventures, with the AI generating new scenarios based on their decisions.

Some other Generative AI text generation tools are : *DuetAI, Bard, AnyWord,* and many more.

3. Music Generation Tools

Generative music generation tools can create real music of different genres. Examples of Generative AI music generation tools are being listed in the table below.

Table 2.5 *Generative AI Music Generation Tools*

	Tool	Description	Application	Example
1.	Amper Music	Amper Music is a platform that allows users to create custom music tracks using AI.	It is ideal for video creators, marketers, and musicians to produce royalty-free music quickly.	A YouTuber can generate background music for their videos without worrying about copyright issues.
2.	AIVA (Artificial Intelligence Virtual Artist)	AIVA composes original music by learning from existing compositions.	It is used in creating soundtracks for films, video games, & other multimedia projects.	A filmmaker can use AIVA to generate an original score for a movie scene.

Some other Generative AI music generation tools are : *Boomy, SOUNDRAW, Soundful, Loudly, Musicfy, FM,* and many more.

4. Video Generation Tools

Generative video generation tools can generate entirely new video clips from text. Examples of Generative AI video generation tools are being listed in the table below.

Table 2.6 *Generative AI Video Generation Tools*

	Tool	Description	Application	Example
1.	Deepfake Technology	Deepfake technology uses AI to create realistic videos where people appear to do or say things they never did.	It can be used for entertainment, educational content, and even in political satire (though it has significant ethical considerations).	In movies, deepfake technology can be used to bring historical figures to life or to de-age actors.
2.	Synthesia	Synthesia allows users to create AI-generated videos with customizable avatars.	It is useful for creating training videos, marketing content, and personalized messages.	A company can use Synthesia to create a series of training videos featuring a consistent virtual presenter.

Some other Generative AI video generation tools are : *Colossyan, Hour One, D-ID, Elai, HeyGen, Runway, Pictory, Deepbrain AI, InVideo,* and many more.

Benefits of Generative AI Tools

Generative AI tools have become very popular as they offer the following benefits :

(*i*) **Creativity Enhancement.** They help artists, writers, and musicians by providing new ways to create content.

(*ii*) **Efficiency.** They can produce high-quality content quickly, saving time and effort.

(*iii*) **Accessibility.** They make complex content creation accessible to people without specialized skills.

(*iv*) **Personalization.** They allow for the creation of personalized content tailored to individual preferences and needs.

2.8 ETHICAL CONSIDERATIONS OF USING GENERATIVE AI

As generative AI becomes more advanced and widespread, we need to think about the ethical implications. Although Generative AI tools offer numerous benefits, they also raise important ethical issues, such as :

- **Misinformation.** AI-generated content can be used to create fake news or misleading information. For example, during elections, many fake news or misleading content, created through Generative AI, were circulated which some people could not suspect and believed in.
- **Bias.** If the AI is trained on biased data, it can produce biased content. For instance, a generative AI ad for hiring people displayed high-paying positions to males more often than to women, because of the data it was trained with, which had biases against women.
- **Privacy.** Using personal data to generate content can raise privacy concerns. For example, you must have read about or seen some fake videos circulating of some famous people. People's personal data such as information, pictures etc. can be misused by generative AI to create fake content, which is a big threat to privacy.
- **Copyright Violations.** AI-generated content might unintentionally infringe on existing copyrights. For example, a generative AI tool created a script for a movie inspired by a novel, which is copyrighted. This is copyright infringement.

Thus, before using the generative AI tools, one must follow and ensure the following ethical considerations :

(*i*) The users must ensure that the AI training data is fair and unbiased.

(*ii*) The users must protect individual privacy and prevent misuse like spreading misinformation.

(*iii*) Users must consider challenges like automated generation of malicious code or explicit content and must have ways to handle it.

(*iv*) Users must honour intellectual property and licensing. They must ensure that the AI-generated content is not violating this.

To help guide ethical AI development, groups like the OECD (*Organisation for Economic Co-operation and Development*) have proposed principles around transparency, robustness, and accountability for these systems.

Technology companies deploying generative AI will need clear policies and practices to identify and mitigate ethical risks. Humans should always have oversight over these powerful AI systems.

Check Point

Multiple Choice Questions (MCQs)

PART B

1. What is Generative AI ?
   (*a*) A type of AI that follows rules to perform tasks
   (*b*) An AI used for data analysis
   (*c*) A type of AI that creates new content
   (*d*) A robot that can paint pictures

2. Generative AI can create:
   (*a*) Only text
   (*b*) Only images
   (*c*) Only music
   (*d*) Images, text, music, and videos

3. Which of these is an example of narrow AI ?
   (*a*) A chess engine
   (*b*) Siri or Alexa
   (*c*) A spam filter
   (*d*) Both (*a*) and (*b*)

4. Which of the following is a tool that turns photos into artworks ?
   (*a*) GAN Paint (*b*) DeepArt (*c*) ChatGPT (*d*) AI Dungeon

5. What are Generative Adversarial Networks (GANs) composed of ?
   (*a*) Generator and Discriminator
   (*b*) Encoder and Decoder
   (*c*) Painter and Viewer
   (*d*) Player and Opponent

6. Which Generative AI tool is used for generating human-like text ?
   (*a*) DeepArt (*b*) Amper Music (*c*) ChatGPT (*d*) Synthesia

7. What does VAE stand for in Generative AI ?
   (*a*) Variational Adversarial Encoder
   (*b*) Virtual Artificial Environment
   (*c*) Variational Autoencoder
   (*d*) Visual AI Encoder

8. Which tool allows users to create custom music tracks using AI ?
   (*a*) AIVA (*b*) DeepArt (*c*) Amper Music (*d*) GAN Paint

9. Deepfake technology is mainly used for :
   (*a*) Creating realistic videos
   (*b*) Composing music
   (*c*) Writing stories
   (*d*) Analyzing data

10. Which of the following is a key benefit of Generative AI ?
    (*a*) Reduces creativity
    (*b*) Produces low-quality content
    (*c*) Enhances efficiency
    (*d*) Decreases accessibility

11. A tool that creates AI-generated videos with customizable avatars is called :
    (*a*) ChatGPT (*b*) Synthesia (*c*) AI Dungeon (*d*) GAN Paint