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ARTIFICIAL INTELLIGENCE II

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DIGITAL LEARNING CONTENT

UNIT-1

Introduction to AI

What is AI?

- **Artificial intelligence** is the simulation of human intelligence processes by machines, especially computer systems.
- **Examples** of AI applications include expert systems, natural language processing (NLP), speech recognition and machine vision.

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cognitive skills Required for AI

Learning: This aspect of AI programming involves **acquiring data and creating rules, known as algorithms**, to transform it into actionable information. These algorithms provide computing devices with step-by-step instructions for completing specific tasks.

Reasoning: This aspect involves **choosing the right algorithm** to reach a desired outcome.

Self-correction: This aspect **involves algorithms continuously learning and tuning themselve**s to provide the most accurate results possible.

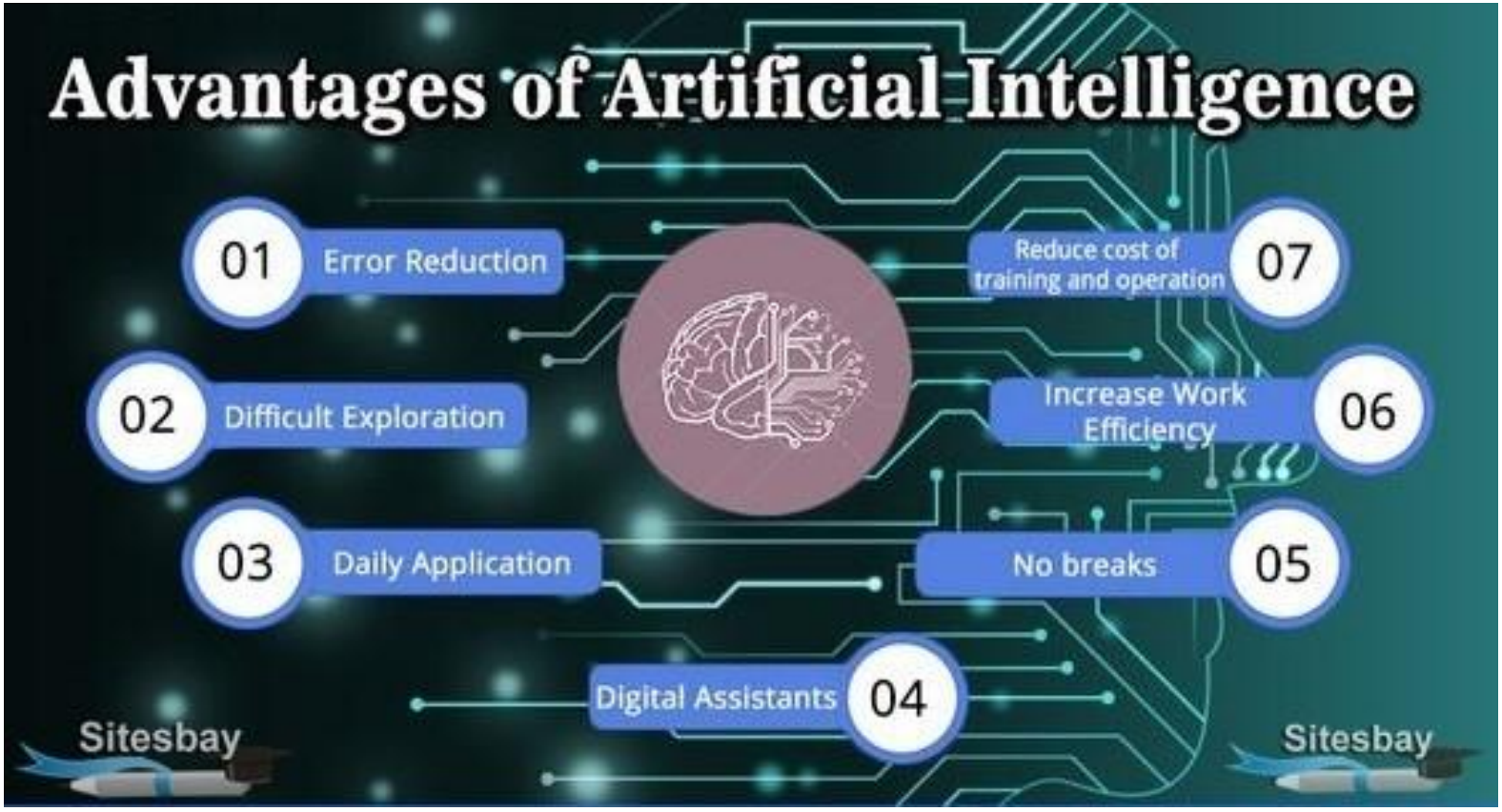
Creativity: This **aspect uses neural networks, rule-based systems, statistical methods and other AI techniques** to generate new images, text, music, ideas and so on.

Why is AI important?

- **AI is important for its potential to change how we live, work and play**.
- It has been effectively used in business to automate tasks traditionally done by humans, including customer service, lead generation, fraud detection and quality control.

https://www.youtube.com/watch?v=WP6z_X5d-Rw

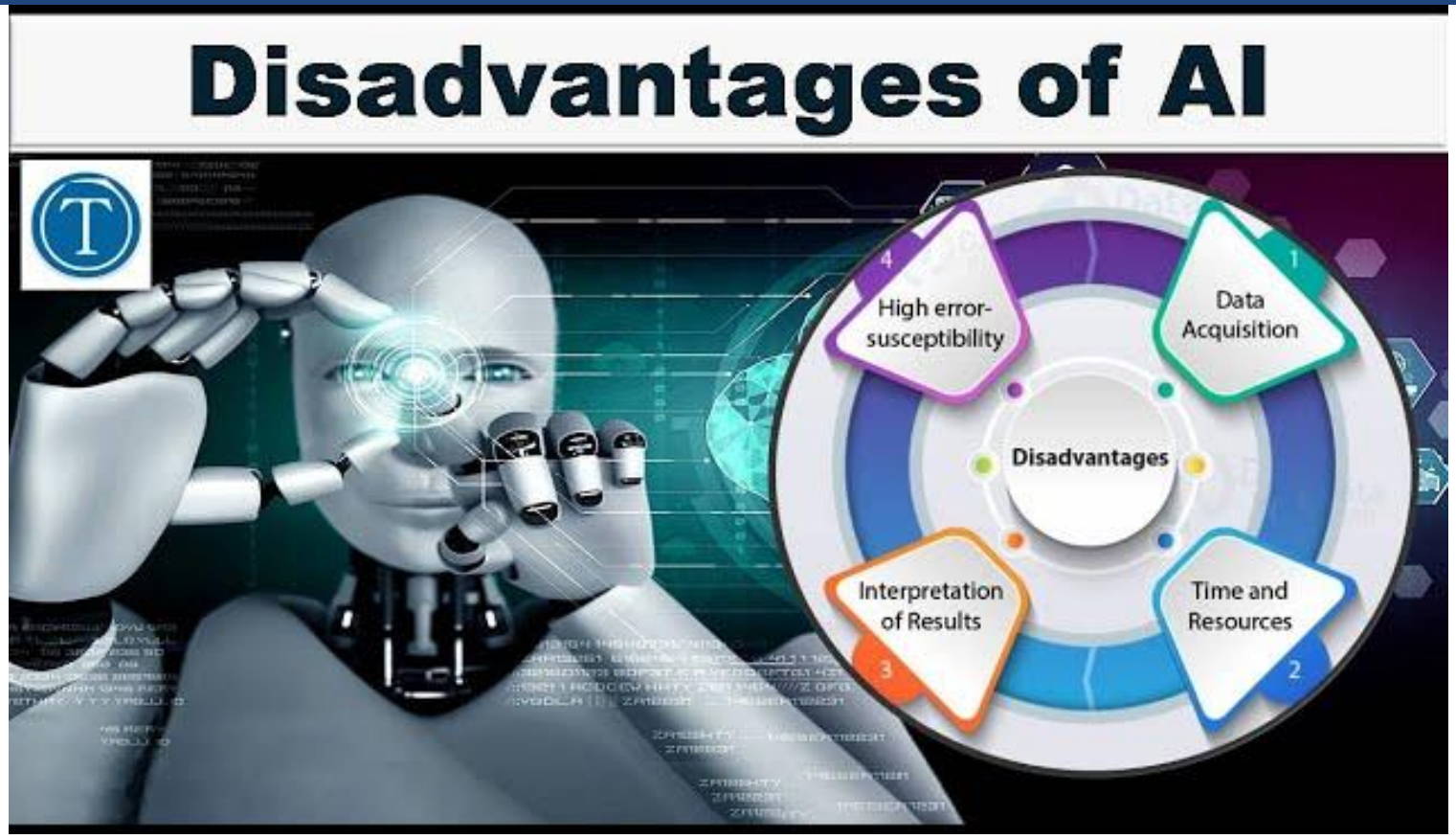
Advantages of AI



Advantages of AI

- **Excellence** in detail-oriented jobs.
- **Efficiency** in data-heavy tasks.
- **Time savings** and productivity gains.
- **Consistency** in results.
- **Customization** and personalization.
- Round-the-clock **availability.**
- **Scalability.**
- **Accelerated** research and development.
- Sustainability and conservation.
- Process **optimization**

Disadvantages of AI



Disadvantages of AI

- High costs.
- Technical complexity.
- Talent gap.
- Algorithmic bias.
- Difficulty with generalization.
- Job displacement.
- Security vulnerabilities.
- Environmental impact.
- Legal issues.

History of AI

1940s

Princeton mathematician John Von Neumann conceived the **architecture for the stored-program computer** -- the idea that a computer's program and the data it processes can be kept in the computer's memory. **Warren McCulloch and Walter Pitts proposed a mathematical model of artificial neurons, laying the foundation for neural networks and other future AI developments.**

1950s

With the advent of modern computers, scientists began to test their ideas about machine intelligence. **In 1950, Turing devised a method for determining whether a computer has intelligence, which he called the imitation game but has become more commonly known as the Turing test**. This test evaluates a computer's ability to convince interrogators that its responses to their questions were made by a human being.

History of AI Continue

1960s

In the wake of the **Dartmouth College conference**, leaders in the fledgling field of **AI predicted that human-created intelligence equivalent to the human brain** was around the corner, **attracting major government and industry support**. Indeed, nearly 20 years of well-funded basic research generated significant advances in AI. **McCarthy developed Lisp, a language originally designed for AI programming that is still used today**.

In the **mid-1960s, MIT professor Joseph Weizenbaum developed Eliza, an early NLP program that laid the foundation for today's chatbots.**

History of AI Continue

1970s

- In the 1970s,, **achieving AGI proved elusive** not imminent, due to limitations in computer processing and memory as well as the complexity of the problem. As a result, government and corporate support for AI research waned, leading to a fallow period lasting **from 1974 to 1980 known as the first AI winter**.
- During this time, the **nascent field of AI saw** a significant decline in funding and interest.

History of AI Continue

1980s

- In the **1980s, research on deep learning techniques and industry adoption of Edward Feigenbaum's expert systems sparked a new wave of AI enthusiasm.**
- Expert systems, which use rule-based programs **to mimic human experts' decision-making**, were applied to tasks such as financial analysis and clinical diagnosis.
- However, because these systems remained costly and limited in their capabilities, AI's resurgence was short-lived, followed by another collapse of government funding and industry support.
- This period of reduced interest and investment, **known as the second AI winter, lasted until the mid-1990s.**

History of AI Continue

1990s

Increases in computational power and an explosion of data sparked an AI renaissance in the mid- to late 1990s, setting the stage for the remarkable advances in AI we see today. The combination of big data and increased computational power propelled breakthroughs in NLP, computer vision, robotics, machine learning and deep learning. A notable milestone occurred in 1997, when Deep Blue defeated Kasparov, becoming the first computer program to beat a world chess champion.

History of AI Continue

2000s

Further advances in machine learning, deep learning, NLP, speech recognition and computer vision gave rise to products and services that have shaped the way we live today. Major developments include the 2000 launch of Google's search engine and the 2001 launch of Amazon's recommendation engine.

2010s

The decade between 2010 and 2020 saw a steady stream of AI developments. These include the launch of Apple's Siri and Amazon's Alexa voice assistants; IBM Watson's victories on Jeopardy; the development of self-driving features for cars; and the implementation of AI-based systems that detect cancers with a high degree of accuracy. The first generative adversarial network was developed, and Google launched TensorFlow, an open source machine learning framework that is widely used in AI development.

History of AI Continue

2020s

The current decade has so far been dominated by the advent of generative AI, which can produce new content based on a user's prompt. These prompts often take the form of text, but they can also be images, videos, design blueprints, music or any other input that the AI system can process. Output content can range from essays to problem-solving explanations to realistic images based on pictures of a person.

In 2020, OpenAI released the third iteration of its GPT language model, but the technology did not reach widespread awareness until 2022. That year, the generative AI wave began with the launch of image generators Dall-E 2 and Midjourney in April and July, respectively. The excitement and hype reached full force with the general release of ChatGPT that November.

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AI vs. machine learning vs. deep learning

	AI	Machine learning	Deep learning
Optimal data volumes	Varying data volumes	Thousands of data points	Big data: millions of data points
Outputs	Anything from predictions to recommendations to decision-making	Numerical value, like a classification or score	Anything from numerical values to free-form elements, like free text and sound
How it works	Machines are programmed to mimic human activity with human-like accuracy	Uses various types of automated algorithms that learn to model functions and predict future actions from data	Uses neural networks that pass data through many processing layers to interpret data features and relationships
How it's managed	Algorithms require human oversight in order to function properly	Algorithms are directed by data analysts to examine specific variables in data sets	Algorithms are largely self-directed on data analysis once they're put into production

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Strong AI vs. weak AI

Narrow AI: This form of AI refers to models trained to perform specific tasks. Narrow AI operates within the context of the tasks it is programmed to perform, without the ability to generalize broadly or learn beyond its initial programming. **Examples of narrow AI include virtual assistants, such as Apple Siri and Amazon Alexa, and recommendation engines, such as those found on streaming platforms like Spotify and Netflix.**

General AI: This type of AI, which does not currently exist, is more often referred to as artificial general intelligence (AGI). If created, AGI would be capable of performing any intellectual task that a **human being can**.

To do so, AGI would need the ability to apply reasoning across a wide range of domains to understand complex problems it was not specifically programmed to solve. an approach that allows for gray areas and gradations of uncertainty, rather than binary, black-and-white outcomes.

4 types of AI

Type 1: Reactive machines.

- These AI systems have **no memory and are task specific.**
- An example is **Deep Blue, the IBM chess** program that beat Russian chess grandmaster Garry Kasparov in the **1990s.**
- Deep Blue was able to identify pieces on a chessboard and make predictions, but because it had no memory, it could not use past experiences to inform future ones.

Type 2: Limited memory

These AI systems **have memory**, so they can use past experiences to inform future decisions.

Some of the decision-making functions **in self-driving cars are designed this way.**

4 types of AI Continue

Type 3: Theory of mind.

Theory of mind is a psychology term. When applied to AI, it refers to a system capable of understanding **emotions**. This type of AI can infer human intentions and predict behavior, a necessary skill for AI systems to become integral members of historically human teams.

Type 4: Self-awareness

In this category, AI systems have a sense of self, which gives them consciousness. Machines with self-awareness understand their own current state. **This type of AI does not yet exist.**

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AI vs. human intelligence: Three important differences

AI		HUMAN INTELLIGENCE
May require millions or billions of samples to learn at a level exceeding average human intelligence, making humans on average more efficient learners than AI systems.	**One-shot vs. multishot learning**	Ability to learn new concepts and ideas from a small number of samples, sometimes from a single one. This ability is referred to as one-shot learning.
Ability to recite, recalling information as it was presented or generating a novel mashup of information that some refer to as imagination but is better described as synthetic recitation.	**Imagination and recitation**	Ability to form ideas, mental sensations and concepts of phenomena that are not present and/or do not exist is considered an important element of being human.
In 2023, most artificial intelligence systems do not possess multimodal learning ability. Autonomous vehicles, however, are able to receive inputs from multiple types of sources to make navigational decisions.	**Multisensory input and output**	Ability to receive and quickly integrate information from all of our senses and use that perception to make decisions. The average human is able to incorporate multimodal inputs and create multimodal outputs.

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What are examples of AI technology, and how is it used today?

Automation

- AI enhances **automation technologies by expanding the range, complexity and number of tasks that can be automated.**

Example :*robotic process automation (RPA), which automates repetitive, rules-based data processing tasks traditionally performed by humans.*

- Because AI helps RPA bots adapt to new data and dynamically respond to process changes, integrating AI and machine learning capabilities enables RPA to manage more complex workflows.

What are examples of AI technology, and how is it used today?

Natural language processing

- NLP refers to the **processing of human language by computer programs.**
- NLP algorithms can **interpret and interact with human language, performing tasks such as translation, speech recognition and sentiment analysis.**

One of the oldest and best-known examples of **NLP is spam detection**, which looks at the subject line and text of an email and decides whether it is junk. More advanced applications of NLP include LLMs such as ChatGPT.

What are examples of AI technology, and how is it used today?

Robotics

- Robotics is a field of engineering that **focuses on the design, manufacturing and operation of robots**: automated machines that replicate and replace human actions, particularly those that are difficult, dangerous or tedious for humans to perform.
- Examples of robotics applications include manufacturing, where robots perform repetitive or hazardous assembly-line tasks, and exploratory missions in distant, difficult-to-access areas such as outer space and the deep sea.

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What are examples of AI technology, and how is it used today?

Autonomous vehicles

- Autonomous vehicles, more colloquially **known as self-driving cars**, can sense and navigate their surrounding environment with minimal or no human input.
- These vehicles rely on a combination of technologies, including radar, GPS, and a range of AI and machine learning algorithms, such as image recognition.

Generative AI

The term **generative AI refers to machine learning systems that can generate new data from text prompts** -- most commonly text and images, but also audio, video, software code, and even genetic sequences and protein structures.

- Through training on massive data sets, these algorithms gradually learn the patterns of the types of media they will be asked to generate, enabling them later to create new content that resembles that training data.

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What are the applications of AI?

- AI in healthcare
- AI in business
- AI in education
- AI in finance and banking
- AI in law
- AI in entertainment and media
- AI in journalism
- AI in software development and IT
- AI in security
- AI in manufacturing
- AI in transportation

https://youtu.be/GIcwYS3enHE

AI techniques

1. Machine Learning (ML)
2. Deep Learning (DL)
3. Natural Language Processing (NLP)
4. Computer Vision (CV)
5. Knowledge Representation and Reasoning (KRR)
6. Fuzzy Logic
7. Genetic Algorithms (GA)
8. Bayesian Networks
9. Swarm Intelligence
10. Rule-Based Systems

AI techniques

Machine learning

- Machine learning is the science of **teaching computers to learn from data and make decisions** without being explicitly programmed to do so.
- **Supervised learning** trains models on **labeled data sets**, enabling them to accurately recognize patterns, predict outcomes or classify new data.
- **Unsupervised learning** trains models to sort through **unlabeled data** sets to find underlying relationships or clusters.
- **Reinforcement learning** takes a different approach, in which models learn to make decisions by acting as agents and **receiving feedback on their actions.**

AI techniques

2. Deep Learning :

Deep Learning is a **subset of machine learning that uses artificial neural networks with multiple layers to model and solve complex problems**.

Application of deep learning :

- Computer Vision: Image recognition, object detection, video analysis.
- Natural Language Processing: Sentiment analysis, machine translation, chatbots.
- Speech Processing: Speech-to-text, voice recognition.
- Healthcare: Medical imaging, drug discovery.
- Autonomous Systems: Self-driving cars, robotics.

AI techniques

3. Natural Language Processing :

- Natural Language Processing (NLP) is **a branch of Artificial Intelligence (AI) that focuses on enabling machines to understand, interpret, generate, and interact with human language.**
- It combines **linguistics and computer science** to process and analyze large amounts of natural language data (**text or speech**).
- **Applications of NLP :**
  - **Chatbots and Virtual Assistants** (e.g., Alexa, ChatGPT).
  - **Sentiment Analysis** (e.g., product reviews, social media).
  - **Search Engines** (e.g., Google's query understanding).
  - **Text Summarization** (e.g., summarizing news articles).
  - **Machine Translation** (e.g., translating documents).

What are examples of AI technology, and how is it used today?

4. Computer vision

- It is field of AI that focuses on **teaching machines how to interpret the visual world.**
- **By analyzing visual information such as camera images and videos** using deep learning models, computer vision systems can learn to identify and classify objects and make decisions based on those analyses.

What are examples of AI technology, and how is it used today?

5. Knowledge Representation and Reasoning (KRR) (KRR) is a field in Artificial Intelligence (AI) that focuses on **how to represent information about the world in a format that a computer system can understand and reason with to solve complex problems.**

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What are examples of AI technology, and how is it used today?

Applications of KRR

1. **Expert Systems**
    1. **Example:** MYCIN (medical diagnosis system), DENDRAL (chemical analysis).
2. **Decision Support Systems (DSS)**
    1. **Example:** Weather forecasting tools, business intelligence systems.
3. **Autonomous Systems**
    1. **Example:** Self-driving cars (Tesla Autopilot), drones for delivery (e.g., Zipline).
4. **Game AI**
    1. **Example:** Chess AI (Deep Blue), procedural content generation in games like Minecraft.
5. **Personalized Recommendations**
    1. **Example:** Netflix recommending movies, Amazon suggesting products.
6. **Diagnostics and Troubleshooting**

- **Example:** Automotive diagnostic tools, network troubleshooting systems.

AI's ethical challenges

- **Bias** due to **improperly trained algorithms** and human prejudices or oversights.
- **Misuse** of generative AI to produce deepfakes, phishing scams and other harmful content.
- **Legal concerns**, including AI libel and copyright issues.
- **Job displacement** due to increasing use of AI to automate workplace tasks.
- **Data privacy concerns**, particularly in fields such as banking, healthcare and legal that deal with sensitive personal data.