Session 13 – AI and Smart Systems

Intelligent Systems

Intelligent Systems are computer systems that can learn from data inputs and use that knowledge to perform tasks that typically require human intelligence.

These systems use algorithms, machine learning, and deep learning to analyse data and learn from it to improve their performance over time.

AI is an example of an intelligent system.

What is AI

Artificial Intelligence (AI) refers to the development of computer systems that can perform tasks that typically require human intelligence, such as:

1. **Learning**: Learning from data inputs and use that knowledge to perform tasks more accurately.
2. **Making generalisations and forming patterns**: AI systems can generalize and create patterns based on data inputs. For example, an AI system can analyse a set of images and learn to recognize a particular object in the images.
3. **Decision making and problem solving**: AI systems can make decisions and solve problems based on the data inputs and the patterns they have identified. For example, an AI system can analyse financial data and make recommendations for investments based on historical performance and market trends.

AI has applications in various fields, including healthcare, finance, transportation, and more.

Types of AI

Artificial Intelligence (AI) can be categorized in various ways based on its capabilities, functionalities, and applications. Here are some common types or classifications of AI:

1. **Based on Capabilities**:
   o **Narrow AI (Weak AI)**: Specialized in one task or a set of related tasks. Most of the AI applications at present, from chatbots to virtual assistants, fall under this category.
   o **General AI (AGI)**: Has the ability to perform any intellectual task that a human being can do. There are several companies which are working on AGI as in 2024.
   o **Superintelligent AI**: Surpasses human intelligence and can perform tasks better than the best human brains in practically every field. It also has a

tendency of self-learning and self-preservation. This is at present a theoretical concept.

2. **Based on Functionality**:
   - o **Reactive Machines**: These are the most basic types of AI systems. They do not have past memory and cannot use past experiences to inform future decisions. IBM's chess-playing Deep Blue is an example.
   - o **Limited Memory**: Uses past experiences (data fed into them) to inform future decisions. They also keep learning from their own performance. Most of the current applications, like search engines, social network recommendation engines, chatbots and virtual personal assistants, are in this category.
   - o **Theory of Mind**: A form of AI that can understand human emotions, beliefs, intentions, and other mental processes. It also has all the capabilities of a Limited Memory AI. The early forms of this AI can be seen now for example, AI used in Cobots, Woebots, latest versions of social network recommendation engines etc.
   - o **Expert systems**: AI systems that are designed to replicate or ever better the decision-making abilities of a human expert in a particular field. Expert systems use a very large knowledge base of rules and facts to make decisions or recommendations based on data inputs.
   - o **Self-aware AI**: A type of AI that has its consciousness, sentiments, and self-awareness besides having all the functionalities of the Theory of Mind AI. This is at present a theoretical concept.

Enabling technologies

AI systems use algorithms, machine learning, and deep learning to analyse data and learn from it to improve their performance over time.

In recent years many new abilities have been added to the AI systems such as visual perception, speech recognition, natural language processing etc.

1. **Machine Learning**: It involves teaching computer systems to learn from data inputs and improve their performance over time. Machine learning algorithms are used to analyze data and identify patterns and relationships that can be used to make predictions or improve performance. Types of machine learning are as follows.
   - o **Supervised Learning**: The model is trained on a labeled dataset, meaning the data is paired with the correct answer.
   - o **Unsupervised Learning**: The model is trained on an unlabeled dataset, finding patterns and relationships in the data on its own.
   - o **Semi-supervised Learning**: Uses both labeled and unlabeled data for training.
   - o **Reinforcement Learning**: The model learns by interacting with its environment and receiving feedback.
2. **Neural Networks and Deep learning**: **Deep learning is a type of machine learning** that uses algorithms based on how our brains work to study and learn from difficult data sets. These algorithms use many layers of computing nodes connected extensively like neural networks to break down the data into smaller units, so that they can make more accurate learning and problem solving.
3. **Natural language processing**: A type of AI that involves teaching computer systems to understand, interpret, and generate human language. Natural language processing

algorithms are used in applications like chatbots, voice assistants, and machine translation.

4. **Computer vision and speech recognition**: Two types of AI that involve teaching computer systems to interpret and understand visual and auditory information. Computer vision algorithms are used in applications like autonomous vehicles and facial recognition, while speech recognition algorithms are used in voice assistants and dictation software.

Generative Artificial Intelligence (AI)

- **Definition and Overview**:
    - o Generative AI refers to machine learning systems capable of producing new, original content.
    - o It involves training machine learning models on existing data to generate content that reflects the characteristics of the training data without directly replicating it.
    - o The generated content can range from text, images, and video to music, speech, software code, and product designs.

Applications of Generative AI

Generative AI is a rapidly evolving field with transformative applications across a multitude of industries.

- **Art**:
    - o Generative AI is employed to craft unique and innovative artworks. For instance, the AI model **DALL-E** is renowned for its ability to generate images based on textual descriptions.
- **Writing**:
    - o Generative AI aids in producing diverse forms of text, from articles and stories to entire books. **ChatGPT**, for example, is a prominent AI writing tool that can generate coherent and contextually relevant text from a given prompt.
- **Software Development**:
    - o Generative AI simplifies code generation, making it more efficient for developers. **GitHub Copilot** is a notable tool that suggests or auto-generates code snippets in real-time as developers type.
- **Product Design**:
    - o Generative AI accelerates the creation of innovative product designs. Tools like **Midjourney** empower designers to swiftly produce unique and functional designs.
- **Healthcare**:
    - o Generative AI is set to revolutionize healthcare. **Ada**, a symptom assessment app developed by medical professionals, leverages AI to provide medical guidance in multiple languages, fostering improved health outcomes.
- **Gaming**:
    - o Generative AI offers infinite possibilities for in-game content and streamlines game development. Techniques like **Generative Adversarial Networks (GANs)** are used to craft unique game levels, quests, and challenges.
- **Marketing**:

- o Generative AI facilitates the creation of personalized marketing content that aligns with a brand's writing style and tone.
- **Fashion**:
  - o Generative AI has made significant inroads in the fashion industry. It enables the creation of AI-generated works such as virtual models and fashion designs.

As generative AI technology continues to advance, its applications are expanding and becoming more integral to various sectors.

Intelligent Systems in day-to-day life

Application Area	Description
E-Commerce	Makes appropriate suggestions and recommendations based on user search history and view preferences.
Education	Personalizes learning experiences and provides tutoring.
Healthcare	Helps doctors with diagnoses, informs when patients are worsening, and even performs critical operations.
Finance	Used for automation, chatbot, adaptive intelligence, algorithm trading, and machine learning in financial processes.
Data Security	Makes data more safe and secure, and determines software bugs and cyber-attacks.
Social Media	Organizes and manages massive amounts of data, analyses data to identify the latest trends, hashtag, and requirement of different users.
Travel & Transport	Makes travel arrangements, suggests hotels, flights, and best routes to customers.
Automotive Industry	Provides virtual assistance for better performance and developing self-driven cars.
Robotics	Creates intelligent robots which can perform tasks with their own experiences without being pre-programmed.
Astronomy	Solves complex universe problems.
Facial Recognition	Used in security systems to identify and verify people from their faces.
Marketing	Helps in predicting customer behaviour, optimizing pricing, and improving customer service.
Natural Language Processing	Used in voice assistants like Siri and Alexa to understand and respond to spoken language.
Gaming	Used to create responsive, adaptive or intelligent behaviours primarily in non-player characters.
Speech Recognition	Transcribes and transforms human speech into a useful format for computer applications.
Vision Systems	These systems can understand, interpret, and comprehend visual input on the computer.
Automotive	Self-driving cars use AI to perceive their surroundings and make decisions.
Advanced Healthcare Analysis & Visualization Predictions	AI can analyse complex medical data to provide visualizations and predictions for healthcare.

NLP Personalization	AI can personalize interactions by understanding and generating human language.

Artificial Intelligence (AI) is rapidly being integrated into our daily lives. The following are some examples of how AI is currently being used:

1. **Smartphones**: AI is used in features such as Face ID, which uses facial recognition technology to unlock one's phone.
2. **Email**: AI is used in email services to provide features such as smart email categorization and quick replies.
3. **Entertainment and Social Apps**: AI is used in apps such as Facebook, YouTube, Instagram and Netflix to provide personalised content recommendations.
4. **Navigation**: AI is used in navigation apps such as Google Maps to provide real-time traffic updates and optimal route suggestions.
5. **Ridesharing Apps**: AI is used in ridesharing apps such as Uber and Lyft to optimize routes and match riders with drivers.
6. **Smart Cars/Self Driving Cars**: AI is used in the development of self-driving cars to enable them to navigate roads and make decisions on their own.
7. **AI in smart homes**: This is done to make smart homes more comfortable and energy-efficient. AI-powered devices like thermostats, lights, and security systems can adapt to user preferences.
8. **Banking and Finance**: AI is used in the banking and finance industry to detect fraud, manage investments, and provide personalized financial advice.
9. **E-commerce**: AI is used in e-commerce to provide personalized product recommendations and improve the search experience.
10. **Healthcare**: AI is used in healthcare to assist with diagnosis, treatment planning, and drug discovery.
11. **Speech Recognition**: AI is used in speech recognition technology to enable voice-activated virtual assistants such as Siri and Alexa.
12. **Video Games**: AI is used in video games to create dynamic, responsive non-playable characters (NPCs) and generate automated game content.

The field of AI is constantly evolving, and new applications are being developed all the time.

Benefits of Artificial Intelligence

1. **Convenience and Improved Standard of Living**:
   o **Smart Homes**: AI-powered devices like thermostats, lights, and security systems can adapt to user preferences, making homes more comfortable and energy-efficient.
   o **Personal Assistants**: Siri, Alexa, and Google Assistant make information retrieval and task management easier.
2. **Accessibility for People with Disabilities**:
   o **Voice-to-Text**: Helps those with hearing impairments communicate effectively.
   o **Screen Readers**: Allow visually impaired individuals to access digital content.
3. **Workplace Safety**:

- o **Hazardous Environments**: Robots can perform tasks in environments that are dangerous for humans, such as deep-sea exploration or nuclear reactor maintenance.
- o **Medical Surgeries**: Robots, with their precision, can assist surgeons in complex procedures, reducing human error.

4. **Efficiency and Productivity**:
   - o **Data Analysis**: AI can sift through vast amounts of data quickly, aiding in research and business insights.
   - o **Agriculture**: Drones can monitor crops and analyze soil health, optimizing yields.

5. **Healthcare Advancements**:
   - o **Disease Identification**: AI can analyze medical images to detect diseases at early stages.
   - o **Drug Discovery**: AI can speed up the process of drug discovery by analyzing complex biochemical interactions.

6. **AI in climate change studies**
   - o **AI in Research**: AI models are being used to predict climate change patterns, analyze space data, and even understand complex biological processes.

Issues of concern about Artificial Intelligence

1. **Mass Unemployment**:
   - o **Automated Industries**: Many manufacturing jobs have been replaced by robots, leading to job losses in certain sectors.
   - o **Service Industry**: With the advent of AI chatbots, many customer service roles are becoming redundant.
   - o **Impact on Consulting Jobs**: AI systems have the potential to automate certain aspects of consulting, such as data analysis and report generation. This could lead to a reduction in demand for traditional consulting services.
   - o **Impact on Market and Business Analysis Jobs**: AI has the potential to automate certain tasks in market and business analysis, such as data analysis, trend identification, and forecasting. This may result in changes to the demand for professionals in these fields and the nature of their work.
   - o **Impact on Writing Jobs**: AI-powered writing tools and content generators have made significant advancements, potentially affecting jobs in content creation, such as copywriting and article writing.
   - o **Impact on Legal Jobs**: AI has the potential to automate certain legal tasks, such as contract review and legal research. This may result in changes to the demand for legal professionals and the nature of legal work.

2. **Racial and Gender Bias**:
   - o **Recruitment**: Some AI recruitment tools have been found to favor certain demographics over others based on biased training data.
   - o **Law Enforcement**: There have been instances where facial recognition tools have misidentified individuals, leading to wrongful arrests.

3. **Privacy Risks**:
   - o **Surveillance**: Governments and corporations can use AI to monitor individuals without their knowledge or consent.
   - o **Data Collection**: Many AI-powered apps collect vast amounts of personal data, which can be misused.

4. **Ethical Concerns**:
   - **Decision Making**: Relying on AI for critical decisions, like medical treatments or legal judgments, can be problematic if the AI makes an error.
   - **Lack of Empathy**: AI doesn't possess human emotions, which can be a concern in roles that require empathy, like therapy or counseling.
5. **Dependence on Technology**:
   - **Over-reliance**: Heavy dependence on AI tools can reduce human skills and problem-solving abilities.
   - **Vulnerabilities**: AI systems can be hacked or malfunction, leading to disruptions.

AI developments in India

Davos 2024 Participation

India actively participated in discussions at Davos 2024, focusing on global challenges such as the transition to clean energy and **AI governance**.

Budget 2024-25 Impact

The Union Budget 2024-25 is anticipated to include investment provisions in 'AI for India' to unlock the full potential of AI. Tech companies are hopeful for measures that foster the development and adoption of AI.

Significant AI Startups in India, 2024

No.	Startup Name	Focus Area
1	Vicarious	Advancement in machine learning and robotics
2	Cognitive scale	AI and cloud computing in the financial services sector
3	Viz AI	AI for expediting care coordination and reducing treatment delays in healthcare
4	Shield AI	Intelligent systems for safeguarding service members and civilians
5	Deep 6 AI	AI in healthcare for revolutionising medical diagnosis and treatment
6	Databricks	The world's first and only lakehouse platform in the cloud
7	Stability AI	AI-driven visual art and open AI tools for image creation based on text input

These startups exemplify the dynamic and growing AI startup landscape in India, offering innovative solutions across various sectors.

AI regulation

Regulations and Guidelines: As AI becomes more integrated into daily life, governments worldwide are looking into regulations to ensure its ethical and safe use.

Approaches to AI regulation

- Development of industry-wide AI guidelines and standards in collaboration with governments, researchers, and other stakeholders to ensure responsible and ethical use of AI.
- Establishment of regulatory sandboxes, which provide a safe space for companies to test and develop AI systems while still being subject to oversight and regulation.

AI regulation and big tech companies

- Big tech companies are engaged in a balancing act of seeking and avoiding AI regulation.
    - They want to avoid stifling innovation with too much regulation.
    - They also recognise the importance of ethical and safe use of AI.
- For instance, platforms like Meta and Microsoft are positioning themselves as responsible users of Artificial Intelligence technology. At the same time, they are seeking to both implement and avoid stringent forms of government regulation.

Balancing innovation and responsible AI development

- A balance must be struck between promoting innovation and ensuring that AI is developed and used in a responsible and ethical manner to benefit society as a whole.