Q1. Define Artificial Intelligence (AI) with examples.

Definition:

Artificial Intelligence (AI) is the branch of computer science that focuses on creating **machines and systems capable of simulating human intelligence**. It enables computers to **think, learn, reason, and make decisions** similar to human beings.

Key Features of AI:

1. **Learning** – Ability to improve performance from experience (Machine Learning).

2. **Reasoning** – Drawing logical conclusions from given information.

3. **Problem-Solving** – Identifying problems and applying strategies to solve them.

4. **Perception** – Recognizing objects, images, and speech from the environment.

5. **Language Understanding** – Processing human language (Natural Language Processing).

Examples of AI in real life:

- **Siri / Alexa / Google Assistant** – Voice-based personal assistants.

- **Google Maps** – Provides real-time navigation using AI and GPS.

- **Self-Driving Cars** – Autonomous vehicles like Tesla.

- **Spam Filters** – Automatically detect junk emails.

👉 **In short**: AI enables machines to behave intelligently like humans.

Q2. Brief History of AI.

The development of AI took place in several stages:

1. **1950 – Turing Test**

   - Alan Turing introduced the idea of a machine that can "think" like humans.

   - Proposed the **Turing Test** to check machine intelligence.

2. **1956 – Birth of AI**

   - John McCarthy coined the term **"Artificial Intelligence"** at the Dartmouth Conference.

   - This marks the official beginning of AI research.

3. **1960s–70s – Expert Systems**

   - AI research focused on **expert systems** (software mimicking human experts).

   - Example: **DENDRAL** (chemical analysis) and **MYCIN** (medical diagnosis).

4. **1980s – Rise of Machine Learning**

   - Introduction of algorithms that allowed computers to "learn" from data.

5. **1997 – Deep Blue vs. Kasparov**

   - IBM's **Deep Blue** defeated world chess champion **Garry Kasparov**, a landmark event.

6. **2010s – Deep Learning & Big Data**

- AI became mainstream due to availability of large datasets and powerful GPUs.

- Applications: Self-driving cars, speech recognition, chatbots, recommendation systems.

👉 **Today, AI is rapidly evolving** with applications in every field including healthcare, business, robotics, and entertainment.

Q3. Applications of AI in Real Life.

Artificial Intelligence is applied in almost all sectors. Some major applications:

1. **Healthcare**

   - Disease diagnosis using AI-powered tools.

   - **Robotic surgeries** and **drug discovery**.

   - Example: IBM Watson for cancer diagnosis.

2. **Business**

   - AI chatbots for customer support.

   - Fraud detection in banking and finance.

   - Predictive analytics for sales forecasting.

3. **Education**

   - Personalized learning platforms (adaptive learning).

   - AI tutors and assessment tools.

   - Example: Duolingo language learning app.

4. **Transport**

   - **Self-driving cars** (Tesla, Waymo).

   - Smart traffic management systems.

5. **Entertainment**

   - Recommendation engines (Netflix, Spotify, YouTube).

   - AI in video games and animation.

👉 AI applications make life **easier, faster, and more efficient**.

Q4. Ethical Considerations in AI.

AI also raises several ethical issues:

1. **Bias in Algorithms**

   - AI systems may learn human biases from training data.

   - Example: AI hiring tools showing gender/racial bias.

2. **Job Displacement**

   - Automation may replace human workers in industries.

   - Example: Robots replacing factory workers.

3. **Privacy Concerns**

   ○ AI requires massive amounts of personal data.

   ○ Leads to risks of **data misuse and surveillance**.

4. **Military & Surveillance Misuse**

   ○ AI can be used in autonomous weapons (killer drones).

   ○ Raises concerns about global security and human rights.

👉 **Solution**: Need for **ethical AI policies**, transparency, and regulations.

Q5. Overview of AI Technologies and Techniques.

AI uses different technologies to function effectively. Major ones are:

1. **Machine Learning (ML)**

   ○ Enables systems to learn from past data and improve automatically.

   ○ Types:

     ■ **Supervised Learning**: Learns from labeled data (e.g., spam detection).

     ■ **Unsupervised Learning**: Finds patterns in unlabeled data (e.g., clustering).

     ■ **Reinforcement Learning**: Learns by reward and punishment (e.g., training robots, AlphaGo).

2. **Deep Learning (DL)**

   ○ A subset of ML that uses **neural networks with multiple layers**.

   ○ Useful in image recognition, speech recognition, and natural language tasks.

   ○ Example: Face ID on smartphones.

3. **Natural Language Processing (NLP)**

   ○ Enables machines to understand, process, and respond to human language.

   ○ Example: Chatbots, Google Translate, sentiment analysis.

4. **Expert Systems**

   ○ AI systems designed to mimic decision-making of human experts.

   ○ Example: Medical diagnostic systems.

5. **Robotics**

   ○ Integration of AI into robots for physical tasks.

   ○ Example: Industrial robots, humanoid robots like Sophia.

👉 These techniques are the **backbone of AI** and are used across industries to develop smart solutions.

◆ **Unit 2: Computer Vision**

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1. Introduction to Computer Vision

Computer Vision (CV) is a field of Artificial Intelligence that focuses on enabling machines to "see," interpret, and understand visual data (images, videos, live camera feeds) in a way similar to the human visual system.

- Unlike human vision, which is based on biological eyes and the brain, computer vision relies on **digital image processing, pattern recognition, and machine learning algorithms**.

- CV allows machines to extract meaningful information such as detecting objects, recognizing faces, identifying patterns, or even making decisions based on visual input.

- For example:

  - **Face unlock on smartphones** uses CV to identify facial features and compare them with stored data.

  - **Google Lens** can recognize objects, text, and landmarks in real time.

👉 Thus, Computer Vision bridges the gap between the visual world and machine understanding, making it one of the most impactful fields of AI today.

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2. Basic Techniques of Computer Vision

Computer Vision works through a series of techniques that allow machines to process and interpret images. Some of the most common techniques include:

1. **Image Preprocessing**

   - Images often contain noise, distortions, or irrelevant details.

   - Preprocessing techniques such as **filtering, blurring, normalization, and resizing** are applied to clean and standardize images before further analysis.

   - Example: Resizing an image to 224x224 pixels before feeding it into a deep learning model.

2. **Edge Detection**

   - Used to identify object boundaries within an image.

   - Algorithms like **Canny** and **Sobel operators** highlight sharp changes in pixel intensity to detect edges.

   - Example: Detecting road lane boundaries in self-driving cars.

3. **Feature Extraction**

   - Identifying important details in an image such as corners, textures, and shapes.

   - Techniques like **SIFT (Scale Invariant Feature Transform)** and **SURF (Speeded-Up Robust Features)** are used.

   - Example: Detecting and matching key points in two images for image stitching (panoramas).

4. **Object Detection**

   - Involves locating and classifying multiple objects in an image or video.

   - Modern approaches include **YOLO (You Only Look Once)** and **R-CNN (Region-based Convolutional Neural Networks)**.

   - Example: Detecting pedestrians, vehicles, and traffic signals in autonomous driving.

👉 These techniques form the backbone of computer vision applications.

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3. Applications of Computer Vision

Computer Vision is applied in multiple real-world domains:

1. **Healthcare**

   - Used for analyzing **X-rays, MRIs, CT scans** to detect tumors, fractures, or abnormalities.

   - AI-assisted diagnostics can speed up detection and reduce human error.

2. **Security and Surveillance**

   - **Face recognition systems** in CCTV cameras are used for crime detection, border control, and access control.

   - Example: Airports use CV for passenger identification.

3. **Self-Driving Cars**

   - CV enables autonomous vehicles to detect **lanes, traffic signs, pedestrians, and other vehicles**.

   - Tesla and Waymo use CV as a core technology.

4. **Retail Industry**

   - Automated checkout stores like **Amazon Go** use CV to detect items picked by customers and automatically bill them without cashiers.

👉 Thus, CV impacts healthcare, security, transportation, and commerce significantly.

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4. Computer Vision Libraries and Tools

There are several libraries and frameworks that support CV development:

1. **OpenCV (Open Source Computer Vision Library)**

   - The most popular CV library used for image processing, object detection, and real-time vision applications.

   - Provides functions for filtering, edge detection, face recognition, etc.

2. **TensorFlow & PyTorch**

   - Deep learning frameworks widely used for building advanced vision models like CNNs (Convolutional Neural Networks).

   - TensorFlow is backed by Google, PyTorch by Facebook.

3. **Keras**

   - A high-level deep learning framework built on top of TensorFlow.

   - Makes it easier to build and train image recognition models with few lines of code.

4. **Scikit-Image**

   - Python library used for scientific image analysis.

   - Provides algorithms for segmentation, feature extraction, and color analysis.

👉 These libraries have made CV research and applications more accessible and powerful.

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5. Ethical Considerations in Computer Vision

Like AI in general, Computer Vision raises serious ethical concerns:

1. **Privacy Issues**

    ○ CCTV surveillance and face recognition systems can monitor individuals without their consent, raising privacy violations.

2. **Misuse of Face Recognition**

    ○ Authoritarian governments can misuse CV to track and suppress citizens.

    ○ Example: Mass surveillance in public spaces.

3. **Bias in Datasets**

    ○ If training datasets are not diverse, CV models may be **biased against race, gender, or ethnicity**.

    ○ Example: Some face recognition systems misidentify people of color more frequently.

4. **Deepfakes**

    ○ CV is used to create highly realistic fake videos/images, leading to misinformation, identity theft, and political manipulation.

👉 Therefore, ethical guidelines and regulations are essential when deploying CV systems.