1. What is AI? Explain its definition based on its categories.

AI is a branch of science that deals with building helping machines to find solutions of complex problems in a human-like fashion. It involves borrowing characteristics from human intelligence and applying them as algorithms in a computer friendly way to solve tasks requiring reasoning, learning, problem solving, perception and language understanding.

AI can be defined on the basis of following categories:

1. Thinking humanly: The cognitive modelling approach

This approach attempts to model how humans think and make decisions to develop computer programs that mimic the human cognitive process, which is done by three ways:

1. Through introspection: trying to catch our own thoughts as they go by
2. Through psychological experiments: observing a person in action
3. Through brain imaging: observing the brain in action

This sufficiently precise theory of the mind can be expressed as a computer program. If the program’s I/O behaviour matches corresponding human behaviour, we can say that the program is operating like a human mind. Example: Building AI that solves problems using techniques derived from studies of how humans solve similar problems.

1. Thinking rationally: The “laws of thought” approach

This approach is based on formal logic and aims to create machines that reason using logical rules to arrive at correct conclusions. It uses syllogisms and mathematical logic like the Greek philosopher Aristotle’s syllogism that argument structures always yield correct conclusion when given correct. Example: Ram is man; all men are mortal. Therefore, Ram is mortal.

The obstacles to this approach are:

1. It is difficult to convert informal knowledge into formal terms using logical notations, especially when the knowledge isn’t 100% certain.
2. There is big difference between solving a problem in principle and in practise. A computer has limited computational resources which may be exhausted unless given guidance as to which reasoning steps to try first.

Example: Logic-based expert systems that use if-then rules to diagnose problems or provide recommendations.

1. Acting humanly: The Turing Test approach (Chinese room argument)

The Turing Test (Alan Turing,1950) says that a computer passes the test if a human interrogator, after posing some written questions, can’t tell whether the written response comes from a person or a computer. The test is for a program to have a conversation with an interrogator for 5 minutes. The interrogator then guesses if conversation is with a program or a person. The program passes the test if it fools the interrogator 30% of the time.

To pass the Turing test, a computer must have the following capabilities:

1. Natural language processing: to communicate in English
2. Knowledge representation: to store what it knows or hears
3. Automated reasoning: to used store information to answers questions and draw new conclusions
4. Machien learning: to adapt to new circumstances and detect, extrapolate patterns

Example: Chatbots that mimic human conversation.

1. Acting rationally: The rational agent approach

A rational agent is an agent that acts to achieve the best outcome or the best expected outcome when there is uncertainty. The goal of this approach is to build agents that maximize performance using the best possible decision in each situation.

Acting rationally means doing things that lead to best results. Sometimes this means thinking logically (like solving a math problem). But sometimes it may mean just doing something that works best is enough. Example: touching a hot stove and pulling our hand away reflexively is a smart (rational) action if even we didn’t reason about it, we just did it to quickly avoid harm.

This approach is better than others because it is more:

1. Flexible: acting rationally doesn’t only mean using logic, there are also other ways
2. Scientific: it is easier to study and improve with science as it’s based on what actually works not just how humans think or behave.

Example: Autonomous vehicles making real-time decisions based on sensor data to avoid obstacles and reach destinations efficiently.

1. Explain in detail about history of AI.

The history of AI is described here:

1. Foundations of AI (1943–1950)
2. 1943 – Warren McCulloch and Walter Pitts:

* Proposed the first model of artificial neurons using Boolean logic.
* This laid the groundwork for connectionism (neural networks).

1. 1950 – Alan Turing published “Computing Machinery and Intelligence”:

* Introduced the idea of a machine’s ability to think.
* Proposed the Turing Test to check if a machine can mimic human intelligence.

1. The Birth of AI (1956)
2. Dartmouth Workshop:

* Coined the term “Artificial Intelligence.
* Led by John McCarthy, Marvin Minsky, Claude Shannon, and others.

1. Key Developments:

* Logic Theorist (by Newell & Simon): First program that mimicked human problem-solving.
* This event marks the official beginning of AI as a field of study.

1. Great Expectations (1952–1969)
2. Newell & Simon:

* Developed the General Problem Solver (GPS) to simulate human reasoning.

1. Arthur Samuel:

* Created a checkers-playing program that learned over time — early machine learning.

1. John McCarthy:

* Created LISP, the second-oldest high-level programming language for AI.

1. Marvin Minsky:

* Proposed “microworlds” (like the Blocks World), which focused on small, manageable AI problems.

1. First AI Winter (1966–1973)
2. Challenges:

* Systems failed to scale up.
* High expectations led to disappointment.
* Combinatorial explosion made search problems unmanageable.

1. Critical Work:

* Minsky & Papert (1969) published Perceptrons, showing limitations of early neural networks, leading to funding cuts.

1. Knowledge-Based Systems Era (1969–1980)
2. Domain-Specific AI emerged:

* DENDRAL (1969): Used for chemical analysis.
* MYCIN: Diagnosed blood infections using rules and uncertain reasoning.

1. Key Concept: Expert Systems

* Mimicked decision-making ability of human experts.

1. AI Becomes an Industry (1980–Present)
2. Rise of commercial AI:

* Development of business rule-based systems (e.g., R1 at DEC, 1982).
* Japan’s Fifth Generation Project (1981) pushed global interest.

1. Led to a boom in AI investment and research.
2. Connectionist Revival (1986–Present)
3. Return of neural networks:

* Rumelhart and McClelland (1986) introduced backpropagation, allowing multi-layer neural nets to learn.

1. Sparked renewed interest in deep learning.
2. AI Becomes a Science (Late 1980s–Present)

Solid advances in:

1. Speech recognition: Hidden Markov Models.
2. Uncertainty reasoning: Bayesian networks.
3. Formal methods and logic in AI systems.
4. Intelligent Agents and Real-World Integration (1995–Present)
5. Focus shifted to agents acting in real environments.
6. AI started handling continuous sensory inputs and making real-time decisions.
7. Used in robotics, autonomous systems, and smart assistants.
8. Explain in detail about application of AI.

The application of AI are as follows:

1. Healthcare:

AI is transforming healthcare by improving diagnosis, treatment, and patient care.

1. Disease Diagnosis: AI detects diseases like cancer, diabetes, and COVID-19 from X-rays, MRI scans, or blood reports (e.g., IBM Watson Health).
2. Medical Imaging: Tools like Google’s DeepMind analyze eye diseases from scans better than human doctors.
3. Virtual Nurses: AI chatbots (like Ada) provide 24/7 health advice.
4. Drug Discovery: AI speeds up drug design and development (e.g., COVID-19 vaccine research).
5. Robotic Surgery: Robots like Da Vinci assist doctors with precise surgery using AI-guided control.
6. Transportation:

AI is making transportation smarter and safer.

1. Self-Driving Cars: AI helps vehicles understand surroundings and drive safely (e.g., Tesla Autopilot, Waymo).
2. Traffic Management: AI predicts and reduces traffic jams using data from sensors and GPS.
3. Fleet Management: Logistics companies use AI to optimize delivery routes and fuel use.
4. Smart Assistants and Communication:

AI powers tools we use every day.

1. Virtual Assistants: Siri, Alexa, Google Assistant understand voice commands, answer questions, and control smart devices.
2. Chatbots: AI bots handle customer service, online shopping, and banking queries 24/7.
3. Language Translation: Tools like Google Translate use AI for real-time language conversion.
4. Speech Recognition: Voice typing, transcription apps (like Otter.ai) use AI to convert speech to text.
5. Finance and Banking:

AI helps detect fraud, manage investments, and automate tasks in finance.

1. Fraud Detection: AI tracks unusual transactions and prevents credit card fraud.
2. Stock Market Prediction: AI analyzes patterns in stock data to suggest investment strategies.
3. Robo-Advisors: Tools like Betterment and Wealthfront give automated financial advice.
4. Credit Scoring: AI evaluates loan eligibility using more than just credit scores.
5. Manufacturing and Industry:

AI is improving efficiency, quality control, and safety in industries.

1. Predictive Maintenance: AI predicts when machines might fail and prevents breakdowns.
2. Quality Inspection: Cameras powered by AI detect product defects on assembly lines.
3. Robotics: AI-controlled robots do tasks like packing, welding, or assembling with precision.
4. Retail and E-commerce:

AI enhances shopping experiences for both customers and sellers.

1. Recommendation Systems: Amazon and Netflix use AI to suggest products or shows.
2. Customer Support: AI chatbots answer questions and help users find products.
3. Inventory Management: AI predicts demand and manages stock levels.
4. Visual Search: Tools like Google Lens help customers find products using pictures.
5. Entertainment and Gaming:

AI is used to create immersive experiences in games and media.

1. Game Characters: NPCs (non-player characters) behave realistically using AI.
2. Content Personalization: YouTube and Spotify recommend songs or videos you like.
3. AI in Music and Art: AI can compose music, generate artwork, or create deepfake videos.
4. Education:

AI supports personalized learning and academic tools.

1. Smart Tutors: AI helps students learn at their own pace (e.g., Duolingo, Khan Academy).
2. Automated Grading: AI can check multiple-choice questions, essays, and homework.
3. Predictive Analytics: AI identifies students who need help before they fall behind.
4. Language Learning: AI provides real-time feedback on pronunciation and grammar.
5. Security and Surveillance:

AI helps improve safety and threat detection.

1. Facial Recognition: AI can recognize faces for security at airports or public places.
2. Intrusion Detection: AI monitors CCTV and detects suspicious behavior automatically.
3. Cybersecurity: AI detects and blocks malware or hacking attempts.
4. Agriculture:

AI is helping farmers improve yield and reduce waste.

1. Crop Monitoring: Drones with AI detect plant diseases and growth stages.
2. Weather Forecasting: AI helps predict rainfall, droughts, and ideal planting times.
3. Automated Irrigation: Smart systems use AI to control water based on soil data.
4. Livestock Monitoring: AI tracks animal health using sensors.
5. Environment and Sustainability:

AI is used to protect the environment and fight climate change.

1. Wildlife Protection: AI tracks animal movements and detects poachers.
2. Climate Modeling: AI predicts future climate changes using global data.
3. Energy Management: AI optimizes use of electricity in smart grids and homes.
4. Government and Law:

AI helps improve public services and governance.

1. Smart Cities: AI manages traffic, lighting, waste collection, and public safety.
2. Legal Research: AI helps lawyers find relevant laws and case histories quickly.
3. Social Services: AI predicts who needs help in welfare and health programs.