Artificial Intelligence

University of Mumbai, B. E. (Information Technology),

Semester –VI
Choice Based Credit Grading Scheme with Holistic and Multidisciplinary Education (CBCGS-HME 2023)
Proposed TCET Autonomy Scheme (w.e.f. A.Y. 2024-25)

T.E. (Information Technology)								**T.E. (SEM: VI)**		
Course Name: Artificial Intelligence								**Course Code: PEC- IT 6013**		
Contact Hours Per Week : 3								**Credits : 3**		
Teaching Scheme (Program Specific)					**Examination Scheme (Formative/ Summative)**					
Modes of Teaching / Learning / Weightage					**Modes of Continuous Assessment / Evaluation**					
Hours Per Week					**Theory (100)**			**Practical/Oral (25)**	**Term Work (25)**	**Total**
Theory	**Tutorial**	**Practical**	**Contact Hours**	**Credits**	**ISE**	**IE**	**ESE**	**Oral**	**TW**	
3	-	-	3	3	20	20	60	-	25	125

ISE: In-Semester Examination - Paper Duration – 1 Hour

IE: Innovative Examination

ESE: End Semester Examination - Paper Duration - 2 Hours

The weightage of marks for continuous evaluation of Term work/Report: Formative (40%), Timely completion of project (40%) and Attendance / Learning Attitude (20%)

Prerequisite: Programming Fundamentals, Mathematics, Data Structures and Algorithms, Basics of Logic and Reasoning (AND, OR, NOT, IMPLIES)

RBT : Revised Bloom's Taxonomy

SYLLABUS (BOOK: AI by Russel & Norvig /Rich & Knight)

1. **Introduction to Intelligent Systems**
2. **Uninformed Search Techniques**
3. **Informed Search Techniques**
4. **Knowledge and Reasoning**
5. **Planning, knowledge and Reasoning**
6. **Expert System and Applications**

Course Outcomes:

Students will be able to:

1	Understand the foundational concepts of AI, intelligent agents, and their environments, including the PEAS framework.
2	Apply uninformed and adversarial search techniques to solve problems and implement strategies like Minimax and Alpha-Beta Pruning.
3	Utilize heuristic-based informed search methods, including A* and Backtracking, for solving complex problems.
4	Develop reasoning systems using propositional and predicate logic and implement basic logic programming with PROLOG.
5	Demonstrate knowledge of planning techniques and learning strategies, such as decision trees and inductive learning, for intelligent systems.
6	Apply and design expert systems for knowledge-based tasks.

Chapter 1: Introduction to Intelligent Systems and Intelligent Agents

Absent numbers:

Module I Content:

- Introduction to AI
- AI Problems and AI techniques
- Solving problems by searching
- Problem Formulation
- State Space Representation
- Structure of Intelligent agents,
- Types of Agents
- Agent Environments PEAS representation for an Agent

OUTLINE

- Introduction to AI
- AI problems and Techniques
- Solving problems by searching
- Problem formulation

Introduction : Artificial Intelligence (AI)

Definitions

"The exciting new effort to make computers think . . . machines with minds, in the full and literal sense" (Haugeland, 1985) "[The automation of] activities that we associate with human thinking, activities such as decision-making, problem solving, learning ..."(Bellman, 1978)	"The study of mental faculties through the use of computational models" (Charniak and McDermott, 1985) "The study of the computations that make it possible to perceive, reason, and act" (Winston, 1992)
"The art of creating machines that perform functions that require intelligence when performed by people" (Kurzweil, 1990) "The study of how to make computers do things at which, at the moment, people are better" (Rich and Knight, 1991)	"A field of study that seeks to explain and emulate intelligent behavior in terms of computational processes" (Schalkoff, 1990) "The branch of computer science that is concerned with the automation of intelligent behavior" (Luger and Stubblefield, 1993)

Other definitions .. Internet

Machine learning and artificial intelligence share the same definition in the minds of many, however, there are some distinct differences

1. “It is the science and engineering of making intelligent machines, especially intelligent computer programs. It is related to the similar task of using computers to understand human intelligence, but AI does not have to confine itself to methods that are biologically observable.” – Stanford	4. “The ability of a machine communicating using natural language over a teletype to fool a person into believing it was a human. “AGI” or “artificial general intelligence” extends this idea to require machines to do everything that humans can do, such as understand images, navigate a robot, recognize and respond appropriately to facial expressions, distinguish music genres, and so on.” Matt Mahoney, PhD, Data Compression Expert
2. “Artificial Intelligence is the study of man-made computational devices and systems which can be made to act in a manner which we would be inclined to call intelligent.” – The University of Louisiana at Lafayette	3. “Defining artificial intelligence isn’t just difficult; it’s impossible, not the least because we don’t really understand human intelligence. Paradoxically, advances in AI will help more to define what human intelligence isn’t than what artificial intelligence is.” – OReilly

Definition Categories

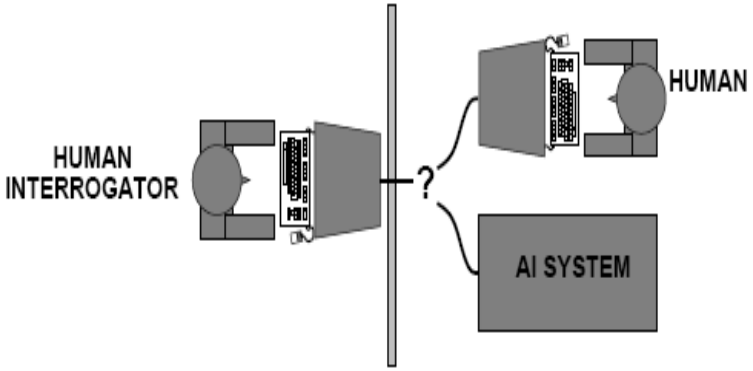
- The definition of AI is categorized into 4 parts as

Systems that think like humans	Systems that think rationally
Systems that act like humans	Systems that act rationally

	Human-like:	**Rationally:**
Think:	(1) Cognitive science Approach	(2) Laws of thought Approach
Act:	(3) Turing Test Approach	(4) Rational agent Approach

Acting Humanly: The Turing test

- Turing (1950) "Computing machinery and intelligence":
- "Can machines think?" −→ "Can machines behave intelligently?"
- Operational test for intelligent behavior: The Imitation Game (Turing test)



- Major components of AI
  - Knowledge
  - Reasoning
  - Language Understanding
  - Machine Learning

Q: Explain turing test designed for satisfactory operational definition of AI

Acting Humanly: The Turing test

- **Natural Language Processing** : to enable it to communicate successfully in English (or some other human language)
- **Knowledge Representation** : to store information provided before or during the interrogation
- **Automated Reasoning** : to use the stored information to answer questions and to draw new conclusions
- **Machine Learning** : to adapt to new circumstances and to detect and extrapolate patterns
- Vision, Motor control and senses

Limitations of Turing test

- Turing test is not reproducible , constructive and amenable to mathematical analysis
- It does not consider about the physical interaction with the interrogator and the environment.

Thinking Humanly: Cognitive Science

- 1960s “cognitive revolution”
- If we are going to say that a given program thinks like a human, we must have some way of determining how humans think. We need to get inside the actual workings of human minds.
- There are three ways to do this:
  - **introspection**—trying to catch our own thoughts as they go by
  - **psychological experiments**
  - **Brain imaging**
- Once we have a sufficiently precise theory of the mind, it becomes possible to express the theory as a computer program.
- The interdisciplinary field of cognitive science brings together computer models from AI and experimental techniques from psychology to try to construct precise and testable theories of the workings of the human mind.

Thinking Rationally: Laws of Thought

- The Greek philosopher **Aristotle:**
  - **Rational** :"right thinking,“ irrefutable reasoning process.
- His famous deductive reasoning gives patterns for argument structures that always gave correct conclusions given correct premises.
- For example,
  - "Socrates is a man; all men are mortal;
    - therefore Socrates is mortal."
- These laws of thought were supposed to govern the operation of the mind and initiated the field of logic.

Acting Rationally

- Rational behavior
  - doing the right thing
- The right thing
  - expected to maximize goal achievement, given the available information
- Doesn't necessarily involve thinking
  - thinking should be in the service of rational action
- Aristotle : Every art and every inquiry, and similarly every action and pursuit, is thought to aim at some good

Rational Agents

- An agent is an entity that perceives and acts
- Designing rational agents
  - An agent is a function from percept histories to actions
  - $f : P* \rightarrow A$
- For any given class of environments and tasks, we seek the agent (or class of agents) with the best performance
- computational limitations make perfect rationality unachievable
- Design best program for given machine resources

AI Prehistory

- Philosophy : logic, methods of reasoning mind as physical system foundations of learning, language, rationality
- Mathematics : formal representation and proof algorithms, computation, (un)decidability, (in)tractability probability
- Psychology : adaptation phenomena of perception and motor control experimental techniques (psychophysics, etc.)
- Economics : formal theory of rational decisions
- Linguistics : knowledge representation grammar
- Neuroscience : plastic physical substrate for mental activity
- Control theory : homeostatic systems, stability simple optimal agent designs

History of AI

- 1943: McCulloch & Pitts: Boolean circuit model of brain
- 1950 : Turing's "Computing Machinery and Intelligence"
- 1952–69 : Look, Ma, no hands!
- 1950s : Early AI programs, including Samuel's checkers program, Newell & Simon's Logic Theorist, Gelernter's Geometry Engine
- 1956 : Dartmouth meeting: "Artificial Intelligence" adopted
- 1965 :Robinson's complete algorithm for logical reasoning
- 1966–74 : AI discovers computational complexity Neural network research almost disappears
- 1969–79 : Early development of knowledge-based systems
- 1980–88 : Expert systems industry booms
- 1988–93 :Expert systems industry busts: "AI Winter"
- 1985–95 :Neural networks return to popularity
- 1988 : Resurgence of probability; general increase in technical depth "Nouvelle AI": ALife, GAs, soft computing
- 1995 : Agents, agents, everywhere . . .
- 2003: Human-level AI back on the agenda

Applications of AI

- Game Playing
- Speech Recognition
- Understanding Natural Language
- Computer Vision
- Expert Systems

Applications of AI

1.Game playing:IBM developed chess playing computer called “DEEP BLUE” which defeated world champion Gary Kasparav in 1997.

2.Autonomous planning and scheduling: NASA developed” Remote Agent Program” to control the scheduling of operation for a spacecraft . Remote Agent Program monitored operation of spaceship and provided information to NASA.

Applications of AI (Continued….)

3.Autonomous Control: The ALVINN computer vision system was trained to drive a car, this system was fitted in minivan fitted with video camera which transmit road images and depending on images best direction to drive was selected. (Example: TESLA autopilot system)

4.Diagnosis:Medical diagnosis program used symptom analysis to predict disease and gave result equivalent to expert physician. Example:MYCIN

Applications of AI (Continued….)

5.ROBOTICS: Many surgeon use Robot called HipNav to do microsurgery

6.Logistics Planning: US forces developed a **Dynamic Analysis and Replanning Tool** to do automatic logistic planning and scheduling for transportation. This tool allowed plan to be generated in hours on providing start point and end destination.

Thank You!