

INTRODUCTION TO ARTIFICIAL INTELLIGENCE

2/7/2018

Module 1



Outline of Contents

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- Artificial Intelligence :
 - ▣ Role of AI in engineering,
 - ▣ AI in daily life,
 - ▣ Intelligence and Artificial Intelligence,
 - ▣ Different task domains of AI,
 - ▣ Programming methods,
 - ▣ Limitations of AI
- Intelligent Agent:
 - ▣ Agent,
 - ▣ Performance Evaluation,
 - ▣ task environment of agent,
 - ▣ Agent classification,
 - ▣ Agent architecture

2/7/2018

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Reading

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- 1) Artificial Intelligence, 3rd Edition, Elaine Rich, Kevin Knight, S.B. Nair, Tata McGraw Hill.
- 2) Artificial Intelligence and Soft Computing for Beginners- Anandita Das, ShroffPublication.
- 3) Dr. S. N. Sivanandam and Dr. S. N. Deepa,"Principles of Soft Computing "John Wiley
- 4) S. Rajsekaran& G.A. VijayalakshmiPai, "Neural Networks, Fuzzy Logic and Genetic Algorithm:Synthesis and Applications" Prentice Hall of India.
- 5) Kumar Satish, "Neural Networks" Tata McGraw Hill
- 6) Timothy J. Ross, "Fuzzy Logic with Engineering Applications" Wiley India.
- 7) Search, Optimization & Machine Learning by *David E. Goldberg*.



Grading

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- **Internal:**
- Assessment consists of two tests (T1 and T2) .The final marks should be the average of the two tests.
- 3 Assignments based on numerical problems.
- Case studies where ever applicable.



Course Educational Objectives (CEO):

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- Course Educational Objectives (CEO): At the end of the course, the students will be able to
 - **CEO4054.1** Identify and describe problems that are amenable to solution by AI methods.
 - **CEO4054.2** Study appropriate soft computing techniques for problem solving
 - **CEO4054.3** Study optimization techniques based on soft computing approach



Course Outcomes (CO):

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- Course Outcomes (CO): At the end of the course, the students will be able to
 - ▣ **MCA4054.1** Understand various AI concepts
 - ▣ **MCA4054.2** Solve the problems using neural networks techniques.
 - ▣ **MCA4054.3** Apply fuzzy logic techniques to find solution of uncertain problems.
 - ▣ **MCA4054.4** Analyze the genetic algorithms and their applications



Module Mapping With Text Books

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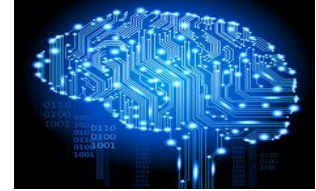
- 1 Introduction to AI (Book I & II)
- 2 Problem Solving (Book I)
- 3 Knowledge Representation (Book I)
- 4 Concepts of Soft Computing (Book III)
- 5 Neural Network (Book III)
- 6 Fuzzy Logic Introduction to Fuzzy Logic, Classical Sets and Fuzzy (Book VI)
- 7 Fuzzy Inference System (Book III & VI)
- 8 Genetic Algorithm (Book III & IV)



What is Artificial Intelligence?

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- ✓ A Scientific And Engineering Discipline Devoted To: Understanding Principles That Make Intelligent Behavior Possible In Natural Or Artificial Systems;
- ✓ Developing Methods For The Design And Implementation Of Useful, Intelligent Artifacts. [Poole, Mackworth, Goebel]



What is intelligence then?

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- Fast thinking?
- Knowledge?
- Ability to pass as a human?
- Ability to reason logically?
- Ability to learn?
- Ability to perceive and act upon one's environment?
- Ability to play chess at grand-master's level?
- . . .



Acting Humanly

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- ❖ “Can machines think?” → “Can machines behave intelligently?”
- ❖ Operational test for intelligent behavior: the imitation game.
- ❖ Predicted that by 2000, a machine might have a 30% chance of fooling a lay person for 5 minutes .
- ❖ Anticipated all major arguments against AI in following 50 years.
- ❖ Suggested major components of AI: knowledge, reasoning, language understanding, learning problem



Some Definitions

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The study of mental faculties through the use of computational models.

Charniak and McDermott, 1985

A field of study that seeks to explain and emulate intelligent behavior in terms of computational processes.

Schalkoff, 1990

The study of how to make computers do things at which, at the moment, people are better

Rich & Knight, 1991



Thinking Humanly: Cognitive Science

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- 1960s “cognitive revolution”: information-processing psychology replaced prevailing orthodoxy of behaviorism.
- Require scientific theories of internal activities of the brain
- What level of abstraction? “Knowledge” or “circuits”?
- How to validate? It requires
 - 1. Predicting and testing behavior of human subjects (top-down, Cognitive Science)
 - 2. Direct identification from neurological data (bottom-up, Cognitive Neuroscience)



Thinking Rationally: Laws of Thought

- Several Greek schools at the time of Aristotle developed various forms of logic:
- Notation and rules of derivation for thoughts. They may or may not have proceeded to the idea of mechanization
- Direct line through mathematics and philosophy to modern AI
- Problems:
 1. Not all intelligent behavior is mediated by logical deliberation
 2. What is the purpose of thinking? What thoughts should I have?



Acting Rationally

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- **Rational behavior:** doing the right thing, that which is expected to maximize goal achievement, given the available information
- Doesn't necessarily involve thinking—e.g., blinking reflex—but 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



Operational Definition of AI

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- Systems that act like humans
 - Turing test.
- Systems that think like humans
 - Cognitive Science
- Systems that think rationally Motivation
 - Logic-based AI
- Systems that act rationally
 - Rational Agents



Artificial Intelligence (AI)

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- Artificial Intelligence (AI) is usually defined as the science of making computers do things that require intelligence when done by humans.
- A.I is the study of ideas that enable computers to be intelligent.
- The collective attributes of a computer, robot, or other device capable of performing functions such as learning, decision making, or other intelligent human behaviors.



Motivation

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- Why Artificial Intelligence?
 - ✓ Computers are fundamentally well suited to performing mechanical computations, using fixed programmed rules.
 - ✓ Artificial machines perform simple monotonous tasks efficiently and reliably, which humans are ill-suited to.
 - ✓ For more complex problems, things get more difficult... Unlike humans, computers have trouble understanding specific situations, and adapting to new situations.
 - ✓ Artificial Intelligence aims to improve machine behavior in tackling such complex tasks.



Motivation

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- Why Artificial Intelligence?
 - ✓ Humans have an interesting approach to problem-solving, based on abstract thought, high-level deliberative reasoning and pattern recognition.
 - ✓ AI research is allowing us to understand our intelligent behavior.
 - ✓ • Artificial Intelligence can help us understand this process by recreating it, then potentially enabling us to enhance it beyond our current capabilities.



Human Intelligence Vs AI

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Human Intelligence

- Intuition, Common sense, Judgment, Creativity, Beliefs etc.
- The ability to demonstrate their intelligence by communicating effectively.
- Plausible Reasoning and Critical thinking.
- Humans are fallible.

Artificial Intelligence

- Ability to simulate human behavior and cognitive processes.
- Capture and preserve human expertise.
- Raise legal and ethical concerns.
- No “common sense”.



Human Intelligence Vs AI

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Human Intelligence

- They have limited knowledge bases.
- Information processing of serial nature proceed very slowly in the brain as compared to computers.
- Humans are unable to retain large amounts of data in memory.

Artificial Intelligence

- Cannot readily deal with
- “mixed” knowledge.
- May have high development costs.
- Fast Response.
- The ability to comprehend large amounts of data quickly.



The Foundations of AI

- Philosophy (423 BC – present):
 - Logic, methods of reasoning.
 - Mind as a physical system.
 - Foundations of learning, language, and rationality.
- Mathematics (Ac.800 – present):
 - Formal representation and proof.
 - Algorithms, computation, decidability, tractability.
 - Probability.
- Psychology (1879 – present):
 - Adaptation.
 - Phenomena of perception and motor control.
 - Experimental techniques.
- Linguistics (1957 – present):
 - Knowledge representation.
 - Grammar.



History of AI

- Gestation of AI (1943-1955)
- Birth of AI (1956)
- Great Expectation (1952-1969)
- Dose of Reality (1966-1973)
- Knowledge-based systems (1969-1979)
- AI becomes an industry (1982-present)
- Return of Neural Networks (1986-present)
- AI becomes a science (1987-present)
- Emergence of intelligent agents (1995-present)



Task Domains of AI

□ Mundane Tasks:

- Perception
 - Vision
 - Speech
- Natural Languages
 - Understanding
 - Generation
 - Translation
- Common sense reasoning
- Robot Control

□ Formal Tasks:

- Games : chess, checkers etc
- Mathematics: Geometry, Logic, Proving properties of programs

□ Expert Tasks:

- Engineering (Design, Fault finding, Manufacturing planning)
- Scientific Analysis
- Medical Diagnosis
- Financial Analysis



AI Technique

- Intelligence requires Knowledge
- Knowledge possesses less desirable properties such as:
 - ▣ Voluminous
 - ▣ Hard to characterize accurately
 - ▣ Constantly changing
 - ▣ Differs from data that can be used
- AI technique is a method that exploits knowledge that should be represented in such a way that:
 - ▣ Knowledge captures generalization
 - ▣ It can be understood by people who must provide it
 - ▣ It can be easily modified to correct errors.
 - ▣ It can be used in variety of situations



Typical AI problems

- Common-place tasks
 - ▣ Recognizing people, objects
 - ▣ Communicating (through natural language)
 - ▣ Navigating around obstacles on the streets
- Expert tasks
 - ▣ Medical diagnosis
 - ▣ Mathematical problem solving
 - ▣ Playing games like chess



Technology

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- How does Artificial Intelligence work?
- • There are many different approaches to Artificial Intelligence. Some are obviously more suited than others in some cases.
- • Over the past five decades, AI research has mostly been focusing on solving specific problems. Numerous solutions have been devised and improved to do so efficiently and reliably.
- • This explains why the field of Artificial Intelligence is split into many branches, ranging from Pattern Recognition to Artificial Life, including Evolutionary Computation and Planning.



Advantage

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- It can help improve our way of life
- ✓ • Machines will be able to do jobs that require detailed instructions
- ✓ • Mental alertness and decision making capabilities
- ✓ • Use robots for heavy construction, military benefits, or even for personal assistance at private homes
- ✓ • There will be less injuries and stress to human beings
- ✓ • Many of our health problems now have possible solutions with the use of artificial intelligence in studies at universities



Cont, Advantage

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- ✓ • Scientists have been using AI to test theories and notions about how our brains work
- ✓ • AI opens up new and exciting avenues for entertainment possibilities.
- ✓ • Ai also makes interactive electronic games more fun by making the computer controlled characters more realistic and human-like.



Applications

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- Game playing
 - There is some AI in them and they play well against people
- Speech recognition
 - Instruct some computers using speech
- Understanding natural language
 - The computer has to be provided with a understanding of the domain the text is about, and this is presently possible only for very limited domains.
- Expert systems
 - One of the first expert systems was MYCIN in 1974, which diagnosed bacterial infections of the blood and suggested treatments. It did better than medical students or practicing doctors, provided its limitations were observed.



Limitations

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- ✓ When will Computers become truly intelligent?
- ✓ To date, all the traits of human intelligence have not been captured and applied together to spawn an intelligent artificial creature.
- ✓ Currently, Artificial Intelligence rather seems to focus on lucrative domain specific applications, which do not necessarily require the full extent of AI capabilities.
- ✓ There is little doubt among the community that artificial machines will be capable of intelligent thought in the near future.



Programming languages used to develop AI

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- Although some all-purpose languages such as C, C++ and Java are used to create intelligent software, two languages are specifically designed for AI: LISP and PROLOG.
- • LISP (LISt Programming) was invented by John McCarthy in 1958. As the name implies, LISP is a programming language that manipulates lists.
- • PROLOG (PROGRAMMING IN LOGIC) is a language that can build a database of facts and a knowledge base of rules. A program in PROLOG can use logical reasoning to answer questions that can be inferred from the knowledge base.