DRONACHARYA
College of Engineering

INTELLIGENT SYSTEMS (CSE-303-F)

Section A

INTRODUCTION: ARTIFICIAL INTELLIGNCE

Lecture 1

What is an Intelligent system?

- What is intelligence?
  - Hard to define unless you list characteristics eg,
    - Reasoning
    - Learning/ Adaptivity
- A truly intelligent system adapts itself to deal with changes in problems (automatic learning).
- *Machine intelligence* has a computer follow problem solving processes something like that in humans.
- *Intelligent systems* display machine-level intelligence, reasoning, often learning, not necessarily self-adapting.

Intelligent systems in business

- Intelligent systems in business utilise one or more *intelligence tools*, usually to aid decision making
- Provides business intelligence to
  - Increase productivity
- Examples of business intelligence – information on
  - Customer behaviour patterns
  - Market trend
- Examples of successful intelligent systems applications in business:
  - Customer service (Customer Relations Modelling)
  - Scheduling (eg Mine Operations)
  - Data mining
  - Financial market prediction
  - Quality control

Intelligent systems in business – examples

- HNC (now Fair Isaac) software's credit card fraud detector Falcon offers 30-70% improvement over existing methods (an example of a neural network).
- MetLife insurance uses automated extraction of information from applications in MITA (an example of language technology use)
- Personalized, Internet-based TV listings (an intelligent agent)
- Hyundai's development apartment construction plans FASTrak-Apt (a Case Based Reasoning project)
- US Occupational Safety and Health Administration (OSHA uses "expert advisors" to help identify fire and other safety hazards at work sites (an expert system).

Source: http://www.newsfactor.com/perl/story/16430.html

Characteristics of intelligent systems

- Possess one or more of these:
  - Capability to extract and store knowledge
  - Human like reasoning process
  - Learning from experience (or training)
  - Finding solutions through processes similar to natural evolution
- Recent trend
  - More sophisticated Interaction with the user through
    - natural language understanding
    - speech recognition and synthesis
    - image analysis
- Most current intelligent systems are based on
  - rule based expert systems
  - one or more of the methodologies belonging to *soft computing*

Artificial Intelligence (AI)

- Primary goal:
  - Development of software aimed at enabling machines to solve Problems through human-like reasoning
- Attempts to build systems based on a model of knowledge representation and processing in the human mind
- Encompasses study of the brain to understand its structure and functions
- Expert systems – an AI success story of the 80s

The Soft Computing (SC) paradigm

- Also known as *Computational Intelligence*
- Unlike conventional computing, SC techniques
  1. can be tolerant of imprecise, incomplete or corrupt input data
  2. solve problems without explicit solution steps
  3. learn the solution through repeated observation and adaptation
  4. can handle information expressed in vague linguistic terms
  5. arrive at an acceptable solution through evolution

The Soft Computing (SC) paradigm (cont'd)

- Few characteristics are common in problem solving by individual humans
- Eevolution is common in nature
- The predominant SC methodologies found in current intelligent systems are:
  - Artificial Neural Networks (ANN)
  - Fuzzy Systems
  - Genetic Algorithms (GA)

Introduction

- What is AI?
- The foundations of AI
- A brief history of AI
- The state of the art
- Introductory problems

What is AI?

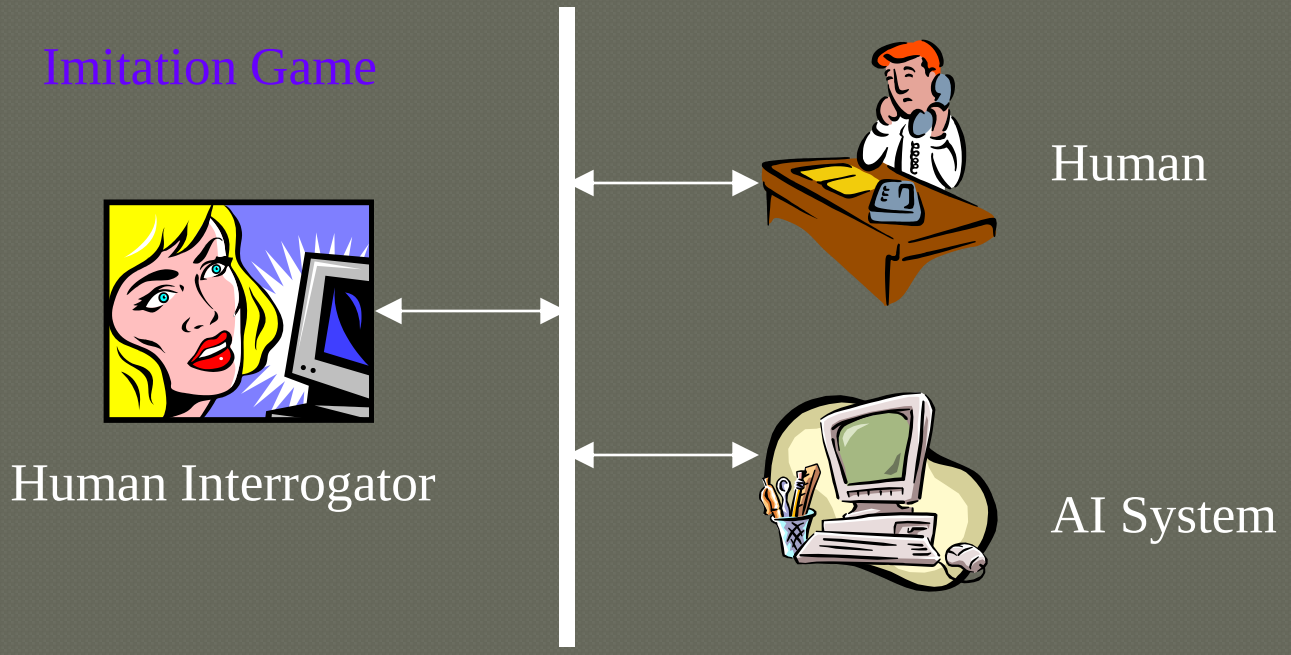
- Intelligence: “ability to learn, understand and think”.
- AI is the study of how to make computers make things which at the moment people do better.
- Examples: Speech recognition, Smell, Face, Object, Intuition, Inferencing, Learning new skills, Decision making.

What is AI?

Thinking humanly -> m/c with mind.	Thinking rationally -> Study of computation that makes it possible to act, reason.
Acting humanly -> study to make comps make things better than people do.	Acting rationally -> concerned with intelligent behaviour in artifacts.

Acting Humanly: The Turing Test

- Alan Turing (1912-1954)
- "Computing Machinery and Intelligence" (1950)



Acting Humanly: The Turing Test

The Turing Test,

- proposed by Alen turing in 1950.
- was designed to provide a satisfatory operational defination of intelligence.
- the computer would need to possess following capabilities,
  - natural language processing : to enable it to communicate successfully
  - knowledge representation: to store what it knows
  - automate d reasoning: to use the stored information to answer question and to draw new conclusion.
  - machine learning : to adapt to new circumstances and detect patterns.
  - computer vision: to perceive object and
  - robotics: to manipulate object and move about .
- AI compose of above disciplines.

Thinking Humanly: Cognitive Modelling

- when we say that a given program thinks like a human, we must have some way to figure out how human thinks.

Thinking Humanly: Cognitive Modelling

- GPS was designed.
- Not content to have a program correctly solving a problem.

  More concerned with comparing its reasoning steps to traces of human solving the same problem.
- Requires testable theories of the workings of the human mind: cognitive science.

Thinking Rationally: Laws of Thought

- Aristotle was one of the first to attempt to codify "right thinking", i.e., irrefutable reasoning processes.

- Formal logic provides a precise notation and rules for representing and reasoning with all kinds of things in the world.

- Obstacles:
  - Informal knowledge representation.
  - Computational complexity and resources.

Acting Rationally

- Acting so as to achieve one's goals, given one's beliefs.
- Does not necessarily involve thinking.
- Advantages:
  - More general than the "laws of thought" approach.
  - More amenable to scientific development than human-based approaches.

The Foundations of AI

- Philosophy (423 BC - present):
  - Logic, methods of reasoning.
  - Mind as a physical system.
  - Foundations of learning, language, and rationality.

- Mathematics (c.800 - present):
  - Formal representation and proof.
  - Algorithms, computation, decidability, tractability.
  - Probability.

The Foundations of AI

- Psychology (1879 - present):
  - Adaptation.
  - Phenomena of perception.
  - Experimental techniques.
- Linguistics (1957 - present):
  - Knowledge representation.
  - Grammar.

A Brief History of AI

- The gestation of AI (1943 - 1956):
  - 1943: McCulloch & Pitts: Boolean circuit model of brain.
  - 1950: Turing's "Computing Machinery and Intelligence".
  - 1956: McCarthy's name "Artificial Intelligence" adopted.
- Early enthusiasm, great expectations (1952 - 1969):
  - Early successful AI programs: Samuel's checkers,

    Newell & Simon's Logic Theorist, Gelernter's Geometry Theorem Prover.
  - Robinson's complete algorithm for logical reasoning.

A Brief History of AI

- A dose of reality (1966 - 1974):
  - AI discovered computational complexity.
  - Neural network research almost disappeared after Minsky & Papert's book in 1969.
- Knowledge-based systems (1969 - 1979):
  - 1969: DENDRAL by Buchanan et al..
  - 1976: MYCIN by Shortliffle.
  - 1979: PROSPECTOR by Duda et al..

A Brief History of AI

- AI becomes an industry (1980 - 1988):
  - Expert systems industry booms.
  - 1981: Japan's 10-year Fifth Generation project.
- The return of NNs and novel AI (1986 - present):
  - Mid 80's: Back-propagation learning algorithm reinvented.
  - Expert systems industry busts.
  - 1988: Resurgence of probability.
  - 1988: Novel AI (ALife, GAs, Soft Computing, …).
  - 1995: Agents everywhere.
  - 2003: Human-level AI back on the agenda.

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

The State of the Art

- Computer beats human in a chess game.
- Computer-human conversation using speech recognition.
- Expert system controls a spacecraft.
- Robot can walk on stairs and hold a cup of water.
- Language translation for webpages.
- Home appliances use fuzzy logic.