**CSC 437 – Artificial Intelligence**

Two big questions by philosophers

1. How does the human mind work?

2. Can non-humans have minds?

Some philosophers believe that machine can do everything humans can do.

Others have openly opposed this idea. Claiming that such highly sophisticated behaviours such as love, creative discovery and moral choice will always be beyond the scope of any machine.

Intelligent: Ability to understand and learn things.

Ability to think and understand instead of doing things by instinct or automation.

**What is Human intelligence?**

1. **Thinking**

2. **Learning** **and Understanding**

3. **Knowledge applying**

4. Acting (Knowing how to behave in a different environment)

5. **Perceiving** (the environment)

6. Automated Behaviour\*\*\*

7. **Solving Problem (and making decisions)**

8. **Pattern Matching and recognition**

9. **Reasoning**

10. **Prediction and Inference** (Inference is like making judgement based on information gotten/evidence.)

11. **Perception**

12. **Analysis**

13. Linguistic Intelligence

14. **Creativity**, **Expressiveness**, **Curiosity**

**Intelligent System is ability of a system to**

- **Calculate**

- **Reason**

- **Learn** **from** **experience**

- **Solve** **problems** and comprehend complex ideas

- Store and retrieve information from memory

- **Use natural language fluently**

- Perceive relationships and analogies

- Classify, generalize and adapt to new situations.

Chapter 2:

**Artificial** **Intelligence**

It means making computer that thinks

Automation of activities we associate with human thinking

These activities are Decision making, pattern recognition, learning patterns.

Creating machines that perform function that require intelligence when performed by people

**\*\*\*Telling a machine to do something that requires intelligence\*\*\***

**Artificial: Something produced by human effort or art rather than originating naturally.**

**Intelligence: The ability to acquire knowledge and use it.**

So, what is AI?

**The study of ideas that enable computers to the intelligent.**

**Strong AI vs Weak AI**

**Strong AI: A robot that is autonomous, thinks for itself and makes its own decisions. Can learn and adapt to new situations and can communicate with humans through the use of language.**

**Weak AI: It’s used to build a computer program that simulates a particular intelligent activity.**

**Ex. Playing chess.**

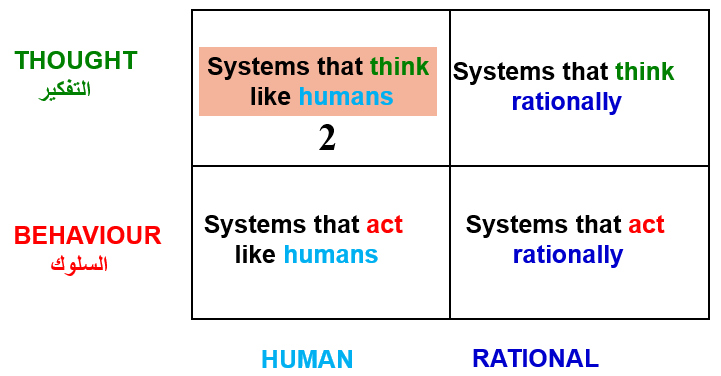
**Categories of AI**

**o Systems that act like humans - Behaviour - Humans**

**o Systems that act rationally - Behaviour - Rational**

**o Systems that think like humans - Thought -Humans**

**o Systems that think rationally - Thought - Rational**



**Acting Humanly**

**What is the Turing Test???**

**It was created by Alan Turin**

**He described the Turin test first in a 1950 paper**

**His motivation was to answer the question “Can machines think?”**

**In this, the system tries to be as indistinguishable from a person as possible. It tries to act like a human and make a third person find it hard to know who’s the human and which is the robot.**

**Although machines of today now pass the Turin test, and this doesn’t mean it answered the question of if machines can think.**

**Turin test is the inability to distinguish computer response from human response.**

**The human interrogator tries to distinguish between the other human and the AI system.**

\* To conduct this test, we need two people and the machine to be evaluated.

\* One person plays the role of the interrogator, who is in a separate room from the computer system (AI system) and the other person.

\* The interrogator can ask questions of either the person or the computer by typing questions and receiving typed responses.

\* However, the interrogator knows them only as A and B and aims to determine (distinguish) which the person is and which is the machine.

**In order to pass the Turing test, computers would need to be able to possess:**

**- Natural Language Processing**

**To communicate successfully**

**- Knowledge Representation**

**To store information**

**- Automated Reasoning**

**To retrieve and answer questions using the stored information**

**- Machine Learning**

**To adapt to new circumstances**

**Thinking Humanly**

If the program’s input/output and timing behaviour matched with the human behaviours, then we can say that the program is working like the human mind.

Humans are observed from ‘inside’

**How humans think:**

**Through Introspection**

**Trying to catch thoughts as they go**

**Through Psychological experiments**

**Observing a person in action**

**Through brain imaging**

**Observing the brain in action.**

**Cognition: The mental process of acquiring knowledge and understanding through thoughts, experience and senses.**

Cognitive science: A field that aims to understand how the brain and mind function.

GPS- General problem solver- It is a problem solver that always keeps track of the human mind regardless of the right answers.

**Think Rationally**

**Humans are not always rational**

**Rational means based on reason or logic.**

**Act Rationally**

**Rational behaviours: means doing the right thing.**

What do we mean by the right thing: That which is expected to maximize goal achievement.

When AI acts rationally

**Advantage**

**- It is more general than using logic**

**It is Logic + Domain Knowledge**

**- It allows extension of the approach with more scientific methodologies**

**Rational Agent**

**Agent: An agent is an entity that perceives and acts.**

For any given class of environment and tasks, we seek the agent with the best performance.

\*\*\*Computational limitations make perfect rationality unachievable\*\*\*

**AI has two major roles:**

**- Study the intelligent part concerned with humans**

**- Represent those actions using computers**

**Rational behaviour may not involve rational thinking**

**\*\*Reflex action**

**Goals of AI**

**-To make computers more useful by making them take over dangerous and tedious tasks.**

**-To understand the principles of AI**

**Academic Disciplines that are important to AI**

- Philosophy – Helps understand how humans think.

- Mathematics – formalizes three main areas of AI: computation, logic, probability.

- Economics: Decision theory, utility.

- Neuroscience: Neurons as information processing units.

- Computer Engineering: Building fast and efficient computers.

- Control Theory: Design systems that maximize an objective function over time.

**How can artifacts operate under their own control?**

- **Psychology/Cognitive Science:** How do humans think and act?

The study of human reasoning

How do people behave, process info, represent knowledge?

- **Linguistics:** Knowledge representation, grammar. For understanding natural languages.

**AI research areas**

**- Natural language processing**

**- Machine learning**

**- Robotics**

**- Expert System**

**- Fuzzy Logic**

**- Automation**

**- Neural Network**

**- Optimization**

**Problems that AI are applied to**

**1. Image processing**

**2. Virtual reality**

**3. Pattern recognition**

**4. Handwriting recognition**

**5. Face recognition**

**6. Speech recognition**

**7. Email spam filtering**

**8. Cognitive**

**9. Natural Language processing**

**10. Cybernetics**

**11. Game theory and strategic planning**

**12. Intelligent agent**

**13. Intelligent control**

**14. Data mining**

**15. Knowledge representation**

**16. Optical character recognition**

**17. Computer Vision**

**18. Diagnosis**

**19. Translation and chatterboxes**

**20. Artificial life**

**21. Concept mining**

**History Of AI**

Birth Of AI

1943 – 1956 1950 – Alan Turin- Turing Machine

Von Neumann - ENIAC

Shannon (A computer for playing chess)

Rise of AI

1956 – late 1960s - LISP (John McCarthy)

GPS – General problem solver

Reality Dawns - Realization that many AI problems are intractable (hard to control or deal with)

1966 - 73

Adding domain knowledge: MYCIN

1969-85 Development of knowledge-based system

Rise of machine learning: Neural network return to popularity

1986-- Major advances in machine learning algorithms and applications

Role of uncertainty Bayesian network as a knowledge representation framework

1990--

Major advances in all areas Scheduling, Games, Data mining, virtual reality, natural language,

Of AI -- 1990 demonstrations in machine learning.

AI as science Integration of learning, reasoning, knowledge representation

1995 -- AI is used in data mining, vision

**AI Application**

- **Gaming**

- **Natural Language Processing**

**- Expert System**

**- Speech Recognition**

**- Intelligent Robot**

**- Smart Cars**

**- Machine Learning**

**- Automatic Programming**

**- Human Performance Modelling**

**- Data Mining and Data Warehousing (Big Data)**

**- Handwriting Recognition**

**- Vision System**

**- Clinical Expert System**

**- Face Recognition**

**Sub fields of AI**

**- Neural Networks**

**- Natural Language Processing**

**- Vision**

**- Robotics**

**- Exert System**

**- Speech Recognition**

**- Machine Learning**

**- Evolutionary Computation**

**- Planning**

**Importance of AI**

**- Game Playing**

**- Speech Recognition**

**- Understanding Natural Language**

**- Computer Vision**

**- Expert System**

**- Heuristic Classification**

**Advantages of Artificial Intelligence**

**1. More powerful and more useful computers**

**2. New and improved interface**

**3. Solving new problems**

**4. Better handling of information**

**5. Relieves information overload**

**6. Conversion of information into knowledge**

**Disadvantages of Artificial Intelligence**

**1. Increased Cost**

**2. Difficulty in software development**

**3. Few experienced programmer**

**4. Few practical products have reached market as yet.**

**Problem Solving**

In order to automatically solve a problem using AI.

We need representation of the problem (Formalization)

Algorithms that use some strategy to solve the problem (Searching technique).

**Problem Formulation**:

**The process of deciding what sort of action to consider, given a goal.**

Goal Formulation:

It is the first step in problem solving

Creating a goal

**Searching strategies for AI**

1. **Informed (Heuristic Search)**

* **Best First Search**
  + **A\*search**
* **Hill Climbing**
* **Constraint Satisfaction**

1. **Un-informed (Blind Search)**

* **Depth first search**
  + **Deep Limited**
    - **Iterative Deepening**
* **Breadth first**
* **Cost-first**

**Search Strategy**

**Search** is the systematic examination of states to find path from **start** to the goal.

**Search** usually results from a lack of knowledge.

Search algorithm output is the solution.