CSE4211: Introduction To Artificial Intelligence

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Reference Books:

1. Dan W. Patterson, Introduction to Artificial Intelligence & Expert Systems, Professor, University of Texas, USA.
2. Elaine Rich, Kevin Knight, S. B Nair, Artificial Intelligence, 3rd Edition, Tata McGraw Hill, USA.
3. Patrick Henry Winston, Artificial Intelligence , Professor, Massachusetts Institute of Technology, USA.

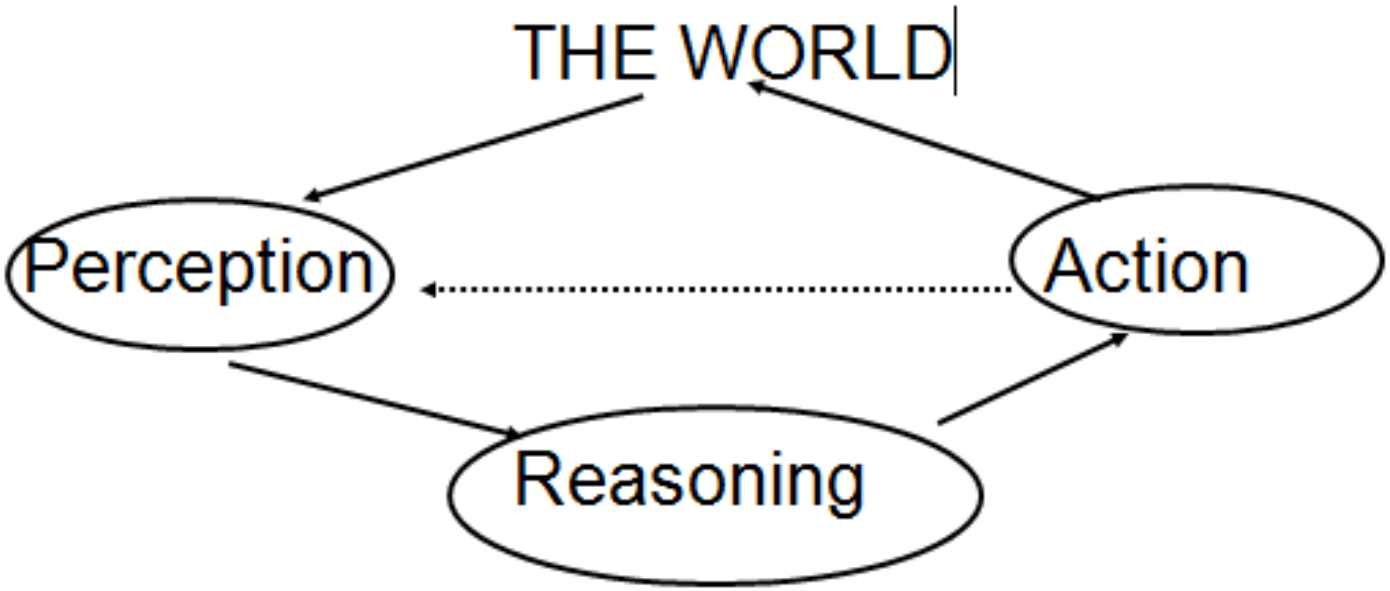
Artificial Intelligence(AI)

- Definition-1:
- Artificial Intelligence (AI) is the study of computations that make it possible to **perceive**, **reason** and **act**.

- Definition-2:
- Artificial Intelligence (AI) is a branch of computer science concerned with the study and creation of computer systems that exhibit some form of intelligence: such as,
  - ❖ systems that learn new concepts and tasks,
  - ❖ systems that can reason and draw useful conclusions about the world around us,
  - ❖ systems that can understand a natural language or perceive and comprehend a visual **scene**, and
  - ❖ systems that perform other types of feats that require human types of intelligence.

Latest Perception of AI

- Three typical components of AI Systems



- Artificial:
  - ❖ Produced by human art or effort, rather than originating naturally.
- Intelligence:

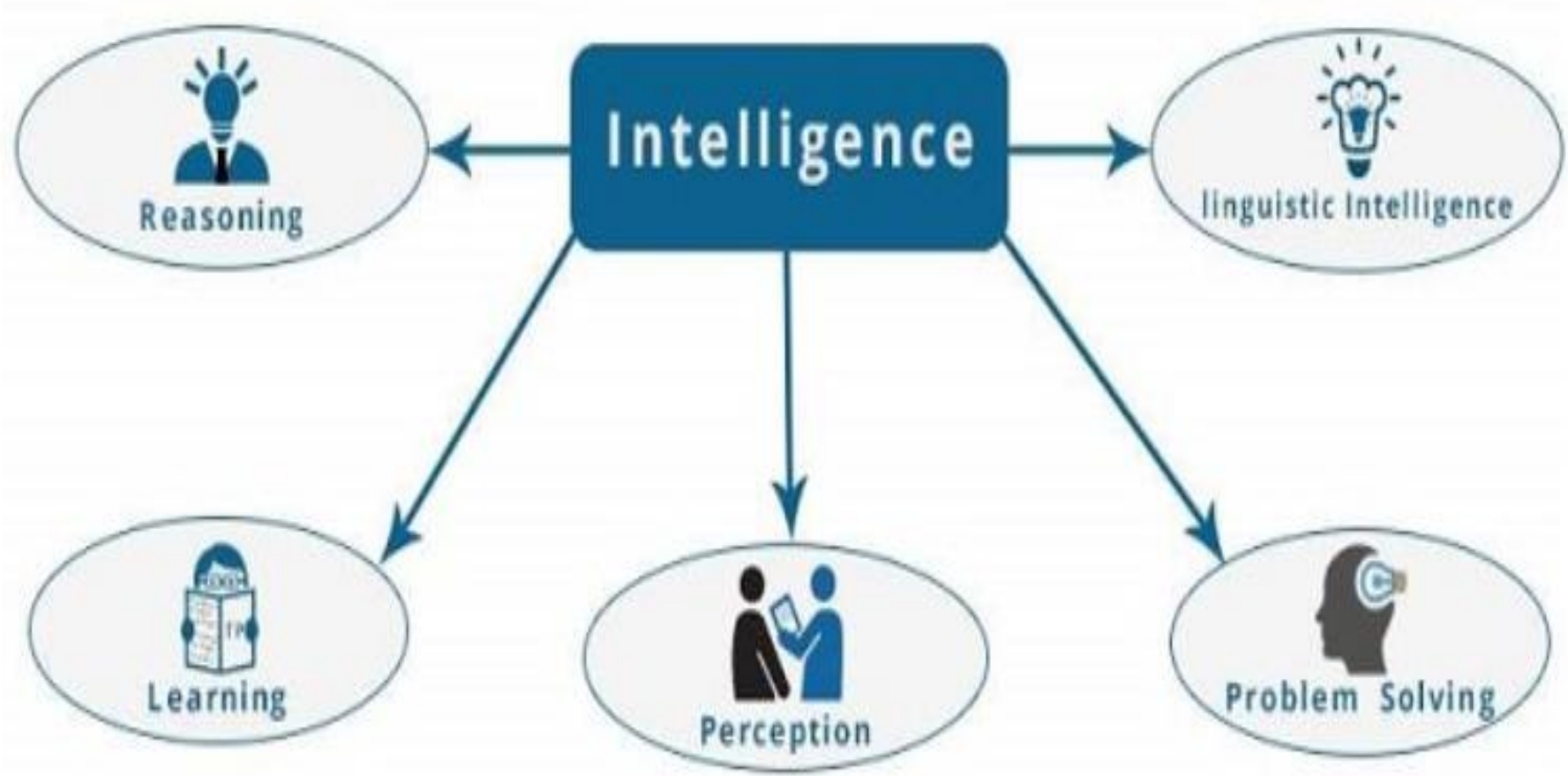
❖ is the ability to acquire knowledge and use it" [Pigford and Baur]

- **So AI is defined as:**
  - ➢ AI is the study of ideas that enable computers to be intelligent.
  - ➢ AI is the part of computer science concerned with design of computer systems that exhibit human intelligence(From the Concise Oxford Dictionary)

What is Intelligence?

- Intelligence is a property of mind that encompasses many related mental abilities, such as the capabilities to
  - Reasoning
  - Learning
  - Problem Solving
  - Perception
  - Linguistic Intelligence

What is Intelligence?



Difference between Human and Machine Intelligence

- Humans perceive by patterns whereas the machines perceive by set of rules and data.
- Humans store and recall information by patterns, machines do it by searching algorithms.
- Humans can figure out the complete object even if some part of it is missing or distorted; whereas the machines cannot do it correctly.

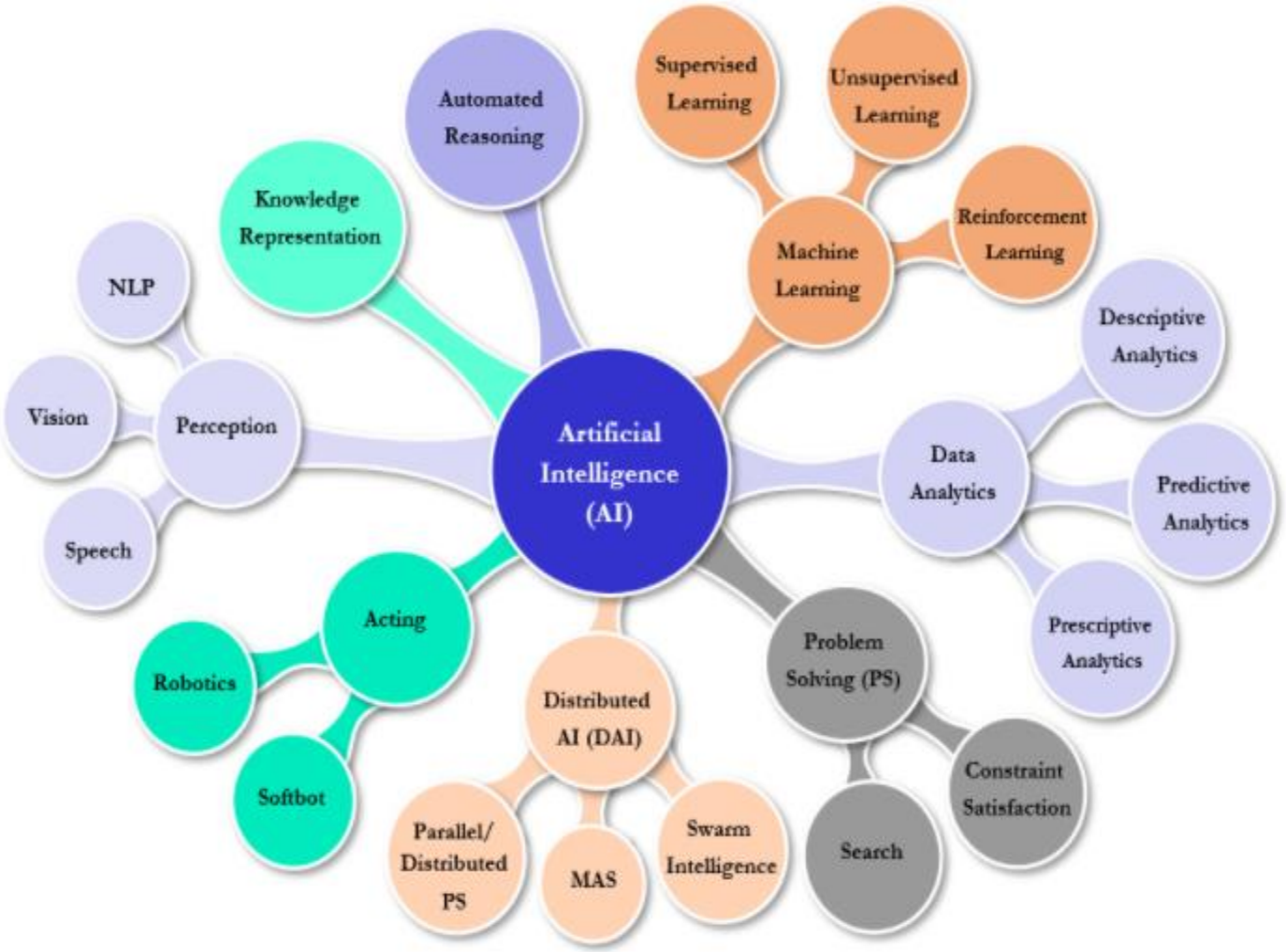
Observations	Human Intelligence	Machine Intelligence
Origin	Human beings are created with the innate ability to think, reason, recall, etc.	Machine intelligence is an innovation which is created by human (scientists).
Speed	Process information slower.	Process information faster.
Decision making	Humans' decisions may be influenced by subjective elements which are not based on figures alone.	Machine intelligence is highly objective in decision making as it analyzes based on purely gathered data.
Accuracy	May be less accurate.	More accurate.
Energy	Uses 25 watts.	Uses 2 watts.
Adaptation	Can easily adapt to changes.	Cannot adapt to changes well.
Multitasking	Can multitask easily.	Cannot multitask easily.
Self-Awareness	Has self-awareness	Still working towards self-awareness.
Social Interaction	Excellent social skills.	Low social skills.
General Function	Innovation	Optimization

Areas of AI

- Areas of AI are:
  - Knowledge representation
  - Robotics
  - Expert systems
  - Natural language understanding
  - Computer vision
  - Theorem proving
  - Game playing
  - reasoning dealing with uncertainty and decision making

Areas of AI

- Learning models, inference techniques
- Pattern recognition
- Search and matching algorithms
- Logic (fuzzy, temporal, modal) in AI
- Planning and scheduling
- Understanding spoken expressions
- Intelligent tutoring systems
- Machine translation systems
- Artificial Neural Networks
- Deep Learning



Applications

- **Business :** Financial strategies, give advice
- **Engineering:** check design, offer suggestions to create new product
- **Manufacturing:** Robotics, Assembly, inspection & maintenance, military weapons, satellites, Space rocket, Sky rockets, Missiles, Ballistic missiles
- **Mining:** used when conditions are dangerous
- **Hospital :** monitoring, diagnosing & prescribing
- **Education :** In teaching and research
- **Household :** AI based Devices for cooking, washing & storing, etc.
- **Farming :** prune trees & selectively harvest mixed crops, biotechnology, genetics engineering.

History of AI

- 1943: early beginnings
  - McCulloch & Pitts: Boolean circuit model of brain
- 1950: Turing
  - Turing's "Computing Machinery and Intelligence“
- 1956: birth of AI
  - Dartmouth meeting: "Artificial Intelligence“ name adopted
- 1950s: initial promise
  - Early AI programs, including
  - Samuel's checkers program
  - Newell & Simon's Logic Theorist
- 1955-65: “great enthusiasm”
  - Newell and Simon: GPS, general problem solver
  - Gelertner: Geometry Theorem Prover
  - McCarthy: invention of LISP

History of AI

- **1966—73: Reality dawns**
  - Realization that many AI problems are intractable
  - Limitations of existing neural network methods identified
    - Neural network research almost disappears
- **1969—85: Adding domain knowledge**
  - Development of knowledge-based systems
  - Success of rule-based expert systems,
    - E.g., DENDRAL, MYCIN
    - But were brittle and did not scale well in practice
- **1986-- Rise of machine learning**
  - Neural networks return to popularity
  - Major advances in machine learning algorithms and applications
- **1990-- Role of uncertainty**
  - Bayesian networks as a knowledge representation framework
- **1995– 2021 AI as Science**
  - Integration of learning, reasoning, knowledge representation, Deeping learning
  - AI methods used in vision, language, data mining, Robotics etc

What is knowledge?

- Knowledge can be defined as the body of facts and principles accumulated by human-kind or the fact, or state of knowing.
- Knowledge should not be confused with data.
- In biological organisms, knowledge is likely stored as complex structures of interconnected neurons.
- In Computer Science, knowledge is also stored as complex structures, but in the form of collections of magnetic spots and voltage states.

Five types of knowledge

- **Meta Knowledge** – It's a knowledge about knowledge and how to gain them
- **Heuristic – Knowledge** – Representing knowledge of some expert in a field or subject.
- **Procedural Knowledge** – Gives information/ knowledge about how to achieve something.
- **Declarative Knowledge** – Its about statements that describe a particular object and its attributes , including some behavior in relation with it.
- **Structural Knowledge** – Describes what relationship exists between concepts/ objects.

Types of Knowledge

- Procedural knowledge is compiled knowledge related to the performance of some task.
- Example: To solve the algebraic equations.

- Declarative knowledge is the passive knowledge expressed as statements of facts about the world.
- Example: Personnel data in a database.

Types of Knowledge

- **Heuristic knowledge** is a special type of knowledge, which is used by human to solve complex problems.
- Examples: Good judgments, tricks, rules of thumb.

Meta Knowledge

- **Meta Knowledge** is knowledge about knowledge.
- The term is used to describe things such as tags, models and taxonomies that describe knowledge.
- Several academic areas including bibliography, the study of books, the philosophy of knowledge, are also considered meta-knowledge.

Structural knowledge

- According to Jonassen (2000), **structural knowledge**, which connects declarative and procedural knowledge.
- **Structural knowledge** is knowledge of how the ideas within a domain are integrated and interrelated.
- Example: Ontology, epistemology, ethics, etc.

Some Terminology on Knowledge

- **Belief:** We define belief as essentially any meaningful and coherent expression that can be represented. Thus a belief may be true or false.
- **Hypothesis:** We define a hypothesis as a justified belief that is not known to be true.

  Thus , a hypothesis is a belief which is backed up with some supporting evidence, but it may still be false.
- **Finally, we define knowledge as true justified belief (Dan W. Petterson).**

Academic Disciplines required to understand AI.

• Philosophy	Logic, methods of reasoning, mind as physical system, foundations of learning, language, rationality.
• Mathematics/ Statistics	Formal representation and proof, algorithms, computation, decision theory, probability.
• Economics	utility, costing
• Neuroscience	neurons as information processing units.
• Psychology/ Cognitive Science	how do people behave, perceive, process information, represent knowledge.
• Computer engineering	building faster computers
• Control theory	design systems that maximize an objective function over time
• Linguistics	knowledge representation, grammar, programming languages

END TODAY

THANKS