Artificial Intelligence

Lecture - 10

Knowledge Representation

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Lecture Outlines

- …
- **Types of Knowledge**
- **Cycle of KR in AI**
- …

"All knowledge that the world has ever received comes from the mind; the infinite library of the universe is in our own mind. Books are infinite in number and time is short. The secret of knowledge is to take what is essential. Take that and try to live up to it."

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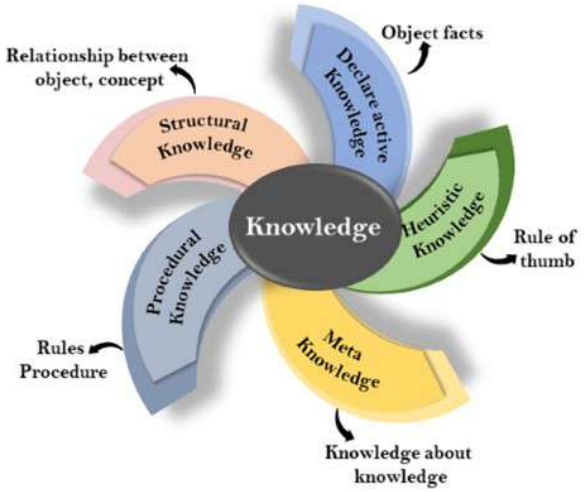
Swami Vivekananda

Types of Knowledge…

- Following are the various types of knowledge:
  1. Declarative Knowledge
  2. Procedural Knowledge
  3. Meta-knowledge
  4. Heuristic knowledge
  5. Structural knowledge

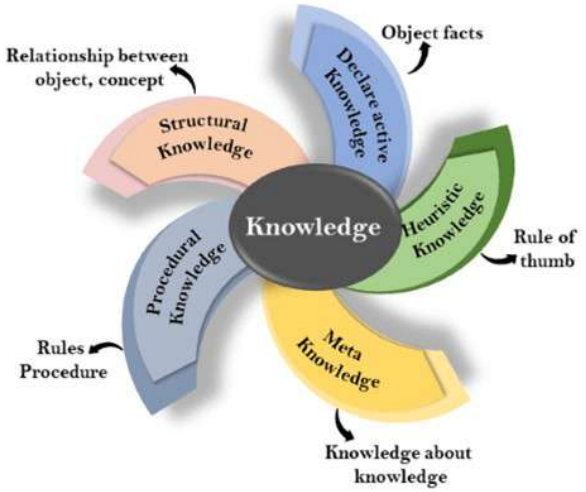
Types of Knowledge…

- **Declarative Knowledge:**
  - Declarative knowledge describes what is known about a problem or something.
  - This includes simple statements that are asserted to be either true or false. It is also called descriptive knowledge and expressed in declarative sentences.
  - It includes concepts, facts, and objects; a list of statements that more fully describes some object or concept.



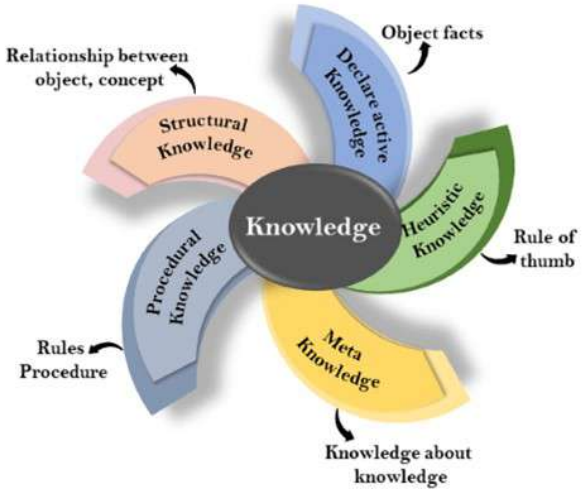
Types of Knowledge…

- **Procedural Knowledge:**
  - Procedural knowledge is also known as imperative knowledge.
  - This knowledge describes how a problem is solved. This type of knowledge provides direction on how to do something.
  - It can be directly applied to any task. It depends on the task on which it can be applied.
  - It includes rules, strategies, procedures, agendas, etc.



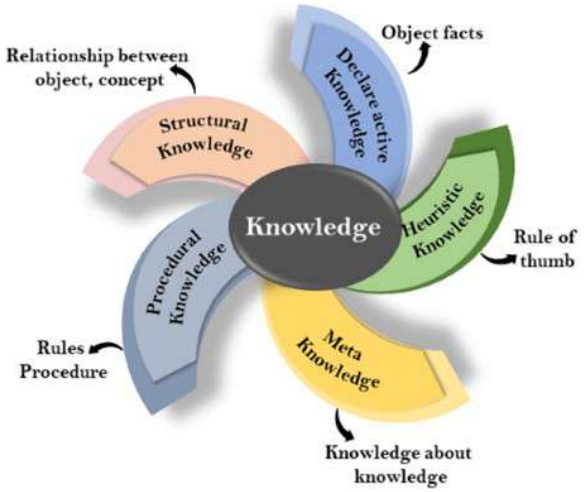
Types of Knowledge…

- **Meta-knowledge:**
  - Meta-knowledge describes knowledge about knowledge.
  - This type of knowledge is used to pick other knowledge that is best suited for solving a problem. Experts use this knowledge to enhance the efficiency of problem solving.
  - It includes knowledge about the other types of knowledge and how to use them.



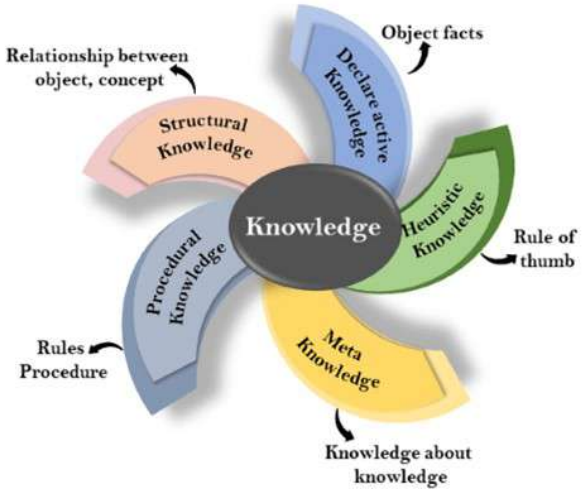
Types of Knowledge…

- **Heuristic knowledge:**
  - Heuristic knowledge is representing knowledge of some experts in a field or subject. That is, it represents the knowledge compiled by an expert through the experience of solving past problems.
  - Heuristic knowledge is often called shallow knowledge.
  - This knowledge is rules of thumb, (a broadly accurate guide or principle, based on practice rather than theory), based on previous experiences, awareness of approaches, and which are good to work but not guaranteed.



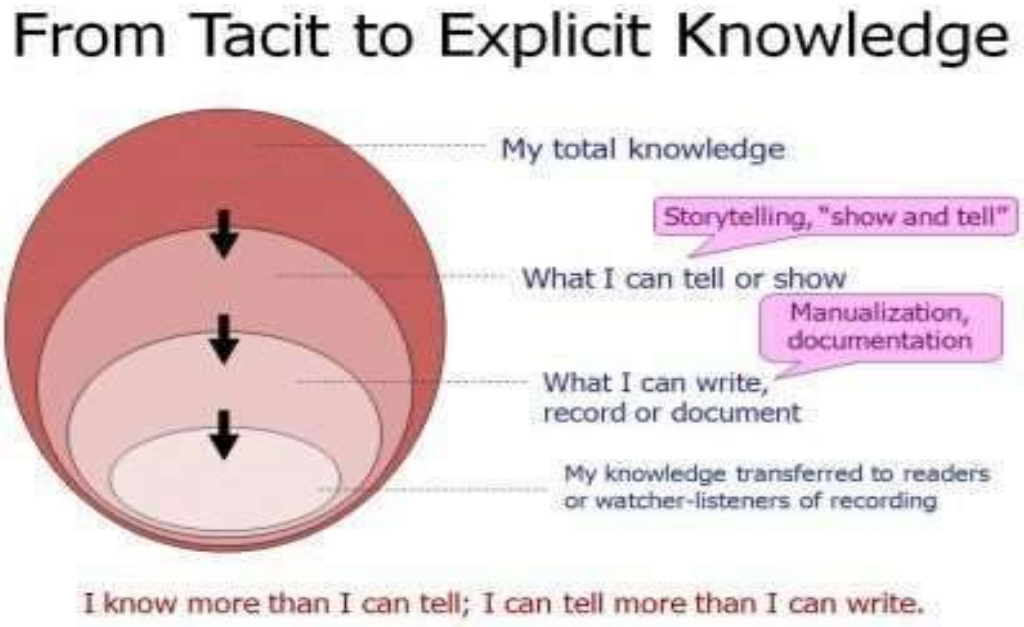
Types of Knowledge

- **Structural knowledge:**
  - It describes knowledge structures, that are the basic knowledge to problem-solving.
  - This type of knowledge describes an expert's overall mental model of the problem.
  - It includes rule sets and relationships between various concepts or objects.

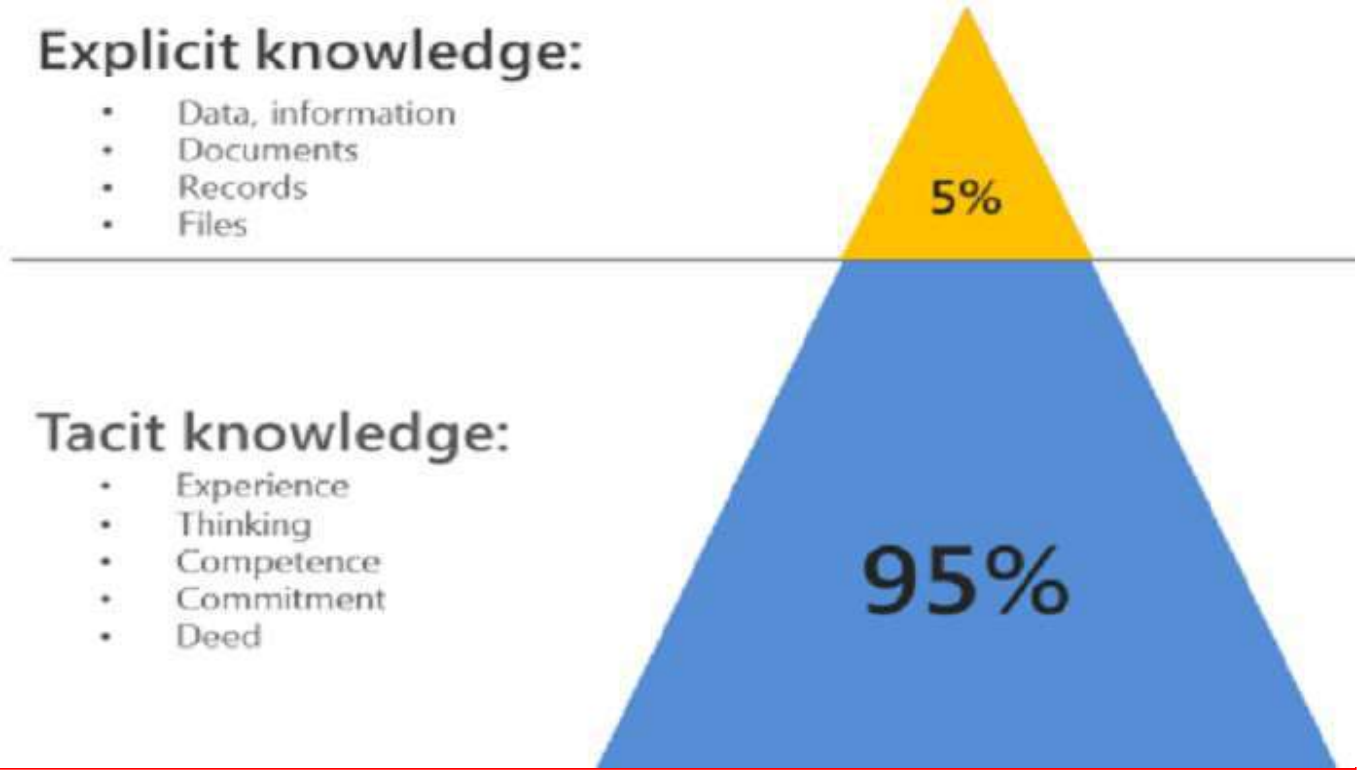


Tacit & Explicit Knowledge…

- The two main classes of knowledge differentiation are **Tacit and Explicit**. The terms "**Tacit**" corresponds to informal and "**Explicit**" corresponds to formal types of knowledge.
- Organizations must be able to capture the knowledge and experience of their employees to be able to change their **Tacit Knowledge** into **Explicit Knowledge**, so it can be used even after the employee is no longer with them.



Tacit & Explicit Knowledge…

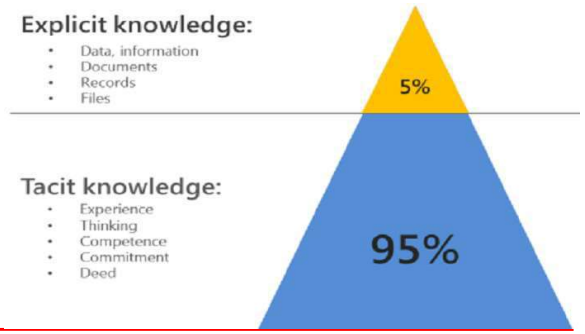


Tacit & Explicit Knowledge…

- **Tacit Knowledge:**

  "Tacit Knowledge is the knowledge of experience, tends to be subjective and physical. It is about 'here and now', relates to a specific practical context."

- **Characteristics of Tacit Knowledge:**
  - Tacit Knowledge is personal, known by an individual and is context specific;
  - It is highly experiential and difficult to document and communicate;
  - Tacit Knowledge sharing involves learning;
  - It cannot easily be codified but can only be transmitted via training & experiences;
  - It is about, 'know-how', 'know-what', 'know-why' and 'know-who'.
- **Examples:**
  - Hands-on skills, special know-how and experiences of employees;
  - Tips on dealing with a difficult challenge;
  - Feedback from customers over the phone;
  - Best practices of the most prolific sales person;
  - Opinion expressed by management.

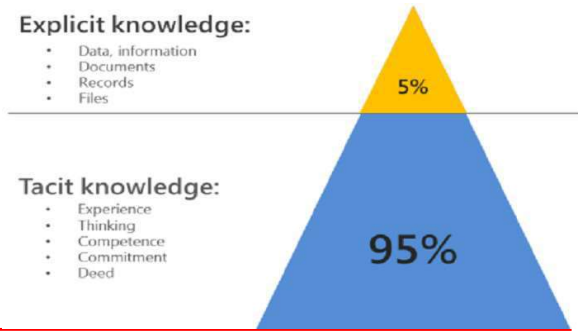


Tacit & Explicit Knowledge

- **Explicit Knowledge:**

  "Explicit Knowledge of rationality and trends to be metaphysical and objective, often relates to past events or objects 'there and then', oriented towards a context free theory."

- **Characteristics of Explicit Knowledge:**
  - Explicit Knowledge is more formal and context independent;
  - It is easily shared and reproducible;
  - It can easily be codified, documented, transformed and conveyed in systematic way.
- **Examples:**
  - Documented work, Procedures and Policies;
  - Operating procedure for a job;
  - Contacts of potential customers in the database;
  - Formal customer complaints and suggestions; and
  - Code of conducts for the organization.



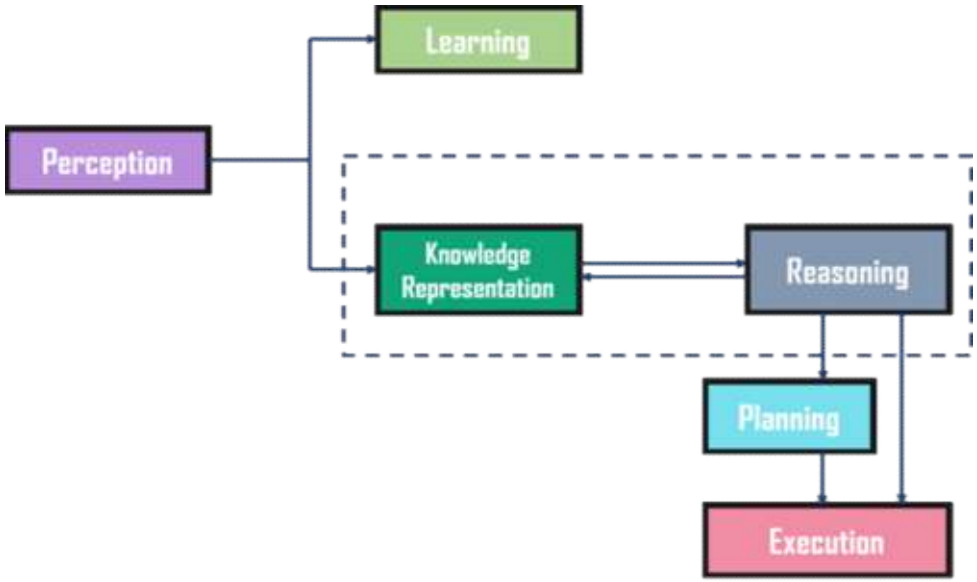
Commonsense Knowledge

- Our ability of answering questions intelligently relies heavily on general knowledge about the world; and the general knowledge about the world and relations that hold in the world is referred to as commonsense knowledge.
- Commonsense knowledge:
  - a very large corpus of knowledge;
  - helps us to understand things like:
    - A pen can fit in the box
    - A box can fit in the pen

Cycle of Knowledge Representation in AI…

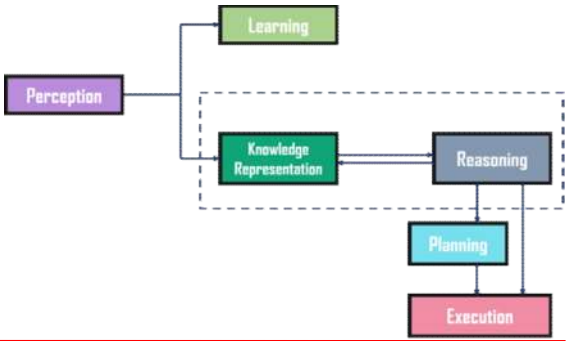
- Artificial Intelligent Systems usually consist of various components to display their intelligent behavior. Some of these components include:
  - **Perception**
  - **Learning**
  - **Knowledge Representation & Reasoning**
  - **Planning**
  - **Execution**
- Here is an example to show the different components of the system and how it works:

The diagram shows the interaction of an AI system with the **real world** and the **components** involved in showing intelligence.



Cycle of Knowledge Representation in AI

- The **Perception component** retrieves data or information from the environment. Also, it defines how to respond when any sense has been detected.
- Then, there is the **Learning Component** that learns from the captured data by the perception component. The goal is to build computers that can be taught instead of programming them.
- The main component in the cycle is **Knowledge Representation and Reasoning** which shows the human-like intelligence in the machines. Knowledge representation is all about understanding intelligence. Also, it defines how automated reasoning procedures can make this knowledge available as needed.
- The **Planning and Execution** components depend on the analysis of knowledge representation and reasoning. Here, planning includes giving an initial state, finding their preconditions and effects, and a sequence of actions to achieve a state in which a particular goal holds. Now once the planning is completed, the final stage is the execution of the entire process.



Knowledge Representation

TO BE CONTINUED…