

What is Knowledge?

- Knowledge can be defined as the body of facts and principles accumulated by humankind or the fact, or state of knowing. It is having a familiarity with language, concepts, procedures, rules, ideas, abstractions, places, customs, facts, and associations, coupled with an ability to use these notions effectively in modeling different aspects of the world.
- Knowledge-based systems may require thousands of facts and rules to perform their intended tasks. So the appropriate facts and rules be easy to locate and retrieve. Knowledge can be organized in memory for easy access by a method known as indexing.
- Decisions in knowledge-based systems needs manipulation of knowledge in specified ways.

Knowledge – Biological Organisms and Computers

- In biological organisms, knowledge is stored as complex structures (symbolic representation) of interconnected neurons.
- Human brain weighs about 3.3 pounds and contains an estimated number of 10^{12} neurons. The neurons and their interconnection capabilities provide about 10^{14} bits of potential storage capacity (Sagan, 1977).
- In computers, knowledge is stored as symbolic structures, but in the form of collections of magnetic spots and voltage states. State-of-the-art storage in computers is in the range of 10^{12} bits with capacities doubling every $\frac{3}{4}$ years.

Unfortunately, there is still a wide gap between representation schemes and efficiencies!

Importance of Knowledge

Over the past few decades, several computer systems have been developed that can perform intelligence tasks such as diagnose diseases, understand human speech and so on. Artificial intelligence is the breakthrough of computer science explaining how it is possible for computers to reason and perceive. It concerns with the study and creation of computer systems that exhibit magnificent form of intelligence. People enjoy this wonderful field because it provides a means of new ideas for representing knowledge and building expert systems. It provides an exciting computational perspective on the mystery of intelligence.

Importance of Knowledge

- Essential for intelligent behavior
- To perform a complex robotic task
- To develop a plan to complete a sequence of intricate operations

Those who possess knowledge are called **experts.**

Different Kinds of Knowledge

Procedural

- Compiled knowledge related to the performance of some task.
- knowing how to do something.
- Steps required to solve an algebraic equation.

Declarative

- Passive knowledge expressed as statements of facts the world.
- Knowing that something is true or false.
- Personal data in a database.

Heuristic

- For good judgments, or strategies, tricks, additional knowledge.

More about Knowledge

- **Belief:** Any meaningful and coherent expression that can be represented.
- **Hypothesis:** A justified belief that is not known to be true.
- **Knowledge:** True justified belief.
- **Metaknowledge:** Knowledge about knowledge, i.e., knowledge about what we know.

Data, Information and Knowledge

- **Data:** A symbolic representation of facts, measurements, or observations. Data is what we collect and store. *Data is the 'raw material', the 'mess of numbers'.*
- **Information:** Meaningful data.
- **Knowledge:** A theoretical or practical understanding of a subject. Knowledge is what helps us to make appropriate decisions. *Knowledge is 'condensed' information. It is a concise presentation of previous experience.*

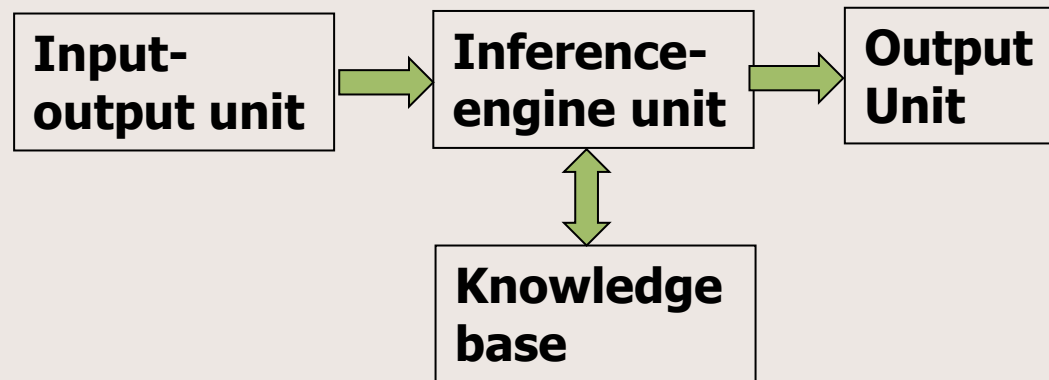
Knowledge should not be confused with data!

Example of Knowledge

- **Rita is tall:** Expresses a simple fact, an attribute possessed by a person.
- **Rafiq loves Rita:** A binary relation between two persons.
- **Liza has learned to use recursion to manipulate linked lists in several programming languages:** Expressing relations between a person and more abstract programming concepts.

Knowledge-Based Expert Systems

Expert systems are knowledge-based systems which contain expert knowledge and can provide an expertise, similar to the one provided by an expert in a restricted application area. For example, an expert system for diagnosis of cars has a knowledge base containing rules for checking a car and finding faulty elements, as it would be done by a specialized engineer.



Components of a knowledge-based system.

knowledge in Expert Systems

Conventional Programming

Algorithms
+ Data Structures
= Programs

Knowledge-Based Systems

Knowledge
+ Inference
= Expert System

Example of Expert Systems

Rule 1:

IF (Score is high) and (Viva is good or GPA is excellent)

THEN (Decision is Selected)

Rule 2:

IF (Score is low) and (Viva is bad or GPA is marginal)

THEN (Decision is Disapprove)

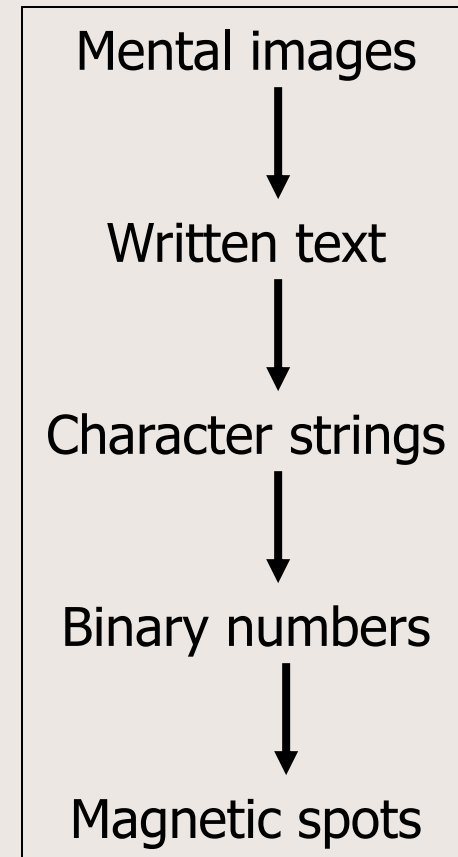
Rules as Knowledge Representation

IF 'traffic light' is green
THEN action is go

IF 'traffic light' is red
THEN action is stop

IF car is dead AND 'fuel tank' is empty
THEN action is 'refuel the car'

John is the father of Jim



Different levels of knowledge representation

FATHER(john,jim) : Representation of a fatherhood family relationship

Organization of Knowledge

- The fact or condition of knowing something with familiarity gained through experience or association.
- Acquaintance with or understanding of a subject.
- Facts and principles accumulated by human kind or the act, fact or state of knowing.
- Familiarity of with language, concepts, procedures, rules, ideas, abstractions, customs, associations.
- Coupled with an ability to use these notions effectively in modeling different aspects of the world.
- Knowledge is the perception about and understanding of a subject.
- Consists of facts, concepts, rules.

Manipulation of Knowledge

- Decisions and actions in knowledge-based systems come from manipulation of the knowledge in specified ways. Typically some form of input will initiate a search for a goal or decision. This requires that known facts in the knowledge-base be located, compared (matched), and possibly altered in some way.
- Manipulations are the computational equivalent of reasoning. All forms of reasoning require a certain amount of searching and matching.

Acquisition of Knowledge

- One of the greatest bottlenecks in building knowledge-rich systems is the acquisition and validation of the knowledge.
- Knowledge can come from various sources, such as experts, textbooks, reports, technical articles, etc.