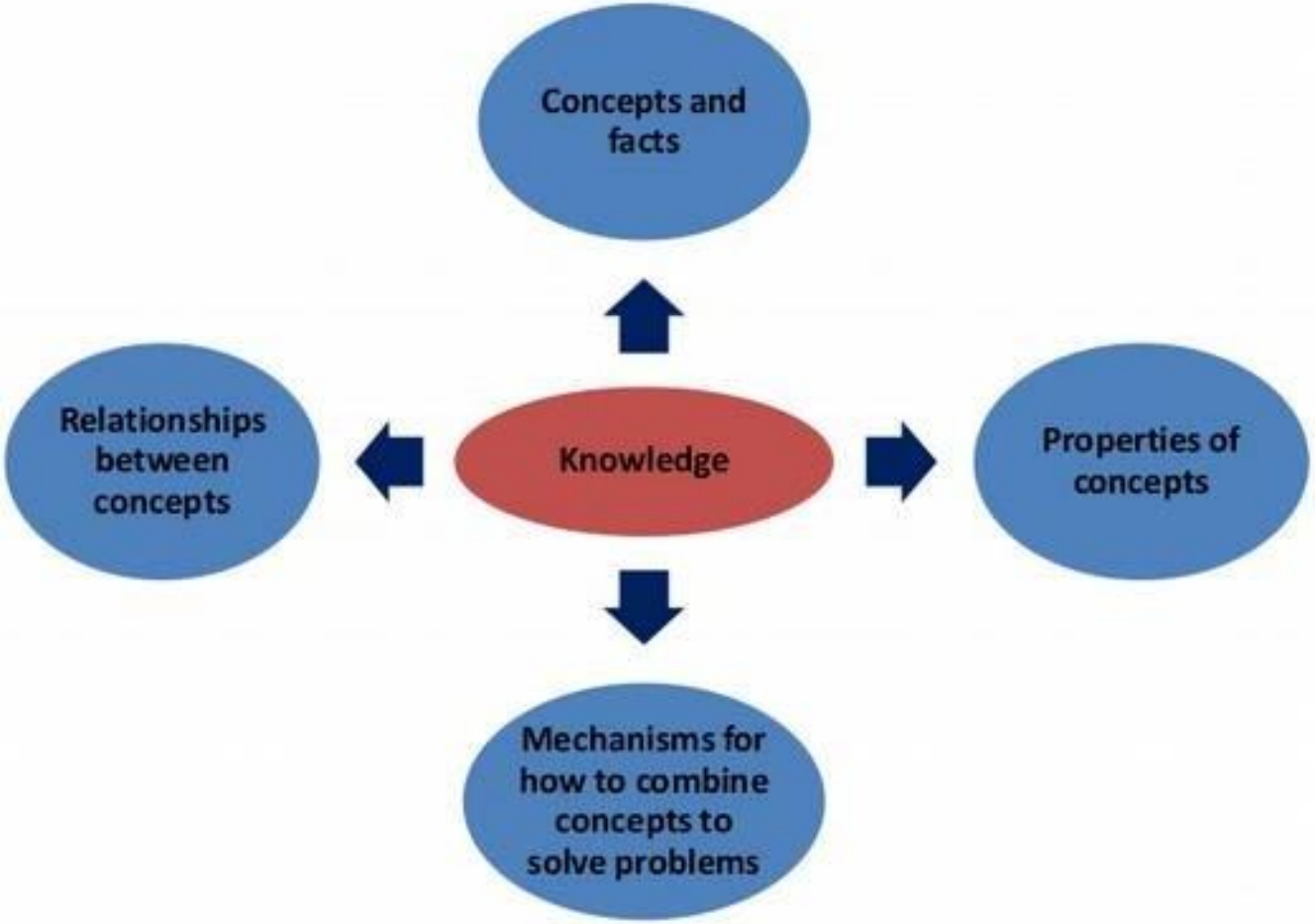
Introduction to Knowledge

What is Knowledge?

- Knowledge is understanding of a subject area.



Why do we need Knowledge Representation?

- Unlike human mind, computers cannot acquire and represent knowledge by themselves.
- It is complicated to machine process a knowledge represented in natural language.
- Human knowledge is of different types.
- Knowledge manipulation involves:
  - Knowledge acquisition: gathering, structuring and organizing knowledge.
  - Knowledge storing: putting the knowledge into computer.
  - Knowledge retrieval: getting the knowledge when needed.
  - Reasoning: gives conclusion, inference or explanation.

Declarative Knowledge

- It gives the simple facts about any organization or phenomenon.
- Declarative knoweldge means representation of facts
- The facts may be static facts or dynamic facts
- Static facts do not change with time e.g. in the college, location is permanenet
- Dynamic facts changes with time e.g. the new courses may be added in the curriculum

Procedural Knowledge

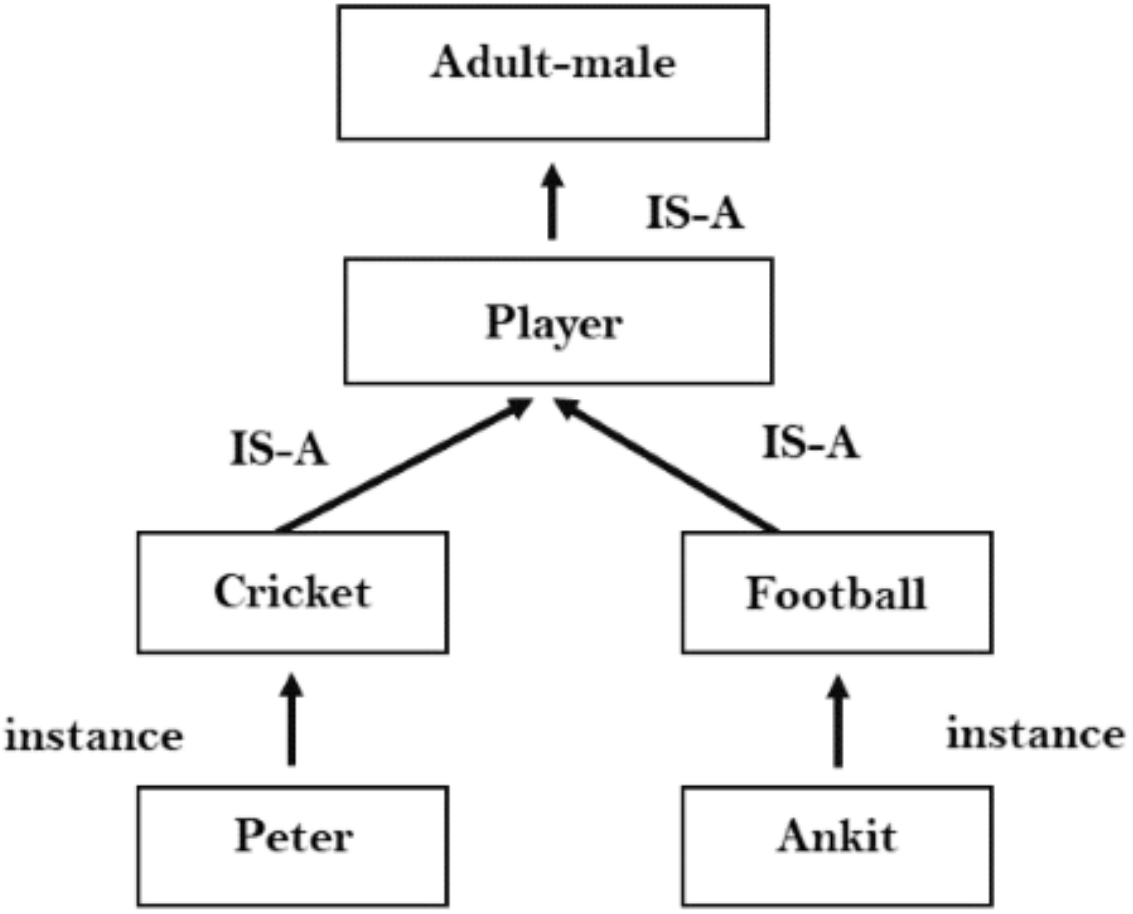
- The decalrative knowledge does not tell anything regarding functioning of the concerned object.
- E.g. It does not tell how a student is examined, how syllabus is framed, how fees deposit is made etc.
- The procedural knowledge represents the functioning of organization.
- It describes dynamic attributes using production rules,
- E.g.
- If: student has deposited fees and
  - student has opted a course and
  - student has attended 90% classes and
  - student has passed the examination

  - Then : declare the student pass

Inheritable Knowledge

- There are many situations where general concepts regarding some event, thing or activity are already known. And object of that particular type inherits all features of that event.
- E.g. College – College has some features like classrooms, teachers, a playground, building, students etc.
- Now, if we say ‘x’ is a college, then X will automatically inherit all the features of the college.
- It may be possible that X has some additional features.
- Here, the relationship ‘has’ indicates the salient features and ‘is a’ represents the variable.

Inheritable Knowledge



Relational Knowledge

- In this type of knowledge, the facts are represented as set of relations in a tabuetc.lar form.
- It can be used to answer simplest questions like “Who is tallest boy”

Player	Height	Weight	Bats
A	6-0	75	Left
B	5-10	65	Right
C	6-2	82	
D	6-3	80	

Heuristic Knowledge

- This type of knowledge can be defined as experimental, rarely discussed knowledge.
- Knowledge of good guessing is heuristic knowledge. Such type of knowledge can not be acquired from books, rather it comes from within the individual and differs from individual to individual.
- E.g. howmay runs the Indian Cricket team would score in a particular one day international match against Australia
- Heuristic knowledge is representing knowledge of some experts in a filed or subject.
- Heuristic knowledge is rules of thumb based on previous experiences, awareness of approaches, and which are good to work but not guaranteed.

Inferential Knowledge

- This method uses inference mechanism to use this knowledge.
- Predicate logic representation is also used to represent inferentia knowledge.
- The inference prodedures implement the standard logic rules o inference.

Common Sense Knowledge

- It is domain independent knowledge.
- It is gained by our experience.
- E.g. regarding the inheritable knowledge of college, the additional knowledge like the concept of preliminary school education, general idea about the concept of education etc.
- A person gains this knowledge, knowingly or unknowingly throughout his life.
- It is the knowledge, which is most difficult to represent and code.

Explicit Knowledge

- Explicit knowledge is the one which an individual holds explicitly (Clear and Conscious Knowledge)
- This knowledge can be expressed clearly into formal language including mathematical expressions, grammatical statements, specifications, manuals etc.

Tacit Knowledge

- It is understood or not expressed in any conventional form.
- The form of knowledge an individual possesses about which he or she may or may not be aware of.
- This kind of knowledge is acquired by experience and involves intangible factors such as personal beliefs, perspective and the value system.

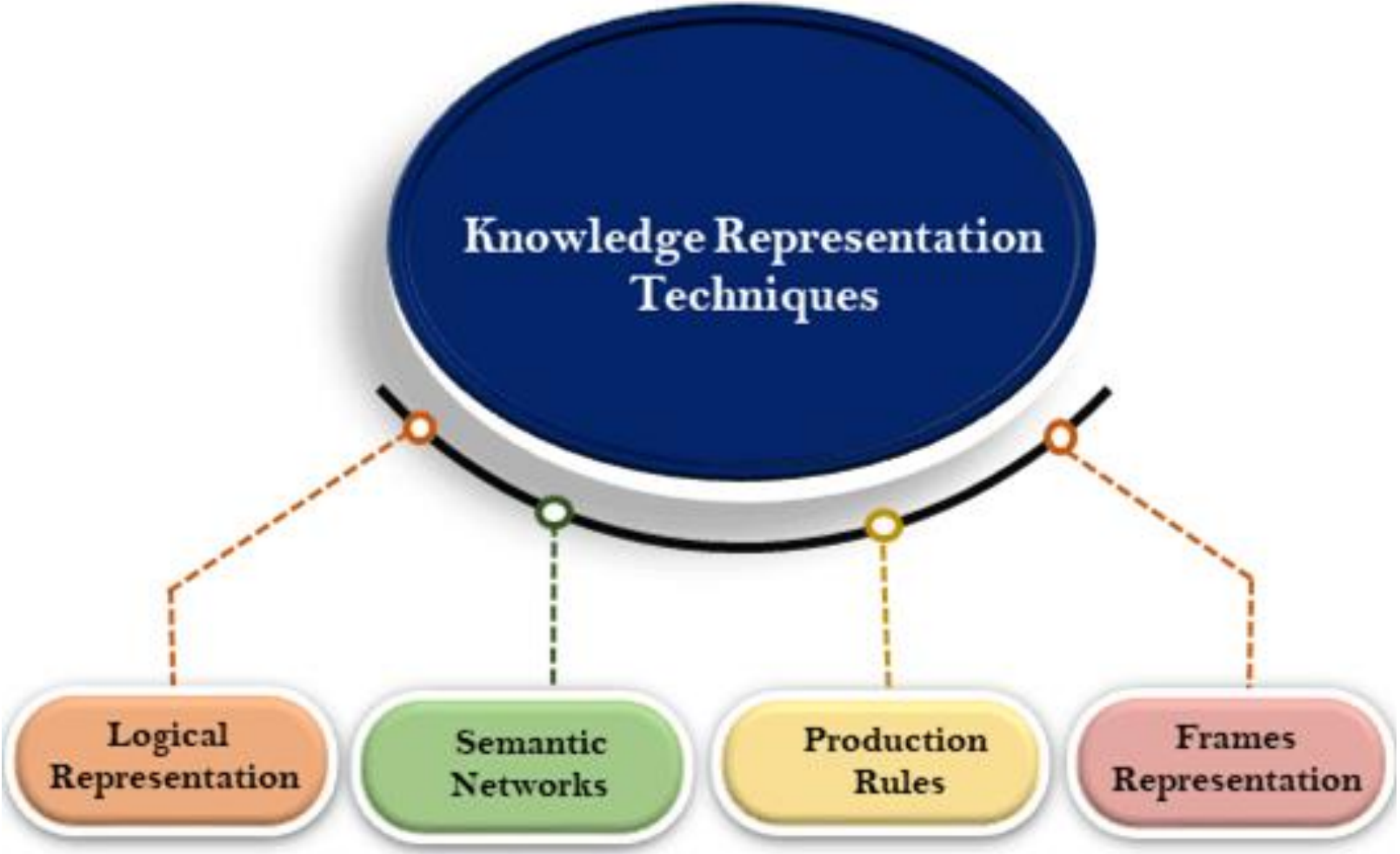
Uncertain Knowledge

- There is one more property of knowledge, that is, it is uncertain and usually incomplete.
- What we provide, is the information which is known to us. We provide the knowledge complete to the best of our capacity, but that is never absolutely complete.
- The real world phenomenon are highly uncertain.
- The kind of knowledge required to represent this is uncertain knowledge.

Techniques of Knowledge Representation

- There are mainly four ways of knowledge representation which are given as follows:

- Logical Representation
- Semantic Network Representation
- Frame Representation
- Production Rules


Knowledge Representation Techniques
Logical Representation
Semantic Networks
Production Rules
Frames Representation

Logical Representation

- Logical representation is a language **with some concrete rules** which deals with propositions and has no ambiguity in representation.
- Logical representation means **drawing a conclusion based on various conditions.**
- Each sentence can be translated into **logics using syntax and semantics.**
- Logical representation can be categorised into mainly two logics:

1)Propositional Logics

2)Predicate logics

Logical Representation

- **Syntax**:
- **Syntaxes are the rules** which decide how we can construct legal sentences in the logic.
- It determines which **symbol** we can use in knowledge representation.
- How to write those symbols.
- **Semantics:**
- Semantics are the rules by which we can interpret the sentence in the logic.
- **Semantic also involves assigning a meaning to each sentence.**

2. Semantic Network Representation

- Semantic networks are alternative of predicate logic for knowledge representation.
- In Semantic networks, we can represent our knowledge in the **form of graphical networks.**
- This network consists of nodes representing **objects and arcs which describe the relationship between those objects.**
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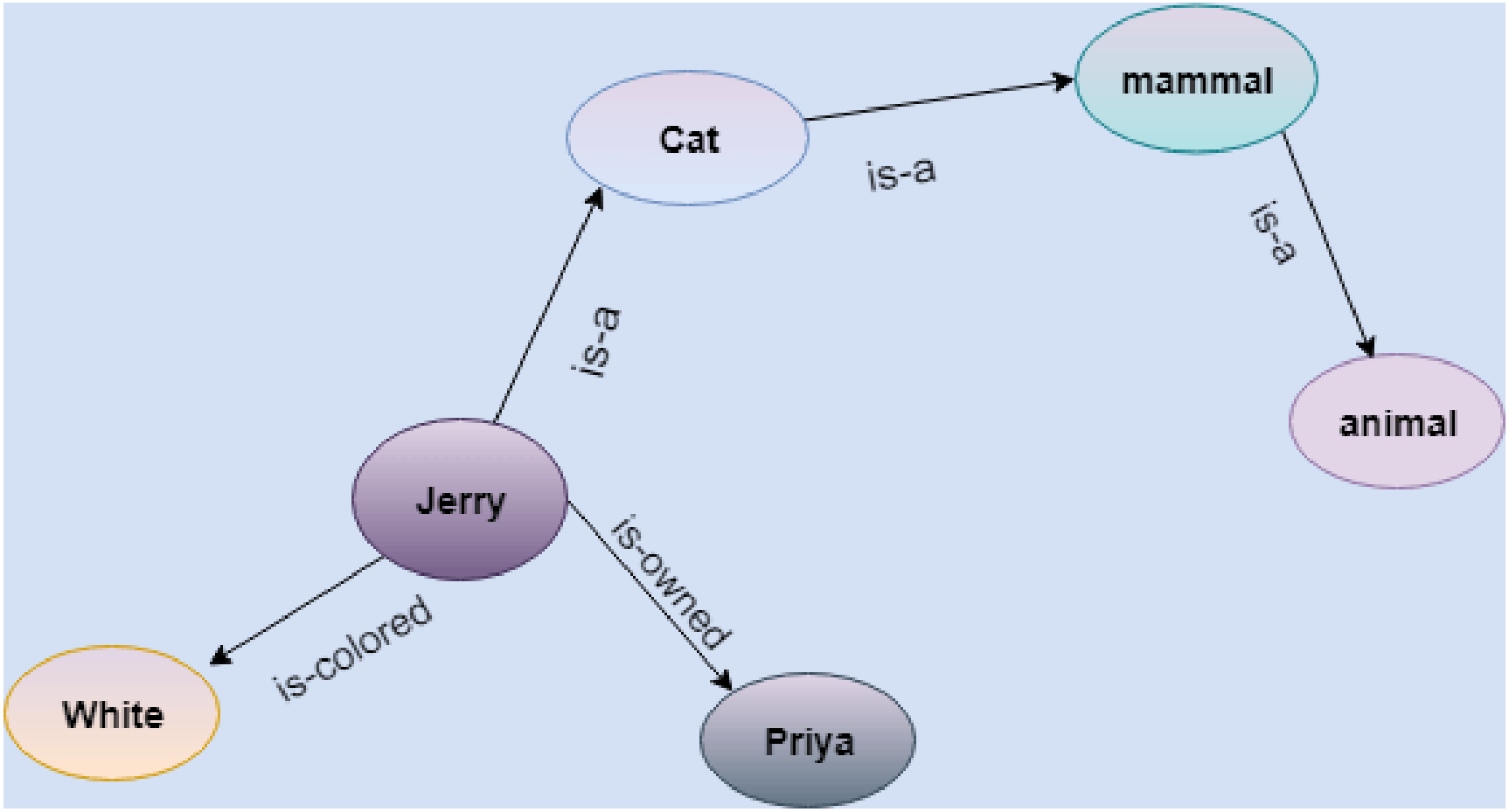
- **Statements:**
- Jerry is a cat.
- Jerry is a mammal
- Jerry is owned by Priya.
- Jerry is brown colored.
- All Mammals are animal.


Cat
mammal
is-a
is-a
animal
is-a
Jerry
is-owned
is-colored
White
Priya

3. Frame Representation

- A frame is a record like structure which consists of a **collection of attributes and its values** to describe an entity in the world.
- Frames are the AI data structure which divides knowledge into substructures by representing stereotypes situations.
- Slots have names and values which are called facets.

Slots	Filters
Title	Artificial Intelligence
Genre	Computer Science
Author	Peter Norvig
Edition	Third Edition
Year	1996
Page	1152

4. Production Rules

- Production rules system consist of **(condition, action) pairs** which mean, "**If condition then action**". It has mainly three parts:

- **The set of production rules**
- **Working Memory**
- **The recognize-act-cycle**
- In production rules agent checks for the condition and if the condition exists then production rule fires and corresponding action is carried out.
- The condition part of the rule determines which rule may be applied to a problem. And the action part carries out the associated problem-solving steps. This complete process is called a recognize-act cycle.

- Example:
- IF (at bus stop AND bus arrives) THEN action (get into the bus)
- IF (on the bus AND paid AND empty seat) THEN action (sit down).
- IF (on bus AND unpaid) THEN action (pay charges).
- IF (bus arrives at destination) THEN action (get down from the bus).

Basic Components of Knowledge

- Set of data
- A Form of belief or hypothesis
- Kind of information

As Set of Data

- Knowledge is different from data.
- Data is **raw form of observations**
- **Knowledge is organised form of data and procedures which can be used for some useful purposes**.

  Eg: Physician treating a patient
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As form of belief of hypothesis

- **Knowledge is different from belief and hypothesis.**

  Belief is any meaningful coherent expression that can be
- expressed.

  Belief may be true or false.

- **Hypothesis is a belief that is backed with some**
- **supporting evidence but it may still be false.**

  Knowledge is true justified belief.

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As kind of Information

- **Information is data plus meaning of the same.**
- When information is capable of creating more information and can become part of some action then it falls in the category of knowledge.

- **Knowledge is information about objects, concepts and relationships that are assumed to exist in a particular area of interest.**

What is Knowledge?

- Difference between data, information and knowledge:
  - Data: Primitive verifiable facts. Example: name of novels available in a library.
  - Information: Analyzed data. Example: The novel that is frequently asked by the members of library is "Harry Potter and the Chamber of Secrets".
  - Knowledge: Analyzed information that is often used for further information deduction. Example: Since the librarian knows the name of the novel that is frequently asked by members, s/he will ask for more copies of the novel the next time s/he places an order.

- Knowledge is richer, structured and more contextual form of information that is required to perform the task of problem solving.
- knowledge are:
  - Understand knowledge
  - Use knowledge for decision making
  - Recognise objects through vision
  - Interpret situations
  - Plan strategies