

Artificial Intelligence(AI)

section4

Knowledge Representation

- 1) knowledge ,Relationship(knowledge,AI)?
- 2) Types of knowledge ?
- 3) knowledge representation,approaches?
- 4) Techniques of KR ?

1) knowledge ,Relationship(knowledge,AI)?

Knowledge is a familiarity, awareness, or understanding of a certain subject or domain, such as facts, information, descriptions, or skills, which is acquired through experience or education by perceiving, discovering, or learning.

Relationship(knowledge,AI):Human beings are good at understanding, reasoning and interpreting knowledge.

And using this knowledge, they are able to perform various actions in the real world. But how do machines perform the same (**solving problem ,conclusion**)

the main goal of knowledge representation is to enable intelligent agent.

2) Types of knowledge ?

Declarative knowledge :-

- refers to facts and information about a topic.
- Unlike other types of knowledge, declarative knowledge focuses on the 'what' as compared to the 'how' or 'why'.
- "knowing something is true or false"
 - can be represented as logic.
 - example: this course is ML,the sun rises from the east

procedural knowledge:-

- knowing how to do something,is the knowledge of goal or task .
- example: how to fix a watch,how to install windows

meta-knowledge:-

- is a knowledge about the knowledge we know
- Meta Knowledge is a very fundamental elements in artificial intelligence."more detailes about the knowledge"

heuristic knowledge:-

- process of gaining knowledge or some desired result by intelligent guesswork
- the clouds looks dark,may be rain.

Structural Knowledge :-

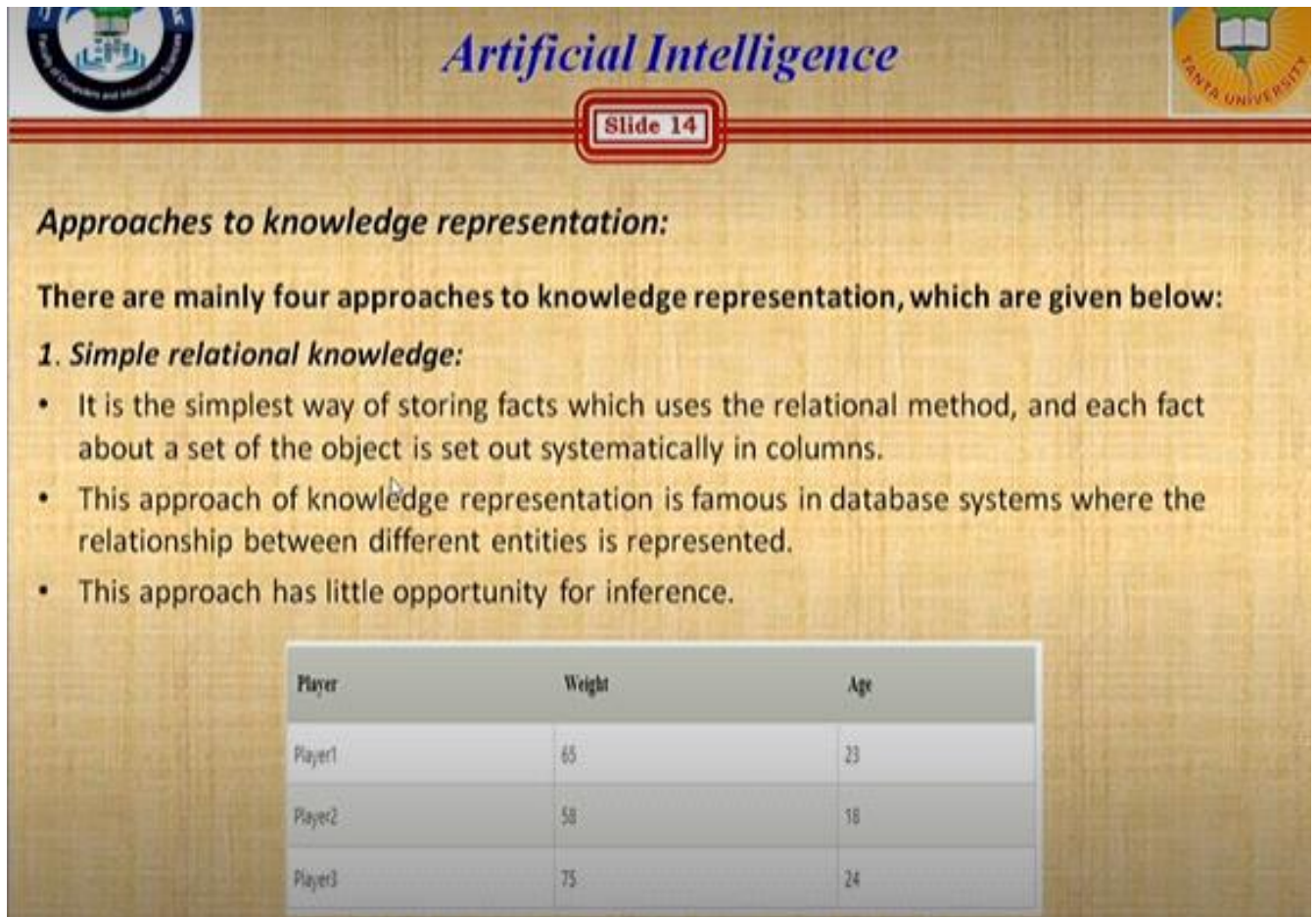
- It is a basic problem-solving knowledge that describes the relationship between concepts and objects.
- example: spatial relations, family relations.

3) knowledge representation,approaches?

knowledge representation:

- is a science of translating knowledge into a format that can be used by the computer, how to people store and manipulate information.

- **method of KR:** logic, rule "if...then", object



The slide is titled "Artificial Intelligence" in a blue serif font, centered at the top. To the left of the title is a circular logo with a building and text, and to the right is a yellow square logo with a book and the text "FANTA UNIVERSITY". Below the title, a red-bordered box contains the text "Slide 14". The main content area has a light beige background with a subtle grid pattern. It begins with the heading "Approaches to knowledge representation:" in bold. Below this, a paragraph states: "There are mainly four approaches to knowledge representation, which are given below:". This is followed by a sub-heading "1. Simple relational knowledge:" in bold. Under this sub-heading, there are three bullet points: "It is the simplest way of storing facts which uses the relational method, and each fact about a set of the object is set out systematically in columns.", "This approach of knowledge representation is famous in database systems where the relationship between different entities is represented.", and "This approach has little opportunity for inference." At the bottom of the slide, there is a table with three columns: "Player", "Weight", and "Age". The table contains three rows of data: Player1 with weight 65 and age 23, Player2 with weight 58 and age 18, and Player3 with weight 75 and age 24.

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Approaches to knowledge representation:

There are mainly four approaches to knowledge representation, which are given below:

1. Simple relational knowledge:

- It is the simplest way of storing facts which uses the relational method, and each fact about a set of the object is set out systematically in columns.
- This approach of knowledge representation is famous in database systems where the relationship between different entities is represented.
- This approach has little opportunity for inference.

Player	Weight	Age
Player1	65	23
Player2	58	18
Player3	75	24

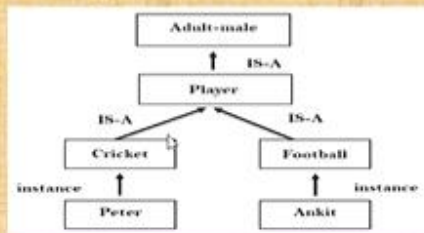


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2- Inheritable knowledge:

- In the inheritable knowledge approach, all data must be stored into a hierarchy of classes.
- All classes should be arranged in a generalized form or a hierarchal manner.
- In this approach, we apply inheritance property.
- Elements inherit values from other members of a class.
- This approach contains inheritable knowledge which shows a relation between instance and class, and it is called instance relation.
- Every individual frame can represent the collection of attributes and its value.
- In this approach, objects and values are represented in Boxed nodes.
- We use Arrows which point from objects to their values.



3. Inferential knowledge:

- Inferential knowledge approach represents knowledge in the form of formal logics.
- This approach can be used to derive more facts.
- It guaranteed correctness.

Example: Let's suppose there are two statements:

- Marcus is a man
- All men are mortal

Then it can represent as;

man(Marcus)

$\forall x = \text{man}(x) \text{ -----> mortal}(x)$

- For example, the sentence "If a bird is a cardinal then it is red" (associating the bird cardinal with the color red) can be written in predicate calculus:

$$\forall X (\text{cardinal}(X) \rightarrow \text{red}(X)).$$

This may be changed, through a series of truth-preserving operations, Chapter 2, into the logically equivalent expression

$$\forall X (\neg \text{red}(X) \rightarrow \neg \text{cardinal}(X)).$$

These two expressions have the same truth value; that is, the second is true if and only if the first is true.

Requirements for knowledge Representation system:

A good knowledge representation system must possess the following properties.

1. Representational Accuracy:

KR system should have the ability to represent all kind of required knowledge.

2. Inferential Adequacy:

KR system should have ability to manipulate the representational structures to produce new knowledge corresponding to existing structure.

3. Inferential Efficiency:

The ability to direct the inferential knowledge mechanism into the most productive directions by storing appropriate guides.

4. Acquisitional efficiency:

The ability to acquire the new knowledge easily using automatic methods.

- **Semantic network** developed by Collins and Quillian, their research on human information storage and response times (Harmon and King 1985).
 - classic representation technique for propositional information
 - Propositions – a form of declarative knowledge, stating facts (true/false)
 - Propositions are called “atoms” – cannot be further subdivided.
 - Semantic nets consist of nodes (objects, concepts, situations) and arcs (relationships between them).

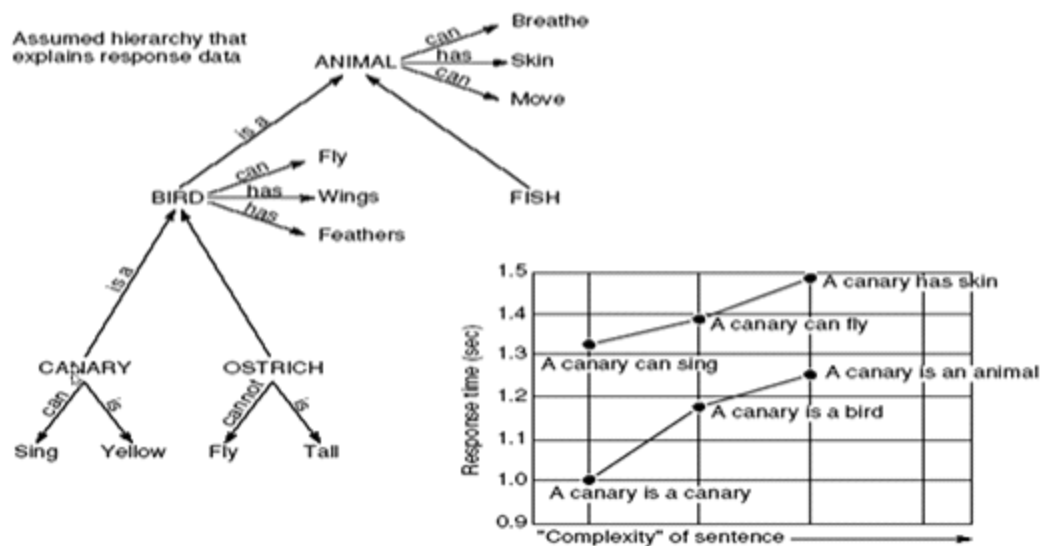
■ Definition

- Represent knowledge (store knowledge) as a **graph**
- **Nodes** (Rectangles) to represent objects, facts, concepts, and situations
- **Arcs** correspond to relations or associations between concepts (objects)
- Nodes and arcs are **labeled**

■ Properties

- Labeled arcs and links
- **Inference** is to find a path between nodes
- **Implement** inheritance
- **Variations** – conceptual graphs

- Figure 7.1 Semantic network developed by Collins and Quillian in their research on human information storage and response times (Harmon and King 1985).



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- Different inferences with given questions.
- The structure of this hierarchy was derived from laboratory testing of human subjects.
- The subjects were asked questions about different properties of birds, such as, "Is a canary a bird?" or "Can a canary sing?" or "Can a canary fly?".

