Al-Mustaqbal University
College of Science
Artificial Intelligence Sciences Department

Knowledge Representation Methods

Lecture 1

Introduction to Knowledge Representation
fundamentals and types

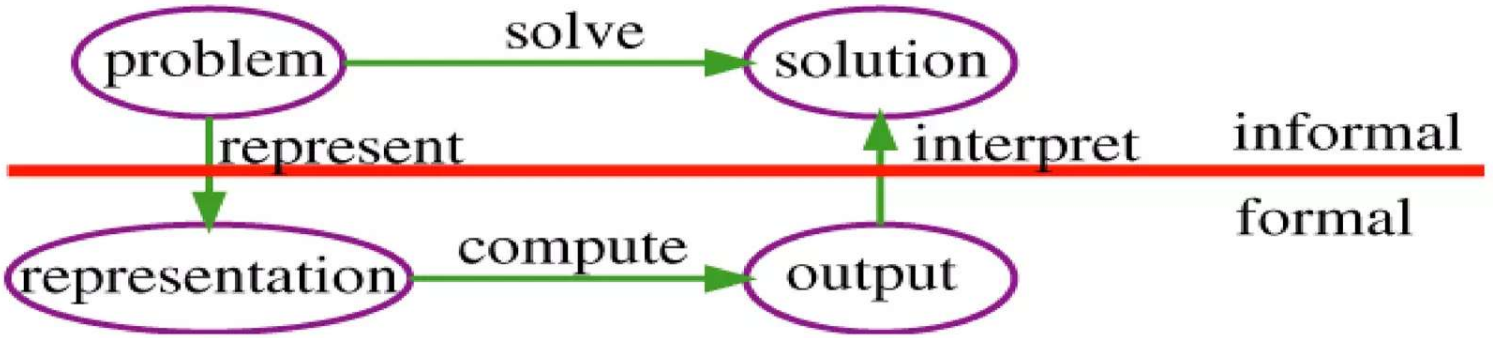
By
Asst. Lect. Ali Al-khawaja

What is knowledge?

- facts, information, and skills acquired through experience or education; the theoretical or practical understanding of a subject.
- Knowledge = information + rules
- EXAMPLE
- Doctors, managers.

What is Knowledge representation?

- Knowledge representation is a relationship between two domains.
- **Knowledge representation**(KR) is the field of **artificial intelligence** (**AI**) that representing information about the world in a form of computer system, that can solve complex tasks, such as diagnosing a medical condition.



TYPES OF KNOWLEDGE

- There are 5 types of knowledge.
- 1) Procedural k.
- 2) Declarative k.
- 3) Meta k.
- 4) Heuristic k.
- 5) Structural k.

1)Procedural Knowledge

- Gives information/ knowledge about how to achieve something.
- Describes how to do things provides set of directions of how to perform certain tasks.
- **Procedural knowledge**, also known as imperative **knowledge**, is the **knowledge** exercised in the performance of some task.
- It depends on targets and problems.
- Example
- How to drive a car?

2)Declarative knowledge

- Its about statements that describe a particular object and its attributes , including some behavior in relation with it.
- *"Can this knowledge be true or false*?"
- It is non-procedural, independent of targets and problem solving.
- Example
- It is sunny today and chemise are red.

3)Meta Knowledge

- It's a knowledge about knowledge and how to gain them.
- Example
- The knowledge that blood pressure is more important for diagnosing a medical condition then eyes color.

4)Heuristic Knowledge

- Representing knowledge of some expert in a field or subject.
- Rules of thumb.
- Heuristic Knowledge are sometimes called shallow knowledge.
- Heuristic knowledge are empirical as opposed to deterministic.

5)Structural Knowledge

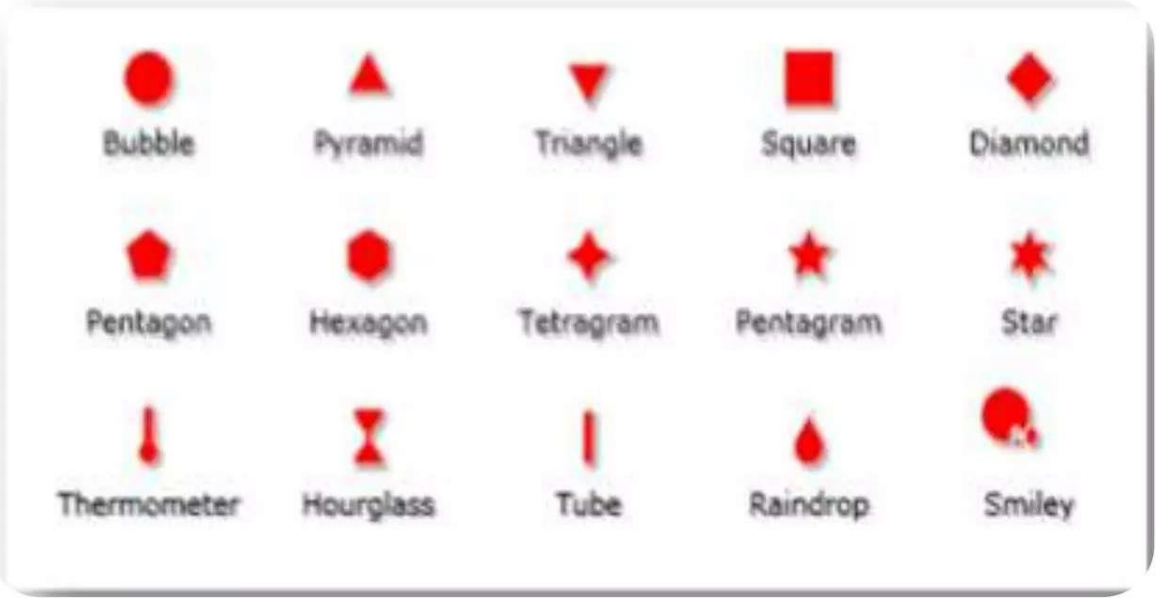
- Describes what relationship exists between concepts/ objects.
- Describe structure and their relationship.
- Example
- How to various part of car fit together to make a car, or knowledge structures in term of concepts, sub concepts and objects.

KNOWLEDGE REPRESENTATION

- There are multiple approaches and scheme that comes to mind when we begin to think about representation.
- 1)Pictures and symbols
- 2)Graphs and network
- 3)Numbers

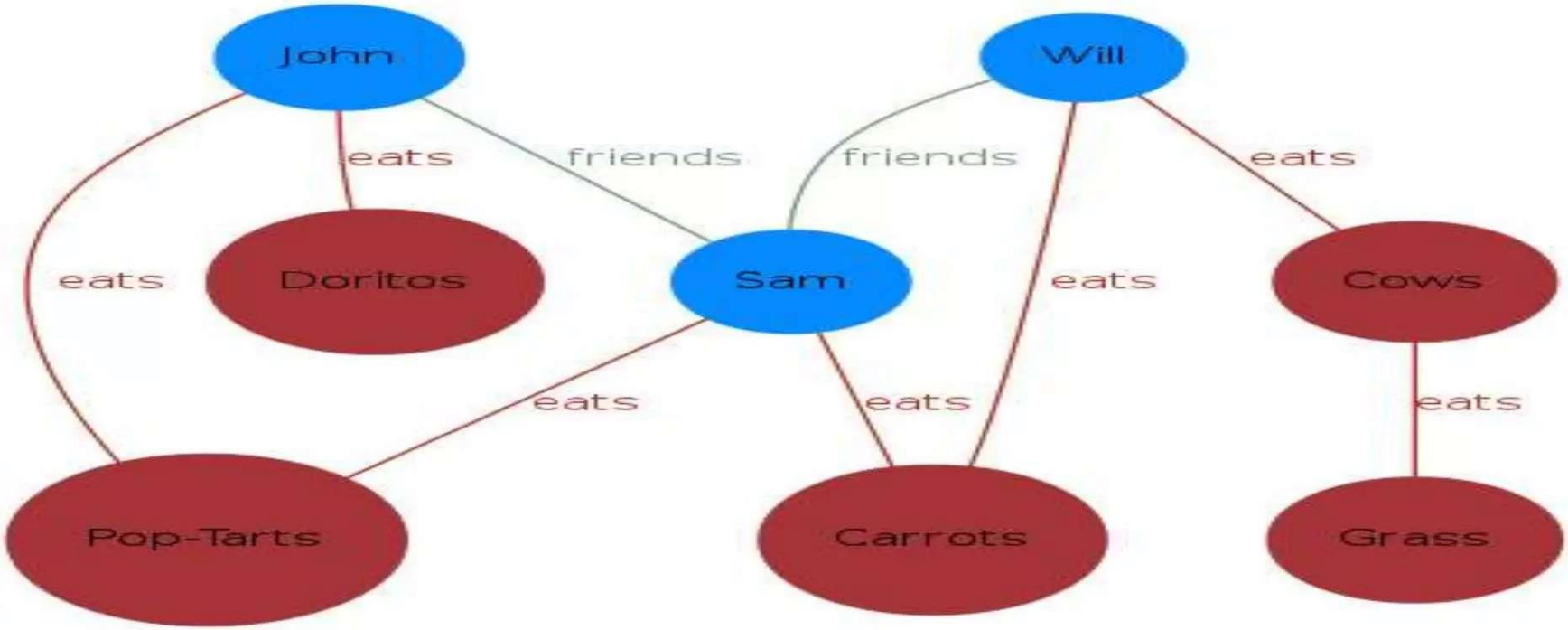
1)Pictures and symbols

- Pictorial representation are not easily translate to useful information is computer because computer can’t interpret pictures directly with out complex reasoning.
- Through pictures are useful for human understanding.



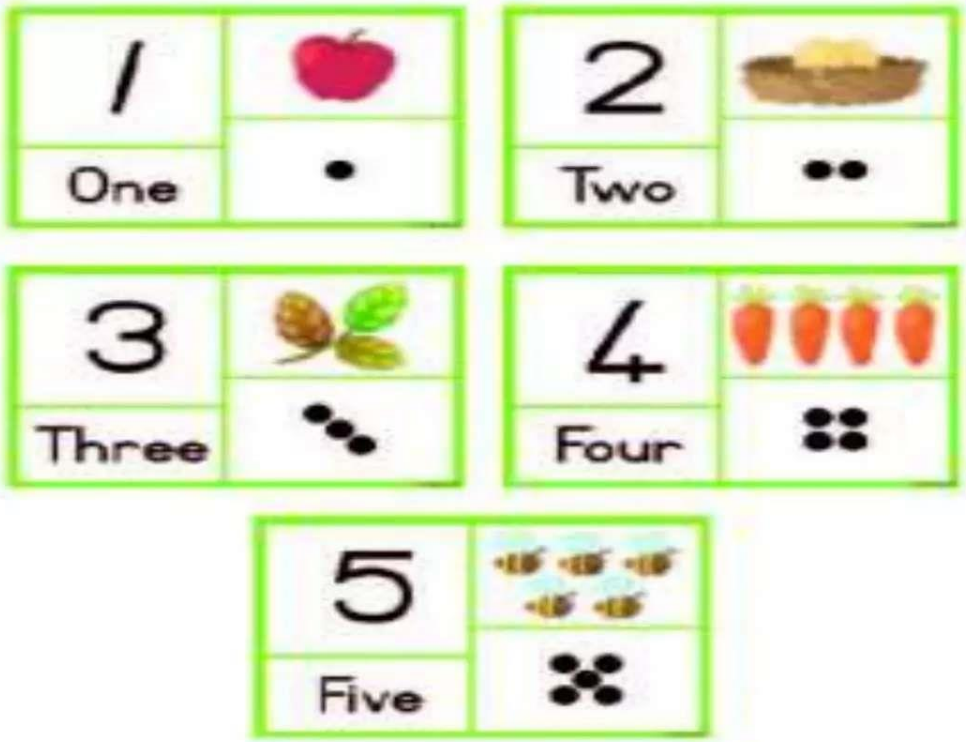
2)Graph and network

- Allows relationship between objects to be incorporated.
- We can represent procedural knowledge using graphs.



3)Numbers

- Numbers are an integral part of knowledge representation used by humans.
- Numbers translate easily to computer representation.



Types of knowledge representation

Basically 4 types of knowledge representation in AI

- 1) Logical representation
- 2) Production rule
- 3) Semantic networks
- 4) Frame representation

1)LOGICAL REPRESENTATION

- In order to give information to agent and get info without errors in communication.
- Logic is based on truth.
- There are 2 types of LR
- 1)propositional logic(PL)
- 2)first order predicate logic(FOL)

Propositional logic

- **Proposition :** A proposition is classified as a declarative sentence which is either true or false.

  eg: *1) It rained yesterday.*

- **Propositional symbols/variables**: P, Q, S, ... (**atomic sentences**)
- Sentences are combined by **Connectives**:

$\wedge$ ...and	[conjunction]
$\vee$ ...or	[disjunction]
$\Rightarrow$ ...implies	[implication / conditional]
$\Leftrightarrow$ ..is equivalent	[biconditional]
$\neg$ ...not	[negation]

- **Literal**: atomic sentence or negated atomic sentence

First-order Predicate Logic

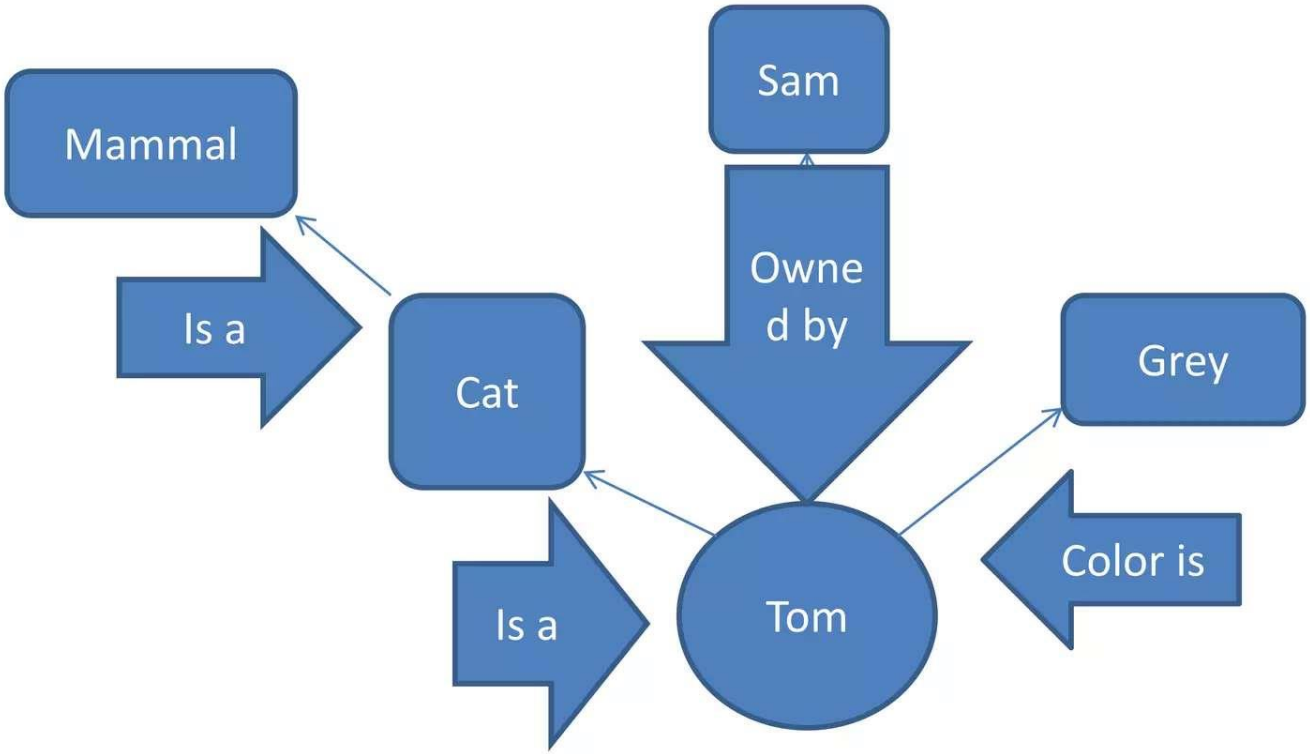
- First-order predicate calculus (FOPL) was developed by logicians to extend the expressiveness of Propositional Logic.
- It is generalization of propositional logic that permits reasoning about world entities (objects) as well as classes and subclasses of objects.
- Prolog is also based on FOPL.
- Predicate logic uses variables and quantifiers which is not present in propositional logic.

2) PRODUCTION RULE

- Consist of <condition,action>pairs.
- Agent check if a conditions holds then give a new situation(state).
- Production rule are belong to and same as propositional logic.

3) SEMENTIC NETWORK

- These represent knowledge in the form of graphical network.
- Example
- Tom is a cat
- Tom is grey in color
- Tom is mammal
- Tom is owned by sam


Mammal
Is a
Cat
Sam
Owne
d by
Grey
Is a
Tom
Color is

4) FRAME REPRESENTATION

- Frames are record like structures that consist of a collection of slots or attributes and the corresponding slot value.
- Slots have names and values called facets.

Thank you…