Knowledge Representation

Knowledge:

- Theoretical or practical understanding of a particular domain.

- In general, knowledge is more than just data, basically it consist of: facts, ideas, beliefs, humistics, rules, associations etc.

Classification of knowledge based on research literature:

1. classification based
2. Decision oriented
3. Descriptive
4. Procedural
5. Reasoning

Knowledge Representation:

- Process of capturing & encoding knowledge in a way that

Can be used by intelligent system.

- Simply, Method used to encode knowledge in intelligent system.

- Involves selecting appropriate representation language
- Defining the vocabulary

& Syntax of Language

- mapping the concept of Knowledge domain onto language.

- Goal of KR is to enable program to reason about the knowledge, make inferences & generate new knowledge.

Issues in KR from AI perspective

- How do people represent knowledge?
- What is the nature of knowledge & how do we represent it?
- Should a representation scheme deal with particular domain or should it be general?

- How expressive is a representation scheme or formal language.

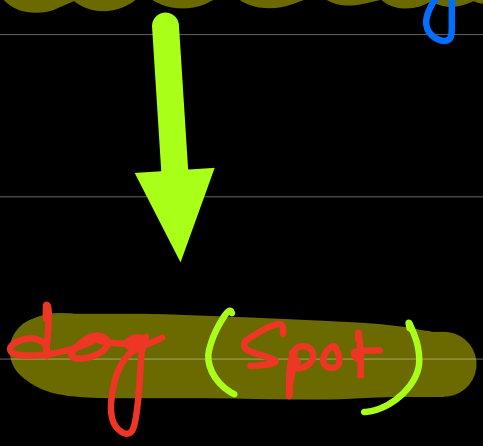
- should a representation scheme be declarative or procedural?

Example:

English language is an obvious way of representing & handling facts.

Logic enables us to consider the following facts:

- Spot is a dog



- Here, we could infer that all dogs have tails,

$$\forall x : dog(x) \rightarrow hastail(x)$$

- Furthermore, we can deduce:

$$hastail(spot)$$

Properties of KR systems:

- Representational Adequacy
  - ability to represent required knowledge

- Inferential Adequacy
  - ability to manipulate knowledge to produce new knowledge

- Inferential Efficiency
  - ability to direct the inferential mechanism in to most productive path
- Acquisitional Efficiency
  - ability to acquire new knowledge automatically whenever possible.

Types of KR system:

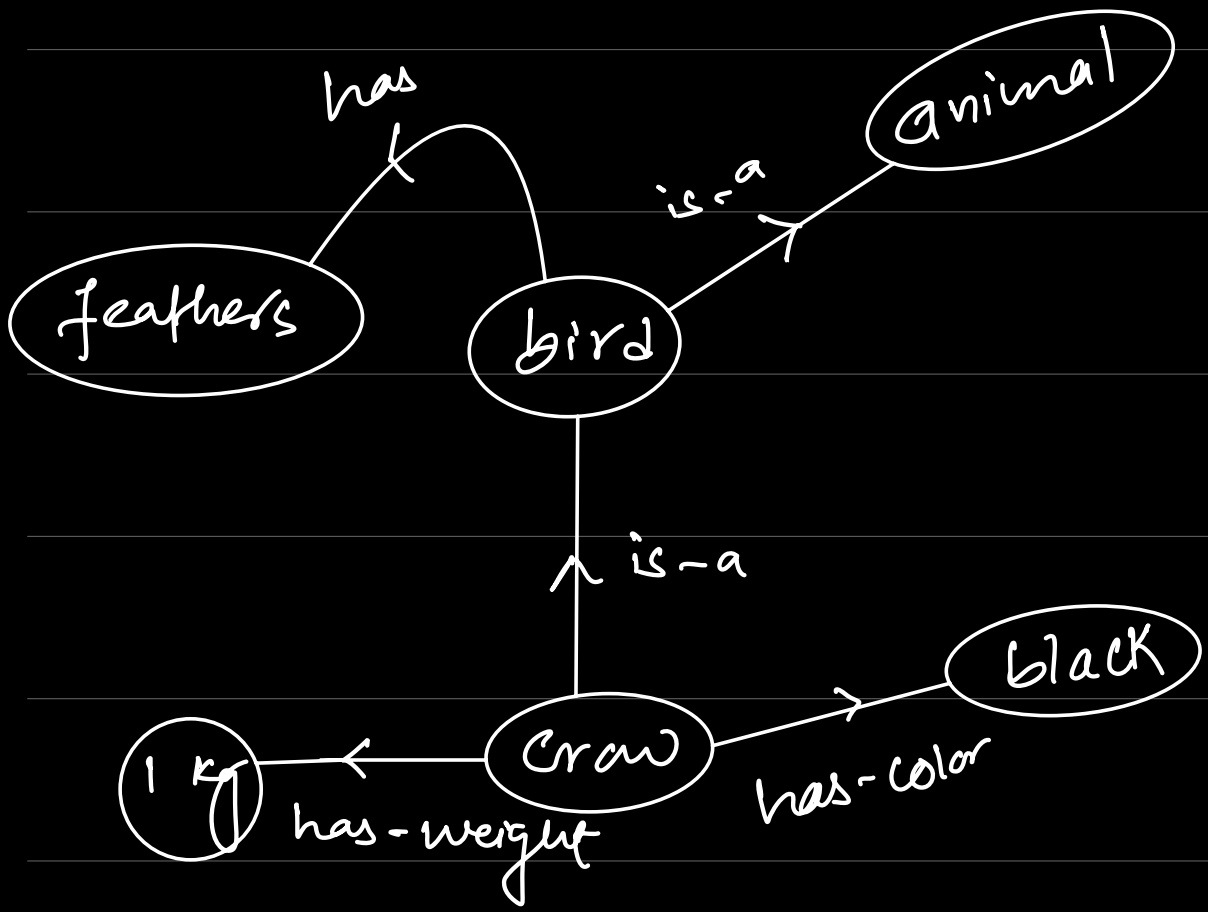
- Semantic Nets
- Frames
- Conceptual Dependencies
- Scripts
- Rule Based system
- Propositional logic
- Predicate logic

Semantic Nets:

- Graphical representation of knowledge in which nodes represent concepts & link represent relationship between them.

- For example:

All birds are animal.
Birds have feathers.
Crow is a bird.
Crow is black in color.
weight of crow is 1 kg.



- is-a : represent class/instance relation

- has-a : identify property relationship

Practice: Represent the following into semantic network

1. Birds are animals.

Birds have feathers.

Birds can fly.

Birds lay eggs.

Sparrow is a bird.

Eagle is a bird.

Black kite is an eagle.

2. Robin is a bird.

clyde is a Robin.

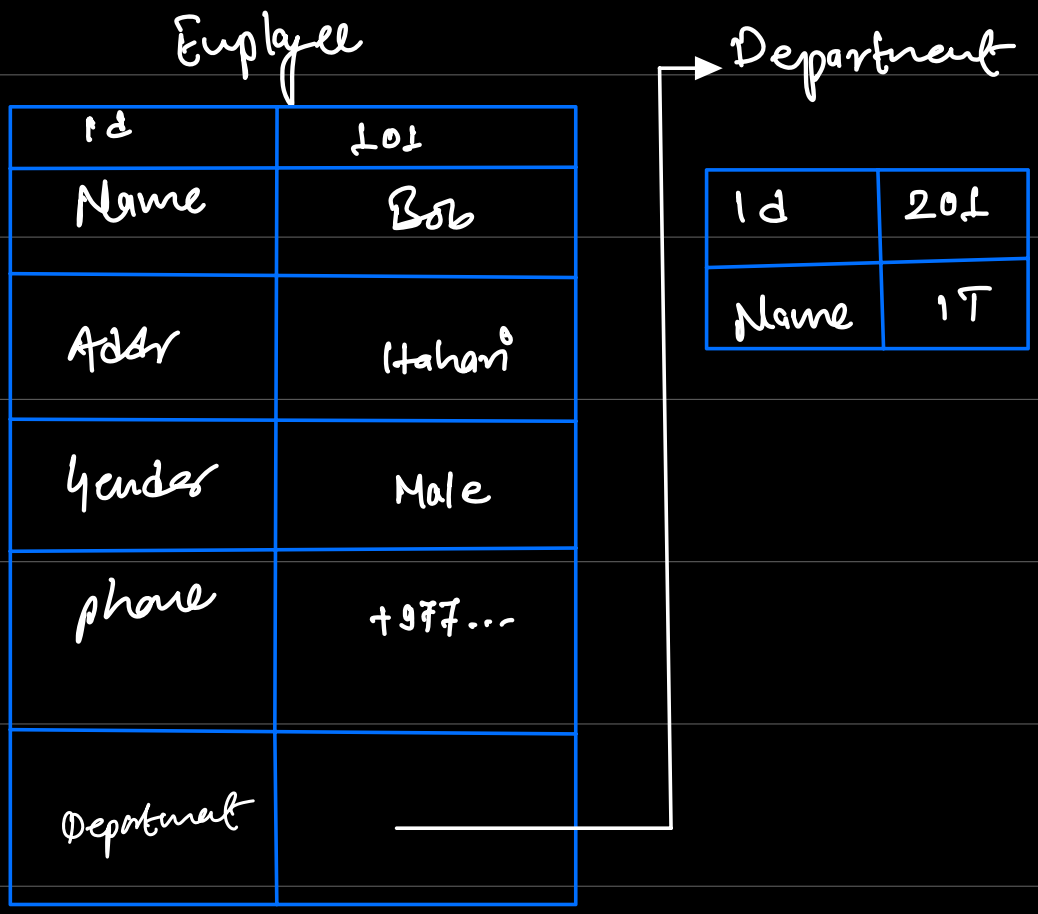
clyde owns a nest from spring 2023 to fall 2023.

Frames:

- It is a data structure
- It contains knowledge about object.
- Represent knowledge about real world entities.

- Each frames contains:
  - Frame object &
  - frame slots

For example:



- Slots includes attributes which define frame object

- slot also includes values associated

with five attributes.

Theory Assignment:

1. Study thoroughly about the following at your own.

- Semantic Network
- Frame
- Conceptual dependencies
- Script and
- Rule based system

Prepare a report for each of the

knowledge representation technique

dites above including the following:

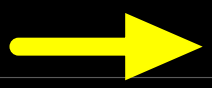
- Definition
- Example
- Advantages & disadvantages
- Types if there exist

Conceptual Dependencies:

- Theory of how to represent the knowledge about events contained in natural languages like english.

- It facilitates for drawing inference from sentence
- Representation of knowledge is independent of language

Following symbol are used to endow knowledge conceptually:

 Represent direction of dependency

 indicate link between actor & action

P indicate past tense

O indicate object case relation

R indicate Recipient case relation

F indicate future tense

Some examples of:

Conceptual dependencies primitives:

ATRANS: Transfer of abstract relation

eg. took, give, lend

PTRANS: Transfer of physical location of some object

eg. move

PROPEL: Application of physical force to object.

eg. pull, push

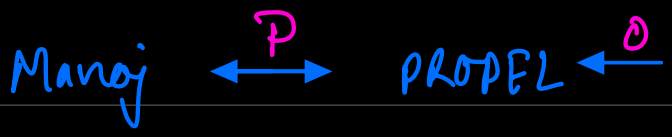
SPEAK : producing sound like say, speak

Conceptual categories:

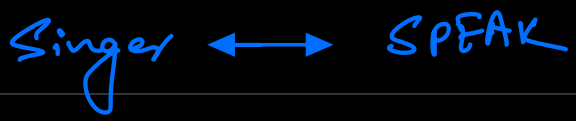
ACT	Represent	Action
PP	"	object (Picture)
AA	"	Modifier of action
PA	"	" " picture
T	"	Time
LOC	"	Locations

For example:

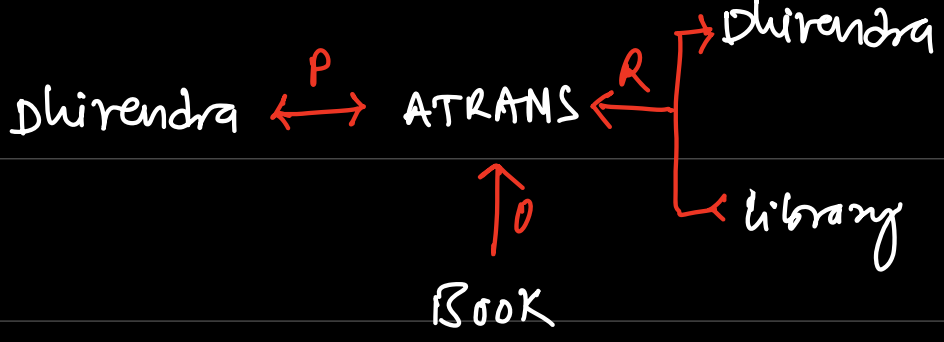
1. Manoj pushed door.



2. Singer is singing.



3. Dhirendra took book from library.



Rule Based System:

- This system applies human made rules to store, sort & manipulate data or facts.

- While doing so, this system mimics human intelligence.

- This system requires:
  - Set of facts or source data
  - Set of rules for manipulating data

Syntax:

IF <premise> THEN <action>