

UNIT-3

Building control algorithms for state space search

- 1) Production System
- 2) Blackboard Architecture

Production System

⇒ The production system is also called production rule system.

⇒ PS is a computer program typically used to provide solution to particular problem which concerned with AI.

⇒ There are mainly 3 things in PS

1) Production Rules

⇒ They are often simply called productions. The production rules are in the form of $C_i \rightarrow A_i$

here C_i is the conditional part where A_i is the action part.

Condition part occupies binary "The action part may primitive - action are done. The action part can call to another production rules also. Set of conditions execute

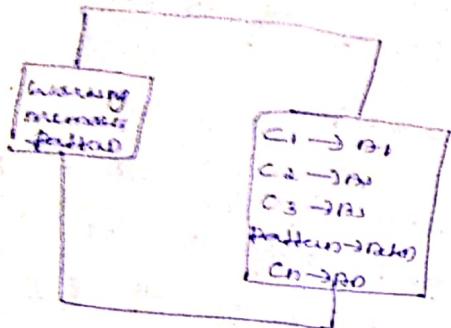
2) Working memory:

working memory contains description of the current state of the world in a reasoning process. i.e.
⇒ when rule you are taking in a reasoning process. etc
then that rule are putting into the main memory

3) The recognize-act cycle.

It forward chaining or blackboard chaining mechanism. The main idea is it control the working memory. There is one main concept process. These are strategy: others conflict resolution, there may be selecting a rule, there may be several applicable rule, which one should be select? The choice may

are based on conflict resolution strategy such as "most rule", "most specific rule", "most recent rule", "random", etc.



Features of production System

1) Simplicity: Production System English set of rules or each sentence is unique in the production system.

Simplicity: Due to use of the IF-THEN structure, each sentence is unique in the production system. The uniqueness makes the knowledge -

Representation: Simple production system can simple manners or complex manners.

a) Modularity

The available knowledge can be made discrete pieces which makes it easy to add, modify, or delete information without any side effect.

b) Modifiability:

This means one can add or modify rules.

c) Knowledge-intensive

The knowledge base of the production system stores pure knowledge. This part does not contain any type of control or programming information. Each production rule is normally unifies or uses English sentence.

Types of production systems

Monotonic production systems

In a monotonic PS

The use of one production system, the involvement of rule never prevent when both rules another rule are selected at the same time.

Non-monotonic PS

This production system increases the problem solving efficiency of machine by not keeping record of changes made in previous search process.

\Rightarrow If we not choose correct rule then don't not - backtrace to the correct rule.

Partially Commutative PS

In this PS if a set of rules used to change state A to state B. Then any allowable combination of these rule will also

produce the same results.

Commutative PS

Combination of both characteristic of monotonic PS.

partially Commutative PS.

Disadvantages

i) opacity: This problem generated by the combination of production rule. The opacity generated less or less production.

ii) generated by the opacity of rules.

iii) absence of learning: Rule based PS does not store the result of past problem for future use. Hence it does not exhibit any type of learning capabilities.

Blackboard Architecture

- ⇒ production System provide great flexibility by allowing us to represent multiple partial solutions simultaneously by en coexisting memory and select next state through conflict resolution.
 - ⇒ Black board extend production system by allowing us to organize working memory into separate module, each of which corresponds to a different subset of production rule.
 - ⇒ Black board underlay these separate sets of production rules and coordinate the actions of these multiple problem solving agents.
- Sometimes called knowledge sources, within a single global structure, the black board.
- ⇒ Many problems require the coordination of a no. of different type of agent.
- ⇒ The black board architecture is an model of control that has been applied other problems requiring the coordination of knowledge sources.
- There is a Central global object called Global blackboard.
-
- ```
graph TD; KSI[KSI] --> GB[Global blackboard]; VLSI[VLSI] --> GB; KSP1[KSP] --> GB; KSP2[KSP] --> GB;
```

## Conceptual graph

⇒ Conceptual graphs are semantic nets -  
representing the meaning of sentence in  
natural language

⇒ Conceptual graphs consist of  
concept nodes and relation nodes.

### Concept nodes:

The concept node represent entities,  
attributes, states and events.

Concept node represent entities.

1) Concrete Concepts: Such as eat, telephone,  
or Restaurant

2) Abstract concepts: including things  
such as love, beauty, and qualities  
that do not correspond to image  
in our mind.

The Conceptual nodes are  
represented in a  
square box

## ② Relation nodes (Represented in oval or circle)

The relation nodes show how the concepts are interconnected.

The relation nodes are already binary nodes.

Concept graphs are finite, connected, bipartite.

Finite: Because any graph can only have a finite no of concepts and any final relation.

Connected: because two parts that are not connected would simply be called ~~two~~ Conceptual graph.

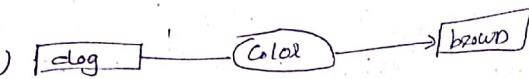
Bipartite: Because there are two different kind of nodes: Concept, Concept and Conceptual relations, and every one links a node of one kind to a node of another kind.

A relation of arity n is represented by a conceptual relation having n arcs.

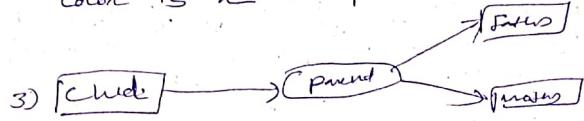
### Axity of Relation



File is an unary relation.



Color is a 2ary relation.

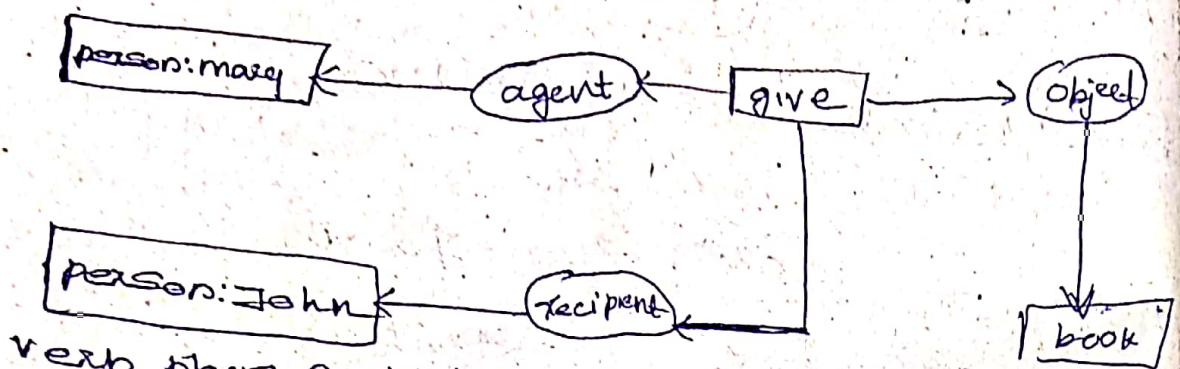


parent is a 3ary relation.

⇒ In Conceptual graph, (C), every concept is a unique individual of particular type. Each bar is labeled with a type label, which indicates the class of type of individual represented by that node.

⇒ Conceptual Graph allows nodes to be labeled simultaneously with the name of the individual - the node person and its type. The two are separated by a colon (":")

Graph of "Mary give John the book"

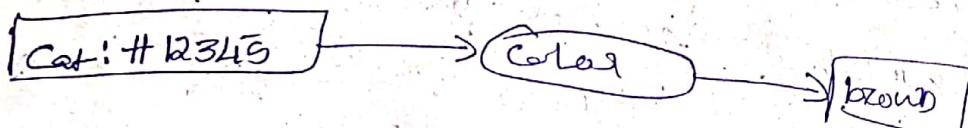


Verb plays central role in this sentence. The Verb "give" in this sentence has an agent, an object, a recipient.

Conceptual Node: Unnamed individual

Consider the example that we do not know the name of a cat that is brown. The unnamed cat is given a unique numbers (#)

Eg:



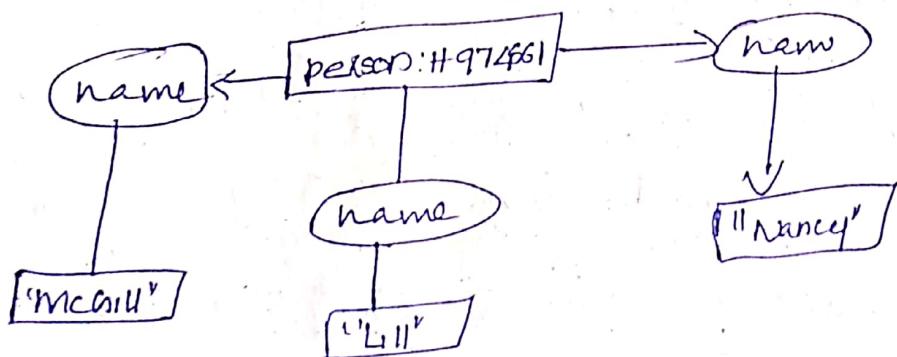
Concept node: multiple name.  
 we Subsequently record each name  
 for cat is called by student  
 name "Sylvestro", "Sugar pie" and  
 "Scruffy bed". The name enclosed  
 in double quotes refers to indicate  
 that it is a string.

```

graph LR
 Cat["Cat : #12345"] --> Name1("name")
 Cat --> Name2("name")
 Cat --> Name3("name")
 Name1 --> Sylvestro["\"Sylvestro\""]
 Name2 --> SugarPie["\"Sugar pie\""]
 Name3 --> ScruffyBed["\"Scruffy bed\""]

```

Conceptual graph of person with three name



## Generalisation and Specialisation

Conceptual graph functions are not specialised without creating new graph from existing graph. This allows us to generalise new graph by either specialising or generalising an existing graph.

There are mainly 4 operations:

\* Copy

\* Restriction

\* Join

\* Simplified

Assume that  $g_1$  and  $g_2$  are conceptual graphs

Copy: For a new graph exactly copied. It is same graph as  $g_1$  and  $g_2$ .

Restriction: It allows conceptual graphs. Concept nodes one graph to be replaced by nodes representing their specialisation.

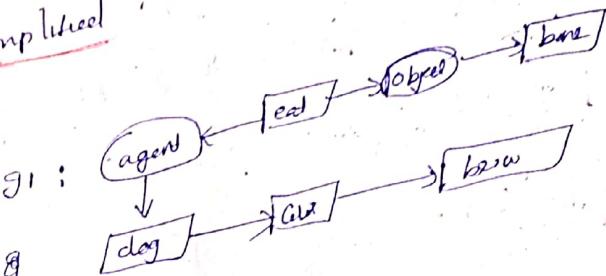
Graphs are built. Graph is labelled with generic names, generic models will be replaced by the functional names.

(a) A better label will be replaced by one of its subtypes.

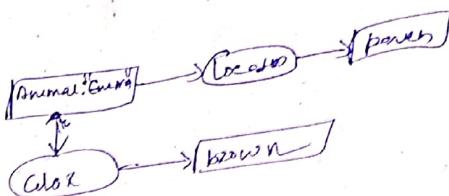
(b) Compone two graph by one simple graph.

(c) Join : Delete duplicate relations

eg:

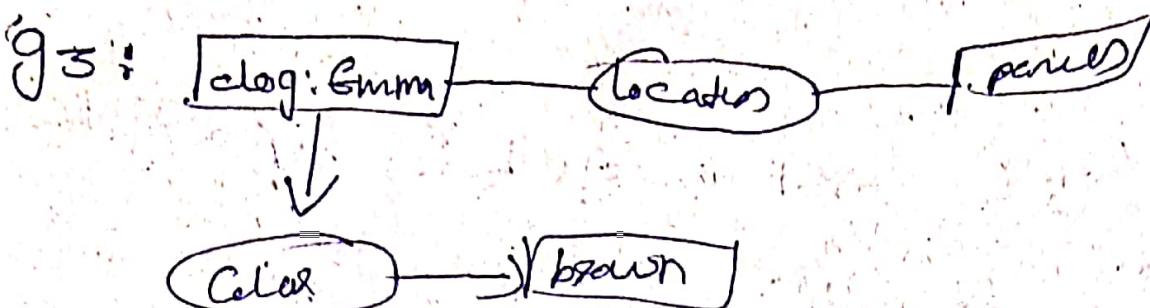


$g_2$ :



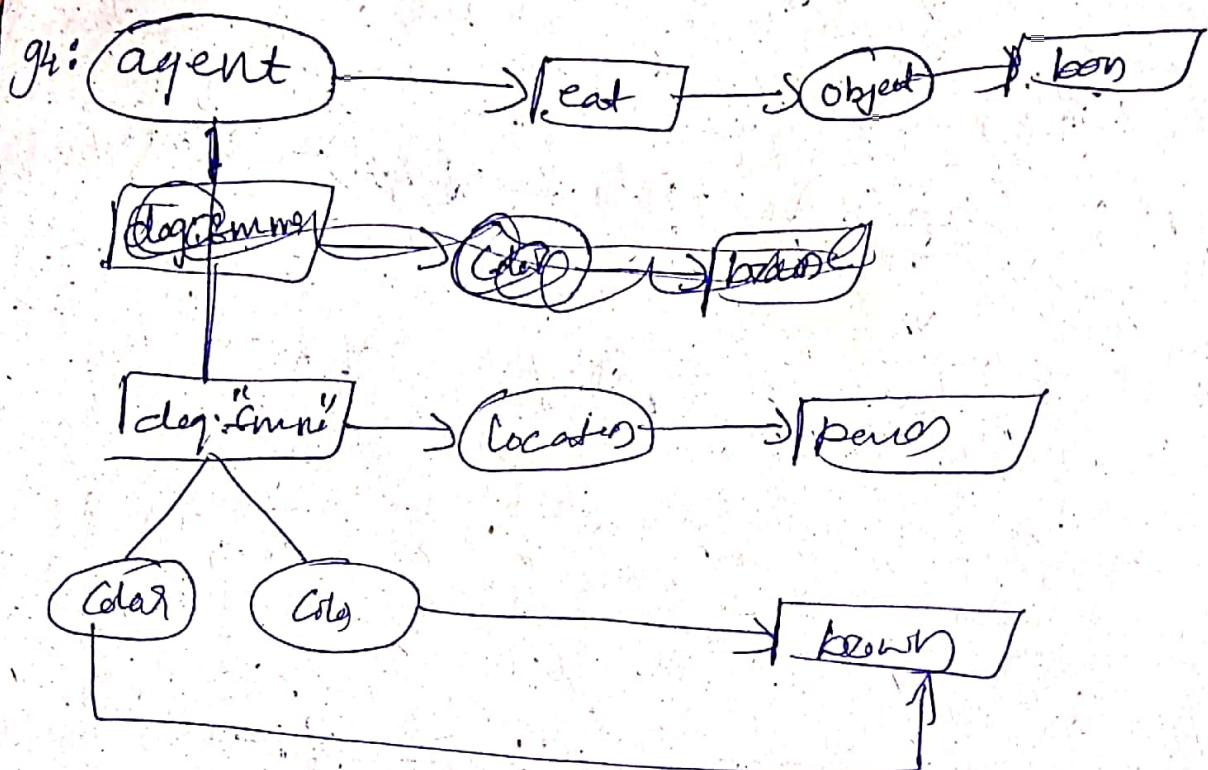
1) Copy: (g<sub>1</sub> and g<sub>2</sub> Copy)

2) Restriction of g<sub>2</sub>:

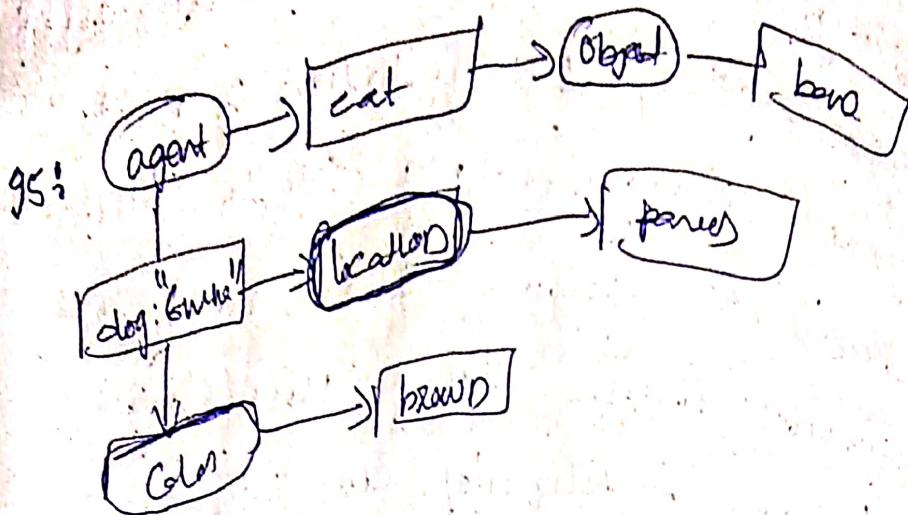


3) Join

The Join g<sub>1</sub> and g<sub>3</sub>



1) Simplified  
Simplified 94



## Knowledge Representation

### Knowledge

knowledge is a familiarity, awareness,  
or understanding someone or something. Such as facts, information, description; or skills, when is acquired through experience by observing, disagreeing or learning.

knowledge representation is -  
AI describes the representation of any knowledge. ~~Basically it is study of the how man believes~~ Human are best for understanding, reasoning, and interpreting knowledge. Humans can perform action based -

On knowledge. But how machine can access these things. Comes under knowledge representation and reasoning  
⇒ knowledge representation is bit more than storing data into database. It allows the machine to learn from that knowledge and behave intelligently like human being.

⇒ KR is responsible for representation of information about the real world. So that a computer can understand and can utilize this knowledge to solve the complex real world problems such as diagnosis in medical conditions or communicating with human in NL.

Following are the kind of knowledge which needs to be represented in AI system

Object: All the facts about object in our world domain

e.g.: Guitar contain String

Events: Events are actions which occur in our world

Performance: It describes behaviour.

Meta knowledge: The knowledge about knowledge

Facts: Facts are truths about real world and what we represent

Knowledge base: The Central

Component of knowledge based agents is the knowledge base. It represents KB.

Type of knowledge

i) declarative knowledge

\* Declarative knowledge know about something.

\* include concepts, fact, and object

\* If is also called descriptive knowledge and expressed in declarative sentence.

# Structure of knowledge

## Sentation

Mainly include

- \* Semantic network
- \* Script
- \* Frame
- \* Conceptual dependency

## Semantic Network

⇒ Semantic nw are alternative of predicate logic for knowledge representation

Sentation

⇒ In semantic nw we can represent our knowledge in the form of graphical nw

⇒ The nodes representing object in the world, and arrow representing relationship b/w those objects.

⇒ Semantic networks are easy to understand and can be easily understood.

→ The Semantic network representation  
consist of mainly two type of  
relations.

- \* IS-A Relation (Inheritance)
- \* kind-of relation

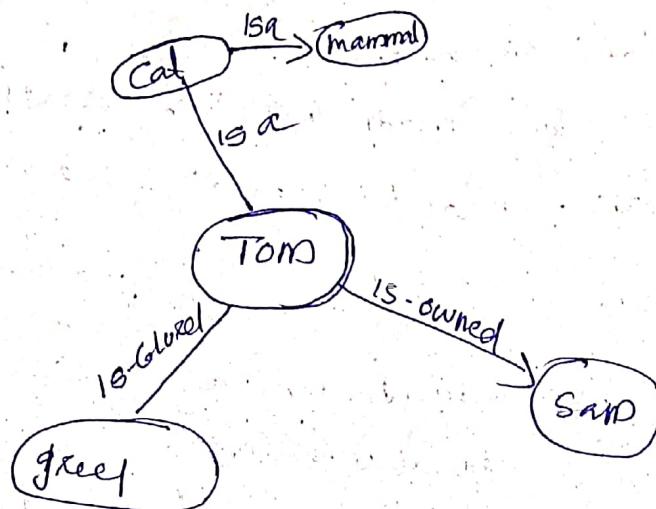
Eg:

Tom is a cat

Tom is grey or colored

Tom is mammal

Tom is owned by Sam



## Q1 Ppt

### Frame

⇒ Frame is a structure that records like a collection of attributes and values to describe an entity in the world.

⇒ These are the broad levels the divides knowledge into Substructure by representing them type situations.

⇒ It consists of collection of slots and slot values.

⇒ These slots may be of any type and size. Slots have names and values.

Frame representation is easy to understand and visualize.

⇒ It is very easy to add slots for new attributes or stations.

### Script

⇒ Script is a knowledge representation scheme similar to frame, but instead of describing an object, the script describes a sequence of events.

### Script Component

1) Entry Conditions or descriptor of environment that must be true for the script to be called.

2) Result or facts that are generated once the script has terminated. 3) Props or the "thing" that script consists of the script.

4) Roles are actors that the individual participant perform.

### Scenes

## Conceptual dependency

- ⇒ Conceptual dependency is a theory of NL which mainly deals with representations of semantic of language.
- ⇒ CD Representation of a sentence is built using the words in the sentence rather than using conceptual primitives which gives intended meaning of words.
- The main motivation for the development of CD as a knowledge representation are given below
- ⇒ To construct Computer programs which can understand NL.
- ⇒ To make inference from the sentence and also identify the situations in which two sentence has similar meaning.
- ⇒ To provide a means of representation which are language independent.

## Issues of KR

- ⇒ There are some issues in knowledge representation.
  - 1) Important attribute  
Important attribute in a system can be identified is very noisy task. Find out the important attribute is difficult.
  - 2) Relationship among objects attributes  
Badly, attributes are used to describe the object and are easily used to describe the object. So, Relationship among attribute are specifically represented. So that relationship are find out is noisy.
  - 3) Choosing granularity of representation  
While deciding the granularity of representation. It necessary to

What are the primitives  
and which level the knowledge  
to be represented?

\* what should be no (small or  
large) of low level primitive  
know primitive ~~on~~ high level  
facts?

#### 4) Representing Set of Objects

If we select an set of object  
there may be ~~one~~ many  
properties associated with the object.

So the set of object can represent  
is very noisy facts.

#### 5) Finding the right structure needed

To represent knowledge there need of  
particular structure... So that structure  
is right. To find the right  
structure is difficult.

## Knowledge Acquisition

⇒ knowledge acquisition is the  
process of extracting, structuring & organi-  
zating knowledge from one or more  
sources.

⇒ process of absorbing and storing  
new information into the memory  
⇒ it is a process of knowledge man-  
agement.

⇒ knowledge acquisition may consist  
of facts, rule, concepts, procedures, heuri-  
stics, formulas, relationships, statistics  
or any other useful information

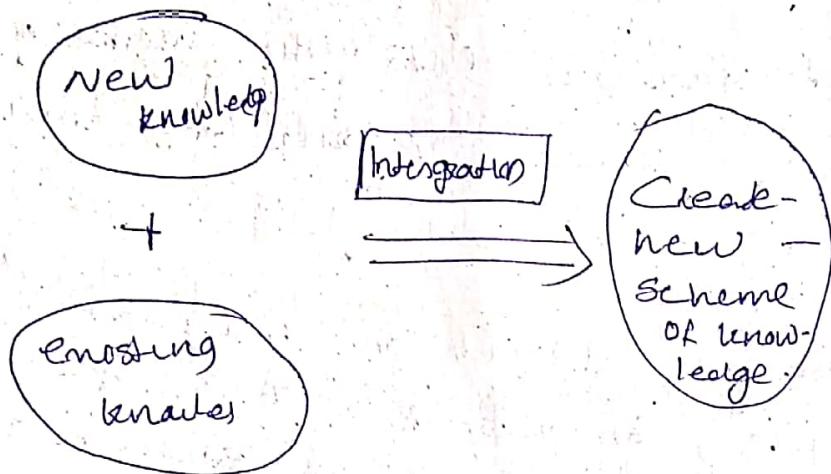
### Characteristic

⇒ knowledge acquisition is the  
gathering or collecting knowledge  
from various sources

⇒ Acquisition is also the process of  
expanding the capabilities of a smart  
human or improving the performance  
at some specific task

⇒ It is the process of adding new knowledge to knowledge base and refining or improving knowledge that was previously acquired.

⇒ The newly acquired knowledge should be integrated with existing knowledge in some meaningful way.



### Task in knowledge Acquisition

1) Collect:

⇒ Acquire knowledge from expert

2) Interpret: Review and identify key informed parts

Acquired knowledge can be interpreted

## Analyze

Farming - Cheeses, Stockades - to solve  
the problem

Design → Farming better cheese standards

## or problem

## KA technique

### Notes

1) Introspection: Expert act as both expert

and knowledge engineer

2) Observation: Expert closely observed -

create

### Explain

3) Induction: process of creating set of -

example enter rules

4) Protocol analysis: Expert is asked -

to perform a task and verbalized -  
thought process