

**Q7.(a) What is knowledge? Describe the importance of knowledge.**

**Ans. Knowledge:-**

*Knowledge can be defined as the body of facts and the principles accumulated by human act, fact or state of knowing.*

*Knowledge is the ability to understand information and then to form judgments, opinions, make predictions and decisions based on that understanding.*

Knowledge also means a familiarity with language, concepts, procedure, rules, ideas, places, facts, associations, coupled with an ability to use these notions effectively in modeling different aspects of world. Without this ability, the facts and concepts are meaningless.

By the Oxford dictionary definition, “*Knowledge is defined as expertise and skills acquired by a person through experience or education, the theoretical or practical understanding of a subject.*”

Knowledge is human understanding of a subject matter that has been acquired through proper study and experience. Knowledge is usually built by learning, thinking and proper understanding of the problem area. It can be considered as the integration of human perceptive process that helps to draw meaningful conclusions.

In order to perform an intelligent action (like solving a given problem, answering a question, playing a specific game, speaking a natural language), one must possess the

relevant knowledge in the form of specific facts and the inter-relations amongst them.

Knowledge is a progression that starts with data that is of limited utility. By organizing or analysing the data, we understand what the data means, and this becomes information. The interpretation or evaluation of information yield knowledge.

Knowledge simply means "*the ideas or understandings which an entity possesses that are used to take effective action to achieve the entity's goal(s). This knowledge is specific to the entity which created it.*"

Knowledge is viewed by the AI experts as a collection of facts about the world to be formally represented in a computer. It forms the knowledge base of an AI system on which the problem solving software should work.

## **Importance of Knowledge:-**

- *Intelligence requires knowledge. That is, to exhibit intelligence, knowledge is required. Knowledge plays a major role in building intelligent systems.*
- *To solve real world problems easily, effectively, efficiently and economically, expert systems are developed using knowledge.*
- *Knowledge serves as a background for articulating possible courses of action, for judging whether courses of action will yield the intended result and for using this judgment in selecting among them, for deciding how actions*

*should be implemented and for actually implementing actions.*

- *Knowledge plays an important role in building AI systems. It is the core aspect of Artificial Intelligence.*

**Q7.(b)** What do you mean by Knowledge Representation? What are the desirable characteristics of knowledge representation scheme? Explain.

**Ans. Knowledge Representation:-**

*Knowledge representation is the method used to encode knowledge in an intelligent system's knowledge base. The object of knowledge representation is to express knowledge in computer-tractable form, so that it can be used to help intelligent system perform well.*

Knowledge representation is a study of ways of how knowledge is actually picturized and how effectively it resembles the representation of knowledge in human brain.

Knowledge representation plays an important role in AI. In order to solve a complex problem in artificial intelligence, one needs both large amount of knowledge and some mechanism for manipulating the knowledge to create solution to new problems. A variety of ways to represent knowledge have been exploited in artificial intelligence programs.

## **Desirable characteristics of a knowledge representation scheme:-**

Following are the desirable characteristics of a knowledge representation scheme:-

- *This representation scheme should have a set of well defined syntax and semantics. This will help in representing various kinds of knowledge.*
- *The representation must be efficient i.e. it should use only limited resources without compromising on the expressive power.*
- *This representation scheme should have a good expressive capacity. A good expressive capability will catalyze the inferencing mechanism in its reasoning process.*

**Q8.(b) Discuss Semantic Net in detail with examples.**

**Ans. Semantic network:**

*Semantic network (or semantic net) is a knowledge representation schema that captures knowledge as a graph.*

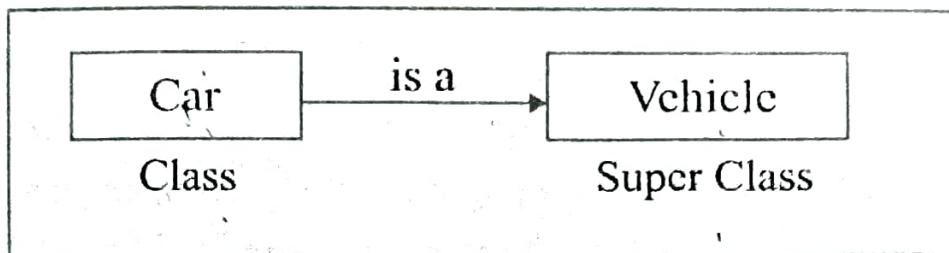
Semantic networks are used for the graphical representation of interrelations between the elements in a knowledge domain, based on patterns of nodes interconnected by arcs. In semantic networks, the knowledge is represented by labeled, directed graphs, whose nodes represent the domain elements (i.e. the objects or concepts) and arcs, the relationships between the elements (e.g. between the objects and/or concepts). The arcs, again, are directed links (arrows) and basically represent binary relations.

Originally, semantic networks were introduced for the representation of linguistic knowledge required for

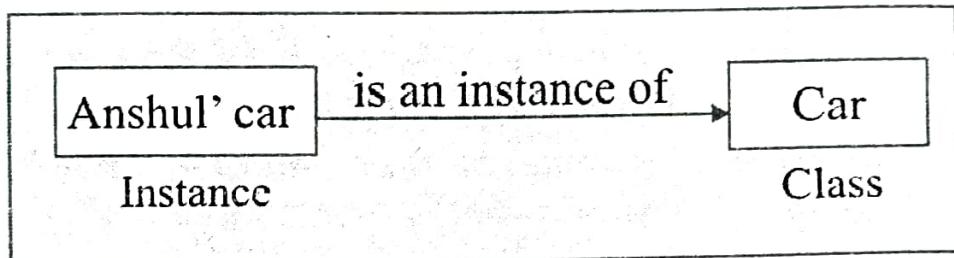
machine translation. Today, they have found general applications in knowledge representation in various areas of AI.

Several kinds of relationships are used in semantic nets:

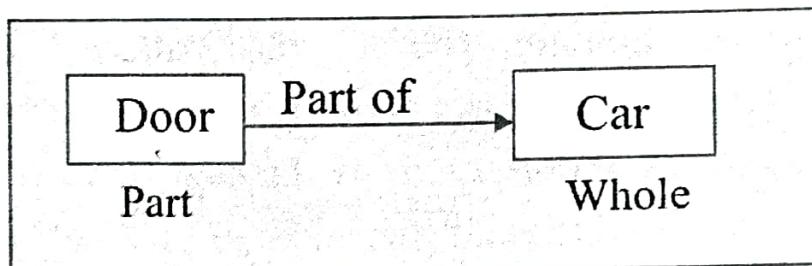
**1. “class – superclass” or “is – a” relationship.**



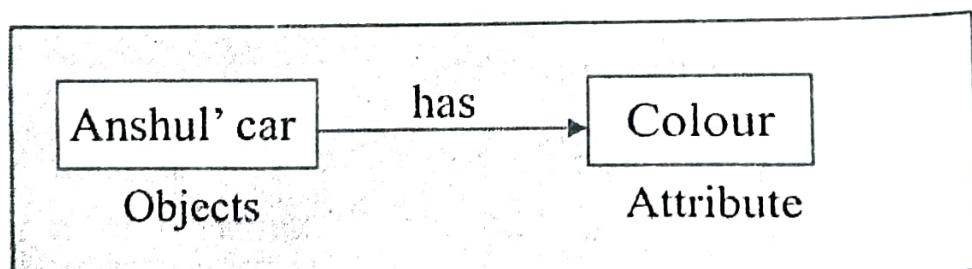
**2. “Instance-class” or “Is an instance of” relationship.**



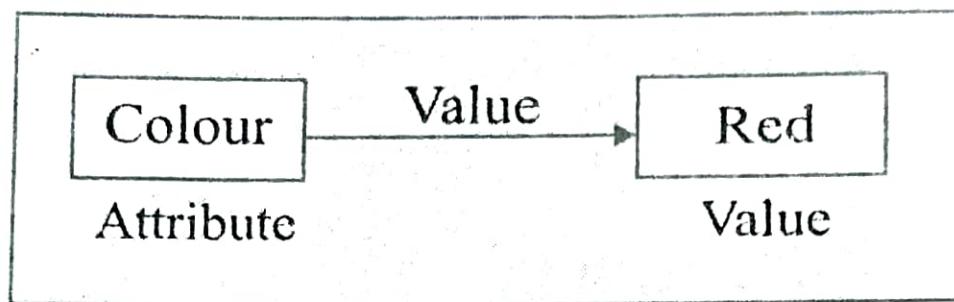
**3. “Part – Whole” or “Part of ” relationship.**



**4. “Object – Attribute” or “Has ” relationship.**



## **5. “Attribute – Value” or “Value ” relationship.**



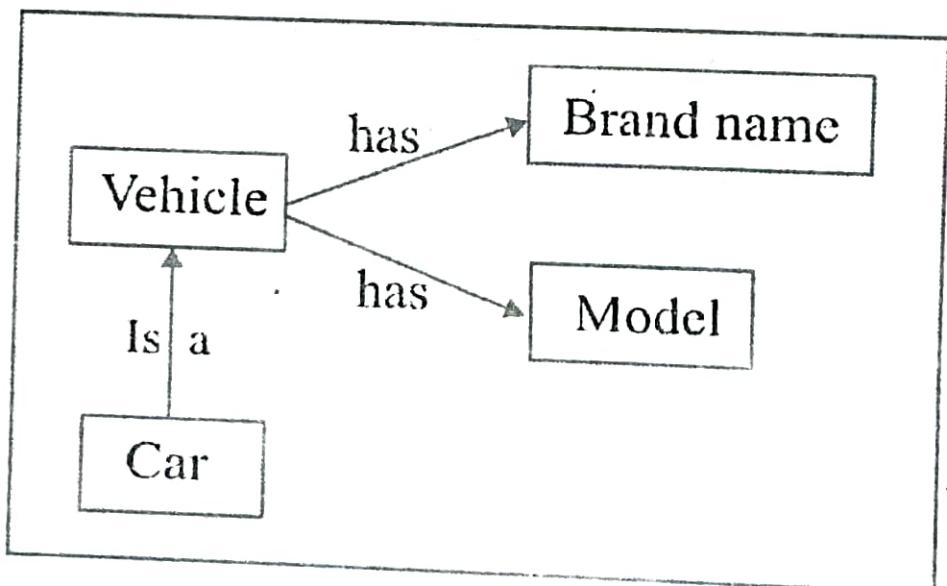
## **6. Logical relationships (and, or, not)**

## **7. Linguistic relationships (examples: likes, owns, travels, ...)**

**Inheritance:-** Inheritance is possible in semantic nets. Inheritance is a process by which the local information of a superclass node is assumed by a class node, a subclass node, and an instance node.

### **Example:**

All vehicles have a brand name and a model. A car is a class of a superclass Vehicle. So Car inherits all features of Vehicle, that is, Brand Name and Model.



**Q9.(a) How frames are used to represent knowledge? Explain with the help of examples. Also write the advantages and disadvantages of frames.**

**Ans.** *Frames are record-like structures that have slots and slot-values for an entity. Using frames, the knowledge about an object/event can be stored together as a unit.*

Frames are important because they allow deep understanding of new situations about which only minimal information is directly available.

A basic idea of frames is that people make use of stereotyped information about typical features of objects, images and situations. Such information is assumed to be structured in large units representing the stereotypes, and these units are what are referred to as “frames”.

*Thus, a frame is a collection of attributes or slots and associated values that describe some real world entity.*

Frames represent knowledge as structured objects which are composed of labeled slots with their values.

Slots are similar to attributes in object-oriented approach; however, they can contain broader information not only declarative, but also procedural information.

**Slots can contain the following information:-**

- **Frame identification information (name)**

Example: A frame which stores knowledge about cars can have a name “Car”.

- **Relationship of this frame to other frames.**

**Example:** A super-class of a frame “Car” is a frame “Vehicle”.

- **Knowledge about an attribute of an object and its value.**

**Example:** A frame “Car” can have an attribute “Number of wheels” with value 4.

- **Frame default information** (These are slot values that are taken to be true when no evidence to the contrary has been found).

**Example:** A frame “Car” can have a slot “Number of doors” with value 4, however, there are cars with only 2 doors.

- **Unspecified values** (Many frame slots may be left unspecified until given a value for a particular instance or needed for problem solving). In this case value of a slot is empty.

**Example:** A frame “Car” can contain a slot “Colour”, however this slot will be empty, because there are a number of different colours. When knowledge about a particular car, for example, Anshul’s car, will be represented, then the slot “Colour” will have a certain value.

### **A frame can include:**

- ***Slots with static values which mean values don't change during the operation of a system.***
- ***Slots with dynamic values which mean values change during the operation of a system.***

Sources of slot values:

- *Initialization*
- *User*
- *External programs*
- *Other frames*
- *Inheritance*

## Frame Structure:-

In general a frame has the following structure:

Name of a frame	
Name of slots	Value of slots

## Example:

Car	
Engine	✓
Number of doors	4

## Frame Types:-

Slot values can point out another frame. By relating frames through slot values a frame system can be acquired.

Three types of frames can be found in a frame system:-

- **Class frame:-** Such a frame includes slots describing attributes of a class of objects. Typically slots of such frames have default information or unspecified values.

**Example:**

Class: Vehicle	
Reg No.	
Model	
Producer	
Owner	

- **A sub-class frame**

**Example:**

Car	
Class: Vehicle	
Reg No.	
Model	
Producer	
Owner	
Number of doors	4
Engine	

- **An instance frame**

**Example:**

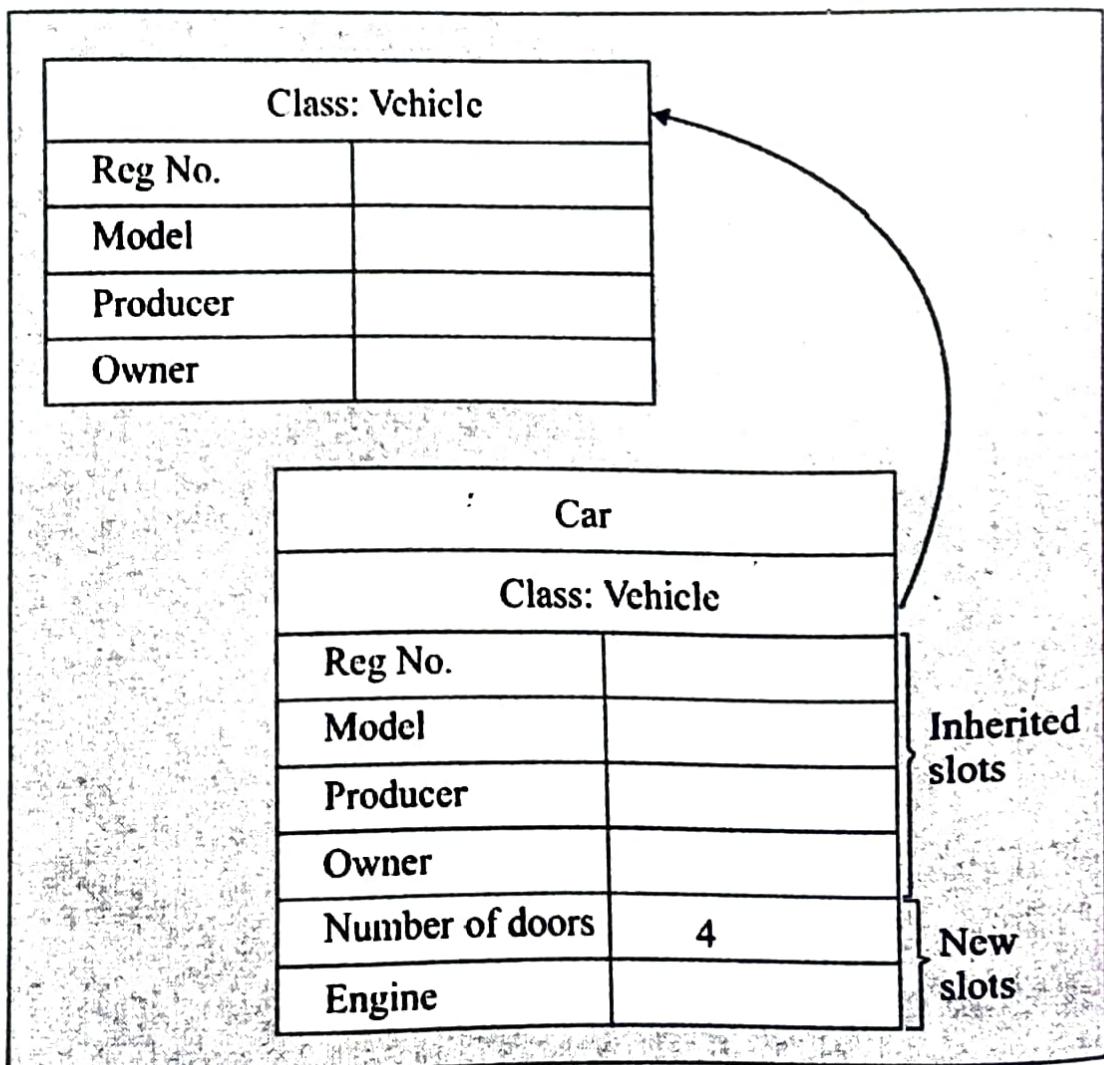
Anshul's car	
Class: Car	
Reg No.	HR12Z 001
Model	2014
Producer	BMW
Owner	Anshul
Number of doors	2
Engine	1.5

## Frame Relationships:-

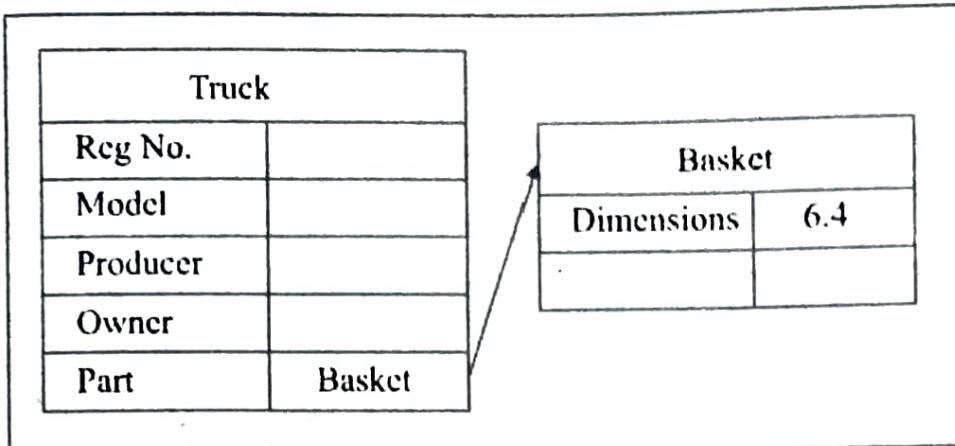
Three types of relationships can relate frames in a frame system:

1. “is – a” relationship. It relates a sub-class frame with a class frame or an instance frame with a sub-class or class frame. In this case a sub-class frame or an instance frame inherits all slots from a class frame, but it can also include new slots.

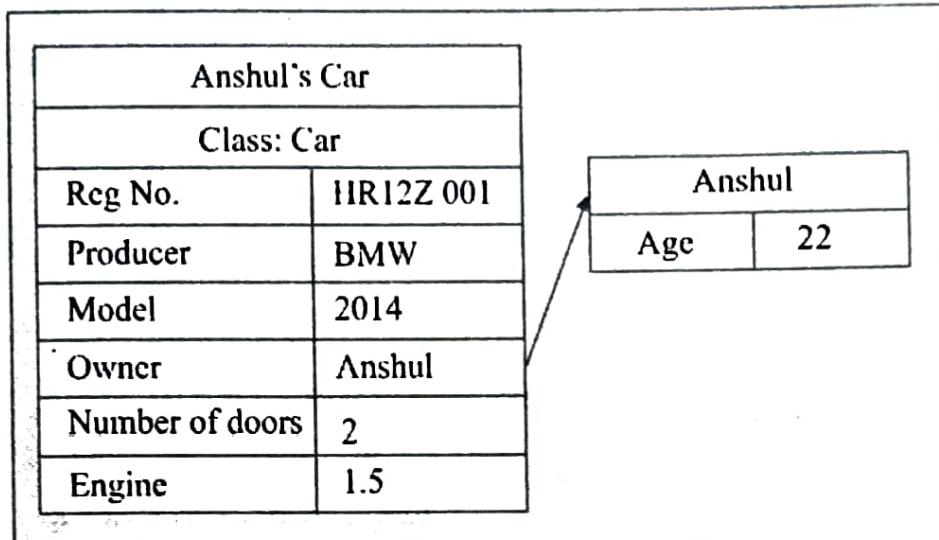
### Example:



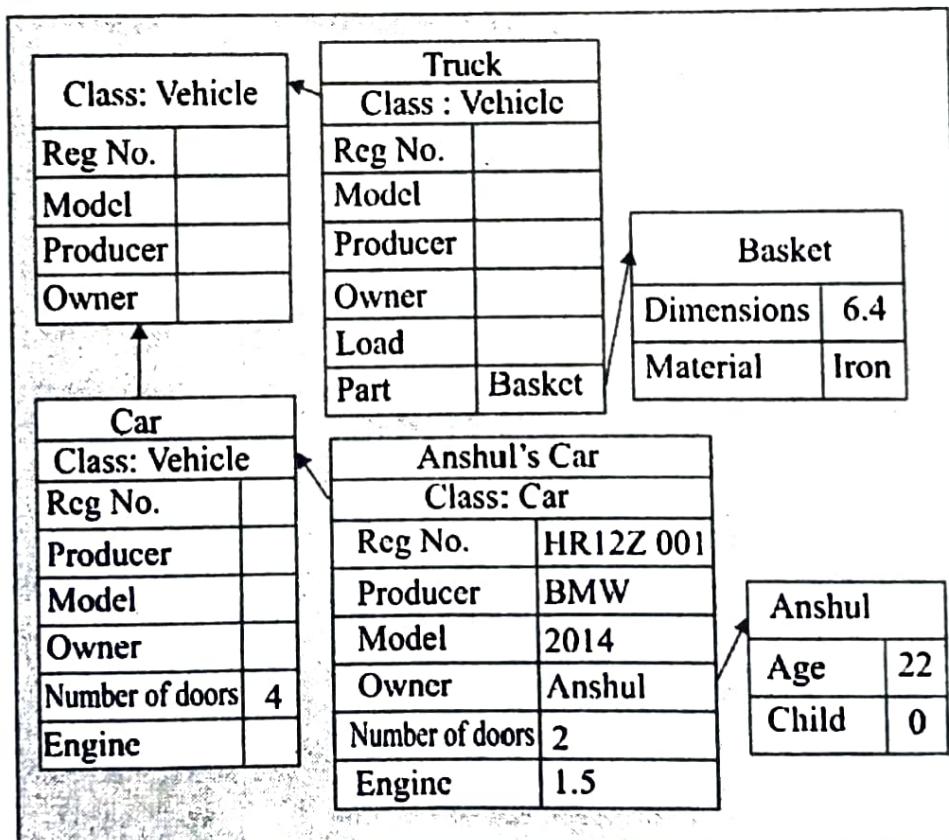
2. “a-part-of ” relationship. It relates whole with its constituent parts.



### 3. Semantic relationship.



### Example:



## **Advantages of Frames:-**

Following are the advantages of frames:-

- *A frame collects information about an object in a single place in an organized manner.*
- *Frames provide a way of associating knowledge with objects.*
- *By relating slots to other kinds of frames, a frame can represent typical structures involving an object; these can be very important for reasoning based on limited information.*
- *Frames may be a relatively efficient way of implementing A.I. applications.*
- *Frames allow data that are stored and computed to be treated in a uniform manner.*

## **Disadvantages of Frames:-**

Following are the disadvantages of frames:-

- *Frames encourage complex representations; little guide to good structuring of a domain.*
- *It is not possible to quantify over slots. For example, there is no way to represent “Some student made 100 in the exam”.*
- *Some things that can be represented in logic cannot be represented well in frames.*
- *It is necessary to repeat the same information to make it usable from different viewpoints, since methods are associated with slots or particular*

*object types. (For example, it may be easy to answer “whom does Anshul love?” but hard to answer “who loves Priya?”.)*

**Q9.(b) Explain scripts in detail and make scripts for the following:**

- (i) **Going to see the movie.**
- (ii) **Going to the bank to withdraw money.**

**Ans. Scripts:-**

*A script is a structured representation describing a stereotyped sequence of events in a particular context.*

Scripts are used in natural language understanding systems to organize a knowledge base in terms of the situations that the system should understand.

Scripts use a frame like structure to represent the commonly occurring experiences like going to the movies, eating in a restaurant, shopping in a supermarket or visiting an ophthalmologist.

*Thus, a script is a structure that prescribes a set of circumstances which could be expected to follow on from one another.*

Scripts are beneficial because:

- *Events tend to occur in known runs or patterns.*
- *Causal relationships between events exist.*
- *Entry conditions exist which allow an event to take place.*
- *Prerequisites exist upon events taking place.*

## **Components of a script:-**

The components of a script include:

- **Entry conditions:-** These are basic conditions which must be fulfilled before events in the script can occur.
- **Results:-** Conditions that will be true after events in script occurred.
- **Props:-** Slots representing objects involved in events.
- **Roles:-** These are the actions that the individual participants perform.
- **Track:-** Variations on the script. Different tracks may share components of the same script.
- **Scenes:-** The sequence of events that occur.

**Describing a script, special symbols of actions are used. These are:**

<b>Symbol</b>	<b>Meaning</b>	<b>Example</b>
ATRANS	transfer a relationship	<i>give</i>
PTRANS	transfer physical location of an object	<i>go</i>
PROPEL	apply physical force to an object	<i>push</i>
MOVE	move body part by owner	<i>kick</i>
GRASP	grab an object by an actor	<i>hold</i>
INGEST	taking an object by an animal	<i>eat, drink</i>

EXPEL	expel from an animal's body	<i>cry</i>
MTRANS	transfer mental information	<i>tell</i>
MBUILD	mentally make new information	<i>decide</i>
CONC	conceptualize or think about an idea	<i>think</i>
SPEAK	produce sound	<i>say</i>
ATTEND	focus sense organ	<i>listen</i>

### **Example: Script for going to see the movie.**

SCRIPT	:	MOVIE WATCHING
TRACK	:	THEATRE
PROPS	:	CHAIR
		MONEY
		TICKET
		TICKET WINDOW
		MOVIE = M
		CHANGE
ROLES	:	S = Movie viewer
		Tc = Ticket checker
		Tg = Ticket giver
		O = Owner
Entry conditions :		S is interested in the movie.
		S has money.

Results : S has less money.  
O has more money.  
S is pleased.  
S is not pleased.

### **Scene-1: Entering**

S PTRANS S to Theater.  
S ATTEND eyes to ticket window.  
S MBUILD himself in the queue.  
S PTRANS S towards ticket window as queue moves.  
S MOVES S to buy ticket.

### **Scene-2: Buying ticket**

S MBUILD choice to Tg  
Tg PTRANS TICKET to S.  
S ATRANS MONEY to Tg.  
Tg ATRANS CHANGE to S.  
S PTRANS S towards Movie hall.

### **Scene-3: Watching movie**

Tc MTRANS S for ticket  
S PTRANS Ticket to Tc  
Tc PTRANS Ticket to S  
S PTRANS S in the movie hall.

Tc MTRANS S about his chair.

S PTRANS S in the chair

S MTRANS MOVIE

**Scene-4:** Exiting the theater

S PTRANS S towards movie hall door.

S PTRANS S to out of movie hall.

**Example: Script for going to the bank to withdraw money.**

SCRIPT : Withdraw money

TRACK : Bank

PROPS : Money

Counter

Form

Token

ROLES : P = Customer

E = Employee

C = Cashier

Entry conditions : P has no or less money.

The bank is open.

Results : P has more money.

**Scene-1:** Entering

P PTRANS P into the Bank.

P ATTEND eyes to E.

P MOVI . E.

## **Scene-2: Filling form**

P MTRANS signal to E  
E ATRANS form to P.  
P PROPEL form for writing.  
P ATRANS form to P.  
E ATRANS token to P.

## **Scene-3: Withdrawing money**

P ATTEND eyes to the counter  
P PTRANS P to queue at the counter  
P PTRANS token to C  
C ATRANS money to P

## **Scene-4: Exiting the bank**

P PTRANS P to out of bank.

## **Advantages of Scripts:-**

Following are the advantages of scripts:

- *Ability to predict events.*
- *A single coherent interpretation may be build up from a collection of observations.*

## **Disadvantages of Scripts:-**

Following are the disadvantages of scripts:

- *Less general than frames.*
- *May not be suitable to represent all kinds of knowledge.*