14IT705/A

Hall Ticket Number:

IV/IV B.Tech (Regular/Supplementary) DEGREE EXAMINATION

November, 2019 **Information Technology**

Seventh Semester **Artificial Intelligence**

Time: Three Hours **Maximum :** 60 Marks

Answer Question No.1 compulsorily. (1X12 = 12 Marks)

Answer ONE question from each unit. (4X12=48 Marks)

1 Answer all questions (1X12=12 Marks)

a) Define State Space
b) List out Uniformed Search Strategies.
c) What are the Problem Characteristics of Artificial Intelligence?
d) Distinguish between Fact and Predicate.
e) What is Declarative Knowledge
f) What is Forward Reasoning?
g) Define Reactive System.
h) What is Conceptual Dependency?
i) What are the Various Planning Systems?
j) What is Explanation Based Learning?
k) Name the Programming Methods Supported by Expert System Tools?
l) What is Rote Learning?

UNIT I

2 a) Describe Problem characteristics with examples? 6M
b) Briefly explain the travelling salesman problem and find a solution to it? 6M

(OR)

3 a) Write an algorithm for Mean End Analysis? 6M
b) Trace the constraint satisfaction procedure solving the 6M

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UNIT II

4 a) Discuss the role of reasoning in AI. How predicate logic is used in Al to represent knowledge? 6M
b) Define Resolution. Explain with suitable example. 6M

(OR)

5 a) How knowledge can be represented using Procedural knowledge with suitable example? 6M
b) Briefly explain Control Knowledge? 6M

UNIT III

6 a) List Semantic Networks. Explain features of Semantic net. 6M
b) Describe major components of a Restaurant Script. 6M

(OR)

7 a) Discuss about the Nonlinear Planning using Constraint Posting. 6M
b) Describe hierarchical planning methods with relevant examples? 6M

UNIT IV

8 a) Explain in detail about explanation based learning Mechanism. 6M
b) Explain various types of learnings in problem solving. 6M

(OR)

9 a) Explain with neat diagram the architecture of expert system and mention its features. 6M
b) Explain about Knowledge acquisition? 6M

1 Answer all questions **(1X12=12 Marks)**

a) Define State Space
Ans:
An operator produces exactly one new state then it is called State Space.

b) List out Uniformed Search Strategies.
Ans:

1. Breadth-first Search
2. Depth-first Search
3. Depth-limited Search
4. Iterative deepening depth-first search
5. Uniform cost search
6. Bidirectional Search

c) What are the Problem Characteristics of Artificial Intelligence?
Ans:
1. Is the problem decomposable?
2. Can solution steps be ignored or undone?
3. Is the Universal Predictable?
4. Is good solution absolute or relative?
5. The knowledge base consistent?
6. What is the role of Knowledge?
7. Does the task requires interaction with the person?

d) Distinguish between Fact and Predicate.
Ans:
A fact must start with a predicate (which is an atom) and end with a full stop. The predicate may be followed by one or more arguments which are enclosed by parentheses

e) What is Declarative Knowledge
Ans:
Declarative Knowledge also known as Descriptive knowledge, is the type of knowledge which tells the basic knowledge about something and it is more popular than Procedural Knowledge. It emphasize **what to do** something to solve a given problem.

f) What is Forward Reasoning?
Ans:
The forward reasoning is data-driven approach here the process starts with new data and facts in the forward reasoning.

g) Define Reactive System.
Ans:
A reactive system is an architectural style that allows multiple individual applications to coalesce as a single unit, reacting to its surroundings, while remaining aware of each other—this could manifest as being able to scale up/down, load balancing, and even taking some of these steps proactively.

h) What is Conceptual Dependency?
Ans:
Conceptual Dependency originally developed to represent knowledge acquired from natural language input.CD provides:

- a structure into which nodes representing information can be placed
- a specific set of primitives

i) What are the Various Planning Systems?
Ans:
1. Goal Stack Planning.
2. Non-linear Planning using constraint posting.
3.Hierarchical planning

j) What is Explanation Based Learning?
Ans:
In order for an expert system to be an effective tool, people must be able to interact with it easily. To facilitate this interaction, the expert system must have the following two capabilities
1.Explain its reasoning
2. Acquire new knowledge and modifications of old knowledge.

k) Name the Programming Methods Supported by Expert System Tools?
Ans:
1.PROLOG
2.LISP

l) What is Rote Learning?
Ans:

- Rote Learning is basically *memorization.* It is a basic necessity for any intelligent program -- is it a separate learning process?
- Memorization can be a complex subject -- how best to store knowledge?

UNIT-I

2a) Describe Problem characteristics with examples? 6M
Any 6 characteristics 6 marks
Ans:
1. Is the problem decomposable?
A very large and composite problem can be easily solved if it can be broken into smaller problems and recursion could be used. Suppose we want to solve.
Ex:- ∫ x2 + 3x+sin2x cos2x dx
This can be done by breaking it into three smaller problems and solving each by applying specific rules. Adding the results the complete solution is obtained.
2. Can solution steps be ignored or undone?
Problem fall under three classes ignorable, recoverable and irrecoverable. This classification is with reference to the steps of the solution to a problem. Consider thermo proving. 1. Ignorable problems Ex:- theorem proving, Recoverable problems Ex:- 8 puzzle
3. Is the Universal Predictable?
Problems can be classified into those with certain outcome (eight puzzle and water jug problems) and those with uncertain outcome (playing cards). In certain – outcome problems, planning could be done to generate

a sequence of operators that guarantees to a lead to a solution. Planning helps to avoid unwanted solution steps.

4. Is good solution absolute or relative? (Is the solution a state or a path?)

There are two categories of problems. In one, like the water jug and 8 puzzle problems, we are satisfied with the solution, unmindful of the solution path taken, whereas in the other category not just any solution is acceptable

5. The knowledge base consistent?

In some problems the knowledge base is consistent and in some it is not. For example consider the case when a Boolean expression is evaluated.

Ex.Boolean expression evaluation.

6. What is the role of Knowledge?

Though one could have unlimited computing power, the size of the knowledge base available for solving the problem does matter in arriving at a good solution. Take for example the game of playing chess, just the rules for determining legal moves and some simple control mechanism is sufficient to arrive at a solution.

7. Does the task requires interaction with the person?

The problems can again be categorized under two heads.

1. Solitary in which the computer will be given a problem description and will produce an answer, with no intermediate communication and with he demand for an explanation of the reasoning process. Simple theorem proving falls under this category. given the basic rules and laws, the theorem could be proved, if one exists.

Ex:- theorem proving (give basic rules & laws to computer)

8. Problem Classification

Actual problems are examined from the point of view, the task here is examine an input and decide which of a set of known classes.

Ex: - Problems such as medical diagnosis, engineering design**.**

b)Briefly explain the travelling salesman problem and find a solution to it? 6M

STATEMENT:

A salesman has list of cities, each of which he must visit exactly once. (Figure shows) there are direct roads between each pair of cities on the list. Find the route the salesman should follow so that he travels the shortest possible on a found trip, starting at any one of the cities and then returning there.

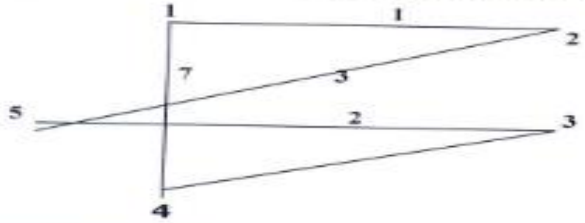
SOLUTIONS:

Using the heuristics search me way proceed to solve as follows:

Arbitrarily select a starting city.

To select the next city, look at all cities not yet visited. Select the one closest to the current city, go to it next.

repeat step 3 until all cities have been visited.



Algorithm produces a tour 1--2--5--3--4--1 with cost 1+3+2+1+7=14, but the traversal 1-5-3-4-2-1 is a tour with cost 5+2+1+4+1=13 is the minimum. This heuristic algorithm, clearly does not always find a minimum cost tour.

Thus we have seen that AI problem may be described as centering on a search process. It can also be described more precisely a process of heuristic search. Heuristic search makes the solution of hard problems feasible.

(OR)

3a) Write an algorithm for Mean End Analysis? 6M

Description---3m

Algorithm-----3m

Ans:

Means-Ends Analysis. This **means** we could solve major parts of a problem first and then return to smaller problems when assembling the final solution. ... STRIPS (A robot Planner) is an advanced problem solver that incorporates **means-ends analysis** and other techniques.

- Let's we take Current state as CURRENT and Goal State as GOAL, then following are the steps for the MEA algorithm.
- **Step 1:** Compare CURRENT to GOAL, if there are no differences between both then return Success and Exit.
- **Step 2:** Else, select the most significant difference and reduce it by doing the following steps until the success or failure occurs.
    - Select a new operator O which is applicable for the current difference, and if there is no such operator, then signal failure.
    - Attempt to apply operator O to CURRENT. Make a description of two states.
      i) O-Start, a state in which O's preconditions are satisfied.
      ii) O-Result, the state that would result if O were applied In O-start.
    - If
      (First-Part<------MEA(CURRENT,O-START)
      And
      (LAST-Part <----- MEA (O-Result, GOAL),
      are successful, then signal Success and return the result of combining FIRST-PART, O, and LAST-PART.

b) Trace the constraint satisfaction procedure solving the 6M

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Ans:

Rules for constraints 3M

Solution 2M

Rules for Solving Crypt arithmetic Problems

1. Each Letter, Symbol represents only one digit throughout the problem.
2. Numbers must not begin with zero i.e. 0567 (wrong), 567 (correct).
3. Aim is to find the value of each letter in the Cryptarithmetic problems
4. There must be only one solution to the Cryptarithmetic problems
5. The numerical base, unless specifically stated, is 10.
6. After replacing letters by their digits, the resulting arithmetic operations must be correct.
7. Carry over can only be 1 in Cryptarithmetic problems

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i.e.78344+83614=162958

where,

D=6, C=7, R=8,A=6,O=3,N=2,G=9,S=4,E=5.

4a) Discuss the role of reasoning in AI. How predicate logic is used in Al to represent knowledge? 6M

Description for role of reasoning---3m

Description for predicate logic----- 3m

Ans:

In information technology a **reasoning system** is a software system that generates conclusions from available knowledge using logical techniques such as deduction and induction. Reasoning systems play an important role in the implementation of artificial intelligence and knowledge-based systems. By the everyday usage definition of the phrase, all computer systems are reasoning systems in that they all automate some type of logic or decision. In typical use in the Information Technology field however, the phrase is usually reserved for systems that perform more complex kinds of reasoning.

A logic is a formal language, with precisely defined syntax and semantics, which supports sound inference. Different logics exist, which allow you to represent different kinds of things, and which allow more or less efficient inference. The logic may be different types like propositional logic, predicate logic, temporal logic, description logic etc. But representing something in logic may not be very natural and inferences may not be efficient.

b) Define Resolution. Explain with suitable example.

Description---------3m

Conversion rules—3m

Resolution is a single rule of inference that can operate efficiently on a special form of sentences.

• The special form is called conjunctive normal form (CNF) or clausal form, and has these properties:
Every sentence is a disjunction (OR) of literals (clauses)
All sentences are implicitly conjuncted (AND)

Resolution produces proofs by *refutation*. In other words, to prove a statement (i.e., show that it is valid), resolution attempts to show that the negation of the statement produces a contradiction with the known statements (i.e. that it is unsatisfiable).

Predicate Logic and CNF

• Converting to CNF is harder - we need to worry about variables and quantifiers.

1. Eliminate all implications →
2. Reduce the scope of all ¬ to single term
3. Make all variable names unique
4. Move quantifiers left
5.Eliminate Existential Quantifiers
6.Eliminate Universal Quantifiers
7. Convert to conjunction of disjunctions

(OR)

5a) How knowledge can be represented using Procedural knowledge with suitable example? 6M

Ans:

Description for Procedural Knowledge--3M

Example and rules---3m

Humans are best at understanding, reasoning, and interpreting knowledge. Human knows things, which is knowledge and as per their knowledge they perform various actions in the real world. **But how machines do all these things comes under knowledge representation and reasoning**. Hence we can describe Knowledge representation

The Procedural knowledge should follows Rules, strategies, agendas, procedures.

◦ Also known as imperative knowledge
◦ Is knowing How to do something
◦ Can be directly applied to a task

◦ Depends upon the task on which it can be applied
◦ Less general
◦ Example: How to cook vegetable or how to prepare a particular dish is procedural knowledge.

b) Briefly explain Control Knowledge?

Ans:

Description---3m
Example------3m

Knowledge about which paths are most likely to lead quickly to a goal state is often called search control knowledge.
Which states are more preferable to others? Which rule to apply in a given situation. The order in which to pursue sub goals Useful sequences of rules to apply. Search control knowledge is Meta knowledge Two issues concerning control rules:

- The first issue is called the utility problem. As we add more and more control knowledge to a system, the system is able to search more judiciously. If there are many control rules, simply matching them all can be very time consuming.
- The second issue concerns with the complexity of the production system interpreter there are a number of AI systems that represent their control knowledge with rules. Example SOAR, PRODIGY SOAR is a general architecture for building intelligent systems.

PRODIGY is a general purpose problem solving system that incorporates several different Learning mechanisms. It can acquire control rules in a number of ways:
Through hand coding by programmers
Through a static analysis of the domain's operators.
Through looking at traces of its own problem solving behavior.
PRODIGY learns control rules from its experience, but unlike SOAR it learns from its failures.

UNIT-III

6a) List Semantic Networks. Explain features of Semantic net.

Ans:

Description---3m
Features and example—3m
In semantic nets information is represented as:
– set of nodes connected to each other by a set of labelled arcs.
• Nodes represent: various objects / values of the attributes of object.
• Arcs represent: relationships among nodes.
The semantic Networks are two types
1. Semantic Networks
2. Partitioned semantic nets

These values can also be represented in logic as: *isa(person, mammal), instance(Mike-Hall, person) team(Mike-*

*Hall, Cardiff)*We have already seen how conventional predicates such as *lecturer(dave)* can be written as *instance (dave, lecturer)* Recall that *isa* and *instance* represent inheritance and are popular in many

Knowledge representation schemes. But we have a problem: *How we can have more than 2 place predicates in semantic nets? E.g. score(Cardiff, Llanelli,)* Solution:

- Create new nodes to represent new objects either contained or alluded to in the knowledge, *game* and *fixture* in the current example.
  Relate information to nodes and fill up slots (Fig :)

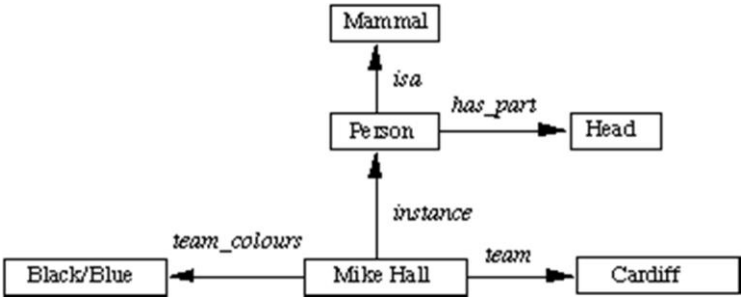
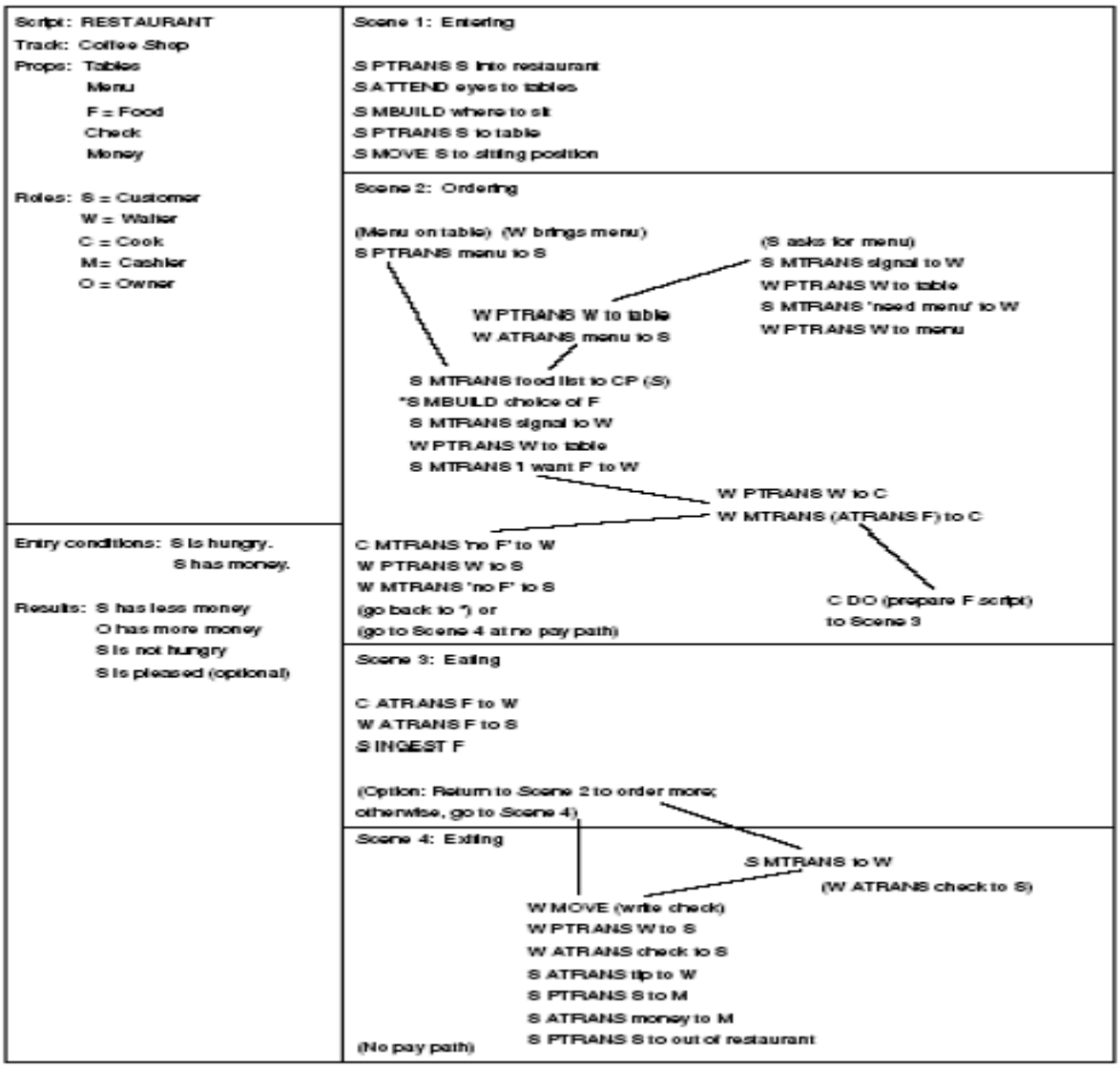


Fig: A Semantic Network

b) Describe major components of a Restaurant Script.



(OR)

7a) Discuss about the Nonlinear Planning using Constraint Posting. 6M

Ans:

Description ----3m

Example Explanation----3m

Let us reconsider the **SUSSMAN ANOMALY**

- Problems such as this one require sub problems to be worked on simultaneously.
- Thus a nonlinear plan using heuristics such as:
    1. Try to achieve ON(A,B) clearing block A putting block C on the table.
    2. Achieve ON(B,C) by stacking block B on block C.
    3. Complete ON(A,B) by stacking block A on block B.

Constraint posting has emerged as a central technique in recent planning systems (*E.g.* MOLGEN and TWEAK)

Constraint posting builds up a plan by:

- suggesting operators,
- trying to order them, and
- Produce bindings between variables in the operators and actual blocks.

The initial plan consists of no steps and by studying the goal state ideas for the possible steps are generated.

There is *no order or detail* at this stage.

Gradually more detail is introduced and constraints about the order of subsets of the steps are introduced until a *completely ordered* sequence is created.

In this problem means-end analysis suggests two steps with end conditions ON(A,B) and ON(B,C) which indicates the operator STACK giving the layout shown below where the operator is preceded by its preconditions and followed by its post conditions:

CLEAR(B)	CLEAR(C)
*HOLDING(A)	*HOLDING(B)
_____	_____
STACK(A,B)	STACK(B,C)
_____	_____
ARMEMPTY	ARMEMPTY
ON(A,B)	ON(B,C)
¬ CLEAR(B)	¬ CLEAR(C)
¬ HOLDING(A)	¬ HOLDING(B)

NOTE:

- There is no order at this stage.
- Unachieved preconditions are starred (*).
- Both of the HOLDING preconditions are unachieved since the arm holds nothing in the initial state.
- Delete post conditions are marked by (¬).

b) Describe hierarchical planning methods with relevant examples? 6M

Ans:

Principle ----2m
Procedure---2m
Example-----2m

- hierarchical organization of 'actions'
- complex and less complex (or: abstract) actions
- lowest level reflects directly executable actions

Procedure

- planning starts with complex action on top
- plan constructed through action decomposition
- substitute complex action with plan of less complex actions (pre-defined plan schemata; or learning of plans/plan abstraction)
- overall plan must generate effect of complex action

Hierarchical Planning / Plan Decomposition

Plans are organized in a hierarchy. Links between nodes at different levels in the hierarchy denote a decomposition of a "complex action" into more primitive actions (operator expansion).

Example:

move (x, y, z)

operator
expansion pickup (x, y) putdown (x, z)

The lowest level corresponds to executable actions of the agent.

UNIT-IV

8a) Explain in detail about explanation based learning Mechanism.

Ans:

Description----3m
Example-------3m

Humans appear to learn quite a lot from one example. Basic idea: Use results from one examples problem solving effort next time around. An EBL accepts 4 kinds of input:

A training example-- what the learning *sees* in the world.

A goal concept-- a high level description of what the program is supposed to learn.

An operational criterion-- a description of which concepts are usable.

A domain theory-- a set of rules that describe relationships between objects and actions in a domain.

From this EBL computes a generalisation of the training example that is sufficient not only to describe the goal concept but also satisfies the operational criterion.

This has two steps:

Explanation-- the domain theory is used to prune away all unimportant aspects of the training example with respect to the goal concept.

Generalisation-- the explanation is generalised as far possible while still describing the goal concept.

EBL example

Goal: To get to Brecon -- a picturesque welsh market town famous for its mountains (beacons) and its Jazz festival.

The training data is:

near(Cardiff, Brecon),
airport(Cardiff)

The Domain Knowledge is:

$near(x,y) \wedge holds(loc(x),s) \rightarrow holds(loc(y), result(drive(x,y),s))$

airport(z) → loc(z), result(fly(z),s)))

In this case operational criterion is: We must express concept definition in pure description language syntax.

Our goal can expressed as follows:

holds (loc(Brecon),s) -- find some situation *s* for this holds.

We can prove this holds with *s* defined by:

result(drive(Cardiff,Brecon),
result(fly(Cardiff), s')))

We can fly to Cardiff and then drive to Brecon.

If we analyse the proof (say with an ATMS). We can learn a few general rules from it.

b) Explain various types of learnings in problem solving. 6M

Description for each method----2m

There are three basic methods in which a system can learn from its own experiences.

- Learning by Parameter Adjustment.
- Learning by Macro Operators.
- Learning by Chunking.

Learning by Parameter Adjustment

So the basic idea of idea of parameter adjustment is to:

- Start with some estimate of the correct weight settings.
- Modify the weight in the program on the basis of accumulated experiences.
- Features that appear to be good predictors will have their weights increased and bad ones will be decreased.

Learning by Macro Operators

The basic idea here is similar to Rote Learning:

Avoid expensive recomputation

Macro-operators can be used to group a whole series of actions into one.

For example: Making dinner can be described a lay the table, cook dinner, serve dinner. We could treat laying the table as on action even though it involves a sequence of actions.

Learning by Chunking

Chunking involves similar ideas to Macro Operators and originates from psychological ideas on memory and problem solving.

The computational basis is in production systems (studied earlier).

SOAR is a system that use production rules to represent its knowledge. It also employs chunking to learn from experience.

(OR)

9a) Explain with neat diagram the architecture of expert system and mention its features.

Ans:

Diagram---3m

Characteristics and capabilities—3m

What are Expert Systems?

The expert systems are the computer applications developed to solve complex problems in a particular domain, at the level of extra-ordinary human intelligence and expertise.

Characteristics of Expert Systems

- High performance
- Understandable
- Reliable
- Highly responsive

Capabilities of Expert Systems

The expert systems are capable of −

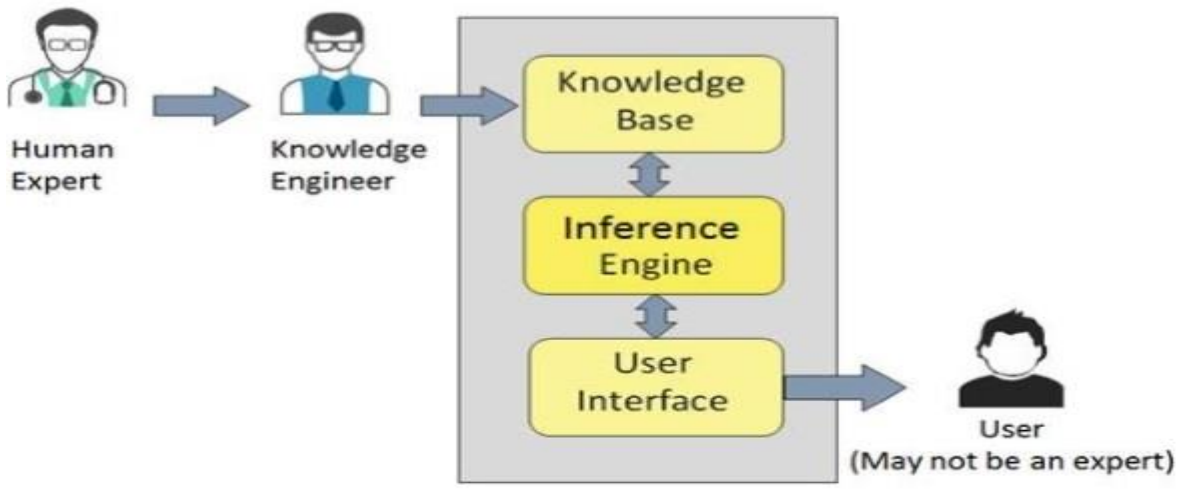
- Advising
- Instructing and assisting human in decision making
- Demonstrating
- Deriving a solution
- Diagnosing
- Explaining
- Interpreting input
- Predicting results
- Justifying the conclusion
- Suggesting alternative options to a problem

Components of Expert Systems

The components of ES include −

- Knowledge Base
- Inference Engine
- User Interface

Let us see them one by one briefly −



b) Explain about Knowledge acquisition?

Ans:

Description----3m

Explanation---------3m

Typically, a knowledge engineer interviews a domain expert to elucidate expert knowledge, which is then translated into rules. After the initial system is built, it must be iteratively refined until it approximates expert-level performance. This process is expensive and time-consuming, so it is worthwhile to look for more automatic ways of constructing expert knowledge bases. While no totally automatic knowledge acquisition systems yet exist, **there are many programs that interact with domain experts to extract expert knowledge efficiently.**

These programs provide support for the following activities:

- Entering knowledge.
- Maintaining knowledge base consistency.
- Ensuring knowledge base completeness

The most useful knowledge acquisition programs are those that are restricted to a particular problem-solving paradigm, e.g., diagnosis or design. It is important to be able to enumerate the roles that knowledge can play in the problem-solving process.

The acquisition proceeds through several steps:

1. **Initial knowledge base construction**. MOLE asks the expert to list common symptoms or complaints that might require diagnosis, For each symptom, MOLE prompts for a list of possible explanations.

2. **Refinement of the knowledge base.**

MOLE now tries to identify the weaknesses of the knowledge base- One approach is to find holes and prompt the expert to fill them.

It is difficult, in general, to know whether a knowledge base is complete, so instead MOLE lets the expert watch MOLE-p solving sample problems.

Signature of the HOD.

Signature of the internal Examiner (B. Krishnaiah)

Name of the external Examiners	Name of the college	Dept.	Signature