2067.

(1) Define AI artificial intelligence(AI). Explain the behaviour of AI. what do you mean by Turing test? Explain.

→ Artifical Intelligence is the parts of Computer Science Concerned with designing intelligence Computer systems that is, systems that exhibit the characteristics we associate with intelligence in human behaviour.

The behaviour of AI are as follow.

(a) System that think like humans:-
The exciting new effort to make computers think --- machine with mind, in the full and liberal sense " (Haugeland 1985)

(b) System that think rationally:
"The study of mental facilities thought the use of Computational models" (Charniak and McDermott, 1985)

(c) System that act like human:
"The are of creating machines that perform functions that require intelligence when performed by people" (Kurzweil 1990)

(d) System that act rationally
Computational intelligence is the study of the "design of intelligence agents" (Poole et al, 1998)

Turning Test:
The turning test approach by Alan Turning (1950) was design to convince the pople that whether a particular machine can think or not. The test involves an interrogator who interacts with one human and one machine. within a given time the interrogator has to find out which of the two the human is, and which one the machine

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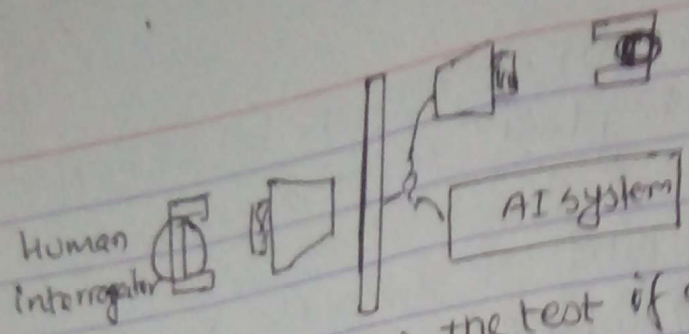


The computer passes the test if a human interrogator after posing some written questions cannot tell whether the written or not.

To passes turning test, a computer must have following capabilities.

→ Natural language processing: must be able to communicate successfully in English

→ Knowledge representation: To store what is known and hears

→ Automated reasoning: Answer the questions based on the stored information.

→ machine learning: must be able to adapt in new circumstances

Turning test avoid the physical interactions with human interrogator. physical simulation of human being is not necessary for testing the intelligence.

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② Why disjuctive normal form is required? Explain all the steps with examples.

→ A sentance that is expressed as a conjection of dejuction of literals is said to be conjective normal form. A sentence in CNF contains only k literals per clause is said to be in k-CNF

eg $(p \vee q) \wedge (q \vee r) \wedge (p \vee r)$

Algorithm:

(i) Eliminate $\leftrightarrow$ rewriting $p \leftrightarrow q$ as $(p \rightarrow q) \wedge (q \rightarrow p)$

(ii) Eliminate $\rightarrow$ rewriting $p \rightarrow q$ as $\neg p \vee q$

(iii) Use Demorgan's law to push $\neg$ inwards $\sim(p \rightarrow q) \equiv p \wedge \sim q$

- rewrite $\neg(p \wedge q)$ as $\neg p \vee \neg q$
- rewrite $\neg(p \vee q)$ as $\neg p \wedge \neg q$

(iv) Eliminate double negations rewrite $\neg\neg p$ as $p$

Use the distributive laws to get CNF:

- rewrite $(p \wedge q) \vee r$ as $(p \vee r) \wedge (q \vee r)$

(v) Flatten nested clauses

- $(p \wedge q) \wedge r$ as $p \wedge q \wedge r$
- $(p \vee q) \vee r$ as $p \vee q \vee r$

eg. let's illustrate the conversion to CNF by using an example.

$B \Leftrightarrow (A \vee C)$

- Eliminate $\Leftrightarrow$ replacing $\alpha \Leftrightarrow \beta$ with $(\alpha \Rightarrow \beta) \wedge (\beta \Rightarrow \alpha)$
  - $(B \Rightarrow (A \vee C)) \wedge ((A \vee C) \Rightarrow B)$
- Eliminate $\Rightarrow$ replacing $\alpha \Rightarrow \beta$ with $\neg\alpha \vee \beta$
  - $(\neg B \vee A \vee C) \wedge ((\neg A \wedge \neg C) \vee B))$
- Apply distributive law ($\wedge$ over $\vee$) and flatten
  - $(\neg B \vee A \vee C) \wedge (\neg A \vee B) \wedge (\neg C \vee B)$

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Inference: Inference is a general term representing the derivation of new knowledge from existing knowledge and axioms within a string step, and can be done by many kinds such as, induction deduction and abduction. For eg. "modus tollens" is rule of inference

Reasoning: Reasoning is the context of the goal and carried out via a reason process including multiple inference choices deciding such search have to be made as which axiom to give -

(3) Differentiate betn inference and reasoning. why probabilistic reasoning in important in the AI ? Explain with an example.

→ along with which knowledge in order to derive new knowledge

Resolution is a particular kind by reasoning involving the 'resolution rule'

probabilistic reasoning:-

probabilistic reasoning is basically logical reasoning based on the chance that some event will or will not occur. one could use a coin flip as an example of probabilistic reasoning.

Importance: → applying the B societal brands, advertisers such as consumer report often use probability statistics to sell their products. Automobile to the public that their product is better than the other and often time these probabilities.

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Searching can also solving problems prop-
-mance the are.

→ completness → Time complexity

→ space Complexity → optimality/Admissibility.

<u>depth first search</u>:

look for the goal node among all the children of the current node before using the sibling of this node ie expand deepest ~~unp~~ unexpanded node.

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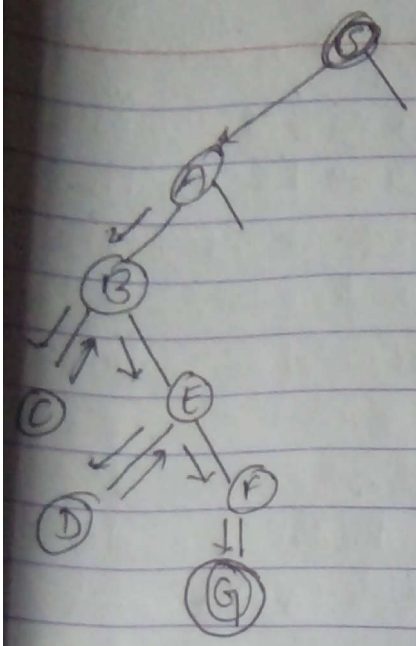
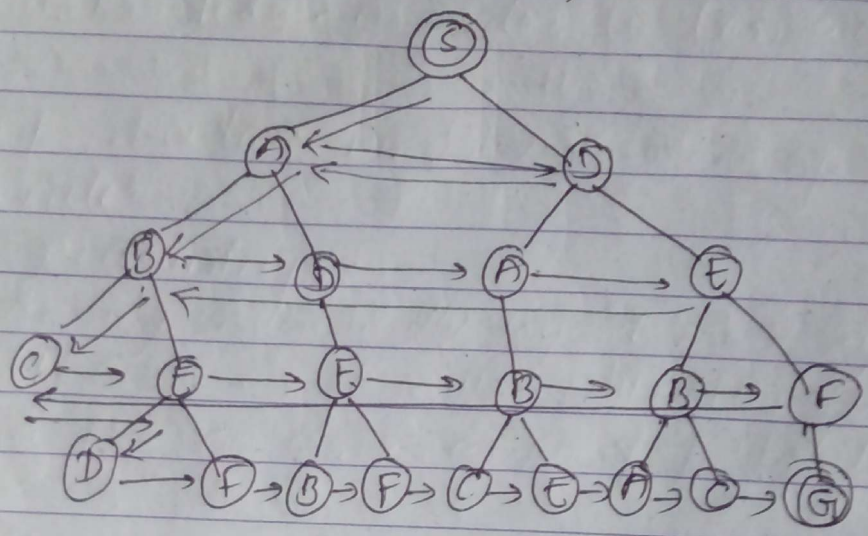



## Breadth first search :-

All nodes are expended at a given depth in the search tree before any node at the next level are expanded until the goal reached. Expand shallowest unexpanded node.

Constraint: Do not generate a child node if the node is already parent to avoid more loop




(5)

(e.g.)

Knowledge come from learning. Learning come of searching for the right information. The best proof of that is google. In order to take any decision on the learn. any thing you need to research data, usually historical. The more data you have, the better. The faster you can search it the better.

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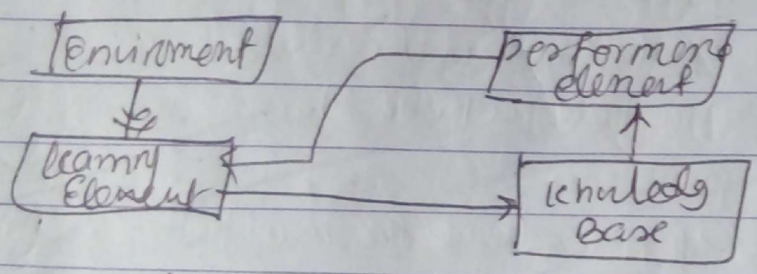
(6) Define learning. why learning frame work is required? Explain about learning frame work with block diagram and examples.

→ learning it self a problem solving process machine can't be intelligent until they are able to do new thing or to adpot a new situation learning can be done from enviroment which provide the information at required level. Another way of learning is through from taking advice from others people also learn their own solving experience and examples.

~~Learning frame work is required~~

There are four major compond in a learning system




Knowledge engineering: with a block diagram

- Knowledge engineering is a field with Artificial intelligence that develops knowledge-base systems
- such system are computer programs that contain large amount of knowledge rules, and reasoning mechanism to provide solution to real-world problem.
- The knowledge engineering is the process of filling man expert system knowledge base

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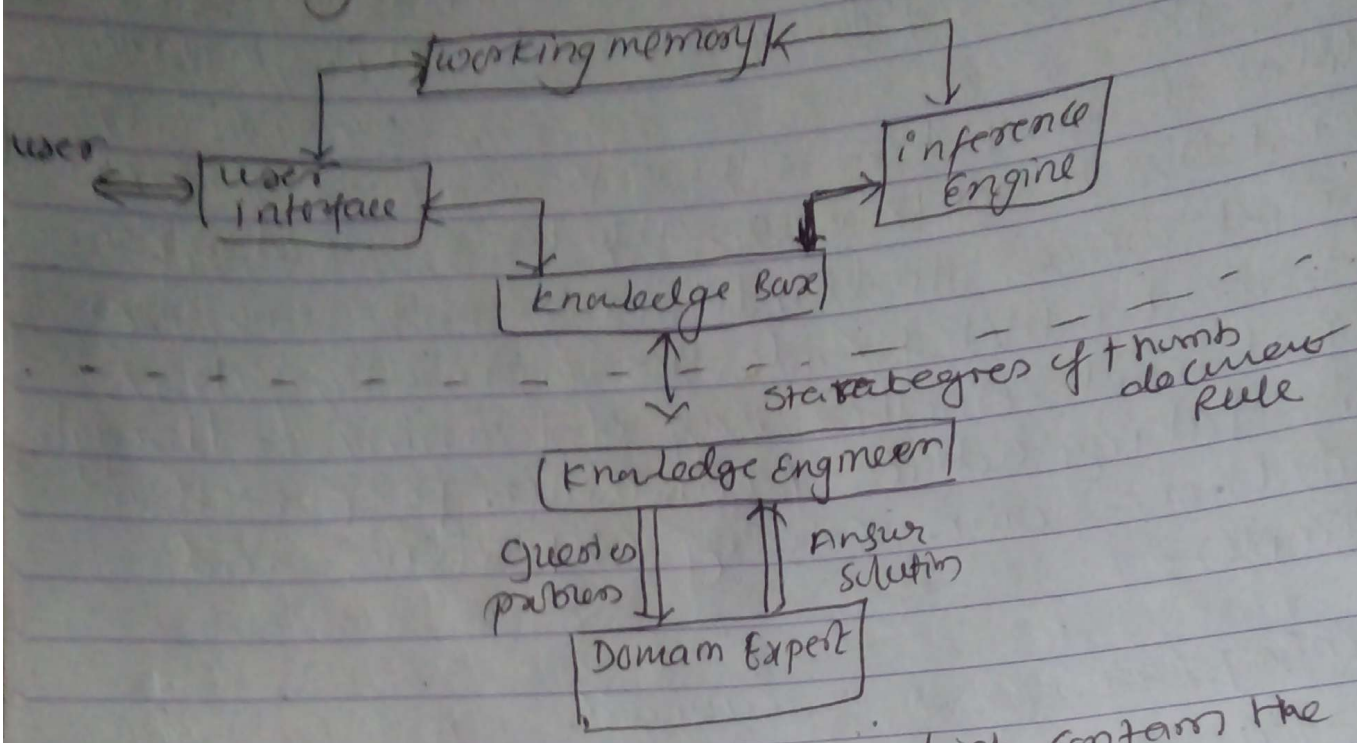
Block diagram:




(i) Expert system:- A data structure which contain the rule often in If Then rules, knowledge engineering is the process of filling an expert system knowledge base.

(ii) working memory: a data structure which stores information about a specific problem.

(iii) Inference engine: a set of procedure for manufacturing knowledge base with problem specific data in working memory.

(iv) user Interface: controls the dialog between user and the system.

- Domain experts: The individual who currently are experts in solving the problem; here the system is intended to solve.

- Knowledge Engineer: The individual who will be consulting with the system to get advice which would have been provided by the expert.

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7) What is a Baye's theorem? explain its applications

→ Baye's theory:

It allows us to compute the single term $P(b|a)$ in terms of three terms, $P(a|b)$, $P(b)$ and $P(a)$. That seems like two steps backward but Bayes's rule is useful in practice because there are many cases where we do have good probability estimates for these three numbers and need to compute the fourth.

useful for assessing diagnostic probability from causal probability

$$P(\text{cause}|\text{effect}) = \frac{P(\text{effect}|\text{cause})\, P(\text{cause})}{P(\text{effect})}$$

Diagnostic knowledge is often more fragile than causal knowledge.

The applications of Bayes theorem are

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(9) What is a back propagation? Explain all the steps involved in the back propagation with an example.

→ Back propagation.

It is a supervised learning method and is an implementation of the Delta rule, it requires a teacher that knows, or can calculate, the desired output for any given input. it is most useful for feed-forward networks (that have no connections that loop).

Back propagation ~~req~~ requires that the activation function used by the artificial neurons (or nodes) is differentiable.

i. present a training sample to the neural network

ii. Compare the network's output to the desired output from that sample. calculate the error in each output neuron.

(iii) for each neuron, calculate what the output should have been, and a scaling factor, ~~error~~ in ~~each output neuron~~. how much lower or higher

(iii) ~~for each neuron, calculate what the output should have been~~ the output must be adjusted to match the desired output. This is the local error.

(iv) Adjust the weights of each neuron to lower the local error.

(v) Assign 'blame for the local error to neurons at the previous level, giving greater responsibility to neurons connected by stronger weights.

(vi) Repeat from step (iii) on the neurons at the previous level, using each ones "blame" as its error

eg. it is used to (more general sense) calculation of the gradient and its use in stochastic gradient descent.

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2068

1. What is Artificial Intelligence (AI)? Describe your own criteria for Computer program to be considered intelligent.

→ see. 2067 S.N. 1.

Human intelligence involves both mundance and export reasoning mundan reasoning means all those things which all can routinely do in order to act and interact to the world. One of the practical goals of AI is to implement aspects of human intelligence in computer. Computer are also widely used as a tool ~~which~~ with which to study congnitive phenomena. Computational modeling use simulations to study how human intelligence may be structured.

Vision:- Ability to make sense of what we see.

Natural language: Ability to communicate within english or other language.

plannings: Ability to decide in a good sequence.

Robotic: Ability to act and move in the world.

So the above points shows that Computer program to be considered intelligent.

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~~2075~~
2067

~~(9) Do you agree the development of Artificial Intelligence has had some negative effect on the society? if you agree list some of them and put your opinion in the support of development of Artificial intelligence.~~

→ Yes

(10) Define natural language processing. Explain the different issues involved in the natural language processing.

→ Natural language processing (NLP) is the attempt to extract the fuller meaning representation from the free text. Natural language processing is a technique which involves converting spoken or written human language into a form which can be processed by computers and vice versa.

(i) Communication: Communication is the intentional exchange of information through production and perception of sign drawn from a shared system of conventional signs. Communication is important in partially observable environments where two or more agents works together to achieve a goal.

(ii) Speech act: Any activity done by the agent to produce language is called speech Act. Speech act doesn't always mean producing sound; it may be any other activity for communication.

(iii) Formal language: Formal language is defined as a (possibly finite) set of string; each string is a concatenation of terminal symbols (sometimes called words)

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formal language have strict mathematical definitions. This is in construct to the natural language like Nepali English and chine etc.

(iv) Grammar: A grammar is a finite set of rules that specifies a language. Formal language always have official grammar but natural language have no officials grammar. Linguistics are trying to discover the properties of natural language through scientific inquiry and trying to codify them.

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(3) What is the state space representation of problem? Represent the root finding problem having four citizens into state space representation (you can choose any ordining of citizens and links) and divise the complete problem formulation.

→ Space state representation of problem.

The state space is commonly defined as a directed graph in which each node is a state and each are represents the application of an operator transforming a state to a successor state.

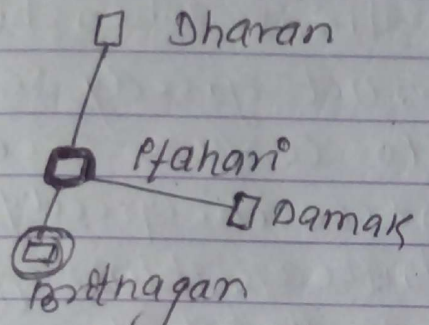


Fig. Represent the root finding problem having four citizes into state space representation

The above problem can be familiates

(i) State: All four cities

(ii) initiate state: initiate state would be "in Biratnagar; visited {Biratnagar}".

(iii) A typical intermediate state would be "In Damak; visited {Biratnagar, Pahari, Damak}"

(iv) A goal test would check whether the agent is in Biratnagar and 4 cities have been visited

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18

(a) What is heuristic information? Suppose that we run a greedy search algorithm with $h(n) = -g(n)$ and $h(n) = g(n)$. What sort of search will the greedy search follows in each case?

→

A heuristic function or simply a heuristic is a function that ranks alternatives in various search algorithms at each branching step basing on an available information in order to make a decision which branch is to be followed during a search. It is denoted by $h(n)$

(a) The best nodes (those with the lowest scores), will be those with the longest paths, so when $h(n) = -g(n)$ emulates depth first search, not greedy search.

A common mistake was to confuse greedy search with best first, or A* search. Greedy search use $f(n) = h(n)$ since in this case $h(n) = -g(n)$ the deeper a node is in tree, the better its f-cost will be

(b) Here, when $h(n) = g(n)$ this emulates breadth first search not greedy search. As we know greedy search uses $f(n) = h(n)$ since in this case $h(n) = g(n)$ $\neq f(n) = h(n)$

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(5) State whether the following sentences are valid, unsatisfible or neither.

(a) Smoke ⇒ Smoke (b) Smoke ⇒ Fire (c) (Smoke ⇒ Fire) ⇒ (¬Smoke ⇒ ¬Fire)

(d) Smoke ∨ Fire ∨ ¬Fire.

Soln - (a) Truth Table for Smoke ⇒ Smoke

| Smoke | Smoke | Smoke ⇒ Smoke |
|---|---|---|
| T | T | T |
| F | F | T |

Here (Smoke ⇒ Smoke) is the under all interpretation. Hence it is a valid sentence.

(b) Smoke ⇒ Fire

| Smoke | Fire | Smok ⇒ Fire |
|---|---|---|
| T | T | T |
| T | F | F |
| F | T | T |
| F | F | T |

it is neither sansatifable nor valid because interpretation that make all true or all falls.

(c) (Smoke ⇒ Fire) = (¬ Smoke ⇒ ¬Fire)

| Smoke | Fire | ¬Smoke | ¬ Fire | Smok ⇒ Fire | ¬Smoke ⇒ ¬Fire | (Smoke ⇒ Fire) ⇒ (¬Smoke ⇒ ¬Fire) |
|---|---|---|---|---|---|---|
| T | T | F | F | T | T | T |
| T | F | F | T | F | T | T |
| F | T | T | F | T | F | F |
| F | F | T | T | T | T | T |

it is nither unsatifible nor valid but is satisfiable and invalid.

(d) Smoke ∨ Fire ∨ ¬Fire.

| Smoke | Fire | ¬Fire | Smoke ∨ Fire | Smoke ∨ Fire ∨ ¬Fire |
|---|---|---|---|---|
| T | T | F | T | T |
| T | F | T | T | T |
| F | T | F | T | T |
| F | F | T | F | T |

Here the given formula is true for all model here it is valid sentence.

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⑥ Consider the knowledge base.
"if it is hot and humid then it is raining. if it is humid then it is hot. it humid."

ⓐ Describe a set a propostional letters which can be used to represent the knoledge base.

→ The symbol which are used to represnt each proposition or sentence, for eg P,Q,R --- are known as set of propositional letters.

ⓑ Translate the KB into propertional letter using your propositional letter from part ⓐ.

→ H: it is hot
HM: it is hamid
R: it is raining

ⓒ It is raining? Answer the question by using logical inference rules with the KB

→ we can represent the given KB statment in English into the following formul of propertional logic

(i) $(H \wedge HM) \Rightarrow R$
(ii) $HM \Rightarrow H$
(iii) $HM$
(iv) $R$ to show.

using modous ponens on (ii) and (iii) we get $\left[\therefore \frac{P \to Q, \; P}{\therefore Q}\right]$

(v) $H$

using conjuction on (v) and (iii) we get $\left(\frac{P, Q}{P \wedge Q}\right)$,

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(vi) HAHM
using modus phones on (i) and (vi) we get
(vii) R (which is need to be prove)
hence it is raining.

7) what do you mean by knowledge representation? Explain the characteristic of representation.

→ Knowledge representation is concerned with encoding the human knowledge into the form that is efficiently manipulated by the computer. knowledge that is represented in AI system are following

Object: Guitar has string
Event: Ram played Guitar
performance: Dirt cleared by vaccum cleaner.
meta-knowledge: Renuka knows that she can read street singns along the way to find where it is
Facts: Truths about real world and what we represent

The characteristics of representation are as follow

⇒ Representation adequacy: The ability to represent all of the kinds of knowledge that are need in a certain domain.

⇒ inferential adequancy: The ability to represent all of kinds of inferential procedures (produces that manipulate the representational structure in such a way as to derive new structure corresponding to new knowledge inferred from old)

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⇒ Inferential efficiency: The ability to represent efficient inference procedures (For instance, by incorporating into the knowledge additional information that can be used to focus the attention of these inference mechanism in the most promising directions.

⇒ acquisitional efficiency: The ability to acquire new information easily.

(9) What is Baye's Rule? Discuss the use of Baye's rule for uncertain reasoning.

→ see - 2067 QN. 7

$$p(b/a) = P(a/b) * p(b) / p(a)$$

proof of bays rule.

$$p(a/b) = p(a \wedge b) / p(b)$$

$$p(a \wedge b) = p(a/b)\ p(b) \quad - (i)$$

Similarly

$$p(b/a) = p(a \wedge b) / p(a)$$

$$p(a \wedge b) = p(b/a) \cdot p(a) \quad - (ii)$$

Equating (i) and (ii)

$$p(a/b)\, p(b) = p(b/a) \cdot p(a)$$

$$\Rightarrow p(b/a) = p(a/b) \frac{p(b)}{p(a)}$$

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Baye's rule is useful in practise because there are many cases where we have good probability estimates for three of the four probabilities involved, and therefore can compute the fourth one.

A doctor knows that the ~~disease~~ meaning meningitis cause the patient to have a stiff neck 70% of the time. The doctor also knows that the probability that a patient has meaningitis is 1/50,000 and the probability that any patient has a stiff neck is ~~1/20~~. Find the probability that a patient with a stiff neck has meningitis.

Soln

Let s be the proposition that the patient has a stiff neck and m be the proposition that the patient has meaningitis we have,

$p(s/m) = \cancel{0.07}\ 0.7$

$p(m) = 1/50,000$

$p(s) = \cancel{0.01}\ \cancel{1/20}\ 0.01$

$p(m/s) = p(s/m) * p(m) / p(s) \Rightarrow (0.7 * 1/50000) / (0.01)$

$\Rightarrow \cancel{0.0002}.\ 0.0014$

That is, we expect has than 1 is 700 punts with a staff neck to have meanng.

Event though a staff neck is quick strongly indicated by meaningits (with probability 0.7) the probability of miningitis on the patient remains small. This is because the prior probability of staff necks is much higher than that of meningitis.

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(6) After your yearly checkup, the doctor has bad news and good news. The bad news is that you tested positive for a serious diseases and the test is 99% accurate (ie the probability of testing positive given that you have the disease is 0.99 as is the probability of testing negative if you don't have the deases). The good news is that this is rare diseases, strikes only one in 10,000 people.

(a) why is it good news that the disease is rare?

(b) what are the chances that you actually the deases.

Soln,

(a) probability of string of this deases $= \frac{1}{10,000}$

As propability of string this deases is very small so it is good news that the diseases is rare.

(b)

Let $P(T)$ = ~~positive~~ positive test.

$P(D)$ = Having diseases

$P(D) = 1/10000 = 0.0001$

Chance actually have deases $P(D/T) = ?$

Given

$$P(T/D) = 0.99$$

$$P(T/D^c) = 0.99$$

$$P(D/T) = \frac{\{P(T/D) * P(D)\}}{\{P(T/D) + P(D)\} + \{+(T/D^c) + P(D^c)\}}$$

$$= \frac{0.0001 * 0.99}{0.0001 * 0.99 + (0.9999 * 0.99)} = \frac{1}{10009} \Rightarrow 9.99 \times$$

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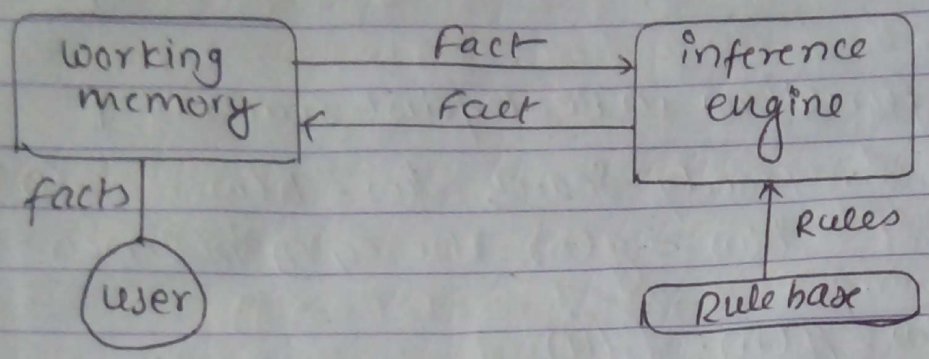
2069

1) What do you mean by Fardward chaining? Why it is required? Explain it ~~wht~~ with two practile example.




in fordward channing system we start with the initial facts, and keep using the rules to draw row intermediate conclusion (or taken actions) given those facts. The process terminates when the final conclusion is established.

→ ~~Backward~~ fird ward channing is required because forward chaning is one of the main method of reasoning when using inference rules.

→ Describe logically as repeated application of modus phenens

→ Fordward chaining starts with the available data and uses inference rule to extract more data until a goal is reached.

Example, The rule base contings the following four rules

- if x crocks and eats flies - Then x is a frog
- if x chirps and sings - Then x is canary
- if x is a frog - Then x is green
- if x is canary - then x is yellow.

Goal: Conclude the color of a pet named fritz, given that the croaks and eat flies.

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Q.70

(3) if we set the heuristic function $h(n) = g(n)$ for both greedy as well A*. what will be effect in the algorithm? explain.

→ The heuristic function in Best first search is

(a) Also we know greedy search $f(n) = h(n)$ —— (i)

NO if we set $h(n) = g(n)$ the eq (i) becomes

$$f(n) = g(n) \text{ -- (ii)}$$

Then it find exact cost of getting to the current node that is it uses exact cost function instead of estimated minimum cost of getting from n to goal state.

(b) As we know A* search uses $f(n) = g(n) + h(n)$ - (i)

Now if we set $h(n) = g(n)$ then it becomes

$$f(n) = 2g(n) \text{ - (ii)}$$

This is exactly like uniform-cost search factor of two makes no difference in ordering of the nodes

(4) The minimax algorithm returns the best move for max under the assumption that MIN play optimally. what happens when MIN plays suboptimally

→ point

MIN playing suboptimally mean by defination that MIN selects a move with minimum utility greater than or equal to the move predicated by MinMax.

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→ The outcome of MAX can only be the same or better if MIN plays suboptimally compared to MIN playing optimally. So, in general, it seems like a good idea to use minimax.

→ However suppose MAX assumes MIN plays optimally and minimax determines that MIN will win. In such cases, all moves are losing and are "equally good", including those that lose immediately. A better algorithm would make moves for which it is more difficult for MIN to find the winning line

Example.

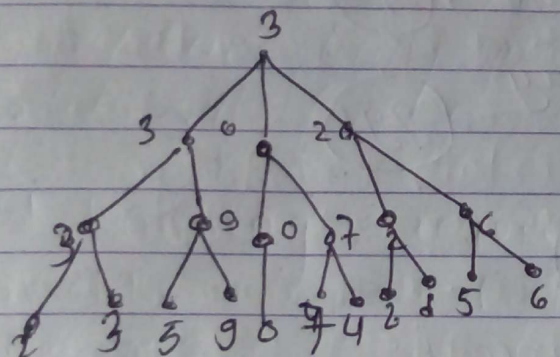
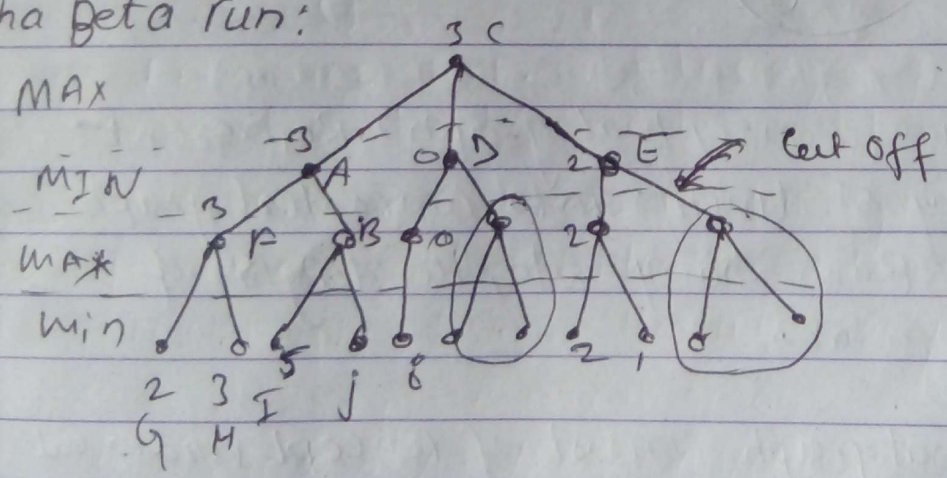


Fig minimax without pruning

Alpha Beta run:

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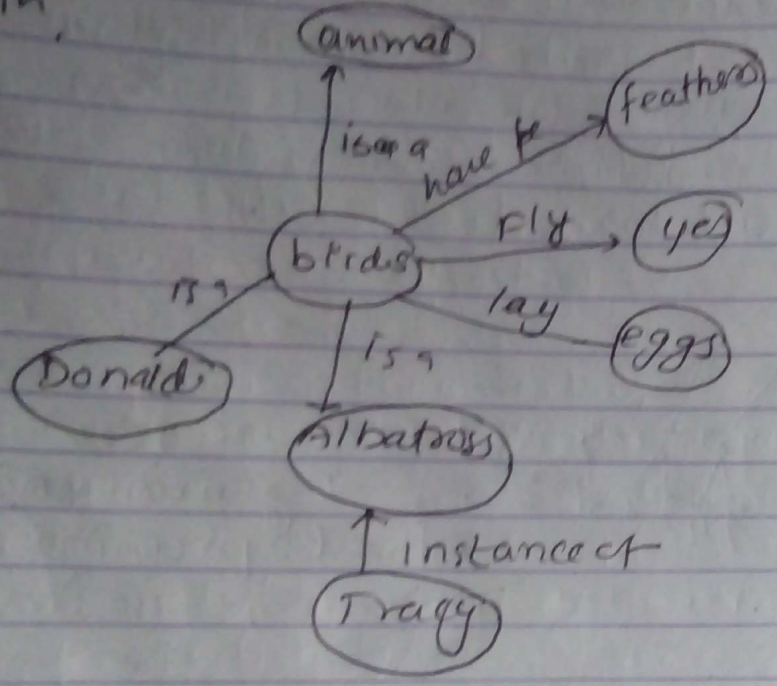
(6) Represent the following sentence into first order logic.
Birds are animals.
Birds have feathers, fly and lay eggs
Albatross is a bird
Donald is a bird
Tracy is an aliator.

Soln,




(8) What are conceptual graph? Represent the following statment into conceptual graph
"King Ram marry sita, the daughter of king janak"

→ A conceptual graph consist of concept nodes and relation nodes.

(i) The concept node represent entities, attributes state and events. Concept node represent:

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(a) either a concrete concepts : such as a cat, telephone or restrant are charactered by our ability to form an image of them in our minds.

(b) or a abstract concepts : such as love beauty and loyealty that do not correspond to mlage in our minds

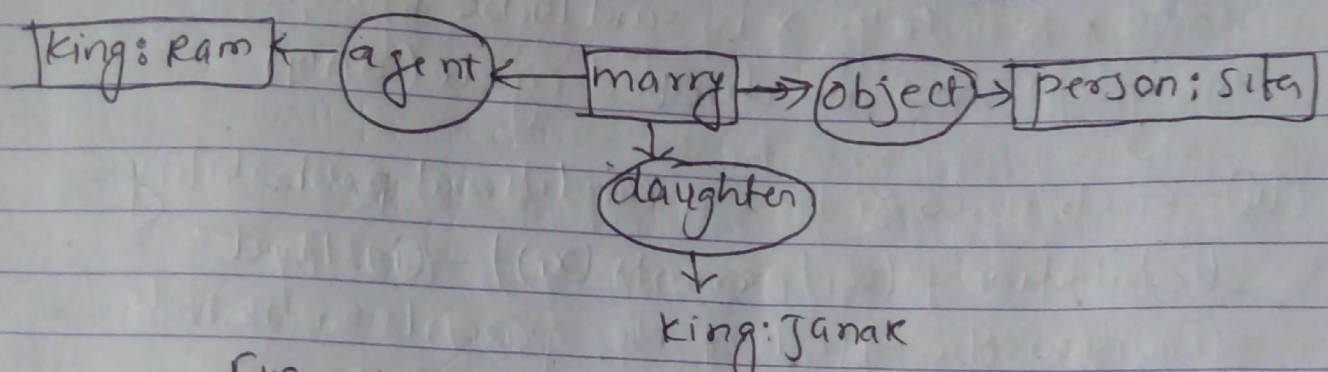


Fig: King Ram marry Sita, the daughter of King Janak

(10) What is Bayesian Network? Explain how Bayesian Network represents and inference the uncertain knowledge.

→

Bayesian Network is a data structure to represent the dependencies among variables. Basian network can represent essentially any full point probability distribution and in many cases can do so very concisely.

- Bayesian Network is also called belife networks or probabilistic network or casual network or knowledge.

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A Baysian network is a directed a cyclic graphical model graph, it contains the following information
(i) Each node corresponds to a random variable which may be discrete or continous
(ii) A set of directed link or arrows connected pairs of nodes. if there is an arrow from node x to node y. x is said to be parent of y. The graph has no directed cycle (DAG)
(iii) Each node $x_i$ has a conditional probability distribution $P(x_i | parents(x_i))$ —(i) that quanties the effect of the parents on the node.

<u>inference the uncertain knowledge</u>
<u>(inference in Bayesian network)</u> :-
It is one of the exact inference in Baysian network. Any conditional probability can be compated by summing terms from the full joint distribution

$$P(X/e) = \alpha P(X,e) = \alpha \sum_{y} P(X,e,y)$$

x denots the query variable
e denots the set of evidence variable
y: denots the hidden variables
$\alpha$ is Normalization.

Example: practical Bayesian network to estimate the probability of a burglary with given evidence who has or ~~has~~ has not call

variable: Burglary, Earthquake, Alarm, JohnCalls MaryCalls.

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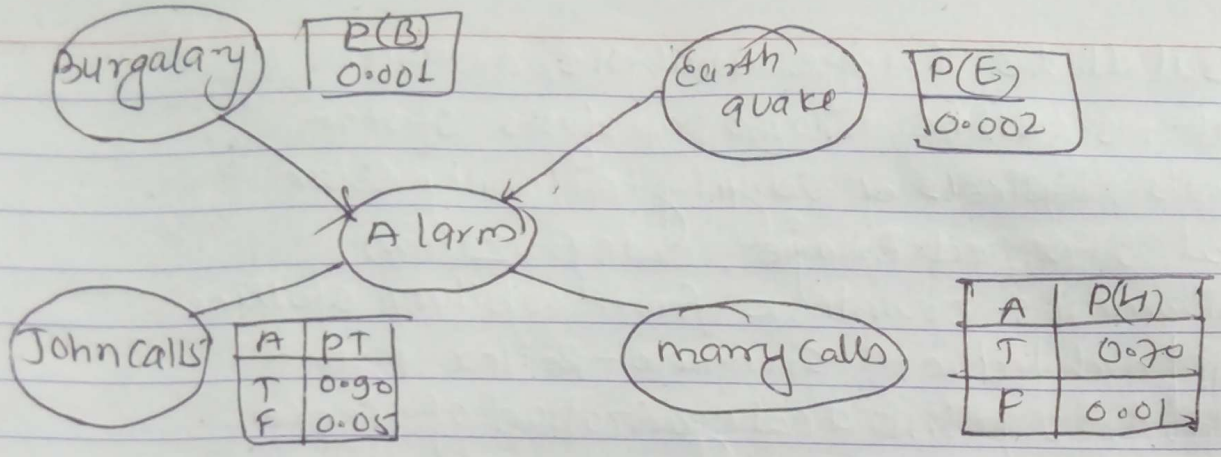


The probabilities associated with the nodes reflect our representation of the causal relationships.
A Bayesian network provides a complete description of the domain in the sense that one can compute the probability of any state of the world (represented as a particular assignment to each variables.

2068 | 2071

(2) For each of the following agents, determine what types of agent architecture is most approprite (i.e. table lookup simple reflex, goal-based or utility-based?

(a) medical | diagnosis System.

Agent : medical | diagnosis system
Action: questions, tests, treatments
Goal : Healthy patient, minimize cost
Environment: patient, Hospital, staff
Agent architecture : Table-lookup, Agent
percepts : system, finding patients answers

Q2

(b) satellite image analysis system
Agent : satellite image analysis system
percepts : pixels of varying intenity color
Goal : Correct image categorization
Environment : Downlink from orbitary stallice
Agent | architecture : simplex-Reflex Agent
Actions : print a categorization of scence

(c) part-picking robots
Agent : part picking robot
percepts : pixel of varying intensity
Actions : pick up parts and sort into bins
Goals : place parts in correct bins
Environment :- Convey or belt with parts : bins
Architecture : Cool based Agent.

(d) Refinery robot
Agent : Refinery robot
percepts : ~~open, close, valves adjust temperature~~
~~Ac~~ temperature, pressure reducing
Actions : open ; close, valves ; adjust temperature
Goals : maximize purity, yield, safety
Environment : Refinery, operators
Architecture : simplex Reflex Agent

(e) interactive English tutor

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Agent : interactive English tutor
Precepts : Typed words
Actions : print exercises, suggestions, correctness
Goals : Miximize student score on the test
Environment : set of students, testing agencys
Architecture : utility - Based Agent ( Because we need optimal goal)

2071 (6)

Consider the following sentence:

$[(Food \Rightarrow party) \vee (drinks \Rightarrow party)] \Rightarrow [(Food \wedge drinks) \Rightarrow party]$

(a) Convert the right hand and left hand sides of main implication into CNF

(b) prove the validity of sentence using resolution.

Soln,

Let $F = Food$
$P = party$
$D = drinks$

then $[(F \Rightarrow P) \vee (D \Rightarrow P)] \Rightarrow [(F \wedge D) \Rightarrow P]$

For LHS $(F \Rightarrow P) \vee (D \Rightarrow P)$

Step (1) eliminate $\Rightarrow$ as $P \Rightarrow Q = \neg P \cup Q$

ie $(F \Rightarrow P) \vee (D \Rightarrow P) = (\neg F \vee P) \vee (\neg D \vee P)$

Step (2) using associated law in (1) we get

$(\neg F \cup P \cup \neg D)$ is in CNF - (1)

For RHS of main implication is $[(F \cap D) \Rightarrow P]$

Steps Remove '$\Rightarrow$' using $P \Rightarrow Q = \neg P \vee Q$

ie $(P \cap D) \Rightarrow P = \neg(F \cap D) \vee P$

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Step II use De-morgan's law $\neg(p \wedge q) = \neg p \vee \neg q$ then

$\neg(F \wedge D) = (\neg F \vee \neg D) \vee q$

Step III, ~~use De~~ associate law we get

$(\neg F \vee \neg D \vee R)$ is in CNF --- (ii)

(b) The KB contains

(i) $(\neg F \vee p \vee \neg D)$

(ii) $(\neg F \vee \neg D \vee q)$

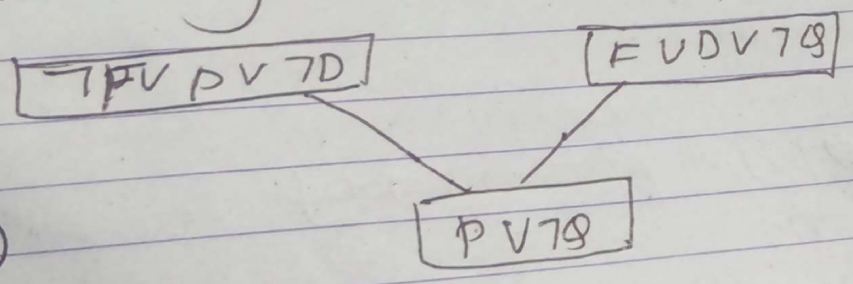
Now we have to show $\neg(\neg F \vee \neg D \vee q)$ by using resolution

Hence new KB contains.

(i) $(\neg F \vee p \vee \neg D)$

(ii) $\neg(\neg F \vee \neg D \vee q) = (F \vee D \vee \neg q)$

Now using resolution algorithm




सतेंद्र कुमार

2071

(9) What is the difference between symbolic and non-symbolic AI? Represent the following knowledge in semantic network. Robin is bird, Clyde is Robin, Clyde owns a nest from spring 2014 to fall 2014.

| → Symbolic AI | non-Symbolic AI |
|---|---|
| (i) Symbolic AI often associated with the idea that "intelligence is computation" and "the brain is a computer" | (i) it is often associated with the idea that "intelligence is adaptive behaviour" and "it arises from the dynamical interactions of networks of simple components". |
| (ii) Eg planning maps are symbolic representation | (ii) Eg. ANNs (artificial neural networks. |

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2070

(1) what is "Turing test" in Artificial intelligence (AI) ? criticize the performance of the "Turing Test" to measures the intelligence of the machine.

→ see Q.No.1, page1 -

critices of Turing test:

→ Test is not reproducible, amenable or constructive to mathematical analysis as it is more important to study the underlined principle of intelligence than to duplicate example.

→ Try to evalute machine intelligence is terms of human intelligence is fundamental mistake. it focus to much on the behaviour of conversation.

Factors required to passing turing test.

→ Natural language processing : To communicate easily

→ knowledge Representation: To store facts and rules.

→ Automated reasoning : To draw conclusion from stored knowledge.

→ Machine learning : To adopt new circumstance and detect pattern.

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2071

① Define with suitable supporting statments and example," Artificial intelligence is the System that act like humans".

→ 'Act like humanly'

"The art of creating machines that perform functions that required intelligence when performed by people."

- machine is required to act as humans do
- Turing Test, proposed by Alan Turing (1950) Turing's definition of intelligent behavior as the ability to acheives human-level performance in all cengitive task. The test involves an interrogator who interacts with one human and one machine, within a given time the integrator has to find out which of the two the human is and which one the machine

- Issue to solve in order to pass the test using a terminal: natural language processing knowledge represented automated reasoning machine learning.

eg. a turing test approach

2069

② "System that think like humans" and "System that act like humans" are the parts of artificial intelligence justify the statement with practical example.

- see - 2071 - 1 page 38

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Thinking humanly.
- It is the action or process of acquiring knowledge and understanding through, experience or the sense. machine needs to understand how human think.
- It is mainly concerned with investigation, development of human behaviour and working of human mind in the computer.

Example: General problem solver (GPS) develop by Newell & Simon (1961) attempted to synthesis the human solving process. Compares the steps of the problem with the reasoning to human subject solving the same problem.

2 breadth first / time
depth
Bidirection

2070 ② Explain the uniformed search technique with example.

The uniformed search techiques are as follow:

A) ~~Brea~~ Breadth first search, (BFS)
→ proceeds level by level down the search tree.
→ Starting from the root node (initial state explores children of the root node, left to right.
→ If no solution is ground, expands the first (left most) child of the root, these expands the second node at depth 1 and so on

Algorithm:
- place to start node in the queue.
- Examine the node at the front of the queue.

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a. if the queue is empty, stop
b. if the node is the goal, stop
c. otherwise, add the children of the node of the end of the queue.

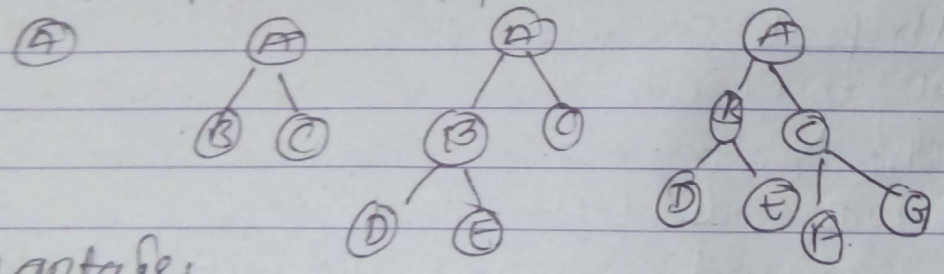
properties.

- Completness:
Complete if the goal node is at Infinite depth.
- optimality:
it is guranteed to find the shortest path
- b is an branching factors and d as tree depth level.

Time complexity: $O(b^{d+1})$
Space Complexity $O(b^{d+1}$

<u>example.</u>

put the start node in the queue, example the first element of the queue. if it is the goal state, stop, otherwise put in children in the queue




Advantages:
- Guranteed to find a solution (ie one exists)
- Depending on the problem, can be guranteed to find one optimal solution.

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Disadvantage:
- more complex to implement
- Need a lot of memory for storing the state space if the search space has a high branching factors.

## ~~Area~~ Depth first search (DFS):-

- DFS process drawn a single branch of the tree at a time if expand the root node, then the leftmost child of the root n always expand a node at the deepest level of the tree. only when the search hits a dead end (a reachable solution which can not be extended), the search back track (retrace one step) and expand nodes at higher level

Algorithms:
- put the start node on the stack
- while stack is not empty.
- (a) pop the stack
- (b) if the top of stack is the goal, stop ~~the top of the stack on the stack (pro~~
- (c) otherwise push the nodes connected to the top of the stack on the stack (provided they are not already on

Completness: if search space is infinite and search space contains loops then DFS may not find solution.

Time Complexity: $= O(b^m)$

Space complexity $= O(bm)$

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Depth limit search.

- it is DF-search with depth limit l
  - ie node at depth l is assumed to have no successors
  - problem knowledge can be used to guess the value of l

Solves the infinite-path problem of DFS. yet it introduces another source of problem if we are not able to find good guess of l. Let d is the depth of shallowest solution.

if l<d then incompleteness result

if l≥d then ~~d~~ not optimal.

Time complexity : $O(b^l)$

Space complexity $O(bl)$

eg. Number of nodes for b = 10 and d = 5 both at for right

$N(IDS) = 50 + 400 + 3000 + 10000 + 100000 = 123450$

$N(BFS) = 10 + 100 + 1000 + 10000 + 99999 = 1111100$

Bidirectional search:

This is search algorithm which replaces a single search ~~algorithm~~ graph, which is likely to with two smaller graphs - one straight from the initial state and one starting from the goal state. it then, expands nodes from the start and goal statement simultaneously check at each stage if the nodes of one have been generated by the other ie they meet in the middle if so the path concentration is the solution.

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- completness: yes
- optimality: yes (if done correct strategy: eg breath first)
- Time complexity $O(b^{d/2})$
- Space complexity $O(b^{d/2})$

Drawback of uniform search:
- Criterion to choose next node to expand depends only on a global criterion: level
- Doesnt exploit the structure of the problem
- one may prefer to use a more flexicable rule, that takes advantage of what is being discovered on the way, and hunches about by comparing the current state and to desired state.

2069
⑤ Justify that AI can't exist without searching. Explain in detail about any two types of informed search with suitable example.

→ See- page 6- QN.5-

Informed search
(heurestic search)
A* Search:

{Hill climbing search
Best first search
Greedy search
A* search
Simulated Annealing}

- It finds a minimal cost-path joining the start node and a goal node for node 'n'.

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Evalution function: $f(n) = g(n) + h(n)$

where

$g(n)$ = cost so far to reach n $f(x)$ in root

$h(n)$ = estimate cost to goal from n

Thus $f(n)$ estimates always the lowest total cost of any solution path going through node n

→ Avoiding expanding path that are already expensive

→ The main drawback of A* algorithm and indeed of any best first search is its memory requirement

→ A* search example (find path from A to B)

Here evalute nodes connected to source Evalute $f(n) = g$

+ $h(n)$ for each node ~~Set~~

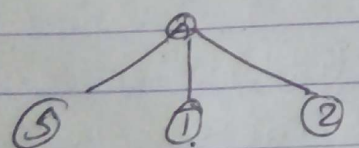
- select node with lowest $g(n)$ value

eg.

step 1

366+0 = 366

step 2

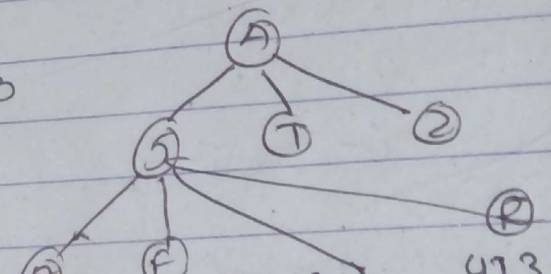



393 = 140+253

449 = 75+374

477 = 118+378

step3



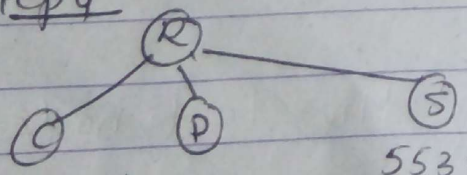

415 = 239+176

473 = 220+19

646 = 280+366

671 = 291+380

step4

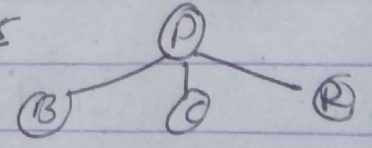



526 = 366+160

553 = 300+253

417 = 317+100

step5




418 = 418+0

615 = 455+160

607 = 404 +19

Best first search

- A node is selected for expansion based on evaluation function f(n)
- Node with lowest evaluation function is expanded first
- The evaluation function must represent some estimate of the cost of the path from state to the closest goal state.
- One important heuristic function is h(n)
- h(n) is the estimates cost of the cheapest path from node to the goal.
- Types.
  - Greedy Best first search
  - A* search.

2071

(5) Briefly describes the approach of knowledge representation with example.

→ Representating information about the world in a form that a computer system can utilize to solve complex task

→ it is a set of ontological commitments ie an answer of question.

→ Knowledge representation can be logical representation or structured representation

→ Representing the rules and constraints is through the use of logic rules, formally known as knowledge representation.

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A good system for knowledge representation should have

(i) Represential Adequacy:- Ability to represent all kind of knowledge that are needed in the domain

(ii) Inferential Adequency:
Ability to manipulate to represential structure in such a way as to derive new structure corresponding to new knowledge infered from old.

(iii) inferential efficiency: Ability to incorporate into the knowledge structure additional information that can be used to focus the attention of the inference machiom in the most efficient directions.

(iv) Acquisitional Efficiency: Ability to acquire new information easily

eg. "Ram caught a cold"
An letter ask each Ram ill you migh expect "yes", he has a cold but computer must know. In this context
cold = diseases and caught as the past tense of catch.
we represent the information as predicate in a computer
(RAM, caught - diseases, cold - diseases).

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2069

(7) what do you mean by causal network? Explain it with practical application.

→ A causal network is acyclic cnct cyclic directed graph arising from an evolution of substitution system. The ~~solution~~ substitutions system is a map which uses a set of rules to transform elements of a sequence into a new sequence using a set of rules which translate from the original sequence to its transformation.

For eg. The substitution system would take

$10 \to 011 \to 1100 \to 001111 \to \ldots$

$$\boxed{\begin{array}{l} 1 \to 0 \\ 0 \to 11 \end{array}}$$

A causal network is Bayesian network with an explicit requirement that the relationship be causal

See → Bayesian network.

2070

(7.) What is an expert system? Explain the architecture and feature of rule-based expert system.

→ An expert system is a computer system which performance is guided by specific expert knowledge in solving problems.

- a computer system that stimulates the decision making process of human expert in a specific domain

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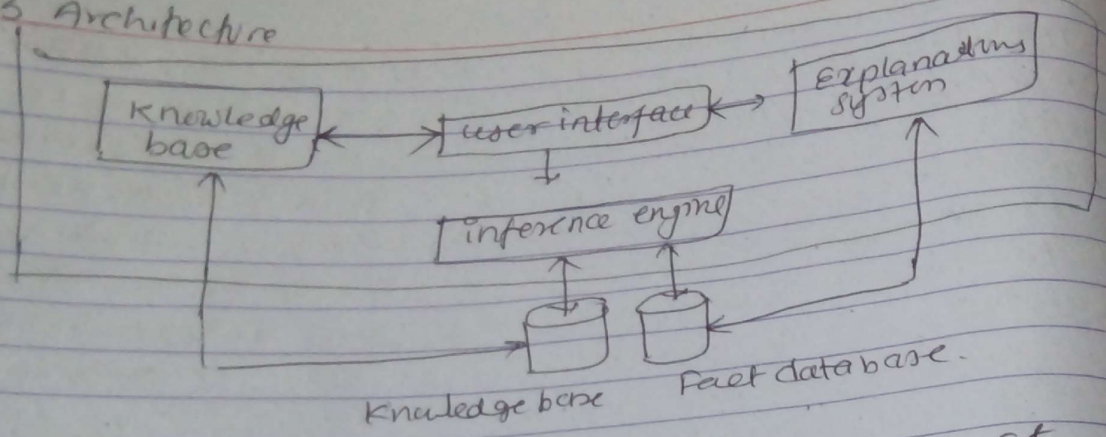
ES Architecture




Knowledge base:
Knowledge base are collected from a number of human experts and modified by a knowledges engineer.

Knowledge base = facts + rules.

Facts are the type of declarative knowledge which describes what is known about a given problem. They are statements which are asserted into the working memory with either true or false value. The defination, hypothesis, theorms, probability, images measurements, relationships, constrains, observation etc will be the ~~false~~ facts.

Inference engines:
Makes inferences by deciding which rules are statisfacted by facts and fires the rules. The major tasks performed by the inference engine include.

(i) The reasoning task: implement the rules to discover new data

(ii) The control task: determine the order in which rules are fired.

(iii) The explanation task:
response to a user request to explain why certain data is required

(iv) The how task: respond to a user request to report how a conclusion was reached.

(v) The uncertaining task:
manage uncertainity in the data

<u>user interface:</u>

The component of an expert system that communicated with the user is known is the user interface. The communication performed by a user interface is bidirection. at the simplest level we must be able to describe our problem to the expert system and the system must be able to respond with its recommendations

<u>Features of an expert system:</u>

→ The program should be useful
→ The program should be useable
→ The program should be educational when appropriate
→ The program should be able to explain it advice.
→ The program should be able to respond to simple questions.
→ The programs should be able to learn new knowledge
→ The programs knowledge should be easily modified.

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Advantage of ~~Expert~~:-

→ it provides consistent answer for repetitive decisions, processes and task

→ hold and maintained significant level of information.

→ Encourage organization to classify the logic of their decision making

→ Ask question like human expertise.

Disadvantage:

- lack of common sense needed in some decision making

→ Cannot make creative response as human expert would in unusual circumstances

- error may occur in knowledge base and lead to wrong decision.

→ cannot adopt changing environment unless knowledge base is changed.

2069

(8) ~~Exp~~ What is neutral network? Explain any one type of neural network with practile example

→ An artifical neural network (ANN) is an information processing paradigm that is inspired by the way biological nervous system, such as the brain process information. The key element of this

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paradigm is the novel structure of the information processing system. it is composed large no of highly interconnected processing elements (neurons) working in unison to solve specific problems. ANNs like people, learn by example. An ANN is configured for a specific application, such as pattern recognition or data classification, through a learning process.

Types of Neural networks

(1) single of Neutral network:

1) Single layer feed fardward network

A neural network in which all the inputs connected directly to the outputs is called a single-layer neural network or a preception network. since each output unit is independent of the other each weight affects only one of the outputs.

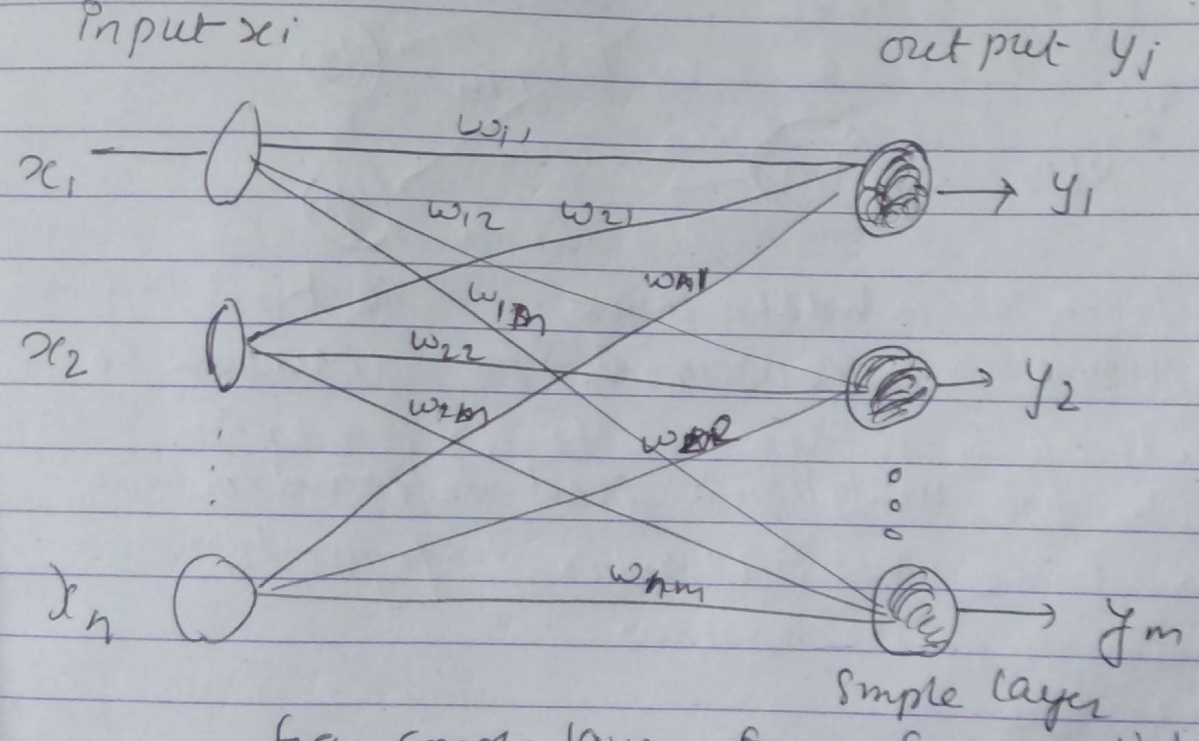


fig. single-layer-feed forward Network.

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(2) multilayer feed forward network (multilayer perceptron)

multilayer feed forward network, The netural network which contain input, output layers and some hidden layer also is called multilayer neural network. The advantage of adding hidden layers is that it enlarges the space of hypotheses layers of the network are normally ~~fully~~ fully connected

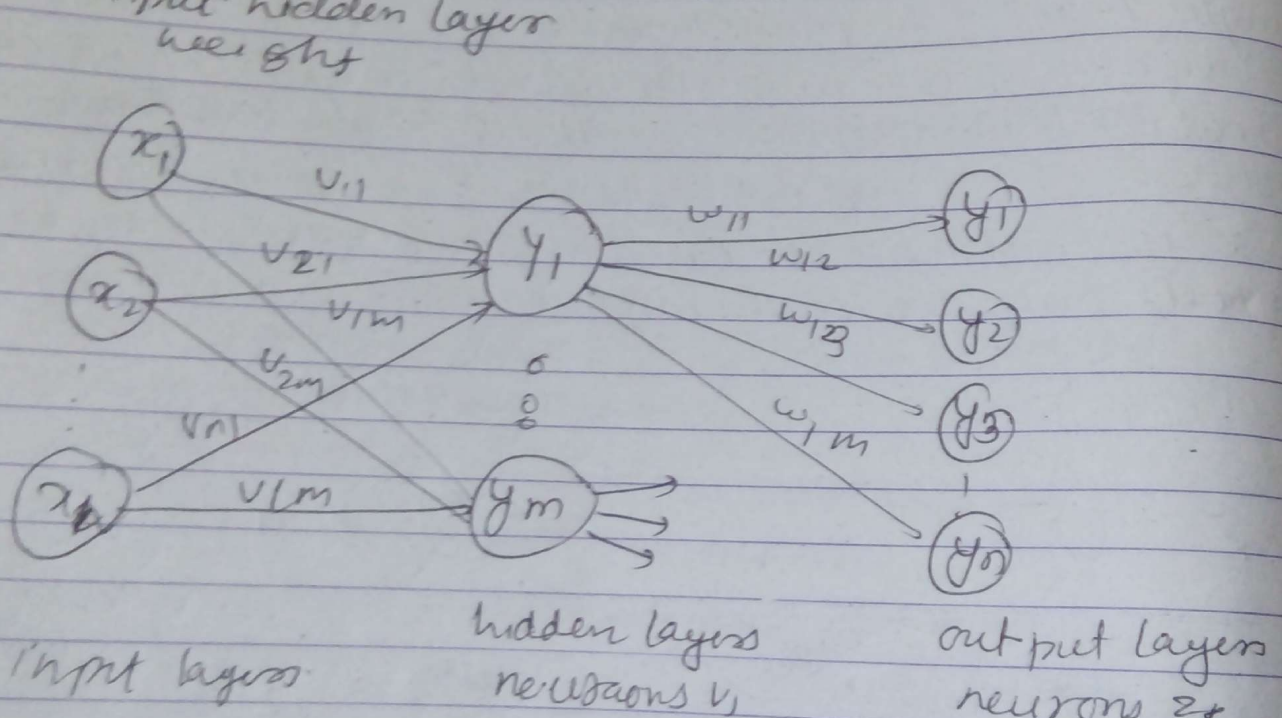


fig. multilayer feed forward network in (L-m-n) configuration.

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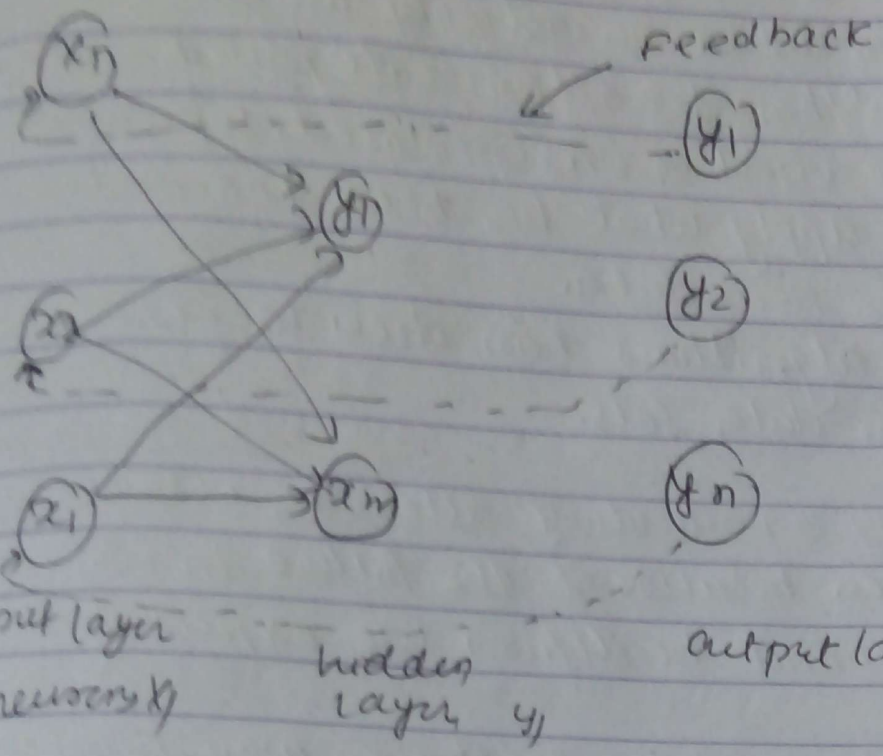
network
(2) Recurrence Relation (feed back)




(2070)

(9) What is machine learning? Explain the learning from analogy and instance based learning?

→

machine learning is type of AI that provides computer with the ability to learn without being explicity programmed machnie learnny focuses on the development of computer programs that can teach themselve to grow and change when exposed to new dat.

The process of machine learning is similar to that of data mining. Both system search through data to look for patterns. However instead of extracting data for human comprehension, machine learning uses

the data to detect the patterns in data and adjust program action accordingly. Machine learning algorithm are often categorized are being supervised or unsupervised; supervised algorithm can apply what has been learned in the past to new data.
unsupervised algorithms can draw ~~in gene~~ inference from data sets.

Machine learning is particularly attractive in several real life problem because of the follows in reasons
- Some tasks cannot be defined we expect by example.
- Working environment of machines may not be known at design time.
- Explicit knowledge encoding may be difficult and not available
- Environments change over time
- Biological system learn.

Recently, learning is widely used in number of application area including
→ Data mining and knowledge discovery
- speech / image / video (pattern) recognition
- Adaptive control
→ Autonomous vehicles (robots)
→ Decision support system
→ Bio informatics
- [ www

Formally, a computer program is said to learn from experience E with respect to some class of tasks T and performance measure P, if it performance at task in T as measured by P improves with experience E.
Thus learning system is characterized by
- Task T
- experience E

## Learning by Analogy:-

- Analog is a reasoning process of transferring information from a particular subject to another
- analog plays a significant role in problem solving such as decision making, perception, memory, creativity emotion, explanation and communication.
- It lies behind basic tasks such as the identification of places, objects and
- people, for example in face perception and facial recognition systems.

## Inductive learning: (instance based learning)

Inductive learning is a powerful strategy for helping machine deepen their understand of context and develop their inference and evidence-gathering skills. In an inductive learning, machine examine group and label specific "bit" of information the find patterns.

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