explained informed search techniques

2069 Explain two types of informed search with example.

1. Uniformed Search
   - Breadth first search
   - Depth first search
   - Depth limit search
   - Bidirectional search

2. Informed search or Heuristic search
   - Hill climbing search
   - Best first search
   - Greedy search
   - A* search
   - Simulated Annealing

Breadth first search (BFS)

IMP

2073

→ Proceeds level by level down the search tree

→ starting from the root node (initial state) explores all children of the root node, left to right

→ If no solution is found, expands the first (leftmost) child of the root node, then expands the second node at depth 2 and so on.

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Algorithm

- place the start node in the queue
- Examine the node at the front of the queue
  - 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

- **completeness:**
  Complete if the goal node is at finite depth

- **Optimality**
  It is guranteed to find the shortest path

- b as branching factor and d as tree depth level

Time complexity :

$$O(b^{d+1})$$

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Space Complexity :

$$O(b^{d+1})$$

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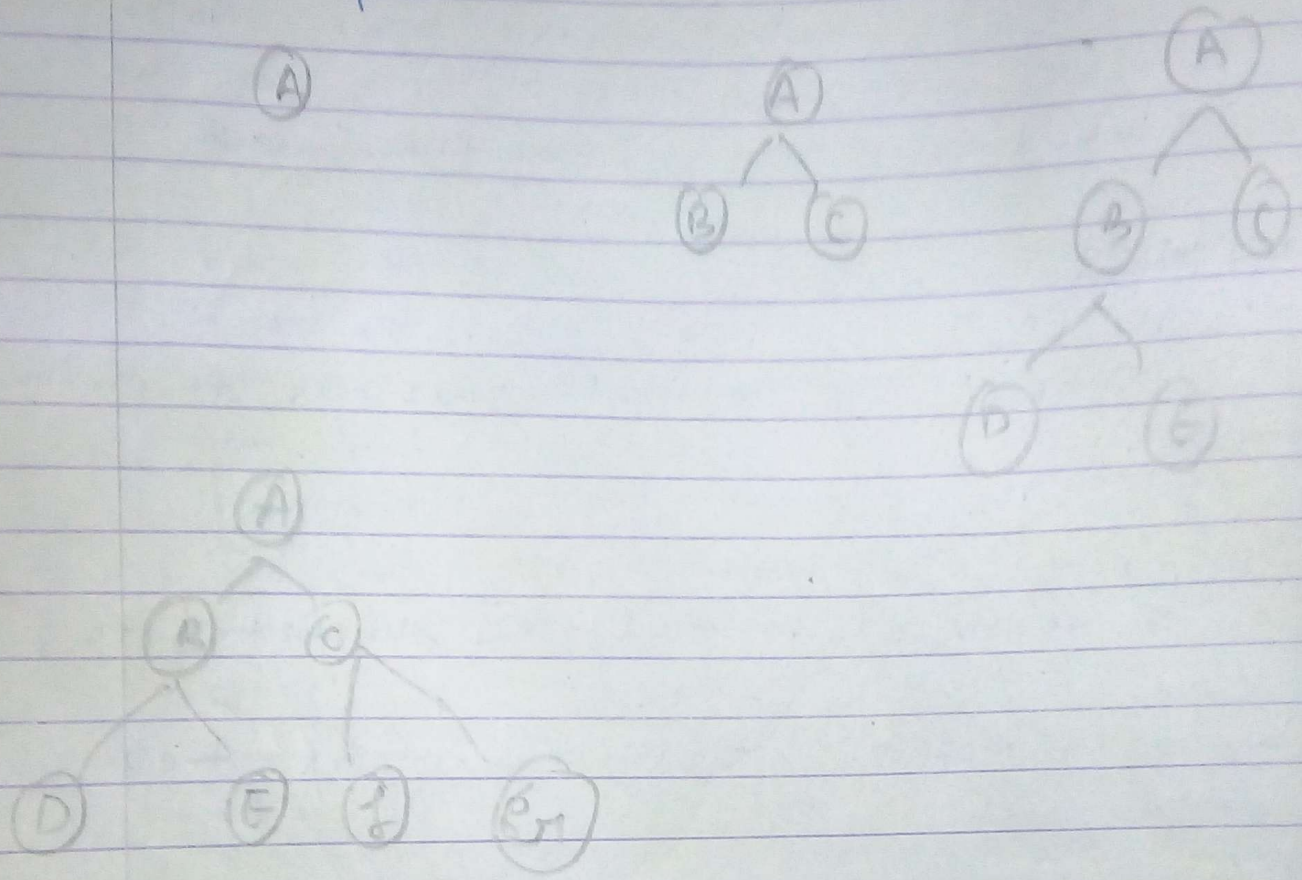
BFS example (find path A to

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



Advantages

- Guranteed to find a solution (if one exists);
- Depending on the problem, can be guranteed to find an optimal solution.

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Disadvantages

- More complex to implement
- Need a lot of memory for storing the state space if the search space has a high branching factor.

Imp

B. Depth first search (DFS)

2073

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- It processes a single complete branch of the tree at a time.
- It expands the root node, then the leftmost child of the root node.
- Always expands a node at the deepest level of the tree.
- Only when the search hits a dead end (a partial solution which can't be extended), the search backtrack (retracing the steps) and expand nodes at higher levels.

Algorithm

→ 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

c. otherwise push the nodes connected to the top of the stack on the stack (provided they are not already on

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C. A* Search

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

→ Evaluation function : $f(n) = g(n) + h(n)$

where,

$g(n)$ = cost so far to reach n from root

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

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

→ Avoid expanding paths 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, evaluate nodes connected to source.
Evaluate $f(n) = g(n) + h(n)$ for each node.
Select node with lowest $f(n)$ value.

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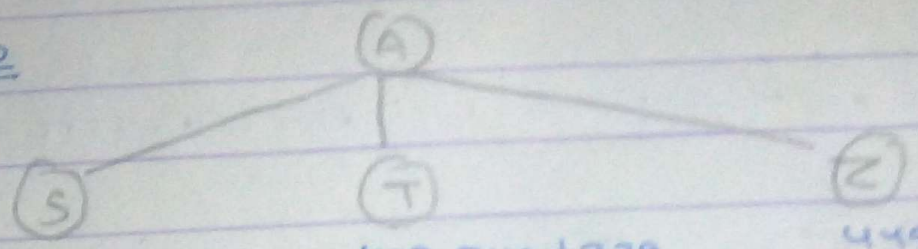
Step 1

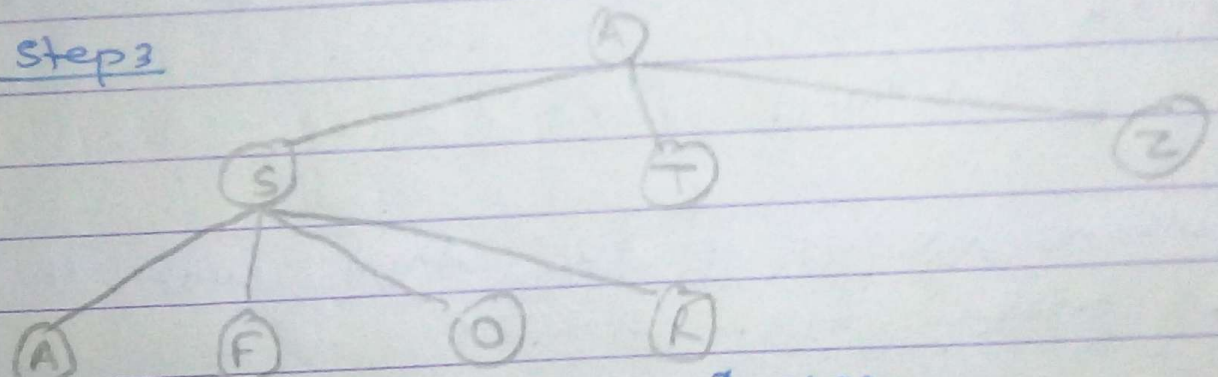
366+0=366

Step 2



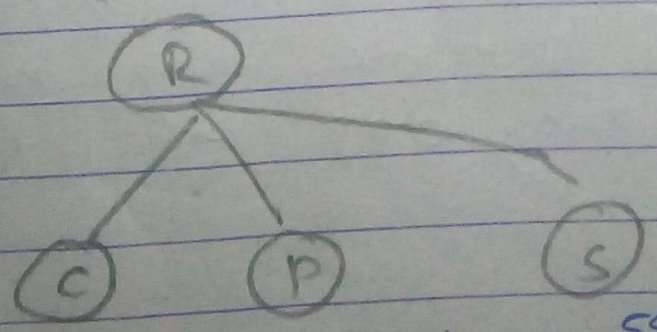
393=140+253 447=118+329 449=75+374

Step 3



646=280+366 415=239+176 671=291+380 423=220+193

Step 4



526=366+160 417=317+100 553=300+253

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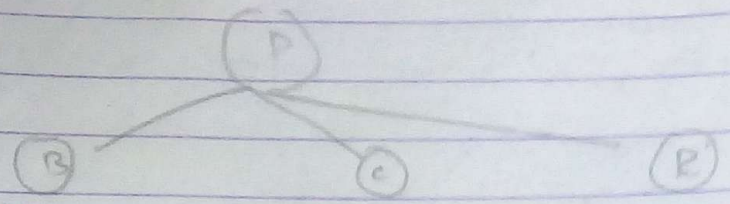
2073: What do you mean by admissible heuristic then what improvement is done in A* Search is given greedy search? prove the A* search is optimal solution.

Steps :-



418 = 418 + 0 615 = 455 + 160 607 = 414 + 193

→ Admissible heuristics

- A heuristics h(n) is admissible if for every node n,

$$h(n) \leq h^*(n),$$

where $h^*(n)$ is the true cost to reach the goal state from n.

- Example :
  $h_{SLD}(n)$ (never over estimates the actual road distance)

- An admissible heuristic never overestimates the cost to reach the goal, i.e, it is optimistic.

- Theorem:
  If h(n) is admissible, A* using GRAPH - SEARCH is complete
  - space complexity = $O(b^d)$
  - TIME complexity = $O(b^d)$

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Consistent heuristics

- A heuristics is consistent if for every node n, every successor n' of n generated by any action a,

$$h(n) \leq c(n, a, n') + h(n')$$

If h is consistent, we have

$$f(n') = g(n') + h(n')$$
$$= g(n) + c(n, a, n') + h(n')$$
$$\geq g(n) + h(n)$$
$$= f(n)$$

i.e, f(n) is non-decreasing along any path.

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Translate the following sentence into FOPL.

every, all, for each, → ∀

2070 Q 69

Translate sentences into statements of predicate logic

2073 ① Every student in this class has pass Digital logic.

Soln

Domain: student in this class only.

$p(x)$: x in the class who pass digital logic.

$\forall x\, p(x)$

{कुन Domain लिने}

Domain: All students

$p(x)$: x is a student in this class

$Q(x)$: x is pass in Digital logic.

$\forall x\, (p(x) \rightarrow Q(x))$

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2069 why normal form are required in AI
How do you convert to the disjunctive normal form. Explain all the steps with practical example.
2072

CNF (Conjuctive Normal Form)

2071 A sentence that is expressed as a conjunction of disjunction of literals is said to be conjuctive normal form.
(Imp)

Example:-

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

Conversion procedure for CNF

Step 1:

Eliminate $\leftrightarrow$, replacing $p \Leftrightarrow q$ with $(p \rightarrow q) \wedge (q \rightarrow p)$

Step 2:

Eliminate $\rightarrow$, replacing $p \rightarrow q$ with $\neg p \vee q$

Step 3:

CNF requires $\neg$ (negation) to appear only in literals, so we "move $\neg$ inward" by repeated application of the following equivalences.

$\neg(\neg p) = p$

$\neg(p \wedge q) = (\neg p \vee \neg q)$

$\neg(p \vee q) = (\neg p \wedge \neg q)$

Step 4:

Now, we have a sentence containing nested $\wedge$ and $\vee$ operators applied to literals. We apply distributive law, distributing $\vee$ over $\wedge$ wherever ~~people~~ possible.

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i.e $p \vee (q \wedge r) \equiv (p \vee q) \wedge (p \vee r)$

The original sentence is now in CNF.

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2069: What do you mean by casual network, explain it with practical example.

Casual Network

A casual network is acyclic (not cyclic directed graph arising from an evolution of substitution system. The substitution 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

$10 \rightarrow 011 \rightarrow 11100 \rightarrow 0011111 \rightarrow \ldots$

$1 \rightarrow 0$
$0 \rightarrow 11$

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

2069: What is Bayesian network? explain

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2072 relationship be cause?

2070 what is Bayesian network? explain Bay. Net. and inference the uncertain knowledge.

Reasoning in Belief network:-

A ~~Bay~~ Bayesian network, Bayes' network, Belief network or probabilistic directed acyclic graphical model (a type of statistical model) that represents a set of random variables and their conditional dependencies via a directed acyclic graph (dag)

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For eg:- Bayesian network are used to represent the probabilistic relation between the disease symptoms. from ~~to~~ given symptom the network can be used to compute probabilities of presence of various disease.

Formally, Bayesian network are directed acyclic graph whose needs represent random variables in Bayesian sense:-

- They may be observable quantities latent variables, unknown parameters or hypothesis.

Edges represent conditional dependencies nodes which are not connected represent variables which are conditionally independent of each other. each node is associated with probability function that take a input a particular set of values for node parent variables & gives the probability of the variable represented by the node. Bayesian network are used for modeling knowledge in computational biology, medicine, document classification, information retrieval, semantic search, image processing, data

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Approaches to KR

A good KR system should have the following approach to representing the given information so that the reasoning becomes easy.

Representional Adequacy

It is ability to represent all kinds of knowledge that are needed in a particular domain.

Inferential adequacy

It is the ability to manipulate the different facts that are represented in a standard format in such a way that it derives new structured knowledge from an old one.

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3. <u>Inferential efficiency</u>

It is the ability to derive the new facts from the given fact in an efficient or optimal manner that is a good knowledge representation should be able to incorporate some additional information which can be used to focus the attention of inference engine in the most promising direction.

4. <u>Acquisitional Adequacy</u>

It is the ability to acquire new knowledge from the environment in an efficient manner.

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2022

Expert System

- An expert system is a computer system whose 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.

ES Architecture

The expert system composed of the following main components:

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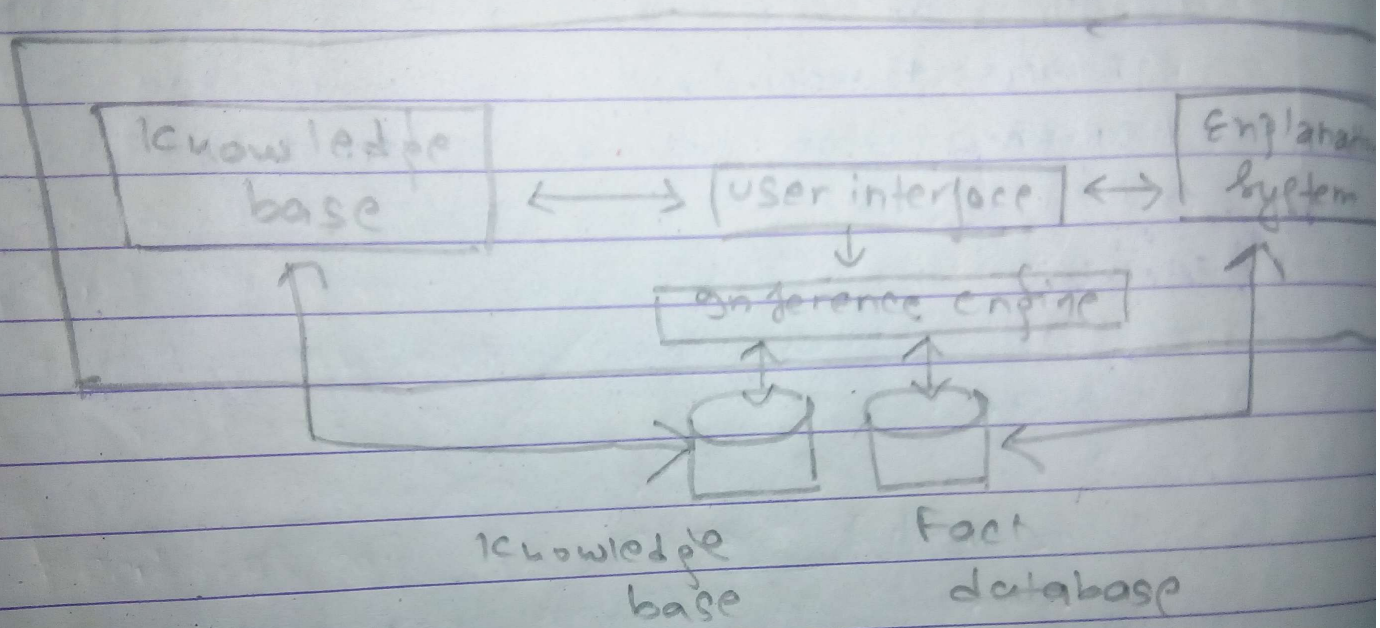

knowledge base:
knowledge are collected from a number of human experts and modified by a knowledge engineer.

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knowledge base = facts + rules.

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

Inference Engines

Makes inference by deciding which rules are satisfied by facts, and fires the rules. The major tasks performed by the inference engine include:

1. The reasoning task:
   implement the rules to discover new data.
2. The control task
   determine the order in which rules are fired
3. The explanation task
   respond to a user request to explain why certain data is required.

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4. The how task:
respond to a user request to report how a conclusion was reached.

5. The uncertainity task
manage uncertainty in the data.

User Interface
The component of an expert system that communicate with the user is known as 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.

Features of an expert system
→ "The program should be useful".
→ "The program should be usable"
→ "The program should be educational when appropriate."
→ "The program should be able to explain its advice".

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→ "The program should be able to respond to simple questions."
→ "The program should be able to learn new knowledge."
→ The program's knowledge should be easily modified".

Advantages
- It provides consistent answer for repetitive decisions, processes and tasks.
- hold and maintained significant level of information
- Encourage organization to clarify the logic of their decision making.
- Ask question like human expertise.

Disadvantage
- Lack of common sense needed in some decision making.
- cannot make creative responce as human expert would in unusual circumstances.
- error may occur in knowledge base and lead to wrong decision.
- Can not adopt changing environment unless knowledge base is changed.

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2069 Explain type of neural network?

Types of Neural network

1. Single layer feed forward network.

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

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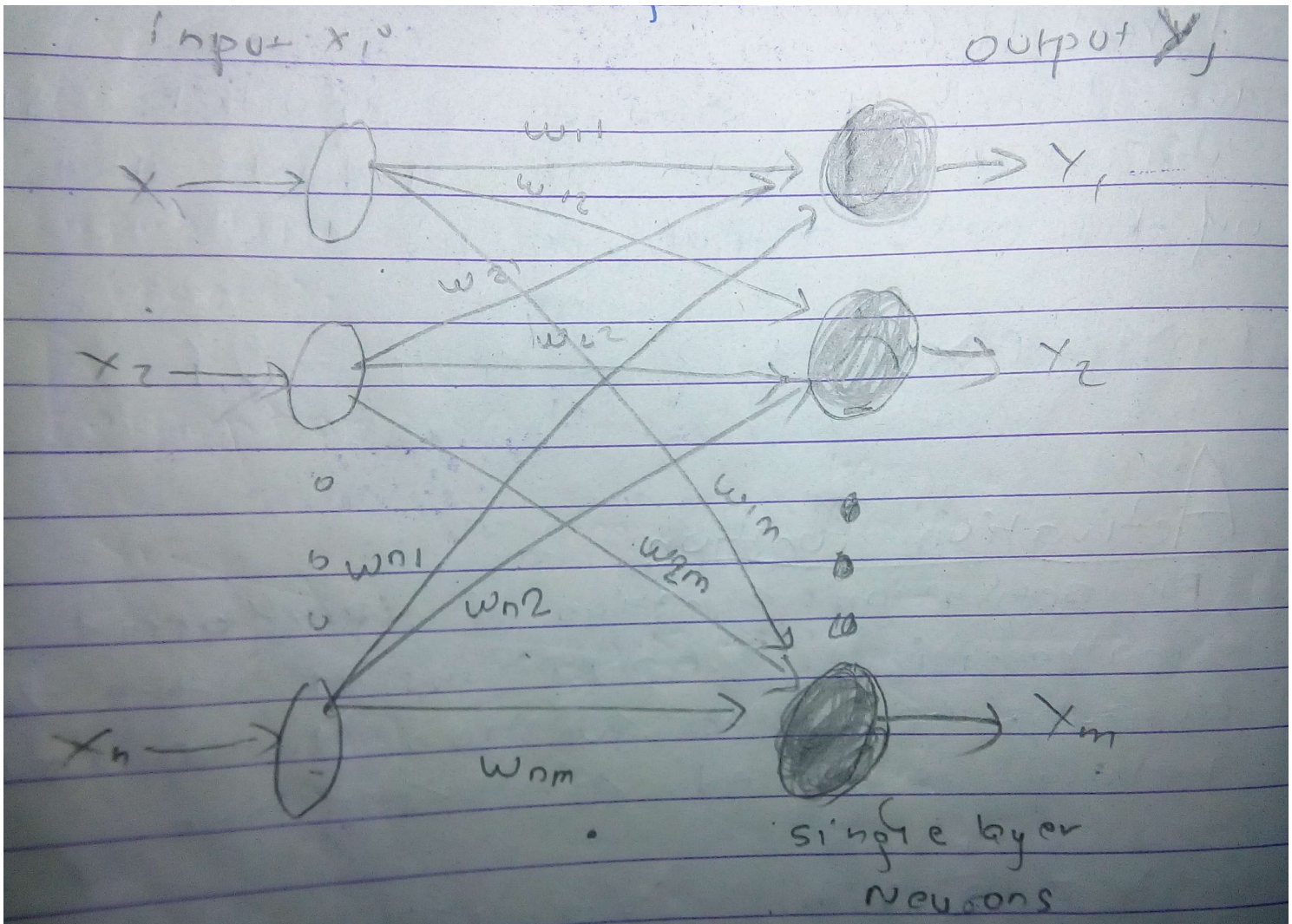

fig. Single layer - feed - forward Network.

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2. Multilayer feed forward network (multilayer perceptron)

The neural network which contains inputs, 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 hypothesis. layers of the network are normally fully connected.

input hidden layer output hidden

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are normally fully connected.

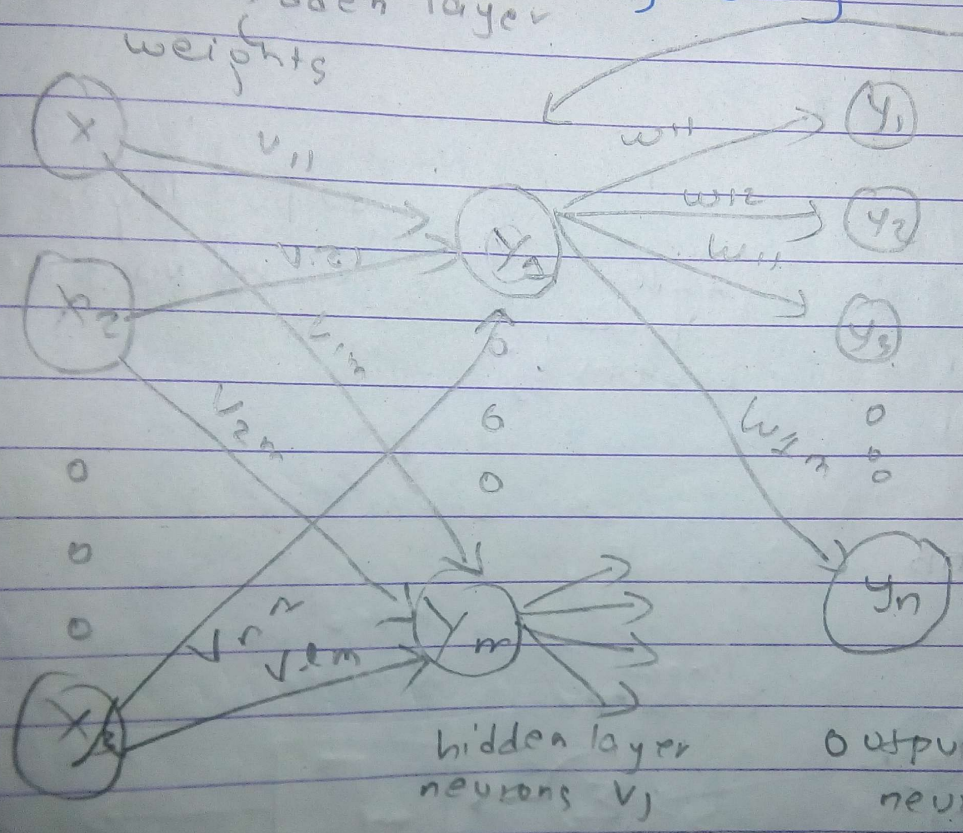

fig: multilayer feed-forward network in (l-m-n) configuration

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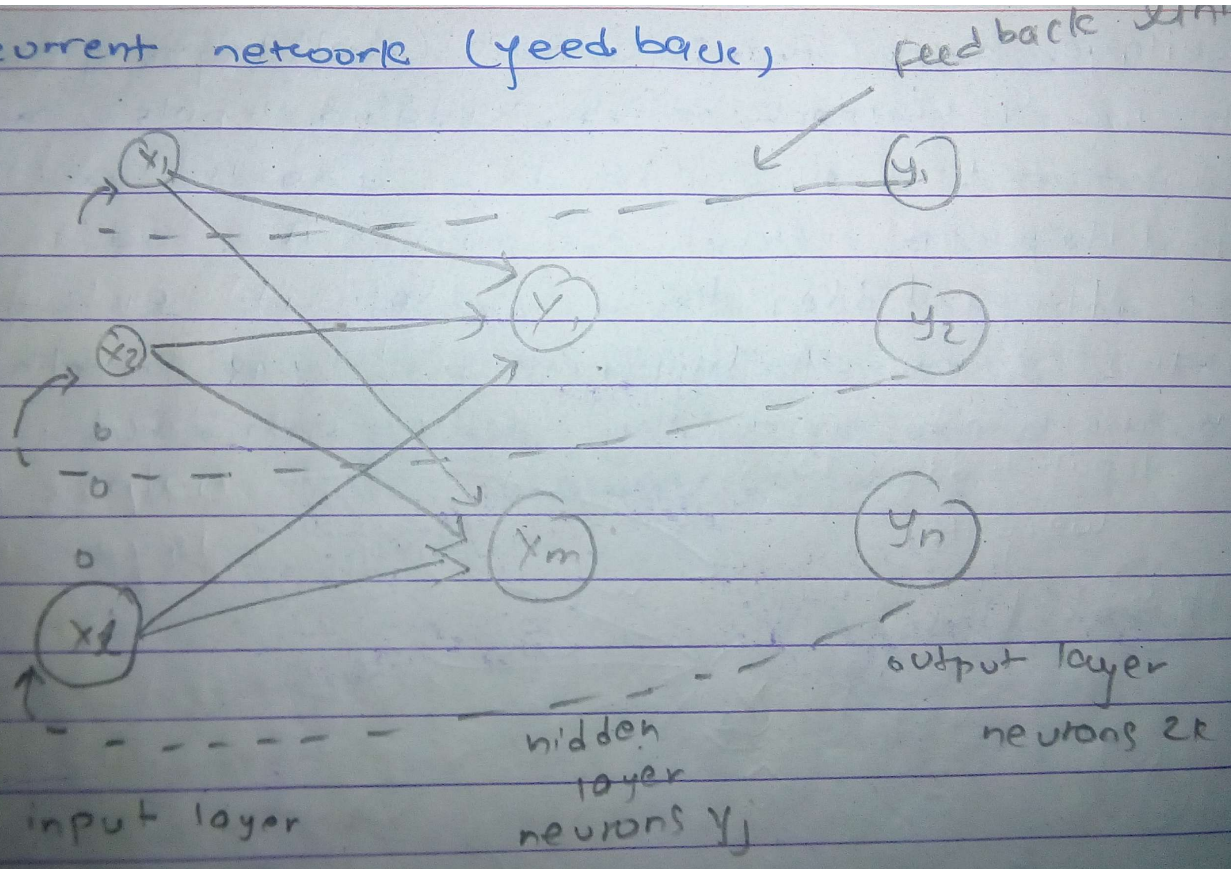
3. Recurrent network (feed back)



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3. Define NLP. Explain the different issues involved in the natural language processing.

Natural language processing

NLP is the process of understanding and generation of our language to the means of human-computer interfacing through voice. This is mostly used in database system, export system, automatic text translation system or text summarization system. The task of mapping the sound wave to a string of words is called speech recognition. It has the problem of background noise, inter-speaking variation and intra-speaker variation.

NLP = NLU + NLG, where

NLU : speech / text to meaning

NLG : meaning to text / speech.

Problems in NLP

multiple meaning of words in different places of world. for example:

Flat = house (for englishman)

and

Flat = Puncture (for American man).

one sentences may have multiple meaning.

for example:

"I saw Tajmahal flying over Agra".

This has two meaning that whether Tajmahal or person is flying.

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- single word may have multiple meaning.
  For example:
  copy = notebook
  copy = transfer data in computer.

- Language phrase will give seprate meaning in combind way and its segmented way.
  For example: get-rid-off = Release,
  get = obtain

Phases of NLP

- speech recognition
  including word-spotting, speech separation, sound classification

- speech coding
  Encoding sound wave to binary code

- Speech synthesis
  production of speech by the computer

NLP Processes

A complete NLP system consists of programs that perform all these functions

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Syntactic Analysis

- Syntactic analysis takes an input sentence and produces a representation of its grammatical structure.
- A grammer describes the valid parts of speech of a language and how to combind them into phrases.
- The grammer of English is nearly content free.

Semantic Analysis

- Semantic analysis is a process of converting the syntactic representing into a meaning representation. This involves the word sense determination, sentence level analysis, and knowledge representation

Pragmatic Analysis

- Pragmatics ~~analysis~~ comprises aspects of meaning that depend upon the content or upon facts about real world.

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Unit 6

2070: What is machine learning.

Machine Learning:

Machine learning is type of AI that provides computers with the ability to learn without being enplicity programmed. Machine learning focuses on the development of computer programs that can teach themselves to grow and change when exposed to new data.

The process of machine learning is similar to that of data mining. Both systems 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 actions accordingly. Machine learning algorithms are often categorized as being supervised or unsupervised. Supervised algorithm can apply what has been learned in the past to new data. Unsupervised algorithms can drew inference from ~~database~~ sets.

Machine learning is particularly attracting in several real life problem because of the following reasons:

- some tasks cannot be defined well except 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 systems learn

Recently, learning is widely used in number of application areas including,

- Data mining and knowledge discovery
- speech / image / video (pattern) recognition
- Adaptive control
- Autonomous vehicles / robots
- Decision support systems
- Bioinformatics
- 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
- performance measure P

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2071 What do you mean by learning by induction? explain inductive learning process with example.

Learning by Analogy

2070 → Analogy is a reasoning process of transferring information from a particular subject to another. analogy plays a significant role in problem solving such as decision making, perception, memory, creativity, emotion, explanation, and communication. It lies behind basic taker task such as the identification of places, objects and people, for example, in face perception and facial recognition systems.

2070 → Instance based learning

Inductive Learning

Inductive learning is a powerful strategy for helping machine deepen their understanding of content and develop their inference and evidence-gathering skills. In an inductive learning, machines examine, group, and label specific "bits" of information to find patterns.

Explanation based learning (EBL)

Explanation-based learning is a form of machine learning that exploits a very strong, or even perfect, domain theory to make generalizations or from concepts from training.

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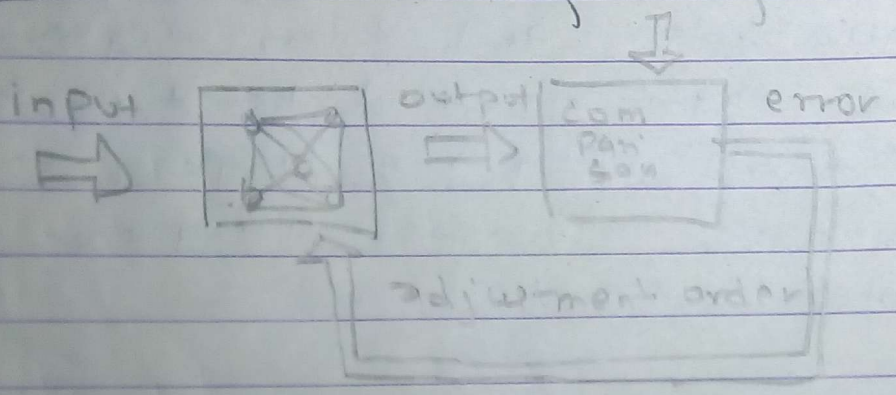
Learning may be classified into two catogories

a) supervised learning
b) unsupervised learning

Supervised Learning



In supervised learning, the network is presented with inputs together with the target outputs. The most common supervised learning method is the "error correction method".

Error correction method is used for networks which their neurons have discrete output functions. Neural networks are trained with this method in order to reduce the error to zero.

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Unsupervised learning

In unsupervised learning, there is no teacher (target signal) from outside and the network adjusts its weights in response to only the input patterns. The most common unsupervised learning method is cluster analysis, which is used for exploratory data analysis to find hidden patterns or grouping in data.

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2023:

Define the model-based and case based system. Discuss which system is suitable for the following problems.

i. Electronic circuit testing
ii. Legal Reasoning.

Sol^n

- A model based system is based on a model of the structure and behaviour of the device that the system is designed to simulate
- used for well structured problems
  - Not for stock modeling, not well structure
  - Engineering problems
    - example: Diagnosing hardware or a machine
    - example: Automobile diagnostics
- Based on written documentation
- The problem is extracting knowledge
- observed behaviour (what the device is actually doing) is compared with predicted behaviour (what the device should do)
- could be mathematical equation

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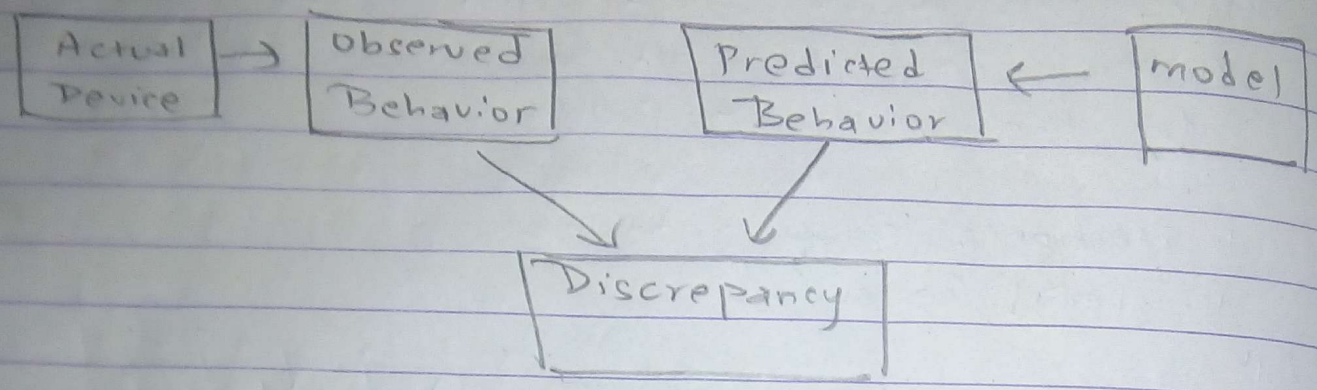

Model based Reasoning.

Case base Reasoning

- collection of a set of cases
  - store a case in a case base

- ~~CBR~~ CBR is based on human processing model in some problem areas
  - Thinking about how human processes information
  - Try to remember previous case / recall similar cases & modify to fit a new situation

example : law, diagnosis, strategic planning

- Human experts depend on past experiences when solving problem.

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- Electronic circuit testing
  ⇒ Model-Base

- Legal Reasoning
  ⇒ case-base.

2073 Q.no. 6.

~~what~~ :

Difference between inference and reasoning. why probabilistic reasoning is important in the AI?

⇒

Inference is a general term representing the derivation of new knowledge from existing knowledge and aims within a single step, and can be one of many kinds, such as, induction, deduction and abduction. for example "modus tollens" is role of inference.

⇒

Reasoning is in context of a goal and carried out via a search process. ~~involving~~ involving multiple inferences. ~~choices~~ ~~do~~ choices during such search have to be made such as which axiom to fire

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along with which knowledge in order to derive new knowledge.

Resolution is a particular kind of 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 this to societal trends, advertisers, such as consumer reports often use probablity statics, to sell their products. Automobile ranking etc ... are used to demonstrate to the public that their product is better than the others and often time these probabilistic.

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2073: 3.

Justify that searching is one of the important part of AI.

⇒

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

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2072: What is learning by induction? Explain
Q. no 6. inductive learning process with example.

This involves the process of learning by example. where a system tries to induce a general rule from a set of observed instances.

This involves classification - assigning, to a particular input, the name of a class to which it belongs. classification is important to many problem solving tasks.

A learning system has to capable of evolving its own class descriptions.

- Initial class definations may not be adequate.
- The world may not be well understood or rapidly changing.

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