



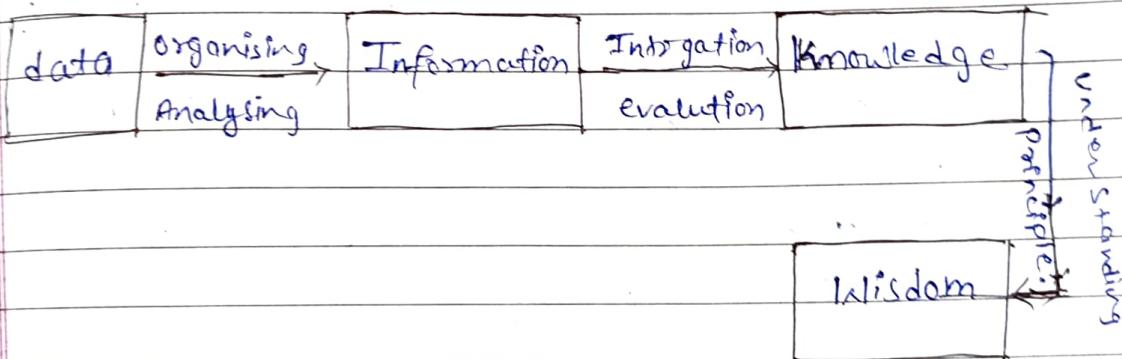
Knowledge Representation

Introduction to Knowledge:-

Knowledge is a general term that always starts with the data/fact, organises and analyses the data to generate information.

The interpretation or evaluation of information is referred as knowledge.

Knowledge helps to enhance the intelligence and concerned with the wisdom. The progression of the knowledge can be represented like:-



Wisdom:- Wisdom is the basic concept that always uncovers and understanding the principle of relationship that always describe patterns basically wisdom concerned with the "Why".

Knowledge describes about what to do and how to represent the knowledge.



Knowledge types:- Knowledge is categorized into two forms :-

- ① Tacit / Implicit / Informal.
- ② Explicit / Formal.

These two types of knowledge have their own characteristics or behaviour where Implicit or Informal comes from experience, actions or within the human body.

In case of Explicit knowledge it always comes from concept, process, rules & regulation, principles and it exists outside a human being.

In both cases we utilize facts, there process, apply procedure, etc.

Based upon knowledge creation process, we broadly represent it two types:-

- ① Declarative knowledge.
- ② Procedural knowledge.

~~Issues~~ Issues in knowledge representation:-

The basic goal of knowledge representation is to conclude the statement from knowledge. The issues that arise while using knowledge representation techniques are many. In that case, we have to consider specifically:-

- ① Important attributes:- Any attributes of object must be in form of "Instance" and "Isn". These are important because this support inheritance property.

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Q) Relationship among attributes:- whenever we used to describe object, the relationship b/w ^{that} attribute of an object must be specific. and hold the properties and hold the properties to represent any knowledge.

choosing Granularity :- Whenever knowledge representation need to be describe it must ^{represented} consider that, at what level should the knowledge be and what are the basic term. It may be small no., large no., high level facts, low level fact.

set of objects:- It determines certain properties of objects that are true as a member of set of object.

finding Right Structure :- It is about access right structure for describing any choice like:-

- ① How to perform initial selection.
- ② How to filled and appropriate details.
- ③ How to find a better structure. etc.

knowledge Representation system Requirements (Properties):-
A Good Knowledge Representation enables fast and accurate access to knowledge & understanding of the content so, It should have some specific properties like,-

① Representational Adequacy :- The ability to represent all kinds of knowledge that are needed.



2. Inferential Adequacy :- The ability to manipulate the representational structures to derive the new structure corresponding to new knowledge from old.

3. Inferential Efficiency :- The ability to (use old info & new info) incorporate additional information into the knowledge structure that can be used to focus the most promising directions.

4. Acquisitional Efficiency :- The ability to acquire new knowledge using automatic method whenever possible rather than involvement of human.

Note :- Tommy is a dog :- / dog (Tommy)

All dogs has tails :- $\forall (x) : \text{dog}(x) \rightarrow \text{has}(\text{tail})$

* LOGIC :- Logic is term that concerned with the truth statement about the world.

Generally, each statement is either true or false and logic includes :-

(a) Syntax :- Specifies the symbols of the language ^{about} how they can be combined to form sentences.

(b) Semantics :- It specifies how to assign a truth value to a sentence based on its meaning in the world. It means,



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what facts a sentences refers to.

Inference procedures :- It specifies method for computing new sentences from an existing sentence.

All the above parts in logic applied in representation of any sentence ~~or~~ and generate knowledge.

Basically, logic is a language for reasoning a collection of rules that helps to express the knowledge. Broadly logic has two types:-

① propositional logic, that specifies the study of statement & their connectivity.

② predicate logic, is the study of individual and their properties.

Rules to build a logic based Representations -

- 1 User defines a set of "symbols" and the associated "semantics".
- 2 Logic defines ways of putting symbol together so that user can define legal sentence to represent true facts.
- 3 Logic defines to generate new sentences from

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(iv) sentences either true or false. but not both called proposition.

(v) A declarative sentence express a "statement" with a proposition as content.

Ex:- The declarative sentence is snow is white expresses that Snow is white that express it is true.

* Types of Logic :-

Broadly logic has further classified in two formation that is one :-

- propositional logic
- predicate logic.

→ Propositional logic :- It is a statement that represents declarative sentence and specifies about true and false logic. In the representation pre-specifies about

(i) propositions are sentences, either true or false but not both.

(2.) If proposition is true, then the truth value is true.

(3.) If proposition is false, then the truth value is false.

Propositional logic describes the way of joining or modifying entire propositions, statements or sentences. It means, it always declare a sentence that represents the suitable sense of statement.



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We use statement, variable and symbols when are related and

Simple statement either true or false, basic prepositions represent the symbols in form of P, Q, R.

Operators or connectives are used that always represent the statement.

The representation are like.

Connectives	Symbols	Read As.
(i) Assertion	P	P is true.
(ii) Negation	$\neg P$	Not P is false.
(iii) Conjunction	$P \wedge Q$, • & &	AND Both P & Q are true.
(iv) Disjunction	$P \vee Q$, +	OR Either P is true or Q is true or both
(v) Implication	$P \rightarrow Q$, P \Rightarrow	if-then if P is true, then Q is true, means P implies Q.
(vi) Equivalence	$P \leftrightarrow Q$ \equiv $P \rightarrow Q$	it and only if P and Q are either both true or both false.

During representation, we use truth value by the help of truth table to represent all the connectives.



P	$\neg P$	$\neg \neg P$	$\neg \neg \neg P$	$P \wedge Q$	$P \vee Q$	$P \rightarrow Q$	$P \leftrightarrow Q$
T	F	T	T	T	T	T	T
T	F	F	T	F	T	F	F
F	T	T	F	F	T	F	F
F	F	T	T	F	F	T	T

→ Predicate logic.

Propositional logic is not that much powerful for all types of assertions so to handle it and satisfies the requirement of a language, predicate logic is useful.

It is

Powerful for expression and reasoning as well as always built upon the idea of propositional logic. It has two component.

(a) A subject.

(b) A predicate.

The subject is, what the sentence is about. The predicate is, always tells something about the subject.

Allot. so
(V) (Ǝ)

Predicate logic quantifiers:- Generally a predicate logic made up of propositional by the help of two operators and before applying we first assign a value to the variable and then quantify the variable using a quantifiers.

Applying quantifiers on variables:-

(a) Variable x , here it always says that x is a variable where value can be assigned.



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(b)

Declaration $x : a$, it always declares variables x and instead as, "x is an element of set a".

(c)

Statement P is an element of x. If P is statement about x, it can be represented.

Like $\boxed{Q} \quad x : a . p$

$Q \rightarrow$ Quantifiers

$x \rightarrow$ Declaration of variable x

a \rightarrow Statement

p \rightarrow Qualification of statement,

Quantifiers are of two types:-

① Universal Quantifiers - denoted by \forall

② Existential Quantifiers - denoted by \exists

Universal Quantifiers always concern with the "all of / for all" and follow the representation of any statement.

Statements like any English sentence that need to be properly represented and shows the logic of prediction.

Q. All dogs like bones.

$\forall(x) : \text{dogs}(x) \rightarrow \text{like}(x, \text{bones})$

Q. All cars have wheels.

$\forall(x) : \text{cars}(x) \rightarrow \text{have}(x, \text{wheels})$

Q. Everything is valuable.

$\forall(x) : \text{valuable}(x)$.



→ Everything is an animal/minimal or vegetable.
 $\forall(x) : \text{animal}(x) \vee \text{minimal}(x) \vee \text{vegetable}(x)$.

→ Mohan loves everyone.
 $\forall(x) : \text{loves}(\text{mohan}, x)$

→ Everyone loves mohan.
 $\forall(x) : \text{loves}(x, \text{mohan})$

* Existential Quantifier (\exists) "there exist".

\exists allows us to state that an object always represents if it is available for atleast one variable of the statement is true.

\exists always exist
 the facts that has less representation as well as it exist some.

External quantification is like $\exists x : p$, that can be read as "there exist an x such that P holds"
 a is universe. & b discourse.

x is a member of value..

p is statement about x .

Ex:- Some people likes reading hence they gave good knowledge.

$\exists(x) : \text{people}(x) \wedge \text{like}(x, \text{read}) \rightarrow \text{gain}(x, \text{knowledge})$.

→ Everybody loves Somebody :-

$\forall(x) : \exists(y) : \text{loves}(x, y)$

→ Somebody loves every body

$\exists(x) : \forall(y) : \text{loves}(x, y)$.



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All Indian were either loyal to ~~Chinese~~ or hated them.
N(x) : Indian(x) \rightarrow Loyal(x, Chinese) \vee Hated(x, Chinese).

Resolution: Resolution is a procedure used in proving that arguments which are expressible in predicate logic are correct.

Resolution is a procedure that produce proofs by contradiction.

Resolution tend to generate a theorem proving technique for sentence in propositional logic and predicate logic.

Res-Resolution is a rule of inference that theorem prover in computer form. It always concern with the proper specification about correct/in correct logic of any sentence.

Logic programming:— It is a collection of logic statement that always specifies logical relation b/w entities.

Logical programming perform computation that determines whether are not, a particular conclusion follows logical statements.

There are varieties of characteristics like :-

- ① The program consist of a set of statement.
- ② The rules of inference determines that the given statements provides truth value or not.
- ③ The execution of a logic program always helps in the construction of a goal statement.



4.1 The programmer specifies basic logic relationship but does not specifies the manner in which inferences rules are applied.

Any programming languages are consist of these basic elements.

- ① The syntax.
- ② The semantics of program.
- ③ The computational model.

Any programming language organize computations in procedural form or declarative form.

In declarative form prolog is a programming language and most popular logic programming system that also concern with the syntax semantics and their own computational model.

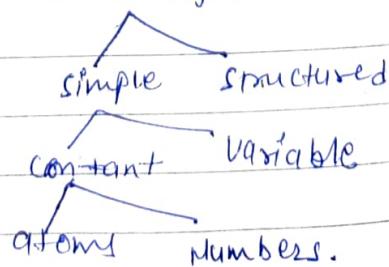
In context of Prolog program, Syntax is an important term that always guide to write a program using statement expansion etc.

further, the component of syntax are divided into two parts.

- ① Data components
- ② Program components.

Data components :-

Data object (terms)



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Data components are a collection of data objects which are represented above.

Data objects of any kind is called terms.

It is also divided further in forms of simple and structured data object.

Simple data objects includes atoms, numbers and variables.

Atom a lower case letter that is followed by other letters and underscore (-), like -athis-

It also may be string of special character as well as string of any character enclosed within single like < >, ::, ABC, 1234.

Number that means numerical value that will be either integers or real numbers exal- 0, 2, -16, '33, 0.5, -33, 73, 62.

Variables always written by a capital letter followed by other letters, digits or - like, -125, list, list-value.

Structured Data Objects:-

It has further divided into general structure and special structure.

General structure is a ^{structure} term that is formed by functor and a list of arguments.

Functor is an atom

List of arguments appears between parenthesis; separated by a comma(,) and each argument is a term.



Eg:- greater than (9,6)
plus (2,3,5)

Special structure data object- are always concerned with the ordered collection of terms, called a list, always offers a convenient notation to represent like empty list- can be represented by [].

Non-empty list carries multiple elements between sequence brackets, separating elements by commas.
Ex- [apple, mango, grapes]
[sunny, Rainy, Spring]

Program Component

A program component always concerned with the PROLOG program which is a collection of predicate or rule, that establishes a relationships between objects. The components :-

- (a.) CLAUSE
- (b.) PREDICATE
- (c.) SENTENCE
- (d.) SUBJECT

(a) CLAUSE:- CLAUSE is a term of program component that is a collection of grammatically related words and building blocks of sentences.

Every sentence contains one or more clauses that represent any statement as well as form a proper sentences.

Includes two basic terminologies that is known as SUBJECT and PREDICATE.

That sentences fit



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SUBJECT is what the sentence is about.

PREDICATE tells something about the subject.

Ex:- **Subject** 'cow' **Predicate** eats grass.

From the above sentences we got the idea that 'cow' is a **SUBJECT** and **PREDICATE** is 'eats grass'.

It completes concern with

the CLAUSE.

(ii) **PREDICATE** :- Predicate is nothing but combination of one or more clauses with the two sides like <Left hand side> :- <Right hand side>.

In this format,

LHS is a single goal called Goal.

RHS is composed of

one or more goals, separated by commas, called sub goals. of the goal on LHS.

grand-parents (x, y) :- parent (x, z), parent (z, y)

Vehicle () :- Two wheeler. (BIKE, SCOOTY).

(iii) **SENTENCE** :- Sentence is a part of any statement that need to be interpreted and represent the knowledge. either in propositional logic or predicate logic.

(iv) **SUBJECT** :- It is a part of any sentences that always maintains the way of representation through which any object can work appropriately.

Basically subject

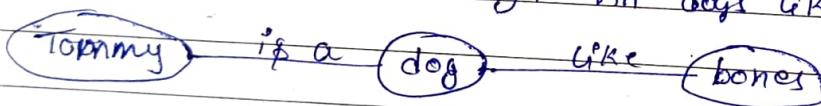
always plays a crucial role in the representation of the sentence as well as logic representation.



Semantic Networks :- It is a kind of approach to represent the knowledge and maintain the statement with the different approach. According to its need it always creates multiple links because of the network and establishes a proper relationship in the knowledge representation.

Basically, semantic networks are an attribute of predicate logic in knowledge representation, where we can store the knowledge in form of graphs with node representing object and arc representing relationship between those objects.

Ex:- Tommy is a dog. All dogs like bone.



Q. Tom is a cat.

Tom caught a bird.

Tom is owned by John.

Tom is ginger in color.

Cats like cream.

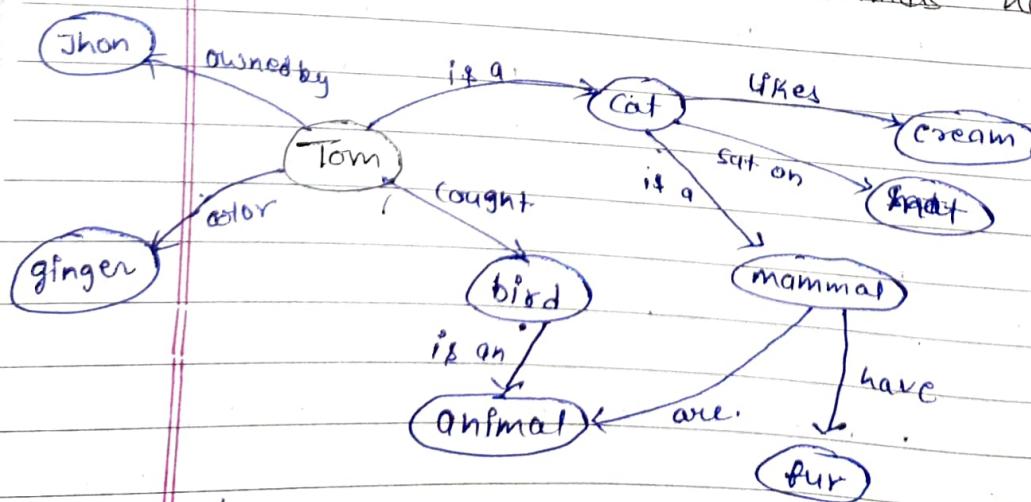
The cat sat on the mat.

A cat is a mammal.

A bird is an animal.

All mammals are animals.

Mammals have fur.





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Generally semantic network helps to extract the concept of statement, their meaning and a form in which they are connected to others.

This connection establishes a knowledge by using different nodes/ object and varieties of relationships.

So we can say that, semantic network always used to establish a proper relationship among objects by the utilization of needs as well as spread information in form of knowledge.

In the conclusion, according to the representation of above network, it is always used as an alternative to predicate logic, ease to represent knowledge rather than predicate logic in form of graphs with suitable approach.

Frame system in knowledge representation:-

Frame system is mainly concern with the representation of knowledge, that permit us to use the concept of inheritance. Frame system always concern with collection of attributes and associated values that describes same entity in the world.

Frames are general records like structure which consist of collection of slots and slots value, that may be any size or any type.

Slots have names and values or slots, a slot may have any numbers of facts, each with any numbers of values.



Basically, a slot can contain information, attributes condition or other related frames, that represented to fulfill the purpose.

Each frame should start with open parenthesis and closed with closed parenthesis.

Syntax of frame

(<frame name>

<slot1> (fact1 (val1 , val2 ... valn))

<slot2> (fact2 (val1 , val2 ... valn))

D. Create a frame of the person who is Ram to a doctor. He is 40. His wife name is Sita. They have two children Babu & Rita. They live in the city of Ranchi in the Jharkhand. The pincode is 835401.

→ (Ram

(profession (value doctor))

(Age (value 40))

(wife (value Sita))

(children (value Babu, Rita))

(Address

(locality (value 2nd street))

(city (value Ranchi))

(state (value Jharkhand))

(pincode (value 835401)))

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Conceptual Dependency or (C.D.).

It is another technique or method in which we can represent knowledge and uses Unified no. of primitives and rules to represent any natural language statement.

C.D. theory is based on the use of knowledge representation where understanding & processing of any statement / natural language is possible.

Generally C.D. maintains the way of statement and also a powerful representation of any concept.

It also captures maximum conceptual as well as the scenario the statement which helps to represent the statement. Some primitives that used in C.D. like:-

1) Acrs - Actions

2) PPs - Pictures Producers and describe about objects.

3) AAs - Actions Aiders. It is modifiers of actions.

4) PAs - Pictures Aiders. Modifiers of PPs.

5) Ts - Time of Actions.

C.D.

Provides both a structure and a specific set of primitives at a particular level. During basic like:- using primitives it also uses some terminologies to represent the knowledge.

1)



Dissection of dependency.

2)



It indicates two way link b/w actor and actions.



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- 3.) P It shows the past tense.
- 4.) O The objective case violation.
- 5.) NIL Describe about present tense.
- 6.) R Recipient Case violation.
- 7.) F Future tense
- 8.) T Transition
- 9.) T_s Start of Transition
- 10.) T_f Finish of Transition.
- 11.) ? Interrogative
- 12.) C Conditional.
- In CoD, Representation of actions are build from a set of primitives. like :-
- 1.) ATRANS - Transfer of an abstract relationship e.g.- give, take, accept.
- 2.) PTRANS :- Transfer the physical location of an object e.g.- go, come, run, walk, etc.
- 3.) MTRANS - Transfer of mental information like feel.
- 4.) PROPEL - Application of physical force to an object



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like. push, pull, throw etc.

5.) MOVE - movement of body parts, by its owner.
like kick.

6.) GRASP - Grasping of an object by an action
like clutch.

7.) INGEST - Ingestation of an object by a human
or an animal like eat.

8.) EXPEL :- Expel from a human or an animal
like cry, sneezing.

9.) SPEAK - Production of sound like say.

10.) ATTEND :- focusing of a sense organ towards
anything like listen.

The main goal of CD representation is
to captures the internal concept of a
sentence and represent externally.

In Normal
representation of concept, besides actor and
objects, other concepts of time, location, source
and destination are also mentioned.

So, to fulfill
all these conceptual dependency has varieties
of primitives to represent it successfully.

To represent
all the primitives, there are varieties of representation
according to the sentences like :-

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1. $\text{PP} \leftrightarrow \text{CT}$:- It describes the relationship between an actor and an event.

e.g.:- Ram ran

Ram \xleftrightarrow{P} PTRANS.

Here P is the past tense.

2) $\text{PP} \leftrightarrow \text{PA}$. It describes the relationship b/w a PP and a PA where the PA indicates one characteristic of PP.

e.g.- Ram is tall.

Ram $\xleftrightarrow{\text{NIL}}$ Tall . Ram \leftrightarrow height.

3) $\text{PP} \leftrightarrow \text{PP}$ It describes the relationship b/w two PPs where one PP is defined by other.

e.g.- Ram is a doctor.

Ram $\xleftrightarrow{\text{NIL}}$ doctor.

4) $\begin{array}{c} \text{PP} \\ \uparrow \\ \text{PA} \end{array} \text{ OR } \begin{array}{c} \text{PP} \\ \downarrow \\ \text{PA} \end{array}$:- It describes the relationship b/w the PP and PA where PA indicates one attribute of PP.

e.g.- A nice boy is a doctor.

(PP) Boy $\xleftrightarrow{\text{NIL}}$ doctor.

(PA) Nice.

5) $\begin{array}{c} \text{PP} \\ \uparrow \\ \text{PP} \end{array}$:- It describes the relationship b/w PPs where one PP is owned by another PP.

e.g.:- Ram's cat

cat
↑
Ram.



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Ravi likes all kind of food.

Propositional logic :- $\forall(x) : \text{Food}(x) \rightarrow \text{Likes}(\text{Ravi}, x)$.

Semantics :- Ravi Likes Food

Apples and chicken are food.

→ food(Apple & chicken) ⊨ food(Apple) & food(chicken).

Anything anyone eats and is not killed is food.

→ $\forall(x) : \forall(y) : \text{eats}(x, y) \wedge \neg \text{killed}(x) \rightarrow \text{Food}(y)$.

Every philosopher write at least one book.

→ $\forall(x) : \text{philosopher}(x) \rightarrow \exists(y) : \text{Book}(y) \wedge \text{write}(x, y)$.

Ontologies :-

Ontologies are a powerful tool for organising and understanding information in a structured way.

They provide a framework for defining the relationships b/w different concepts making it easier to share and analyse data.

Generally,

ontologies allows us to define different and complex structure and new relationship b/w terms and member of classes.

Generally it is used in research work, scientific functionalities and in laboratories to establishing a proper relationship b/w among the class/ component.



Components of ontologies :-

According to behavior, ontology includes varieties of components through which information can be organise effectively. Components are :-

- ① Individuals :- It is also known as object or concept. that represents the atomic level of ontology.
- ② classes :- shades of collection of various objects.
- ③ attributes :- properties of an object.
- ④ relations :- The way in which concepts are related to one another.

In the conclusion, ontologies are essential for organising and interpreting complex information.

By defining clear relationship between concepts.

It plays a crucial role in enhancement of data management to improve the better communication as well as functionalities of technologies like AI.

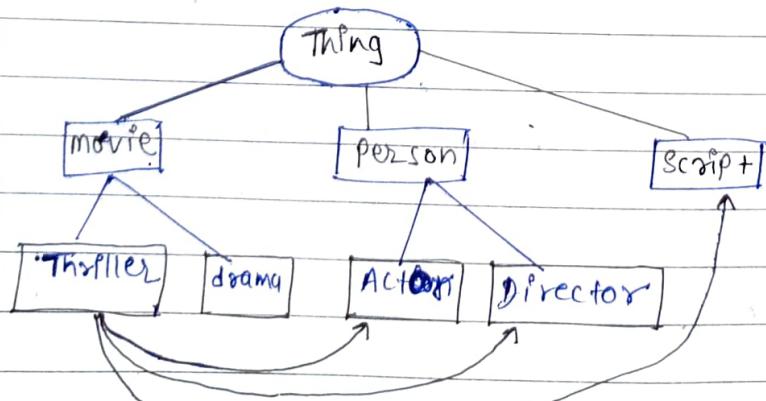


fig:- ontologies depicting module.



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Learning Concept

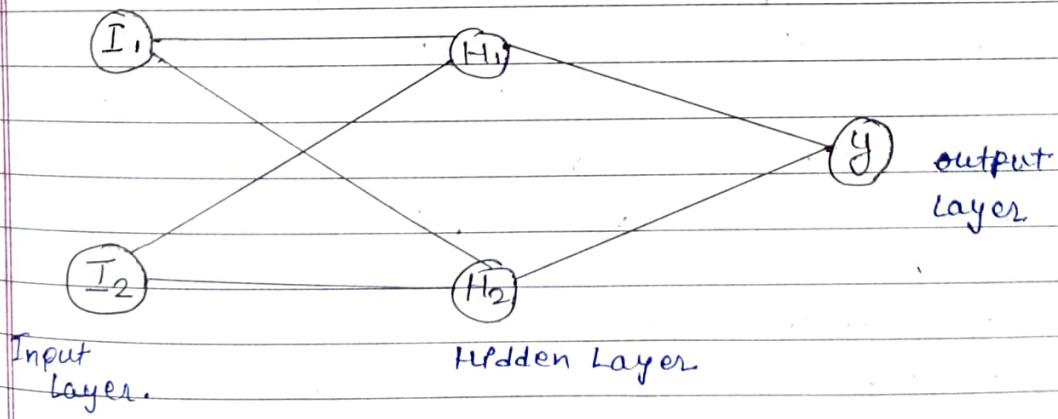
Introduction to Neural Network & Concept :-

It is a kind of concept in computer science in AI which provides a way to implement a device that always behaves like a human brain.

The main objective is to develop the system that performed various Computational task faster than the traditional system. These task include pattern recognition, classification, approximation, optimization and data clustering (clustering).

Based on the above fundamental functionalities it has several application areas like speech recognition, pattern recognition, character identification, human face identification etc.

Basically, A Neural Network nothing more than a bunch of neurons, connected together and perform the operation to get the optimal output.



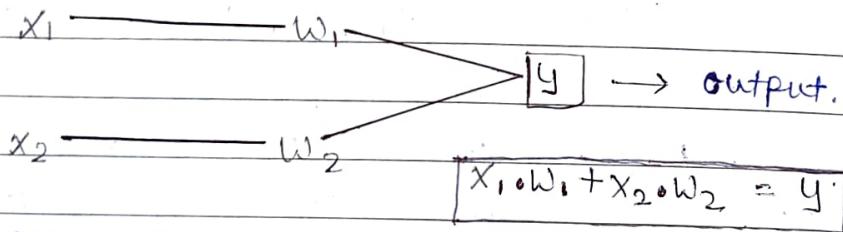


According to the given network, we get the idea, it has two input layer like I_1 & I_2 , one hidden layer with the two neurons and an output layer.

It has a proper structure that represents a particular network where hidden layer place b/w input & output layer. Hidden layer more than one layer.

* What is Neuron?

A Neuron is the basic processing unit in a neural network and it is same like the human brain. It takes input does some calculation and produces output.



The figure shows the processing where input Neurons are multiplied by their weight and all the weighted inputs are added to generate the output.

The sum are passed through an activation function to generate the output. To do this it has several terminologies like:-

- (1) ~~Nucleus~~ Nuclear
- (2) axon \rightarrow output unit/Node.
- (3) Dendrite. (Input node).
4. Synaptic Junction.

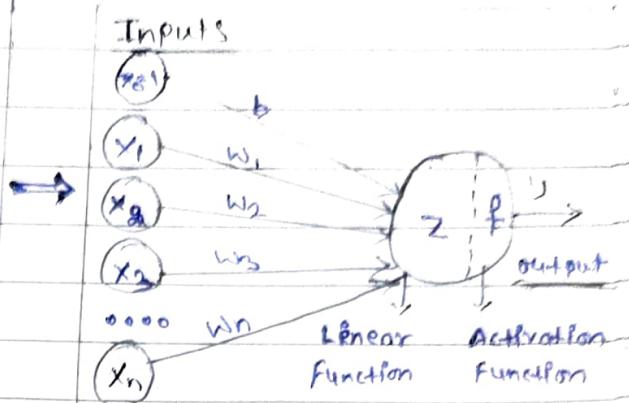
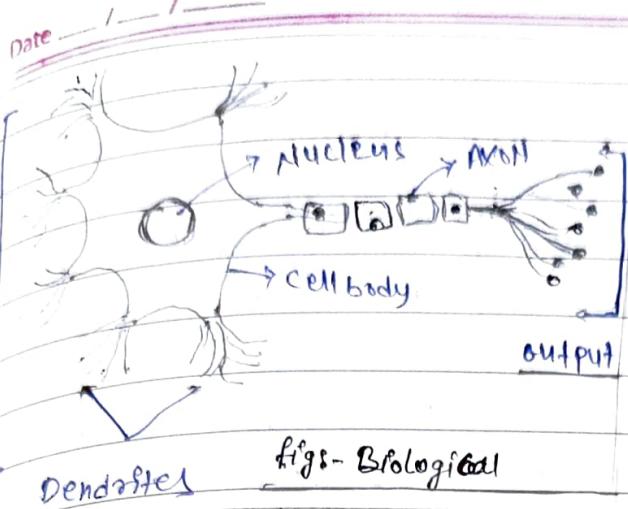


fig:- artificial.

According to the above figure we get the idea that the single input from action of neurons through semantic function output generated or activated which is carry over through dendrites.

The process that always helps to maintain the weight and dendrites provides a desired axon.

During processing, semantic function handle all the dendrites with their processing light weights. To produce to desired axon.

According the desired output - result sometimes it requires to modify either weight or process to get the desired result.

In the comparison of these two figures is that, left figure shows the biological structure of human body and right side figure follow the concept, logic, and way of processing to achieve a objective, that is create an artificial machine that always perform varieties of operations just like human being.

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* Artificial Neural Network (ANN):-

It is an extension of neural network in terms of functionalities in the implementation of devices that behaves like a human being and always represent as Artificial Neural Network (ANN).

powerful learning module that acquires or learns collection of units/elements that are interconnected in some pattern to allow some command to the units.

These units are also called node or neurons that operates in parallel.

Basically, ANN is nothing but an implementation tool that always helps to maintain the functionalities of each and every devices. Generally, ANN contains Artificial Neurons which is called unit. And units are maintained the functionalities and overall ANN.

ANN maintains the information processing just like a biological neural system in our body. It is a Artificial device structure where highly interconnection has establishes to solve specific problem as well as configured for any specific application like deep learning, pattern recognition, speech recognition NLP etc.

ANN also process information with high speed rapid solving scenario and give quick response and many more comes under these categories. Overall all these are represented as an expert system and due to these expertise, in ~~sufficiently~~ manage info, categories info and give the response.





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according to new Scenario

Just like the architecture of a neural network, it has also several layers like an input layer, an output layer and a hidden layer.

The input layer receives data from the outside world, which the neural network need to analyse.

Then, this data passes through one or more hidden layer that transforms the input into data that is actually valuable for the output layer.

Finally, the output layer provides an output in the form of response of the ANN to the input data provide.

* Advantages of ANNs:-

According to functionalities or behaviour of ANN it has some specific advantages like :-

Adaptive Learning, where it has ability to learn how to do task based on the given data.

Self organisation, and ANN can create its own organisation or representation of the information that it receives during learning time.

Real-time operations, ANN computation may be carried out in parallel with their specific architecture including specific hardware devices that always handle live events.



(iv) fault tolerance , it's specific about any kind of error or distortion can be handle automatically to maintain the performance.

Differences between Human brain and ANN.

Property	Human brain	ANN
i) shape	3-D volume of organic matter	2-D sheet of inorganic matter.
ii) Power	Powered by ATP (Adenosine Triphosphate)	Powered by DC main.
iii) Signal in clock	No centralized clock.	Centralized clock to maintain synchronization.
iv) Clock speed	H ₂ , MHz, GHz, all involved	In form of GHz mostly.
v) Fault tolerance	Highly	Highly
vi) performance	By Learning	By programming.

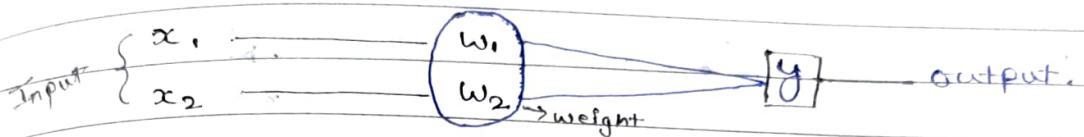
* Learning Method :- Learning is a concept in AI/Generally in ANN which applies the method of modifying the weight of any network. Generally, modification requires because of the (to) get the desired result rather than actual output.

Weight modification always shows the connection between the Neurons of a specified Network. that process to get the output.



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It is one of the most important properties of a neural network to improve their performance by the past experience. A Neural Network learns about its environment through an interactive process of adjustment applied to its weight.



Learning is a process by which the parameters of the Neural Network are adapted through a process that helps to maintain the entire functionalities of the Network. The type of learning is determined by the parameter in which the changes take place.

Entire concept of learning process maintaining the sequence of events like:-

- ① The Neural Network is stimulated by an environment.
- ② The Neural Network undergoes changes in its parameters.
- ③ The Neural Network responds in a new way to the environment because of the changes that have occurred in its internal structure.

Learning Paradigms →

There are three major learning paradigms →

- ① Supervised Learning.
- ② Unsupervised Learning.
- ③ Reinforcement Learning.



All the above three paradigms perform the same operations to modify or make some changes in Network.

(1) Supervised Learning:-

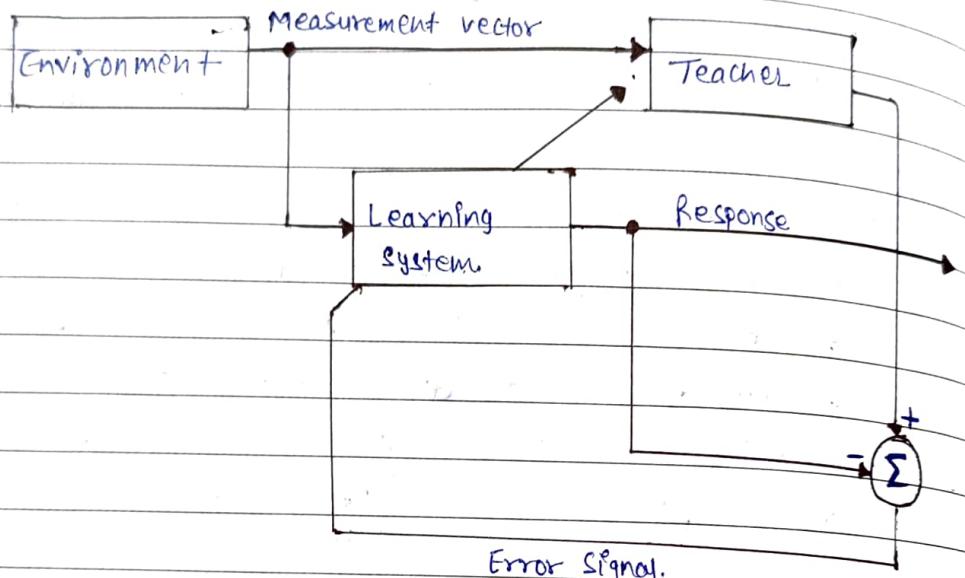


fig: Block diagram of Supervised Learning Model.

Supervised Learning that also referred as Learning with a Teacher, a Learning technique that sets Parameters of an ANN. This Learning process is dependent and the Input vector presented on the Network that gives output vector.

The output vector is compared with the desired output vector.

An Error signal is generated, if there is difference between actual output and the desired output vector.

On the basis of this error signals, The weights are adjusted until the actual output is matched with the desired output.



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 All the processing of unsupervised learning is dependent on a Teacher that classifies, checks, matches and then take necessary actions.

Unsupervised Learning :-

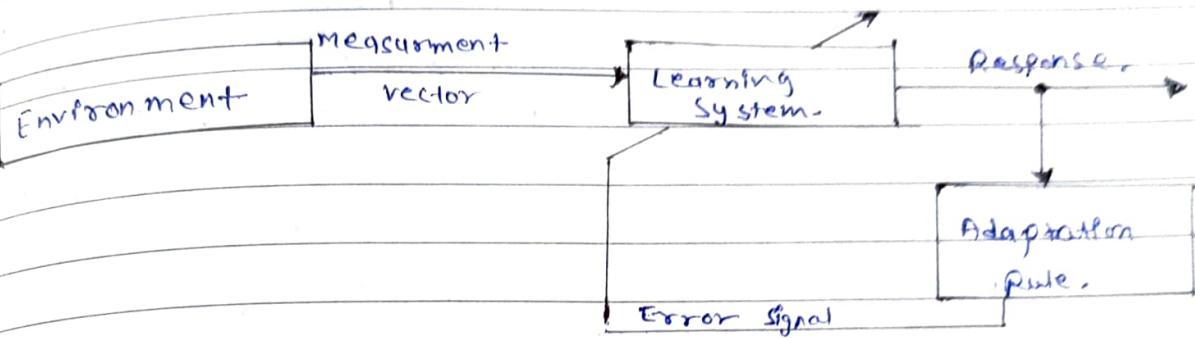


Fig:- Block diagram of an unsupervised ^{Task} learning

According to its name, this type of learning is turn without the supervision of a Teacher. It means, there is no training set or a teacher to monitor the progress in the learning process of Neural Network.

The learning process is independent where the input vectors are combined to form a cluster (same type), and there is no feedback from the Environment as to what should be with a desired output. and it correct or not.

This method doesn't need a desired output for each input vector. Rather than in this type of learning the network itself must discover the pattern and feature from the input data and establishes a relationship to get the output vector.

The behavior of the unsupervised learning system depends on the



activation rule use to control flow, the weights are adjusted.

(iii) Reinforcement Learning:-

It is a Learning Techniques that sets parameters of an ANN. Generally, Reinforcement Learning is concerned with the, "How an ANN should take actions in an environment".

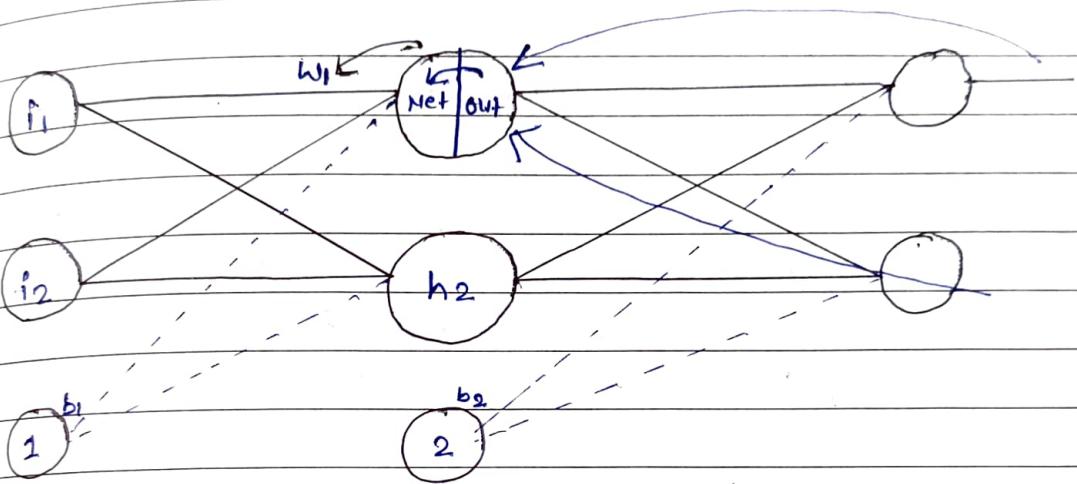
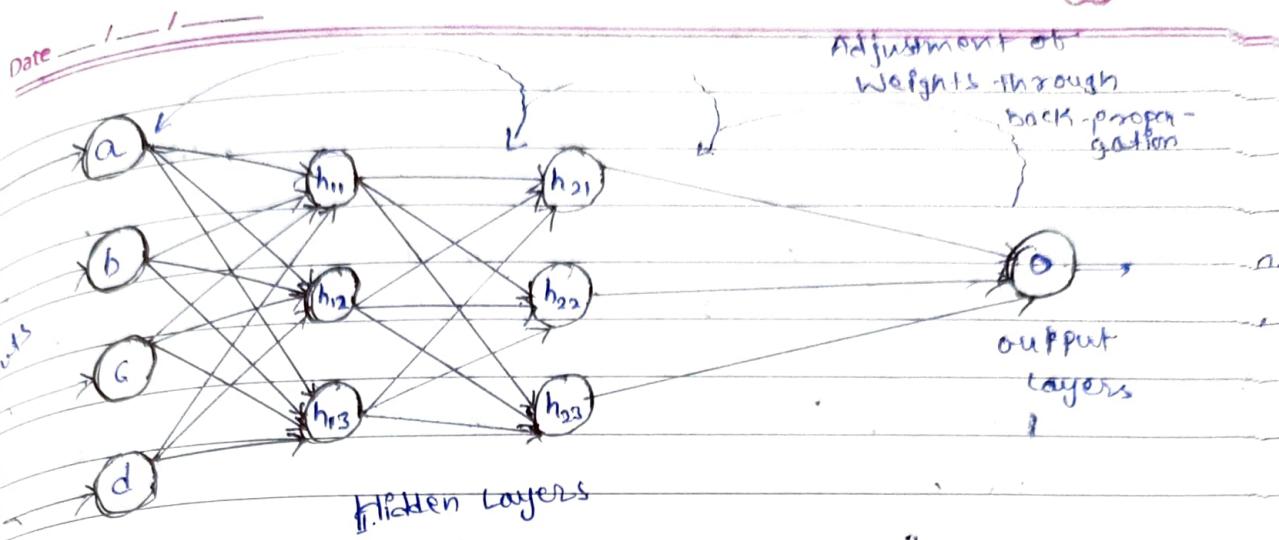
According to its name this type of learning is used to reinforce or increase the strength of a network over some critical information.

It also handle the complexities of the network and identify whether was right or wrong, possibly how right or wrong it was.



Back propagation:- It is a central mechanism by which neural Network learns. It is the messengers, telling the Network whether or not the Network made a mistake during prediction.

The discovery of Back propagation is one of the most important milestone in neural network research where we always talk about transmission of information, and that information relates to the error produced by the neural network.



During prediction, a neural network propagates signal forward through nodes of the network until it reaches the output layer where decision is made. The network then propagates its info about the error backward through the network based upon the information adjustment can be carry out to get the desired result. Some times this method is also called chain rule.

In simple term, after each forward pass through a network, back propagation performs a backward pass while adjusting the modules parameter like nodes.



It is a commonly used network where the neural network is initialised, weight are set for individual elements for neurons, inputs are loaded and passed through the network of neurons, and network provides an output.

Finally, Back propagation helps to adjust the weight of the neurons so that the output is closer and closer.

Terminologies in Back Propagation:-

- (i) Input:- Source data feed into the neural network with goal of making a decision or prediction about the data. The data broken down into binary signal, to allow it to be processed.
- (ii) Training set:- A set of output for which the current outputs are known, which can be used to train the neural network.
- (iii) Outputs:- The output of the neural network can be total value b/w 0 & 1, or a boolean value also.
- (iv) Activation function:- Each neurons accepts part of the input and passes it through activation function. to get the output.
- (v) Weight space:- Each neurons is given a numeric weight, it apply to the activation function that provides output.



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vi) Initialization:- Setting the weight at the beginning before the ~~model~~ is trained.

It initializes the weights randomly and then start optimizing it.

Unit - 5

planning & Representation of planning.

planning:- planning is nothing but, "the process of doing a sequence of actions to achieve our goal".

A plan is a representation of the basic structure of the input, specific process & the output. The process of planning is a "Bottom-up process", to provide ideas & knowledge and applied it to achieve a goal.

The knowledge of the task is represented by sets of production rules, each rules in the bottom-up process of a fuzzy ^(concreteness) predicates which describes the relations between the objects.

The kind of activities with the environments objects is referred as classical planning environment.

In case of non-classical planning environment, it is not completely observed & involved in the processing. It may partial involvement through which process can be continue.



In any case of planning, when a particular problem will be solved, at that time some specific rules can be applied to the problem, compute it and then get the solution.

To maintain proper planning system several component are described:-

① States:- for a planning process, the planner always uses some logical condition some state.

② goal:- A goal is a specified state that needs to be achieved.

③ actions:- It is actual process that can be executed and achieved the goal.

④ Precondition:- It always involved before the action can be executed.

⑤ Effect:- It describes how the state changes when the action can be executed.

As we know that planning in AI always plays a crucial role because it allows machine to :-

① Think ahead, describes about evaluation of multiple possible outcome, before selecting the optimal one.

2. Adopt to change, determines about uncertain environment where AI can revise ^{their} plans by getting new information.



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11)

Autonomously specifies about Autonomous device, like robots, which describe about machine to perform task independently.

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Symbolic Centralized vs Reactive, distributed systems

Centralized Systems: It is a type of computing architecture, where most of the processing & data storage handled by a single central server. It always manages all operation, resources & data, and act as a hub through which all request are processed and perform computational task.

The main features are that:-

- ① Single point of control
- ② Simplicity
- ③ Efficiency.

Major drawback also associated like:-

- ① Scalability issues.
- ② Single point of failure may damages entire processing.

During planning in context of AI, it necessary to maintain all data/information which are applied in any specific device. AI always manufacture.



versatile type of device so it requires pre-planning to manage these operations. In learning, it's centralized and any other system.

- * Reactive planning: - It is completely different approach than centralized reactive planning is suitable for highly dynamic and unpredictable environment.

predefined plan is a simple approach to handle but whenever continuous changes in the environment occurs, we need a smart device to handle it and reactive planning need to applied then.

This approach does not concerned with full plan earlier but always focuses on immediate respond to the current situation.

The basic key feature of reactive planning are:-

- ① Real-time adaption, specifies that changes in environment handled
- ② No-pre computed plan, that focuses on immediate action.

* Challenges / Issues / Drawback.

Reactive plan is not for the long term plan and for the achievement of short term goal as it suitable for reactive planning.



Importance of Planning in AI.

Planning is essential in AI, because of varieties of reasons and some common are:-

1. Efficiency and optimization
2. Adaptability
3. Autonomy.
4. Decision making.

* Challenges in AI planning.

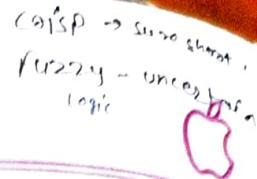
Apart from its importance some issues also associate with the like:-

1. Computational complexity.
2. Scalability issues.
3. Handling uncertainty.

* Applications of AI planning:-

The role of planning in AI is very crucial because various applications can be introduced through a suitable plan. Broadly varieties of areas where AI planning works:-

1. Robotics
2. Health Care.
3. Autonomous vehicle/vehicle.
4. Gaming
5. Supply chain management
etc.



Uncertainty

Uncertainty in AI:-

Till now, we have learned knowledge representation using predicate logic and other method with certainty, which means we were sure about the predicates.

With this knowledge representation, we may write like $A \rightarrow B$, which means if A is true then B must be true.

Now consider a situation where we are not sure about whether A is true or not, then this cannot express this statement. This situation is called uncertainty.

So, to represent uncertain knowledge where we are not sure about the predicates, we need uncertain reasoning or probabilistic reasoning.

Causes of uncertainty:-

There are variety of causes of uncertainty occur in real world like:-

- Information occurred from unreliable sources.
- Experimental Error.
- Temperature variation.
- Equipment fault.
- Climate change.

Uncertain domain in AI.

AI System operates in environment where uncertainty is a fundamental aspect. Representing & reasoning about knowledge in uncertain domain is crucial for building robust and intelligent system.



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and uncertain domain in AI always concerned with the specific field or environment where the available information is incomplete, noisy, ambiguous or unpredictable.

Uncertain domain means AI system to handle and manage uncertainty in a structured manner.

Incomplete information specifies that the system does not have access all require data to make a complete decision.

Ambiguity were infon might be unclear or multiple interpretation

Noise, specifies that data might be corrupted or inaccurate due to some error or external factor.

Unpredictable that is random event and processes occurs.

To handle uncertainty in real world application is greatly necessary to operate the system effectively representation should be accurate and always concern with the reliable predictions for effective decision making process.

Handling uncertainty is crucial for the AI system and we can do some basic functions to handle it:-

- ① make informed decision based on probabilistic reasoning.
- ② Adapt new infon and changing environment.
- ③ provide robust and reliable performance in complex scenarios.

* probabilistic reasoning / scenario :-

probabilistic reasoning is way of knowledge representation where we apply the concept of probability to indicate the uncertainty in knowledge.

Probability theory always handle uncertainty and we use probability in probabilistic reasoning because it provides a way to handle the uncertainty due to some one's ignorance or laziness.

* Techniques in Probabilistic Reasoning / Need for probabilistic reasoning in AI.

Whatever concept has introduced about probabilistic reasoning it is really essential in AI because

- when there are unpredictable outcomes.
- when specifications or possibilities of predicates becomes too large to handle.
- when an unknown error occurs during an experiment.

Apart from all these probabilistic reasoning is also important to different tasks like,

- Machine Learning, helps algorithm learn from possibly incomplete or noisy data.

- Robotics, provides robots the capability to act in dynamic and uncertain environments.

- NLP:- provides a platform to computers to understand human languages as well as all its ambiguity.

- Decision making systems:- Always empowers AI to



generate well informed decision and judgments based on the alternatives.

In terms of technique, we also consider some specification that maintains the varieties of functions like:-

- ① Inference:- It is the process of computing the probability of certain variables given known values of other variables.
- ② Learning; It involves the off data, the parameters and structure of probabilistic model based on the observed data.
- ③ Decision making:- Utilising probabilistic model to make decision that maximise expected outcomes and also involves some specific value.

Applications of probabilistic reasoning in AI.

There are varieties of applications domain where actually probabilistic reasoning:-

- ① Robotics, where PR enables robots to interact with uncertain environment. They always based on (SLAM) describes simultaneous localization & mapping.
- ② Health Care, one of the most important area where Probabilist model helps in diagnosis etc to symptoms and gives results.



③ finance, In this sector, PR is used to ~~representing~~
the market behaviour, risks and helps in
making investment decision.

* Key concept of probabilistic reasoning

① Bayesian Networks:- It is a kind of tool of
probabilistic reasoning that
always describe about detective based
functionalities to identify any kind of fact.

Basically it is a graphical based model that
shows the relationship b/w variables and
their conditional probabilities.

The main advantage
is that it is very effective to express cause
and effect as well as missing info and
due to this reason it is widely used in
medical science.

② Markov Model:-

We use this model to represent weather
forecasting.

It means this model predicates
the future state of the system from
its current state and its past history.

This model always useful for weather where
the probability that a sunny day will be
followed by a rainy day. It is most effective
and also applicable to recognise speech, their
prediction of words as well as probability of the
next word.



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(3)

Bayes's Rule/Law:- It is based on the probabilistic reasoning that always concerned with the functionalities of conditional probability and provides an approximation at any given event. Generally Bayes's rule/Theorem in AI is the most fundamental approach of probability & according to this. It allows us to revise our assumption or the probability of an event that will occur & provides a new info or evidence.

Bayes's law always concerned with the relation of conditional probability of two random events. and these marginal probability can be generate.

Concisely, we can say that its provides a way to calculate the value of the probability of $P(B|A)$ by using of knowledge of $P(A|B)$.

Before proceeding about Bayes's theorem, we must know the basic idea of some element like:-

- (1) $P(A)$:- It describes the probability that given A occurs.
- (2) $P(B)$:- It defines the probability that given B occurs.
- (3) $P(A|B)$:- It is the probability of the occurrence of event A given that event B has already occurred.
- (4) $P(B|A)$:- It can be represent as probability of event B occurring given that event A occurred.



5. $P(A \cap B)$:- It is the probability where events A & B will occur together.

To apply Bayes's theorem to calculate conditional probability we use the formula that is:

$$P(A|B) = P(A \cap B) / P(B).$$

We can also extend it $\frac{P(A)}{\text{in form of } P(A)*P(B|A)/P(B)}$
Based upon the above formula, the probability of event can be processed in AI on the basis of given expected outcome. During applying Bayes's some elements must be considered:-

① Prior Probability ($P(A)$) :- It concerned with the probability of event A, prior to considering

and we present what we know or believe about 'A' based on previous knowledge.

② Likelihood ($P(B|A)$) :- The probability of evidence B given the occurrence of event A. It means it describes how strongly the evidence points forward the event.

③ Evidence :- It element specifies about the ^{evidence} that always observed about ^{whole process}, rather to specifies if it is valid or not.

④ Posterior :- Posterior probability $P(A|B)$ is event event of A that describe about some new evidence of B.

Basically, it specifies that what is the probability that A is true given evidence B observed.



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During using Base algorithm/theorem & the above elements provides a better platform to represent either event A or B by considering the new evidence.

In AI, Bayes's theorem

provides a better approach to make decisions according to specific probability with uncertain data.

We use the mathematical derivation to calculate the conditional probability event A or event B.

$$P(B|A) = P(A \cap B) / P(A).$$

Q: In a class, there are 70% of students who like English & 40% of the students likes English & mathematics and then what is the % of students those who's likes English & also like math.

$A = A$ is the event that students like math,

$B = B$ is the event that students like English

$$P(A|B) = \frac{P(A \cap B)}{P(B)} = \frac{0.4}{0.7} = 57\%.$$

Q: Considering an email filtering system that needs to determine whether an incoming email is a spam or not based on the presence of the word win in the email. Probabilities are :-

0.2(20%) $P(S)$:- the prior probability that any given are spam

0.8(80%) $P(h)$:- the prior probability that given is not spam.

0.6(60%) $P(W|h)$:- the probability of the word win appears in a spam email.

0.1(10%) $P(W|S)$:- the probability that the word win appears in the non-spam emails.

We want to find probability of $P(S|W)$.



→ To calculate,

$P(w)$, the probability that any email contains the words win. So we have to apply the formula $P(w) = P(w|s) * P(s) + P(w|h) * P(h)$.
The probability of word win.

$$\begin{aligned} P(w) &= P(w|s) * P(s) + P(w|h) * P(h) \\ &= 0.6 * 0.2 + 0.8 * 0.1 \\ &= 0.12 + 0.08 \\ &= 0.20 \end{aligned}$$

$$P(s|w) = \frac{P(s|w)}{P(w)} =$$

Q. A person has undertaken a job the probabilities of completion of job on time with and without train are 0.94 and 0.95 respectively if the probability that it will rain is 0.5 then determine the probability that the job will be completed on time.

→ Suppose that the event of doing job will be completed on time and maybe it ranges then we have to represent the probability of range $P(A) = 0.15$.

In case of No range will be $P(\text{N.R}) = 1 - 0.45 = 0.55$.



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Degree of Belief & Degree of Truth:-

In AI, a degree of belief refers to a level of certainty about any specific statement or proposition. It is completely differs from a simple true/false value, allows us to represent uncertainty & partial knowledge.

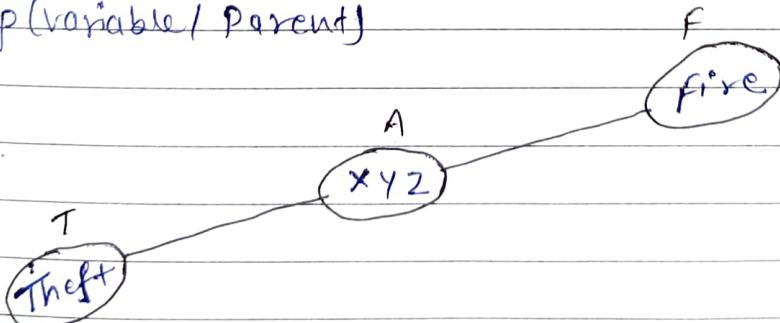
Degree of Belief is mainly represented by probability theory where decision can be made under uncertainty.

Bayesian model uses the Degree of belief concept, handle uncertainty and make prediction or decision based on probabilities.

During representation through Bayesian model, it uses graphical concept to represent the probabilistic relationship among variables.

In graph representation variables are represented as node and dependencies can be represented with edges.

In graphical representation each node's probability depends on its parent nodes, and expressed as $p(\text{variable} | \text{Parent})$



Probabilistic model analysis a graphical representation that performs the operation like prediction and anomaly detection.

Bulgary.



Bayesian is a valuable tool for understanding and solving problem involving uncertain events.

According to the above figure we have a node A that is represented as house of xyz, which has two alert probability like :- a) Theft(T) (b) Fire(F), are the child of the parent node A.

According to degree of belief xyz always knows that in case of any occurrence of error either fire or theft he will get alert. In that case probability theory is applied when chances of know get in alert because of some issues and represented as false event.

Here, it is quite difficult to mention the value in case of false event and it is neither calculated nor computed. It's only observed according to the given situation.