→ Military – Autonomous robot can reach inaccessible and hazardous zones during war.

Robot named Daksh developed by DRDO is in function to destroy life threatning objects safely.

Medicine → (MYCIN)

Exploration :- Robots Rock climbers used for space exploration, underwater drones used for ocean Exploration

Entertainment :- Robotics in Games

Search knowledge and Abstraction in A.I

Search knowledge

In order to solve Complex problems encountered in artificial intelligence one needs both a large amount of knowledge and some mechanisms for manipulating that knowledge to create solutions to new problems.

To search a knowledge base efficiently it is necessary to represent the knowledge base in a systematic way so that it can be searched easily.

In large knowledge bases that contain thousands of rules, the intractability of search is an overriding concern.

- knowledge about path most likely to lead quickly to a goal state is often called search control knowledge

Abstraction

Abstraction is a mental facility that permits human to view real world problems with varying degrees of details depending on the current context of the problem.

(Abstraction means to hide the details of something.)

Natural Language Processing

It is a Subfield of AI. It studies the problems inherent in the processing and manipulation of natural language and natural language understanding devised to make Computers understand statements written in human language.

Fundamental Problems in NLP

Problem 1 Words used by one set of people Can have different meaning for different set of people.

Problem 2 - The functional Structure of the sentence itself Can give rise to ambiguities. eg for example
I saw tajmahal flying over agra
Here who is flying tajmahal or person

Problem 3:- Extensive use of Pronoun increases ambiguities -
Ravi went to the super market. He found his favourite brand Coffee powder in rack five. He paid for it and left.
Here to what object the pronoun 'it' refers to: the supermarket or Coffee powder or rack five.

Problem-4 Conjunctions used in natural language to avoid repetition of phrases also Cause NLP
Example :- Ram and Shyam went to a restaurant. While Ram had a Cup of Coffee and Shyam had Tea.
In this sentence we have supressed had a Cup of.

Semantic Analysis

The structures created by the syntactic analyzer are assigned meanings. In other words, a mapping is made between the syntactic structures and objects in the task domain.

Discourse Integration

The meaning of individual sentence may depend on the sentences that precede it and may influence the meanings of the sentences that follow it.

Pragmatic Analysis - The structure representing what was said is reinterpreted to determine what was actually meant

Example I want to Print Bill's .init file

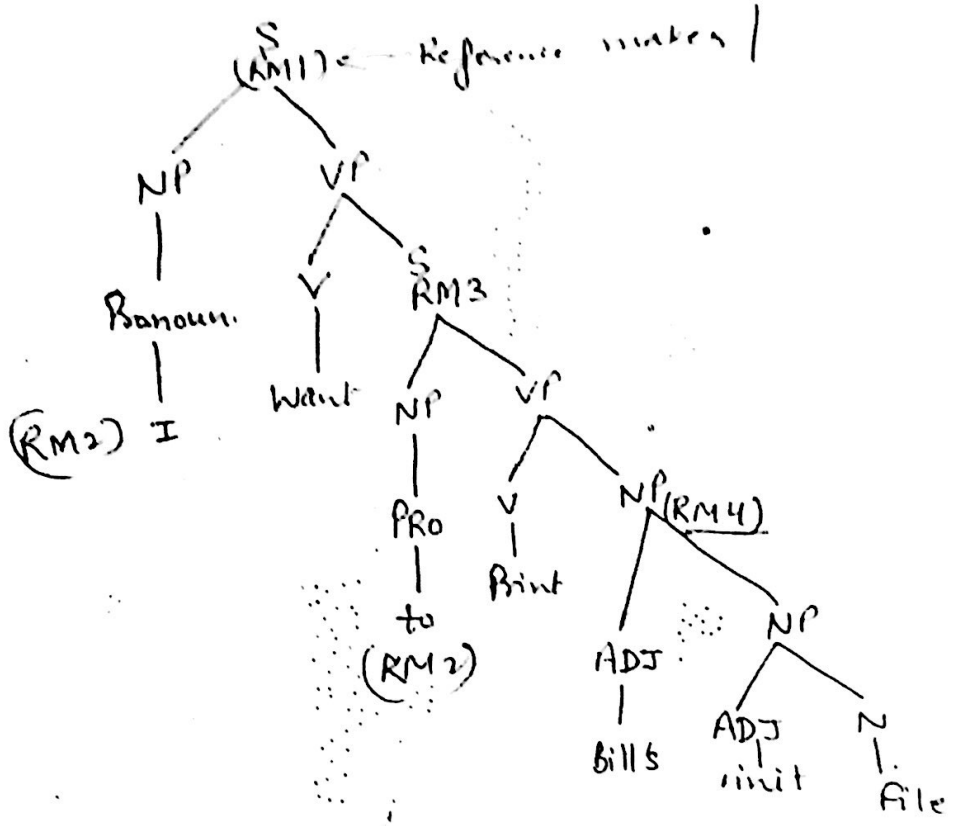
Morphological Analysis :-

Bill's → Bill (Proper noun)
"s" → Possessive Suffix

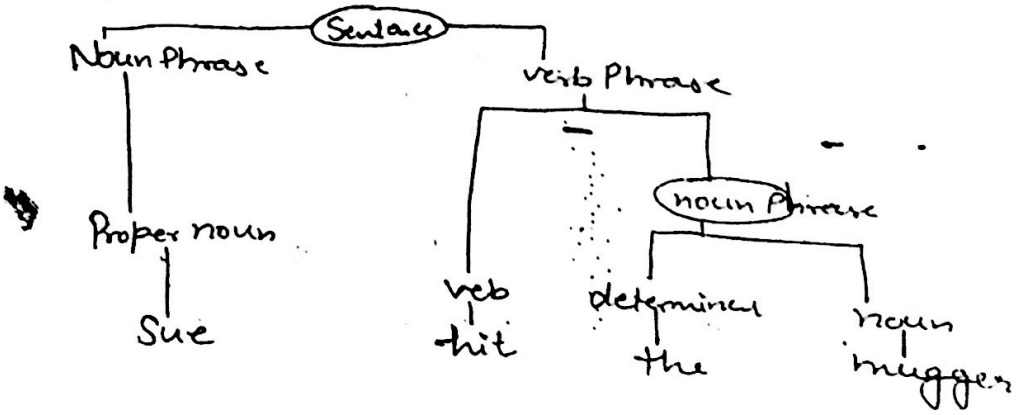
.init → Recognize as a file extension that is functioning as an ~~obj~~ adjective in the sequence

Syntactic Analysis :-

Example :- I want to Print Bill's .init file.



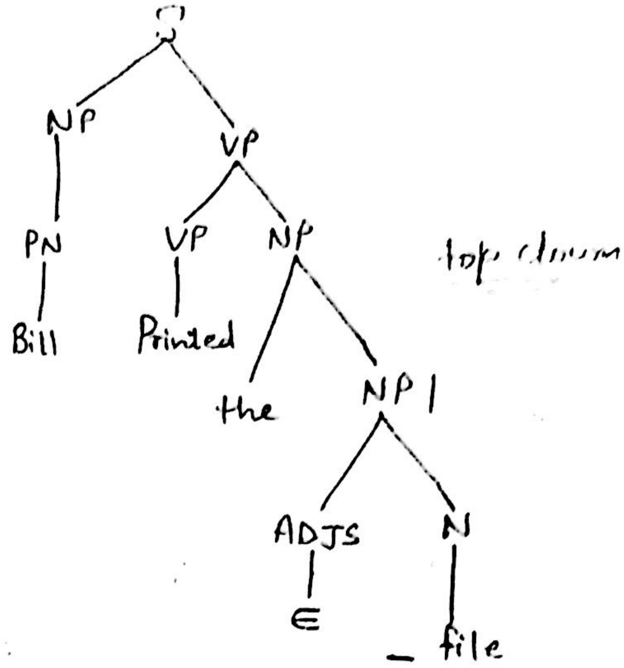
Parser - 2 Example



Two Types of parsing

Top down parsing :- Begin with the start symbol and apply the grammer rules forward until the symbols at the terminals of the tree Correspond to the Components of the sentence being passed.

Bottom-up parsing () Begin with the sentence to be parsed and apply the grammar rules backward until a single tree whose terminals are the words of the sentence and whose top node is the start symbol has been produced



- four ways of handling Sentences (Interpretation)
  - → All paths
  - → Best path with Backtracking
  - → Best Path with Patchup (follow one path at a time but when an error is detected, explictly shuffle around the Components that has already been formed.)
  - → wait and see: follow only one path, but rather than making decisions about the functions of each Component as it is encountered procasttinate the decision until enough information is available to make the decision Correctly.

Augmented Transition Networks

Augmented transition Network is a top-down parsing procedure that allows various kinds of knowledge to be incorporated into the parsing system so it can operate efficiently

(Statements Parsers using Set of states)
as RM.

Semantic Analysis

→ follows Mapping process

→ No Single, definitive Language in which all Sentences meanings can be described

Lexical Processing

First Step in any semantic Processing system is to look up the individual words in a dictionary (or lexicon) and extract their meanings

for example

→ A geometrical shape with four equal sides
→ A baseball field.
→ An extremely hard and Valuable gemstone.

{ Joan saw Susan's diamond shimmering from across the room }

It is necessary to know that neither gemstones geometrical shapes

nor baseball fields shimmer whereas gemstones do

Ambiguity in lexical Mapping

→ It Can be a Verb meaning 'to signify'
→ It Can be a noun meaning "Statistical average"
→ It Can be an adjective meaning "Unpleasant"/Cheap"

The Process of determining the Correct meaning of an individual word is Called word Sense disambiguation or lexical disambiguation.

Word Sense Example

In Example Suppose, the baseball field interpretation of "diamond" Could be marked as a LOCATION.

Then the Correct meaning of "diamond" Could be marked as a LOCATION.

Such Simple properties of word senses are Called Semantic Markers

Other useful Semantic Markers are

→ Physical_object ⟵ { Example I dropped my diamond }
→ ANIMATE_OBJECT
→ ABSTRACT_OBJECT

Sentence Level Processing

Approaches for creating a Semantic representation of a Sentence

1 → Semantic Grammers

It Combines Syntactic, Semantic and Pragmatic knowledge into a single Set of rules in the form of Grammer.
{ result is also Semantic }

2 → Case Grammers

In which the Structure that is built by the parser Contains some Semantic info. although further interpretation may also be necessary.

3 → Conceptual parsing

- Syntactic and Semantic knowledge is Combined into a single interpretation System that is driven by Semantic knowledge. (Prog X)

4 → Compositional Semantic Information :-

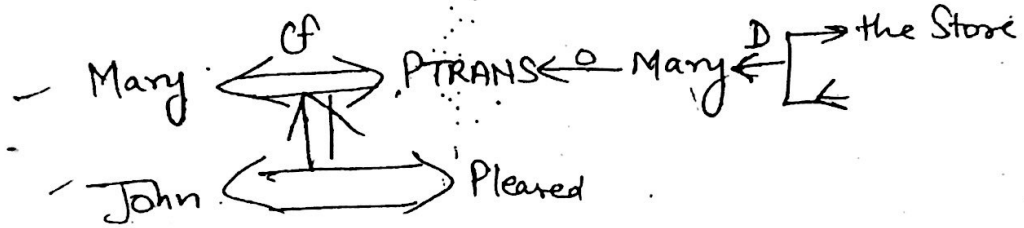
Semantic Processing is applied to the result of Performing a Syntactic Parse.

Conceptual Parsing

Strategy of finding Both the Structure and the meaning of Sentence in one Step.

Example

John wanted Mary to go to the Store



PP → Picture Producer

PTRANS → Physical Transfer

Speech Acts

The elements of Communicative plans are called speech acts

Preconditions & Postconditions.

Request (A, B, R)

Precondition: Know-What (A, LOCATION (B))

CAN-PERFORM (B, R)

WILLING-TO-PERFORM (BR)

POSTCONDITION : WILL (PERFORM (B, R))

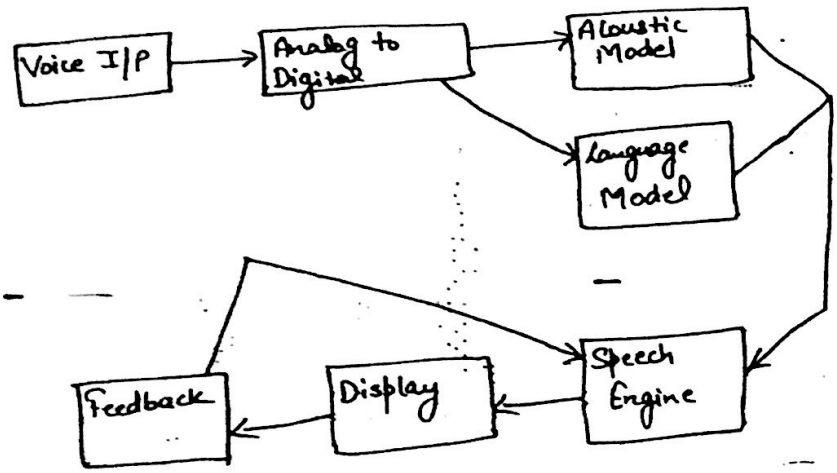
Speech and Vision Processing

Speech recognition means understanding voice by the Computer and performing any required task.

Uses of Speech recognition Sys.

→ System Control / Navigation
→ Commercial / Industrial applications (In Car Steering Sys.)
→ Voice dialing (handsfree)

Recognition



Acoustic Model

Created by taking audio recordings of speech and their text transcriptions and using software to create statistical representations of the sound that make up each word.
It is used by a speech recognition engine to recognize speech.

Language Model

It is used in many natural language processing application such as speech recognition tries to capture the properties of a language and to predict the next word in a speech sequence.

Two types of Speech Recognition

- Speaker dependent (used for dictation Software)
- Speaker Independent (Commonly used in telephone applications)

Speaker Dependent

→ Works by learning the unique characters.

→ New users must first train the Software.

Speaker - Independent

→ No training is involved.

→ Generally less accurate than speaker - dependent

→ They limit the grammer they use by using a smaller list of recognized words

What Computers do ?

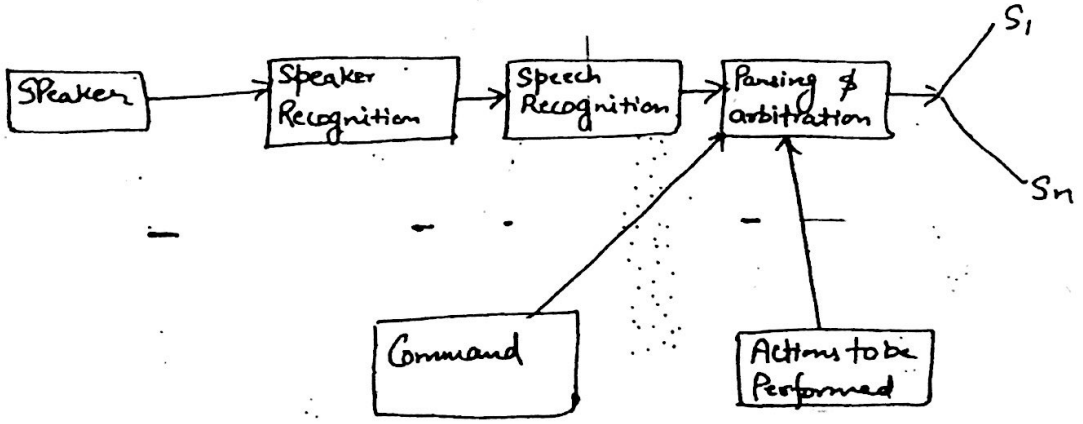
→ Digitization

→ Acoustic analysis of the speech signal

→ Linguistic - interpretation

Processes involved in Speech processing

→ Digitization (A to D / Sampling / Quantization)
→ Signal processing (Separate Speech from background noise)
→ Phonetics (Variability in human speech)
→ Phonology (Recognizing individual sound distinctions)
→ Semantics & pragmatics
→ Lexicology and Syntax



OBJECT IDENTIFICATION / VISION PROCESSING

(a.) Brightness Based Recognition

Given the subset of image pixels that corresponds to a candidate object, defines the features to be the raw pixel brightness values themselves.

(b) Feature Based Recognition

Instead of using raw pixel brightness as feature, we can detect and mark spatially located features such as regions and Edges.

Advantages

→ fewer Edges than pixels.

→ Provides Most Extensive Info about the Environment.

EXPERT SYSTEM

Learning in AI

The agent percepts should be used not only for acting but also for improving future performance.

Tasks to learn for an agent

→ What state will be the result of an action?
→ How will the changing world evolve?
→ What is the value of each state?
→ Which kind of states has high (low) value?
→ Which percepts are relevant?

Learning task is estimation of functions $y = f(x)$:

$X \to Y$

The agent is fed with examples $(x_1, y_1), (x_2, y_2) \cdots (x_n, y_n)$

Inductive learning

Problem: find a hypothesis h
Such that $h \approx F$

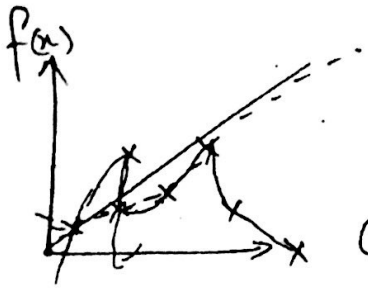
given a training set of examples
which hypothesis is best?

→ All learning methods make assumptions about f.
This Preference is called a "bias"

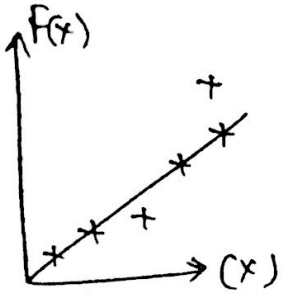
h. Should Perform well on the examples AND on unseen examples: "h should generalised well".

Construct/adjust h to agree with f on training set

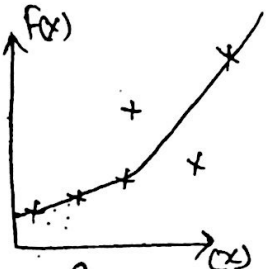
(h is Consistent if it agrees with f on all examples)



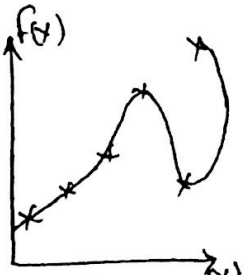
Curve fitting method.



Curve-1



Curve-2



Curve-3

Types Of learning

Supervised learning

Given a value x, f(x) is immediately provided by a "supervisor" f(x) is learned from a numbered examples : $(x_1, y_1), (x_2, y_2) \cdots (x_n, y_n)$

Reinforcement learning

A Correct answer y is not provided for each x
Rather a general evaluation is proved after a sequence of actions.

unsupervised learning

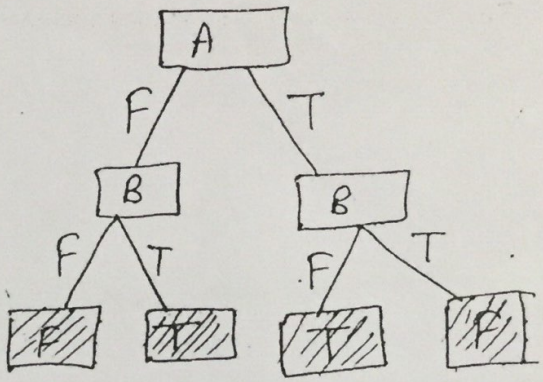
The agent learns relationships among it's Percepts.
i.e it Perform clustering.

Decision Tree Method

one possible representation for hypothesis.

Decision trees can express any function of the input attributes.

A	B	AxorB
F	F	F
F	T	T
T	F	T
T	T	F



Example true tree for deciding whether to wait :-

Condition