

**NLP**

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# Natural Language



- Example

- .exe file is used to run a program.
- To run a program executable file is used.
- You should search .exe file to run a program
- If u want 2 execute the program, please take the exe file from the floppy.

# Natural Language



- Difficulties related to NLP
  - word sense ambiguity
  - structural ambiguity
  - semantic ambiguity
  - referential ambiguity

# Steps In NLP

A decorative graphic at the top of the slide consists of six circles arranged in a horizontal line. The first circle is solid light purple. The second circle is white with a light purple outline. The third circle is solid light purple. The fourth circle is white with a light purple outline. The fifth circle is solid light purple. The sixth circle is solid light purple.

- Morphological Analysis
- Syntactic Analysis
- Semantic Analysis
- Discourse Integration
- Pragmatic Analysis



# Morphological Analysis

- Analysis of the individual words into their components.
- Separation of non-word tokens from the words  
e.g. punctuation
- Assignment of syntactic categories to all words in the sentence.

# Morphological Analysis

The title 'Morphological Analysis' is centered at the top. It is flanked by five circles: a solid light purple circle on the far left, a hollow light purple circle, a solid light purple circle, a hollow light purple circle, and a solid light purple circle on the far right.

Example :

**Raj's printing press prints .doc files.**

- Raj's
- prints
- .doc

# Syntactic Analysis



- Step in which a flat input sentence is converted into a hierarchical structure that corresponds to the units of meaning in the sentence.
- It is also called as Parsing.

# Syntactic Analysis



- Importance :
  - Reductions in the number of constituents semantics system have to consider.
  - Reduction in overall system complexity .
  - Checking the structural correctness of the sentences

# Syntactic Analysis



- **Components :**

Grammar: Declarative representation of the syntactic facts about the language

Parser: A procedure that compares the grammar against input sentences to produce parsed structure

# Syntactic Analysis



- SIMPLE GRAMMAR :

S → NP VP

NP → the NP1

NP → PN

NP → NP1

NP1 → ADJS N

ADJS → e | ADJ ADJS

VP → V

VP → V NP

# Syntactic Analysis



- FACTS :

N → file | printer

PN → Bill

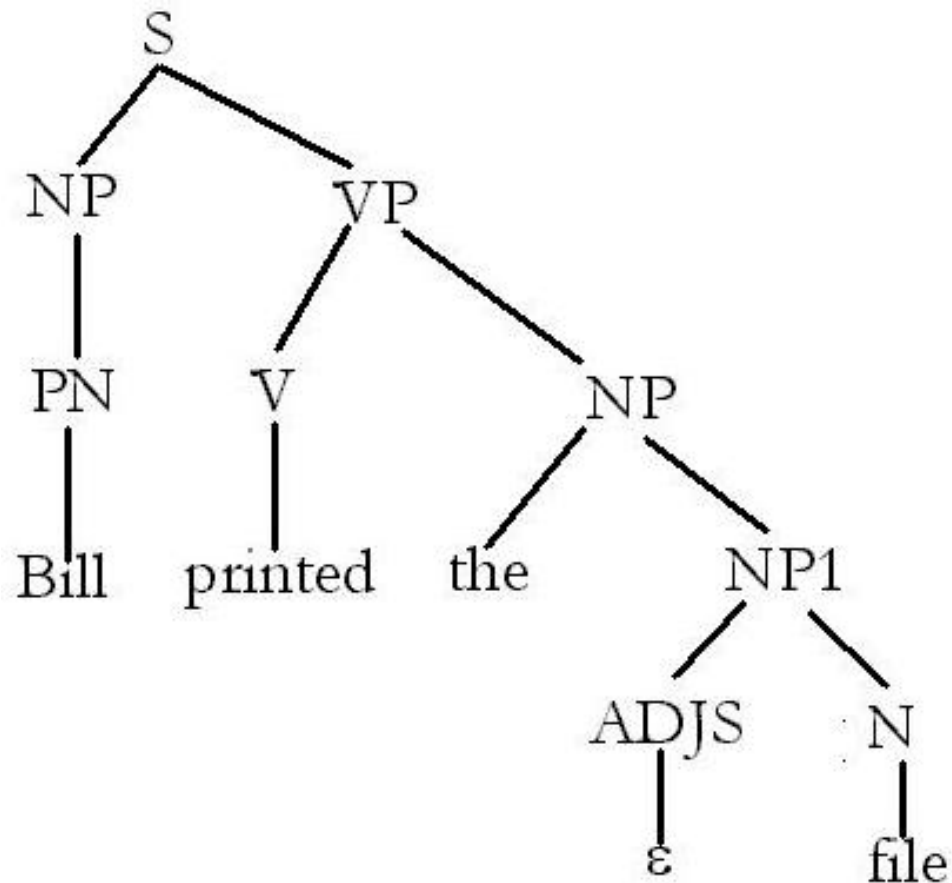
PRO → I

ADJ → short | long | fast

V → printed | created | want

# SYNTACTIC ANALYSIS

Bill printed the  
file.

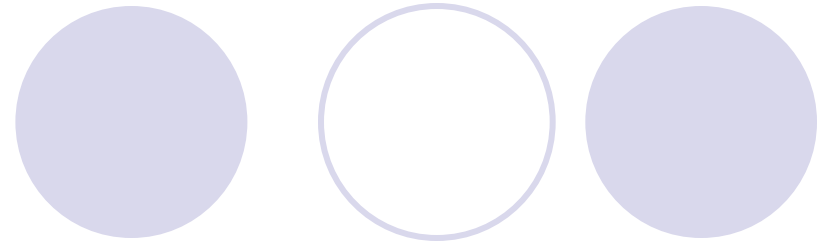


# Semantic Analysis

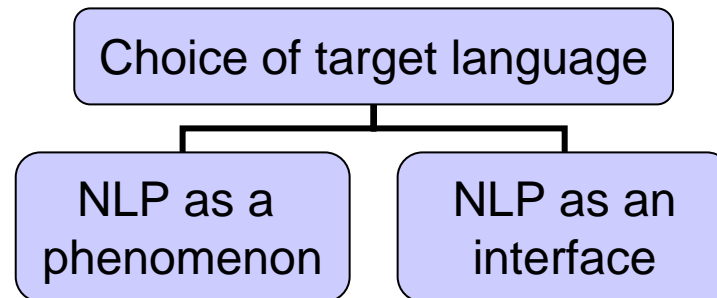


- Maps individual words into appropriate objects in the knowledge base
- Create structures to correspond to the way meanings of the words combine with each other
- Purpose
  - Creation of target language
  - Imposition of constraints on the representations
  - Has access to knowledge

# Target Language



- Final meaning representation language including the representational framework and specific meaning vocabulary



# Step 1 – Lexical Processing

- Meaning of words. Eg.
- Ambiguity
- *Word sense disambiguation or lexical disambiguation. How?*
- Semantic markers
- Extension – Preference semantics
- Unfortunately...

# Step 2 – Sentence Level Processing

- Several Approaches
  - Semantic grammars
  - Case grammars
  - Conceptual parsing
  - Approximately compositional semantic interpretation

# Semantic Grammar



- CFG. Combines syntactic, semantic and pragmatic knowledge into a **SINGLE** set of rules in the form of grammar. Semantic description
- Meaning = Result of parsing + applying semantic actions
- Grammar rules based on key semantic concepts

# Semantic Grammar contd.

$S \rightarrow I \text{ want to ACTION}$

{ command ACTION }

$USER \rightarrow \text{Bill} \mid \text{Susan}$

{ value }

- Advantages

- Immediate results after parsing
- Avoid many ambiguities

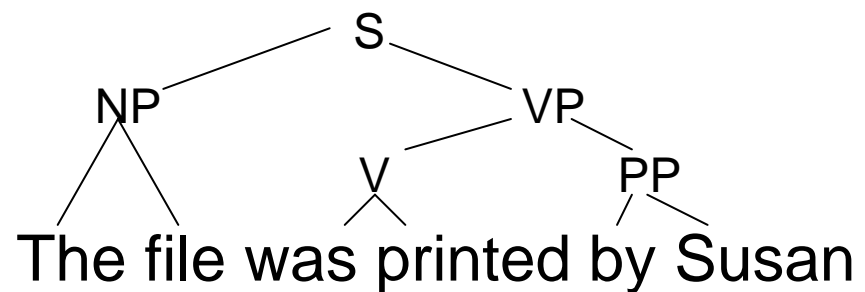
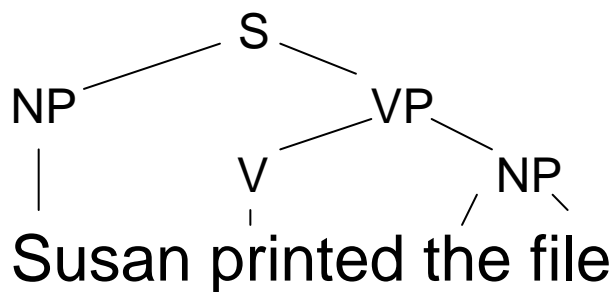
- Disadvantages

- More rules
- Parsing may be expensive

# Case Grammar

- Grammar rules written to describe syntactic (rather than semantic regularities)
- Structures produced are semantic (rather than syntactic)

Eg:



# Interaction Between Syntax & Semantics

- Decisions on how controls will be passed back and forth
  - Every time syntactic constituent formed, apply semantic interpretation immediately
  - Wait until the entire sentence has been parsed, then interpret
- No magic solution. Combination of above two approaches used or a heuristically driven compromise



# Discourse And Pragmatic Reasoning

- Importance of context in understanding Texts and Dialogues

# Relationship Between Phrases And Parts Of Their Discourse Contexts

- Identical Entities: Anaphoric References
  - Bill had a red balloon.
  - John wanted it.
- Parts of Entities
  - Sue opened the book she just bought.
  - The title page was torn.

# Relationships Contd.



- Parts of actions

- John went on a business trip to New York.
- He left on an early morning flight.

- Entities involved in actions

- My house was broken into last week.
- They took the TV and the stereo.

- Names of Individuals

- Dave went to the movies.



# Relationships Contd.

- Causal chains

- There was a big snow storm yesterday.
- The schools were closed today.

- Planning Sequences

- Sally wanted a new car.
- She decided to get a new job.



# Relationships Contd.

- Illocutionary force
  - It sure is cold in here.
- Implicit presuppositions
  - Did Joe fail CS101?

# Approaches



- To carry out multiple-sentence understanding
  - Have a large knowledge base
  - Restrict the domain of discourse.

# Kinds Of Knowledge Required



- The current focus of dialogue
- A model of each participant's current beliefs
- The goal-driven character of dialogue.
- The rules of conversation shared by all participants.

# Using Focus To Facilitate Understanding



- Focus on the relevant parts of the available knowledge base.
  - Task-oriented discourses
  - Signals for dramatic changes of focus
    - On the other hand, etc.
- Use that knowledge to resolve ambiguities and to make connections amongst things that were said.
  - Salient Relations wrt. Object in focus:
    - physical-part-of, temporal-part-of, element-of

# Modeling Beliefs



- **Group Beliefs :**

- assumed to be shared between all the participants in a linguistic event.
- No need for any explicit notion of belief in the knowledge base.

- **Individual Beliefs :**

- Explicit predicates needed
- use modal logic

# Modal Logic



- Classical Logic : deals with the truth or falsehood of different statements as they are.
- Modal logic : concerned with the different modes in which a statement may be true.
  - Truth in current state of world
  - Temporal logic (past and future)
  - Conditional logic (If-Then-Else)

# Knowledge Base Representation

Use knowledge base partitioning

- Represent efficiently the large set of beliefs shared by all participants
- Represent accurately the smaller set of individual beliefs

(Use partitioned Semantic Nets)

# Using Goals And Plans For Understanding

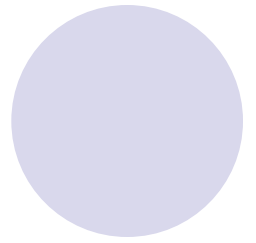
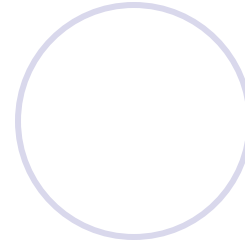
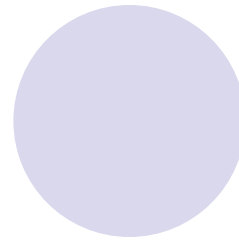
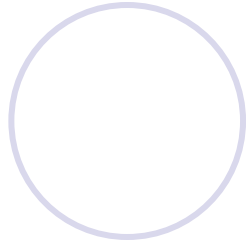
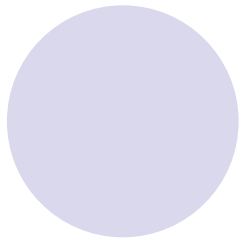


- Identify the Goals.
- Identify the Plans used for reaching the goal.

# Using Goals And Plans For Understanding



- Eg: John was anxious to get his daughter's new bike put together before Christmas Eve. He looked high and low for a screw-driver.
  - Goal – putting together the bike
  - Plan – putting together the various subparts , until the bike is complete.
  - At least one of the sub-plans requires a screwdriver.



Speech Acts : similar to other operators.

- Use modal operators, eg: KNOW, BELIEVE, ETC.
- Conversational Postulates: to analyze indirect speech acts
- Rules about conversation that are shared by all speakers.



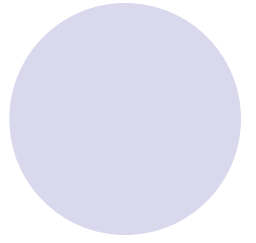
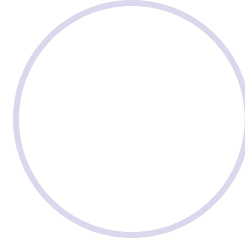
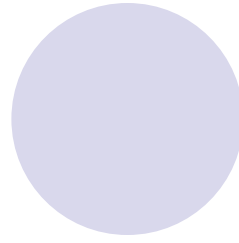
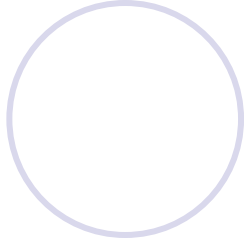
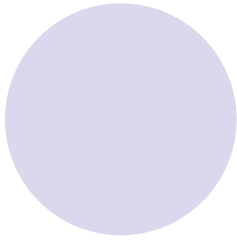
# Conversational Postulates

- Sincerity conditions
- Reasonableness Conditions
- Appropriateness Conditions

# Constraints



- Discourse Processing :
  - The entities involved in the sentence must have either been explicitly introduced or they must be related to entities that were.
  - The overall discourse must be coherent.
- Pragmatic Reasoning :
  - The meaning of the sentence must be consistent with the known goals of the user.



Thank You!