Language & Grammar

Reading: Chap 1, Siddiqui & Tiwari

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Natural Language Processing

Topics

Introduction

Grammar types

Phrase structure grammar

Transformational Grammar

Grammar – Introduction

- Grammar – set of rules to parse and generate sentences in a language

- Rules – related at language (word) level not at knowledge level

Grammar types

- Generalized phrase structure (Chomsky, 1957)
- Transformational grammar (Chomsky, 1957)
- Dependency grammar
- Lexical functional grammar
- Government and binding
- Paninian grammar
- Tree-adjoining grammar (Joshi, 1985)
- Link grammar
- Grammar focused on derivation – phrase structure
- Grammars focused on relationships – dependency, lexical functional, Paninian and link grammar

Phrase Structure Grammar

- Use phrase structure rules or rewrite rules
- Use these rules to specify or generate all grammatical (well-formed) sentences in a language
- Based on constituency relations hence known as constituency grammar
- Grammars based on constituency
    - Generalized phrase structure grammar
    - Head-driven phrase structure grammar
    - Lexical functional grammar
    - Government and binding theory
    - Categorial grammar
- What is constituency relation?

Constituency relation

- View sentence structure in terms of the constituency relation.

- The constituency relation derives from the subject-predicate division of Latin and Greek grammars that is based on logic.

- Basic clause structure is divided into subject (*noun phrase* NP) and predicate (*verb phrase* VP).

- View sentence structure in terms of this one-to-one-or-more correspondence.

Constituency relation
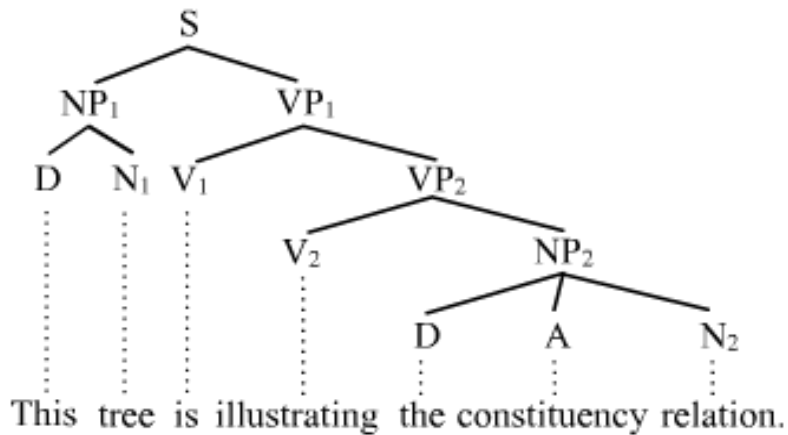

Constituency relation (PSG)
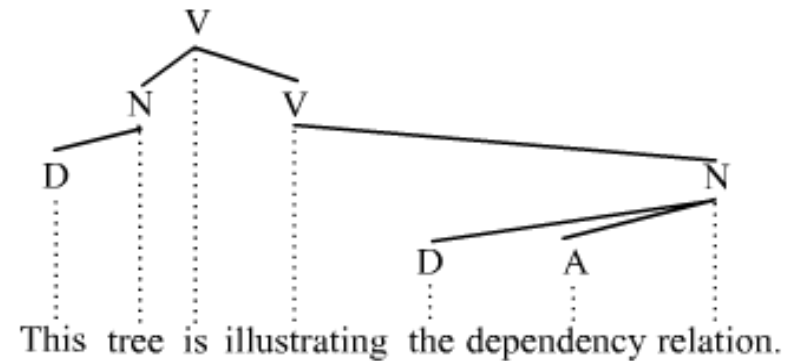
Dependency relation

Syntactic structure

- Chomsky argued – PSGs are not adequate to specify natural language

- Each sentence has two levels of representation – deep structure and surface structure

- Deep structure – structure that conveys the *meaning* of a sentence

- Surface structure – arrangement of constituents that reflects the *word order arrangement*

Syntactic structure

Surface structure — Form used in communication

Deep structure — Meaning
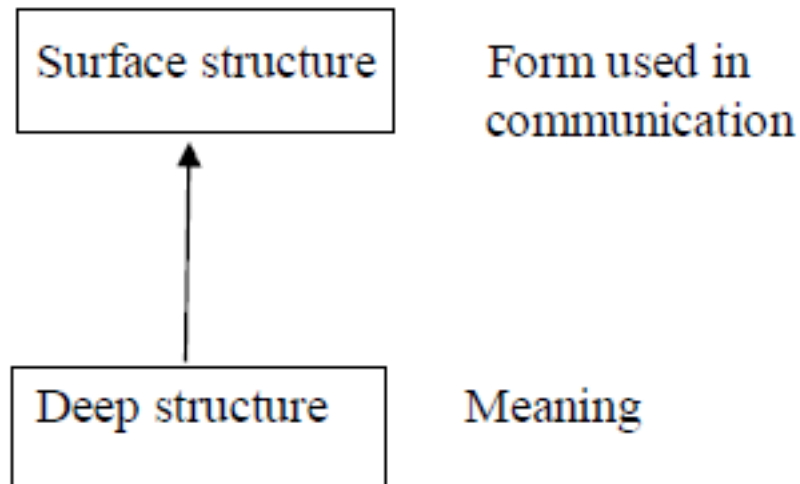
Syntactic structure

- Surface structure – order of a words

  - English: *She ate an apple*

  - Japanese: *She an apple ate*

  - Tamil: *She an apple ate*

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- Different surface-level representations having same meaning share a common deep-level representations

Syntactic structure

- Sentences having same meaning (deep structure):

1. Ram plays violin

2. Violin is played by Ram
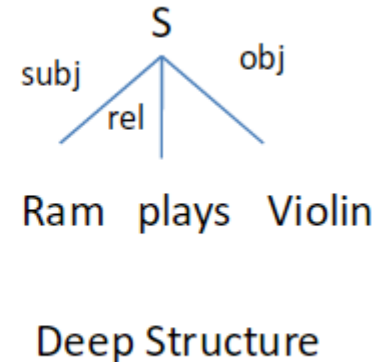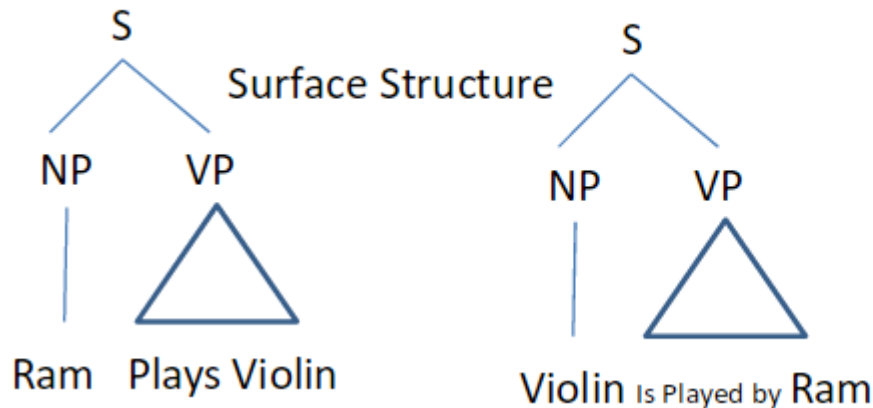
Topics

- Introduction

- Grammar types

- Phrase structure grammar

- **Transformational Grammar**

Transformational grammar

- Three components:

- Phrase structure grammar : set of rules that generate natural language sentences and assign a structural description

- Transformational rules : transform one phrase-marker (underlying) into another another phrase-marker (derived) eg. an active sentence into passive one

- Morphophonemic rules : match each sentence representation to a string of phonemes

Transformational grammar

- Phrase structure grammar:

  S → NP + VP

  VP → V + NP

  NP → Det + Noun

  V → Aux + Verb

  Det → the, a, an, …

  Verb → catch, write, eat, …

  Noun → police, snatcher, …

  Aux → will, is, can, …

- Sentence1: *The police* *will catch* *the snatcher*

  $$NP1 - \quad Aux - V - \qquad NP2$$

Transformational grammar

- Transformational rule:

- Transformation involves addition of 'be' 'en' and rearrangements of certain constituents

$$NP_1 - Aux - V - NP_2 \rightarrow NP_2 - Aux + be + en - V - by + NP_1$$

The sentence1 becomes:

The + *snatcher* + will + be + en + catch + by + police

a rule to word reordering:

The + snatcher + will + be + catch + en + by + police

Transformational grammar

- Morphophonemic rule:

- Convert *catch+en* to *caught*

  The + snatcher + will + be + caught + by + police

Thank You

References:

Natural Language Processing and Information Retrieval :

Tanveen Siddiqui & Tiwary