Computational Linguistics

Lecture 5

Dr. Dina Khattab

dina.khattab@cis.asu.edu.eg

CONTEXT FREE GRAMMAR (CFG)

Grammar or Syntax

➢The way words are arranged together (Structure).

Why Syntax?

Syntactic analysis is a key component in many applications

➢ Grammar checkers

➢ Conversational agents

➢ Question answering

➢ Information extraction

➢ Machine translation

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Context-Free Grammars

Consist of:

- Rules

- Terminals

- Non-terminal

Context-Free Grammars

➢ **Terminals**

We'll take these to be words (for now)

➢ **Non-Terminals**

The constituents in a language (e.g., noun phrase)

➢ **Rules**

Consist of a single non-terminal on the <u>left</u> and any number of terminals and non-terminals on the <u>right</u>
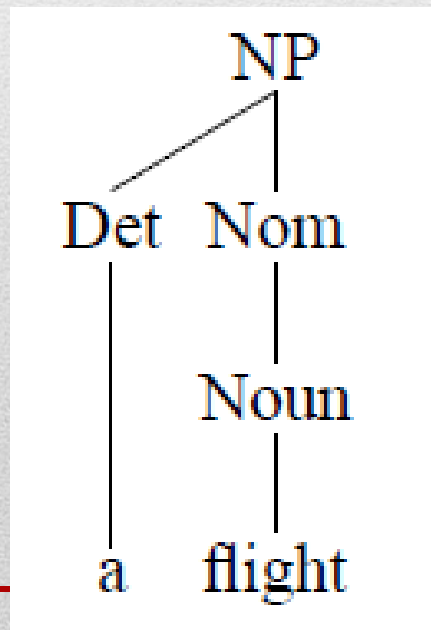
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➤ Here are some rules for our noun phrases

$$NP \rightarrow Det\ Nominal$$
$$NP \rightarrow ProperNoun$$
$$Nominal \rightarrow Noun\ |\ Nominal\ Noun$$

➤ Lexicon: set of rules that introduce these terminals

$$Det \rightarrow a$$
$$Det \rightarrow the$$
$$Noun \rightarrow flight$$

➤ From these rules we can say NP can be " a flight"

➢ We say the string '*a flight*' can be **derived** from the nonterminal *NP*

➢ A CFG can be used to randomly generate a series of strings.

➢ A derivation can be represented by a **parse tree**

```
          NP
         ╱  |
      Det   Nom
       |     |
       |    Noun
       |     |
       a   flight
```

➢The <u>formal language </u>defined by a CFG is the set of strings that are derivable from the designated **start symbol** called *S*.

➢We can express the fact that a sentence can consist of a **noun phrase** and a **verb phrase**:

$S \rightarrow NP\ VP$ I prefer a morning flight

An Example Grammar

S	$\rightarrow$	*NP VP*	I + want a morning flight
NP	$\rightarrow$	*Pronoun*	I
	|	*Proper-Noun*	Los Angeles
	|	*Det Nominal*	a + flight
Nominal	$\rightarrow$	*Noun Nominal*	morning + flight
	|	*Noun*	flights
VP	$\rightarrow$	*Verb*	do
	|	*Verb NP*	want + a flight
	|	*Verb NP PP*	leave + Boston + in the morning
	|	*Verb PP*	leaving + on Thursday
PP	$\rightarrow$	*Preposition NP*	from + Los Angeles

An Example Lexicon

$Noun \rightarrow flights \mid breeze \mid trip \mid morning \mid \ldots$

$Verb \rightarrow is \mid prefer \mid like \mid need \mid want \mid fly$

$Adjective \rightarrow cheapest \mid non-stop \mid first \mid latest \mid other \mid direct \mid \ldots$

$Pronoun \rightarrow me \mid I \mid you \mid it \mid \ldots$

$Proper\text{-}Noun \rightarrow Alaska \mid Baltimore \mid Los\ Angeles \mid Chicago \mid United \mid American \mid \ldots$

$Determiner \rightarrow the \mid a \mid an \mid this \mid these \mid that \mid \ldots$

$Preposition \rightarrow from \mid to \mid on \mid near \mid \ldots$

$Conjunction \rightarrow and \mid or \mid but \mid \ldots$