

Formal Syntax & Grammar Engineering (Exercise 1)

Background Reading

Read Sections 2.1 through 2.7, 2.10, and 3.1 through 3.3 from Sag, Wasow, & Bender (2003). Make sure to compare their examples and grammars to our slide copies and observe where in the lecture we have in some cases (further) simplified over the book.

1 Regular Expressions vs. Context-Free Grammars

- (a) Is it possible to provide a regular expression that exactly describes the following language, i.e. the language consisting of all strings composed of a sequence of some number of A symbols, followed by the exact same number of B symbols:

$$\{AB, AAB, AAAB, AAAAB, \dots\}$$

If yes, please provide the regular expression; if not, explain in one or two sentences why the above language is beyond the scope of regular expressions.

- (b) Provide a context-free grammar to generate the language above (often referred to as $A^n B^n$); please be reasonable formal and specify the context-free grammar in terms of the four elements of the quadruple $\langle C, \Sigma, P, S \rangle$.

2 Natural Language Ambiguity

In your own words, describe how the following sentences of English are ambiguous, for example paraphrasing each possible interpretation in English, and intuitively identify the nature of the ambiguity:

- (a) *Kim saw the astronomer with the telescope.*
- (b) *Sandy saw her duck.*
- (c) *Visiting relatives can be dangerous.*
- (d) *Bo saw that gas can explode.*

3 Symmetric English

Consider the language defined by the following grammar (assuming the start symbol 'S'):

$S \rightarrow NP VP$	$NP \rightarrow oslo$
$NP \rightarrow PP NP PP$	$NP \rightarrow dogs$
$VP \rightarrow VP PP$	$V \rightarrow barked$
$VP \rightarrow V$	$P \rightarrow in$
$PP \rightarrow P NP$	$P \rightarrow near$

- (a) For each sentence length from two to nine words, give an example sentence in Symmetric English, if any exist.
- (b) Draw the syntax tree for each reading assigned by the grammar of Symmetric English to the following sentence, or explain why it has no readings:
 - (i) *near in oslo dogs near oslo dogs in oslo barked.*

Submit your results in email to Stephan and Lilja by noon on Friday, October 29.