

Ling. 610 Fall 2013  
Problem Set #1 22 points

Due Tues. 9/17

1. 4 points

Present a finite-state grammar, in graphic form, for each of the following languages. Try to make the grammar as simple as possible.

- a. That man laughed  
That man and that man laughed  
That man and that man and that man laughed  
etc.
- b. The syntax student is happy  
The syntax students are happy  
The syntax student really is happy  
The syntax students really are happy  
The syntax student really really is happy  
etc.

2. 4 points

- a. Discuss a phenomenon demonstrating the infinitude of human languages.
- b. Discuss a phenomenon demonstrating that sentences in human languages have structure.

3. 3 points

Given the following context-free PS grammar, give a derivation for each of the following sentences:  
*abc, aaabc, aabbbbbc*

$S \rightarrow ABC \quad A \rightarrow Aa \quad A \rightarrow a \quad B \rightarrow Bb \quad B \rightarrow b \quad C \rightarrow c$

4. 5 points

Given the following PS grammar, provide the information requested in A-C.

$S \rightarrow AB \quad A \rightarrow aA \quad B \rightarrow b \quad A \rightarrow a$

- A. Provide all of the equivalent derivations for the sentence *aab*.
- B. Give the (set theoretic) phrase marker for the sentence *aab*.
- C. Give the reduced phrase marker for the sentence *aab* (that is, the subset of the phrase marker consisting of the terminal string and the monostrings).

[Remember, to get from one line of a derivation to the next, exactly one rule applies once. Also, recall that two derivations are equivalent if they differ only in the order of application of rules.]

5. 6 points

Consider the following languages and provide the information requested in A and B.

- a.  $a^n b f c^n$  (*abfc, aabfcc, aaabfcc, etc.*)  
where  $n$  is greater than 0 ( $n > 0$ )
- b.  $b^n a^{n-1}$  (*bba, bbbaa, etc.*) ( $n > 1$ )

- A. Write a context-free ( $\Sigma, F$ ) grammar for each of these languages. Make the grammars as simple as possible. (Be very careful to avoid 'overgeneration', i.e., generating sentences that are not in the language.)
- B. Give derivations for 2 sentences from language a., and 2 from language b.