

Final Examination, CSE477-Ling549, Fall 2003

PLEASE RETURN YOUR EXAMINATION TO THE FRONT DESK IN IRCS, 3401 WALNUT, 4TH FLOOR BY DEC 12. PLEASE TURN IN YOUR PROJECTS AT THE SAME ADDRESS BY NO LATER THAN DEC 19. FOR PROBLEM 4 FROM THE MID-TERM EXAM, IF YOU RECEIVED THE GRADE OF S- OR LESS FOR THAT PROBLEM THEN SUBMIT YOUR FINAL VERSION BY DEC 19 ALSO.

DO NOT SPEND MORE THAN 6 HOURS FOR THE FINAL EXAMINATION BELOW.

Problem 1: 15 points

Let $\Sigma = \{a, b\}$. A palindrome over $\Sigma = \{a, b\}$ can be defined as a string w that reads the same forward and backward or by the following definition.

- (a) ϵ , the null string, is a palindrome.
- (b) If $a \in \Sigma$ then the string a is a palindrome.
- (c) If x is a palindrome and $a \in \Sigma$ then the string axa is a palindrome.
- (d) Nothing is a palindrome unless it follows from (a) through (c).

Show by *induction* that the two definitions are equivalent.

Problem 2: 20 points

Show that the language L ,

$$L = \{ww \mid w \in \{0, 1\}^*\}$$

is not a regular (finite state) language. Use the pumping lemma for finite state languages. Hint: Try the string $w = 0^p 10^p 1$, for some appropriate p .

The language L is also not a context-free language. Try to show this by using the pumping lemma for context-free languages. Again you need to choose a specific string. Will the string w mentioned above work in this case? If so, show that it will work. If not, suggest some other string that will work.

Problem 3: 15 points

For each language corresponding to the regular expressions below give two strings that are in the language and two strings that are not in the language.

- (a) a^*b^*
- (b) $a^* + b^*$
- (c) $(a + ba + bb)(a + b)^*$

Problem 4: 15 points

- (a) Give a context-free grammar for the language for the language

$$L = \{a^i b^j c^k \mid i, j, k \geq 0 \text{ and either } i = j \text{ or } j = k\}$$

(b) Is the grammar for L ambiguous? If yes then give an ambiguous string in the language, otherwise show why the grammar is unambiguous.

Problem 5: 40 points

Construct a Lexicalized Tree-Adjoining Grammar (LTAG) that will be adequate to describe the sentence types listed below. It will be sufficient to show the elementary trees and the ‘derivation’ trees for the sentences listed below.

1. Mary left.
2. Mary left yesterday
3. Mary thinks Harry left yesterday.
4. Bill invited Harry for the party.
5. Who did Bill invite for the party?
6. Who do you think Bill invited for the party?
7. John seems to like pizza.
8. Bill thinks John seems to like pizza.
9. Mary makes John laugh.
10. The mother gave a toy to the baby.
11. A toy was given to the baby by the mother.
12. The baby gave a nice smile.

When you construct the LTAG please make sure that you keep in mind the notions of locality of elementary trees and the encapsulation of lexical anchors and their arguments.

Please do not write too much. If you show the elementary trees and the derivation tree for each sentence clearly, I will be able to make the right inferences.