

**Final Examination, CSE477-Ling549, Fall 2000**

Please return your examination to Room 555 Moore or to the front desk in IRCS by DEC 12 2000.

**Problem 1: 15 points**

Let  $L$  be the language over the alphabet  $\{a, b\}$  such that  $\#a's = \text{twice } \#b's$  and the  $a's$  and  $b's$  can appear in any order. Show that  $L$  is a context-free language by constructing a CFG for  $L$  and also a PDA for  $L$ .

**Problem 2: 10 points**

Construct a binary normal form (Chomsky Normal Form) for the CFG whose productions are

$$S \rightarrow TST|T|e$$

$$T \rightarrow 00|e$$

**Problem 3: 15 points**

$$\text{Let } L = \{a^i b^i c^i d^i \mid i \geq 1\}$$

Show that  $L$  is not a context-free language by using the pumping lemma for CFL's.

**Problem 4: 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 5: 15 points**

In a Categorical Grammar *The cat chased the mouse* can have two derivations. In a CFG *John saw a man with a telescope* can have two derivations also.

What is difference between these two ambiguities?

**Problem 6: 30 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. Mary makes John laugh.
9. The mother gave a toy to the baby.
10. 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 basic structures and derivations clearly, I will be able to make the right inferences.