

**Final Examination, CSE 477/Ling 549, Fall, 2002**  
**DUE DATE: DECEMBER 6 2002**

This is a take home examination and it is an open book examination. You may consult any resources you wish as long as they are non-human. **Do not spend more than 6 hours total.**

If you got less than 90 points in the mid-term examination you may resubmit the problem concerning finite state transducers, if you wish. This is not a requirement. It is an option available to you.

**DUE DATE: DECEMBER 6 2002. You may leave your answer book at the front desk at IRCS, 3401 Walnut, 4th Floor.**

**Problem 1: 15 points**

Let  $G$  be a CFG whose production rules are

$$S \rightarrow SbS$$

$$S \rightarrow a$$

Show that  $G$  is an ambiguous grammar. Is  $L(G)$ , the language of  $G$ , ambiguous or unambiguous? Justify your answer.

**Problem 2: 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 3: 15 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 4: 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 are these two derivations in each case? What is difference between these two ambiguities?

**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.