

Final Examination: CSE 477, Spring 95. May 8 1995. 1:30 p.m. - 3:30 p.m.

Do problems worth 100 points or more. If you do problems worth more than 100 points I will count only the best answers towards 100 points.

1 Problem 1: 20 points

Write a regular expression for the following over the alphabet $\{0,1\}$. Justify your answer.

The set of all strings not containing 101 as a substring.

2 Problem 2: 20 points

Construct a finite state automaton equivalent to the following regular expression

$$(11 + 0)^*(00 + 1)^*$$

The automaton can be nondeterministic and can have ϵ moves.

3 Problem 3: 10 points

Give a finite state grammar for the following language over the alphabet $\{a, b\}$.

$$L_1 = \{w \mid w \text{ contains exactly one occurrence of } a \text{ or exactly one occurrence of } b \text{ or both.}\}$$

4 Problem 4: 15 points

By using the pumping lemma for context-free languages show that the language L_2

$$L_2 = \{a^p b^q c^{\max(p,q)}\}$$

is not a context-free language.

5 Problem 5: 20 points

Let L_3 be a language over the alphabet $\{a, b\}$ such that $\#a's = \#b's = k$ and the $a's$ and $b's$ can appear in any order. Show that L_3 is a context-free language. Hint: Construct an equivalent pushdown automaton.

6 Problem 6: 15 points

Let L_4 be a language similar to L_3 in Problem 5 except that $\#a's$ is twice $\#b's$. Is L_4 a context-free language? Justify your answer.

7 Problem 7: 15 points

Show that the language L_5 over the alphabet $\{a, b, c\}$

$$L_5 = \{a^m b^m c^{2m} \mid m \geq 1\}$$

is not a context-free language.

8 Problem 8: 15 points

Give a context-sensitive grammar for the language L_5 in Problem 7. Justify your answer. Hint: First show that a permutation such as $XY \rightarrow YX$ can be accomplished by context-sensitive rules. Then use permutation rules directly.

9 Problem 9: 20 points

Give a tree-adjoining grammar for the language L_3 in Problem 5. Justify your answer.