
PROBLEM SET 6

CS 373: THEORY OF COMPUTATION

Assigned: October 10, 2013 Due on: October 17, 2013

Instructions: This homework has 3 problems that can be solved in groups of size at most 3. Please follow the homework guidelines given on the class website. Solutions not following these guidelines will not be graded.

Recommended Reading: Lectures 12, and 13.

Problem 1. [Category: Design+Proof] Let L be the language consisting all strings over $\{a, b\}$ that have twice as many a s as b s. For example, $aababa \in L$ and $\epsilon \in L$ but $a \notin L$.

1. Design a context-free grammar for L . [5 points]
2. Prove that your grammar is correct. [5 points]

Problem 2. [Category: Comprehension+Design] Let $G = (V, \Sigma, R, \langle \text{STMT} \rangle)$ be the following grammar

$$\begin{aligned} \langle \text{STMT} \rangle &\longrightarrow \langle \text{ASSIGN} \rangle \mid \langle \text{IF-THEN} \rangle \mid \langle \text{IF-THEN-ELSE} \rangle \\ \langle \text{IF-THEN} \rangle &\longrightarrow \text{if condition then } \langle \text{STMT} \rangle \\ \langle \text{IF-THEN-ELSE} \rangle &\longrightarrow \text{if condition then } \langle \text{STMT} \rangle \text{ else } \langle \text{STMT} \rangle \\ \langle \text{assign} \rangle &\longrightarrow \text{a} := 1 \end{aligned}$$

where $\Sigma = \{\text{if, then, else, condition, a} := 1\}$ and $V = \{\langle \text{STMT} \rangle, \langle \text{IF-THEN} \rangle, \langle \text{IF-THEN-ELSE} \rangle, \langle \text{ASSIGN} \rangle\}$. G is a natural looking grammar for a fragment of a programming language, but G is ambiguous.

1. Show that G is ambiguous. [5 points]
2. Give a new unambiguous grammar for the same language. You need not prove that your grammar is correct but explain your construction. You may want to look at examples in Lecture 12. [5 points]

Problem 3. [Category: Design] Design a PDA to recognize the language $C = \{x\#y \mid x, y \in \{0, 1\}^* \text{ and } x \neq y\}$; thus, $C \subseteq \{0, 1, \#\}^*$. You need not prove that your construction is correct, but you should clearly explain the intuition behind your construction. [10 points]