

HW 8 CMSC 452. Morally DUE Oct 28

NOTE- THIS HW IS TWO PAGES LONG

1. (0 points) What is your name? Write it clearly. Staple your HW. When is the midterm?
2. (30 points) Let G be the following grammar:
 - Nonterminals are S, A, B , terminals are $\{a, b\}$, Start symbol is S .
 - Rules are
$$\begin{aligned} S &\rightarrow AB \\ A &\rightarrow BS \\ B &\rightarrow SA \\ A &\rightarrow a \\ B &\rightarrow b \\ B &\rightarrow e \end{aligned}$$

Use the procedure shown in class (and its in the notes) to determine if the following strings are in $L(G)$.

HINT- to save time you can use some of the intermediary results from a prior problem. For example, not that in the second problem you will need $W[aa]$. AH- but you already know that from the first problem.

- (a) $aabb$
- (b) $bbaab$
- (c) $bbbaabbab$

3. (30 points) Let G be a grammar in Chomsky Normal Form and let $L = L(G)$. Let $n \in \mathbb{N}$. We want to know ALL of the following:

- (a) Is $a^n \in L$
- (b) Is $a^{n-1}b \in L$
- (c) Is $a^{n-2}b^2 \in L$
- (d) \vdots
- (e) Is $ab^{n-1} \in L$
- (f) Is $b^n \in L$.

You COULD do this in $O(n^4)$ time— just do each one individually. Give an algorithm that does BETTER than $O(n^4)$.

4. (30 points) Let T be a tree where every internal node has one or two children. Assume that the tree's internal nodes are labelled with elements of the set $\{A_1, \dots, A_M\}$. Fill in the following sentence and prove it:

If T has at least XXX leaves then there must be a branch that has the same label on it twice.

(NOTE- XXX will be a function of M .)

5. (10 points) How is the last question relevant to the material in this course?