CS3311 Homework 7   Due date: Wednesday, October 20, 2010, in class

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The answers, comments, and programs (if any) must be the original work of the author. While discussion with others is permitted and encouraged, the final work should be done individually. You are not allowed to work in groups. You are allowed to build on the material supplied in the class. If you use any other source than the class notes and the textbook, specify it clearly.

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1. *(2+3+10 points)* Consider the following grammar:

$$S \to BSA \,|\, A$$
$$A \to aA \,|\, \lambda$$
$$B \to Bba \,|\, \lambda$$

a. Transform the grammar into $G1$ so that the recursion to the start symbol is removed.

b. Show the set of nullable variables in $G1$.

c. Construct an essentially noncontracting grammar $G2$ (with a non-recursive start symbol) equivalent to $G1$.

2. *(2+3+10 points)* Consider the following grammar:

$$S \to ABC \,|\, aBC$$
$$A \to aA \,|\, BC$$
$$B \to bB \,|\, \lambda$$
$$C \to cC \,|\, \lambda$$

a. Transform the grammar into $G1$ so that the recursion to the start symbol is removed.
b. Show the set of nullable variables in $G1$.
c. Construct an essentially noncontracting grammar $G2$ (with a non-recursive start symbol) equivalent to $G1$.

3. *(5+10 points)* Consider the following grammar G. Note that the grammar does not contain λ-rules.

$$S \to AB \,|\, C$$
$$A \to aA \,|\, B$$
$$B \to bB \,|\, C$$
$$C \to cC \,|\, a \,|\, A$$

a. Use algorithm 4.3.1 to construct the `CHAIN` sets for the variables in V.

b. Construct an equivalent grammar G_c that does not contain chain rules.

Please turn the page over.

4. *(40 points)* Consider the following grammar G:

$$S \rightarrow ACH \,|\, BB$$
$$A \rightarrow aA \,|\, aF$$
$$B \rightarrow CFH \,|\, b$$
$$C \rightarrow aC \,|\, DH$$
$$D \rightarrow aD \,|\, BD \,|\, Ca$$
$$F \rightarrow bB \,|\, b$$
$$H \rightarrow dH \,|\, d$$

a. Construct the TERM set for G and construct the equivalent grammar G_T that does not contain variables that do not generate strings of terminals.

b. Construct the REACH set for G_T and construct the equivalent grammar G_U that does not contain useless variables.

5. *(15 points)* Show that all the symbols of the grammar

$$S \rightarrow AB \,|\, C$$
$$A \rightarrow aA \,|\, a$$
$$B \rightarrow bB \,|\, b$$
$$C \rightarrow D \,|\, E$$
$$D \rightarrow aDb \,|\, c$$
$$E \rightarrow bEa \,|\, c$$

are useful. Construct an equivalent grammar G_C by removing the chain rules from G. Show that G_C contains useless symbols.