CS3311 Homework 10 Due: Wednesday, March 29, 2017, by class time, 12:05pm
(scanned submissions are not allowed) Submission: Typed, pdf on Canvas

The answers 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. Any other source must be specified clearly.

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

$S \to a \mid aA \mid BC$
$A \to aB \mid b$
$B \to Aa$
$C \to cCD$
$D \to ddd$

(a) Construct the TERM set for G.

(b) Use the TERM set to construct an equivalent grammar G_T that does not contain variables that do not generate strings of terminals.

2. *(10+10 points)* Consider the following grammar G where Σ contains every word listed in the rules: $\Sigma = \{$ `Michigan, Tech, ..., cool` $\}$.

$S \to$ `Michigan Tech CS gives` $N \mid$ `Having a graduate degree is` R
$T \to$ `Being in a computing field is` D
$N \to$ `BSc degrees` $\mid$ `MSc degrees` $\mid$ `PhD degrees`
$R \to$ `fun` $\mid$ `intellectually challenging` $\mid$
`financially rewarding` $\mid$
`not as hard as one would think` $\mid$
`a worthwhile option to explore`
$D \to$ `fun` $\mid$ `awesome` $\mid$ `cool`

(a) Construct the REACH set for G.

(b) Use the REACH set to construct an equivalent grammar G_U that does not contain unreachable variables.

3. *(20 points)* Convert the following grammar G into Chomsky normal form. Show your steps clearly. Note that G already satisfies the conditions on the start symbol S, λ-rules, useless symbols, and chain rules.

$S \to bT \qquad T \to aAA \mid AbAT \qquad A \to aT \mid bT \mid a$

4. *(40 points)* Remove left recursion from the following grammar using the method described in class.

$S \to A \mid B$
$A \to AAA \mid a \mid B$
$B \to BBb \mid b$