CS3331 - Assignment 2 - 2018

Context-Free Languages

Due: 9 am Friday, Oct 26, 2018 (Latest to submit: 9 am Monday, Oct 29)

1. (30pt) Let $L = \{w \in \{\mathsf{A}\text{–}\mathsf{Z}, \neg, \wedge, \vee, \rightarrow, (,)\}^* : w \text{ is a syntactically legal Boolean expression}\}$.

   (a) Write an unambiguous context-free grammar that generates L. The grammar should both:
   - use the following precedence levels to the operators (from highest to lowest): $\neg, \wedge, \vee,$ and $\rightarrow$;
   - associate left given operators of equal precedence (if an operator $\sim$ is left-associative, then $\mathsf{A} \sim \mathsf{B} \sim \mathsf{C}$ is interpreted as $(\mathsf{A} \sim \mathsf{B}) \sim \mathsf{C}$).

   (b) Show the parse tree that your grammar will produce for the string

   $$\neg\mathsf{A} \rightarrow \mathsf{B} \rightarrow (\neg\mathsf{A} \rightarrow \neg\mathsf{B} \rightarrow \mathsf{A})$$

2. (40pt) For each of the following languages L, prove whether L is regular, context-free but not regular, or not context-free:

   (a) $L = \{w^R x w : w \in \{\mathtt{a}, \mathtt{b}\}^* \text{ and } x \in \{\mathtt{a}, \mathtt{b}\}^+\}$.

   (b) $L = \{wx : 2|w| = 3|x| \text{ and } w, x \in \mathtt{0}^+\mathtt{1}^+\}$.

   (c) $L = \{wxx : |w| = 2|x| \text{ and } w \in \{\mathtt{a}, \mathtt{b}\}^* \text{ and } x \in \{\mathtt{c}\}^*\}$.

3. (30pt) Show that the following problem is decidable: Given a FSM M and a PDA P, is $L(M) \cap L(P)$ infinite?

Note well: You may submit your assignment in one of two ways:

- Ideally, submit your solution as a pdf file on OWL (scanned written assignments are fine).
- Otherwise **staple your assignment** and hand in solutions in class or to the 3331 dropbox (locker #306, across from the elevator on the 3rd floor of Middlesex College).

Assignments **will not be accepted after 9:00 am Oct 29**.