CS21004 - Tutorial 10

April 1st, 2019

Instructions: For the problems with 'to submit', please write the answers neatly in loose sheets and submit to the TA before the end of the tutorial.

1. Let $max(L) = \{w | w \in L$ but for no string $wx(x \neq \epsilon)$ is in $L\}$. Are the CFL's closed under the max operation?

2. Prove or disprove. Let C be a context-free language and R be a regular language. Then $C - R$ is neccessarily context-free, and so is $R - C$. (To submit)

3. Let $half(L) = \{w |$ for some x such that $|x| = |w|, wx \in L\}$. Notice that odd-length words in L do not contribute to $half(L)$. Are the CFLs closed under $half$ operation? (To submit)

4. A *shuffle* of two strings α and β is a string γ of length $|\alpha| + |\beta|$, in which α and β are non-overlapping subsequences (not neccessarily substrings). For example, all shuffles of *ab* and *cd* are *abcd*, *cabd*, *cdab*, *acbd*, *acdb* and *cadb*. For two languages A and B, we define $shuffle(A, B)$ as the language consisting of all shuffles of $\alpha \in A$ and all $\beta \in B$. Prove or disprove the following statements. (To submit)

   (a) If L is a CFL and R is a regular language then $shuffle(L, R)$ is a CFL.

   (b) If L_1 and L_2 are CFLs then $shuffle(L_1, L_2)$ is a CFL.

5. Consider $L = \{a^n b^n c^n | n \geq 0\}$. Is $\overline{L}$ a CFL? (Home)