

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 $\max(L) = \{w \mid w \in L \text{ but for no string } wx (x \neq \epsilon) \text{ is in } L\}$. 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 necessarily context-free, and so is $R - C$. (To submit)
3. Let $\text{half}(L) = \{w \mid \text{for some } x \text{ such that } |x| = |w|, wx \in L\}$. Notice that odd-length words in L do not contribute to $\text{half}(L)$. 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 necessarily 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 $\text{shuffle}(A, B)$ 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 $\text{shuffle}(L, R)$ is a CFL.
 - (b) If L_1 and L_2 are CFLs then $\text{shuffle}(L_1, L_2)$ is a CFL.
5. Consider $L = \{a^n b^n c^n \mid n \geq 0\}$. Is \bar{L} a CFL? (Home)