Ma2201/CS2022 Quiz 0110

1. (3 **pts**) Give a context free grammar for the language of all w in $\{a, b, c\}^*$ such that w = uv, where $n_a(u) = n_b(u)$, $n_c(u) = 0$, and $n_b(v) = n_c(v)$, $n_a(u) = 0$.

Of course, your grammar should generate every string in this language, and leave out none.

The "plan" I start with, is that any such word has a subword ab or ba, in the first section, and these might occur anywhere, and the same for b and c in the second section. So the rule is to insert these strings, making sure there is a place for the next insertion:

$$\begin{array}{cccc} G:S & \to I \mid J \\ I & \to \lambda \mid IaIbI \mid IbIaI \\ J & \to \lambda \mid JbJcJ \mid JcJcJ & \clubsuit \end{array}$$

2. (3 **pts**) The string $w = a^2(ab)^3 b^5 c^3$ is in the language of question one. Give a derivation tree for w with respect to your grammar.

♣ My grammar is ambiguous, so there is more than one tree. You can make it faster if you add some more "unnecessary" rules the grammar, like $S \rightarrow a^2(ab)^3 b^5 c^3$, which won't hurt the grammar, doesn't effect the language, but gives a much faster tree.



3. (4 **pts**) Give a context free grammar for the language of all $w \in \{a, b\}^*$ such that $w = a^i b^j a^k$ and i + k - j = 0.

 \clubsuit So $w = (a^i b^i)(b^k a^k)$ the we can make the simple grammar:

$$\begin{array}{ccc} G:S & \to A \mid B \\ A & \to aAb \mid \lambda \\ B & \to bBa \mid \lambda \end{array}$$

1 of 1