CS3231 : Tutorial - 5

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1. Give unambiguous context-free grammars for the following languages. Below $\Sigma = \{0, 1\}$.
   (a) $\{w|\ w$ contains equal number if 1s and 0s$\}$.
   (b) $\{w|$ the number of 1s is at least the number of 0s in $w\ \}$.
2. Let $A/B = \{w|\ wx \in A$ for some $x \in B\}$. Show that if A is CFL and B is regular then A/B is CFL.
3. Use pumping lemma to show that the following languages are not context free.
   (a) $\{0^n1^n0^n1^n|\ n \geq 0\}$.
   (b) $\{w\#t|\ w$ is a substring of t, where $w, t \in \{a, b\}^*\}$.
   (c) $\{a^ib^j|\ i = kj$ for some positive integer $k\}$.
   (d) $\{w \in \{0, 1\}^*|\ w$ is a palindrome containing an equal number of 0s and 1s$\}$.
4. If A and B are languages, define $A \odot B = \{xy|\ x \in A$ and $y \in B$ and $|x| = |y|\}$. Show that if A and B are regular languages then $A \odot B$ is CFL.