Homework 4

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1. Use the CFL pumping lemma to show following language not to be context-free:
   $\{a^i b^j c^k | i < j < k\}$.

2. Consider the CFG G defined by productions:

   $$S \to aS|Sb|a|b$$

   Prove by induction on the string length that no string in $L(G)$ has ba as a substring.

3. Convert the PDA $P = (\{p, q\}, (0, 1), \{X, Z_0\}, \delta, q, Z_0)$ to a CFG, if δ is given by:

   (1) $\delta(q, 1, Z_0) = \{(q, XZ_0)\}$
   (2) $\delta(q, 1, X) = \{(q, XX)\}$
   (3) $\delta(q, 0, X) = \{(p, X)\}$
   (4) $\delta(q, \varepsilon, Z_0) = \{(q, \varepsilon)\}$
   (5) $\delta(p, 1, X) = \{(p, \varepsilon)\}$
   (6) $\delta(p, 0, Z_0) = \{(q, Z_0)\}$

4. Design Turing machine for the language: $\{\ ww^R \mid w$ is any string of 0's and 1's $\}$.