Introduction to the Theory of Computation
Homework 4
Due 10/13/2017
These are problems

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Problem 0: Readings
Read Chapter 2 in Sipser's book.

Problem 1
Describe a simple algorithm for each of the following tasks:

- Converting a regular expression into a context-free grammar.

- Converting an NFA into a context-free grammar.

Problem 2
Prove that the intersection of a context-free language and a regular language is context-free. Use this result to show that

$$A = \{w | w \in \{a, b, c\}^* \text{ and contains equal numbers of } a, b, \text{ and } c\}$$

is not context-free.

Problem 3
Give a short proof that if G is a grammar in Chomsky normal form, then for any string $w \in L(G)$ such that $|w| \geq 1$, exactly $2n - 1$ steps are required for any derivation of w.

Problem 4
Give an example of a language that is not CFL but that does satisfy the three conditions of the pumping lemma for CFL.

Problem 5
Let G be:

$$S \rightarrow aSb \mid bY \mid Ya$$
$$Y \rightarrow bY \mid aY \mid \epsilon$$

Give a simple description of $L(G)$ in English. Use that description to give a CFG for the complement of $L(G)$.

Problem 6
Show that $\{x\#y \mid x, y \in \{0,1\}^* \text{ and } x \neq y\}$ is context-free.