Homework Assignment # 6

Due Date: Friday, March 3 (at the *beginning* of class)

1. (25 points; 20 for part a and 5 for part b)
    a. Convert the following CFG G over $\Sigma = \{a, b\}$ to an equivalent PDA using the procedure discussed in class [see Lemma 2.21 in the text (Lemma 2.13 in the 1st edition)]:
$$S \rightarrow aSb \mid bY \mid Ya$$
$$Y \rightarrow bY \mid aY \mid \varepsilon$$
    Show <u>all states</u> of your PDA.
    b. Give a simple description of L(G) in English.

2. (25 points; 10 for part a and 15 for part b) For any two <u>regular languages</u> A and B, define the language $L = \{xy \mid x \in A, y \in B, \text{ and } |x| = |y|\}$.
    a. Show that L need not be regular by giving a counterexample.
    b. Show that L is a context free language by giving a <u>detailed but informal description</u> of a PDA that accepts L. See Example 2.18 in the textbook (2.11 in the 1st ed.) for the level of detail required for the description. You do not need to draw the state diagram. (Hint: Make use of DFAs for A and B in constructing your PDA).

3. (30 points; 15 each) Use the pumping lemma for CFLs to show that the following languages over $\Sigma = \{0, 1\}$ are not context free:
    a. $\{0^i 1^j 0^i 1^j \mid i, j \geq 0\}$
    b. $\{ww^R w \mid w \in \{0,1\}*\}$

4. (20 points; 10 each) Give the sequence of configurations (see page 144 in the text for a sample run; page 132 in 1st ed) that the Turing machine M_1 (Figure 3.10 in 2nd edition only) enters on the following input strings:
    a. 01#0
    b. 101#101
    <u>Note</u>: Do not use the machine M_1 in the 1st edition (Figure 3.5 in that edition); this is a different and much larger machine. Use the machine M_1 in the 2nd edition.