Homework #3
COMP 3200
Fall 2023
Prof. Stucki

1) Answer each part for the following context-free grammar G:

$$S \to XSX \mid R$$
$$R \to \texttt{a}T\texttt{b} \mid \texttt{b}T\texttt{a}$$
$$T \to XTX \mid X \mid \varepsilon$$
$$X \to \texttt{a} \mid \texttt{b}$$

   a) What are the terminals and non-terminals of G?
   b) Give three examples of strings in L(G).
   c) Give three examples of strings *not* in L(G).
   d) True or False: $T \Rightarrow \texttt{aba}$
   e) True or False: $T \Rightarrow^* \texttt{aba}$
   f) True or False: $T \Rightarrow T$
   g) True or False: $T \Rightarrow^* T$
   h) True or False: $XXX \Rightarrow^* \texttt{aba}$
   i) True or False: $X \Rightarrow^* \texttt{aba}$
   j) True or False: $T \Rightarrow^* XX$
   k) True or False: $T \Rightarrow^* XXX$
   l) True or False: $S \Rightarrow^* \varepsilon$
   m) Give a description in English of L(G).

2) Give context free grammars that generate the following languages. In parts (a-e) the alphabet is {0, 1}. In part (f) the alphabet is {0, 1, 2}.

   a) $\{w \mid$ the length of w is odd$\}$
   b) $\{w \mid$ the length of w is odd and the middle symbol is 0$\}$
   c) $\{0^m1^n \mid m > n > 0\}$
   d) $\{w \mid w$ contains more 1s than 0s$\}$
   e) $\varnothing$
   f) $\{0^i1^j2^k \mid$ either $i = j$ or $j = k$ or $i = k\}$

3) Provide PDAs that recognize each of the languages in question 2.