CPSC 406: ASSIGNMENT 3

DUE MARCH 5, 7:00PM

Problem 1

Given the following grammar:

$E \rightarrow E + T | T$
$T \rightarrow T * F | F$
$F \rightarrow (E) | a$

Give the parse trees for each string:

- a
- $a + a$
- $a + a + a$
- $((a))$

Problem 2

Give CFG's that generate the following languages. In each case the alphabet Σ is $\{0, 1\}$.

- $\{w | w$ contains at least three 1s$\}$
- $\{w | w$ starts and ends with the same symbol$\}$
- $\{w | w$ contains more 1s than 0s$\}$

Problem 3

Design a PDA to recognize the language $\{ww^r | w \in \{0, 1\}^*\}$, where w^r means w written backwards.

Problem 4

Prove that the class of context free languages is closed under the union operation.

Problem 5

The **pumping lemma for context-free languages** states that if A is a CFL, then there is a number p (the pumping length) where, if s is any string in A of length at least p, then s may be divided into five pieces $s = uvxyz$ satisfying the conditions:

- For each $i \geq 0, uv^ixy^iz \in A$

- $|vy| > 0$
- $|vxy| \leq p$

Use this pumping lemma for CFL's to prove that the language $B = \{a^n b^n c^n | n \geq 0\}$ is not context free.

Submission Instructions

Submit as a PDF to the digital dropbox by the due date above. Your assignment MUST be written in LaTeX.