CSCI 4325
Practice for Quiz/Exam 3

Problem 1: Prove that the following languages are not regular.

(a) $L_1 = \{ww \mid w \in \{a, b\}^*\}$
(b) $L_2 = \{w \mid w \in \{a, b\}^*$ and the number of a's is greater than the number of b's$\}$
(c) $L_3 = \{a^n b^n c^n \mid n \geq 0\}$
(d) $L_4 = \{ww^R \mid w, w^R \in \{a, b\}^*$ and w^R is the reversal of $w\}$

Problem 2: Design a CFG to generate the following languages.

(a) $L_1 = \{w \mid w \in \{a, b\}^*$ and w has twice as many a's than b's$\}$.
(b) $L_2 = \{a^i b^j \mid i \neq j\}$

Problem 3: Consider the following CFG $G = (V, \Sigma, R, E)$, where V, Σ, and R are as follows:

$V = \{+, -, *, /, (,), id, T, F, E\}$,
$\Sigma = \{+, -, *, /, (,), id\}$,
$R = \{E \longrightarrow E + T \mid E - T \mid T,$
$T \longrightarrow T * F \mid T / F \mid F,$
$F \longrightarrow (E) \mid id\}$

(a) Draw a parse tree for $w = (id + id * id) / (id - id)$.
(b) Prove that G is unambiguous.

Problem 4: Use the TM M_1, which appears in Example 3.9 on page 173. For each part, give the sequence of configurations that M_1 enters when started on the input string ending with a reject or accept.

(a) 0#0
(b) 1##1
(c) 10#11
(d) 10#10

Problem 5: Give implementation-level descriptions of Turing machines that decide the following languages over the alphabet $\Sigma = \{a, b\}$.

(a) $\{w \mid w$ contains twice as many a's as b's$\}$
(b) $\{w \mid w$ does not contain twice as many a's as b's$\}$