Spring 2009 **CMSC 452: Homework 3** Clyde Kruskal

Due at the start of class Tuesday, April 7, 2009.

Problem 1. (Exercises 3.6 (page 111) in Kinber and Smith.)
Consider the grammar $G = \{S \to aSbS \mid bSaS \mid e\}$.

a. Give a derivation for the strings *aaabbabb* and *baaaabbabb*.

b. Describe the language $L(G)$.

Problem 2. Consider the language of all words over the alphabet $\{a, b\}$ with either twice as many a's as b's or twice as many b's as a's. For example *aba*, *bab*, *babaaa*, and *bababb* are in the language. The empty word is also in the language.

a. Give a context free grammar that generates all words in the language.

b. Give a PDA that recognizes all words in the language.

Problem 3. Consider the language of all words over the alphabet $\{a, b\}$ with *more than* twice as many a's as b's. or *more than* twice as many b's as a's. For example a, *aaba*, *babaaaa*, and *babbbbabb* are in the language, but *aab* and *bab* are not.

a. Give a context free grammar that generates all words in the language.

b. Give a PDA that recognizes all words in the language.

Problem 4. A **queue automaton** is a device like a pushdown automaton, except the stack is replaced by a queue.

a. Formally define

i. a **queue automaton**;

ii. a **configuration**;

iii. the **yields in one step** relation between configurations;

iv. the notion that an automaton **accepts** a string;

b. Construct the queue automaton that accepts all strings over the alphabet $\{a, b\}$ with the same number of a's as b's.

c. State a language that is accepted by a queue automaton, but not a pushdown automaton. Construct the queue automaton. No proof necessary for the latter.