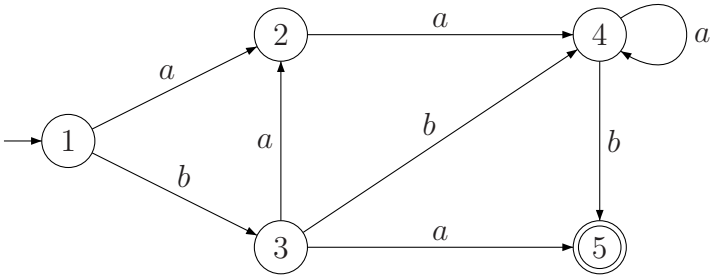
Fall 2013 **Exam #2** COSC 362

Name: _____

Write all of your responses on the exam paper or on the extra paper provided. Turn in all work and this exam paper.

1. (*20 Points*) Convert the following NFA to a regular expression.



2. (*15 Points Each*) Prove or disprove that each of the following languages are regular.

(a) $L = \{w \mid n_a(w) \neq n_b(w)\}$

(b) $L = \{a^n b^n \mid n \geq 1\} \cup \{a^{n+5} b^n \mid n \geq 1\}$

3. (*15 Points*) Find a context-free grammar for the following language.

$$L = \{a^n b^m c^k \mid m = 3n + 2k\}$$

4. (*15 Points*) Show that the following grammar is ambiguous.

$$\begin{aligned} S &\longrightarrow aABb \\ A &\longrightarrow bBA \,|\, aA \,|\, aAA \,|\, b \\ B &\longrightarrow abB \,|\, \lambda \end{aligned}$$

5. (*30 Points*) Consider the following grammar, G. In each conversion step below, follow the conversion or removal algorithm discussed in class.

$$\begin{aligned} S &\longrightarrow abAB \\ A &\longrightarrow bAB \,|\, \lambda \\ B &\longrightarrow BAa \,|\, A \,|\, \lambda \\ C &\longrightarrow aAD \\ D &\longrightarrow aAB \end{aligned}$$

(a) Remove all useless productions.

(b) Remove all λ-productions from your result in 5a.

(c) Remove all unit-productions from your result in 5b.

(d) Convert the grammar into Chomsky Normal Form from your result in 5c.