CSCI565 - Compiler Design

Spring 2012

Homework 1

Due Wednesday, Jan. 25, 2012 at 3.30 PM in class

Please label all pages you turn in with your name and student number.

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Problem 1 [40 points]: Consider the alphabet \( \Sigma = \{a, b\} \).

a) Consider the Non-Deterministic Finite Automaton (NFA) depicted below. Why is this automaton non-deterministic? Explain the various sources of indeterminacy.

b) Do the sentences \( w_1 = \text{"aba"} \) and \( w_2 = \text{"aab"} \) belong to the language generated by this FA? Justify.

c) Convert the NFA in part a) to a DFA using the subset construction. Show the mapping between the states in the NFA and the resulting DFA.

d) Minimize the DFA using the iterative refinement algorithm discussed in class. Show your intermediate partition results and double check the DFA using the sentences \( w_1 \) and \( w_2 \).

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Problem 2 [30 points]: Consider the DFA below with starting state 1 and accepting state 2:

a) Describe in English the set of strings accepted by this DFA.

b) Using the Kleene construction algorithm derive the regular expression recognized by this automaton simplifying it as much as possible.
Problem 3 [10 points] Let L be a regular language over a finite alphabet $\Sigma$. Show that the language consisting of all strings not in L over the same alphabet is also regular.

Problem 4 [20 points]: Prove (using an informal but convincing argumentation) the pumping lemma for regular languages: If L is a regular language, then there is an integer $n \geq 1$ such that any string $w$ of length $\text{len}(w) \geq n$ can be written as $xyz$ where $xy$ has length $\text{len}(xy) \leq n$, and $y$ is not epsilon and for all $i \geq 0$, $xy^iz$ is also in $L$.

*Hint: Choose $n = \text{number of states in some DFA to recognize } L$ and use the pigeonhole principle.*