CS 352 – Compiling and Programming Systems
Mid-term Examination, 10/26/11

Instructions: Read carefully through the whole exam first and plan your time. Note the relative weight of each question and part (as a percentage of the score for the whole exam). The total points is 100 (*ie*, your grade will be the percentage of your answers that are correct).

This exam is **closed book, closed notes**. You may *not* refer to any book or other materials.

You have **60 minutes** to complete both (2) questions. Write your answers on this paper (use both sides if necessary).

Name:

Student Number:

Signature:

1. (Regular expressions, finite automata; 40%) Consider the following languages L and M formed from the alphabet $\Sigma = \{a, b\}$:

$$L = \{l \in \Sigma^* \mid l \text{ consists of a single } a, \text{ optionally followed by a sequence of } b\text{s}\}$$

$$M = \{m \in \Sigma^* \mid m \text{ consists of an optional sequence of } a\text{s, followed by a single } b\}$$

   (a) (5%) Write a regular expression for each of L, M and $L \cup M$.

(b) (15%) As described in class, *systematically* construct an NFA that accepts $L \cup M$.

(c) (15%) Using the subset construction, convert your NFA into a DFA. Make sure to indicate the start and final states of your DFA.

(d) (5%) Optimize your DFA by merging equivalent states.

2. (Parsing; 60%) Consider the following simple grammar and the language it describes:

$$
\begin{aligned}
S &\rightarrow AB \\
A &\rightarrow Aa \\
A &\rightarrow \varepsilon \\
B &\rightarrow bB \\
B &\rightarrow b
\end{aligned}
$$

(a) (5%) In words say what *language* this grammar describes?

(b) (5%) Write a regular expression for this *language*.

(c) (5%) Is this *language* LL(1)? Explain. [There is a simple argument.]

(d) (5%) Is this *grammar* LL(1)? Explain. [There is a simple argument.]

(e) (15%) *Transform* the grammar, if necessary, and derive an LL(1) parse table to parse this language.

(f) (15%) Consider the *original* (untransformed) grammar. Is the original *grammar* LR(0)? Explain. [Consider the sets of LR(0) items.]

(g) (5%) Is the original grammar SLR(1)? Explain. [Do SLR(1) lookaheads resolve any LR(0) conflicts from the previous question?]

(h) (5%) Is the original grammar LR(1)? Explain. [There is a simple argument.]