Formal Languages and Automata

Weekend assignment

You are to hand in the assignment with a signed copy of the plagiarism form to Mr Vincent Sammut by Monday 23rd April 2007. Without this form, your assignment will not be marked. Assignments handed in late will be marked to zero.

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1. Rigorously prove that the following grammar produces more as than bs (where S is the start symbol):

   \[ S \to aSS \mid SaAb \mid a \]
   \[ A \to ab \mid bAAbaa \]

   **Hint:** Start by proving that A always produces an equal number of as and bs. Then prove that S always produces more as and Ss (combined) then bs. *Do not try to identify the sentential forms!*

2. In this question, you are to construct three regular grammars (based just on the description given), and then combine them together using standard constructions.

   (a) Design a regular grammar which accepts binary numbers (including real numbers and ones in exponential notation). For example, the grammar should allow 1001, 11.0e0101 and 00111.001 but not 21 or hello or 001e0.11 (the exponent must be an integer).

   (b) Design another regular grammar which accepts variable names (over the symbols a, b, 0, 1, and with the usual restrictions that numbers may only appear at the end of a variable name, and all variable names must start with a letter).

   (c) Design yet another regular grammar which accepts only the string `:=`.

   (d) Using standard constructions, and the regular grammars given above, construct a non-deterministic finite state automaton which accepts strings in any of the following forms:

   \( \langle \text{variable} \rangle := \langle \text{variable} \rangle \)
   \( \langle \text{variable} \rangle := \langle \text{number} \rangle \)

   Explain (in steps) how the NFSA was constructed.