**CS 310T-31 - TPCS: Theory of Computation**

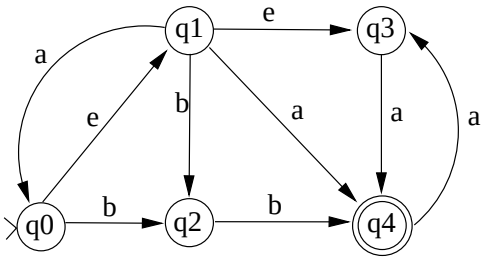
**Midterm 1**

June 5, 2004

1. Draw a state diagram for a nondeterministic finite automata that accepts the following language:

$$(010 \cup 111 \cup 101)^*$$

2. Given the following NFA, convert it to a DFA



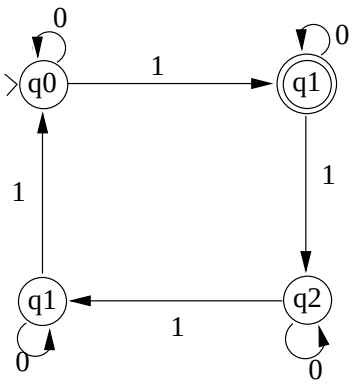
3. Construct deterministic finite automata accepting each of the following languages

   (a) $\{ w \in \{a, b\}^* :$ each $a$ is immediately followed by two $b$'s$\}$
   (b) $\{ w \in \{0, 1\}^* : w$ has a number of 0's that is multiple of four$\}$

4. Give some examples of strings in, and not in, these sets where $\Sigma = \{0, 1\}$.

   (i) $\{w :$ for some $u \in \Sigma\Sigma\Sigma, w = uu^{\mathrm{R}}\}$
   (ii) $\{w :$ for some $u \in \Sigma^*, www = uu\}$

5. Derive the regular expression corresponding to the following FA




6. What language is represented by the regular expresion $(0^*10^*10^*10^*)^*$?

7. Give context-free grammars that generate the following languages. The alphabet $\Sigma$ is {0, 1, #}

   (a) $\{w \ / \ w$ starts and ends with the same symbol, the length is odd, and the middle symbol is # $\}$

   (b) $\{w \ / \ w = v\#v^R\}$, that is, the set of strings that read the same both ways (palindrome) and have # as the middle symbol

8. Use the pumping lemma to show that the language $B = \{0^n 1^{2n} 0^n \mid n \geq 0\}$ is not context free

9. (Extra Credit) Consider the following grammar $(W, \Sigma, R, S)$:

   $W = \{S, A, N, V, P\}$,

   $\Sigma = \{$Jim, big, green, cheese, ate$\}$,

   $R = \{P \rightarrow N \mid AP$,

   $S \rightarrow PVP$,

   $A \rightarrow$ big $\mid$ green,

   $N \rightarrow$ cheese $\mid$ Jim,

   $V \rightarrow$ ate$\}$

   Draw the parse tree for the example "big Jim ate green cheese"