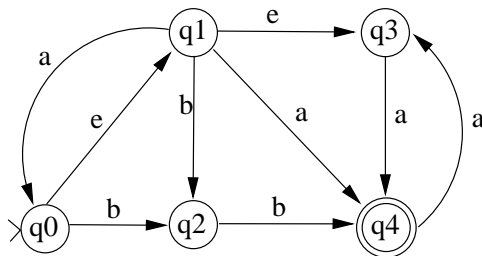


CS 310T-31 - TPCS: Theory of Computation
Midterm 1
June 5, 2004

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) $\{ w \in \{a, b\}^* : \text{each } a \text{ is immediately followed by two } b\text{'s} \}$

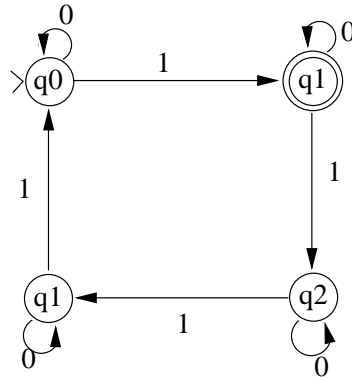
(b) $\{ w \in \{0, 1\}^* : w \text{ has a number of } 0\text{'s that is multiple of four} \}$

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

(i) $\{ w : \text{for some } u \in \Sigma\Sigma\Sigma, w = uu^R \}$

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

5. Derive the regular expression corresponding to the following FA



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

7. Give context-free grammars that generate the following languages. The alphabet Σ is $\{0, 1, \#\}$
- (a) $\{w \mid w \text{ starts and ends with the same symbol, the length is odd, and the middle symbol is } \#\}$
 - (b) $\{w \mid w = v\#v^R\}$, 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 $B = \{0^n 1^{2^n} 0^n \mid n \geq 0\}$ is not context free

9. (Extra Credit) Consider the following grammar (W, Σ, R, S) :

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

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

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

$S \rightarrow PVP,$

$A \rightarrow \text{big} \mid \text{green},$

$N \rightarrow \text{cheese} \mid \text{Jim},$

$V \rightarrow \text{ate}\}$

Draw the parse tree for the example “big Jim ate green cheese”