CSC238S **Problem Set 4** **Due: April 7/97**

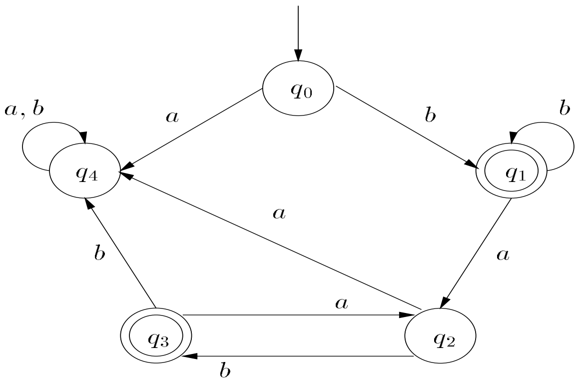
1. Provide the state diagram for a DFA M such that

$$L(M) = \{w \in \{a,b\}^* \mid \text{ if } w \text{ contains the substring } abb \text{ then it later contains the disjoint substring } baa$$

2. Provide the state diagram for a NDFA M such that

$$L(M) = \{w \in \{a,b\}^* \mid \text{ if } w \text{ contains the substring } abb \text{ then } w \text{ also contains the (not necessarily disjoint) substring } baa$$

3. Consider the following NDFA M.



Give a regular expression R such that $L(R) = L(M)$.

4. Let $L_1 \subseteq \sum^*$ and $L_2 \subseteq \sum^*$. Define the "shuffled" language $L_1 \parallel L_2$ as follows: $\sigma_1\sigma_2\cdots\sigma_n \in L_1 \parallel L_2$ iff $\exists i_1 < i_2 < \cdots < i_r$ and $\exists j_1 < j_2 < \cdots < j_s$ such that

   (a) $\{i_k | 1 \leq k \leq r\} \cap \{j_\ell | 1 \leq \ell \leq s\} = \emptyset$

   (b) $r + s = n$

   (c) $\sigma_{i_1}\sigma_{i_2}\cdots\sigma_{i_r} \in L_1$

   (d) $\sigma_{j_1}\sigma_{j_2}\cdots\sigma_{j_s} \in L_2$

   Prove that if L_1 and L_2 are regular then $L_1 \parallel L_2$ is regular.

5. Prove that $L = \{ww | w \in \{a,b\}^*\}$ is not regular.