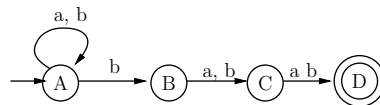


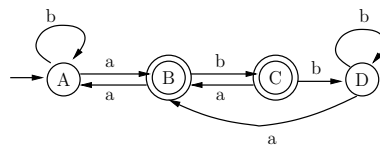
CIS 262: Fall 2008: Midterm 1, October 7, 12.00–1.20pm

You are allowed to consult your class notes and the textbook.

1. Answer each of the questions below with a brief justification (one or two sentences). 30pts
 - (a) If a DFA A has exactly one state, what can we conclude about the language it accepts?
 - (b) Suppose A is a DFA and B is an NFA such that $L(A) = L(B)$. If A has k states, what can we conclude about the number of states of B ?
 - (c) In the translation from a DFA to a regular expression by eliminating states one by one, does the final regular expression depend on the order in which states are eliminated?
2. For $\Sigma = \{a, b\}$, consider the language L containing words that begin with a and end with b .
 - (a) Draw a DFA A for L . 10pts
 - (b) For each state q of the DFA A in part (a), give a regular expression R_q that describes the words that lead the DFA from its initial state to q . 20pts
3. Prove that the language $\{0^n 1^m 2^{n+m} \mid n, m \geq 0\}$ is not regular using the Pumping lemma. 30pts
4. Convert the NFA shown below to a DFA by applying the determinization procedure. It suffices to show only the reachable states of the result, but for each state of the result, clearly show the corresponding set of states of the original NFA. 15pts



5. Minimize the DFA shown below by applying the minimization procedure. Show clearly steps of the algorithm. 15pts



6. Given a word w , let $Insert(w)$ be the set of words that can be obtained from w by inserting symbols in w . At every position, zero or more symbols may be inserted. For example, $Insert(\varepsilon)$ is the set of all words and $Insert(a)$ is the set of words that contain an a symbol. The operation extends to languages: given a language L , $Insert(L)$ contains words that can be obtained by inserting symbols in some word in L . That is: $Insert(L) = \{u \in \Sigma^* \mid \exists w \in L, u \in Insert(w)\}$.
 - (a) If $L = a(a + b)^*b$, for $\Sigma = \{a, b\}$, give a DFA or a regular expression for $Insert(L)$. 10pts
 - (b) Let L be a language, and let A be a DFA for L with states Q , initial state q_0 , final states F , and transition function δ . Define an automaton B that accepts $Insert(L)$. The automaton B can be a DFA or an NFA or an ε -NFA. You need not give a rigorous proof that B accepts exactly $Insert(L)$, but you should state the various components of B (such as its states and transitions) precisely, and explain why your construction works. 20pts