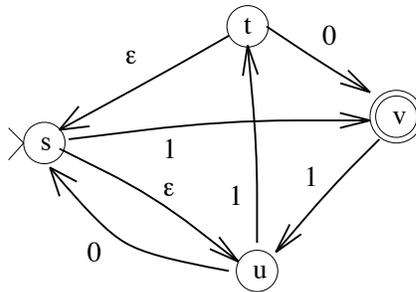


CSE 322
Introduction to Formal Models in Computer Science

Sample Midterm

Closed Book, Closed Notes. Answer the problems on the exam paper. Each problem starts on a new page. Make sure you write your NAME on the paper. If you need extra space use the back of a page.

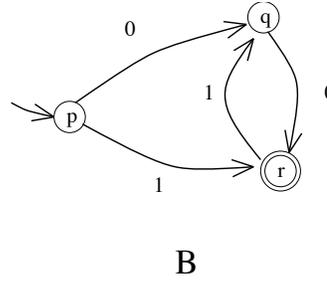
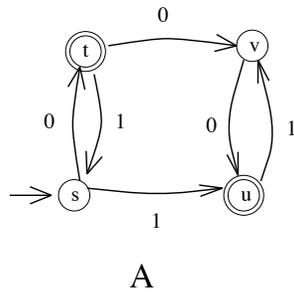
1. Answer True or False and BRIEFLY JUSTIFY your answers to the following questions. All strings considered are over some fixed alphabet Σ .
 - (a) If L is a regular language and $K \subseteq L$ then K is a regular language.
 - (b) If M is a DFA and $A = L(M)$ then in general one can not build a DFA to accept A^R .
 - (c) If A is regular and $A \cup B$ is regular then so is B .
 - (d) Let A be a language over $\{0, 1\}$ and x_0 and x_1 be strings. For any $z \in A$ one can get a new string by replacing all 0's in z by the string x_0 and 1's in the string by x_1 . Let $A_{substitute}$ be the new language created from A by taking all these new strings. If A is regular then $A_{substitute}$ will be regular.
2.
 - (a) Draw the state diagram of an NFA M that recognizes the language $a^*b(b \cup ab)^*a$. You don't have to use any particular construction method but you should try to avoid unnecessary states.
 - (b) For the machine you defined in part (a), give the values of Q, Σ, δ, s, F where $M = (Q, \Sigma, \delta, s, F)$.
 - (c) Show the TREE of all computation paths string $aababba$ could follow in M . Is it accepted by M ? Why?
3. Build a DFA equivalent to the following NFA using the "subset construction." You only need to show states that are reachable from the start state of your DFA (*but* do not attempt to simplify further).



4. In class we discussed GENERAL constructions that would take NFAs that accept languages A and B and produce NFAs that accept

- (a) $A \cup B$
- (b) $A \circ B$
- (c) A^*

Apply these GENERAL constructions to the NFAs A and B below (just draw the state diagrams).



5. Let $A = \{xx^R \mid x \in \{a, b\}^*\}$. Use the pumping lemma to prove that A is not a regular language.