NAME: _____ FLORIDA INT'L UNIV.

MAD 3512: Quiz #1 - Spring 2010 TIME: 25 min.

Just write "TRUE" or "FALSE"

(10) 1(a) If L is any **language** on $\{a,b\}$, we always have $(L^*)^c = (L^c)^*$. _____

(b) The set of all ***regular expresions*** on $\{0,1\}$ is countable. _____

(c) If L is any **non-empty** language, L^* will always be infinite. _____

(d) If a DFA M has at least one **accepting state,** then $L(M) \neq \emptyset$. _____

(e) If G is a CFG with a production of the form $S \to ASb$ and G has **no useless** production, then L(G) is infinite. _____

Just write down the correct answer.

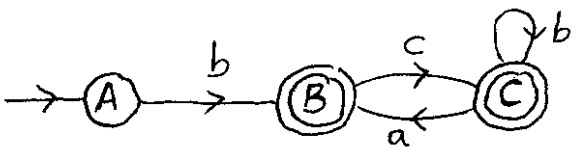
(18) 2(a) Find a ***regular expression*** *E* for the set of all strings in $\{0,1\}^*$ which contains at most one occurrence of the string 00.

Ans: *E* =

(b) If $G = \{S \to ASBB,\ S \to b,\ A \to a,\ B \to b,\ B \to \lambda\}$, then

L(G) =

(c) If M is the **NFA** below, then



L(M) =

(d) Find a **RLG** *G* for $\underline{b}^*.\underline{a}^*.\underline{b}.\underline{a}^*$

Ans: G =

(e) Find a **DFA** M with $L(M) = (\underline{0}.\underline{1})^* + (\underline{1}^*)$

Ans: M =

Use the back of this paper for question #3.

(12) 3(a) Define what are ***useless productions*** in a context-free grammar G.

(b) Define what is a ***leftmost derivation*** in a context-free grammar G.

(c) Define when two states A and B of a DFA *M* are ***indistinguishable***.

(d) Define the ***extended transition function*** of an NFA and specify its ***domain*** *and* ***co-domain***.

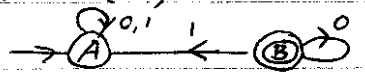
MAD 3512 – Theory of Algorithms — Florida Int'l Univ.

Solutions to Quiz #1 — Spring 2010

1(a) FALSE. Take $L = \emptyset$. Then $\lambda \in (L^c)^*$ but $\lambda \notin (L^*)^c$

(b) TRUE. The set of reg. expr. on $\{0,1\} = \{\underline{\lambda}, \underline{0}, \underline{1}, \emptyset, +, \cdot, *,), (\}^*$

(c) FALSE. Take $L = \{\lambda\}$. Then $L^* = \{\lambda\}$ which is finite

(d) FALSE. Consider the DFA 

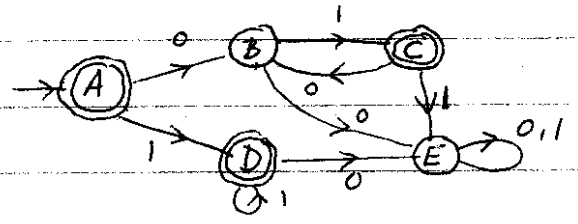
(e) TRUE. $S \to ASb$ will generate $A^n S b^n$ – which will always terminate.

2(a) $E = (\underline{1}+\underline{01})^* \cdot (\underline{\lambda}+\underline{0}) + (\underline{1}+\underline{01})^* \cdot \underline{00} \cdot (\underline{1}+\underline{10})^*$

(b) $L(G) = \{a^n b^{k+1} : 0 \le k \le 2n \text{ and } n \ge 0\}$

(c) $L(M) = \underline{b} \cdot (\underline{c}\, \underline{b}^* \underline{a})^* + \underline{b} \cdot \underline{c} \cdot (\underline{b} + \underline{ac})^*$

(d) G: $S \to bS$, $S \to A$, $A \to aA$, $A \to bB$, $B \to aB$, $B \to \lambda$

(e) M: 

3(a) An unreachable production is one which involves a variable that cannot be reached from the starting variable of G. A non-terminating production is one which contains a variable that does not eventually terminate into terminal symbols. These are the two kinds of useless productions

(b) A leftmost derivation is one in which the leftmost variable is replaced at each step of the derivation.

(c) Two states A and B in a DFA M are indistinguishable if for each string $w \in \Sigma^*$, $\delta^*(A,w) \in \mathcal{A}(M) \Leftrightarrow \delta^*(B,w) \in \mathcal{A}(M)$.
(Σ = input alphabet of M, $\mathcal{A}(M)$ = set of accepting states of M)

(d) The extended transition function of an NFA M is defined by $\Delta^*(p,w) = \{q \in Q : w \text{ can lead you from } p \text{ to } q \text{ in } M\}$
$\text{domain}(\Delta^*) = Q \times \Sigma^*$, $\text{codomain}(\Delta^*) = \mathcal{P}(Q)$.