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B.Tech. First Assessment Examinations – August 2017

Fifth Semester

Computer Science and Engineering

15CSE303 Theory of Computation

[Time: Two hours Maximum: 50 Marks]

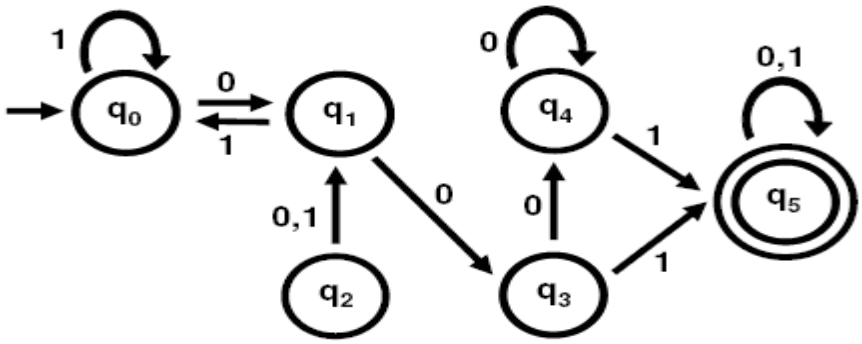
Answer all questions

PART A (3 X 5 = 15)

1. Let Σ = {*a*, *b*} and L1 and L2 are grammars specified below
   $L1 = \{a^n b^m : n \geq 0, m > n\}$
   $L2 = \{a^n b^{2n} : n \geq 0\}$.
   Find a grammar that generates it $L1 \cup L2$.
2. Design a transducer for $|w| \bmod 3$, where $w = a^n$, where $n \geq 1$.
3. Show that the language L= *{vwv, where v,w ∈ {a,b}*, | v | = 2}* is regular.
4. find an NFA without λ transitions and with a single final state that accepts the set {a} U { $b^n : n \geq 1$}
5. Describe Chomsky hierarchy of grammars with example.

PART B (5 X 3 = 15)

6. Minimize the following DFA using table filling algorithm



7. In a Soda vending machine a soda costs 15 cents, and the machine accepts nickels (5 cents) and dimes (10 cents). We have an input sensor to detect nickels (bit 0) and an input sensor to detect dimes (bit 1). Hence input to the finite machine will be a combination of two bits (00 - 0 nickel 0 dimes, 01 - 0 nickel 1 dime…) and the outputs can be ***soda*** if the amount is exactly 15 cents and ***change*** if the amount is greater than 15 cents. The machine stops accepting coins if it has enough money for soda. At a time, only one coin can be inserted into the machine.
   Develop a transducer for the above said scenario.

8. Consider the following grammar G :

S →SAB | λ
A→aA | a
B→bB | λ

a) Give a derivation of ***abbaab***
b) Describe the language L(G) generated by the above grammar?
c) Whether ***abbaab*** can be derived through multiple derivations?

PART C **(10 X 2 = 20)**

9. A man travels with wolf, goat and cabbage. He wants to cross a river from east (E) to west (W). A rowboat is available, but only large enough for the man plus one possession. Wolf eats goat if left alone together. Goat eats cabbage if left alone together. How can the man cross without loss?
Hint: Four moves can be encoded as four symbols:
   - Man crosses with wolf (w)
   - Man crosses with goat (g)
   - Man crosses with cabbage (c)
   - Man crosses with nothing (n)

   Then a sequence of moves is a string, such as the solution gnwgcng : First cross with goat, then cross back with nothing, then cross with wolf... Design a DFA for the above scenario.

10. Consider the following ε–NFA. (**p** is the start state and **r** is the final state)

	ε	a	b	c
→p	{q,r}	Φ	{q}	{r}
q	ϕ	{p}	{r}	{p,q}
*r	Φ	ϕ	ϕ	ϕ

a) Compute the ε–closure of each state
b) Give all the strings of length three or less accepted by the automaton.
c) Convert the automaton to a DFA

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