CENG213 Theory of Computation

Midterm, the 2nd of December 2014

Duration: 100 minutes.

Q1 (30 points). Construct a deterministic finite automaton (DFA) to recognize the following language that's defined on the alphabet $\sum = \{0,1\}$:

The set of strings whose number of 0's is divisible by five and whose number of 1's is even.

Q2 (20 points).

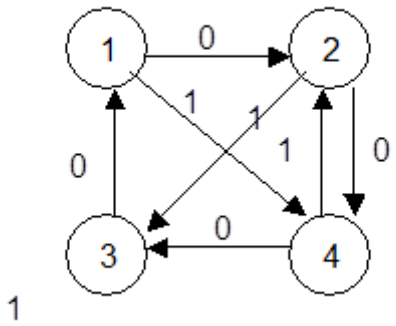
Describe the equivalence classes ($\approx_L$) for the following languages:

a) $\{w \in \{a, b\}^* : w$ has an even number of a's$\}$.
b) $\{w \in \{a, b\}^* : w$ has an even number of a's and number of b's that is divisible by three$\}$.

Q3 (30 points).

Let R_{ij}^k be the regular expression denoting all strings that take a finite automaton from state i to state j without going through any state numbered higher than k.

(a) Give the formula for R_{ij}^k in terms of R_{ij}^l for l<k.



(b) What is the regular expression for R_{34}^2 for the above state diagram?

(c) What is the regular expression for R_{43}^2 for the above state diagram?

You do not need to use the formula in (a) to get your answer to parts (b) and (c).

Q4 (20 points). Consider the alphabet $\sum = \{a, b, (,), \cup, *, \varnothing\}$. Construct a context-free grammar that generates all strings in $\sum^*$ that are regular expressions over $\{a, b\}$.