Mathematics of Computing - Class Assignment 1 (max marks 15)

Indian Statistical Institute, Bangalore

February 7,2017

NB:(a) Write your name on top of this paper. (b) Answer in the space provided. (c) In *all* questions: $\Sigma = \{0, 1\}$.

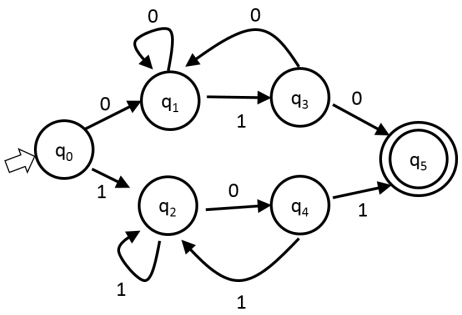
Q1. (2) Draw a DFA for the language expressed by the following regular expression: $(11)^*(10)^*011$

Q2. (2) Draw an NFA for the language $L = \{w | w$ contains a substring of three successive zeros $\}$ which contains four or fewer states.

Q3. (3) Draw DFAs that recognize $L_1 = \phi$, $L_2 = \{\epsilon\}$ and $L_1 \cdot L_2$

Q4. (3) Use pumping lemma to show that $L = \{0^n 1^m | n > m \geq 0\}$ is not regular.

Q5. (5) Consider the following NFA:



Convert it to a regular expression. Notice that the NFA is a GNFA (except for not shown ϕ transitions). Eliminate states one by one; mention the state being eliminated and show the resulting GNFA (with unshown ϕ transitions).

Mathematics of Computing - Class Assignment 2 (max marks 15)

Indian Statistical Institute, Bangalore

March 17,2017

NB:(a) Write your name on top of this paper. (b) Answer in the space provided. (c) All questions in this paper have to do with the grammar defined on the alphabet $\{a, b\}$ with the productions as given below:

$$S \rightarrow aa|bb|aSa|bSb$$

Q1. (3)Draw a **parse tree** for the string $aabbbbaa$

Q2. (6)Give an **NPDA** for the above language by listing its transitions.

Q3. (6)Give a **deterministic** TM that recognizes this language.

Mathematics of Computing - Class Assignment 3 (max marks 15)

Indian Statistical Institute, Bangalore

April 11,2017

NB: Write your name on the sheet.

Q1. $(1 \times 4 = 4)$ Mention if true or false:

(a) Given a DFA D and a string w. It is possible to declare if w is recognized by D or not.

(b) Given a context free grammar G and a string w, it is possible to declare if w belongs to the language produced by G or not.

(c) If a language L over some finite alphabet is Turing decidable then there is a procedure to enumerate all the members of L in order of non-decreasing length.

(d) If a language L over some finite alphabet is Turing recognizable then there is a procedure to enumerate all the members of L in order of non-decreasing length.

Q2. $(2 + 3 = 5)$

(a) Define Turing Recognizable and Turing Decidable languages.

(b) Prove or Disprove: If a language L is Turing Recongnizable and its complement is also Turing Recognizable then L is Turing Decidable.

Q3. $(2 + 4 = 6)$

(a) Describe the language A_{TM} defined in class.

(b) Consider the language below discussed in class:
: $HALT = \{< M, w > \mid \text{TM } M \text{ halts on input } w\}$.
Show that $HALT$ is not Turing decidable by a reduction from A_{TM}.