# CSc 428 Formal Languages

## Midterm

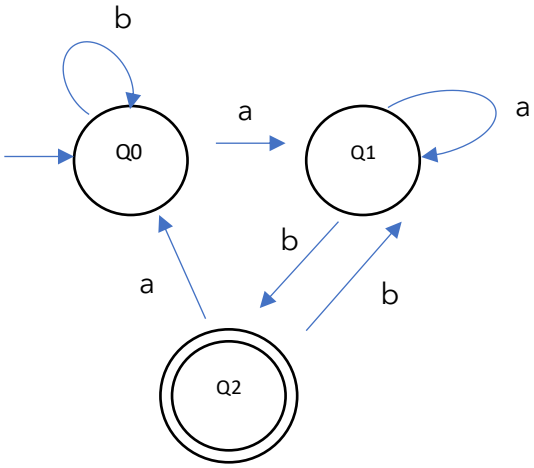
April 9, 2021 @12:00PM – April 10, 2021 @11:59PM

1. A total function f from N (natural numbers) to N (natural numbers) is monotonically increasing If $f(n)$ is less than $f(n)+1$ for all lowercase n, element of capital N for all natural numbers. Proves that there are an uncountable number of monatomic increasing functions.

2. Give a regular expression that represents the decimals, the set of strings over the set $\{a, b, c\}$ in which all the a's come before the b's which in terms come before the c's. it is possible that there are no a, b, or c's.

3. Construct a grammar over the set {a, b} whose language is
$$\{a^m b^i a^n \; such \; that \; i = m + n\}$$

4. Let M be the DFA whose state diagram is given below:




   a. Construct a transition table for M
   b. Which of the string's baba, baab, abab, abaaab are accepted by M?
   c. Give a regular expression for L (M) – for the language of M

5. Show that the formula $(x \vee \sim y) \wedge (\sim x \vee z) \wedge (y \vee \sim z) \wedge (\sim x \vee \sim y) \wedge (y \vee z)$ is NOT satisfiable.

6. Construct a PDA that accepts the following languages: $\{a^i b^j c^k \; such \; that \; i + k = j\}$

7. Note this Turing machine behaves as a generator. Construct a TM that generates the set $\{a^i\ b^i\ such\ that\ i\ \geq\ 0\}$

8. Define the underlying terms below and give an example of each:
    a. P,
    b. NP,
    c. NP-Complete,
    d. CO-NP