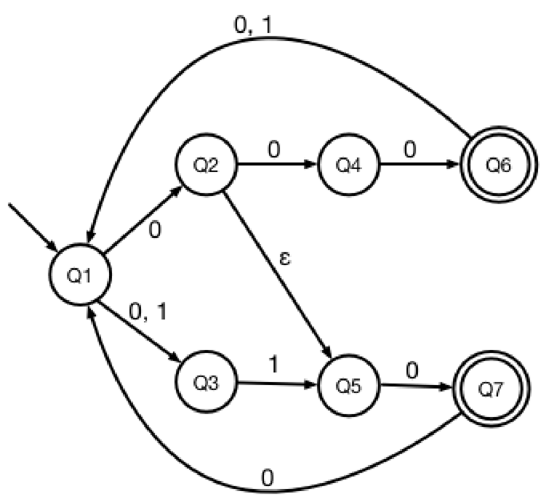
COSC 440 - Midterm, Fall 2018

Instructions: Complete each question to the best of your ability. Partial credit will be given for partially correct answers. Be sure to put your name on this test and any extra sheets of paper that you use. Please answer the questions on extra sheets of paper, not on this test. This exam has 7 questions. SHOW ALL WORK AND STEPS. Be precise with your language! Assume that $\Sigma = \{0, 1\}$ unless otherwise stated. You may use any resources at your disposal except for solution sheets or guides found online. You may work with each other, but each individual must complete their own unique write up of the solutions. You must turn in your completed exam by 10:05am on November 1st. No emailed or digital copies will be accepted.

1. (20 pts) Is $F = \{0^i 1^j | i = kj \text{ for some positive integer } k\}$ context free? Prove your answer. Part of the challenge for this question is deciphering the language so no clarification questions will be allowed for this question.

2. (10 pts) Convert the following NFA to an RE, following the steps noted in Lemma 1.60. Do not simplify the NFA or the resulting RE. Remove each node in order (start with Q1, end with Q7).



3. (10 pts) Let $A = \{0^k u 0^k | k \geq 1 \text{ and } u \in \Sigma^*\}$. Give the RE and NFA for A.

4. (20 pts) Consider the following CFG G:

$$S \to SS | T$$
$$T \to 0T1 | 01$$

Describe $L(G)$ (the language generated by G) and prove that G is ambiguous. Give an unambiguous grammar H where $L(G) = L(H)$ and prove that H is unambiguous and correct.

5. (12 pts) Let $B = \{uv | u \in \Sigma^*, v \in \Sigma^* 1 \Sigma^*, \text{ and } |u| \geq |v|\}$. Give a CFG that generates B.

6. (15 pts) Let the rotational closure of language A be $RC(A) = \{yx | xy \in A\}$. Prove that the class of regular languages is closed under rotational closure.

7. (13 pts) Let $D = \{xy | x, y \in \{0,1\}^* \text{ and } |x| = |y| \text{ but } x \neq y\}$. Create a PDA that recognizes D.