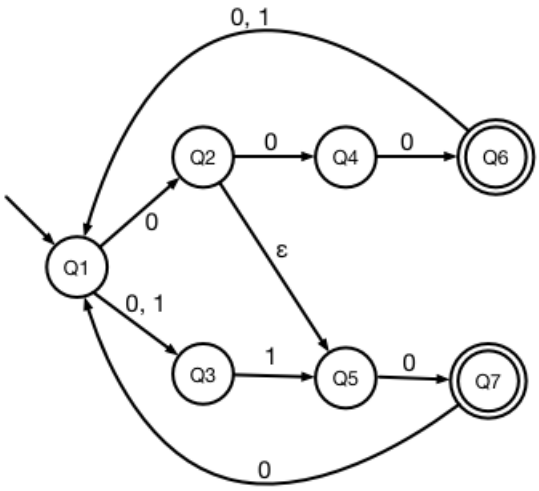
COSC 440 - Midterm, Fall 2020

Instructions: Complete each question to the best of your ability. Partial credit will be given for partially correct answers. Diagrams may be hand drawn (labels included) but all text must be typed and you must ensure that your diagrams are clear. This exam has 5 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, solution manuals, or guides for these problems 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 11:59pm on October 9th using a single document (.docx or .pdf) via email or Blackboard.

1. (25 pts) Is $A = \{ww^R | w \in \Sigma^*\}$ regular? Prove your answer.

2. (20 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. (15 pts) Let $A = \{1^m x 0^n | m, n \geq 1, m \leq n, \text{ and } x \in \Sigma^*\}$. Give the RE and NFA for A.

4. (20 pts) Let $B = \{0^i 1^j 2^k | i, j, k \geq 0 \text{ and if } i = 1 \text{ then } j = k\}, \Sigma = \{0, 1, 2\}$. Give an unambiguous CFG in CNF that generates B. Prove that it is unambiguous and correct.

5. (20 pts) Let $C = \{1^k y | y \in \{0, 1\}^* \text{ and } y \text{ contains at most } k \text{ 1s, for } k \geq 1\}$. Create a PDA that recognizes C.