CSE 211 – Theory of Computation Assignment

Develop Turing machines for two of the following problems using the simulator provided (https://schaetzc.github.io/tursi/). If your student ID mod 3 = m and student ID mod 5 = n, then you need to solve the m-th problem from the first group and the n-th problem from the second group.

1. Design Turing machines for the following languages: (5)
    0. The set of strings with an equal number of 0's and 1's
    1. $\{a^n b^n c^n | n \geq 1\}$
    2. $\{ww^R |$ w is any string of 0's and 1's$\}$

2. Design Turing machines to perform the following operations (the leftmost bit is LSB): (5)

    0. Increment (add 1). The tape initially contains wc where w is a binary number. Your TM should add 1 to w and write the sum to the right of the c.
    1. Decrement (subtract 1). The tape initially contains wc where w is a binary number. Your TM should subtract 1 from w and write the result to the right of the c.
    2. Two's complement. The tape initially contains wc where w is a binary number. Your TM should compute 2's complement of w and write the result to the right of the c.
    3. Logical AND. The tape initially contains w_1cw_2c where w_1 and w_2 are binary numbers. Your TM should compute logical AND of w_1 and w_2 and write the result to the right of the second c.
    4. Logical OR. The tape initially contains w_1cw_2c where w_1 and w_2 are binary numbers. Your TM should compute logical OR of w_1 and w_2 and write the result to the right of the second c.

3. Show that the halting problem, the set of (M,w) pairs such that M halts when given input w is RE but not recursive. (5)

4. a) Suppose A and B are two problems in NP. Explain whether the following two statements are true or false:

i) If B is an NP-complete problem and we find a polynomial time reduction from A to B, then the problem A is also NP-complete.

ii) If B is an NP-complete problem and we find a polynomial time reduction from B to A, then the problem A is also NP-complete.

b) Explain why if you find a polynomial time algorithm for an NP-complete problem, it implies P=NP. (5)

Submission instructions:

Submit the two *.tm files and the solutions to problems 3 and 4 in a zipped folder, named using your student ID, through moodle.