COMP 314 Homework Assignment 2

Note: For the first two questions, it is probably easiest to use JFLAP to implement and test your machine. You can submit a printout from JFLAP as your machine description. However, hand-drawn solutions are also permissible. You must use notation consistent with the class lecture notes and/or JFLAP.

1. (5 points) Construct a Turing machine that replaces any instances of the substring "abc" with the substring "xyz". For example, given input "qwertyabczxcvababcde", the output should be "qwertyxyzzxcvabxyzde".

2. (5 points) Construct a Turing machine that decrements a binary number. For example, on input "1011" the output is "1010", and on input "10000" the output is "01111". You may assume the input consists only of 0s and 1s, and represents a strictly positive binary number. The input and output should have the same number of non-blank characters.

3. (10 points) (Note: In this following question, you may not use arguments based on Python programs. Your argument must be based only on Turing machines.) Prove that the following problem is undecidable. Given a Turing machine T, determine whether T halts on all inputs of even length.

4. (5 points) Using some brief online research, find out about one of the smallest known universal Turing machines. (Here, "smallest" could refer to the number of states and/or alphabet size—feel free to adopt any sensible definition.) In one or two sentences, give some details about the machine, including its number of states, alphabet size, who discovered it, and what year it was discovered.