CS-2349 : Theory of Computation
Programming Assignment 2

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Due on: 11:59 pm, 14 April, 2022
Total points: 25

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*Note: This assignment contributes towards **10 %** of your total grade.* ***You can only use standard library functions for this assignment****. Name your answer files according to question number (`q1.py, q2.py` etc) and zip all your answer scripts into `firstname_lastname_CS2349_P2.zip`. Give adjoining written answers in one PDF document named appropriately. Points will be given for code that is well documented.*
Answer any one of the following questions.

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1. Write a programme to simulate a 2-stack PDA that recognizes the following languages.

   a. $L_1 = \{a^n b^n c^n | n \geq 1\}$ **(10 points)**
   b. $L_2 = \{ww^R | w \in \{0, 1\}\}$ **(10 points)**

   Give the formal description of the machine, the transition table and the adjoining automaton diagram to illustrate your machine. Are these languages Turing recognizable or decidable? How can you tell? **(5 points)**

2. Write a programme to simulate a queue automaton that can perform addition on numbers that are represented in the unary format. In this format, the number 2 is represented as 11 as opposed to the binary 10; the number 5 as 11111 as opposed to 101, and so on.
   You take in the input in the usual manner, that is, the user enters "1 + 2", which you will then convert to a single tape of 1s separated by some delimiter of your choice (keeping '+' as the delimiter would be the direct suggestion), and then process using the automaton. You are free to define how the user enters the numbers to add, but please print the string after converting it into what will be on the tape.

   An example addition is given below:
   $5 + 2 \implies$ "11111 + 11" $\implies$ "1111111"

This can be your final output – what remains on the tape.
Please ensure that you give the formal definition, the transition diagram/table and any adjoining description in addition to properly commenting out your code. Additionally, please remember that you are not allowed to use any non standard library modules.
(15 + 10 = 25 points)