

Choose any 2 of the 3 problems.

1. Consider language $L_1 = \{w : w \text{ starts with the substring "01" and contains the substring "10"}\}$ over $\Sigma_1 = \{0, 1\}$:

- (4 pts) Give a regular expression describing this language L_1 .
- (8 pts) Draw the equivalent state diagram of an NFA for this language L_1 .
- (8 pts) Draw the equivalent state diagram of a DFA for this language L_1 .

2. Consider $\Sigma_2 = \{0, 1, 2\}$:

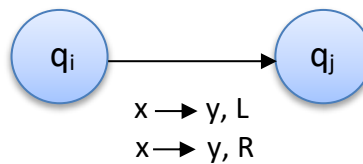
- (4 pts) State the Pumping Lemma for context free languages.
- (16 pts) Prove the following language is not context free: $L_2 = \{0^n 1^n 2^n \mid n \geq 0\}$.

3. For Turing machines:

- (4 pts) Write one difference between Pushdown Automata and Turing machines.
- (16 pts) Draw the state diagram of a Turing machine that recognizes the following language over $\Sigma_3 = \{a, b, c\}$:

$$L_3 = \{w : w \text{ has even length, or } w \text{ begins with "a" and ends in "b"}\}$$

For example, string "acb" is in L_3 , but string "abc" is not in L_3 . Please use the following notation to label your Turing machine transitions:



(read symbol x , write symbol y , direction to move is L or R)