Program Analysis: Assignment-1

Tushar Goyal - UG20210087

▼ Question 1

Write a regular expression that accepts all strings over the alphabet a, b, c that have an even number of a's. If a regular expression is not possible, give a reason why.

This regular expression accepts all the strings containing even number of a’s occurring by ensuring all the a’s that occur are in pair of two, hence even. The string can have any number of b’s, c’s between the a’s and the string can start and end with any number of b’s and c’s with any number of combinations of those.

$$((a(b|c)^*a)^*|(b|c)^*)^*$$

▼ Question 2

Write a regular expression that accepts all strings over the alphabet a, b, c that have the same number of a's and b's. If a regular expression is not possible, give a reason why.

A regular expression to accept all strings over the alphabet a, b, c that have the same number of a's and b's is not possible.

The reason is that the alphabet contains three letters, but the number of a's and b's must be the same. This means that there must be a way to distinguish between strings that have the same number of a's and b's, and strings that do not. However, regular expressions can only distinguish between strings based on their **position** and **repetition** of characters. They cannot distinguish between strings based on the **number** of occurrences of a particular character.

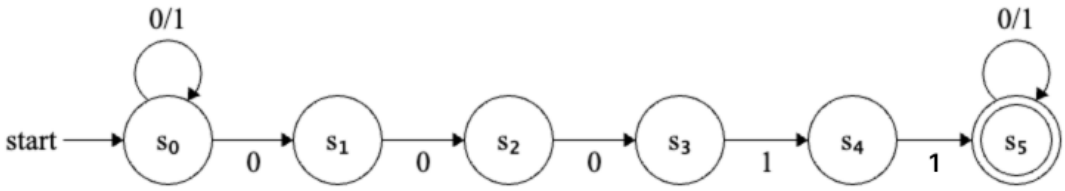
However, we can achieve this by using a context-free grammar or a pushdown automaton, which can keep track of the counts.

▼ Question 3

Consider the regular expression (0|1)*00011(0|1)* -- it accepts all strings over the alphabet 0,1 that contain the sequence 00011 somewhere in it.

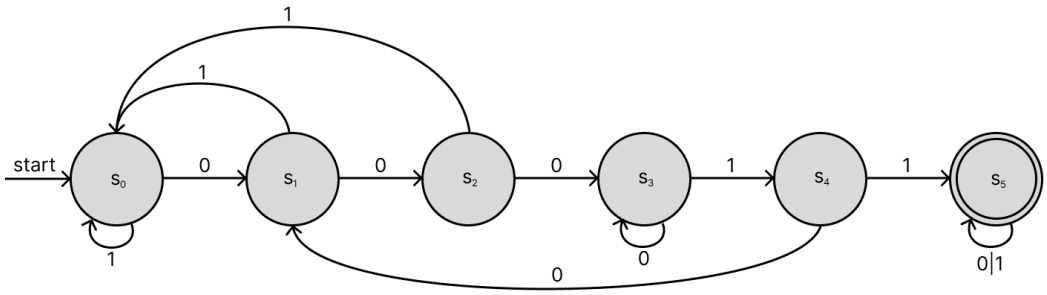
a) Draw a finite automation for it in a straightforward manner. You will find one or more states where there are two edges from the same state labeled with the same symbol. Such a FA is called a Non-deterministic Finite Automation (NFA)

NFA



(b) By observation, draw a Deterministic Finite Automaton (DFA) that accepts the same language. (no need to follow any formal procedure.) A DFA has only one outgoing edge from any state labeled with a particular symbol. (A DFA is better than an NFA since it is directly implementable by a computer program without guessing.)

DFA



▼ Question 4

Write a regular expression and DFA that accepts all the strings of 0's and 1's that represent an even binary number. If a regular expression is not possible, give a reason why. (Do not draw an NFA!).

Binary number can be represent as:

$$(0|1)^*0$$

DFA to accept string of this format: