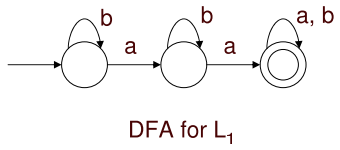
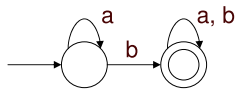
Solutions to Written Assignment 1

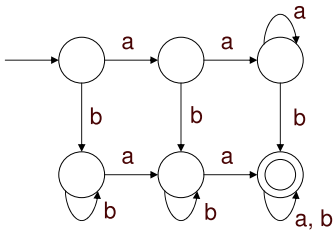
1. DFAs for languages



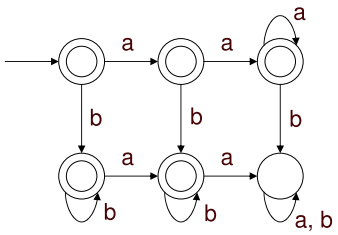
DFA for L_1



DFA for L_2

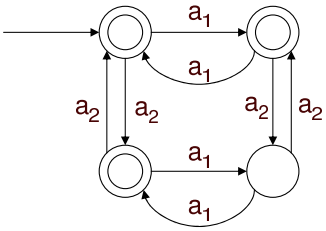


DFA for L_3

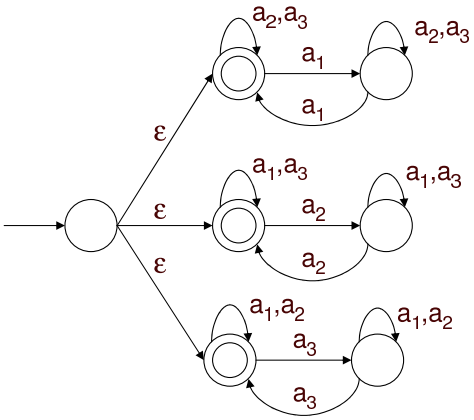


DFA for L_4

2. DFAs and NFAs for languages



DFA for L_2



NFA for L_3

3. Regular expressions

(a) $(0+1)^*0(0+1)^*11$

(b) $\epsilon + 0 + 1 + (00 + 10 + 11)(0 + 1)^*$

(c) $0^*10^*(0^*10^*10^*)^*$

(d) $(00^*10^*10^*) + (0^*100^*10^*) + (0^*10^*100^*)$

4. Regular expression and description from DFA

   - The language of all strings that begin and end with a 0 and have an even, non-zero number of 1s (that is, $2k$ 1s, for some $k \geq 1$).
   - $00^*10^*10^*(10^*10^*)^*0$

5. Lexical analysis

   (a) An even length string of 0s prints all as, while an odd length string of 0s will have one c at the end (because of the maximal munch rule). Thus, strings of 0s generate the language $a^*c?$. Interspersed 1s generate bs, so the full language is

   $$(a^*c?b^+)^*a^*c?$$

   A common mistake might be to incorrectly account for the priority between the rules for 0 and 00.

   (b) Every input string can be divided into three sections (any of which might be empty)

   - An initial string of 1s
   - A section where a string of 0s is followed by a string of 1s, and this pattern repeats (i.e., the language $((0+)(1+))^*$)
   - A final string of 0s

   Thus, this specification can print any string in the language $c^*a^*b^*$.