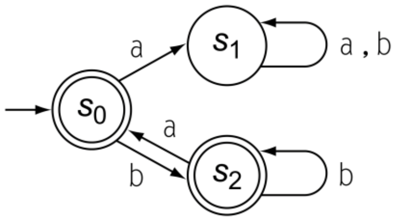
B11015010 羅翡瑩

Compiler Designs, Homework Assignment 1

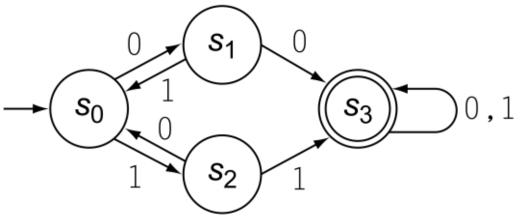
1. Describe the languages accepted by the following NFA. (30%)



a.

- Regex : (b^+(a| ε))*
- Desc: The S1 is a trap state, so no strings accepted that start reading a. Firstly, the strings accepted either empty set (define by s0) or only b (define by s2) or start with b with looping b (define by s2); which means at least there is 1 b – define by b^+ (b^+ means can loop b many times but at least there will be one b, so can't empty b for s2). The strings will end with empty set, b or a as define in s2 and s0 as final state.
- Example of accepted:

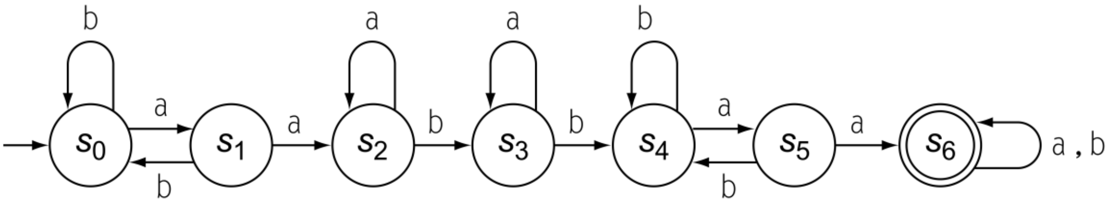
  ε ,b, bbb, bba, ba, bbbaba, bbababb



b.

- Regex : (01|10)*(00|11)(0|1)*
- Desc : The strings can start either 0 or 1, but in the middle if they go for 0, then there will be one 0 next to it – define by 00. If go to 1, then there will be one 1 next to it - define by 11. The substring need to have either 00 or 11. The end of strings can be either 0 , 1, or ε . Language can't be empty set
- Example of accepted:

  0111, 000, 111, 10001, …



c.

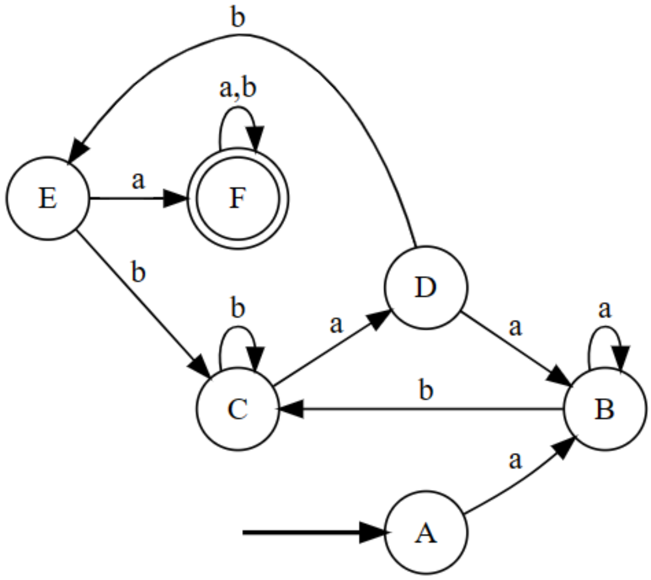
- Regex : (ab | b)* aa a*ba*b (ab | b)* aa (a|b)*
- Desc : The strings can start either a or b. The end of string can end with a or b too.
- Example of accepted:

  ababbaa, bbaabaaabbbabaa, ababaaabaabbaab, …

2. **Construct a DFA accepting each of the following languages (30%)**

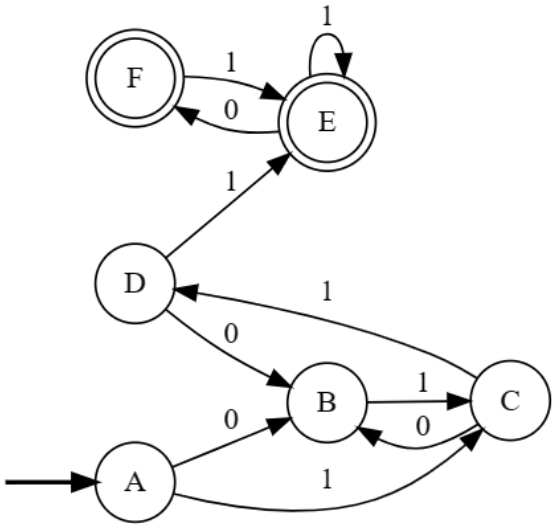
   a. **{w ∈ {a, b}* | w starts with ‘a’ and contains “baba” as a substring}**

      ➢ a (a|b)* (baba) (a|b)*



   b. **{w ∈ {0, 1}* | w contains “111” as a substring and does not contain “00” as a substring}**

      ➢ (01|1)*(01|1)11(01|1)*(0| ε)



   c. **{w ∈ {a, b, c}* | in w the number of ‘a’s modulo 2 is equal to the number of ‘b’s modulo 3}**

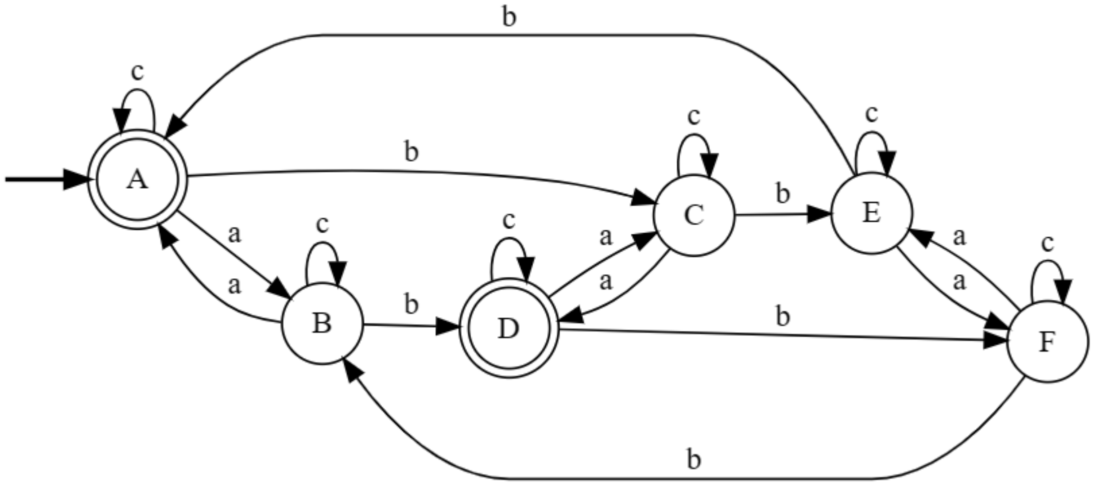
      ➢ Let’s say a = 2, 2 mod 2 = 0

      Let’s say b = 3, 3 mod 3 = 0, by here they both equal to 0

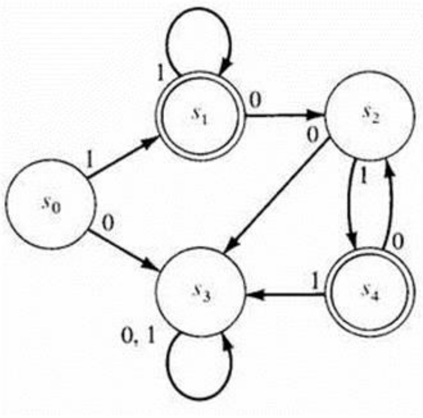
      mod 2 had 2 possible result which is 0 and 1

      mod 3 had 3 possible result which 0, 1 and 2 from here, a multiply by b is 2 multiply by 3 equals to 6, means have 6 states, define by A, B, C, D, E, F below.

- As c not define anywhere, then c will loop in each state
- In here final state is A and D because in these states, the result of mod 2 and mod 3 will be the same



3. **Give a regular expression for the set recognized by the finite-state machine. (10%)**

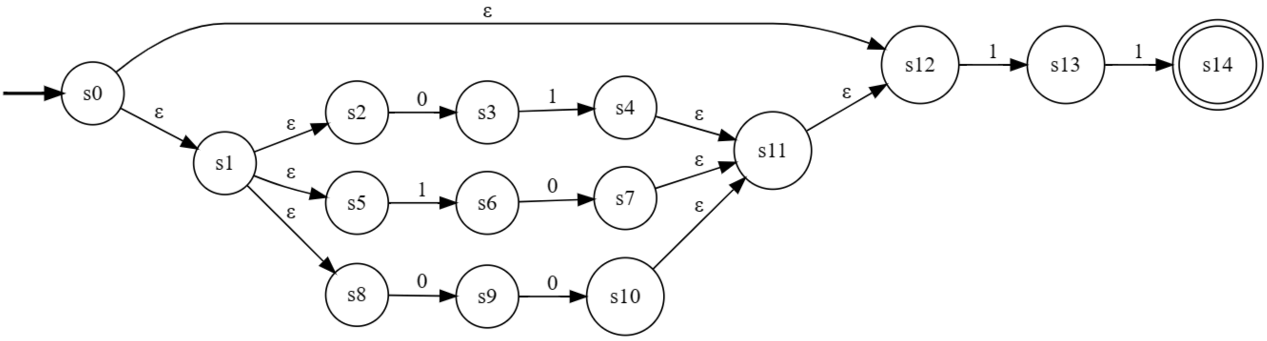


- 11*(ε |0(10)*1)

4. Consider the regular expression: (30%)

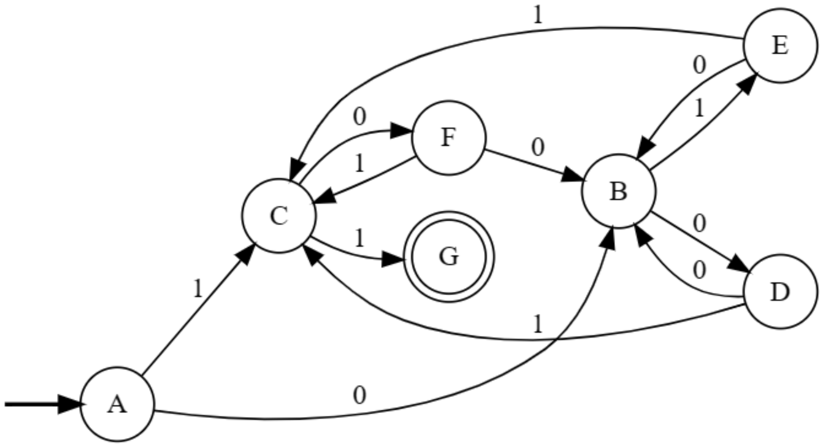
(01 | 10 | 00)∗ 11

a. Use Thompson’s construction to construct an NFA for each regex.



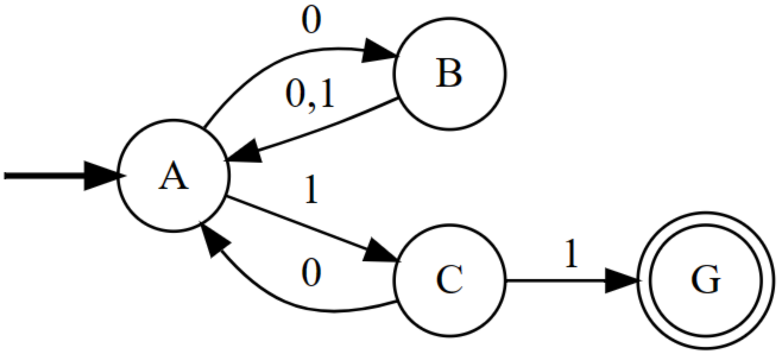
b. Convert the NFAs to DFAs.

NFA State	DFA State	Type	0	1
{s0, s1, s2, s5, s8, s12}	A	Initial	B	C
{s3, s9}	B		D	E
{s6, s13}	C		F	G
{s1, s2, s5, s8, s10, s11, s12}	D		B	C
{s1, s2, s4, s5, s8, s11, s12}	E		B	C
{s1, s2, s5, s7, s8, s11, s12}	F		B	C
{s14}	G	Final		



c. Minimize the DFAs.

DFA State	Min-DFA	Type	0	0,1	1
{A, D, E, F}	A	initial	B		C
{B}	B			A	
{C}	C		A		G
{G}	G	final			


0
B
0,1
A
1
C
0
1
G