

CS – 204: Assignment 1

14 . 02 . 2021

1. L^* –

ab aa baa ab aa

aa aa baa aa

baa aa ab aa

L^4 –

aa aa baa aa

baa aa ab aa

2. Given,

$$\Sigma = \{a, b\}$$

$$L = \{aa, bb\}$$

So,

$$\overline{L} = \Sigma^* - L = \{a, b\}^* - \{aa, bb\}$$

3. a) $P : S \rightarrow bS \mid Sb \mid a$

$$G = (\{S\}, \{a, b\}, S, P)$$

b) $P : S \rightarrow aS \mid bS \mid Sb \mid a$

$$G = (\{S\}, \{a, b\}, S, P)$$

4. a) $P : S \rightarrow aSb \mid Sb \mid b$

$$G = (\{S\}, \{a, b\}, S, P)$$

b) $P : S \rightarrow aSbb \mid \lambda$

$$G = (\{S\}, \{a, b\}, S, P)$$

c) $P : S \rightarrow aSb \mid aa$

$$G = (\{S\}, \{a, b\}, S, P)$$

d) $P : S \rightarrow aSb \mid aaa$

$$G = (\{S\}, \{a, b\}, S, P)$$

e) $P :$

$$S \rightarrow S_1 S_2 B$$

$$S_1 \rightarrow a S_1 b \mid S_1 b \mid b$$

$$S_2 \rightarrow a S_2 b b \mid \lambda$$

$$G = (\{S, S_1, S_2\}, \{a, b, \lambda\}, S, P)$$

f) It can be observed that all elements of $a^n b^{2n}$ are part of $a^n b^m$ except λ . Hence

$$L_1 \cup L_2 = L_1 \cup \{\lambda\}.$$

$$P : S \rightarrow a S b \mid S b \mid b \mid \lambda$$

$$G = (\{S\}, \{a, b, \lambda\}, S, P)$$

5. We will prove that the 2 grammars, G_1 and G_2 are not equivalent by providing a counterexample.

Deriving from the G_1 ,

$$S \Rightarrow a S b \Rightarrow a S S b \Rightarrow a a S b \Rightarrow a a a b$$

Similarly, for G_2

$$S \Rightarrow a S b \Rightarrow a a b$$

$$\Rightarrow a a S b b \Rightarrow a a a b b$$

Thus, $aaab \in G_1$ and $aaab \notin G_2$. As a result, they are not equivalent.

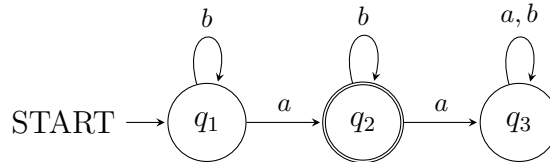


Figure 1: All strings with exactly one a

6. a)

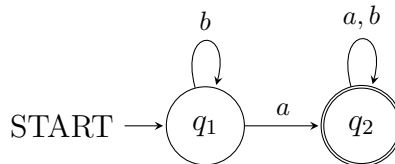


Figure 2: All strings with at least one a

b)

c)

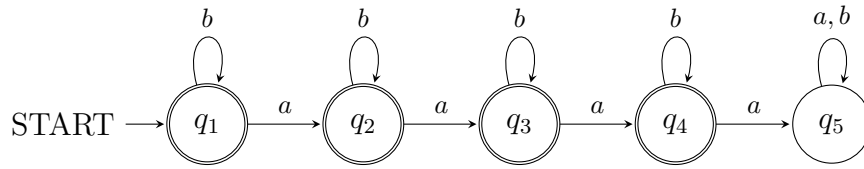


Figure 3: All strings with no more than 3 a's

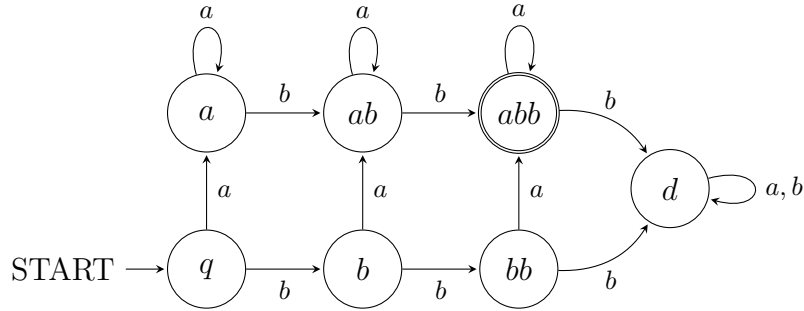


Figure 4: All strings with at least one a and exactly two b's

d)

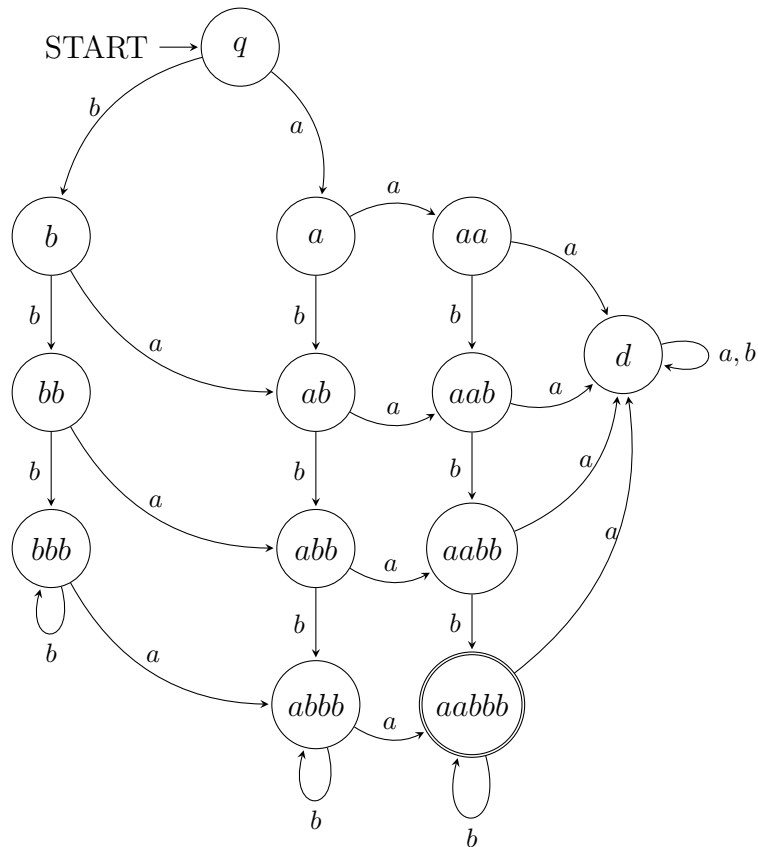


Figure 5: All strings with exactly two a's and more than two b's

e)

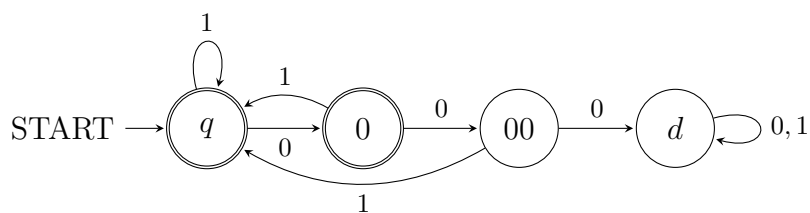


Figure 6: *All strings where every 00 is followed by 1*

7. a)

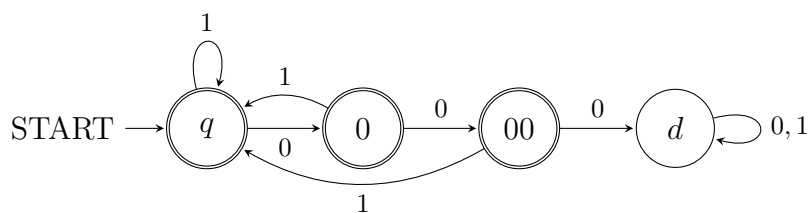


Figure 7: *All strings containing 00 but not 000*

b)

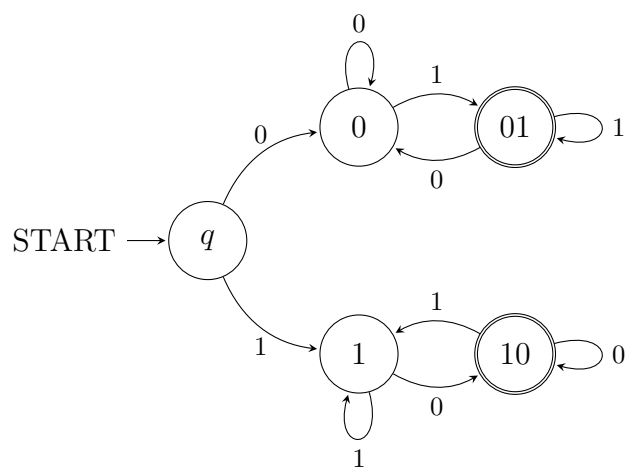


Figure 8: *All strings where leftmost symbol differs from rightmost*

c)

d)

e)

f)

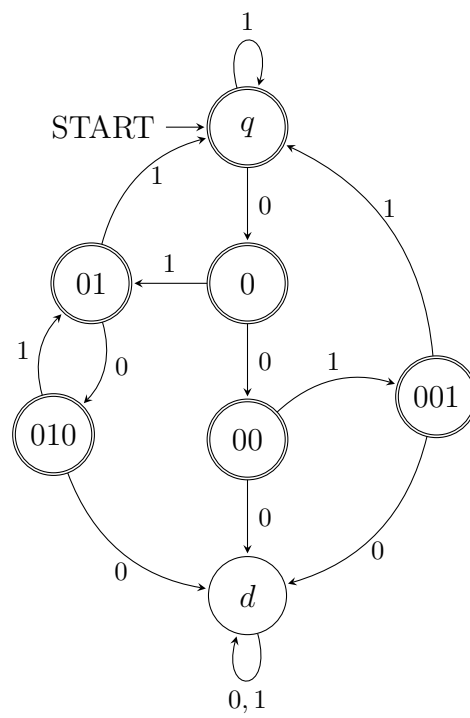


Figure 9: All strings where every substring of 4 symbols has at most 2 0's

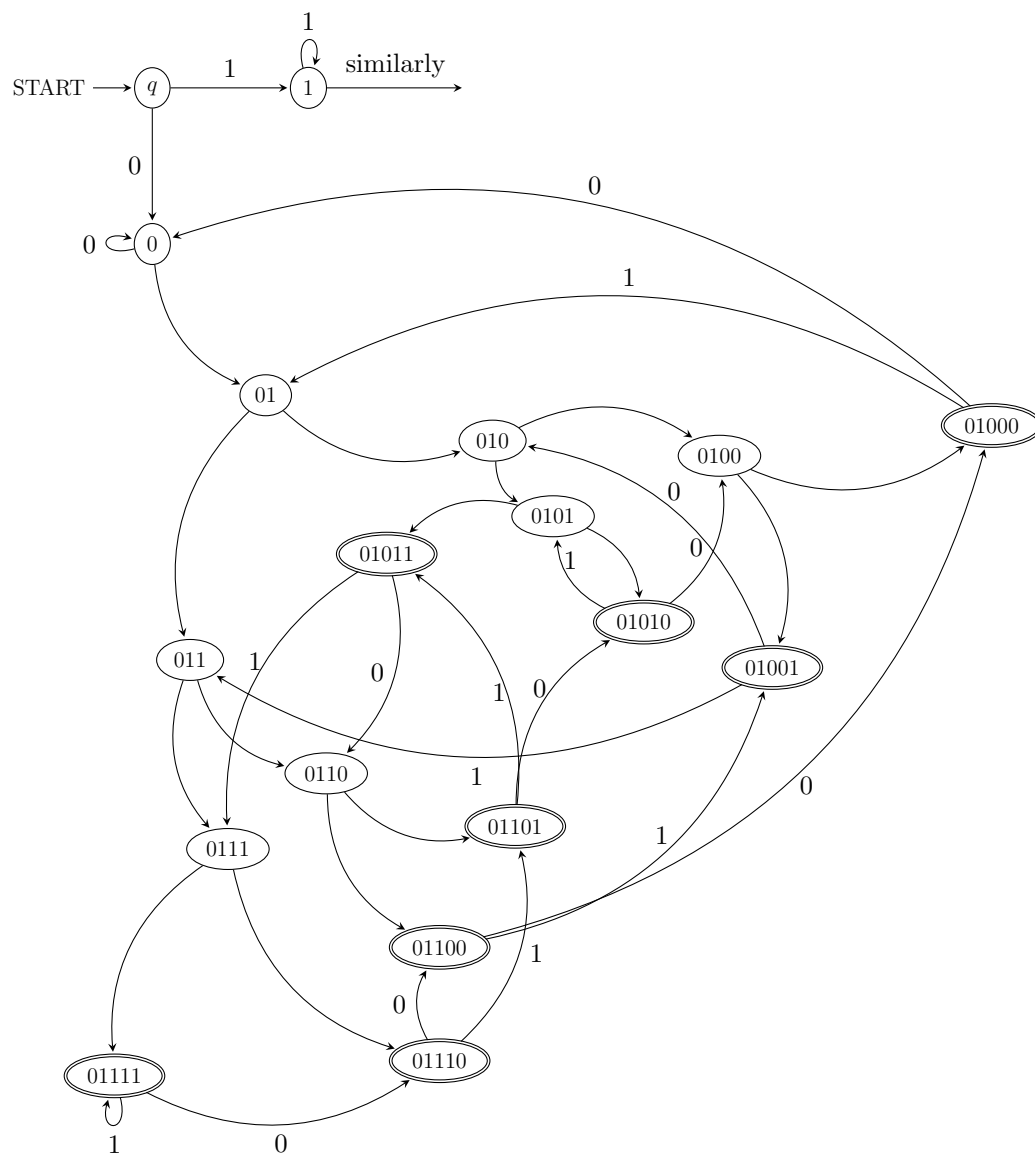


Figure 10: All strings of length 5 or more where 4th symbol from the right is different from leftmost

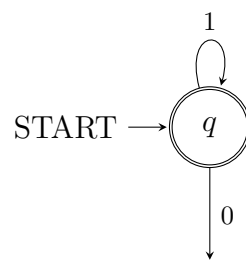


Figure 11: *All strings where every substring of 4 symbols has at most 2 0's*