CS-206: Assignments 1, 2

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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) $P : S \to bS \mid Sb \mid a$
   $G = (\{S\}, \{a, b\}, S, P)$

   b) $P : S \to aS \mid bS \mid Sb \mid a$
   $G = (\{S\}, \{a, b\}, S, P)$

4. a) $P : S \to aSb \mid Sb \mid b$
   $G = (\{S\}, \{a, b\}, S, P)$

   b) $P : S \to aSbb \mid \lambda$
   $G = (\{S\}, \{a, b\}, S, P)$

   c) $P : S \to aSb \mid aa$
   $G = (\{S\}, \{a, b\}, S, P)$

d) $P : S \to aSb \mid aaa$
$G = (\{S\}, \{a, b\}, S, P)$

e) P :
$S \to S_1 S_2 B$
$S_1 \to aS_1 b \mid S_1 b \mid b$
$S_2 \to aS_2 bb \mid \lambda$

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

f) It can be observed that all elements of $a^n b^{2n}$ are part of $a^n b^m$ except λ. Hence $L_1 \cup L_2 = L_1 \cup \{\lambda\}$.
$P : S \to aSb \mid Sb \mid b \mid \lambda$
$G = (\{S\}, \{a, b, \lambda\}, S, P)$

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,

$$S \Rightarrow aSb \Rightarrow aSSb \Rightarrow aaSb \Rightarrow aaab$$

Similarly, for G_2

$$S \Rightarrow aSb \Rightarrow aab$$
$$\Rightarrow aaSbb \Rightarrow aaabb$$

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

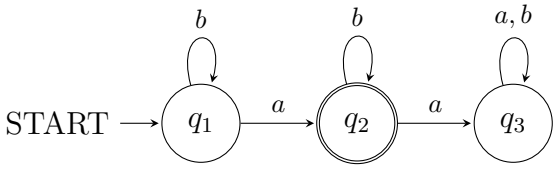

Figure 1: *All strings with exactly one a*

6. a)

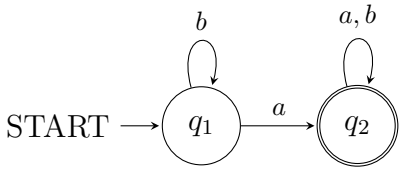

Figure 2: *All strings with at least one a*

b)

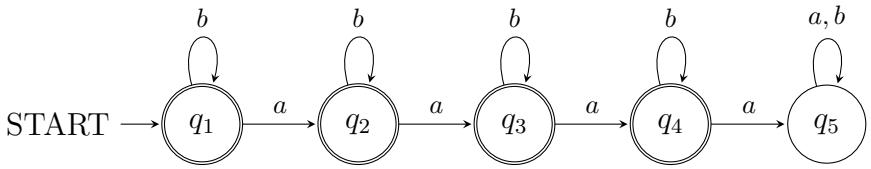

Figure 3: *All strings with no more than 3 a's*

c)

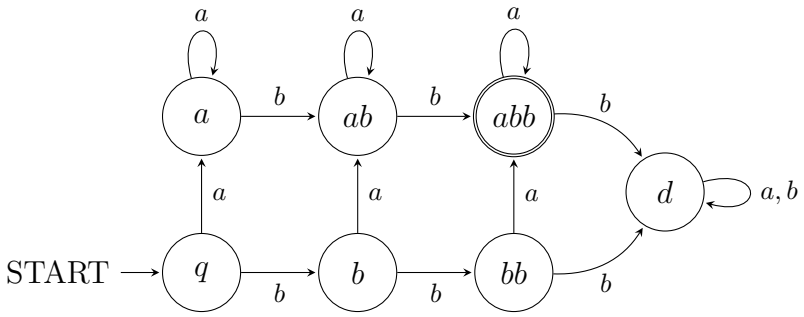

Figure 4: *All strings with at least one a and exactly two b's*

d)

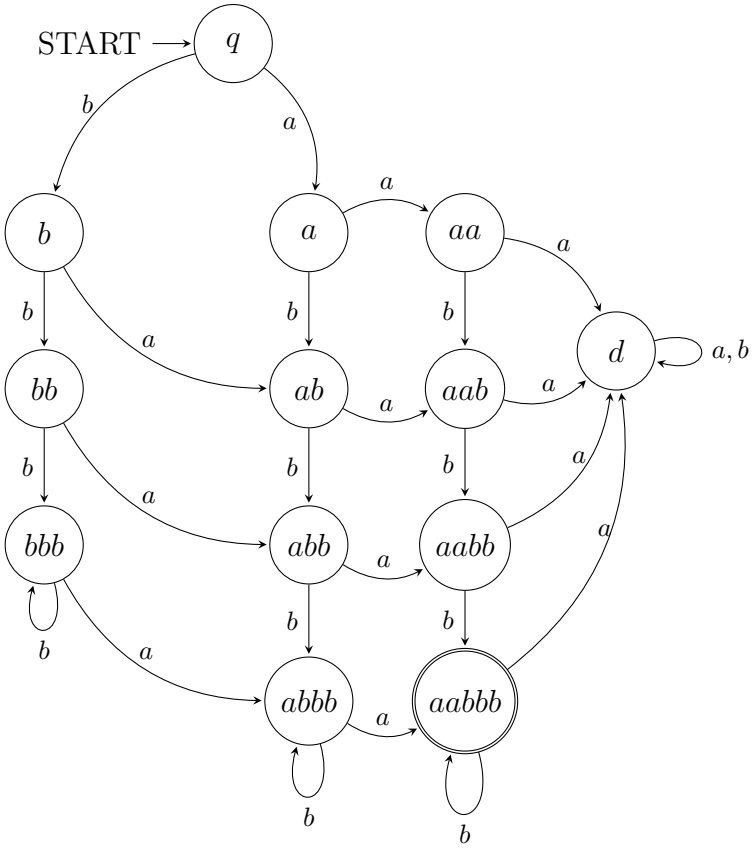

Figure 5: *All strings with exactly two a's and more than two b's*

e)

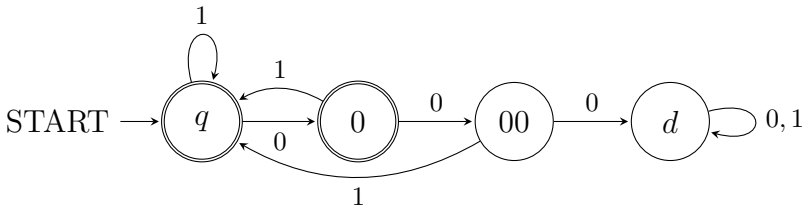

Figure 6: *All strings where every 00 is followed by 1*

7. a)

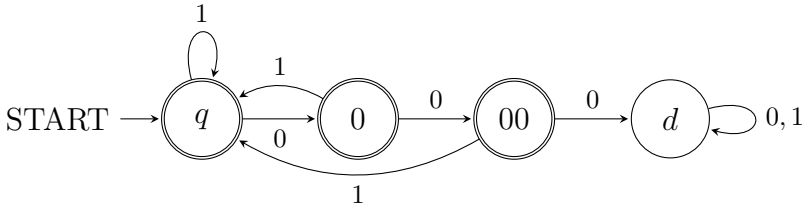

Figure 7: *All strings containing 00 but not 000*

b)

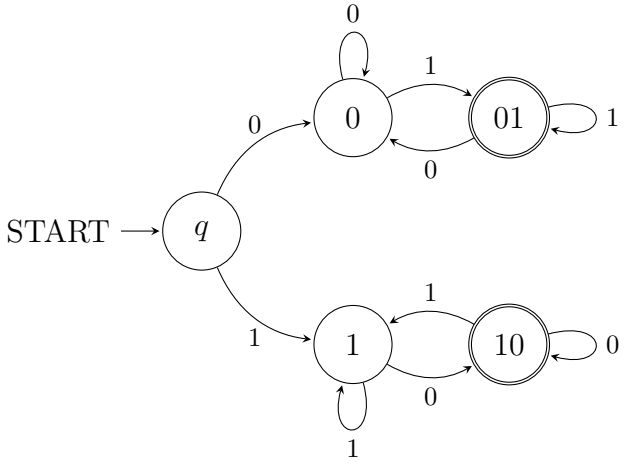

Figure 8: *All strings where leftmost symbol differs from rightmost*

c)

d)

e)

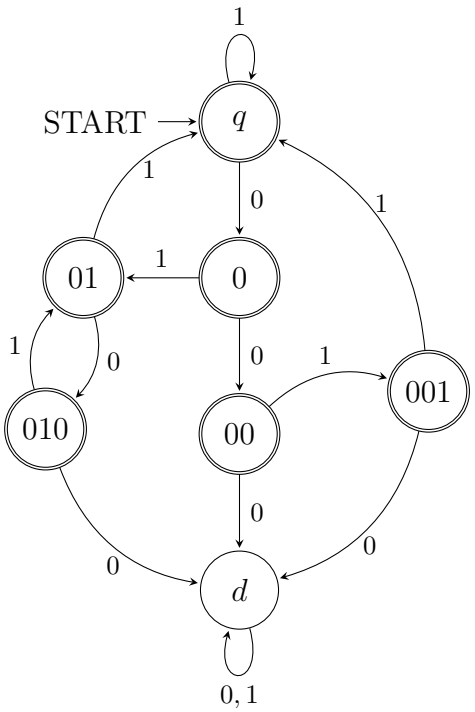

Figure 9: *All strings where every substring of 4 symbols has at most 2 0's*

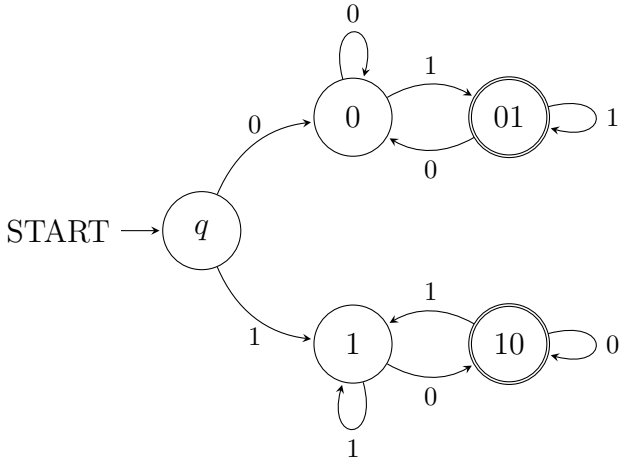

Figure 10: *All strings of length 5 or more where 4th symbol from the right is different from leftmost*