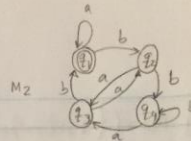
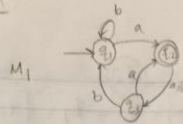


Adel Danandeh

1.1



M_1

- (a) q_1
- (b) $\{q_2\}$
- (c) $q_1 \rightarrow q_2 \rightarrow q_3 \rightarrow q_1 \rightarrow q_1$ ends up in q_1 at the end
- (d) No
- (e) No, M_1 does not accept ϵ .

M_2

- (a) q_1
- (b) $\{q_1, q_4\}$
- (c) $q_1 \rightarrow q_1 \rightarrow q_2 \rightarrow q_4$
- (d) Yes, M_2 does accept $aabb$.
- (e) Yes, M_2 accepts ϵ .

1.2

- (a) $M_1 = (\{q_1, q_2, q_3\}, \{a, b\}, \delta, q_1, \{q_2\})$.

	a	b
q_1	q_2	q_1
q_2	q_3	q_3
q_3	q_2	q_1

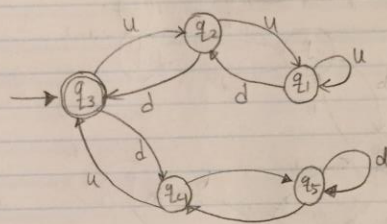
⑥ $M_2 = (\{q_1, q_2, q_3, q_4\}, \{a, b\}, \delta_2, q_1, \{q_1, q_4\})$

function δ_2

	a	b
q_1	q_1	q_2
q_2	q_3	q_4
q_3	q_2	q_1
q_4	q_3	q_4

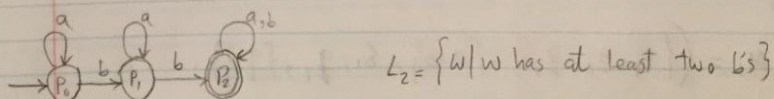
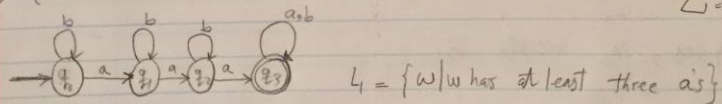
1.3 $M = (\{q_1, q_2, q_3, q_4, q_5\}, \{u, d\}, \delta, q_3, \{q_3\})$

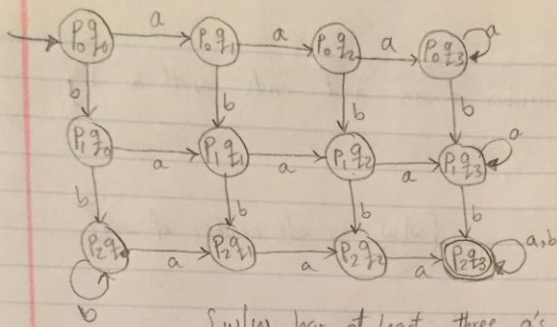
	u	d
q_1	q_1	q_2
q_2	q_1	q_3
q_3	q_2	q_4
q_4	q_3	q_5
q_5	q_4	q_5



1.4

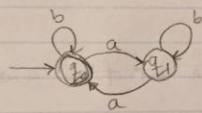
① $\{w \mid w \text{ has at least three a's and at least two b's}\} \quad \Sigma = \{a, b\}$



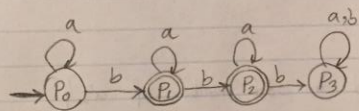


$\{w \mid w \text{ has at least three } a\text{'s and at least two } b\text{'s}\}$

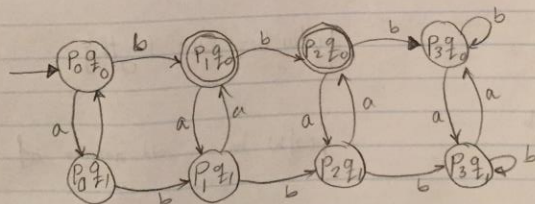
(C) $\{w \mid w \text{ has an even number of } a\text{'s and one or two } b\text{'s}\}$



$\{w \mid w \text{ has an even number of } a\text{'s}\}$

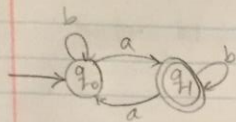


$\{w \mid w \text{ has one or two } b\text{'s}\}$

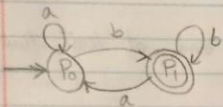


$\{w \mid w \text{ has an even number of } a\text{'s and one or two } b\text{'s}\}$

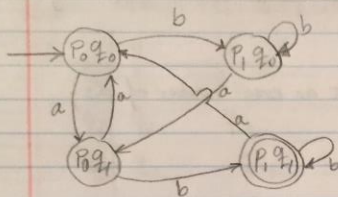
⑦ $\{w \mid w \text{ has odd number of a's and ends with a b}\}$



$\{w \mid w \text{ has odd number of a's}\}$

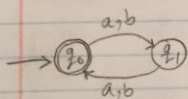


$\{w \mid w \text{ ends with a b}\}$

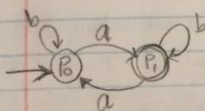


$\{w \mid w \text{ has odd number of a's and ends with a b}\}$

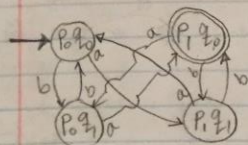
⑧ $\{w \mid w \text{ has even length and an odd number of a's}\}$



$\{w \mid w \text{ has even length}\}$



$\{w \mid w \text{ has an odd number of a's}\}$

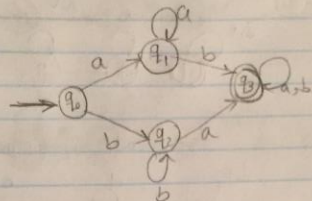


$\{w \mid w \text{ has even length and an odd number of a's}\}$

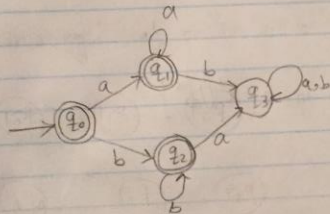
1.5 c, d, e, f, g, h

c) $\{w \mid w \text{ contains neither the substrings } ab \text{ nor } ba\}$

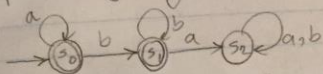
$\{w \mid w \text{ contains either the substring } ab \text{ or } ba\}$



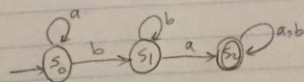
$\{w \mid w \text{ contains neither the substring } ab \text{ nor } ba\}$



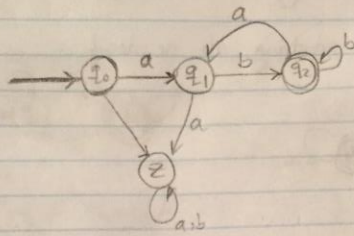
d) $\{w \mid w \text{ is any string, not in } a^*b^*\}$



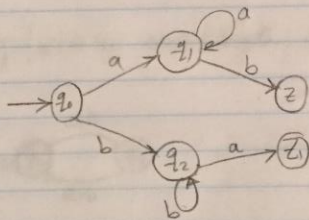
$\{w \mid w \text{ is any string in } a^*b^*\}$



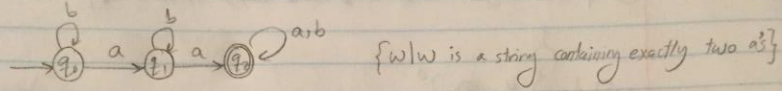
e) $\{w \mid w \text{ is any string not in } (ab^+)^*\}$



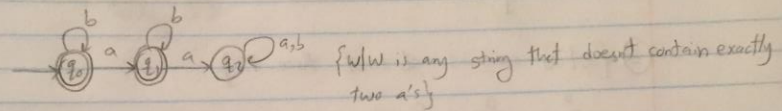
f) $\{w \mid w \text{ is any string, not in } a^* \cup b^*\}$



② $\{w \mid w \text{ is any string that doesn't contain exactly two } a's\}$

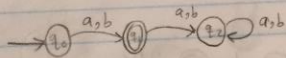


$\{w \mid w \text{ is a string containing exactly two } a's\}$

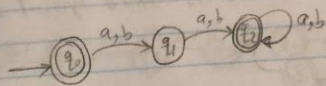


$\{w \mid w \text{ is any string that doesn't contain exactly two } a's\}$

h) $\{w \mid w \text{ is any string except } a \text{ and } b\}$

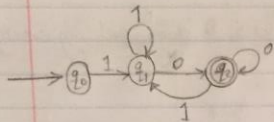


Now we negate the accepting states:

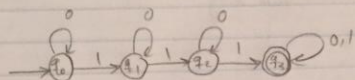


1.6

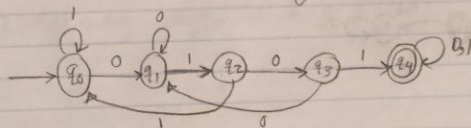
(a) $\{w \mid w \text{ begins with a 1 and ends with a 0}\}$



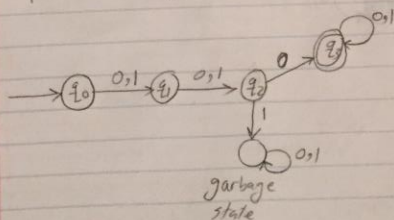
(b) $\{w \mid w \text{ contains at least three 1's}\}$



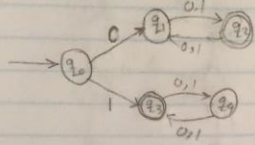
(c) $\{w \mid w \text{ contains the substring 0101}\}$



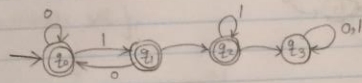
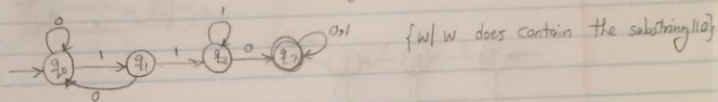
(d) $\{w \mid w \text{ has length at least 3 and its third symbol is a 0}\}$



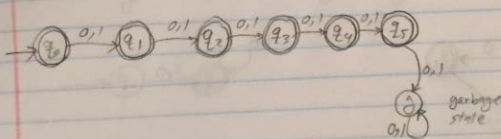
e) $\{w \mid w \text{ starts with 0 and has odd length, or starts with 1 and has even length}\}$



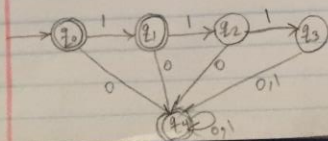
f) $\{w \mid w \text{ doesn't contain the substring } 110\}$



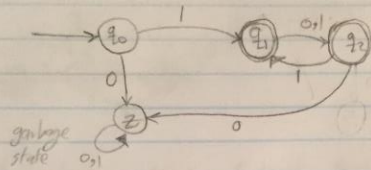
g) $\{w \mid \text{the length of } w \text{ is at most } 5\}$



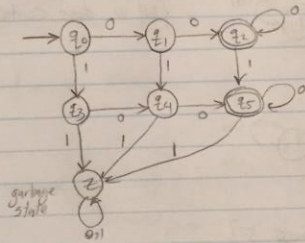
h) $\{w \mid w \text{ is any string except } 11 \text{ and } 111\}$



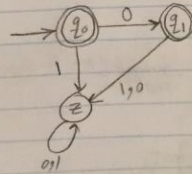
i) $\{w \mid \text{every odd position of } w \text{ is a } 1\}$



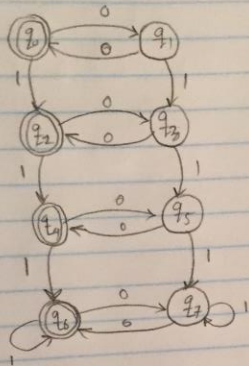
j) $\{w \mid w \text{ contains at least two } 0\text{'s and at most one } 1\}$



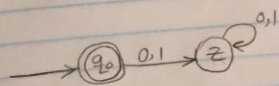
k) $\{ \epsilon, 0 \}$



1) $\{w \mid w \text{ contains an even number of 0's, or contains exactly two 1's}\}$



m) $\{\text{the empty set}\}$



n) All strings except the empty string

