2.1.1

$\because e \in L(M)$

$\therefore (s, e) \vdash_M^* (q_e, e)$, when $q_e \in F$

$\because (s, e) \vdash_M (q_e, w)$ is not always tenable for (q_e, w)

$\Rightarrow (s, e) = (q_e, e)$

$\Rightarrow s = q_e$

$\Rightarrow s \in F$

2.1.2

(c) the string has same as and bs, and in pre-order, there are not 2 more as than bs, or bs than as.

(d) the string has same as and bs, and in pre-order, there are not 1 more as than bs, or bs than as.

2.1.3

(c) $M = (K, \Sigma, \delta, s, F)$

$K = \{q_0, q_1, q_2, q_3\}$, $\Sigma = \{a, b\}$, $s = q_0$

$F = \{q_0, q_1, q_2\}$

q	a	$\delta(q, a)$
q_0	a	q_1
q_0	b	q_2
q_1	a	q_3
q_1	b	q_2
q_2	a	q_1
q_2	b	q_3
q_3	a	q_3
q_3	b	q_3

2.1.3

(e) $M = (K, \Sigma, \delta, s, F)$

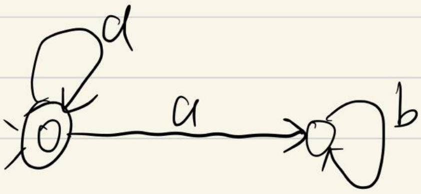
$K = \{q_0, q_1, q_2, q_3, q_4, q_5\}$, $\Sigma = \{a, b\}$

$s = q_0$, $F = \{q_5\}$

q	a	$\delta(q, a)$
q_0	a	q_1
q_0	b	q_2
q_1	a	q_1
q_1	b	q_3
q_2	a	q_4
q_2	b	q_2
q_3	a	q_5
q_3	b	q_3
q_4	a	q_4
q_4	b	q_5
q_5	a	q_5
q_5	b	q_5

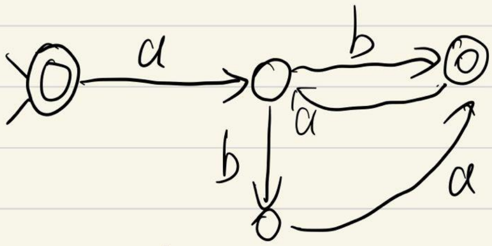
2.2.1

(a)



$\{a^*\}$

(b)



$\{a(baa \cup ba)^*(b \cup ba)\}$

2.2.6

(a) $M = (K, \Sigma, \Delta, s, F)$

$K = \{q_0, q_1, q_2, q_3\}$, $\Sigma = \{a, b\}$, $s = q_0$, $F = \{q_0\}$

Δ:

q	a	q^*
q_0	a	q_1
q_1	a	q_2
q_1	b	q_0
q_1	b	q_3
q_2	a	q_0
q_3	b	q_0

(b) $K = \{\{q_0\}, \{q_1\}, \{q_3\}, \{q_0, q_1\}, \{q_0, q_2\}, \{q_1, q_3\}, \phi\}$, $s = q_0$

$\Sigma = \{a, b\}$, $F = \{\{q_0\}, \{q_0, q_1\}, \{q_0, q_2\}\}$

q	a	$\delta(q, a)$
q_0	a	q_1
q_0	b	ϕ
q_1	a	q_3
q_1	b	q_0, q_2
q_3	a	ϕ
q_3	b	q_0
q_0, q_1	a	q_1, q_3
q_0, q_1	b	q_0, q_2

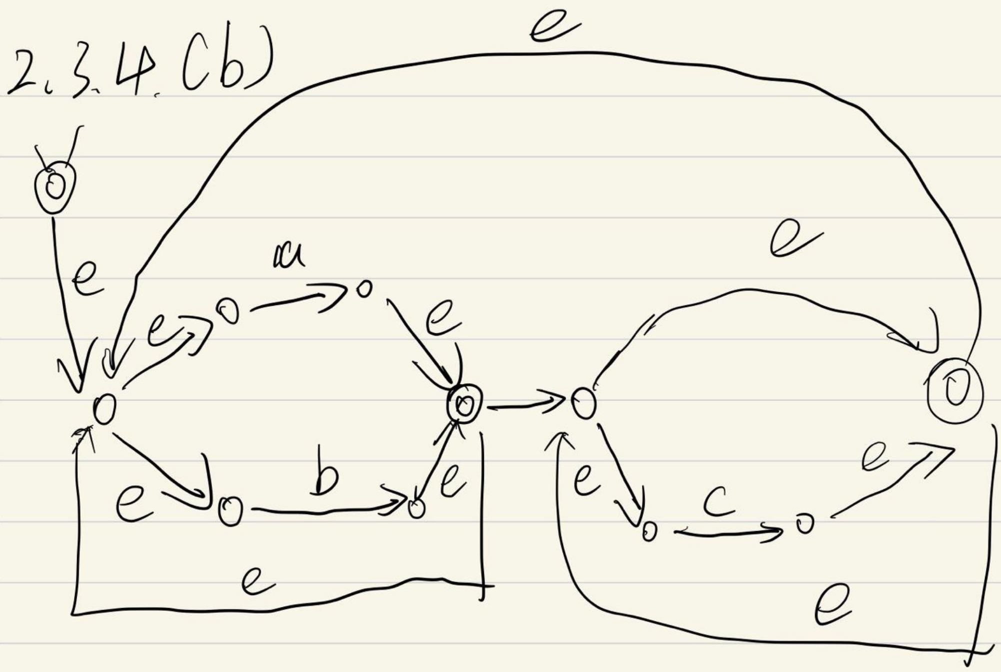
q_0, q_2	a	q_0, q_1
q_0, q_2	b	ϕ
q_1, q_3	a	q_3
q_1, q_3	b	q_0, q_2
ϕ	a	ϕ
ϕ	b	ϕ

2.2.10

Only |K| of the 2 |K| states of the new automaton will be reachable.

Each of these states will have {q} for some q ∈ K. If we identify {q} with q, we have a bijection between the states of the old automata and the reachable states of the new one. With respect to this bijection, δ, s, and F will be identical between the old machine and the new. Since ∑ is the same, there is a natural isomorphism between the old and the automaton formed from the new one by discarding unreachable states.

2.3.4 (b)



2.3.7

(a)

$a^*b(a\cup ba^*b)^*$

(b)

$((a(a\cup b))\cup(b(a\cup b)))^*$

(c)

$b^*aa^*b(bb^*aa^*b\cup ab)^*a(a\cup b)^*$

(d)

$(a\cup ba^*a)(ba^*a)^*b(a\cup b)^*$

2.4.5

(a)

suppose L is regular

so $L_1 = L \cap a^* b^* a^* = \{a^n b^{2m} a^n\}$ is regular

let $w = a^n b^{2m} a^n = xyz$, $|xy| \leq n$

$y = a^i$, $xz = a^{n-i} b^{2m} a^n \notin L$.

$\Rightarrow L$ is not regular

2.4.8

(a) X : unregular language is the subset of Σ^*

(b). X : empty set

(c) √ : $\{xy \mid x \in L, y \notin L\} = L \circ \bar{L}$, L is regular
$\Rightarrow L \circ \bar{L}$ is complement , the concatenation is regular

(d) X : with the example of $a^n b a^n$

(e) √ : L and L^R is regular, their intersection is regular too

(f) X : any language can be written as union of single sets . Since not every language is regular, so it is false

(g) √ : let $x = e$. $\{xyx^R \mid x, y \in \Sigma^*\} = \Sigma^*$