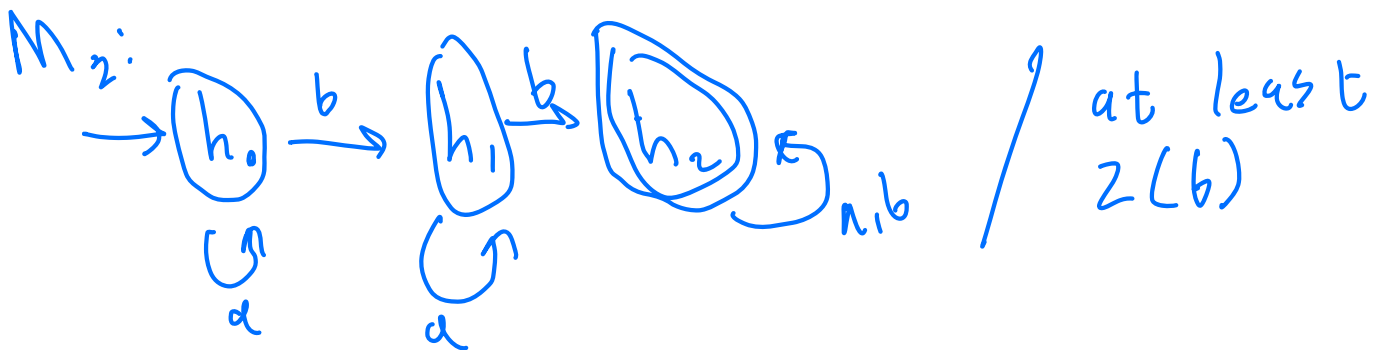
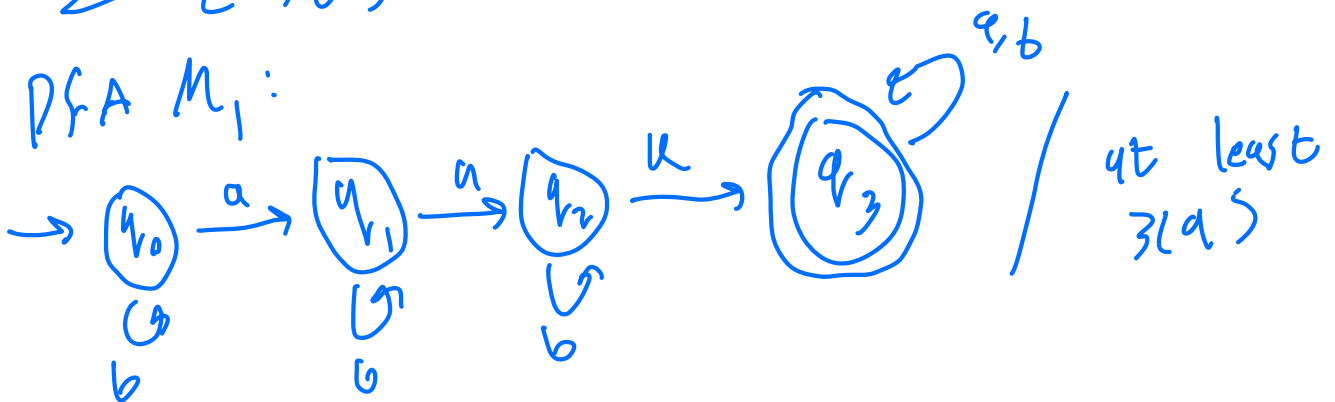


4. Each of the following languages is the intersection of two simpler languages. In each part, construct DFAs for the simpler languages, then combine them by construction to give the state diagram for the language given. In all parts, the alphabet is $\Sigma = \{a, b\}$.

(a) $\{w | w \text{ has at least three } a\text{'s and at least two } b\text{'s}\}$.

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

DFA M_1 :



$$\therefore M_1(Q_1, \Sigma, \delta, q_0, f)$$

$$Q_1 = \{q_0, q_1, q_2, q_3\}$$

$$\Sigma_1 = \{a, b\}$$

$$f_1 = \{q_3\}$$

$$\text{starting} = \{q_0\}$$

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

$$\therefore M_2(Q_2, \Sigma_2, \delta_2, q_0, f_2)$$

$$Q = \{h_0, h_1, h_2\}$$

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

$$F_2 = \{h_2\}$$

$$\text{starting} = h_0$$

	a	b
$\rightarrow h_0$	h_0	h_1
h_1	h_1	h_2^*
h_2^*	h_2^*	h_2^*

$$M_1 \cap M_2: (Q, \Sigma, \delta, (q_0, h_0), f)$$

$$Q = \{ (q_0, h_0), (q_0, h_1), (q_0, h_2), (q_1, h_0), (q_1, h_1), (q_1, h_2), (q_2, h_0), (q_2, h_1), (q_2, h_2), (q_3, h_0), (q_3, h_1), (q_3, h_2) \}$$

$$f = \{ (q_3, h_2) \} \Rightarrow f_1 \times f_2$$

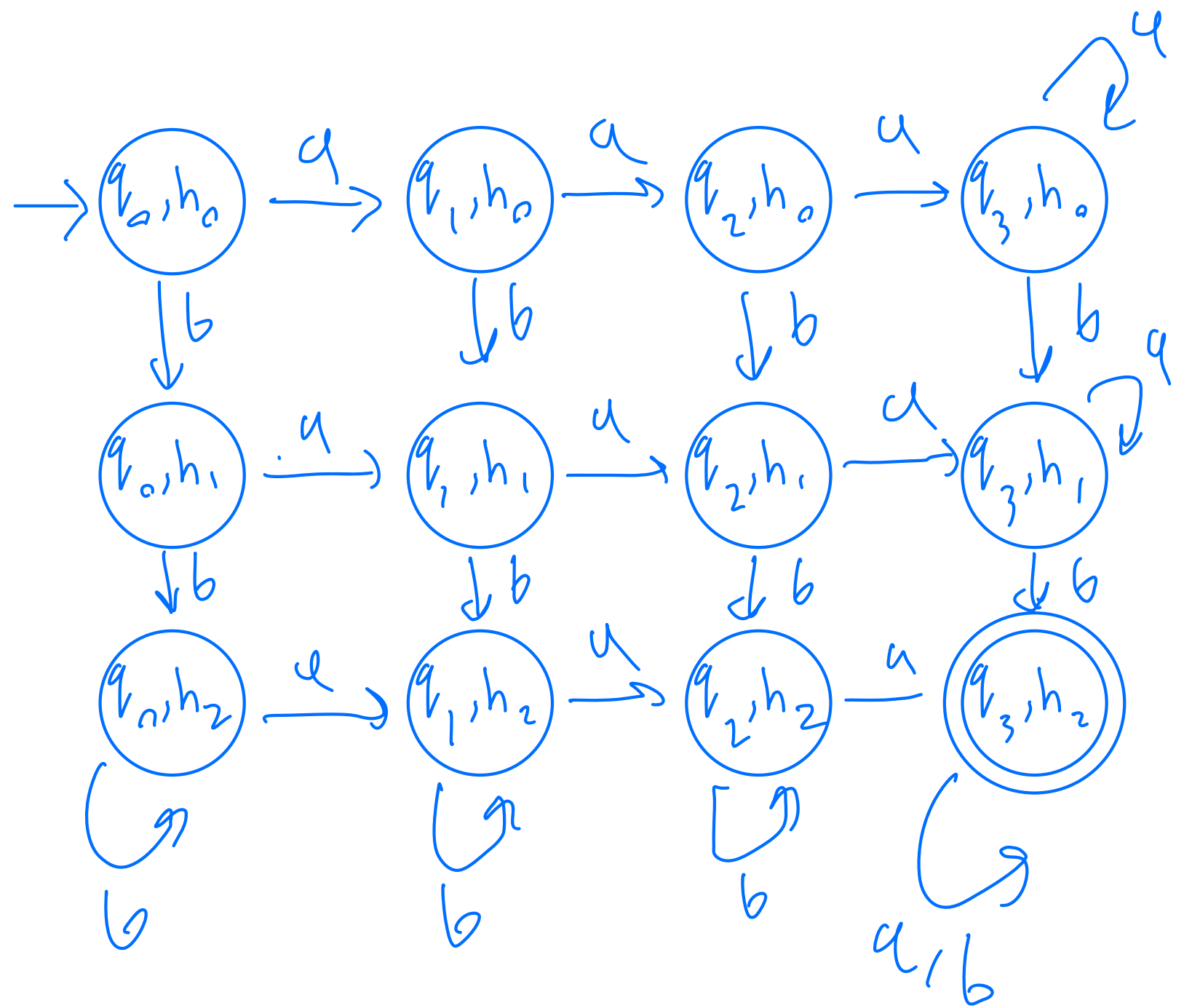
$$\text{starting} = \{ (q_0, h_0) \}$$

cross
product

6

→

	a	b
(q_0, h_0)	(q_1, h_0)	(q_0, h_1)
(q_0, h_1)	(q_1, h_1)	(q_0, h_2)
(q_0, h_2)	(q_1, h_2)	(q_0, h_2)
(q_1, h_0)	(q_2, h_0)	(q_1, h_1)
(q_1, h_1)	(q_2, h_1)	(q_1, h_2)
(q_1, h_2)	(q_2, h_2)	(q_1, h_2)
(q_2, h_0)	(q_3, h_0)	(q_2, h_1)
(q_2, h_1)	(q_3, h_1)	(q_2, h_2)
(q_2, h_2)	(q_3, h_2)	(q_2, h_2)
(q_3, h_0)	(q_3, h_0)	(q_3, h_1)
(q_3, h_1)	(q_3, h_1)	$(q_3, h_2)^*$
$(q_3, h_2)^*$	$(q_3, h_2)^*$	$(q_3, h_2)^*$



* یاد رہے کہ (q_3) نہ صرف کل (q_3) منطقیہ
 accept و کل (h_2) accept

at last 3a or 2b

