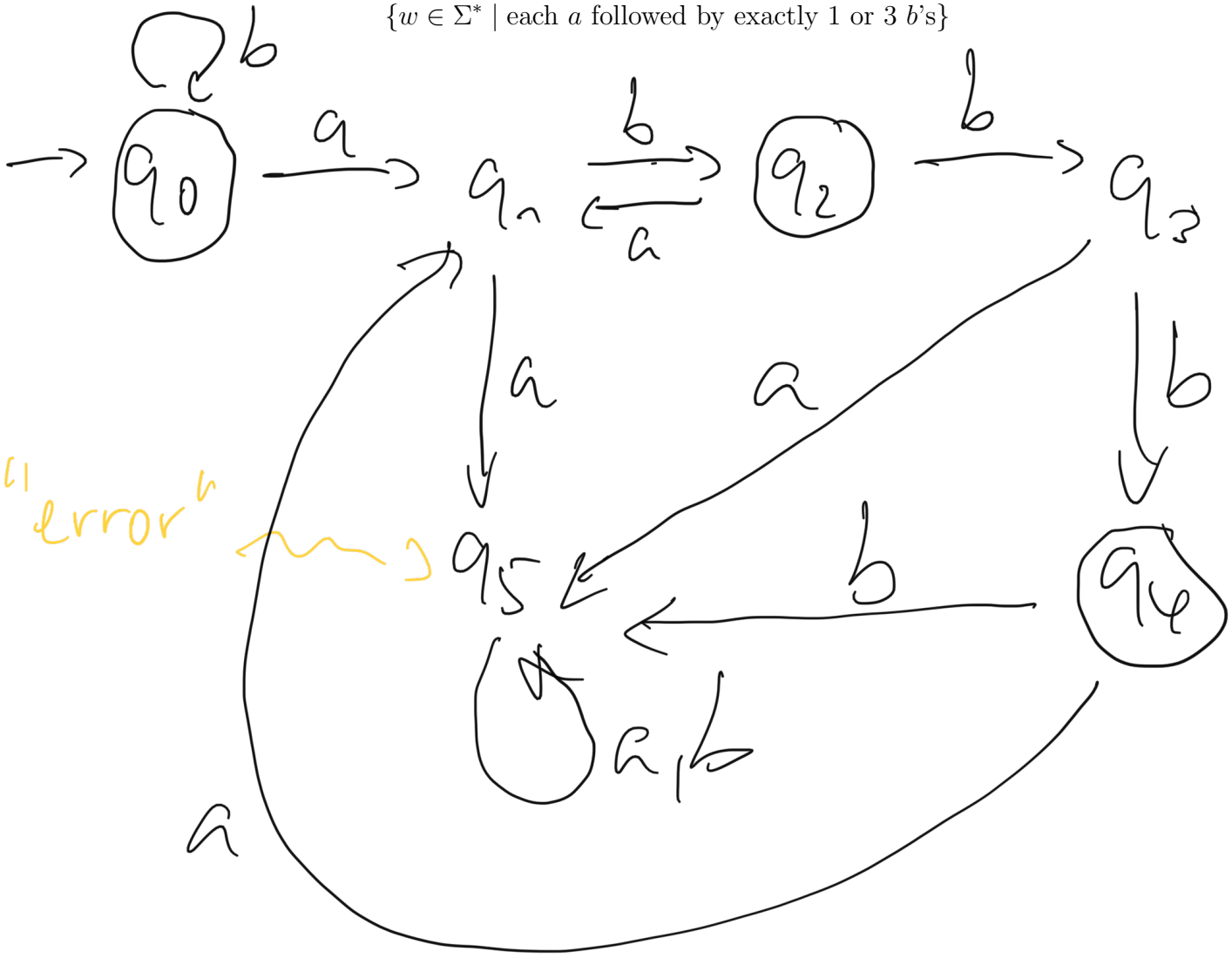
Exercises (Regular Languages)

A2: Construction of Deterministic Finite Automata

Task: Construct a DFA over $\Sigma := \{a, b\}$ that accepts the following language:

$$\{w \in \Sigma^* \mid \text{each } a \text{ followed by exactly 1 or 3 } b\text{'s}\}$$



A2: Construction of Deterministic Finite Automata

Task: Construct a DFA over $\Sigma := \{0, 1\}$ that accepts the following language:

$$\{w \in \Sigma^* \mid \text{decimal value of } w \text{ divisible by } 4\}$$

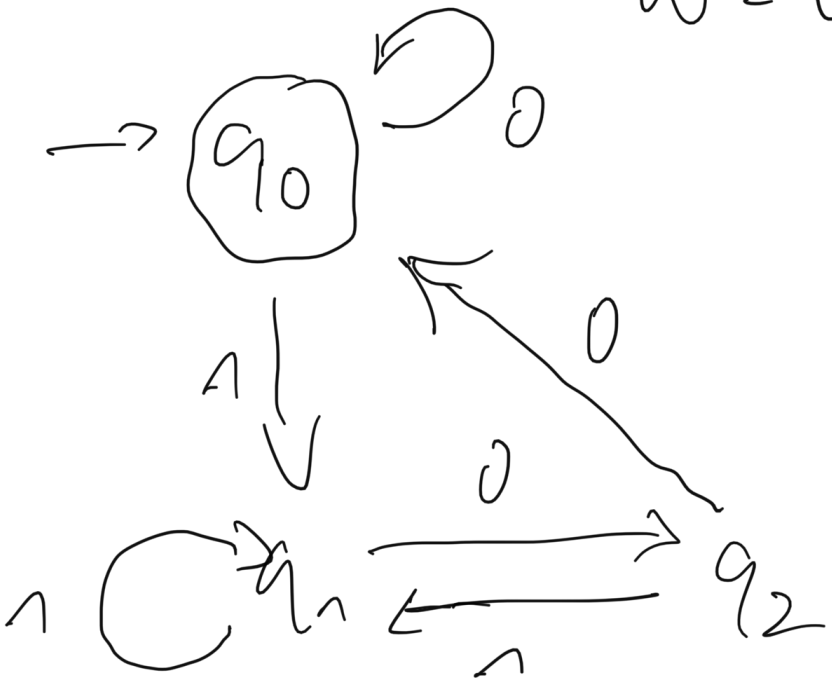
$w = \varepsilon$? ✓ 01 ✗

$w = 1$? ✗ 10 ✓

0 ✓ 11 ✗

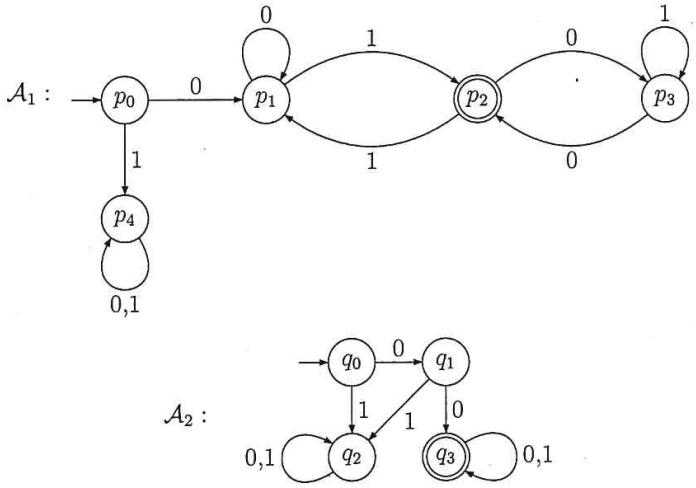
00 ✓

Equivalent: w of the form $w = v00 \mid \varepsilon \mid 0$



A3: Operations on Automata

Task: Let $\mathfrak{A}_1$ and $\mathfrak{A}_2$ be the following automata over $\Sigma = \{0, 1\}$:



Construct two automata that respectively recognise the intersection and the union of the languages accepted by $\mathfrak{A}_1$ and $\mathfrak{A}_2$.

Product construction;

p_0, q_0 p_1, q_1 p_2, q_3

p_4, q_2 p_1, q_2 p_2, q_3

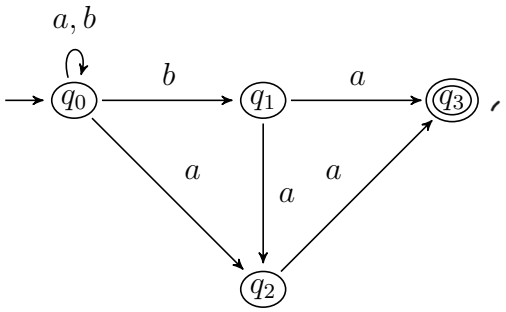
p_3, q_2 p_4, q_2 p_3, q_3

final for ∩

final for ∪

A4: Nondeterministic Finite Automata

Task: Let $\mathfrak{A}$ be the following NFA over $\Sigma := \{a, b\}$.



Determine the reachability sets $R_{\mathfrak{A}}(\varepsilon)$, $R_{\mathfrak{A}}(b)$, $R_{\mathfrak{A}}(ba)$, and $R_{\mathfrak{A}}(baa)$.

$R_{\mathfrak{A}}(\varepsilon) = \{q_0\}$

$R_{\mathfrak{A}}(aw) = \{q'' \mid q \xrightarrow{a} q' \; q' \xrightarrow{w} q''\}$

$R_{\mathfrak{A}}(\varepsilon) = \{q_0\}$

$R_{\mathfrak{A}}(b) = \{q_0, q_1\}$

$R_{\mathfrak{A}}(ba) = \{q_0, q_2, q_3\}$

$R_{\mathfrak{A}}(baa) = \{q_0, q_2, q_3\}$

$\Rightarrow \{b \notin L(\mathfrak{A}),\ ba, baa \in L(\mathfrak{A})\}$

A5: Powerset Construction

Task: Apply the powerset construction to transform the following NFA $\mathfrak{A}$ over $\Sigma := \{a, b, c\}$ into an equivalent DFA.