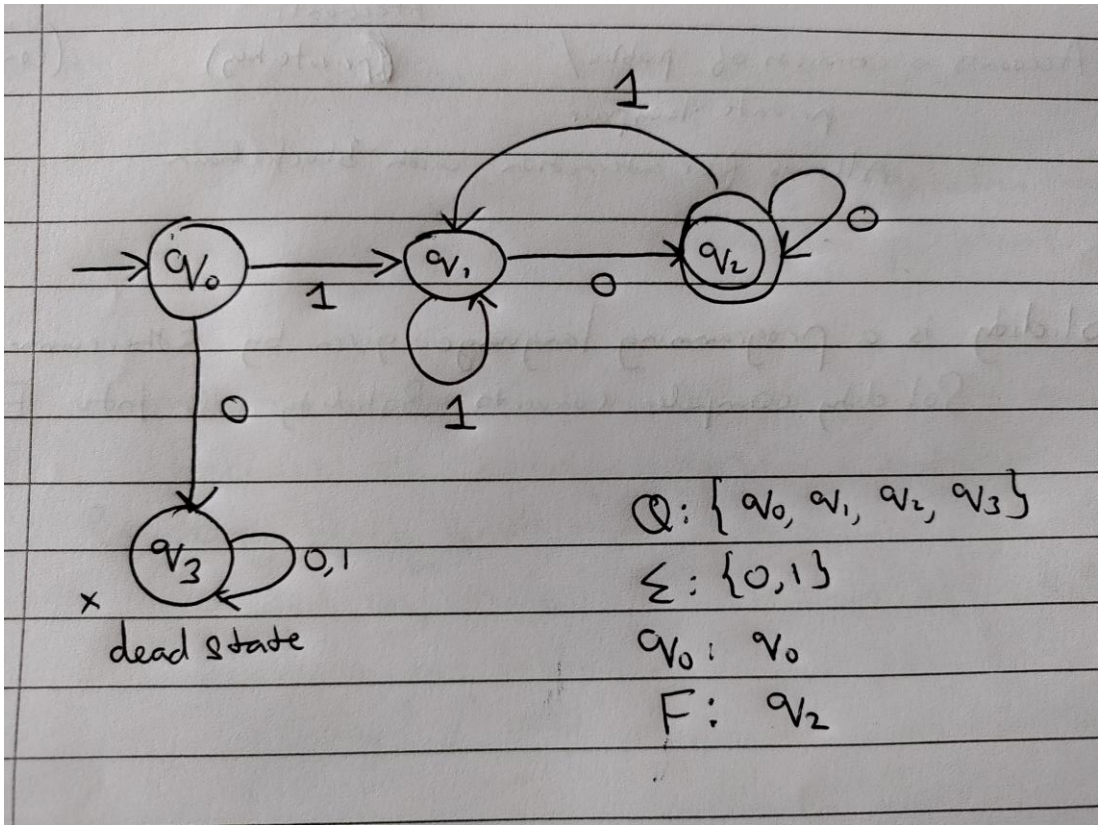
Assignment 2 Solution

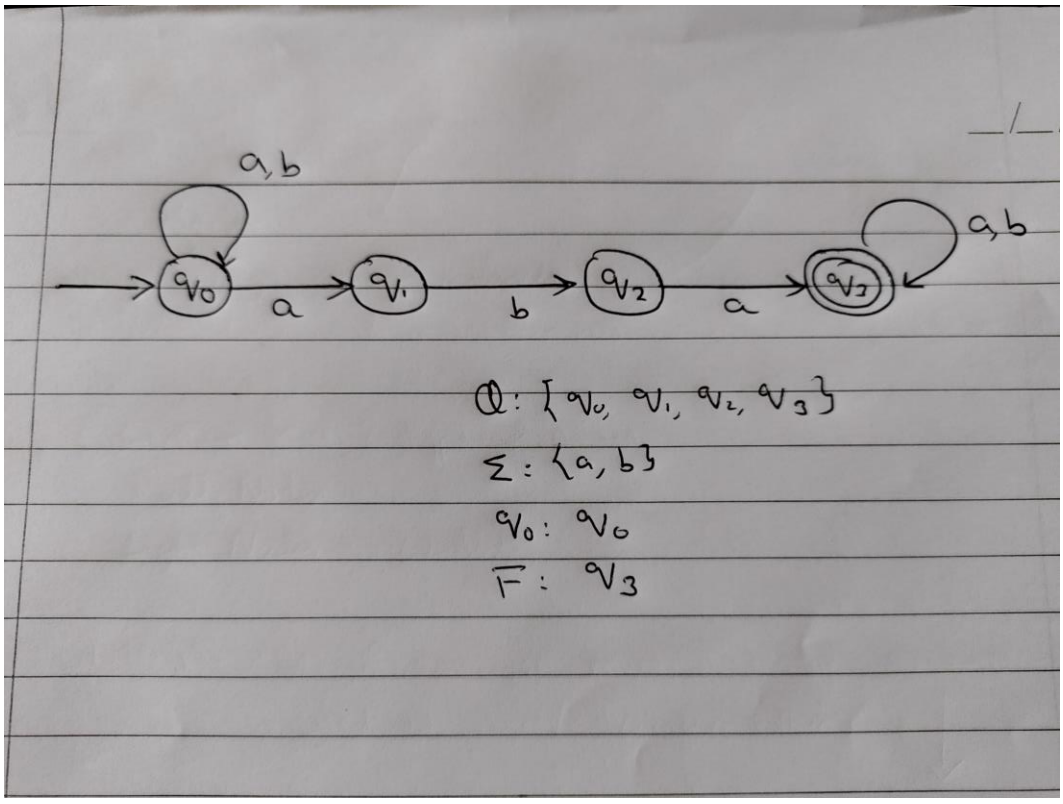
1. DFA Construction
   Consider the language L over the alphabet {0,1} defined as follows: L contains all strings that start with '1' and end with '0'. Construct a DFA (Deterministic Finite Automaton) that recognizes this language.

   Answer:



2. NFA Construction
   Define a language L over the alphabet {a, b} as follows: L contains all strings that contain the substring 'aba'. Design an NFA (Nondeterministic Finite Automaton) that recognizes this language.

   Answer:



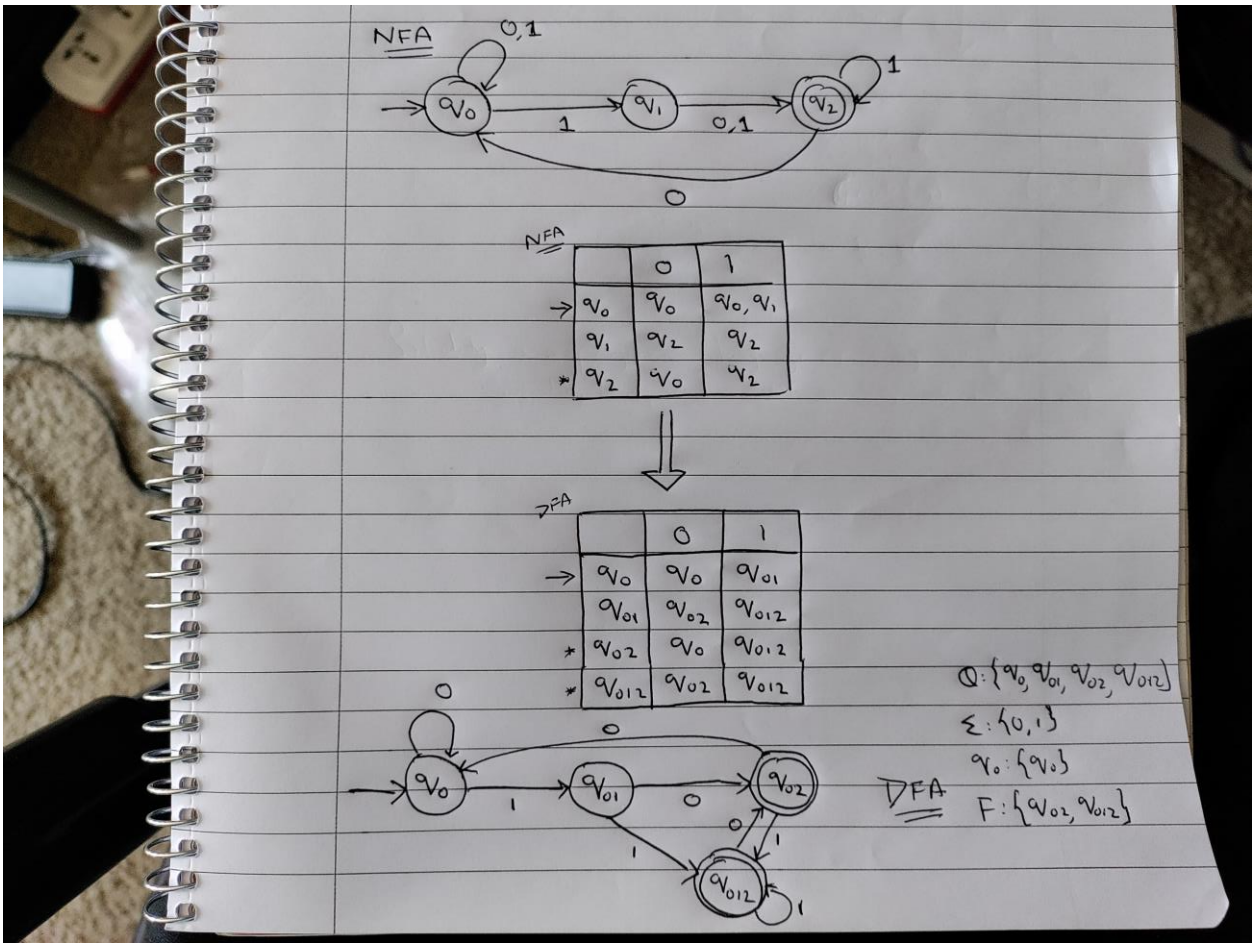
3. NFA to DFA Conversion

   Given the NFA below:

   N = ({q0, q1, q2}, {0, 1}, δ, q0, {q2})
   where δ is given by:
   δ(q0, 0) = {q0}
   δ(q0, 1) = {q0, q1}
   δ(q1, 0) = {q2}
   δ(q1, 1) = {q2}
   δ(q2, 0) = {q0}
   δ(q2, 1) = {q2}

   Convert the given NFA N to an equivalent DFA using the subset construction method.

   Answer:



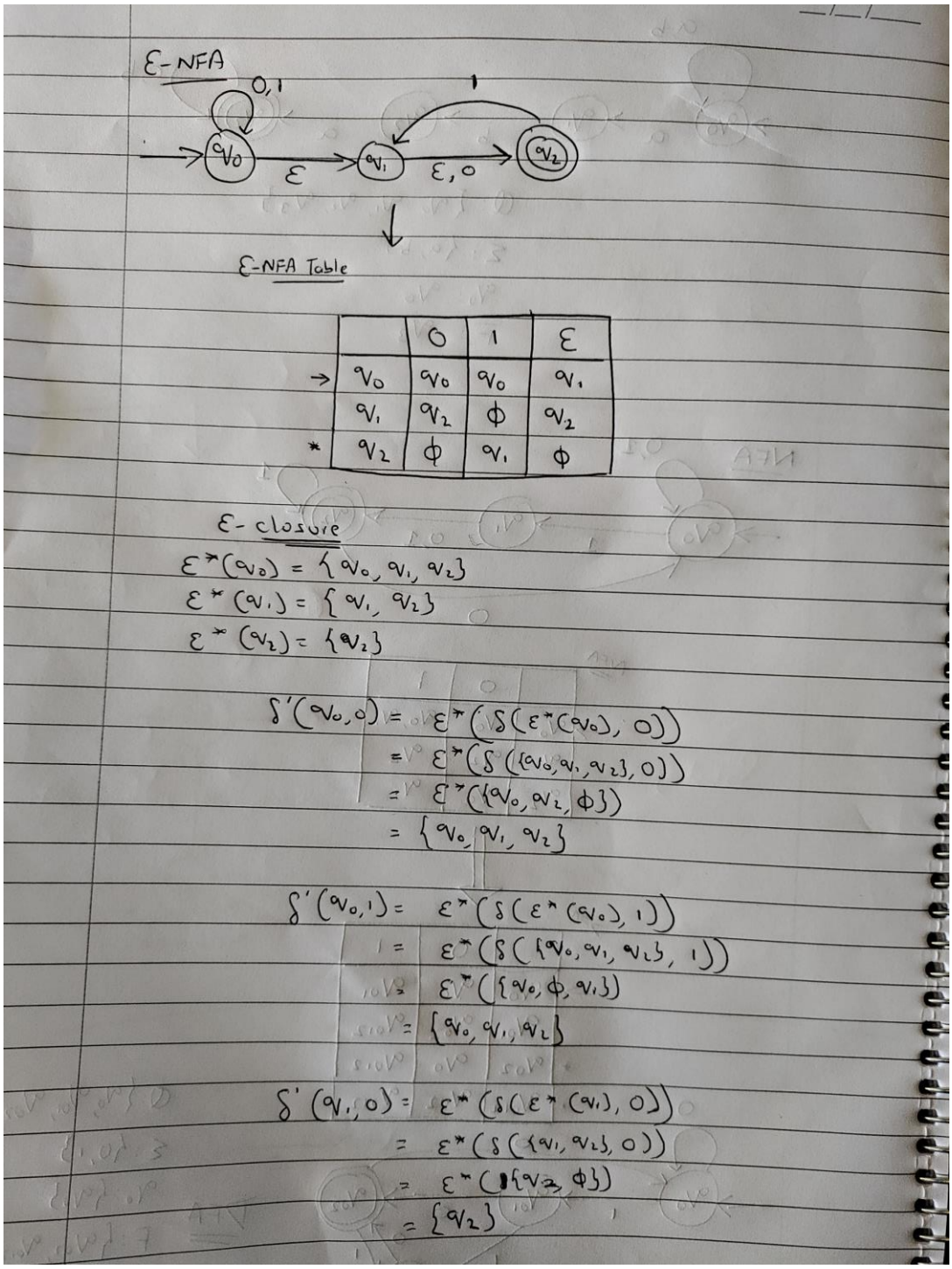
4. ε-NFA to NFA Conversion

   Consider an ε-NFA M over the alphabet {0, 1} with the following transition function:

   M = ({q0, q1, q2}, {0, 1}, δ, q0, {q2})
   where δ is given by:
   δ(q0, ε) = {q1}
   δ(q0, 0) = {q0}
   δ(q0, 1) = {q0}
   δ(q1, 0) = {q2}
   δ(q1, ε) = {q2}
   δ(q2, 1) = {q1}

Convert the given ε-NFA M to an equivalent NFA by eliminating ε-transitions.

Answer:



		0	1	ε
→	q_0	q_0	q_0	q_1
	q_1	q_2	ϕ	q_2
*	q_2	ϕ	q_1	ϕ

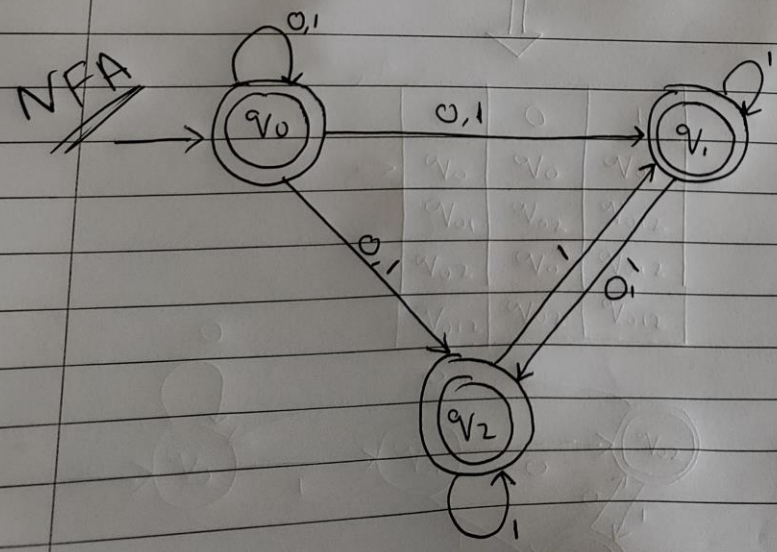
$$\delta'(q_1, 1) = \varepsilon^*(\delta(\varepsilon^*(q_1), 1))$$
$$= \varepsilon^*(\delta(\{q_1, q_2\}, 1))$$
$$= \varepsilon^*(\{\phi, q_1\})$$
$$= \{q_1, q_2\}$$

$$\delta'(q_2, 0) = \varepsilon^*(\delta(\varepsilon^*(q_2), 0))$$
$$= \varepsilon^*(\delta(q_2, 0))$$
$$= \varepsilon^*(\phi) = \phi$$

$$\delta'(q_2, 1) = \varepsilon^*(\delta(\varepsilon^*(q_2), 1))$$
$$= \varepsilon^*(\delta(q_2, 1))$$
$$= \varepsilon^*(q_1)$$
$$= \{q_1, q_2\}$$

⇓

		0	1
→	q_0	$\{q_0, q_1, q_2\}$	$\{q_0, q_1, q_2\}$
*	q_1	$\{q_2\}$	$\{q_1, q_2\}$
*	q_2	ϕ	$\{q_1, q_2\}$



$Q: \{q_0, q_1, q_2\}$
$\Sigma: \{0, 1\}$
$q_0: \{q_0\}$
$F: \{q_0, q_1, q_2\}$