Team Members:

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Problem 1.

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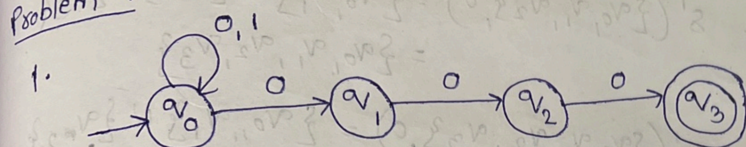
1.



2. Given, NFA $N = (Q, \Sigma, \delta, q_0, F)$ where

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

$\Sigma = \{0, 1\}$

$q_0 = \{q_0\}$

$F = \{q_3\}$

$\delta(q_0, 0) = \{q_0, q_1\}$

$\delta(q_0, 1) = \{q_0\}$

$\delta(q_1, 0) = \{q_2\}$

$\delta(q_2, 0) = \{q_3\}$

Now, $det(N) = (Q', \Sigma, \delta', q_0', F')$ where

$Q' = P(Q) = \{\phi, \{q_0\}, \{q_0, q_1\}, \{q_0, q_1, q_2\}, \ldots \}$

$q_0' = \hat{\Delta}(q_0, \epsilon) = \{q_0\}$

$\Sigma = \{0, 1\}$

$F' = \{A \subseteq Q \mid A \cap F \neq \emptyset\}$
$= \{\{q_3\}, \{q_0, q_3\}, \{q_0, q_1, q_3\}, \ldots\}$

$\delta'(\{q_1, q_2 \ldots q_K\}, a) = \hat{\Delta}(q_1, a) \cup \hat{\Delta}(q_2, a) \ldots \hat{\Delta}(q_K, a)$

$\delta'(\{q_0\}, 0) = \{q_0, q_1\}$

$\delta'(\{q_0\}, 1) = \{q_0\}$

$\delta'(\{q_0, q_1\}, 0) = \{q_0, q_1\} \cup \{q_2\}$
$= \{q_0, q_1, q_2\}$

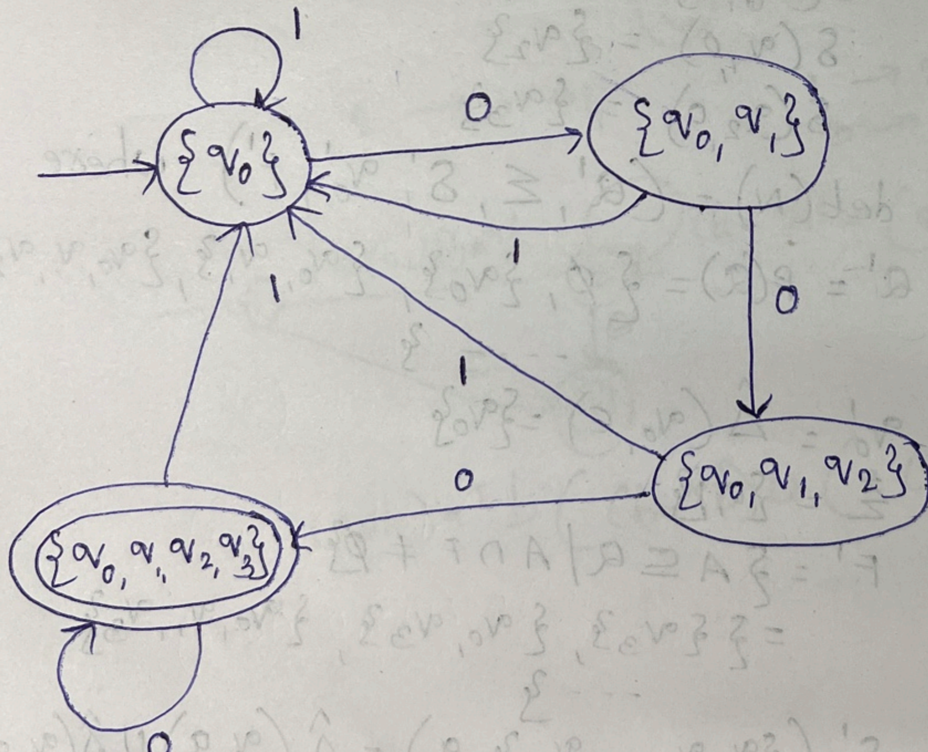
$\delta'(\{q_0, q_1\}, 1) = \{q_0\} \cup \{\ \} = \{q_0\}$

$\delta'(\{q_0, q_1, q_2\}, 0) = \{q_0, q_1\} \cup \{q_2\} \cup \{q_3\}$
$= \{q_0, q_1, q_2, q_3\}$

$\delta'(\{q_0, q_1, q_2, q_3\}, 0) = \{q_0, q_1\} \cup \{q_2\} \cup \{q_3\} \cup \{\ \}$
$= \{q_0, q_1, q_2, q_3\}$

$\delta'(\{q_0, q_1, q_2, q_3\}, 1) = \{q_0\} \cup \{\ \} \cup \{\ \} \cup \{\ \}$
$= \{q_0\}$

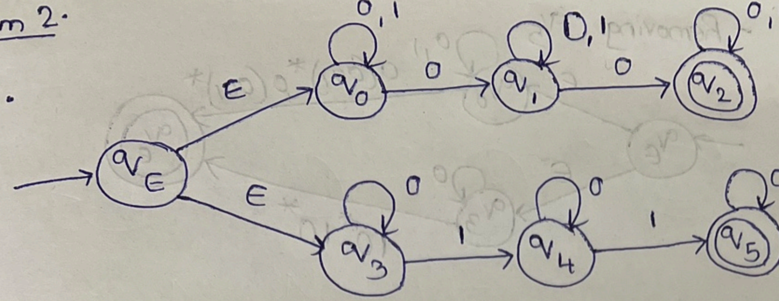
$\delta'(\{q_0, q_1, q_2\}, 1) = \{q_0\} \cup \{\ \} \cup \{\ \}$
$= \{q_0\}$



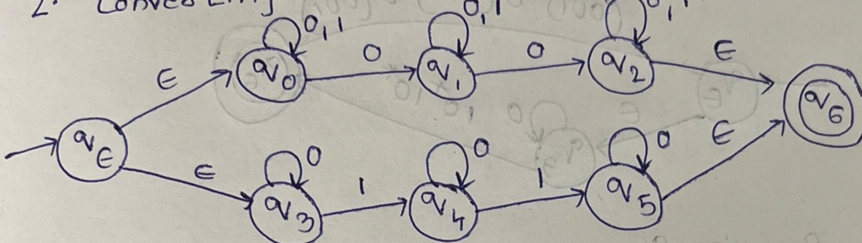
Problem 2.

Problem 2.

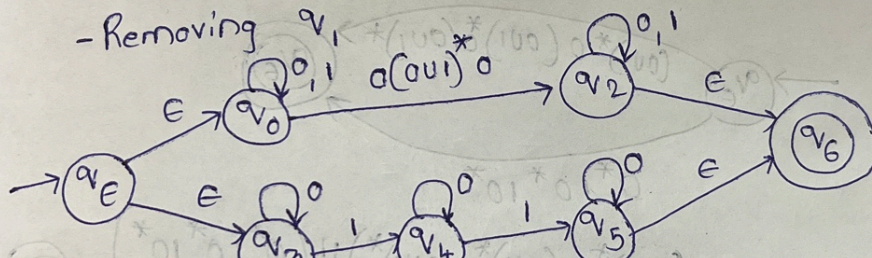
1.



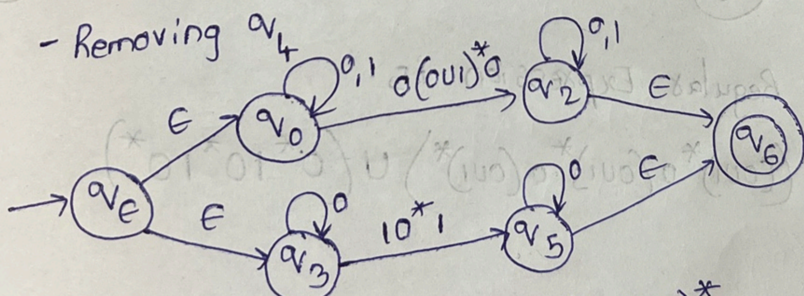
2. Converting to GNFA



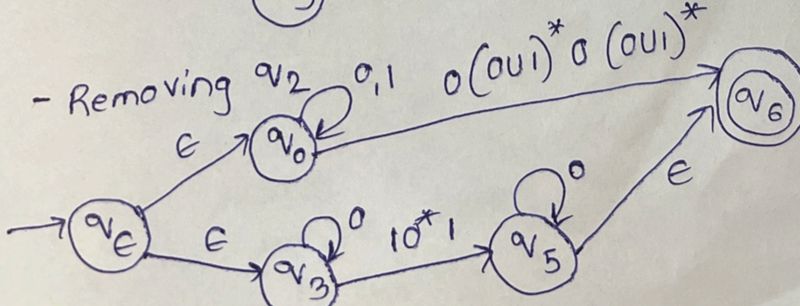
- Removing q_1



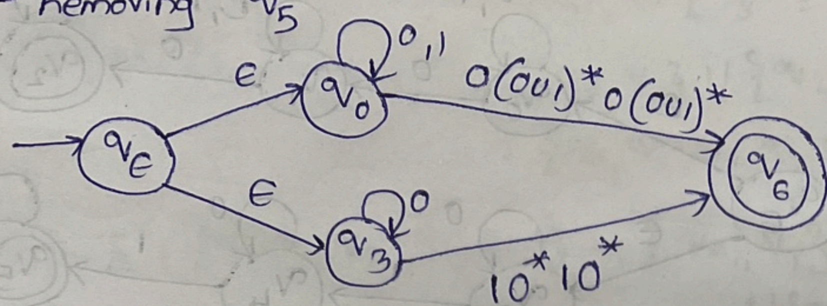
- Removing q_4



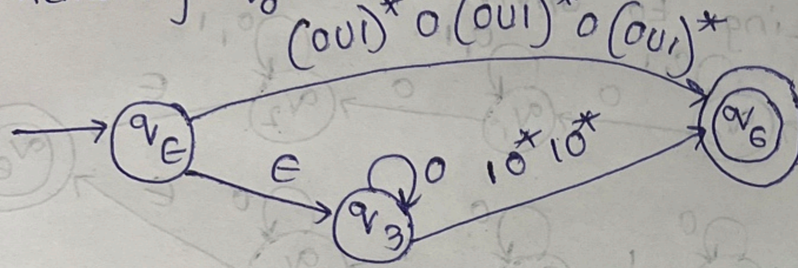
- Removing q_2



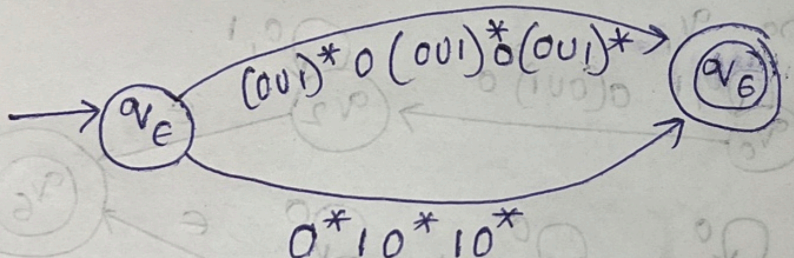
- Removing q_5

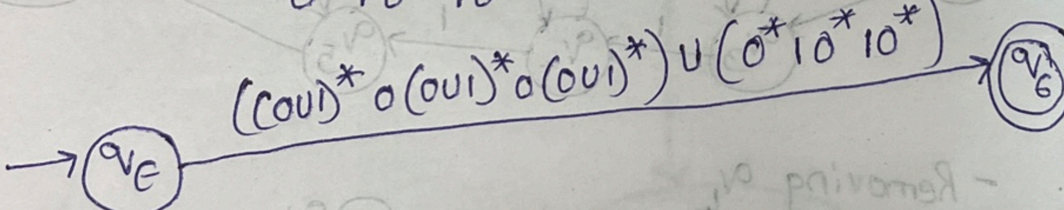


- Removing q_0



- Removing q_3





$\therefore$ Regular Expression is

$$\boxed{((0\cup1)^*0(0\cup1)^*0(0\cup1)^*)\cup(0^*10^*10^*)}$$

Problem 3.

Problem 3.

1.

(a) This is a set of all binary strings

(b) This is a set of all binary strings that starts with 0, ends with 1 & have alternating 0s and 1s.

(c) This is a set of all binary strings that doesn't have '010' as a substring

2.

(a) $1^*(0 \cup \epsilon)1^*(0 \cup \epsilon)1^*(0 \cup \epsilon)1^*$

(b) $(10 \cup 01)^*(0 \cup 1 \cup \epsilon)$

(c) $(1 \cup 01 \cup 001)^* 000 (1 \cup 10 \cup 100)^*$

Problem 4.

Problem 4.

- Let C be a regular language with P as pumping lemma constant.
- let $w = 1^P 0 1^P$. We can say that $w \in C$
- Let $x = 1^i$, $y = 1^j$ & $z = 1^K 0 1^P$ where $i + j + K = P$ & $j > 0$ and $w = xyz$
- Let $w^0 = xy^0 z$

$$= 1^i (1^j)^0 1^K 0 1^P$$

$$= 1^{i+K} 0 1^P$$

- Since $i + K + j = P$

$\Rightarrow i + K < P$

That means w^0 has more 1s after 0 which doesn't belong to C.

which doesn't satisfy pumping lemma, which

∴ C doesn't satisfy pumping lemma, which means C is not regular.