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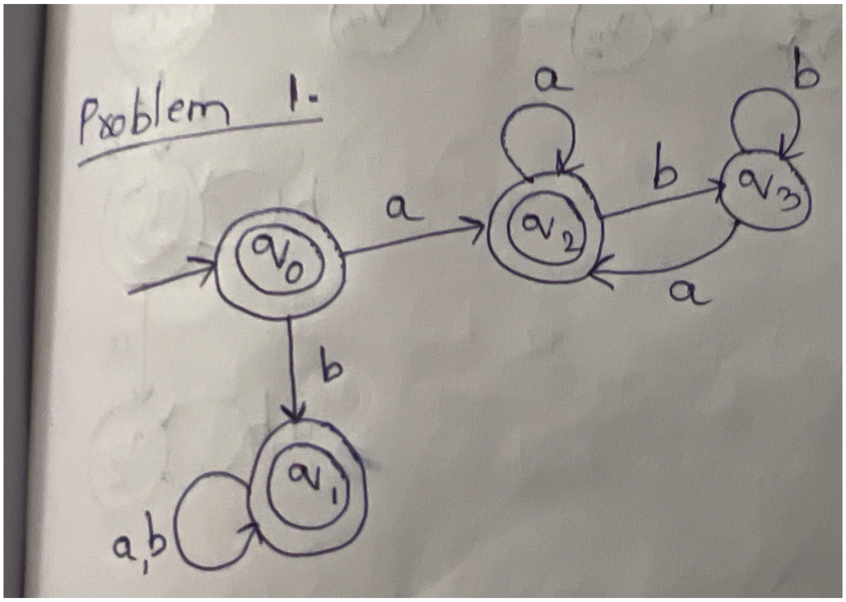
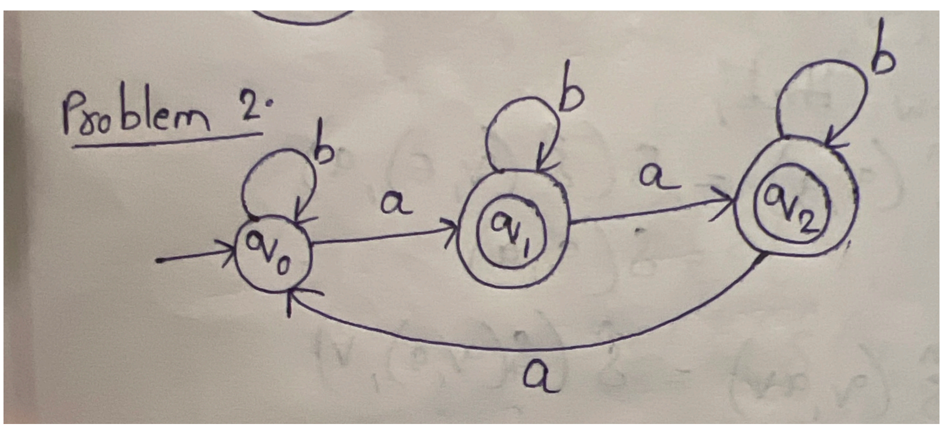
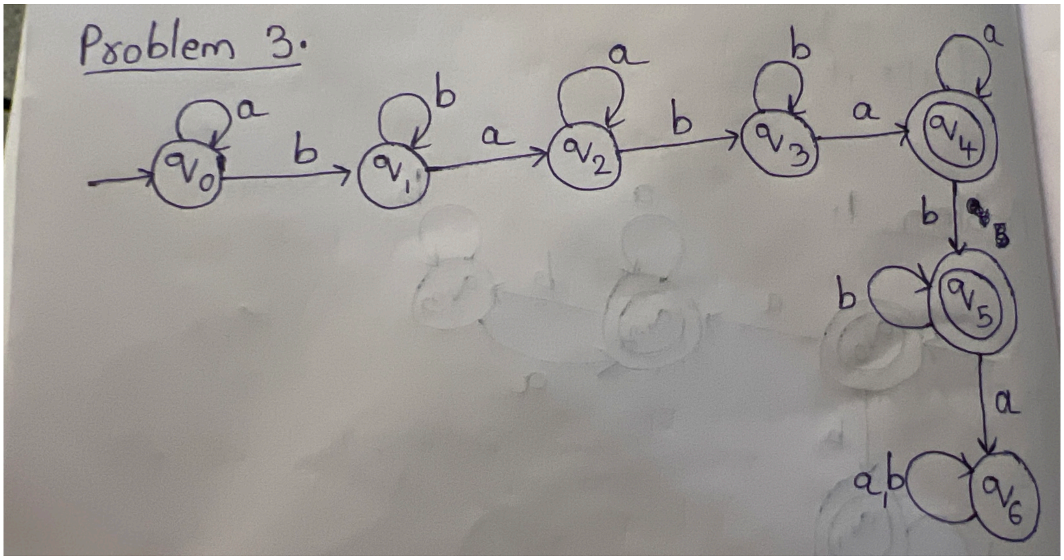
Problem 1.



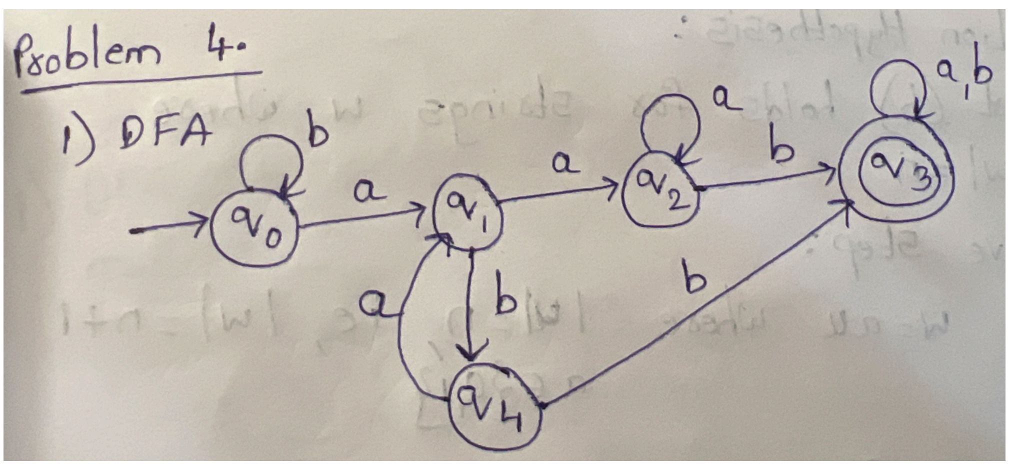
Problem 2.

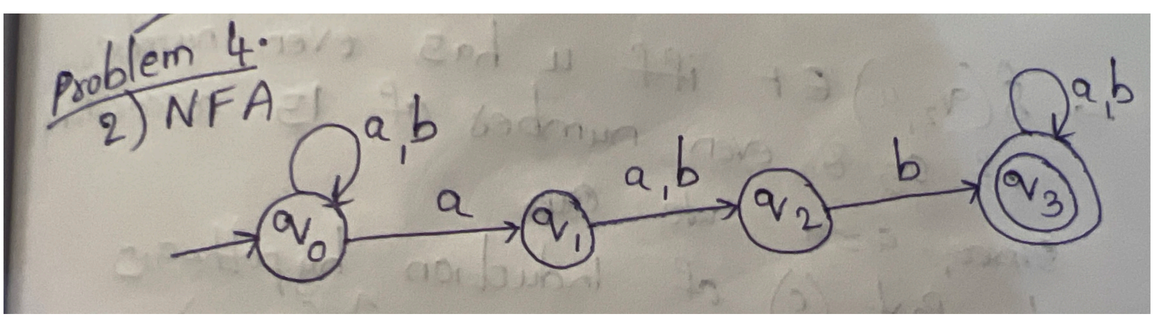


Problem 3.



Problem 4.





Problem 5.

Problem 5.

Part (b) states that

$\hat{\delta}(q_1, w) \in F$ iff w has odd number of 0s & even number of 1s

Base case: $|w| = 0$

So, w has even number of 0s & even number of 1s

since $\hat{\delta}(q_1, \epsilon) = q_1$

$\hat{\delta}(q_1, w) = q_1$

Since $q_1 \notin F$ & w has even number of 1s, the number of 0s & even, the statement holds for base case.

Induction Hypothesis:

Part (b) holds for strings w where $|w| = n$

Inductive step:

Let $w = au$ where $|u| = n$, i.e. $|w| = n+1$, $a \in \{0,1\}$

Case $a = 0$:

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

→ $\hat{\delta}(q_2, u) \in F$ iff u has even number of 1s & even number of 0s according to Part (c) of Induction hypothesis

→ Since, $a = 0$ we can say $\hat{\delta}(q_1, w) \in F$ iff w has odd number of 0s & even ~~odd~~ number of 1s

Case $a = 1$:

$$\hat{\delta}(q_1, 1u) = \hat{\delta}(\delta(q_1, 1), u)$$
$$= \hat{\delta}(q_0, u)$$

→ $\hat{\delta}(q_0, u) \in F$ iff u has odd number of 0s & odd number of 1s according to Part (a) of Induction hypothesis

→ since $a = 1$ we can say $\hat{\delta}(q_1, w) \in F$ iff w has odd number of 0s & even number of 1s

$\therefore$ $\hat{\delta}(q_1, w) \in F$ iff w has odd number of 0s & even number of 1s.