Home Assignment

[redacted]
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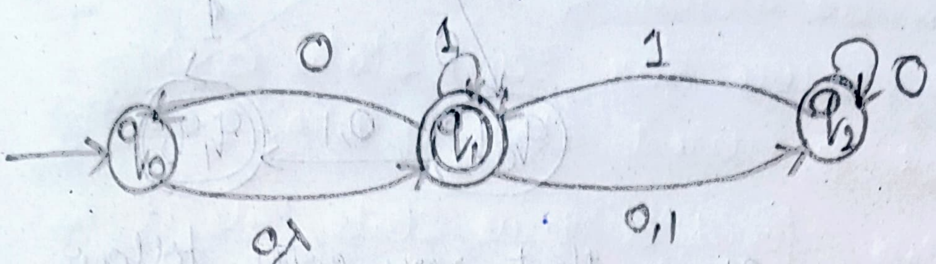
① Convert the following NFA to DFA



Sol) $\delta(q_0, 0) \longrightarrow \{q_1, q_2\}$

$\delta(q_0, 1) \longrightarrow \{q_1, q_2\}$

$\delta(q_1, 0) \longrightarrow \{q_0, q_2\}$

$\delta(q_1, 1) \longrightarrow \{q_1, q_2\}$

$\delta(q_2, 0) \longrightarrow \{q_2\}$

$\delta(q_2, 1) \longrightarrow \{q_1\}$

$\delta(q_0, 1) \cup \delta(q_2, 0) = \{q_0, q_2\}$

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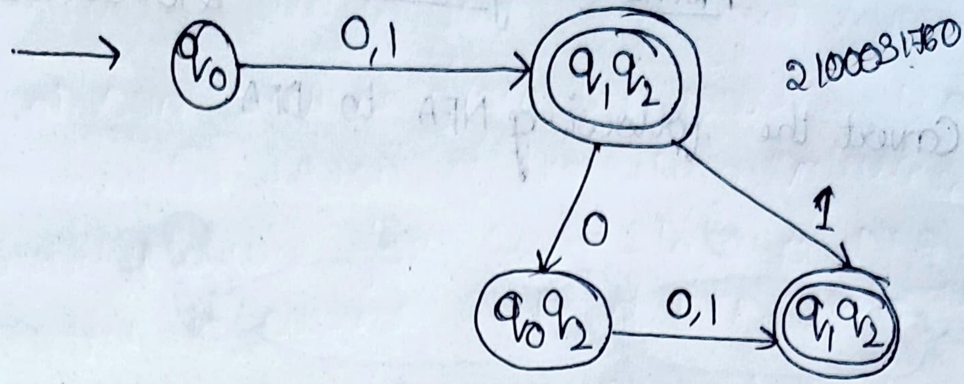

(2) Show the Steps that you will follow to find that the following language is not regular $L = \{a^n b^p a^k : k \geq (n+p)\}$

Sol) The pumping lemma States that for any regular language L, there exists a pumping length p. Such that any String S in L with $|S| \geq p$ can be written as $S = xyz$ where

1. $|xy| \leq p$
2. $|y| > 0$
3. for all $i \geq 0$ $xy^iz \in L$

Step 1:

Assume that L is regular, then there exists a pumping length p for L. Let, $S = a^p b^p a^{(p+n)}$ be a String in L where $|S| = 3p+n \geq p$.

According to pumping lemma, S can be written as $S = xyz$ where $|xy| \leq p$ and $|y| \geq 0$ & $xy^iz \in L$ $\forall i \geq 0$

Let,

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$x = a^u$

$y = a^v$

$z = a^p b^p a^{(p+n-u+v)}$, where $0 < u+v \leq p$.

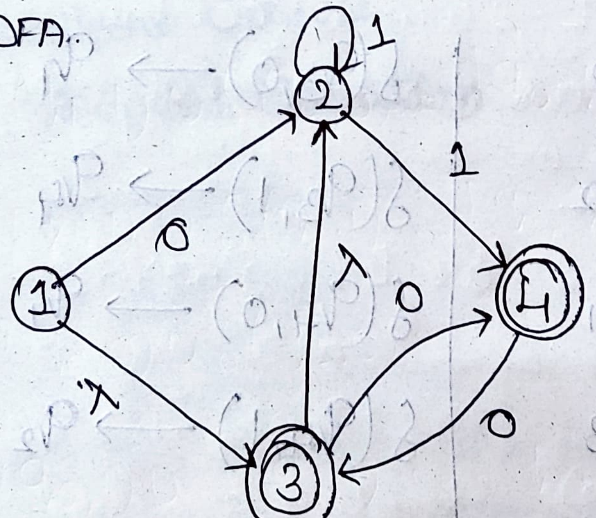
1. $|xy| = |a^u a^v| = u+v \leq p$

2. $|y| = |a^v| = v > 0$

However, this contradicts the condition that $k \geq n+p$, because $2v+u+p+n$, So we can choose $i=2$ to get a String not in L.

$\therefore$ Assumpⁿ that L is regular is false.

③ Write the Steps to convert an NFA with ϵ transitions to a DFA. Use the Steps mentioned to convert the following NFA to DFA.



Sol) Steps to convert ϵNFA to DFA

1. We will take the ϵ-closure for the Starting State of NFA as Starting State of DFA.

2. Find the states for each input symbol that can traverse from the present. That means the union of transition values & their closure for each state of NFA present in current state of DFA. 2100031760

3. If we found a new state, take it as current state & repeat step 2

4. Mark the states of DFA as a final state which contains the final states of NFA.

④ Construct a DFA for language $L = \{w \in \{0,1\}^* \}$: w ends with '01' & has odd no. of 1's }

Sol)

$\delta(q_0, 0) \rightarrow q_0$

$\delta(q_0, 1) \rightarrow q_2$

$\delta(q_1, 0) \rightarrow q_1$

$\delta(q_1, 1) \rightarrow q_3$

$\delta(q_2, 0) \rightarrow q_1$

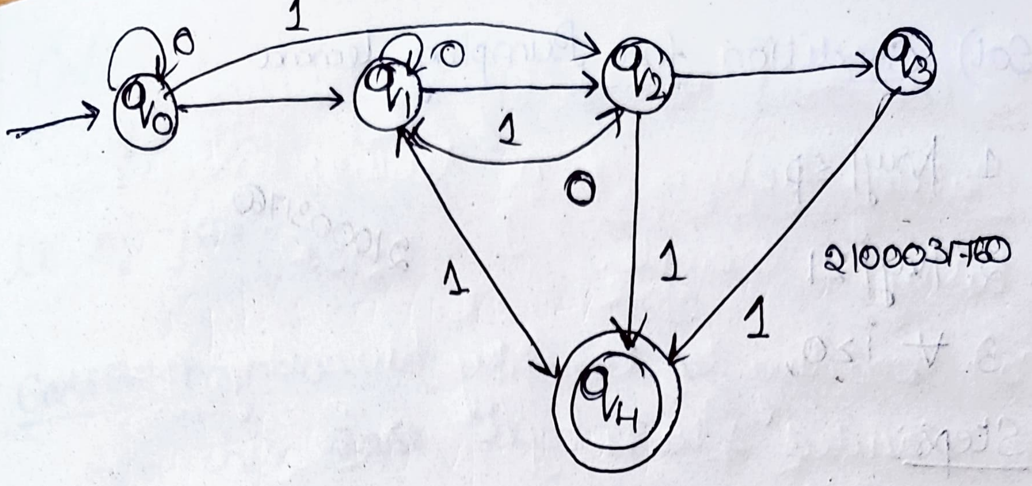
$\delta(q_2, 1) \rightarrow q_4$

$\delta(q_3, 0) \rightarrow q_1$

$\delta(q_3, 1) \rightarrow q_4$

$\delta(q_4, 0) \rightarrow q_1$

$\delta(q_4, 1) \rightarrow q_2$



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⑤ Explain properties a CFL?

Ans)
The context free languages are closed under some specific operation, closed means after doing that operation on a context free language

Closure Properties

1. Union Operation
2. Concatenation
3. Kleene Closure
4. Reversal Operation
5. Homomorphism
6. Substitution.

⑥ State pumping lemma for a language to be context-free. Describe the procedure of determining if a language is context free.

CFL : L = {ww: w{a,b}*}.

Sol) Condition for Pumping lemma

1. $|vxy| \leq p$

2. $|vy| > 1$

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3. $\forall\ i \geq 0$,

Steps:

1. Assume the language is context-free language

2. Find the pumping length p for L

3. Choose a String ω in L such that $|\omega| \geq P$

4. write ω as $\omega = uvxyz$, where $|vxy| \leq P$, $|vy| > 1$ & u, v, x, y, z are string

Using this procedure we can show that the language $L = \{\omega c\omega : \omega$ contains an equal no. of a's & b's$\}$ is not context Free Language.

⑦ Construct PDA for $L = \{0^n 1^m 2^m 3^n : m, n \geq 0\}$

Sol) Case 1: $(m=0)$

In this case input String will be of form $\{0^n 3^n\}$.

Case 2: $n=0$.

In this case the input string will be of form $\{1^m 2^m\}$.

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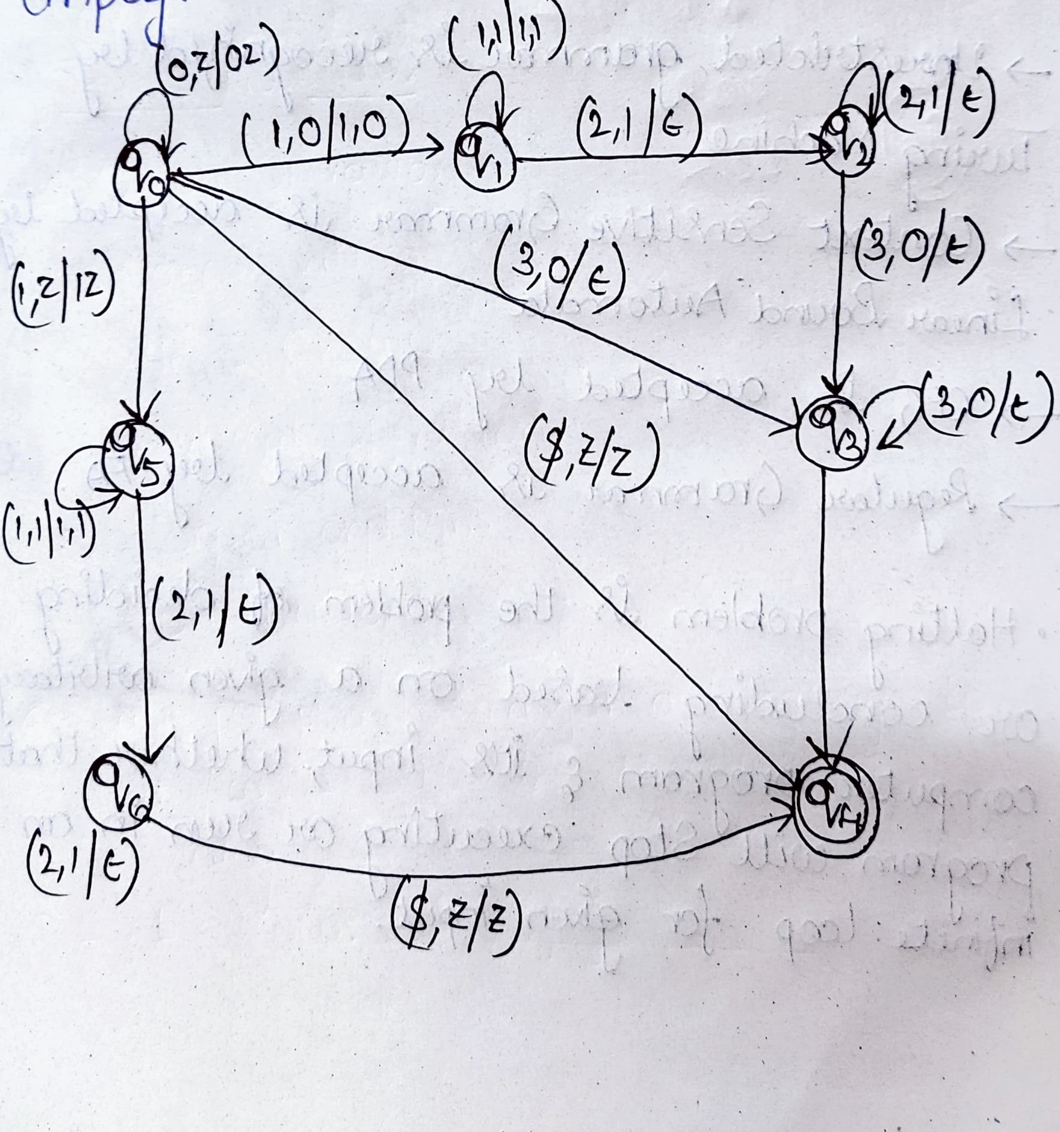
Case 3: $m,n>0$

In this case, the input string will be of form $\{0^n 1^m 2^m 3^n\}$.

Case 4: $m=n=0$.

In this case input string will be empty.



⑧ Write about Chomsky Hierarchy & Halting Problem of a turing machine by taking a example. 2100031760

Sol) According to chomsky hierarchy, grammar is divided into 4 types.

1. Type 0 as Unrestricted Grammar
2. Type 1 as Context Sensitive Grammar
3. Type 2 as Context Free Grammar
4. Type 3 as Regular Grammar

→ Unrestricted grammar is recognized by Turing Machine

→ Context Sensitive Grammar is accepted by Linear Bound Automata

→ CFG is accepted by PDA

→ Regular Grammar is accepted by FA.

• Halting problem is the problem of deciding or concluding based on a given arbitrary computer program & its input, whether that program will Stop executing or run in an infinite loop for given input.

Ex:

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Input - Program P & a String S

Output - If P Stops on S return 1

Otherwise, If P enters into a endless loop returns 0

Let us consider the Halting Problem called H having the Soln.

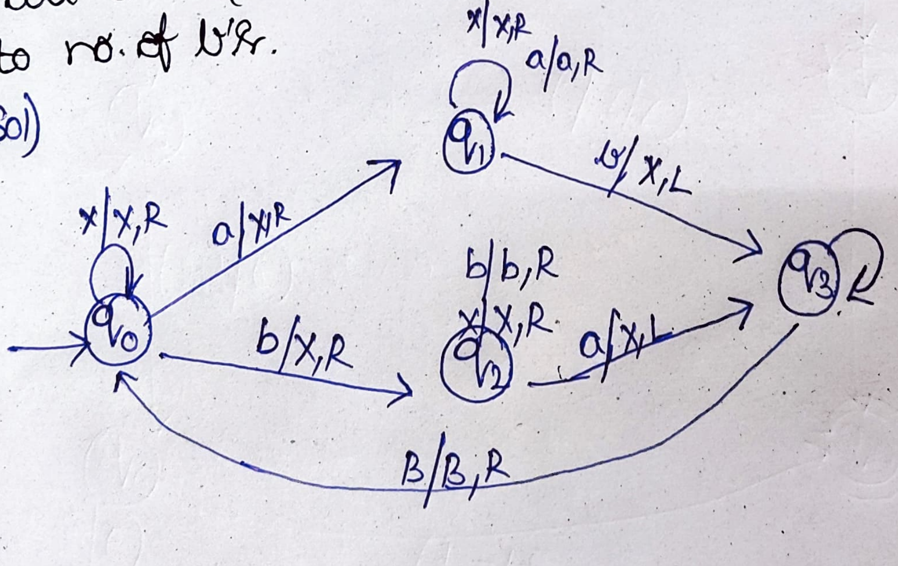
Now H takes the following two inputs

- Program P
- Input S

If P Stops on S, then H results in "Halt", Otherwise H gives the result "loop"

(9) Construct the Turing machine that accepts all a's & b's such that no. of a's is equal to no. of b's.

Sol)



⑩ Construct a Turing Machine for Language

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$L = \{ww : w \in \{0,1\}^*\}$

Sol)