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TOC - Assignment - 4.

① $L = \{a^n b^n c^n \mid n \geq 0\}$.

Ans Suppose L is regular.
Then, L will be as a finite state automata.

By pumping Lemma, there is a n such that $z \in L$ and $|z| \geq n$.

$z = uvw$ such that $uv^i w \in L$.

Take $z = a^k b^k c^k$, $z \in L$.

To process a^k, the DFA must go through $k+1$ states and there is a state q that occurs more than once.

$$\delta^*(q, a^i) = q, \quad i > 0.$$

Thus, it can be pumped zero or more times. If we pump it 0 times, it is $a^j b^k c^k \in L$, $j < k$.
If it is more than once, $a^j b^k c^k \notin L$, $j > k$ which is a contradiction.

Hence, $a^n b^n c^n$ is not Regular.

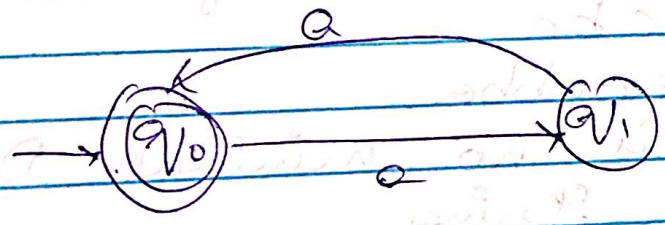
② $L = \{ x x^R \mid x^R$ is the reversal of $x \}$.
$\Sigma = \{a\}$.

Ans Suppose L is regular.

Since, the set of alphabets is only a i.e, $\Sigma = \{a\}$.

$x x^R = a^{2n}$, $n \geq 1$

The DFA looks like:



Which is a minimal DFA for xx^R.

Since, this has a minimal DFA, it is regular.

If L is a regular Language, then there is a unique DFA 'M' having smallest number of states.

(3). $L = \{xcx^R \mid \text{where } x \in \{a,b\}^*\}$

Ans. Suppose L is a regular language.
Then there is a minimal DFA M with K states such that $L = L(M)$

Take $z \in L$ and $|z| \geq K$

$xcx^R \in z$

It contains strings like
abcba,
abbacabba.

There is no minimal DFA for the above strings.

If xcx^R is considered as uvw
There is no v^i which satisfies $uv^iw \in z$.

Hence, xcx^R is not Regular.

(4). $L = \{a^n b c^m b^p \mid n+m=p\}$

Ans Here, if $n = 0 \Rightarrow m = p$.

The Language can be rewritten as

$L = \{c^m b^m\}$

For this case, there is no minimal DFA.

If $c^m b^m \in \{$, such that

$uvw \in \{$. such that $uv^i w \in \{$.

This also has a pumping pattern for strings like cccbbb.

where $u = c$, $v = cc$, $w = bbb$.

This has a pumping pattern.

Hence, $L = \{a^n c^m b^p \mid n+m=p\}$ is not regular.

⑤. $L = \{0^n 1^m \mid n \geq m\}$.

Ans If $n = m \Rightarrow L = \{0^n 1^n\}$.

For this Case, there is a pumping pattern and there is no minimum DFA.

It has strings like 00001111.

If There is a n such that $z \in L$ and $|z| > n$.

$z = uvw$ such that $uv^i w$

$u = 00$ $v = 00$ $w = 1111$.

V has a pumping pattern.

Hence, $L = \{0^n 1^m \mid n \geq m\}$ is not regular.