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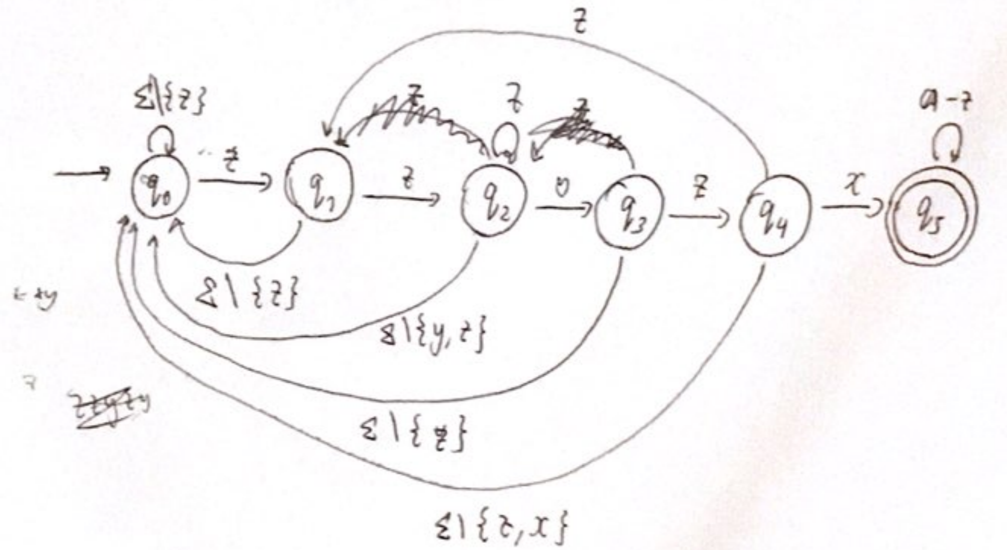
4) (i) A problem is NP-complete if ~~A~~:

1) $A \leq_p$, $\forall A \in NP$ (NP hard)

2) $B \in NP$

(ii) Circuit SAT, 3SAT, 4SAT

1) $zzyzx$



3 (ii) AFSOC that $NOYOLO_{TM}$ is decidable. This mean there is a Turing machine that decides it. Let called machine N.

$N(\langle M, x\rangle)$ where x is an input string (yolo)

$$N(\langle M, x\rangle) = \begin{cases} \text{reject if } M \text{ accept } \cancel{\text{string yolo}}\ x \\ \text{accept if } M \text{ rejects } \cancel{\text{string yolo}}\ x \\ \text{reject if } M \text{ loops on } x \end{cases}$$

Using N we can create another Machine ~~R~~ ~~R⟨M⟩~~ $R\langle M\rangle$

We then run $N\langle M, \langle M\rangle\rangle$. We have:

$$R(\langle M\rangle) = \begin{cases} \text{reject if } M \text{ accept } \langle M\rangle \\ \text{accept if } M \text{ reject } \langle M\rangle \\ \text{reject if } M \text{ loop on } \langle M\rangle \end{cases}$$

Applying $M = R$ we have

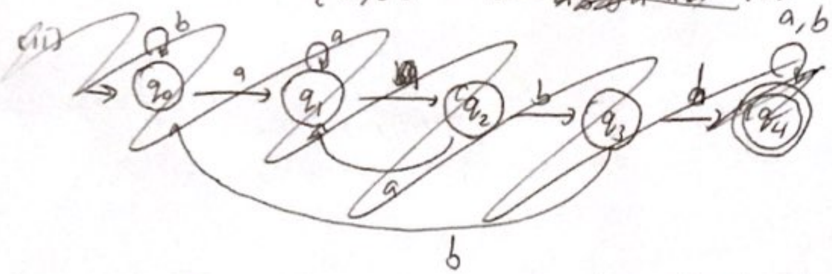
$$R(\langle R\rangle) = \begin{cases} \text{reject if } R \text{ accept } \langle R\rangle \\ \text{accept if } R \text{ reject } \langle R\rangle \\ \text{reject if } R \text{ loop on } \langle R\rangle \end{cases}$$

this contradict so N and R cannot exist. Hence $NOYOLO_{TM}$ is not Turing decidible.

2) (i) 1) ~~B~~ = { $w \in \{a,b\}^* : w = a^i b^i \ \exists\ i \geq 0$ }

A = { $w \in \{a,b\}^*$: ~~w =~~ is string that contain aabb

(ii)



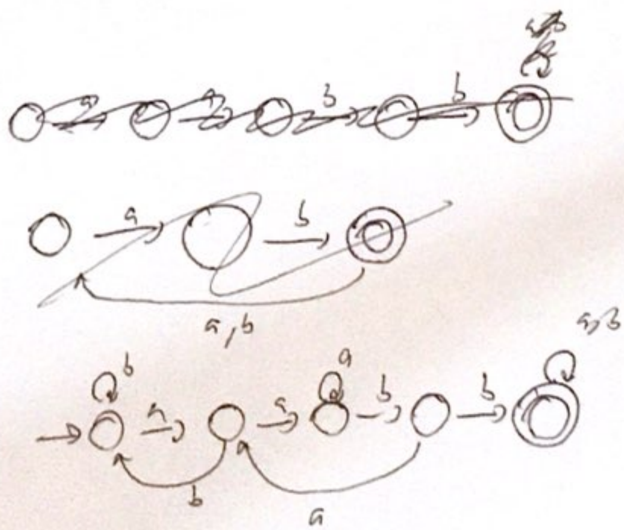
A language if ~~decidabl~~ regular if there's a DFA that recognize it.

(iii) AFSOC that B is regular. then there is a pumping lenegth $P \geq 1$ given by pumping lemma. Consider String $w = a^P b^P$. From this we know that :

1) w can be split into $w = xyz$
2) $|xy| \leq p$, $|y| > 0$
3) $y = a^j$, $1 \leq j$

According to the pumping lemma $xyyz = a^{p+j} b^p$ should be in L. However $xyyz \notin L$. Therefore B is not a reguler language.

(ii)



~~4 (iii) Show that $(k+1)$ coloring is $\in NP$~~

~~Certificate : Color assignment~~

3(i) A language is Turing Decidable if there is a turing machine that decides it. Let construct a turing machine from the DFA. Let called it M.

M = On input x

Check if x = yolo

if yes, reject

~~if~~ else, accept

4 (iii) $(k+1)$ coloring where $k \geq 1$ is the same as k colorings where $k \geq 2$.

5 (i) Certificate: a set of $n-1$ edges of G

Verifier: ~~Check if the sum of the weight is equal to k and that the~~

Check if the edges can form a connected graph in $O(n)$ time

then check if the sum of the weight is equal to k.

(ii)