1. Regular Language:

* If A is a regular Language then A has a pumping length P. then any string S $|S| \geq P$ may be divided by 3 part (x,y,z) and so that true the following condition

$xy^iz \in A$ for A in $i \geq 0$

$|y| > 0$

$|xy| \leq P$.

---

2. Deterministric PDA

* PDA Define $(Q, \Sigma, \Gamma, \delta, q_0, z_0, F)$ is Deterministric

For Q in Q, z in z_0 and (q_0, Σ, z_0) not empty and (q_0, a, z_0) empty and all a in Σ

For Q in Q, z in z_0 and $\Sigma \cup \{e\}$ does not (q_0, a, z_0) has a more than one element.

---

3. Technique.

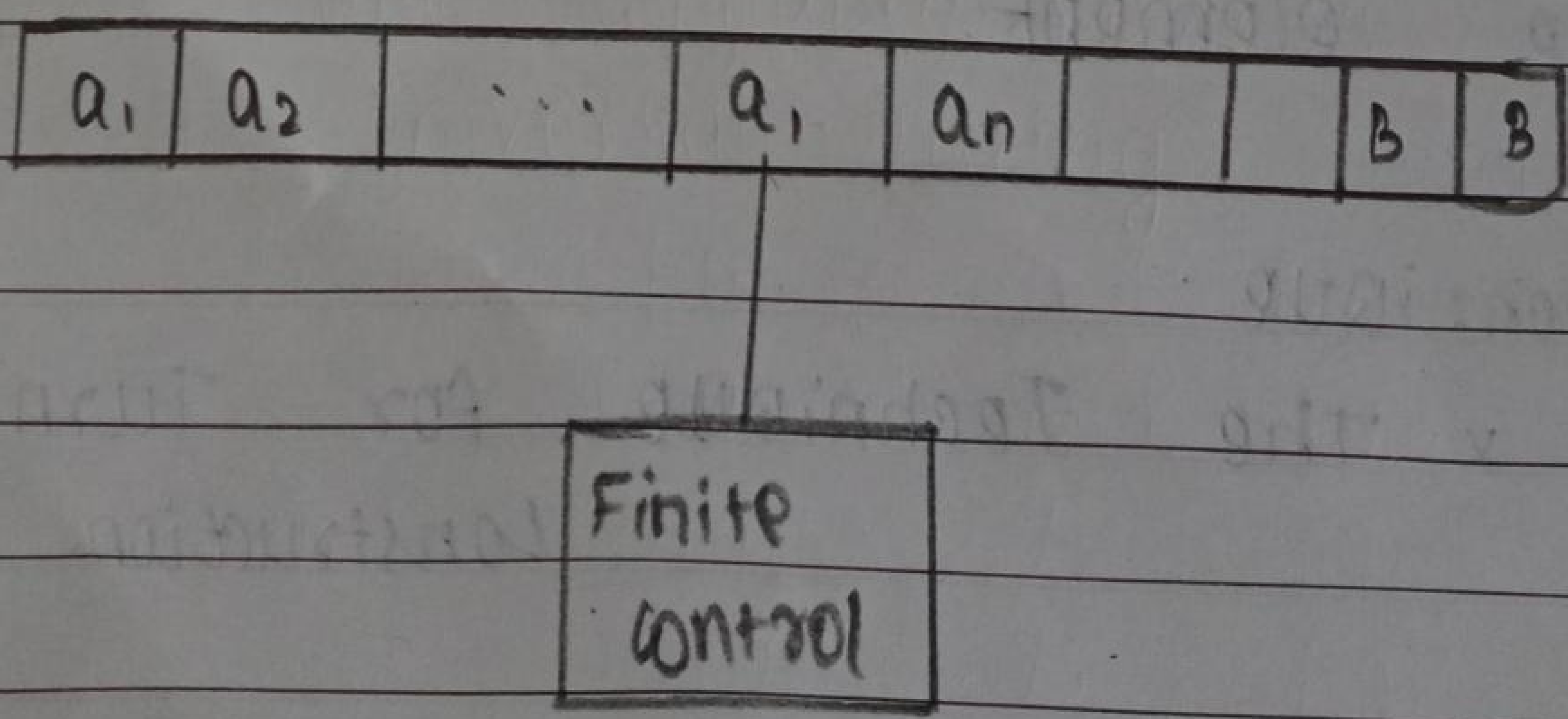
* The Technique for Turning Machine Construction.

1. ~~Set~~ Storage in finite control
2. checking off symbol
3. Shifting off
4. Multi track
5. Subroutine.

4. Turning Machine:

* The basic Mode of Turning Machine
    1. finite control
    2. An Inifite Tape
    3. Tape Head.
* The input tape divided into a cell and the Tape infinite right.
* each cell must hold a only symbol
* Each Tape head move the both direction.

$M = \{Q, \Sigma, \Gamma, \delta, q_0, B, F\}$.



5. Define ID

* The instantaneous define as a
$\alpha_1 Q \alpha_2$.

where
Q = is a current state.
α_1, α_2 = is a string input.
$(\alpha_1 Q \alpha_2)$ is a Instantaneous description of Turning Machine.

6. Multi tape:

* Multitape is a variation of the Turning Machine
* It utilize several tape
* Each tape has a head for reading and writing.
* The first input apperance in 1 and. Other has Blank symbol.

7. recursively enumerable.

* The Language acceptor by Turning Machine is recursively enumerable Language.

* The recursively enumerable set include a regular and CFG.
* Some Language of recursively enumerable not accepted by the Turning machine.

recursive Language:
* The recursive set is subset of the recursively ennumerable Language.
* All Language of recursive set is accepted by the Turning Machine.

8. Universal Turning machine.
* The problem is undecidable.
* ~~The Tur~~ "Does turning Machine M accept input w" Both M and w is a parameter of the problem.
* In Formulation problem is a Language. The input restricted be over the {0,1}. And the taple alphabet {0,1,B}. Thus called a Universal Turing Machine.

11 b)

$\delta(q_0, 0, z_0) = \delta(q_0, x z_0)$
$\delta(q_0, 0, x) = \delta(q_0, xx)$
$\delta(q_0, 1, x) = \delta(q_1, \epsilon)$
$\delta(q_1, 1, x) = \delta(q_1, \epsilon)$
$\delta(q_1, \epsilon, x) = \delta(q_1, \epsilon)$
$\delta(q_1, \epsilon, z_0) = \delta(q_1, \epsilon)$.

$(\{q_0, q_1\}, \{0,1\}, \{x, Z_0\}, \delta, q_0, q_0\}$

$V = \{ S, [q_0, x, q_0], [q_0, x, q_1], [q_1, x, q_0],$
$[q_1, x, q_1], [q_0, z_0, q_0], [q_0, z_0, q_1],$
$[q_1, z_0, q_0]$ $[q_1, z_0, q_1]$
$\}$.

$T = \{0, 1\}$.

$S \rightarrow [q_0, z_0, q_0]$
$S \rightarrow [q_0, z_0, q_1]$.

$\delta(q_0, 0, z_0) = \delta(q_0, x z_0)$

× $[q_0, z_0, q_0] = 0[q_0, x, q_0]$ $[q_0, z_0, q_0]$
× $[q_0, z_0, q_0] = 0[q_0, x, q_1]$ $[q_1, z_0, q_0]$
$[q_0, z_0, q_1] = 0[q_0, x, q_0]$ $[q_0, z_0, q_1]$
$[q_0, z_0, q_1] = 0[q_0, x, q_1]$ $[q_1, z_0, q_1]$.

$\delta(q_0, 0, X) = \delta(q_0, XX)$

× $[q_0, X, q_0] = 0\,[q_0, X, q_0]\,[q_0, X, q_0]$
× $[q_0, X, q_0] = 0\,[q_0, X, q_1]\,[q_1, X, q_0]$
$[q_0, X, q_1] = 0\,[q_0, X, q_0]\,[q_0, X, q_1]$
$[q_0, X, q_1] = 0\,[q_0, X, q_1]\,[q_1, X, q_1]$

$\delta(q_0, 1, X) = \delta(q_1, \epsilon)$

$[q_0, X, q_1] = 1$

$\delta(q_1, 1, X) = \delta(q_1, \epsilon)$

$[q_1, X, q_1] = 1$

$\delta(q_1, \epsilon, X) = \delta(q_1, \epsilon)$

$[q_1, X, q_1] = \epsilon$.

~~$\delta((q_1, Z_0, \epsilon q_1$~~
$\delta(q_1, \epsilon, Z_0) = \epsilon(q_1, \epsilon)$

$[q_1, Z_0, q_1] = \epsilon$.

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* above the No production for the $[q_1, x, q_0]$, and $[q_1, z_0, q_0]$
* Find the similar element.
then remove that production also.
* then Remove the $[q_0, x, q_0]$ and $[q_0, x, q_0]$ and $[q_0, z_0, q_0]$ and $[q_0, z_0, q_0]$.
* then Final Resultant are:

$S \to [q_0, z_0, q_0]$
$S \to [q_0, z_0, q_1]$.

Resultant:

$[q_0, z_0, q_1] = 0 [q_0, x, q_0] [q_0, z_0, z_1]$
$[q_0, z_0, q_1] = 0 [q_0, x, q_1] [q_0, z_0, z_1]$
$[q_0, x, q_1] - 0 [q_0, x, q_0] [q_0, x, q_1]$
$[q_0, x, q_1] = 0 [q_0, x, q_1] [q_0, x, q_1]$.
$[q_0, x, q_1] = 1$
$[q_1, x, q_1] = 1$
$[q_1, x, q_1] = \epsilon$
$[q_1, z_0, q_1] = \epsilon$.
$S \to [q_0, z_0, q_0]$
$S \to [q_0, z_0, q_1]$.

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12a) Turning Machine:

* The ~~Mae~~ Basic Mode of the Turing Machine

1. finite control
2. An Infinite Tape
3. Tape Head.

* The input tape divided into a cell and the Tape infinite right.

* each cell must contain a one symbol

* Each Tape head More the both direction.

$M = \{Q, \Sigma, \Gamma, \delta, q_0, B, F\}$

Q - Set of state

Σ - Set of input

Γ - Set Of Stack symbol

q_0 - initial state

δ - set of transition

B - Blank

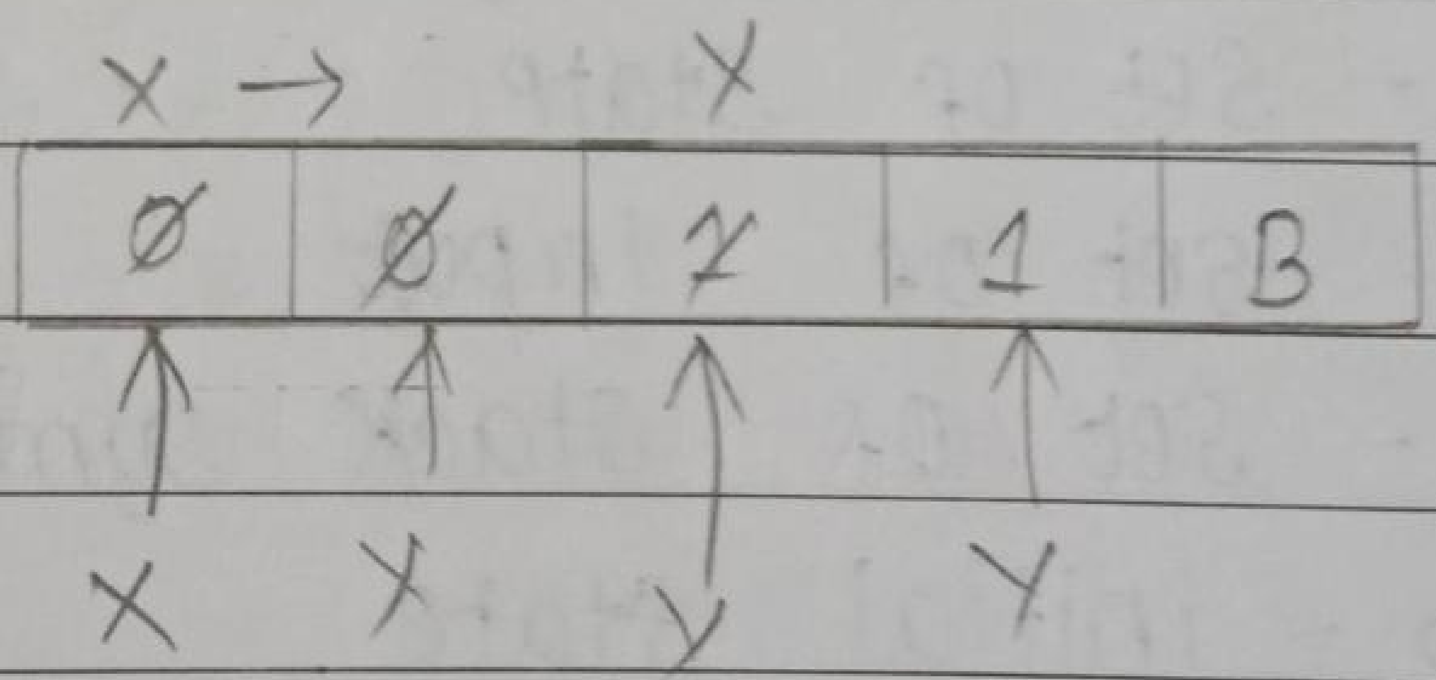
F - Set of Final state.

$0^n 1^n$.

$0^2 1^2$

0	0	1	1	B

* First replace the 0 to x then. move to the right position then. Move to the right position.
* then replace the 1 to y then move to find the Left most 0 then replace the next position 0 to x
* Then find the right most 1 then replace the next position 1 to Y
* Then Read the Blank symbol.



	0	1	X	Y	B.
q_0	(q_1, X, R)			(q_3, Y, R)	
q_1	$(q_1, 0, R)$	(q_2, Y, L)		(q_1, Y, R)	
q_2	$(q_2, 0, L)$		(q_0, X, R)	(q_2, Y, L)	
q_3				(q_3, Y, R)	(q_4, B, R)
q_4	-	-	-	-	-.

check the Turing Machine accept the 0011

$q_0 0011 \vdash X q_1 011 \vdash X 0 q_1 11 \vdash$

~~X0Xq2~~ ~~$X q_2 1 Y 1$~~

$X q_1 Y 11 \vdash X Y q_1 11 \vdash$

$X q_1 Y 1 Y \vdash X X q_2 Y Y \vdash$

$X q_2 X Y Y \vdash X X q_0 Y Y$

$\vdash X X Y q_3 Y \vdash X X Y Y q_3 B.$

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$\vdash XXYYBQ_3.$

$M = \{Q, \Sigma, \Gamma, \delta, q_0, B, F\}.$

$Q = \{q_0, q_1, q_2, q_3, q_4\}$

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

$\Gamma = \{0, 1, X, Y, Z\}$

$q_0 = q_0$

$F = q_4$

δ

	0	1	X	Y	B
q_0	(q_1, X, R)	–	–	(q_3, Y, R)	–
q_1	$(q_1, 0, R)$	(q_2, Y, L)	–	(q_1, Y, R)	–
q_2	$(q_2, 0, L)$	–	(q_0, X, R)	(q_2, Y, L)	–
q_3	–	–	–	(q_3, Y, R)	(q_4, B, R)
q_4	–	–	–	–	–

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13.b) Turing Machine:

* The Basic Mode of the Turing Machine :

1. Finite control
2. An Infinite tape
3. Tape Head.

* In Input Tape divided into a cell and the Tape infinite right.

* each cell must contain a one symbol

* Each Tape head move the both direction.

$$M = \{Q, \Sigma, \Gamma, \delta, q_0, B, F\}.$$

Q - set of state

Σ - set of input symbol

Γ - set of stack symbol

q_0 - initial state.

δ - set of transition.

B - Blank symbol

F - set of final state.

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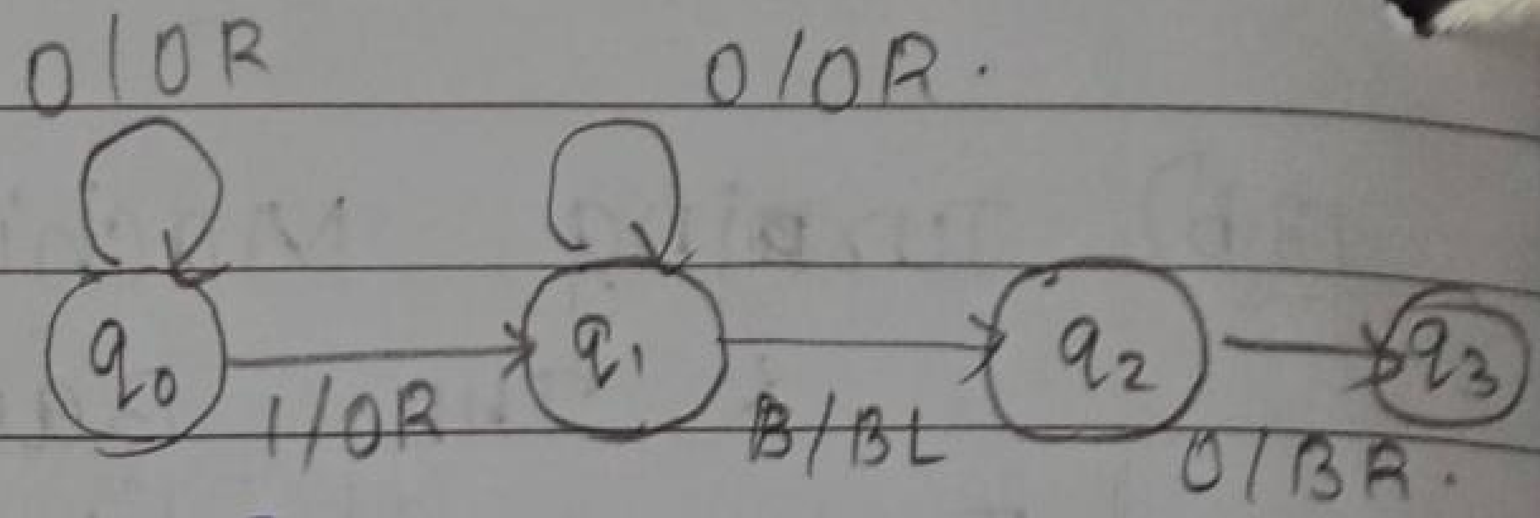


	0	1	B
q_0	$(q_0,0,R)$	$(q_1,0,R)$	-
q_1	$(q_1,0,R)$	-	(q_2,B,L).
q_2	(q_3,B,R).	-	-
q_3	-	-	-

$0^m 1 0^n$.

Now check $= 0^3 1 0^1$

$q_0 00010 \vdash 0 q_0 0010 \vdash$
$00 q_0 010 \vdash 000 q_0 10 \vdash$
$0000 q_1 0 \vdash 00000 q_1 B$.
$\vdash 0000 q_2 BB. \quad \vdash 0000 B q_3 B$

Result $= 0000 B q_3 B$.

$B0BBq_2 \vdash B0Bq_4B \vdash B0q_6BB$.

Result $= B0q_6BB$.

$M = \{Q, \Sigma, \Gamma, \delta, q_0, B, F\}$.

$Q = \{q_0, q_1, q_2, q_3, q_4, q_5, q_6\}$

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

$\Gamma = \{0, 1, B\}$.

$q_0 = q_0$

$F = \{q_6\}$.

14a) closure properties.

1. complement of recursive Language is recursive
2. Union of two recursive Language is recursive.
3. union of two recursively enumerable Language is recursively enumerable.
4. It is a L and complement of L' both are recursively enumerable. That L and hence L' is recursive.

1. complement of recursive Language is recursive.

* Let L be a recursive Language and M is a Turing Machine all input halts and accept L.

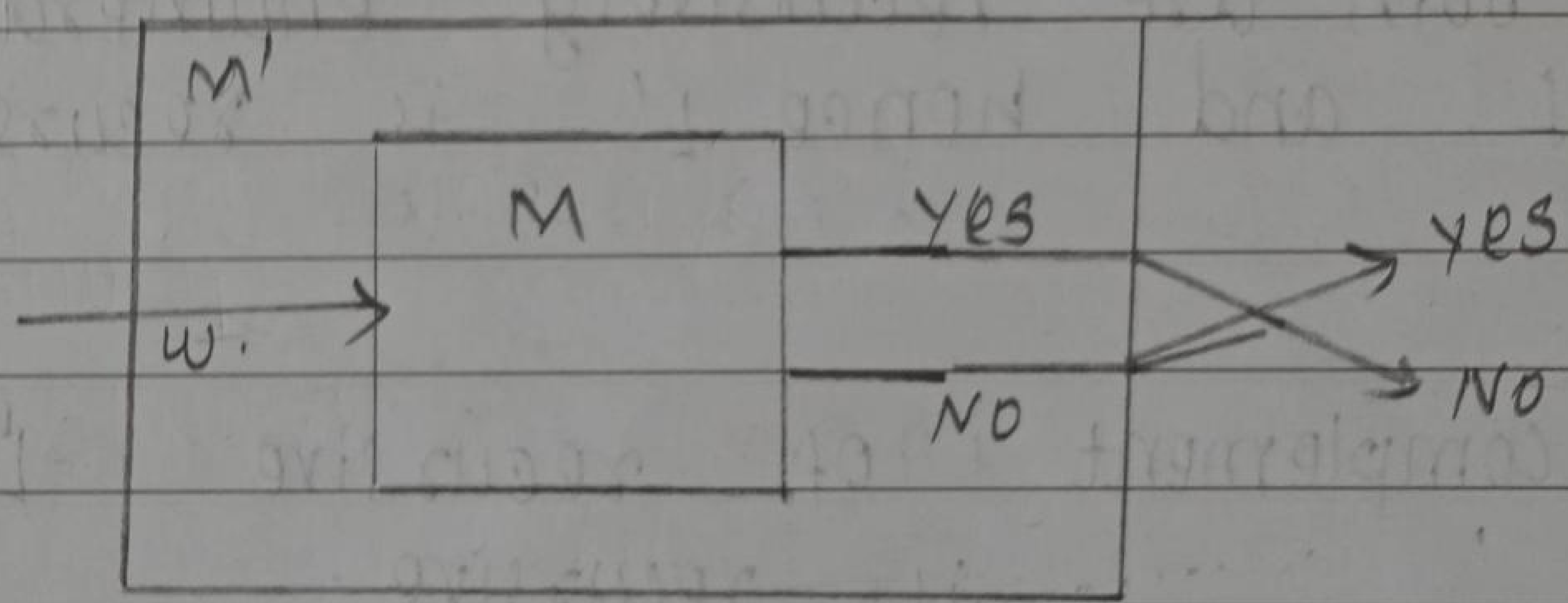
* construct M' from M. M is enter a final state w. The M' halt without ~~accepting~~ accepted.

* M' is enter a Final State the M halt without accepted.

* since one of those event is occur M is a Algorithm.

* L(M') is a L so, the complement of the recursive Language is recursive.

* Hence proved complement of recursive language is recursive



2. union of the two recursive language is recursive

union of the two recursively enumerable Language is recursively enumerable.

* L_1 and L_2 is a recursive Language accepted Algorithm M_1 and M_2.

* Construct M from M, simulate. First M_1

* M_1 is accept M is accept and. M_1 is reject. M_2 simulate the M and accept M accept.

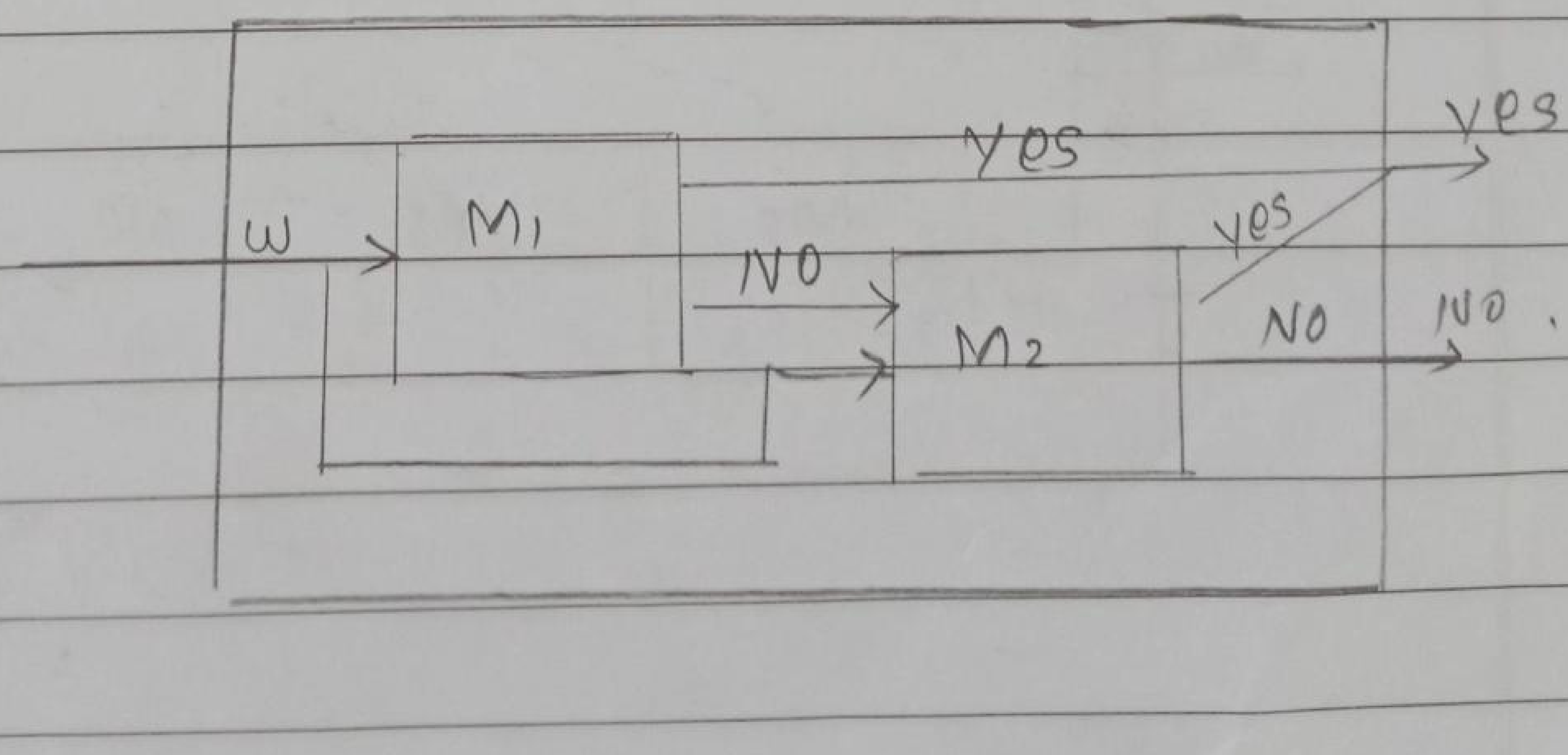
* Since M_1 and M_2 is a accepting Algorithm so, M is $L_1 \cup L_2$.

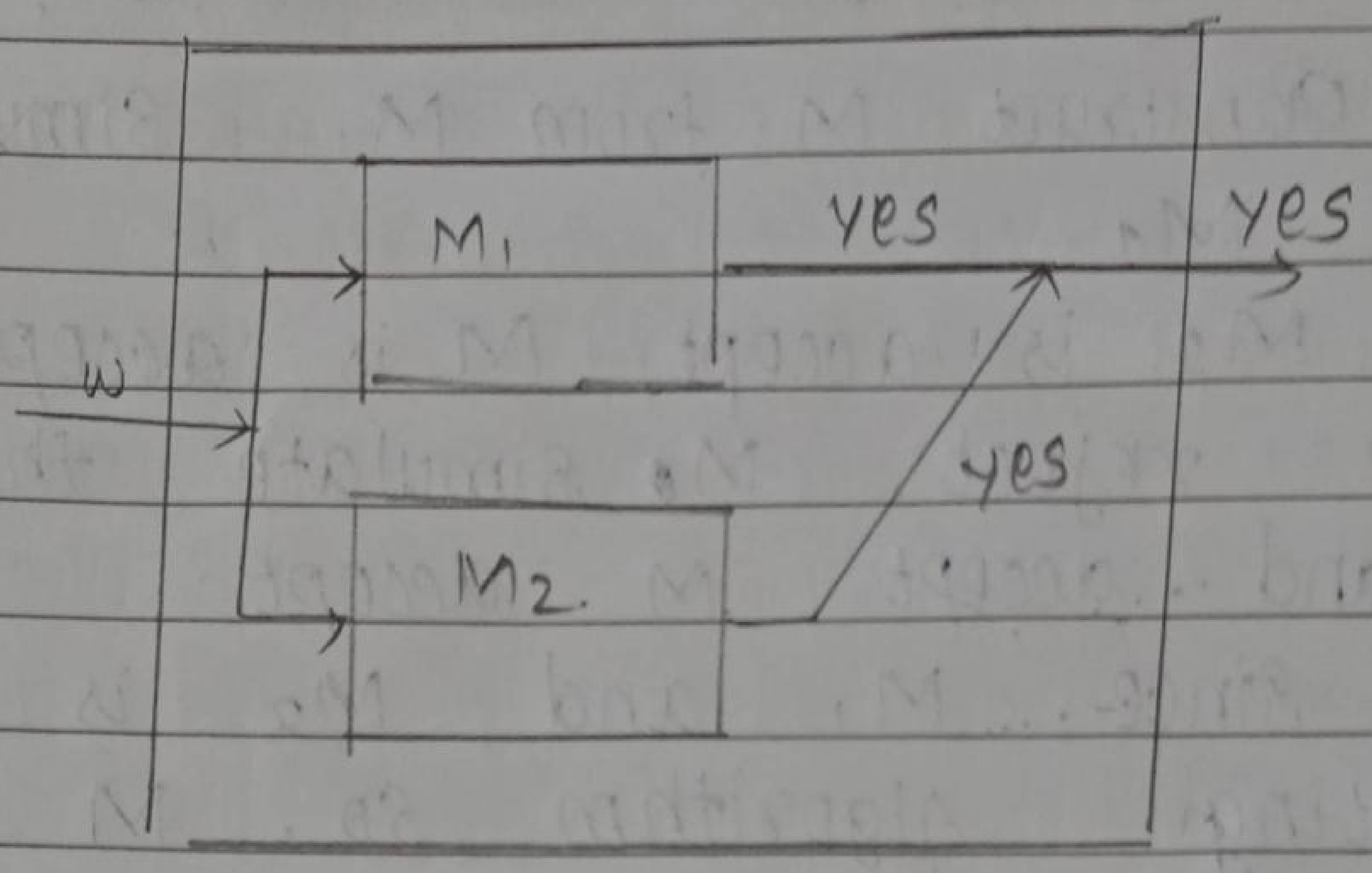
* Since ~~recursive~~ union of recursive Language is recursive

* M_1 May not halt.

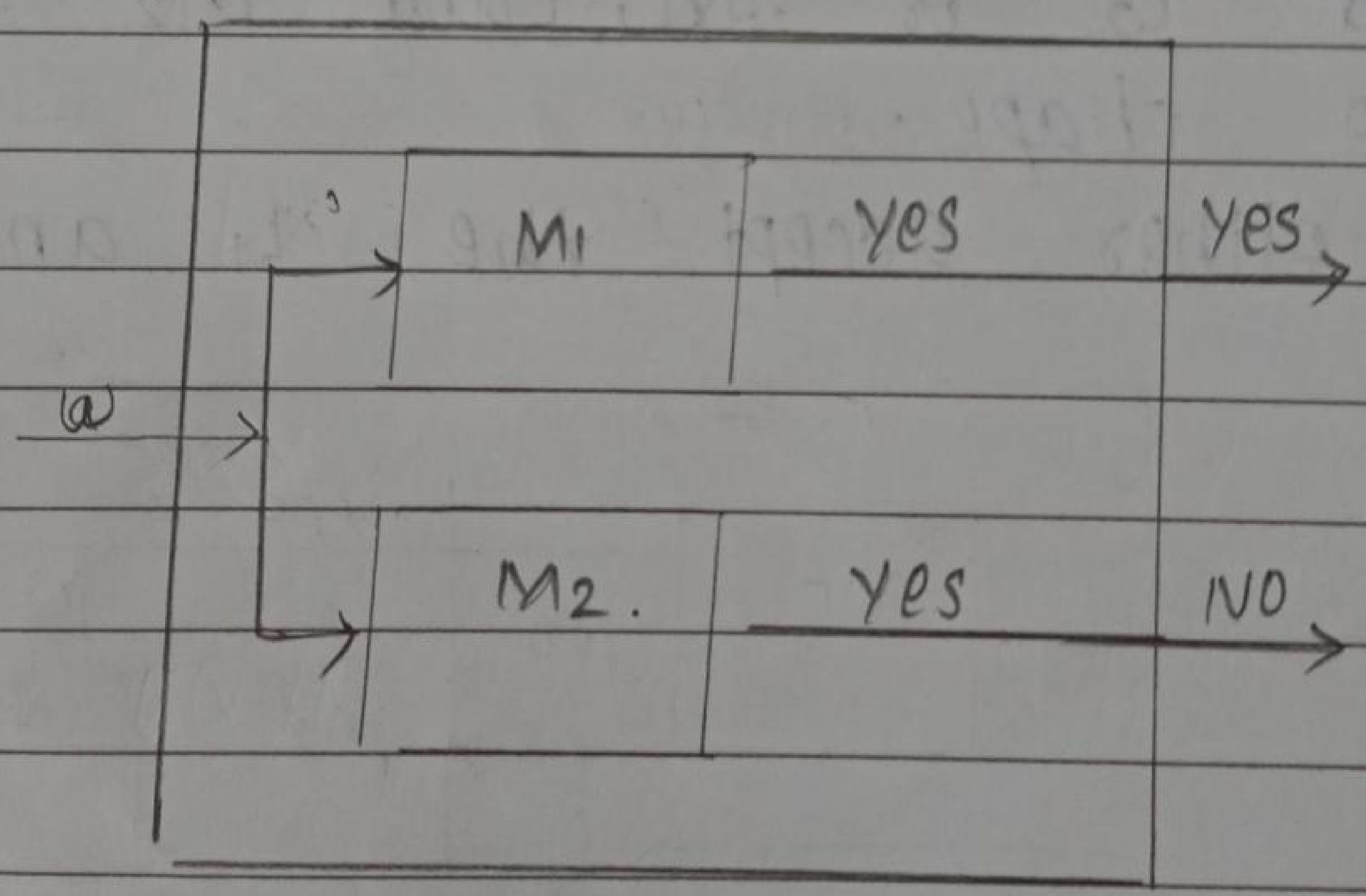
* Instead simulate simultenously L_1 and L_2 or M_1 and M_2 in a seperate tape.

* either accept the L_1 and L_2.





It is a language L and complement of L' both are recursively enumerable. That L and hence L' is recursive.



* Turing Machine M_1 and M_2 accepted Language L and $\bar{L}$

* construct M simulate the M_1 accept M accept reject w.

* M simulate the M_1 and accept Iff M accept.

* We know that L and $\bar{L}$ is a accept.

* The result is "yes" or "NO" not a ~~Bo~~ say Both.

* So, $L(M')$ is L So, L is a recursive.

* Hence proved the Language L and $\bar{L}$ is a recursively enumerable that L and complete $\bar{L}$ is a recursive.

15(b) PCP.

First Pair

List A	List B.
#	#qW

Group I

List A	List B.
X	X
#	# X For in Γ

Group II

List A	List B.
qX	YP $\delta(q,x) = (P,Y,R)$
ZQX	PZY $\delta(q,x) = (P,Y,L)$
ZQ#	#PZY $\delta(q,B) = (P,Y,R)$
ZQ#	#PZY $\delta(q,B) = (P,Y,L)$

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Group III

List A	List B.
~~q~~ xqy	q
xq	q
qy	q

q For in F, x, y in Γ.

Group IV

List A	List B
$q\#\#$	$\#$

q For in F

$M = \{q, \Sigma, \Gamma, \delta, q_0, B, q_3\}$.

$q = \{q_1, q_2, q_3, q\}$ $\Gamma = \{0, 1\}$.

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

Sol:

Group I

First Pair.

List A	List B
#	# q_0 01

Group II.

List A	List B
1	1
0	0.

Group III

$\delta(q_1, 0) = (q_2, 1, R)$.

$q_1 0 = 1 q_2$.

$\delta(q_1, 1) = (q_2, 0, L)$

$0 q_1 1 = q_2 0 0$.

$1 q_1 1 = q_2 1 0$.

$\delta(q_1, B) = (q_2, 1, L)$.

$0 q_1 \# = q_2 0 1$

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$1 q_1 \blacksquare = q_2 1 1.$

$\delta(q_2, 0) = (q_3, 0, L)$

$0 q_2 0 = q_3 0 0$

$1 q_2 0 = q_3 1 0.$

$\delta(q_2, 1) = (q_2, 0, L)$

$q_2 1 = 0 Q_2.$

$\delta(q_2, B) = (q_2, 0, R)$

$q_2 \blacksquare = 0 q_2.$

Group III

List A	List B
$1 q_3 1$	q_3
$1 q_3 0$	q_3
$0 q_3 1$	q_3
$1 q_3 1$	q_3
$0 q_3$	q_3
$q_3 0$	$q_3.$

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Group IV.

List A — List B

$q_3\#\#$ — $\#$

$q_1 01 \vdash 1q_2 1$ $(\because q_1 0 = 1q_2)$ $q_2 11$

$\vdash 10q_2$ $(\because q_2 = 0Q_2)$. $q_2 011$

$\vdash 1q_2 0$

$\vdash 0q_2$

$\vdash q_3$.

16a) Pumping Lemma for regular Language.

* If A is a regular Language then A has a pumping. Length P. then any. String S. $|s| \geq P$ may be divided. by 3 part (x, y, z) and so that true the following.

condition:

$xy^i z \in A$ for A in $i \geq 0$.

$|y| > 0$

$|xy| \leq P$.

Application

* Assume A is a regular Language.

* A has a pumping Length (say P)

* S is a string, a ~~Stny~~ Long string pumped P ($|S| \geq P$).

* S is divided into a 3 part. (x, y, z)

* $xy^iz \notin A$ For any $i \geq 0$.

* Show that a no one Satisfy a Three condition Three condition at a same time.

* S is not pumped = CONTRADIC-TION.

i) $L = \{\{a^n b^n \mid n > 0\}\}$.

* Assume A is a regular language
* A has a pumping length p.

$a^n b^n = a^p b^p$

$p = 7$

$S = a^7 b^7$.

$S = aaaa\ aaa\ bbbb\ bbb$.

S divided into a Three part

$S = xy^i z$.

Case 1

$S = \underbrace{aa}_{x}\underbrace{aaaa}_{y}\underbrace{a\ bbbb\ bbb}_{z}$.

$S = xy^i z$

$i = 2$.

$= xy^2 z$.

$= aa\ aaaa\ aaaa\ a\ bbbb\ bbb$.

$= a^{11} b^7$

$= a^{11} b^7 \notin A$

Case 2

$S = aaaa\,aaa\,b\,\underbrace{bbb}_{y}\,\underbrace{bbb}_{z}.$

$S = xy^iz. \quad i=2.$

$= xy^2z$

$= aaaa\,aaa\,b\,bbbbbb\,bbb.$

$= a^7 b^{10} \notin A.$

Case 3.

$S = \underbrace{aaaa}_{x}\,\underbrace{aaabb}_{y}\,\underbrace{bbbbb}_{z}.$

$S = xy^iz \quad i=2.$

$= xy^2z.$

$= aaaa\,aaabb\,aaabb\,bbbbb$

$= a^{10}b^9 \notin A.$

L is not a regular.

$L = \{\{a^n b^n \mid n>0\}\}$ not a regular.

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pumping Lemma for CFL.

*. If A is a context Free Language then A has a pumping Length p. then any string s $|s| \geq p$ may be divided into 5 part (uvxyz) and so that true the following.

condition:

$uv^ixy^iz \in A$ for A in $i \geq 0$.

$|vy| > 0$

$|vxy| \leq p$.

Application:

*. Assume A is a context Free Language.

* A has a pumping Length (say P)

* S is a string, a any Long. String pumped P ($|s| \geq P$)

* S is divided into a 5 part (u, v, x, y, z).

* show that a no one satisfy a Three condition at a same time.

S is not pumped = CONTRADICTION.

17) $L = \{\{a^n b^n c^n \mid n > 0\}\}$.

* Assume A is a context Free Language
* A has a pumping length P.

$a^n b^n c^n = a^p b^p c^p$.

$p = 5$

$S = a^5 b^5 c^5$.

$S = aaaaa\ bbbbb\ ccccc$.

$S = uv^i xy^i z$.

case 1

$$S = \underbrace{aa}_{u}\underbrace{aaa}_{v}\underbrace{bbb}_{x}\underbrace{bb}_{y}\ \underbrace{ccccc}_{z}.$$

$= uv^i xy^i z \quad i = 2.$

$= aa\ aaaaaa\ bbbbbbb\ ccccc.$

$= a^8 b^7 c^5 \notin A.$

case 2.

$$S = \underbrace{aa}_{u}\underbrace{aaab}_{v}\underbrace{bbb}_{x}\underbrace{bcc}_{y}\underbrace{ccc}_{z}.$$

$= uv^i xy^i z \quad i = 2.$

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$= aa\ aaab\ aaabbbb\ bcc\ bcc\ ccc$

$= a^8 b^7 b^7 \notin A.$

case 3

$\underbrace{aaaa}_{u}\underbrace{a}_{v}\ \underbrace{bbb}_{x}\underbrace{bb}_{y}\ \underbrace{ccccc}_{z}.$

$uv^ixy^iz \quad i = 2.$

$= aaaaaa\ bbbbbbb\ ccccc$

$= a^6 b^7 c^5 \notin A.$

So, L is not a context Free Language.

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