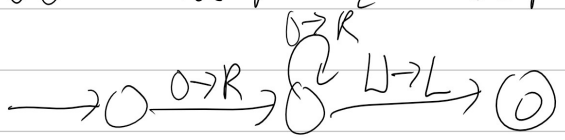
TM design [Accepter
most powerful [transducer

TM → Accepter?

Accepter: after a seq of moves enter an accepting state and halt if WEL
otherwise, do not halt or halt in a non-accepting state

Transducer: get input, produce output
s.t., transform input into ouput.

0^{n^2} Accept or Accepter (TM)?

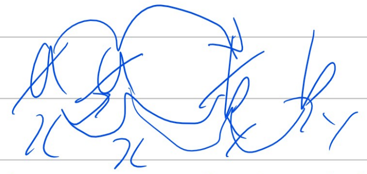


input: λ → halt on initial state
0 → accept
00 → accept
⋮

Transducer: $q_0 w \vdash_M^* q_f f(w)$

ex1) design a TM that accepts $L = \{a^n b^n, n \geq 1\}$ → CFL

→ count operation을 해야한다.

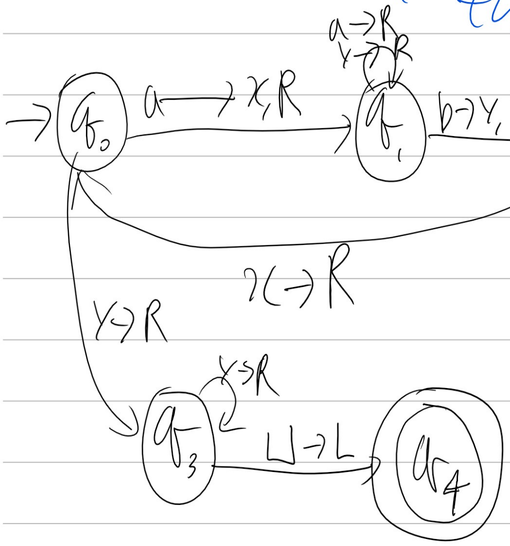


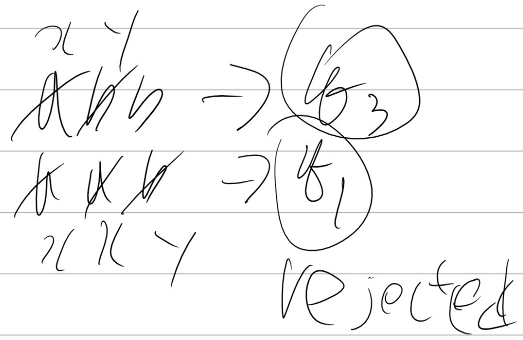
no more a, and b → accept

abb ?

aab ?

⇒
- replace the leftmost a w/ x
- find the leftmost b and replace w/ Y
- no more a & b remain; the string is in L.





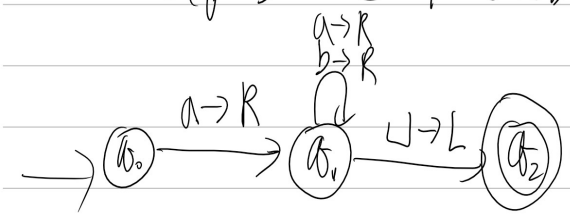
aabb is acceptable?

$q_0 aabb \vdash x q_1 abb \vdash xa q_1 bb \vdash x q_2 aYb \vdash q_2 xaYb$
$\vdash x q_0 aYb \vdash xx q_1 Yb \vdash xxY q_1 b \vdash xx q_2 YY \vdash x q_2 xYY$
$\vdash xx q_0 YY \vdash xxY q_3 Y \vdash xxYY q_3 \sqcup \vdash xxY q_4 Y$

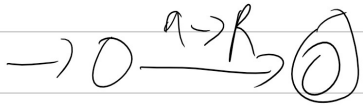
accept states

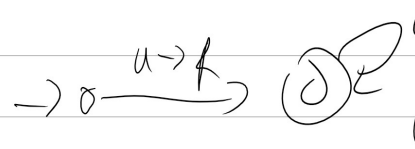
$\Sigma = \{a, b\}$
$\Gamma = \{a, b, x, Y, \sqcup\}$ — 헷갈리지 말자.

ex2) Design a TM w/ three states that accepts $L = \{a(a+b)^*\}$ over $\Sigma = \{a, b\}$



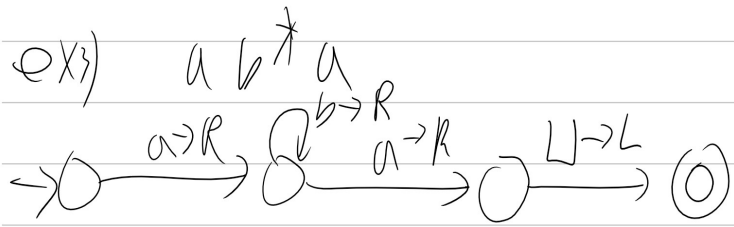
vs



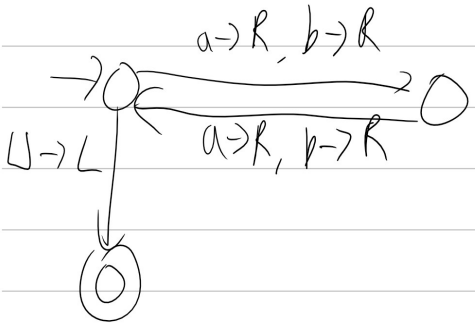


⇒ 이러면 halt하지 않는다.

ex3) ab^*a

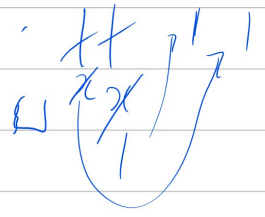


ex4) $L = \{w \mid$ is even$\}$



ex5) Design a TM that copies the string of 1's. More precisely, $q_0 w \vdash^* q_5 ww$, for any $w \in \{1\}^*$

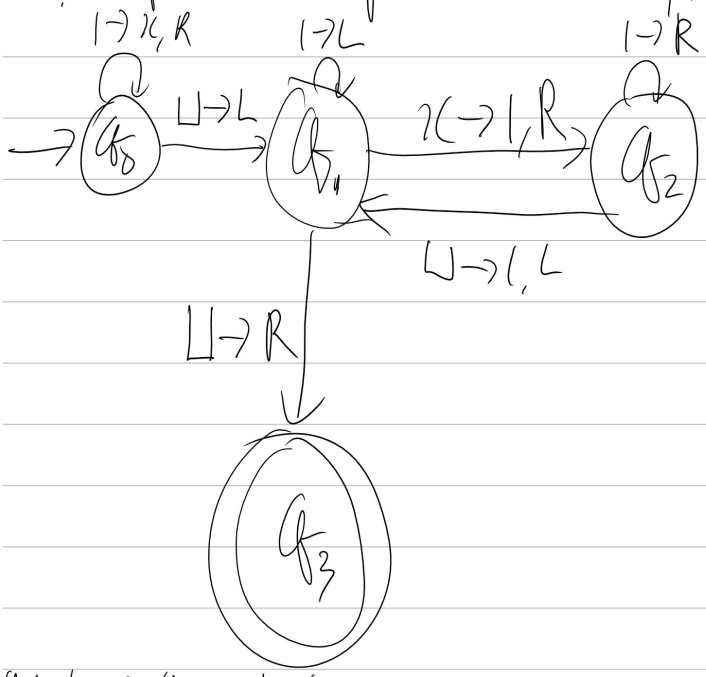
input: 11 → output: 1111 : transducer.



ex5)

· Process:

1. replace every 1 w/ x
2. Find the rightmost x and replace w/ 1
3. Travel to the right end, and creat a 1
4. repeat Step 2, 3 until no more x exist



$q_0 1 \vdash x q_0 \sqcup 1 \vdash q_1 x 1 \vdash x q_2 \sqcup 1 \vdash q_1 11 \vdash q_1 \sqcup 11 \vdash q_3 11$