〈계산이론〉

successful factor - key   success factors

money - 72
luck - 47
skills - 82
people
knowledge - 96
attitude - 100

유사과학이다~ 이 house이야~

Turing machines

-> simple but powerful

-> stack도 없고, 그냥 tape 하나일뿐.

<-> 좌우로 움직이고, 읽고 쓸 수 있는 machine이다.

-> algorithmic computation

Closure Properties of context-free Languages

CFL is closed under union, concat, star

Prove: $\to$ CFG or PDA

Union of two language $L_1(G_1)$ and $L_2(G_2)$

$G_{union} = (V_1 \cup V_2 \cup \{S\}, T_1 \cup T_2, P_1 \cup P_2 \cup \{S \to S_1 | S_2\})$

Union: $\begin{cases} S \to S_1 | S_2 \\ S_1 \to \text{\textasciitilde\textasciitilde} \\ S_2 \to \text{\textasciitilde\textasciitilde} \\ \vdots \end{cases}$

Concat: $\begin{cases} S \to S_1 S_2 \\ S_1 \to \text{\textasciitilde\textasciitilde} \\ S_2 \to \text{\textasciitilde\textasciitilde} \\ \vdots \end{cases}$

star: $S \to S_1 S \mid \lambda$

ex) L_1: $S \to aSb \mid \lambda$

L_2: $S \to aaSb \mid \lambda$

$L_1 \cup L_2$: $S \to S_1 \mid S_2$

$S_1 \to aS_1b \mid \lambda$

$S_2 \to aaS_2b \mid \lambda$

$L_1 \cdot L_2$: $S \to S_1 S_2$

$S_1 \to aS_1b \mid \lambda$

$S_2 \to aaS_2b \mid \lambda$

L_1^*: $S \to S_1 S \mid \lambda$

$S_1 \to aS_1b \mid \lambda$

CFL is not closed under intersection

Proof)

$L_1 = \{0^n 1^n 0^m : n \ge 0, m \ge 0\}$

$L_2 = \{0^n 1^m 0^m : n \ge 0, m \ge 0\}$

$L_1 \cap L_2 = \{0^n 1^n 0^n : n \ge 0\} \to$ not CFG

$$L_1 : \left.\begin{array}{l} S \to S_1 S_2 \\ S_1 \to 0 S_1 1 \mid \lambda \\ S_2 \to 0 S_2 \mid \lambda \end{array}\right\} \to \text{CFG}$$

$$L_2 : \left.\begin{array}{l} S \to S_1 S_2 \\ S_1 \to 0 S_1 \mid \lambda \\ S_2 \to 1 S_2 0 \mid \lambda \end{array}\right\} \to \text{CFG}$$

$L_1 \cap L_2 = \{0^n 1^n 0^n : n \ge 0\} \to$ not CFG

$\text{CFL} \cap \text{CFL} =$ Not CFL

$\overline{L_1}$? $L_1 \cap L_2 = \overline{(\overline{L_1} \cup \overline{L_2})}$

만일 complement 가 closure 이면,
$L_1 \cap L_2$ 이 closure가 된다.

	RL	CFL
union	O	O
concate	O	O
star	O	O
intersection	O	X
complement	O	X

만일 operation을 정의할 때,
union, concat, star로 구성되면
closure, 아니면, not CFL이
생길 수 있을 듯.

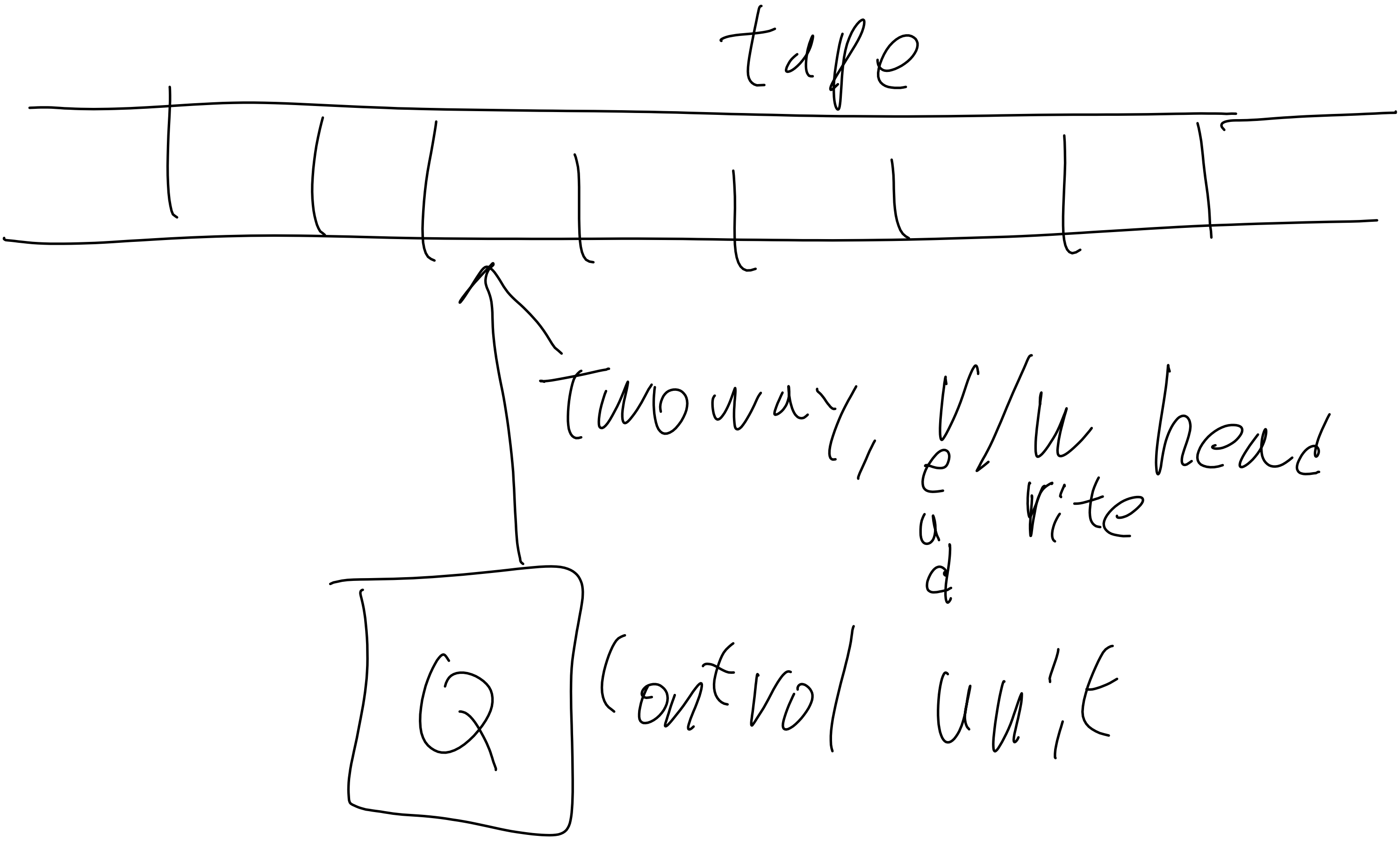
TM:

one Turing machine ⟷ one computation

⟷ solvable

push down automata: unlimited memory

Turing machine illimited memory



Tape is infinite

basic operation:

1. check current state.
   (If halt state → terminate)
2. read symbol
3.

$TM = (Q, \Sigma, \Gamma, \sqcup, q_0, F)$

Σ: alphabet, $\sqcup \notin \Sigma$

$\sqcup \in \Gamma$

$\delta : Q \times \Gamma \to Q \times \Gamma \times \{L, R\}$

δ: powerful in principle,
small instructions are adequate for doing complicated tasks

$\sqcup \in \Gamma$, $\sqcup$ is a blank

ex) M_1, abb, a를 b로 바꾼다.

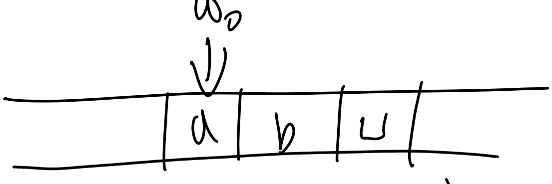
abb

↓

bbb

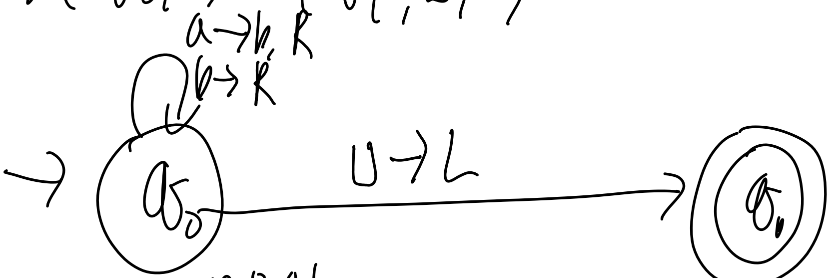
input: abb
output: bbb

$Q = \{q_0, q_1\}$
$\Sigma = \{a, b\}$
$\Gamma = \{a, b, \sqcup\}$
$q_0 = q_0$
$q_1 \in F$



$\delta(q_0, a) = (q_0, b, R)$,
$\delta(q_0, b) = (q_0, b, R)$
$\delta(q_0, \sqcup) = (q_1, \sqcup, L)$

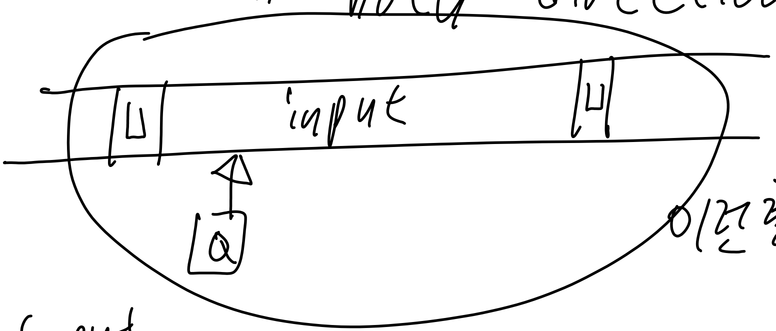
$\delta(q_0, a) = (q_0, b, R)$
$\delta(q_0, b) = (q_0, b, R)$
$\delta(q_0, \sqcup) = (q_1, \sqcup, L)$



label < DFA: a
PDA: a, b→c
TM: a→b, R
a→a, R
≡ a→R

⇒ Design TM!

standard TM
→ has tape that is unbounded in both direction

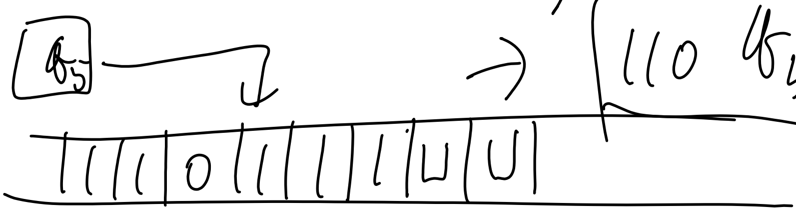


이런형태 이다.

⇒ same input, same state → same action.

Configuration of TM

input → in | put (header) → $u\ q\ v$
u | v



state → $\boxed{110\ q_5\ 111}$

이렇게 describe 가능

$u a q_i b v \vdash u q_j a c v$ if $\delta(q_i, b) = (q_j, c, L)$;

$u a q_i b v \vdash u a c q_j v$ if $\delta(q_i, b) = (q_j, c, R)$

ex) q_0

⊔	a	b	⊔

$q_0 a b \vdash b q_0 b \vdash b b q_0 ⊔ \vdash b q_1 b$

이건 해줘도되고 안해도된다.

다만 input이 ⊔이란 표시해준 것 뿐이다.