1)

13주-목 (11/29) Turing - Church's Thesis

① Ackerman ftn is not primitive recursive but computable.

TM is computable … Turing's ~~Church's~~ Thesis

μ-recursive partial ftn is computable … Church's Thesis

TM = μ-rec. par ftn … Turing Church's Thesis

ftn - theory

- primitive ~~partial~~ rec. ftn — countably infinite
- Ackermman ftn
  - computable but not primitive rec.

Ackermman function

$$A(0, y) =_1 \sigma(y)$$

$$A(\sigma(x), 0) =_2 A(x, 1)$$

$$A(\sigma(x), \sigma(y)) =_3 A(x, A(\sigma(x), y))$$

$$A(2, 1) =_3 A(1, A(2, 0))$$

$$A(2,0) =_2 A(1, 1) =_3 A(0, A(1, 0))$$

$$A(1,0) =_2 A(0, 1) =_1 2$$

빠져나감.

$$A(0, 2) =_1 3$$

$$= A(1, 3)$$

$$=_3 A(0, A(1, 2)) \rightarrow A(0, 4) =_1 5$$

$$A(1, 2) =_3 A(0, A(1, 1)) =_3 A(0, A(0, A(1, 0)))$$

$$=_2 A(0, A(0, A(0, 1)))$$

$$=_1 A(0, A(0, 2))$$

$$=_1 A(0, 3) =_1 4$$

Ackermann ftn is computable but not primitive recursion!

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② Minimization (μ) ftn.

<u>Thm</u> $\exists$ computable total ftn $N \to N$ which is not primitive recursive.

total ftn : $N \to N$ ... $\cancel{|N|^{|N|}}$ ... uncountable

p.r.f : countable

Q.E.D.

※ $f: A \to B$
$|f| = |B|^{|A|}$

Def : $f: N^m \to N$ from $g: N^{m+1} \to N$.

$f(\vec{x}^m) \triangleq \mu y [g(\vec{x}^m, y) = 0]$

$= \underset{(\mu)}{\text{minimum}}(y)\ y \in N$ s.t. $[g(\vec{x}^m, y) = 0] \wedge \forall 0 \le z < y\ \exists g(\vec{x}^m, z)$

최초로 $g(\vec{x}, y) = 0$으로 하는 y.

단 y보다 작은 수 z에서는 $g(\vec{x}, z)$가 정의되어 있다 (partial ftn)

※ min은 TM의 성질을 함수에 포함시킨 정의다.

monus : $\dot{-}$
$\dot{-} : N_0 \times N_0 \to N_0$

Def : p.r. + $\underset{(\varphi)}{\mu}$.r $\triangleq$ μ.r.$\underset{(\varphi)}{f}$

Thm μ.r.p.f is Turing computable

proof : program in TP 9-1 p 13. (더하기 exit_loop := false)

QED

μ.r.p.f $\Rightarrow$ TM

Thm TM $\Rightarrow$ μ.r.p.f (강의노트 9-3 표현 $\Rightarrow$ simulate)

TM configuration $\Gamma^* \times Q \times \Gamma^*$

(α, p, β)

$\downarrow$

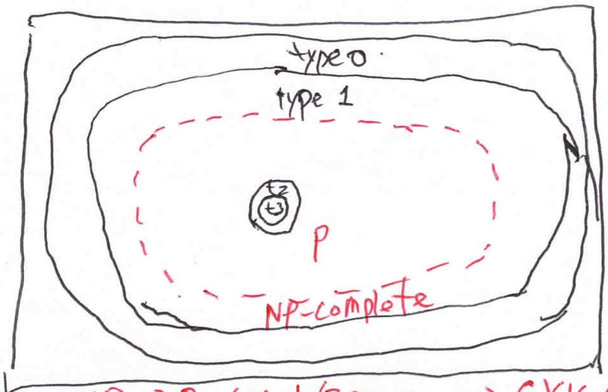
$(w, p, n) \in N^3$ — 단 final state는 0이다 ($\because$ minimization)

w ↑ $\text{int}(\alpha\beta)$, p ↑ Q, n ↑ head position

$(w, p, n) \longrightarrow (w', p', n')$

① μrpf $\Rightarrow$ TM
② TM $\Rightarrow$ μrpf

$\Big\rangle$ TM = μrpf



NP $\Rightarrow$ P (예: L/R parser $\Rightarrow$ CYK $O(n^3)$)