

TMs
computing
functions

TM $M_{s(y)}$:

Erase input, write y and halt.

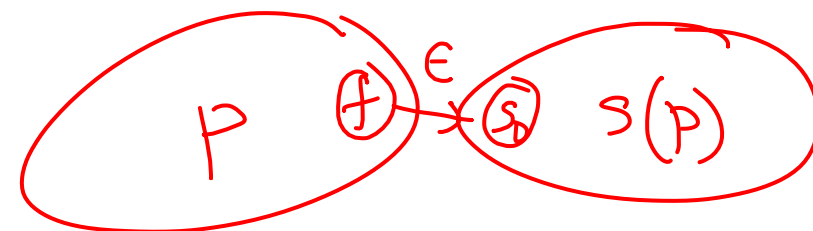
TM M_a :

On input y , output $s(y)$.

TM M_b :

On input p , output ~~$p \parallel s(p)$~~ .

$s(p) \parallel p$



$(Q, s_0, \delta, \Sigma, \emptyset, F)$



use 11 as separator

represent 0 as 00

represent 1 as 01

What does $M_{\frac{s(b) \parallel s(s(b))}{}}$ do?



Erases input, outputs $s(b)$.

What does $M_{\frac{s(b) \parallel b}{}}$ do?



Self-reproducing TM

Outputs $s(b) \parallel b$

Recursion Theorem: Let f be any computable function. Then there exists a p such

$$\text{that } M_p = M_{f(p)}.$$

Computable function: there is a TM computing f which halts on all inputs.

First-order logic

Predicates : $Q(x_1, x_2, \dots, x_k)$
Variables taking value from D

Logical operations : \wedge, \vee, \neg

Quantifiers : \forall, \exists

and a valuation of predicates,
Given a formula F_h decide if it is true.

If D is infinite, how does one represent
input? Represent each predicate as a TM.

Define predicate H as:

$H(p, x, t)$: TM M_p halts on input x
within t steps.

M_p halts on x iff $\exists t H(p, x, t)$