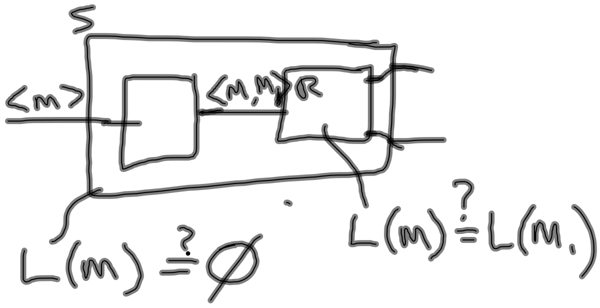
$EQ_{TM} = \{\langle M_1, M_2\rangle \mid M_1, M_2$ are TM and $L(M_1) = L(M_2)\}$

EQ_{TM} is undecidable

proof by contradiction:

assume EQ_{TM} is decidable by TM, R.

Show that E_{TM} is decidable (which is a contradiction)



Construct S: on input $\langle M\rangle$

1. Run R on input $\langle M, M_1\rangle$ where M_1 is a TM that rejects all input.

2. If R accepts, accept. If R rejects, reject.

So S decides E_{TM} which is a contradiction.

Therefore there is no decider for EQ_{TM}.

configurations

$$10110q_3 10110$$

<u>computational history</u>

sequence of configs

$C_1, C_2, C_3, \ldots C_\ell$

<u>Accepting comp. history</u>

a) C_1 is start config.

b) C_ℓ is an accept config

c) each C_i follows from C_{i-1} according to rules for M.

Linear Bounded Automata (LBA)

- like a TM
- tape is only as long as the input.

LBA's accept CSLs

can decide A_{DFA}, A_{CFG}, E_{DFA}, E_{CFG}

M is a LBA

q states

g symbols

n input length

There are exactly $q \cdot n \cdot g^n$ distinct configurations

A_{LBA} is decidable

E_{LBA} is undecidable

$$10q_2101 \rightarrow 100q_301 \rightarrow 10q_2101$$

Post Correspondence Problem (PCP)

given $\left\{ \left[\frac{b}{ca}\right], \left[\frac{a}{ab}\right], \left[\frac{ca}{a}\right], \left[\frac{abc}{c}\right] \right\}$

$$\left[\frac{a}{ab}\right]\left[\frac{b}{ca}\right]\left[\frac{ca}{a}\right]\left[\frac{a}{ab}\right]\left[\frac{abc}{c}\right]$$

abcaaabc