The Halting Problem False (not Turing Decidable)

TM (Turing Machine) M, string w, can you determine if M halts on w?

Encoding

An encoding of a TM M refers to the 7 tuple in the definition of M:

(S, A, Ã, t, i, Saa, Sreg) - states, read alphabet, write alphabet, transition mapping, initial state, accept state, reject state

LTM = {<M,W> | M is a TM and M accepts w}

Turing recognizable because you can create a TM N that does the following:

i) Input <M, W>

ii) Run M on w

iii) Accept if M accepts w, reject otherwise

Prop: LTM is not Turing Decidable

Proof: Asume LTM is decidable, there exists a decider H for LTM.

In more words: Given <M, w>, H accepts if M accepts w, H rejects if M doesnt accept w.

Define D by:

i) On input <M>, run H on <M, <M>>

ii) Output the opposite of what H outputs

- If H accepts <M, <M>>, D rejects <M>

- If H rejects <M,<M>>, D accepts <M>

Run D on <D>

- accept <D> if D rejects <D> ⇒⇐ <D> is D’s encoding

- rejects <D> if D accepts <D> ⇒⇐

D cannot exist ⇒ H cannot exist.

Prop: LTM is Turing-recognisable

Defined N, input <M,w>