

Simulating (partial) Halt Deciders Defeat the Halting Problem Proofs

A simulating halt decider correctly predicts whether or not its correctly simulated input can possibly reach its own final state and halt. It does this by correctly recognizing several non-halting behavior patterns in a finite number of steps of correct simulation. Inputs that do terminate are simply simulated until they complete.

When a simulating halt decider correctly simulates N steps of its input it derives the exact same N steps that a pure UTM would derive because it is itself a UTM with extra features.

My reviewers cannot show that any of the extra features added to the UTM change the behavior of the simulated input for the first N steps of simulation:

- Watching the behavior doesn't change it.
- Matching non-halting behavior patterns doesn't change it
- Even aborting the simulation after N steps doesn't change the first N steps.

Because of all this we can know that the first N steps of input D simulated by simulating halt decider H are the actual behavior that D presents to H for these same N steps.

computation that halts... “the Turing machine will halt whenever it enters a final state” (Linz:1990:234)

When we see (after N steps) that D correctly simulated by H cannot possibly reach its simulated final state in any finite number of steps of correct simulation then we have conclusive proof that D presents non-halting behavior to H.

Summary of Linz Halting Problem Proof

The Linz halting problem proof constructs its counter-example input $\langle \hat{H} \rangle$ on the basis of prepending and appending states to the original Linz H, (assumed halt decider) thus is named `embedded_H`.

Original Linz Turing Machine H

`H.q0 <M> w \vdash^* H.qy` // Turing Machine description M and finite string w, reject state

`H.q0 <M> w \vdash^* H.qn` // Turing Machine description M and finite string w, accept state

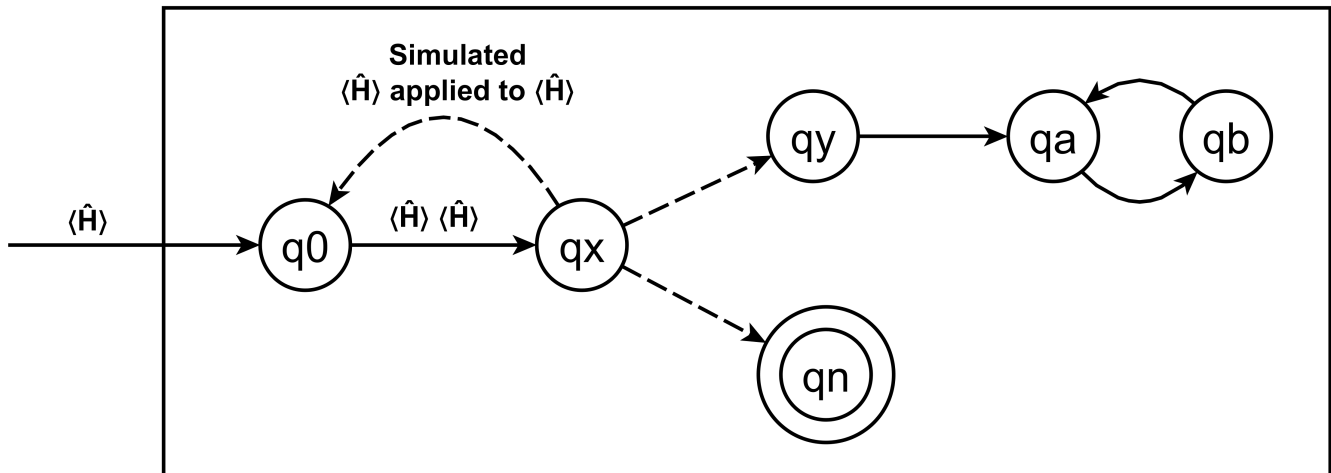
`(q0)` is prepended to H to copy the $\langle \hat{H} \rangle$ input of \hat{H} . The transition from `(qa)` to `(qb)` is the conventional infinite loop appended to the `(qy)` accept state of `embedded_H`. \vdash^* indicates an arbitrary number of moves.

The Linz term “move” means a state transition and its corresponding tape head action `{move_left, move_right, read, write}`.

`$\hat{H}.q0 <M> \vdash^* \text{embedded_H} <M> <M> \vdash^* \hat{H}.qy \infty$` // see diagram below for `(qa)` and `(qb)`

`$\hat{H}.q0 <M> \vdash^* \text{embedded_H} <M> <M> \vdash^* \hat{H}.qn$`

Analysis of Linz Halting Problem Proof



When \hat{H} is applied to $\langle \hat{H} \rangle$

$\hat{H}.q_0 \langle \hat{H} \rangle \vdash^* \text{embedded_H} \langle \hat{H} \rangle \langle \hat{H} \rangle \vdash^* \hat{H}.q_y \infty$

$\hat{H}.q_0 \langle \hat{H} \rangle \vdash^* \text{embedded_H} \langle \hat{H} \rangle \langle \hat{H} \rangle \vdash^* \hat{H}.q_n$

computation that halts... “the Turing machine will halt whenever it enters a final state”
(Linz:1990:234)

Non-halting behavior patterns can be matched in N steps

$\langle \hat{H} \rangle$ Halting is reaching its simulated final state of $\langle \hat{H}.q_n \rangle$ in a finite number of steps

N steps of $\langle \hat{H} \rangle$ correctly simulated by embedded_H are the actual behavior of this input:

(q0) The input $\langle \hat{H} \rangle$ is copied then transitions to embedded_H

embedded_H is applied to $\langle \hat{H} \rangle \langle \hat{H} \rangle$ (input and copy)

which simulates $\langle \hat{H} \rangle$ applied to $\langle \hat{H} \rangle$

which begins at its own simulated (q0) to repeat the process

This process continues to repeat until embedded_H recognizes the repeating pattern and aborts its simulation of $\langle \hat{H} \rangle \langle \hat{H} \rangle$. embedded_H can see the same repeating pattern that we see.

Every "rebuttal" simply ignores this key fact

$\langle \hat{H} \rangle \langle \hat{H} \rangle$ correctly simulated by embedded_H cannot possibly reach its own simulated final state of $\langle \hat{H}.q_n \rangle$ and halt in any finite number of steps of correct simulation.

Linz, Peter 1990. An Introduction to Formal Languages and Automata. Lexington/Toronto: D. C. Heath and Company. (317-320)

Concrete Rebuttal of Halting Theorem with fully operational software

Simulating halt decider H correctly predicts whether or not D correctly simulated by H can possibly reach its own final state in any finite number of correctly simulated steps. It does this by correctly recognizing several non-halting behavior patterns in a finite number of steps of correct simulation. Inputs that do terminate are simply simulated until they complete.

```
01 int D(int (*x)())
02 {
03     int Halt_Status = H(x, x);
04     if (Halt_Status)
05         HERE: goto HERE;
06     return Halt_Status;
07 }
08
09 void main()
10 {
11     H(D,D);
12 }
```

We form an isomorphism to the Linz Turing Machine analysis in the C programming language. It has the key required element that D attempts to do the opposite of whatever value H returns.

For any program H that might determine whether programs halt, a "pathological" program D, called with some input, can pass its own source and its input to H and then specifically do the opposite of what H predicts D will do. No H can exist that handles this case.

https://en.wikipedia.org/wiki/Halting_problem

As was proved above in the Linz example the first N steps of input D correctly simulated by simulating halt decider H are the actual behavior that D presents to H for these same N steps.

When H correctly determines (after N simulated steps) that D correctly simulated by H cannot possibly reach its own final state on line 6 and halt then H has conclusive proof that D presents non-halting behavior to H.

Execution Trace when H never aborts its simulation

main() calls H(D,D) that simulates D(D) at line 11

keeps repeating: simulated D(D) calls simulated H(D,D) that simulates D(D) at line 03 ...

This proves that D correctly simulated by H cannot possibly reach its own simulated final state at line 6 and halt in any finite number of steps of correct simulation.

When H aborts its simulation and returns 0 it is only affirming this verified fact.

H(D,D) fully operational in x86utm operating system: <https://github.com/plolcott/x86utm>

Source-code of several different partial halt deciders and their sample inputs.

<https://github.com/plolcott/x86utm/blob/master/Halt7.c>