Back to the future

Friday, May 30, 2025 1:20 PM

Administrivia.

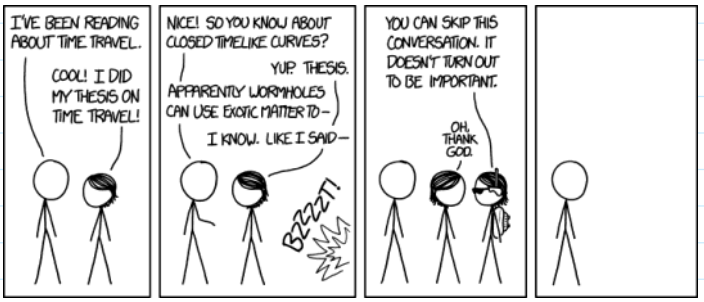
- Practice Final is out

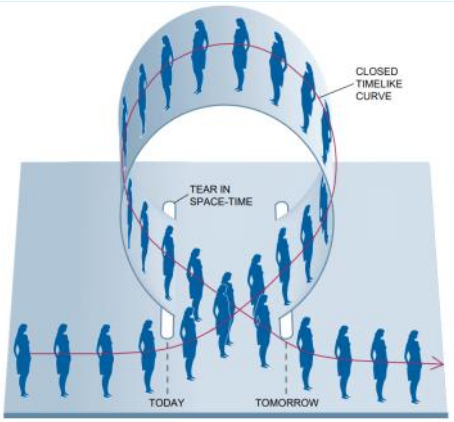
↑ Probability!

How do we use new phenomena as resource?

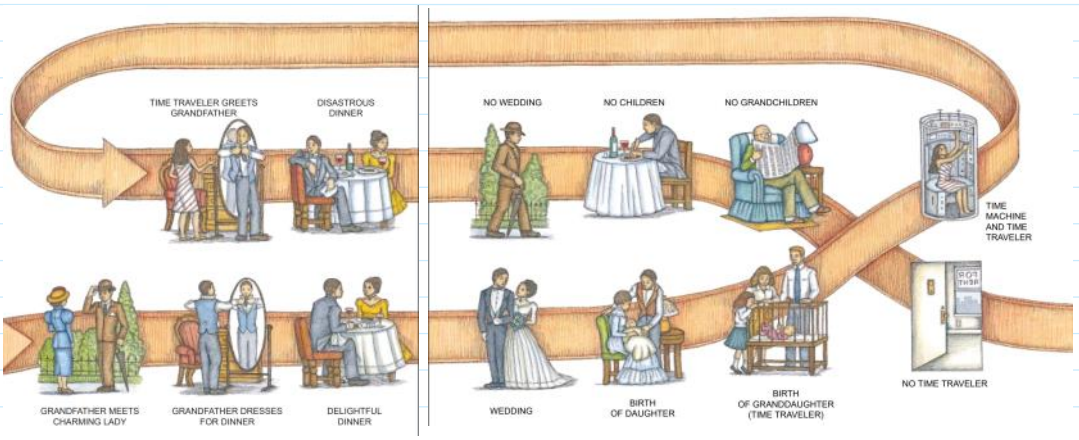
Start w/ a basic one:

Closed Timelike Curves. (CTCs)



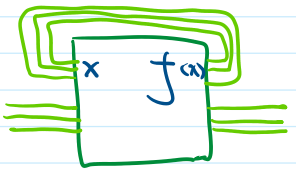


Obvious Problem:



Deutsch Model [Deutsch '91]. [Brun '03]. [Bacon '04] [Aaronson-Watrous '08]

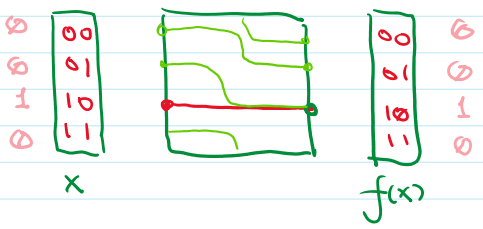
- key idea: causal consistency

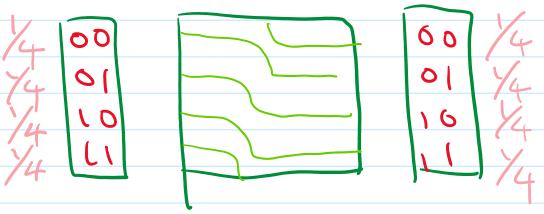


Example. SAT ϕ

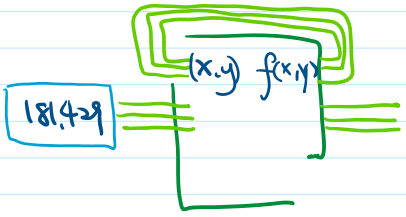
Build $f(x) = \begin{cases} x & \text{if } \phi(x) = \text{true} \\ (x+1) \bmod 2^n & \text{if } \phi(x) = \text{false}. \end{cases}$

YES instance.



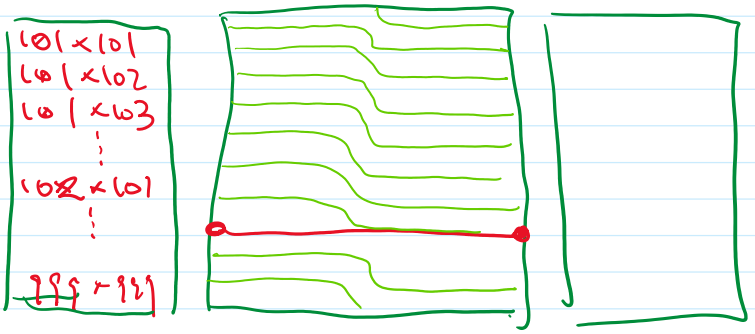


Example. [HPMOR. Ch 17].



$f(x,y)$ if $x \cdot y = 181429$

$$f(x,y)=\begin{cases}(x,y) & \text{if } x\cdot y=181,429.\\ (x,y+1) & \text{if } x\cdot y\neq 181,429. \quad y<999\\ (x+1,2) & \text{if } \quad " \quad y\geq 999\\ (101,101) & \text{if } x=y=999\end{cases}$$

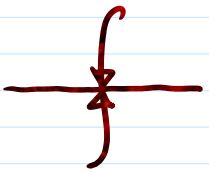


"DO NOT MESS WITH TIME."

Thm $NP \subseteq P_{CTC} = PSPACE$.

"pf": Using time like space under general relativity!

Grandfather paradox is not the obstable. $P \neq NP$ is.



Conclusion.

- Universal Computation is (one of) the greatest innovation.
- Challenges how to view the world.
- Can be modeled & studied.
- Sharpens thinking skills.

Where to go from here? (Onward!)

Thank you for learning ToC w/ me.

Fin