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**From:** Joscha Bach [REDACTED]  
**Sent:** Monday, December 31, 2018 4:54 PM  
**To:** Jeffrey Epstein  
**Subject:** Re:

This is the solution of the TSP for all towns of the US that have more than 500 residents:

The fact that TSP is NP hard does not mean that it cannot be approximated efficiently, and even solved for most practical cases. Amoebas and many other biological systems can often implement a parallel graph traversal that gives a good enough solution for a TSP like problem. However, approximate solutions to TSP cannot usually be mapped to solutions to other NP hard problems (i.e. crypto).

I suspect that we are not on the same page wrt the nature and scope of computation.

The way I see it, mathematics is the domain of all languages. All modeling takes place in a language, so modeling (including thinking, which is a kind of modeling) is a subset of mathematics. "Classical mathematics" is a branch of math that has "time-less" semantics, i.e. the mapping between the statements and its semantics (for instance, the axioms that a statement can be reduced to in a proof) can take an arbitrary number of steps, including infinitely many. Gödel could show that if we allow self referential statements, we cannot always guarantee that the proof does not lead to contradictions and the semantics of the statement become undecidable. Turing generalized Gödel's idea and demonstrated that the problem crops up once the proof can have infinitely many steps, i.e. a machine that performs the proof is not guaranteed to terminate its execution.

These problems at the foundations of classical mathematics disappear once we switch to constructive mathematics. We can recover the functionality of classical mathematics (like geometry, real numbers and continuous transitions) by replacing all entities that require infinite numbers of steps to generate by generator functions, and distinguish between values and functions. Evaluating a function comes at a cost that is being left to the one that wants to determine an approximate value.

Constructive mathematics and computation are the same thing. In computation, performing a transformation in a language comes at a non-zero cost, and infinite-cost transitions cannot be made.

My proposal is simply that the languages in which we describe our observations at the foundational level should be computational. (Constructive math is the subset of math that works, and modeling and thinking are subsets of constructive math.)

I found that many mathematicians (including Hilbert) have been constructivists for a long time, because they were aware of the implications of Gödel's proof and how to deal with it. Chaitin and others have since done a lot of work in exploring the equivalence of computation and "math that works". In my view, mathematics is a code library for thinking, with a bug that was discovered and resolved in the first half of the last century. However, most physicists are using that code library without being aware of that bug and its resolution, which may have contributed to the issues in foundational physics that prevent physicists from solving the puzzle.

Our human minds seem to have two separate modeling systems: one is perceptual, and it optimizes for coherence, i.e. consistency with the sensory input and within the model that predicts the sensory input. We are always in a possible universe, where possible refers to a state in which all the present perceptual elements are compatible with each other.

Reasoning is a separate system that repairs =erception, whenever the perception is inconsistent. Reasoning optimizes =or truth, i.e. some kind of proof, which is more narrow than coherence. =The perceptual system does not spell out its axioms.) Mathematics =ormalizes subsets or reasoning and perception in ways that always =llows proofs, usually at the cost of using a discrete low dimensional =odeling language. When we talk about things like "culture", we tend to =se language where the symbols are less narrowly defined. Wittgenstein's =project was to fix that by recovering a semantics of natural language =hat is amenable to proof. By his own estimate, he did not succeed. =arvin had the same goal, and I think he did try until the end. The =olution might be to give up on natural language as the primary carrier =f thought, and use a perceptual language instead, upon which we anchor =he natural language as a tool for disambiguation.

Let me know when there =s a good time for skype.

J

On Dec 30, 2018, at 07:40, J <jeevacation@gmail.com> wrote:

as the traveling salesman is np =oes the ameoba still compute???? or do you assume =olving a problem , is always a computation. ? is kissing =omeone a computation? does computation always involve =asurement? . is perception a computation , or is =hout a computation.? is culture a computation. ? Im =egining to think that the things that we cant measure are =ubject to different rules

On Sun, =ec 30, 2018 at 7:29 AM Joscha Bach <[REDACTED]> wrote:  
Sure! Will =e back late tonight. Tomorrow?

Am =0.12.2018 um 13:22 schrieb J <jeevacation@gmail.com>:

ok =nbsp;skype me when you have time.

On Sun, Dec 30, 2018 at 7:21 AM Joscha Bach <[REDACTED]> wrote:

On the way back from =ermany to Boston (was here for three days to give an invited talk at =he Chaos Communication Congress).

Am =0.12.2018 um 12:18 schrieb J <jeevacation@gmail.com>:

where are =ou?

On Sun, Dec 30, 2018 at =:07 AM Joscha Bach <[REDACTED]> wrote:

This year's installment of the Computation to =onsciousness series.

Thank you!

Joscha

<https://www.popularmechanics.com/science/math/a25686417/amoeba-ath/>

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