A new problem for rule following

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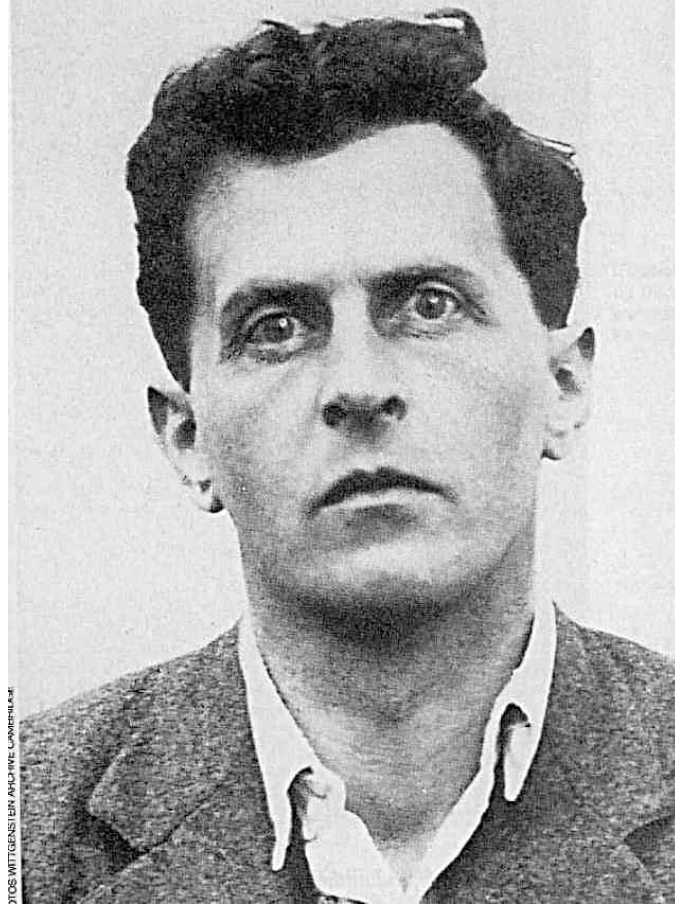
Cambridge

Non-Turing computers are the new non-Euclidean geometries

'It is absolutely impossible that anybody who understands the question and knows Turing's definition should decide for a different concept'

Hao Wang

Experiment escorts us last —
His pungent company
Will not allow an Axiom
An Opportunity

EMILY DICKINSON

The totality of our so-called knowledge or beliefs, from the most casual matters of geography and history to the profoundest laws of atomic physics or even of pure mathematics and logic, is a man-made fabric which impinges on experience only along the edges. Or, to change the figure, total science is like a field of force whose boundary conditions are experience. A conflict with experience at the periphery occasions readjustments in the interior of the field. Truth values have to be redistributed over some of our statements. Re-evaluation of some statements entails re-evaluation of others, because of their logical interconnections - the logical laws being in turn simply certain further statements of the system, certain further elements of the field. Having re-evaluated one statement we must re-evaluate some others, whether they be statements logically connected with the first or whether they be the statements of logical connections themselves. But the total field is so undetermined by its boundary conditions, experience, that there is much latitude of choice as to what statements to re-evaluate in the light of any single contrary experience. No particular experiences are linked with any particular statements in the interior of the field, except indirectly through considerations of equilibrium affecting the field as a whole.

Quine 1951 'Two dogmas of empiricism'

- Our theories capture the world
- Undetermined
- *Nothing* is immune from revision
- Fundamental revisions are rare

paradigm (a theory)

new 'evidence'

opposition

tension

revolution

new paradigm (a new theory)

Concept of Geometry

Euclidean Geometry

Lobachevskian, Reimannian Geometry

Tension

Pure geometry

        Euclidean Geometry
        Lobachevskian
        Reimannian
        Schwarzschild
        ...

Physical Geometry

General relativity, etc.

Tension (roughly late 18^{the} century-1915)

'I fear the uproar of the Boeotians' (Gauss)

Kant (EG is true a priori)

EG is 'natural', 'perfect', 'intuitive', 'intuitive', 'ideal'

Poincaré: EG is conventionally true

Russell (1897): non-Euclidean geometeries with constant curvature are permissible

Computers

New evidence is coming to light…

philosophy/logic
(infinite, paradoxes, first-
order logic M-H decidable,
determinism)

supertasks

(Version of Thomspon's Lamp,
super-computations)

mathematics
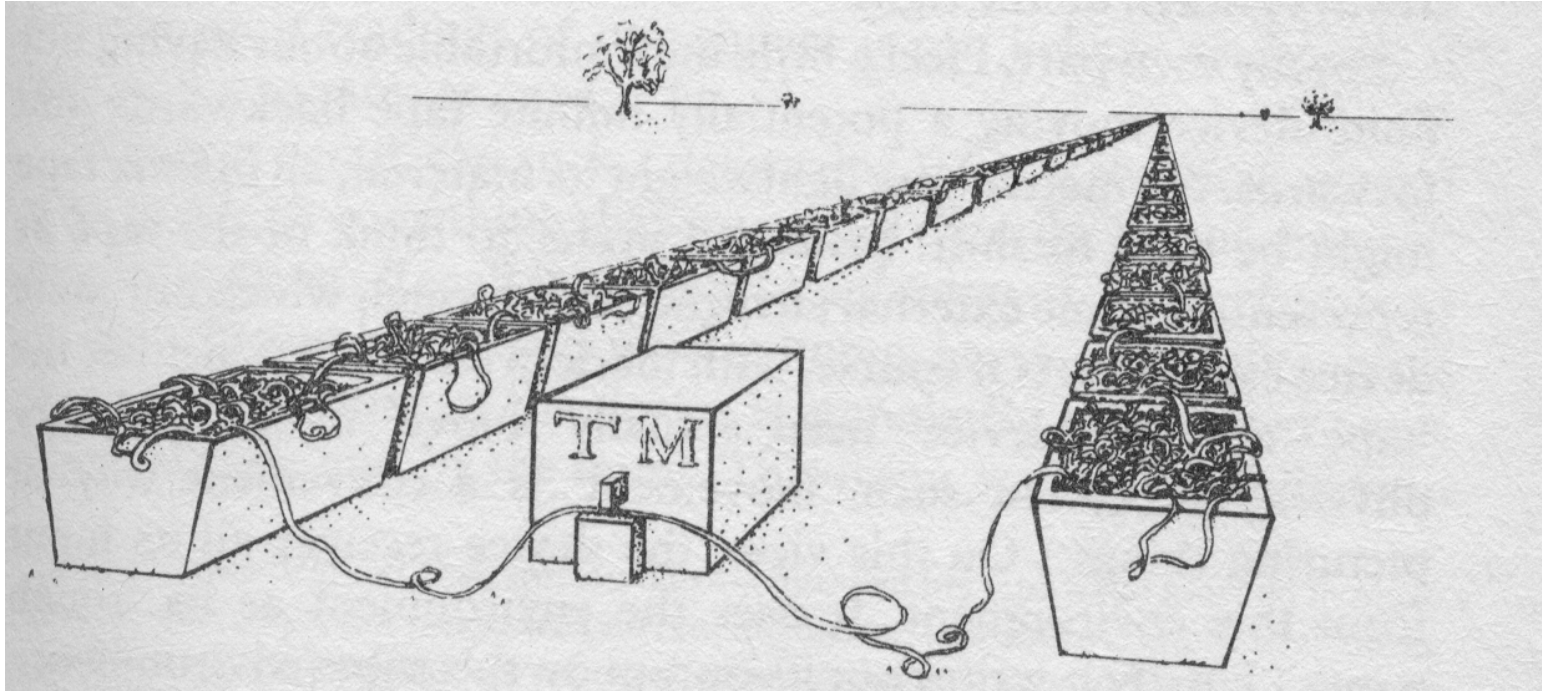
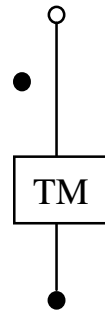(non-globally hyperbolic,
not forever spatially closed)

M-H worlds

physics

(blue-shifts, cosmic
censorship hypothesis)

computability

(new TM-based computers,
new concept of Computability)

TM

Ordinary
Turing
machine
(OTM)

Concept of Computability

The Turing machine

Various new computers (mould, SADs)

tension

Pure computability   **Physical computability**

OTM, SAD$_1$, …   Assess the physical

theories

that house these computers

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Schwarzschild
...

General relativity, etc.

Typical geometrical question:

Do the angles of a triangle sum to 180°?

Pure: Yes in Euclidean geometry, No in Lobachevskian, No in Reimannian, etc.

Physical: Actually No

Typical computability question:

Is the halting problem decidable?

Pure: No by OTM, Yes by SAD$_1$, etc.

Physical: problem connected with as yet unsolved cosmic
censorship hypothesis (Nemeti's group).

Question: Is the SAD_1 'less real' than the OTM?

Answer: Is Lobachevskian geometry 'less real' than Euclidean geometry?

Pure models do not compete, e.g. no infinite *vs.* finite

The 'true geometry' is Euclidean geometry ('Euclid's thesis')

For: 'pure', natural, intuitive, different yet equivalent axiomatizations.

Against: Reimannian geometry etc.

Neither is right (pseudo statement)

The 'Ideal Computer' is a Turing machine (CT thesis)

For: 'pure', natural, intuitive, different yet equivalent axiomatizations.

Against: SAD_1 machine etc.

Neither is right (this is no ideal computer, just as there is no ture geometry)

What is a computer?

What is a geometry?

Think Computability, think Geometry