

A New Foundation for Computing (Really?)

Four related papers

- Two Lessons of Logic, Cantwell Smith (1987)
- Biting the Silver Bullet ... Harel (1992)
- Computer Programming for Noughts-and-Crosses: New Frontiers, Beynon/Joy (1994)
- The Interpretation of States: A New Foundation for Computation, Beynon/Russ (1992)

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Two Lessons of Logic

(1) *The irreducibility of content to form*

Two 'somewhat independent' aspects of any symbol system:

First factor = mechanics (proof theory)

Second factor = meanings (model theory)

(2) *Need for a single theoretical stance*

'a vantage point from which both [factors] can be seen'

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Three assumptions of logic

- (i) that use can be ignored
- (ii) that locally the two symbolic factors can be treated independently
- (iii) that language and modelling should be treated completely differently

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Main conclusions

- In rejecting those assumptions ('untenable for AI') we must not lose sight of the two lessons
- We need 'theoretical frameworks that do justice to practice' - really hard to find
- Content (semantics) of a program is not in machine: need 'semantics of semantics', which will 'reach outside the machine'.

Biting the Silver Bullet

- 'The werewolves of one-person programs are gone, never to return'
- Complex reactive systems 'much more massive and intricate than one-person programs'
- Vanilla approach to modelling .. grand-scale improvement in constructing such systems... 'could very well match changes in solving one-person algorithmic problems'
- Means for modelling the system (visual formalisms)
- Techniques for analyzing the model (model checking, scenarios, CASE tools, code generation)

Interpretation of States (I)

Claim that computation needs reference to:

Perceived changes of state in physical processes, and the interpretation of reliable state changes

'interpretation' here refers to the recognition (or the 'making') of a correspondence between patterns of observables in model and in referent.

Interpretation of States (II)

We view Harel's distinction of 1-person programming and reactive systems in the light of Cantwell-Smith's first and second factors of a symbol system.

Both kinds of programming require interaction of the two factors while second factor more prominent in reactive systems.

Neither such interaction, nor the second factor, have support from the mathematical theory of computation.

Hence the motivation for our suggested new conceptual framework for computing - one that gives priority to experience and modelling but also embraces mathematical abstractions.