On the difficulty of describing difficult things

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Pioneering research and skills

Formal semantics: why, and why not?

- Early 1970s a time of hope for formalists
- Van Wijngaarden and IBM Vienna Lab had full language descriptions
- Hoare and Scott/Strachey had deep theoretical methods
- But shining future didn't materialise


Regus

Programming was/is hard!

- Errors in programs, worse in compilers
- Intuitive understanding OK but serious worries about correctness (cf Software Crisis)
- Core aspect of (imperative PLs): variables and values using a state
- but increasing challenges:
  - sharing; procedures; jumps; concurrency (!)

Motivations

- Theory
  - formalising foundations of computing: develop a theory
  - combat “vague feeling of unease”

    C. Strachey. Towards a formal semantics. In Formal Language Description Languages. *North-Holland, 1966.*
- Practice
  - correctness of compilers
  - designing programming languages
  - standardisation

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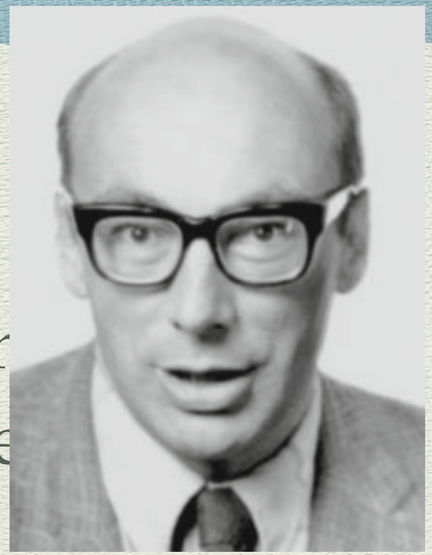
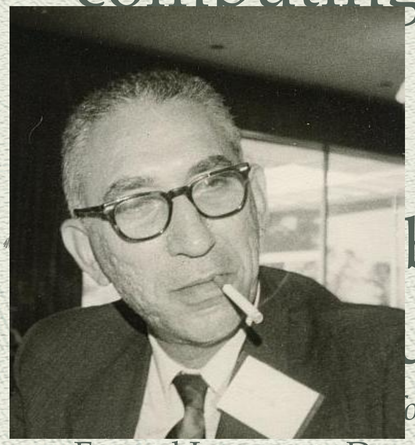


Motivations

computing: develob



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Formal Language Descri

North-Holland, 1966.

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Different approaches

- Fundamental similarities (see [JA18])
- But notational differences made serious impact on usability
- Often result of different backgrounds
- *But* most came to semantics from language design

Different approaches

Hoare: […] But, of course, difficult things are difficult to describe.

Strachey: What is “difficult” very much depends on the frame-work of thinking.

Kurt Walk. Minutes of the 3rd meeting of IFIP WG 2.2 on Formal Language Description Languages, April 1969. Held in Vienna, Austria. Chaired by T. B. Steel.

Organisations

- Academic: MC, PRG, Stanford…
  - "highly critical and thoughtful atmosphere in which *ad hoc* or superficial ideas are given very short shrift"—Strachey

    Christopher Strachey. Curriculum vitae. Christopher Strachey Collection, Bodleian Library, Oxford. Box 248, A.3., 1971.
  - Commercial: IBM
  - Need for a product always a constraint
- Umbrellas: ACM, IFIP

Collaborations

- Landin/Strachey; Scott/Strachey; PRG students
- Edinburgh hub around Milner/Burstall
- VAB a group: Bekič, Jones also travelled
  - one early influence a visit from Scott in 1969—traces a line back to van Wijngaarden!
- IFIP WG 2.2 a counter example

The semantics problem

- Does a new language give meaning?
  - "Because it takes pages and pages of gobbledygook to describe how a programming language works, it's hard to prove that a given program actually does what it is supposed to. Therefore, programmers must learn not only this enormously complicated language but, to prove their programs will work, they must also learn a highly technical logical system in which to reason about them."
    Claire Stegmann and John W. Backus. Pathfinder. Think, 45(4), July / August 1979.
- McCarthy: "nothing can be explained to a stone"
  John McCarthy. A formal description of a subset of ALGOL 60. In Formal Language Description Languages. *1966*

Too complex!

UDL-III version III

IBM Vienna's full formal definition of PL/I

On ALGOL 68

TURSKI: In Grenoble we decided that the proposed description method is a milestone in the development of the language.

RANDELL: A milestone or a millstone?

General laughter follows.

W. M. Turski. Minutes of the 8th meeting of IFIP WG 2.1. May 1967. Held in Zandvoort, Netherlands. Chaired by W. L. van der Poel.

Or not expressive enough?

Caracciolo: A reduction to simpler questions would mean to omit the proper problem.

Scott: Only the most primitive, non-problematic things have been dealt with using this approach.

Laski: A language definition should specify as little as possible.

Kurt Walk. Minutes of the 3rd meeting of IFIP WG 2.2 on Formal Language Description Languages, April 1969. Held in Vienna, Austria. Chaired by T. B. Steel.

Impactful elsewhere

- Defining the whole of a PL was a huge task
- So: separate problem and address instead:
  - program correctness
  - or concurrency
  - or type theory
  - *or* build semantics into PL (functional)
- … all influenced by classic formal semantics

Please read my thesis :-)

- Great to join history of computing community
- Thanks to HaPoC for supporting me so far
- (and PROGRAMme too)
- Coming up next: concurrency!

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