Formalism in the Forest

The 1964 IFIP Formal Language Description Languages Working Conference

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Before we start...
λ notation

- Alonzo Church (1932)
- Notation for un-named functions & set of conversion rules
- \( \lambda x. xx \)
- \( \lambda f. \lambda x. f x \) (1)
- \( \lambda f. \lambda x. f f x \) (2) … etc
Background: HLLs

- Emerging complexity in control
- High-level languages:
  - FORTRAN 1954, B-O 1955
- Compiler correctness
- Understanding computation
Background: IFIP

- May 1958, ACM/GAMM project for ‘International Algorithmic Language’
  - = ALGOL 58
- TC-2, WG2.1
  - = ALGOL 60
Background: formalism

- ALGOL 60 report
- Syntax definition: BNF
- McCarthy brings abstraction in 1962
4.2. Assignment statements

4.2.1. Syntax.

\[ \langle \text{left part} \rangle ::= \langle \text{variable} \rangle ::= \]
\[ \langle \text{left part list} \rangle ::= \langle \text{left part} \rangle \mid \langle \text{left part list} \rangle \langle \text{left part} \rangle \]
\[ \langle \text{assignment statement} \rangle ::= \langle \text{left part list} \rangle \langle \text{arithmetic expression} \rangle \mid \]
\[ \langle \text{left part list} \rangle \langle \text{Boolean expression} \rangle \]

4.2.2. Examples. \( s := p[0] := n := n + 1 + s \)
\( n := n + 1 \)
\( A := B/C - v - q \times S \)
\( s[v, k + 2] := 3 - \arctan(s \times \zeta) \)
\( V := Q > Y \land Z \)

4.2.3. Semantics. Assignment statements serve for assigning the value of an expression to one or several variables. The process will in the general case be understood to take place in three steps as follows:

4.2.3.1. Any subscript expressions occurring in the left part variables are evaluated in sequence from left to right.

4.2.3.2. The expression of the statement is evaluated.

4.2.3.3. The value of the expression is assigned to all the left part variables, with any subscript expressions having values as evaluated in step 4.2.3.1.
Conference suggestion

- TC-2 organised and sponsored; Zemanek chaired
- Partial IBM funding
- Minutes show narrowing of focus
- Friedrich Bauer: “the problem today is to find or develop suitable formalization to reduce recurrent languages and concepts to the usable level.”
Conference intention

- Brian Randell: “meeting of minds” intended

- “I remember one or two of the theorists—I think Saul Gorn and another one [...]—being overheard walking along, I think one with his arm around the other’s shoulders [...] saying something along the lines of ‘Well there’s them and there’s us.’”
Program
Location

- Baden-bei-Wien, Krainerhütte hotel
- 15th–18th September 1964
- Sandwiched in between WG2.1 meetings
Structure & proceedings

- Multisession
- Proceedings edited by Tom Steel include discussions
- Scientific secretaries
- Excursions
John McCarthy

- Member of WG2.1
- Previous: LISP, science of computation
- ‘A formal description of a subset of ALGOL’
- Introduced abstract syntax & abstract interpretation
- Interesting subset choice; operational semantics
Aadrian van Wijngaarden

- “Founding father of Dutch computer science”
- ‘Recursive definition of syntax and semantics’
- Syntactical rewriting approach
- Transformation of procedures particularly noteworthy
Vienna Lab

- Staffing and organising
- One talk: Kurt Walk ‘Entropy and Testability of Context-Free Languages’
- Conference as a learning experience
Tony Hoare

- Present as new member of WG2.1

- No paper, but valuable comment

- “First, we must give a great deal of thought to deciding which things we want to leave imprecisely defined. Second, in any formal or informal description of a language, we must have a mechanism for failing to define things.”
Christopher Strachey

- Computing science pioneer
- ‘Towards a formal semantics’
- Early ideas which led to denotational semantics
- Mapping to known domain of functions
Peter Landin

- Working for Strachey’s consultancy business
- ‘A formal description of ALGOL 60’
- Lambda-based IAEs
- SECD machine
Fraser Duncan

- After-dinner speaker: ‘Our ultimate metalanguage’
- Went missing, and was reluctant to speak
- ‘Encouraged’ to speak: talk was amusing but made a serious point
Aftermath

- WG2.1: Reception somewhat lukewarm!
- ALGOL 68
- Vienna: PL/I
- Strachey: Denotational semantics
- Hoare: Axiomatic basis
COMPUTING SCIENCE

An Exegesis of Four Formal Descriptions of ALGOL 60

Cliff B. Jones, Troy K. Astarte

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