30 Years of Higher-Order Unification

Gérard Huet

INRIA

TPHOL 2002, Hampton

35 Years of Higher-Order Unification

Gérard Huet

TPPHOL 2007, Some far away place

40 Years of Higher-Order Unification

Not me!

TPPHOLT 2012, Trou les Oies

Too much is too much

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\begin{gripe}
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- Too many papers on too narrow topics
- Not enough thematic mobility
- Not enough interdisciplinary work
- Too much Brownian Motion Research

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\end{gripe}
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Mating

`\begin{benediction}`

- At LICS in Santa Cruz, Dana Scott preached the Wedding of Logic and CS
- Today I preach Free Love among Disciplines

`\end{benediction}`

Preaching (in the desert)

Warning. Advice intended for students and young scientists.

`\begin{preach}`

- Change research topic every 5 years
- Change discipline at least once in your career
- Open-mindedness
- Seek Applications for the Joy of it
- Do what only you can do
- Ne soyez pas un mouton de Panurge
- Don't try to own a topic

`\end{preach}`

Between Logic and Algebra

- Linear Logic as Logical Foundations
- No Contraction, no Weakening
- Sequents as Bags of Literals
- Lambek Syntactic Calculus \ /
- Non Commutative LL
- Non Associative LL
- Pregroups

What I attempted to do

- A commented bibliography on the topic
- With some reference to applications
- What happened

In a nutshell

- Dowek. Handbook of automated theorem proving.
- Miller's patterns and mixed prefixes
- λ Prolog
- Dependent Types
- Decidability of restricted matching
- Mixing β and equations
- Rewrite Logic, Explicit Substitutions
- Ooge de Moor & Sittampalam. Matching order 2.5.
- Loader. Higher-order β matching is undecidable.

The main results in my PhD

- Undecidability
- Non-well foundedness
- Constraints
- Pre-unifiers

One of my Trento slides

Non-deterministic programming is no big deal. Why should you surrender control to a PROLOG blackbox ?

The three golden rules of non-deterministic programming:

- Identify well your search state space
- Represent states as non-mutable data
- Prove termination

The last point is essential for understanding the granularity and enforcing completeness.

The main results in my Doctorat d'Etat

- Correct definition of CSU
- CSM Pre-unifiers
- Second-order matching
- Implementation
- Principal Unifiers of Regular Terms

The main open problems at the time

- Second-order unification
- Associative unification
- 3rd and higher order matching

Where to find HO terms

- in mathematical descriptions
- in logical proofs
- in computer programs
- in semantic descriptions of natural language
- in DNA patterns ?
- in ...

Applications

- Proof assistants and theorem provers
- Software engineering
- Computational linguistics
- Health ?

Computational Linguistics and HOU

- Montague Semantics
- Anaphora resolution
- Pronouns
- Focus
- Ellipsis
- Accent
- Colors

Anaphora Resolution

- John likes Mary and Peter does too.
- $like(j, m) \wedge R(p)$
- $R(j) = like(j, m)$
- $R \leftarrow \lambda x.like(x, m)$

More complex examples

- John likes his wife and Peter too.
- John says that he likes his mother and Peter does too.
- John spent his paycheck but Peter saved it.
- Mary wants to go to Spain and Fred wants to go to Peru but because of limited resources, only one of them will.

Speech and Linguistics

- The Watergate tapes
- Language as a playpen for linguists
- Typical papers in CL
- Non-well foundedness of publications

Promising future investigations ?

- Proof nets & GoI
- Computational Mathematics
- Constraints engines
- Cayenne
- Literate Programming
- Understanding natural language
- Understanding genes
- Cognitive Science