EuroProofNet: Overview of Work by WG6 Type Theory

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Activities of WG6 Type Theory
https://europroofnet.github.io/wg6/

- 17-18 April 2025: WG6 meeting, Genoa, Italy
  https://europroofnet.github.io/wg6-genoa/

- 4-5 April 2024: WG6 meeting, Leuven, Belgium
  https://europroofnet.github.io/wg6-leuven/

- 24-25 April 2023: WG6 meeting, Vienna, Austria
  https://europroofnet.github.io/wg6-vienna/

- 20-21 May 2022: kickoff meeting Syntax and Semantics of Type
  Theories, Stockholm University, Sweden
  https://europroofnet.github.io/wg6-kickoff-stockholm/

The work of WG6 has been:

- by research groups

- by individual researchers

- on various tasks, primarily focussed on developments of layers of Syntax-Semantics Interfaces

- Type Theory:

  - specific varieties, on specific tasks

  - generalised Type Theory for covering the mathematical notion of algorithm

- for applications to and developments of Proof and Verification systems, in implemented, computerised systems:

  - fully automatic

  - user-guided assistance by proof and verification systems

- Type-Theoretic Denotational Semantics

- Algorithmic Syntax-Semantics Interfaces for computing denotations, via algorithmic Type Theories, e.g.:
  Type-Theory of Acyclic / Full Recursion L_{ar}^{λ} / L_r^{λ}

  - translations between Computational Syntax-Semantics of Natural Language of Mathematics and suitable versions of Type Theories

  - Type Theory provides reduction calculi of reducing logic terms to canonical forms

  - terms in canonical forms provide algorithmic computations of denotational values of terms and proof objects, e.g., lemmas and theorems

  - parametric algorithms including parametric data to be instantiated by specific objects

Theoretical development of Type Theory of Recursion and Algorithms (TTR, TTA), ready for implementations of:

- algorithmic syntax-semantics interfaces, at the object level, within TTR, TTA:

- ready for computerised system of extended reduction calculus of TTR, TTA

- algorithmic syntax-semantics interfaces, between Computational Grammar of Natural Language of Mathematics and TTR, TTA

- translations between formal languages of logic frameworks (esp., Deducti) and TTR, TTA

- D15. Prototype implementation of the mathematical framework, with basic user interface, user documentation and gallery of examples of type theories:

  - BiSikkel: A Multimode Logical Framework
    A proof-of-concept prototype demonstrating the feasibility and advantages of multi-mode embedded type theory in off-the-shelf proof assistants

  - References:
    BiSikkel: A Multimode Logical Framework in Agda Authors: Joris Ceulemans, Andreas Nuyts, Dominique Devriese
    https://arxiv.org/abs/2207.00843
    https://dl.acm.org/doi/abs/10.1145/3704844

- D15. Prototype implementation of the mathematical framework, with basic user interface, user documentation and gallery of examples of type theories:

    - an upper level prototype system that is highly instrumental for further developments:
    Andromeda 2: a proof checker for user-definable dependently-typed theories
    by Andrej Bauer and others, Ljubljana, Slovenia
    `https://www.andromeda-prover.org/`

    - Andromeda 2 has been updated to compile on latest version of OCaml and made it compliant with the OCaml package manager, and easy to install

    Thanks for the EuroProofNet: Looking Forward!