

# EU TYPES WG 3: Types in Programming

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(Email me: include "COST WG 3" in subject)

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# Tasks

- ① The design, study and deployment in a concrete programming environment of type theories that capture other properties **beyond functional correctness**, for example, *resource usage*, matching *communications*, *secure multi-party computation*, and *modularity*. (Related to WG1)
- ② Design and deployment of **new strongly typed programming languages**, update of existing languages with refined type systems based on the findings of this work group.
- ③ Automated reasoning tools and proof assistants, including **type inference** (possibly also for untyped code), **program synthesis**, and **matching** (for example to retrieve a piece of code from a library that should satisfy a given specification).

# Progress reports for WG3 I

## ① Patrick Bahr and Rasmus Møgelberg

- Modal type theory (RaTT) based on guarded recursion for implementing and verifying reactive programs. Simply-typed version at ICFP 2019: *Simply RaTT: A Fitch-style Modal Calculus for Reactive Programming Without Space Leaks.*

## ② Henning Basold:

- A language for probabilistic guarded recursion based on a generalization of the topos of trees to arbitrary well-ordered index categories.  
CALCO-paper *Coinduction in Flow: The Later Modality in Fibrations.*

## ③ Lars Birkedal:

- With L. Skorstengaard and D. Devriese: POPL-2019 paper *StkTokens: enforcing well-bracketed control flow and stack encapsulation using linear capabilities* and *Reasoning about a capability machine with local capabilities: Provably safe stack and return pointer management.*

## Progress reports for WG3 II

- With A. Karbyshev, K. Svendsen, A. Askarov: POST-2018 paper *Compositional non-interference for concurrent programs via separation and framing.*
- ④ Jesper Cockx:
  - ICFP-2018 paper *Eliminating dependent (co)pattern matching.*
- ⑤ Bas Spitters: **Opening 7.5MEUR blockchain research center with strong emphasis on type theoretic verification and types in industry**, see <http://cs.au.dk/research/centers/concordiumaudk/>.
  - CSF-2018 paper on types and security (easycrypt): *Computer-aided proofs for multiparty computation with active security* with H. Haagh, A. Karbyshev, S. Oechsner, P-Y. Strub.
  - An Application of Computable Distributions to the Semantics of Probabilistic Programs* with D. Huang, G. Morrisett.
  - CoqPL'19: *WIP: Formalizing the Concordium consensus protocol in Coq* with T. Dinsdale-Young, D. Tschudi and S. E. Thomsen.

# Short Term Scientific Missions in WG3 I

Guest	Institute	Host	Institute
Paola Giannini	U. del Piemonte Orientale	Violet Ka I Pun	W. Norway U. of Applied Sciences
		<i>Using behavioural types and syntactic models of imperative calculi in the formalization and analysis of reliable systems.</i>	
Violet Ka I Pun	W. Norway Applied Sciences	Ferruccio Damiani	U. Torino
		<i>Behavioural Aggregate Computing for the Internet of Things</i>	
Alceste Scalas	Imperial Coll.	Silvia Ghilezan	U. Novi Sad
		<i>Precise subtyping for interleaved multiparty sessions</i>	
Nobuko Yoshida	Imperial Coll.	Silvia Ghilezan	U. Novi Sad
		<i>Precise subtyping for interleaved multiparty sessions</i>	
Nobuko Yoshida	Imperial Coll.	Dimitrios Kouzapas	U. Cyprus
		<i>A Uniform Framework for Governed Multiparty Session Semantics</i>	

# Short Term Scientific Missions in WG3 II

Radu Ometita

Fac. of Inform.,

Jorge A. Pérez

U. Groningen

Iasi, RO

*Using behavioral types for verifying communication correctness in the Scilla language.*

Wen Kokke

U. Edinburgh

Fabrizio Montesi

U. Southern DK

*Better Late Than Never: A Fully Abstract Semantics for Classical Processes*

Simona terovic

Kas-

U. Novi Sad

Alex Simpson

U. Ljubljana

*Probabilistic reasoning in lambda calculus*

Ohad Kammar

U. Edinburgh

Matija Pretnar

U. Ljubljana

*Eff-Bayes: a modular Bayesian inference library with algebraic effects and handlers*

Edwin Brady

U. St Andrews

Nicola Botta

ETH Zurich

*Abstraction in Idris for Sequential Decision Problems*

# Short Term Scientific Missions in WG3 III

Paolo Giarrusso   EPFL Laussane   Lars Birkedal   Aarhus U.

*Step-indexed logical relations for Dependent Object Types*

# WG3 topics at this meeting I

- Stephanie Weirich: *A Dependently-Typed Core Calculus for GHC*
- WG3 session (Thu afternoon): Types for programming, metatheory
  - Pedro Rocha and Luís Caires:  
*Towards Curry-Howard for Shared Mutable State*
  - P. Bahr, C. U. Graulund and R. E. Møgelberg:  
*Simply RaTT: A Fitch-style Modal Calculus for Reactive Programming*
  - Kenji Maillard, Danel Ahman, R. Atkey, G. Martinez, C. Hritcu, E. Rivas and E. Tanter: *Dijkstra monads for all*
  - Stefan Monnier and Nathaniel Bos:  
*How Erasure is Linked to (im)Predicativity*
- Friday:
  - Adam Chlipala: *Challenges Scaling Type-Theory-Based Verification to Cryptographic Code in Production*
  - Abhishek Dang and Piyush Kurur: *Verse - An EDSL in Coq for verified low-level cryptographic primitives*

## WG3 topics at this meeting II

- Anton Setzer: *A Model of the Blockchain using Induction-Recursion*
- Robert Atkey and James Wood: *Linear metatheory via linear algebra*

# Events

- Past:
  - WG meeting at Aarhus University, DK, October 8-9 (Lars Birkedal, Bas Spitters).
  - WG meeting in Krakow, PL, 23-24 February 2019 (Keiko Nakata, Aleksy Schubert).
- Participate:
  - FSCD 2019, 24-30 June, Dortmund, DE.
  - ICFP 2019, 18-23 August, Berlin, DE.
  - Type-Driven Development TyDe 2019, 18 Aug 2019, with ICFP.
  - ITP 2019, 9-12 Sep, Portland, Oregon, US, with Coq Workshop 2019 and Proof Ground: Interactive Proving Contests
  - PPDP 2019, 7-9 Oct, Porto, PT.
- Contribute:
  - POPL 2020 (**10 Jul**) and CPP 2018 (**21 Oct**), 19-25 Jan 2020, New Orleans, US.
  - CoqPL 2020 !?

# Dissemination

- Results of WG should be more visible.
- Gather results on webpage <https://eotypes.cs.ru.nl>.
- Link from STSMs on <https://eotypes.cs.ru.nl/STSMs> to result (paper, summary).