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Giulio Manzonetto
Curriculum Vitae

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Curriculum Vitae

Personal Information

First name/Surname: Giulio Manzonetto,
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Nationality: Italian,
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Known languages: Italian (mother tongue), French (fluent), English (fluent).

Research experience

Giulio Manzonetto obtained Bachelor's and Master's degrees in Computer Science at the University of Venice. In both cases he wrote a thesis on Logic and Mathematical Foundations of Computer Science under the supervision of Antonino Salibra. During the last year of his Master, he spent five months at the Vrije University of Amsterdam, participating in the activities of Jan Willem Klop's research team. In 2008 he received a joint European doctoral degree in Computer Science from the University of Venice and the University Paris 7 under Chantal Berline and Antonino Salibra. From September 2007 to December 2008 he worked as a post-doc (ATER) at University Paris 7. From January 2009 to October 2009 he worked under Jean-Jacques Lévy as a post-doc at INRIA-Rocquencourt in the MOSCOVA team. From November 2010 to April 2010 he worked as a post-doc at University Paris 13. From May 2010 to August 2011 he held a postdoctoral position at Radboud University of Nijmegen under Henk Barendregt. Since September 2011 he is "Maître de Conférences" (roughly equivalent to the US Associate Professor position) at University Paris 13, Laboratory LIPN. In 2016 he has spent one year at the University Paris 7, laboratory IRIF, in *délégation CNRS*. He received the *Habilitation à diriger des recherches* on March the 7th, 2017.

Education

03/2017	*Habilitation à diriger des recherches.* Institut Galilée, University Paris 13. Thesis: Lambda calculus, linear logic and symbolic computation. Defense: 3rd March 2017.
11/2004–10/2007	*Co-tutored European PhD in Computer Science*. Ca'Foscari University of Venice and University Paris 7 of Paris. Advisors: Antonino Salibra and Chantal Berline. Thesis: Models and theories of λ-calculus. Defense Date: 18th February 2008.
09/2002–10/2004	*Laurea Magistrale [M.Sc.] in Computer Science*. Ca'Foscari University of Venice, Italy. Graduated with full marks: 110/110 cum laude. Advisor: Antonino Salibra. Master Thesis: Topologies and λ-calculus. (In italian)
09/1999–10/2002	*Laurea Triennale [B.Sc.] in Computer Science*. Ca'Foscari University of Venice, Italy. Level in national classification: 108/110. Advisor: Antonino Salibra. Bachelor Thesis: About the approaches on the abstract theory of computability. (In italian)

Attended Phd Schools

07/2015	*Summer School in Logic*, Helsinki, Finland.
02/2012	*Logic and Interactions 2012 — 3rd week* Proofs and Programs, Marseille, France.
07/2010	*5th International School on Rewriting (Advanced Track)*, Utrecht, The Netherlands.
05–06/2006	*34th Spring school in Theoretical Computer Science (EPIT 2006): Games in semantics and verification*, Ile de Ré, France.
01–02/2006	*Geometry of Computation 2006 (Geocal06)*, Marseille, Luminy, France.
07/2005	*Lipari School. Formal Methods: Theory And Practice 17th, International School for Computer Science Researchers*, Lipari Island, Italy.
03/2005	*International School for Graduate Studies in Computer Science*, Bertinoro, Italy.

Employments

09/2011–To Date	*University Paris 13*. Maître de Conférences.
05/2010–08/2011	*Radboud University*. Postdoctoral position, Calmoc project.
11/2009–04/2010	*University Paris 13*. Postdoctoral position at LIPN, Collodi project.
01/2009–10/2009	*INRIA-Rocquencourt*. Postdoctoral position in the MOSCOVA team, ParSec project.
09/2007–12/2008	*University Paris-Diderot, Paris 7, France*. Post-doc (ATER).
09/1999–09/2003	*i.SenSE society*. Developer and Project Manager.

Teaching Activities (see Figure 1)

2011-To Date	Teaching at University Paris 13, France.
2010	Teaching assistant at Radboud University, Netherlands.
2007–2008	Post-doc with teaching duties (ATER) at Paris 7, France.
2007	Teaching assistant at Paris 11 University, France.
2002–2004	Teaching assistant at Ca'Foscari University, Italy.

Since September 2011 Manzonetto is *maître de conférences* at the IUT of Villetaneuse, within the Department R&T (Computer networks and telecommunications). In this context, he has been responsible for several courses, he gave CM's (plenary lectures), TD's (theoretical exercises) and TP's (practical exercises) of computer networks, operating systems and programming in Python. He also taught the course of advanced functional programming at the Master 2 "Programmation et Logiciels Sûrs" of the Institut Galilée. The programming language used in this course was Ocaml. For all the courses mentioned above, he participated in the preparation of the lecture notes, the exercises and the exams as well as in their evaluation. He acted as tutor for several students during their internship of DUT and Licence Professionnelle. He supervised groups of students for the programming language project known as *projet tutoré*.

In 2010 Manzonetto has taught some lessons of advanced lambda calculus (level Master 2) at the Radboud University. From September 2007 to December 2008, Manzonetto worked as an ATER at the University Paris 7, where he taught the TD's and TP's of several courses of level L3 and M1. The programming languages that were used are Ocaml and Java.

In January 2007 he has been teaching assistant at the University Paris Sud, where he gave TD's on advanced databases (level L3). During his Master studies and his first year of PhD, he taught at Ca'Foscari University the TD's of computer architecture and computability (level equivalent to L1 and L3).

We refer to Figure 1 for a detailed list of Manzonetto's teaching activities. The starred titles correspond to courses including a project: for these courses he also participated in the preparation of the project and in the evaluation of the outcomes.

Pedagogical Tutoring.

Internship at industries

2018-2019	Amine Ben Meddah: DUT-R&T, internship at Aigle Azur Subject: Configuration of software for network supervision.
2017-2018	Emmanuel Ilunga Wa Ilunga: LP-ASUR, internship à HILT Technology. Subject: Configure a server NAS.
2015-2016	Axel Ducoron: LP-ASUR, internship at OGEC La Salle Notre-Dame de la Gare. Subject: Network administration for the institute.
2015-2016	Mehdi Zaraba: LP-ASUR, internship at Orange. Subject: Technical support for telecommunications.
2015-2016	Stephan Rosse: DUT-R&T, internship at LIPN. Subject: System administration.
2014-2015	Dorian Sassatelli: LP-ASUR, internship at Orange. Subject: technical education and conception.
2014-2015	Hegel Clervil: LP-ASUR, internship at Air Liquide. Subject: Security of industrial networks.

Title	Level	Kind	Year	Univ.	Hrs
Local area networks	DUT1	CM/TD/TP	2020	IUT Paris 13	33
Programming in Python	DUT1	TP	2019	IUT Paris 13	30
Network architecture and principles	DUT1	CM/TD/TP	2019	IUT Paris 13	40
Introduction to business networks	DUT1	CM/TD/TP	2019	IUT Paris 13	40
Bases of operating systems	DUT1	CM/TP	2019	IUT Paris 13	32
Local area networks	DUT1	TP	2019	IUT Paris 13	12
Introduction to business networks	DUT1	CM/TD/TP	2018	IUT Paris 13	34
Bases of operating systems	DUT1	CM/TP	2018	IUT Paris 13	32
Network architecture and principles	DUT1	CM/TD/TP	2018	IUT Paris 13	38
Programming in Python	DUT1	TP	2018	IUT Paris 13	27
Local area networks	DUT1	TP	2017	IUT Paris 13	12
Introduction to business networks	DUT1	CM/TD/TP	2017	IUT Paris 13	74
Network architecture and principles	DUT1	TD/TP	2017	IUT Paris 13	26
Programming 1*	DUT1	TP	2017	IUT Paris 13	35
Bases of operating systems	DUT1	TP	2017	IUT Paris 13	7
Advanced functional programming*	M2	CM/TD	2016	Institut Galilée	22
Local area networks	DUT1	TD/TP	2016	IUT Paris 13	30
Introduction to business networks	DUT1	TD/TP	2015	IUT Paris 13	37
Network architecture and principles	DUT1	CM/TD/TP	2015	IUT Paris 13	42
Bases of operating systems	DUT1	CM/TP	2015	IUT Paris 13	47
Advanced functional programming*	M2	CM	2015	Institut Galilée	22
Introduction to business networks	DUT1	TD/TP	2014	IUT Paris 13	30
Bases of operating systems	DUT1	CM/TP	2014	IUT Paris 13	32
Advanced functional programming*	M2	CM	2014	Institut Galilée	22
Local area networks	DUT1	TD/TP	2014	IUT Paris 13	24
Network architecture and principles	DUT1	CM/TD/TP	2013	IUT Paris 13	40
Initiation to business networks	DUT1	TD/TP	2013	IUT Paris 13	27
Bases of operating systems	DUT1	CM/TP	2013	IUT Paris 13	32
Computer networks IV	DUT1	TD/TP	2013	IUT Paris 13	39
Introduction to operating systems	DUT1	TP	2012	IUT Paris 13	21
Computer networks I	DUT1	CM/TD	2012	IUT Paris 13	43
Computer networks II	DUT1	TD/TP	2012	IUT Paris 13	24
Computer networks IV	DUT1	TD/TP	2012	IUT Paris 13	39
Introduction to operating systems	DUT1	TP	2011	IUT Paris 13	24
Computer networks I	DUT1	TD	2011	IUT Paris 13	24
Computer networks I	DUT-FC1	CM/TD	2011	IUT Paris 13	20
Computer networks II	DUT1	TD/TP	2011	IUT Paris 13	24
Advanced lambda calculus	M2	CM	2010	Radboud	6
Compiling*	M1	TD/TP	2008	Paris 7	26
Functional programming*	L3	TP	2008	Paris 7	26
Introduction to Java*	M1	TP	2008	Paris 7	26
Project of programming*	M1	TP	2008	Paris 7	25
Syntactical analysis and compiling*	L3	TD/TP	2008	Paris 7	28
Artificial intelligence	M1	TD	2007	Paris 7	28
Algorithms	L3	TD	2007	Paris 7	20
Advanced databases	L3	TP	2007	Paris 11	3
Computer architecture / Computability	L1 / L3	TD	2002–04	Ca'Foscari	80
Total					**1093**

Figure 1: Legend: M = Master, L = Licence (eq. Bachelor), CM = Plenary lectures, TD = Theoretical exercises, TP = Practical exercises. DUT = Technological University Diploma, FC = Formation continue.

2014-2015	Florian Grémiaux: DUT-R&T, internship at LIPN. Subject: Implementation of 802.1x and Kerberos protocols.
2013-2014	Hamdane Hamada: DUT-R&T, internship at SFR Business team Subject: Technical support for telecommunications.
2013-2014	Yapo Seka: DUT-R&T, internship at Coriolis Telecom Subject: Technical support for telecommunications.

Computer Science Project / Projet Tutoré (DUT-R&T)

2015-2016	Stephan Rosse, Breandan Lesueur. Subject: Creating virtual machines with MAGEIA OS for the software Marionnet.
2014-2015	Mamadou Diao Bah, Hicham Haiba, Ismail Moumni, Vivek Sivaneswaran. Subject: Integrating CISCO components in the software Marionnet.

Administrative Responsibilities

At the University of Paris 13 Manzonetto currently has responsibilities at Department level:

2019-To Date	Director of the 2nd year of DUT (directeur des études), IUT of Villetaneuse, Department R&T. Duties: prepare the schedule of the courses, coordinate the professors, handle the students, supervise the research of an internship, organize the final jury.
2019-To Date	Responsible R&T for the International Exchange Program.
2019-To Date	Representative R&T for the Classroom Committee.
2017-To Date	Member of the Department R&T Council of the IUT of Villetaneuse.

Previous responsibilities:

2017-2019	Director of the 1st year of DUT (directeur des études), IUT of Villetaneuse, Department R&T. Duties: prepare the schedule of the courses, coordinate the professors, handle the students, organize additional pedagogical support for weak students (Tutorat).
2013-2016	Director of the 2nd year of DUT (directeur des études), IUT of Villetaneuse, Department R&T. Duties: prepare the schedule of the courses, coordinate the professors, handle the students, supervise the research of an internship, organize the final jury.
2011-2016	Elected member of the Department R&T Council of the IUT of Villetaneuse.

Research

The research worked out by Manzonetto during his PhD thesis has concerned models and theories of the untyped λ-calculus. In collaboration with Berline, Bucciarelli, Ehrhard, and Salibra, his research achievements have included: a general construction of λ-models from reflexive objects in (possibly non-well-pointed) categories; a Stone-style representation theorem for combinatory algebras; and a proof that no effective λ-model can have $\lambda\beta$ or $\lambda\beta\eta$ as its equational theory (this can be seen as a partial answer to an open problem introduced by Honsell in 1984). During his post-doc at INRIA, Manzonetto worked on second-order functional programming languages and proved, together with Tranquilli, that ML^{F} is strongly normalizable. In the context of his postdocs at University Paris 13 and Radboud University, Manzonetto developed an abstract model theory for both typed and untyped resource sensitive λ-calculi. In 2013, he worked with Jim Laird, Guy McCusker and Michele Pagani on quantitative models of linear logic and non-deterministic extensions of PCF. In 2016, together with Salibra and Favro, he proposed a method for algebraising multi-valued propositional logics. He also worked with Breuvart, Intrigila, Polonsky and Ruoppolo on the observational theory $\mathcal{H}^+$ and refuted a conjecture due to Sallé that dates back to 1979.

The results mentioned above, and others, have been published in twenty conference papers, twelve journal papers and five workshop papers. A journal paper has been recently accepted for publication in Logical Methods in Computer Science.

Book (In Preparation). In his book "The Lambda Calculus — Its syntax and semantics", Barendregt described the state of the art of research in λ-calculus at the moment of his publication (1981). This book became an international standard on λ-calculus (with more than 11000 copies sold) and contained a series of interesting open problems and conjectures. In the last 40 years, many of these problems have been solved: some by Manzonetto and his coauthors, some by other researchers (several of these solutions are highly non-trivial and some occupied an entire PhD thesis). The interest on the subject is still widespread in the community, but many researchers are not aware of the progresses that have been done because they are sparse in the literature. For this reason, in 2017, Manzonetto started writing, in collaboration with Barendregt, a monograph collecting all these results in a uniform and accessible presentation.

The editors of the College Publications (Nuffield College Oxford University) already expressed their interest in publishing the book as part of the series "Studies in Logic and the Foundations of Mathematics".

Student supervision.

PhD students:

2019–To Date	Emma Kerinec. Subject: Models of call-by-value λ-calculus based on the Böhm tree semantics.
2018–To Date	Davide Barbarossa (with Tortora de Falco). Subject: Geometry of interaction in connection with the Taylor expansion of λ-terms and the resource calculus.
2012–2016	Domenico Ruoppolo (with Guerrini). Subject: relational graph models and the representability of the corresponding equational theories. Thesis defended on December, 13, 2016.

Post-docs:

2012–2013	Alejandro Dìaz-Caro (with Pagani). Subject: models of non-deterministic call-by-value λ-calculi.
2014–2015	Andrew Polonsky. Subject: syntactic and semantic properties of untyped λ-calculus.

Supervision Master Internship:

01–04 2018	Emma Kerinec (with Pagani): student from ENS-Lyon (Master 2), internship at the laboratory IRIF. Subject: Böhm trees and Taylor expansion in the Call-By-Value setting.
03–08 2016	Ikram Cherigui (with Guerrini): student from MPRI (Master 2), internship at the laboratory LIPN. Subject: combinatorial proofs for strong normalization in the typed setting.
03–08 2012	Domenico Ruoppolo (with Guerrini): student from MPRI (Master 2), internship at the laboratory LIPN. Subject: duality underlying models of call-by-name and call-by-value extensions of the $\lambda\mu$-calculus.

Participations in Research Projects

Starting soon	PPS: "Probabilistic Programming Semantics". ANR PRC project. Local coordinator.
2019–To Date	CoGITARe: "Combining Graded and Intersection Types for the Analyses of Resources". ANR JCJC project.
2013 – 2016	CoQuas: "Computing with quantitative semantics". ANR JCJC project.
2011 – 2013	Complice: "Implicit Computational Complexity, Concurrency and Extraction". ANR Research Project ANR-08-BLANC-0211-01.
2010 – 2011	Calmoc: "Categorical and algebraic models of computation". Principal Investigator. NWO Research Project.
2009 – 2010	Collodi: "Complexity and concurrency through ludics and differential linear logic". Île-de-France/Digiteo Research Project.
2009	ParSec: "Parallelism and security". ANR Research Project ANR-06-SETI-010-02.
2008 – 2010	Concerto: "Control and certification of resources usage". Research Project. Partially funded by MIUR (Ministero dell'Istruzione, Università e Ricerca).
2005 – 2006	Follia: "Logical foundations of abstract programming languages". Research Project. Partially funded by MIUR (Ministero dell'Istruzione, Università e Ricerca).

Manzonetto proved to be able acquiring external funding from various sources. In 2010 he wrote a research proposal for the Dutch "Open Competition" that has been funded by NWO. In 2011 he wrote together with Mazza, Pagani, Vaux and Tasson a proposal for the French JCJC competition that has been funded by ANR. He is now local coordinator of the ANR project PPS, starting in 2020.

Awards and Bonus

2008 Manzonetto's PhD thesis was awarded the Prix EADS de la Meilleure Thèse 2008, category: "Sciences et technologies de l'information et de la communication" (Best PhD thesis award 2008).
2014 PEDR: Prime d'Encadrement Doctorale et de Recherche (4 years, renewed for 4 years).
2020 The paper "Taylor Subsumes Scott, Berry, Kahn and Plotkin" written with Barbarossa received a Distinguished Paper Award at POPL'20. This award highlights papers that the program committee thinks should be read by a broad audience due to their relevance, originality, significance and clarity.

Manzonetto was a contributor of the book "Alan Turing — his work and impact", Elsevier Science, winner in 2013 of the R.R. Hawkins Award from the Association of American Publishers (AAP), as well as the 2013 PROSE Awards for Mathematics and Best in Physical Sciences & Mathematics, also from the AAP.

Qualifications

2017	Habilitation à diriger des recherches.
2018	Qualified as "Professeur des universités", Section: 27 (Computer Science).

Grants

- Post-doctoral fellowship Calmoc Project. Duration: 1 year and 4 months. Started 1/5/2010.
- Post-doctoral fellowship Collodi Project. Duration: 6 months. Started 1/11/2009.
- Post-doctoral fellowship ParSec grant ANR-06-SETI-010-02. Duration: 10 months. Started 1/1/2009.
- PhD fellowship from *Ca'Foscari University of Venice, Italy*. Duration: 3 years. Started 1/11/2004.
- "Erasmus" fellowship from *Ca'Foscari University of Venice, Italy*. Duration: 5 months. Spent at *Vrije Universiteit, Amsterdam, Holland* from February 2004 to June 2004.

Referee Activities

Manzonetto acted as a reviewer for many international journals, conferences and workshops:

NDJFL	Notre Dame Journal of Formal Logic, Duke University Press.
JFP	Journal of Functional Programming, Cambridge University Press.
TCS	Journal "Theoretical Computer Science", Elsevier.
TOCL	Journal "Transactions on Computational Logic", ACM.
LMCS	Journal "Logical Methods in Computer Science".
JSL	Journal of Symbolic Logic, Association for Symbolic Logic.
IPL	Information Processing Letters.
MSCS	Mathematical Structures in Computer Science.
PPDP2006	8th International Symposium on Principles and Practice of Declarative Programming.
CSL2006	15th EACSL Annual Conference on Computer Science Logic.
ICTCS2007	10th Italian Conference on Theoretical Computer Science.
CSL2008	17th EACSL Annual Conference on Computer Science Logic.
LSFA2008	3rd Workshop on Logical and Semantic Frameworks, with Applications.
FOSSACS2009	12th Conference on Foundations of Software Science and Computation Structures.
ESOP2010	19th European Symposium On Programming.
ICALP2010	37th International Colloquium on Automata, Languages and Programming.
PPDP2010	12th International Symposium on Principles and Practice of Declarative Programming.
HOR2010	5th International Workshop on Higher-Order Rewriting.
FOSSACS2011	14th Conference on Foundations of Software Science and Computation Structures.

RTA2011	22^{nd} Rewriting Techniques and Applications.
WoLLIC2011	18^{th} Workshop on Logic, Language, Information and Computation.
ICALP2011	38^{th} International Colloquium on Automata, Languages and Programming.
LATIN2012	10^{th} Latin American Symposium on Theoretical Informatics 2012.
TLCA2013	Typed Lambda Calculi and Applications 2013.
LICS2013	28^{th} Annual ACM/IEEE Symposium on Logic in Computer Science 2013.
CSL-LICS2014	Joint meeting of the 23^{th} EACSL Annual Conference on Computer Science Logic and 29^{th} Annual ACM/IEEE Symposium on Logic in Computer Science.
FOSSACS2017	19^{th} Conference on Foundations of Software Science and Computation Structures.
LICS2017	32^{nd} Annual ACM/IEEE Symposium on Logic in Computer Science.
FSCD2017	2^{nd} International Conference on Formal Structures for Computation and Deduction
LICS2018	33^{rd} Annual ACM/IEEE Symposium on Logic in Computer Science.
LICS2019	34^{th} Annual ACM/IEEE Symposium on Logic in Computer Science.
CSL2020	28^{th} International Conference on Computer Science Logic.
FOSSACS2020	22^{nd} Conference on Foundations of Software Science and Computation Structures.

Reviewer of Research Projects

2011 — 2013	Evaluation of several research proposals of the Kazakhstan scientific community for the "National Center of Science and Technology Evaluation".

Thesis Jury

Dec. 2016	Member of the jury evaluating Ruoppolo's PhD defense.
Oct. 2015	Member of the jury evaluating Breuvart's PhD defense.

Program Committees

FoSSaCS'21	Member of the program committee of International Conference on Foundations of Software Science and Computation Structures 2021.
TLLA 2017	Member of the program committee of Trends in Linear Logic and Applications 2017.

Organization of International Conferences

Together with Chaudhuri and Guerrini, Manzonetto is organizing FSCD and IJCAR that will be co-located in Paris in 2020. He is the main organizer of the affiliated workshops.

CiE 2016	Member of the organizing committee of Computability in Europe, Paris, 2016.
QSLC 2016	Member of the organizing committee of Quantitative Semantics of Logic and Computation, workshop affiliated to CSL, Marseille, 2016.
BLT 2013	Member of the organizing committee of the meeting Bounded Linear Types, rencontre du projet Coquas ANR JCJC, Institut Henri Poincaré, Paris, 2013.
TMLC 2013	Member of the organizing committee of the International Workshop "Theories and Models of the Lambda-Calculus" organized in honour of Prof. Salibra's 60th birthday, Paris.
ICALP 2006	Manzonetto participated in the organization of the 33^{rd} conference "International Colloquium on Automata, Languages and Programming", San Servolo, Venice.

Talks in Conferences

- Refutation of Sallé's longstanding conjecture. FSCD 2017, Oxford, United Kingdom.
- Factor algebras and symbolic computations. LICS 2016, New York, NY, USA.
- Semantics and syntactic characterizations of Morris's equivalence. Domains XI, Paris, France.
- Weighted relational models of typed lambda calculi. LICS 2013, New Orleans, Louisiana, USA.

- Böhm's Theorem for resource λ-calculus through Taylor expansion. TLCA 2011, Novi Sad, Serbia.
- Harnessing ML^F with the power of System F. MFCS 2010, Brno, Czech Republic.
- A general class of models of $\mathcal{H}^\star$. MFCS 2009, Novy Smokovec, Slovakia.
- A relational model of a parallel and non-deterministic λ-calculus. LFCS 2009, Boca Raton, Florida.
- From lambda calculus to universal algebra, and back. MFCS 2008, Torun, Poland.
- Lambda theories of effective lambda models. CSL 2007, Lausanne, Switzerland.
- Not enough points is enough. CSL 2007, Lausanne, Switzerland.

Invited Talks

- Classical realizability, Realizability Workshop 2019, September 29$^{\text{th}}$ 2019, Marseille, France.
- Degrees of extensionality in the theory of Böhm trees, satellite workshop of FSCD'19, Dortmund, Germany, June 28$^{\text{th}}$ 2019.
- The resource calculus. Quantitative Semantics of Logic and Computation, satellite workshop of CSL'16, Marseille, France, September 3$^{\text{rd}}$ 2016.
- Weighted relational differential categories. Association of Symbolic Logic. *University of Waterloo*, Ontario, Canada, May 9$^{\text{th}}$ 2013.
- Loader and Urzyczyn are logically related. Workshop Curry-Howard pour la concurrence. *ENS-Lyon, France*. February 14$^{\text{th}}$, 2013.
- A differential model theory for resource λ-calculi. Foundational Methods in Computer Science 2011. *University of Calgary*, Canada, June 11$^{\text{th}}$ 2011.
- A resource conscious Böhm's Theorem. Workshop Curry-Howard pour la concurrence. *ENS-Lyon, France*. April 5$^{\text{th}}$, 2011.

Recent Talks

- A syntactic and semantic analysis of program equivalences. *LSV, ENS-Cachan, Cachan, France.* Invited by Stephane Le Roux. February 14$^{\text{th}}$ 2020.
- About the power of Taylor expansion. *IRIF, University of Paris, Paris, France.* Invited by Adrien Guatto. November 21$^{\text{st}}$ 2019.
- Several degrees of extensionality in the Böhm tree semantics. *ICIS, Radboud University, Nijmegen, The Netherlands.* Invited by Hermann Geuvers. February 26$^{\text{th}}$ 2019.
- Call-by-value Böhm trees, and all that. *I2M, Université Aix-Marseille, Marseille, France.* Invited by Lionel Vaux. October 4$^{\text{th}}$ 2018.
- Refutation of Sallé Longstanding Conjecture, *I2M, Université Aix-Marseille, Marseille, France.* Invited by Lionel Vaux. February 15$^{\text{th}}$ 2018.
- Refutation of Sallé Longstanding Conjecture, *LAMA, Université Savoie Mont Blanc, Chambéry, France.* Invited by Tom Hirschowitz. November 23$^{\text{rd}}$ 2017.
- New results on Morris's observational theory: the benefits of separating the inseparable. *University of Copenhagen, Denmark.* Invited by Jakob Grue Simonsen. June 8$^{\text{th}}$, 2016.
- New results on Morris's observational theory: the benefits of separating the inseparable. *University of Bath, United Kingdom.* Invited by Guy McCusker. May 10$^{\text{th}}$, 2016.
- New results on Morris's observational theory: the benefits of separating the inseparable. *Università di Torino*, Italy. Invited by Simona Ronchi della Rocca. February 12$^{\text{th}}$, 2016.
- Loader and Urzyczyn are logically related. *ENS-Lyon, France*. Invited by the organizers of the Choco meeting. February 14$^{\text{th}}$, 2013.
- Loader and Urzyczyn are logically related. *University of Bath, United Kingdom*. Invited by Guy McCusker. June 29$^{\text{th}}$, 2012.
- The differential lambda calculus. *LaBRI, INRIA, Bordeaux, France*. Invited by Sylvain Salvati. February 7$^{\text{th}}$, 2012.
- The resource lambda calculus. *Vrije University, Amsterdam, The Netherlands*. Invited by Jan Willem Klop. March 11$^{\text{th}}$, 2011.
- The Relational Model is Fully Abstract for the Resource Calculus with Tests. *University of Bath, UK*. Invited by Guy McCusker. February 9$^{\text{th}}$, 2011.

- Harnessing ML^F with the power of System F. *Vrije Universiteit, Amsterdam, Holland*.
  Invited by Femke van Raamdonk. December 10th, 2010.
- Full abstraction for resource calculus with tests. *ENS-Lyon, France*.
  Invited by Colin Riba. October 21st, 2010.
- A relational model of a parallel and non-deterministic calculus. *University of Paris 12, France*.
  Invited by Frédéric Gava. March 15th, 2010.

Short Visits

21/07/19–03/08/19	Research in Pairs (with H.P. Barendregt), Oberwolfach Mathematical Institute. Oberwolfach, Germany.
23/02/19–03/03/19	Visiting H.P. Barendregt at Radboud University of Nijmegen (NL).
19/01/18–01/06/18	Visiting L. Vaux at Université d'Aix-Marseille (FR).
06/06/16–10/06/16	Visiting J. Simonsen at University of Copenhagen (DK).
08/05/16–15/05/16	Visiting G. McCusker and J. Laird at University of Bath (UK).
08/02/16–13/02/16	Visiting S. Ronchi della Rocca at University of Turin (IT).
20/07/14–26/07/14	Visiting J. Simonsen at University of Copenhagen (DK).
25/06/12–01/07/12	Visiting G. McCusker and J. Laird at University of Bath (UK).
05/02/12–05/02/12	Visiting S. Salvati at LaBRI, Bordeaux (FR).
03/02/11–13/02/11	Visiting G. McCusker and J. Laird at University of Bath (UK).
20/11/10–28/11/10	Visiting M. Pagani at LIPN, Paris 13 (FR).
19/10/10–24/10/10	Visiting P. Tranquilli at ENS-Lyon (FR).
14/02/10–19/02/10	Visiting G. McCusker and J. Laird at University of Bath (UK).
29/08/09–05/09/09	Visiting J.R. Longley at Informatics Forum of Edinburgh (UK).
06/05/09–08/05/09	Visiting H.P. Barendregt at Radboud University of Nijmegen (NL).
01/05/09–05/05/09	Visiting J.W. Klop at Vrije Universiteit of Amsterdam (NL).

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Main achievements

- **Boolean algebras for λ-calculus [32, 11]**: The models of λ-calculus (which are particular "combinatory algebras" called *λ-models*) are *a priori* quite non-standard algebraic structures, then there is a common belief that the λ-calculus is algebraically pathological. Together with Salibra, Manzonetto showed in [32, 11] that this belief is false: Stone's representation theorem for Boolean algebras, which is one of the milestones of modern algebra, can be indeed generalized to combinatory algebras. In every combinatory algebra there is a Boolean algebra of *central elements* (playing the role of idempotent elements in rings), which can be used to represent any combinatory algebra as a Boolean product of indecomposable combinatory algebras. Applications of the Stone representation theorem to λ-calculus were given in [32, 11], thus proving that techniques of universal algebra can be useful for studying the λ-calculus.

- **From λ-calculus to universal algebra and back [29, 28]**: In [29] Manzonetto and Salibra validated the inverse slogan: λ-calculus can be fruitfully applied to universal algebra. Indeed, the authors proved that all the algebraic properties showed in [32, 11] for combinatory algebras, hold for a wider class of algebras, namely *Church algebras*, which model the "if-then-else" instruction of programming languages. This class includes, beside combinatory algebras, all λ-abstraction algebras, all Boolean algebras, and all rings with unit. By generalizing to universal algebra the notion of *easy term* originating from λ-calculus they prove a new result on the lattice $\lambda\mathcal{T}$ of λ-theories: for all natural number n, $\lambda\mathcal{T}$ admits (at the top) a lattice interval which is isomorphic to the free Boolean algebra with n generators. Finally, they prove a general theorem of *pure* universal algebra which can be seen as a *meta version* of Stone's Representation Theorem and in [28] they apply it to study the lattices of equational theories.

- **From categorical to algebraic semantics [31, 27]**: In this process of algebraization of the semantics of λ-calculus, Manzonetto, together with Bucciarelli and Ehrhard, showed that *every* reflexive object of a cartesian closed category (this is the classical categorical definition of a model of λ-calculus) can be viewed as a combinatory algebra which is, moreover, a λ-model. Using this result they have been able to build a new model of λ-calculus, living in a relational semantics, and to study its algebraic properties which make it suitable to model also non-deterministic and parallel extensions of λ-calculus. In [27], Manzonetto has also provided sufficient conditions for categorical models living in arbitrary cpo-enriched cartesian closed categories to have $\mathcal{H}^*$ (the maximal sensible λ-theory) as equational theory, and proved that the above mentioned relational model fulfils these conditions.

- **A relational model of a parallel and non-deterministic calculus [26, 8]**: The relational model $\mathcal{D}$ of [31] satisfies interesting algebraic properties which make it suitable to model a non-deterministic and parallel extension of λ-calculus, called "$\lambda_{+\|}$-calculus". Unlike most traditional approaches, this way of interpreting non-determinism does not require any additional powerdomain construction. Indeed, $\mathcal{D}$ provides a straightforward semantics of *non-determinism* by means of *unions* of interpretations, as well as of *parallelism* by means of a binary, non-idempotent operation available on the model, which is related to the *mix rule* of Linear Logic. Finally, the interpretation of $\lambda_{+\|}$-calculus in $\mathcal{D}$ is "sensible" w.r.t. the operational semantics: a term converges iff it has a non-empty interpretation. This last result has been proved though a non-trivial adaptation of Krivine's realizability technique.

- **A linear logic type discipline for a call-by-value parallel and non-deterministic calculus [18]**: We consider Plotkin's call-by-value λ-calculus extended with a non-deterministic choice and parallel composition. We endow this calculus with a type system based on Girard's second translation of intuitionistic logic into linear logic. We prove that the approach followed in the call-by-name setting [8], also works in call-by-value. In other words, may and must non-determinism can be represented in the system using union and the mix-based operator, respectively. Exploiting the resource consciousness of our system we are able to show not only that a term is typable iff it is converging, but that its typing tree carries enough information to give a bound on the length of its lazy call-by-value reduction. This gives a combinatorial proof of weak normalization for the call-by-value non-deterministic calculus. Moreover, when the typing tree of a term satisfies a minimality condition, the associated measure provides *the exact length* of its reduction.

- **Effective models of λ-calculus [30, 12]:** A longstanding open problem, proposed by Honsell in 1984, asks for the existence of a non-syntactical model of λ-calculus having $\lambda\beta$ or $\lambda\beta\eta$ as equational theory. In collaboration with Berline and Salibra, Manzonetto introduced in [30] a notion of *effective* model of λ-calculus and used this notion to investigate the question of whether the equational/order theory of an effective model can be recursively enumerable (r.e., for short), which is a generalization of Honsell's problem. The authors have proved that no order theory of an effective model can be r.e.; from this it follows that its equational theory cannot be $\lambda\beta$ or $\lambda\beta\eta$. Then, they showed that no effective model living in the stable or strongly stable semantics has an r.e. equational theory. In particular, these results cover all the models which have been introduced individually in the literature.

- **Categorical models of simply typed resource calculi [24]:** In 2003, Ehrhard and Regnier designed the *differential λ-calculus*, a paradigmatic programming language extended with a syntactic derivative operator. This operator is an excellent candidate to increase control over programs executed in environments with bounded resources. Starting from the work of Blute *et Al.* on differential cartesian categories, Manzonetto introduced the notion of *differential λ-category*. He then proved, in collaboration with Bucciarelli and Ehrhard, that such categories constitute a *sound* model of the simply typed differential λ-calculus (thus providing a first abstract definition of model of such a calculus). Subsequently, he showed that these categories also provide a framework to model the simply typed *resource calculus*, a non-lazy axiomatisation of Boudol's λ-calculus with multiplicities. Finally, the authors provide two concrete examples of differential λ-categories, namely, the category $\mathbf{MRel}$ of sets and (multi-)relations, and the category **MFin** of finiteness spaces and finitary (multi-)relations.

- **Categorical models of untyped resource calculi [9]:** In this paper Manzonetto gives a categorical notion of model of the *untyped* differential λ-calculus. More precisely, he shows that *linear* reflexive objects living in differential λ-categories can be used to model the untyped differential λ-calculus, and that this notion of model is sound. Moreover, he provides sufficient conditions on differential λ-categories in order to 'model the Taylor expansion'. This entails that every model living in such categories equates all differential programs having the same Taylor expansion. As expected, it turns out that the relational model $\mathcal{D}$ built in [31] is linear, and that the category $\mathbf{MRel}$ where it lives models the Taylor expansion. Manzonetto also strengthens the relationship found in [24] between the resource and the differential λ-calculus by defining faithful translation maps in the two directions. From the analysis of their properties it follows that these two calculi share the same notion of model.

- **Full abstraction for resource calculi with tests [21, 7]:** In this work Manzonetto, together with Bucciarelli, Carraro and Ehrhard, studies the semantics of the resource calculus extended with new constructions, to be understood as implementing a very simple exception mechanism, and with a "must" parallel composition. This extension already appeared in a differential linear logic setting: it corresponds to the 0-ary tensor and par cells. To implement the corresponding extension of the calculus, they introduced two kinds of expressions: *terms* (that now may also "throw" a test) and *tests* (empty test, parallel composition of tests and "catch"). This *resource calculus with tests*, has a natural denotational interpretation in our relational model $\mathcal{D}$, whose logical structure allows to associate with each element α of $\mathcal{D}$, a test $\alpha^+(\cdot)$ with a hole $(\cdot)$ for a term. The authors then showed that α belongs to the interpretation of a (closed) term M if and only if the test $\alpha^+(M)$ converges. From this fact, they derived easily a full abstraction result for the fragment of the resource calculus with tests in which all ordinary applications are trivial. To extend this result to the full resource calculus with tests, they used the Taylor expansion, which allows to turn any ordinary application into a sum of infinitely many linear applications of all possible arities. They exploited then the fact (proved in [9]) that the Taylor formula holds in the model, as well as a simulation lemma which relates the head reduction of a term with the head reduction of its Taylor expansion.

- **Building differential game semantics [22, 6]:** As proved in [26, 9] the differential λ-calculus and the resource calculus are fundamentally related at a semantic level: both can be interpreted within differential λ-categories. In [22, 6] Manzonetto, in collaboration with Laird and McCusker, presents an abstract construction that takes a symmetric monoidal category and yields a differential λ-category, and show how this construction may be applied to categories of games. In one instance, the authors recover the category previously used to give a fully abstract model of a non-deterministic imperative language. The construction exposes the differential structure already present in this model, and shows how the differential combinator may be encoded in the imperative language. A second instance corresponds to a new differential λ-category. The authors give a model of a simply-typed resource calculus, Resource PCF, in this category and show that it possesses the finite definability property. Comparison with the relational semantics reveals that $\mathbf{MRel}$ also possesses this property and is a fully abstract model of resource PCF.

- **A resource conscious Böhm's theorem [23]:** Böhm's theorem is a fundamental result in λ-calculus. From a computer science perspective, it states that two λ-calculus programs are equivalent when they behave in the same way on all their inputs; as a consequence of Böhm's theorem two programs in "$\beta\eta$-normal form" are equivalent if they are written in the same way, otherwise they can be separated. In the resource calculus the situation looks much more difficult: there are $\beta\eta$-distinct programs which are equivalent because they have the same Taylor expansion, but also $\beta\eta$-distinct programs with different Taylor expansion that cannot be separated. The problem of finding the correct formulation of Böhm's theorem for resource calculus and prove the result has been faced in [23] by Manzonetto and Pagani. First the authors give a simple syntactic equivalence $\equiv_\tau$ capturing the equality of programs having the same Taylor expansion. Second they prove that every two programs P_1, P_2 in β-normal form such that $P_1 \not\equiv^\eta_\tau P_2$ (where $\equiv^\eta_\tau$ is the equivalence generated by η-reduction modulo $\equiv_\tau$) can be separated, which can be seen as a resource conscious analogous of Böhm's theorem. Finally they prove that $\equiv_{\tau}^{\eta}$ is the biggest non-trivial equivalence relation on β-normal forms.

- **Strong normalization of ML^{F} and its variants [10, 25, 37].** ML^{F} is a programming language that enriches ML with the first class polymorphism of system F. The aim is to provide a partial type annotation mechanism with an automatic type reconstructor. It is known that system F is contained in ML^{F} and the inclusion seems to be strict. This makes the question of strong normalization of ML^{F} a non-trivial one, to which Manzonetto and Tranquilli answer positively in [10, 25, 37]. The starting point of this work is $\mathsf{xML}^{\mathsf{F}}$, the Church version of ML^{F}: they first show that $\mathsf{xML}^{\mathsf{F}}$ can be translated into a *coercion calculus* (mapping $\mathsf{xML}^{\mathsf{F}}$ type-instantiations into coercions), and second they prove that the coercion calculus is a decorated version of system F, hence strongly normalizable. The generality of coercion calculus allows to lift this result to all versions of ML^{F} via suitable bisimulation results. Note that, while the strong normalization for β-reductions is a rather theoretical result, the one for type-reductions is needed to safely implement interpreters and compilers.

- **Undecidability results for simply typed and intersection types [20].** In simply typed λ-calculus with one ground type the following theorem due to Loader holds. (i) Given the full model $\mathcal{F}$ over a finite set, the question whether some element $f \in \mathcal{F}$ is λ-definable is undecidable. In the λ-calculus with intersection types based on countably many atoms, the following is proved by Urzyczyn. (ii) It is undecidable whether a type is inhabited. Both statements are major results presented in Barendregt's new book. In collaboration with Salvati, Gehrke and Baredregt, Manzonetto showed that (i) and (ii) follow from each other in a natural way, by interpreting intersection types as continuous functions logically related to elements of $\mathcal{F}$. From this, and a result by Joly on λ-definability, we get that Urzyczyn's theorem already holds for intersection types with at most two atoms.

- **Matrix based semantics for non-deterministic PCF [19].** The category $\mathbf{Rel}$ of sets and relations yields one among the simplest denotational semantics of Linear Logic. It is known that $\mathbf{Rel}$ is the biproduct completion of the Boolean ring. In [19] Manzonetto, in collaboration with Laird, McCusker and Pagani, considers the generalization of this construction to an arbitrary continuous semiring $\mathcal{R}$, producing a cpo-enriched category which is a semantics of linear logic. Its (co)Kleisli category is an adequate model of an extension of PCF, parametrized by $\mathcal{R}$: terms in this extended language can be instrumented by elements of $\mathcal{R}$, leading to an operational notion of reduction weighted by values in $\mathcal{R}$. Thus the choice of $\mathcal{R}$ and of how terms are instrumented allows us to model, both operationally and denotationally, a range of quantitative properties of program execution: specific instances of $\mathcal{R}$ allow us to compare programs not only with respect to "what they can do", but also "in how many steps" or "in how many different ways" (for non-deterministic PCF) or even "with what probability" (for probabilistic PCF).

- **Relational graph models, Taylor expansion and extensionality [17, 15, 5]:** In collaboration with his Phd student Domenico Rouppolo, Manzonetto defined the class of relational graph models and studied the induced order-theories and equational-theories [17]. Using the Taylor expansion, they showed that all λ-terms having the same Böhm tree are equated in any relational graph model. If the model is moreover extensional and preserves the ω-polarities (in a technical sense) then it is inequationally fully abstract for Morris's theory $\mathcal{H}^+$. They also introduced an extensional version of the Taylor expansion, and proved that two λ-terms have the same extensional Taylor expansion exactly when they are equivalent in Morris's sense. Subsequently, together with Breuvart and Polonsky, they strengthen the semantic result above by providing necessary and sufficient conditions for relational graph models in order to capture Morris's pre-order [15]. This gives a precise characterisation of all the models in this class fully abstract for $\mathcal{H}^+$. This result is a consequence of a weak semi-separation property which is proved via a refined Böhm-out technique. Interestingly, this also entails that $\mathcal{H}^+$ is closed under the ω-rule, thus solving a longstanding open problem of λ-calculus. The journal paper [5] presents many results from [15] in a uniform and structured way, and includes original ones, like the description of the minimal λ-theory induced by a relational graph model and the characterization of all relational models fully abstract for $\mathcal{H}^*$.

- **Degrees of extensionality in the theory of Böhm trees and Sallé's conjecture [14, 2]:** The main observational equivalences of the untyped λ-calculus have been characterized in terms of extensional equalities between Böhm trees. It is well known that the λ-theory $\mathcal{H}^*$, arising by taking as observables the head normal forms, equates two λ-terms whenever their Böhm trees are equal up to countably many possibly infinite η-expansions. Similarly, two λ-terms are equal in Morris's original observational theory $\mathcal{H}^+$, generated by considering as observable the β-normal forms, whenever their Böhm trees are equal up to countably many finite η-expansions. The λ-calculus also possesses a strong notion of extensionality called *the ω-rule*, which has been the subject of many investigations. It is a longstanding open problem whether the equivalence $\mathcal{B}\omega$ obtained by closing the theory of Böhm trees under the ω-rule is strictly included in $\mathcal{H}^+$, as conjectured by Sallé in the seventies. In collaboration with Intrigila and Polonsky, I demonstrate that the two aforementioned λ-theories actually coincide, thus disproving Sallé's conjecture. The inclusion $\mathcal{B}\omega \subseteq \mathcal{H}^+$ is a consequence of the fact that the λ-theory $\mathcal{H}^+$ satisfies the ω-rule. The inclusion $\mathcal{H}^+ \subseteq \mathcal{B}\omega$ follows from the fact that whenever two λ-terms are observationally equivalent in $\mathcal{H}^+$ their Böhm trees have a common "η-supremum" that can be λ-defined starting from a stream (infinite sequence) of η-expansions of the identity. It turns out that in $\mathcal{B}\omega$ such a stream is equal to the stream containing infinitely many copies of the identity, a peculiar property that actually makes the two theories collapse.

  As we have shown in [2], the proof technique developed in [14] for proving the latter inclusion is general enough to provide as a byproduct a new characterization, based on bounded η-expansions, of the least extensional equality between Böhm trees. Together, these results provide a taxonomy of the different degrees of extensionality in the theory of Böhm trees.

- **Factor Varieties and Symbolic Computation [16]**: We propose an algebraization of classical and non-classical logics, based on factor varieties and decomposition operators. In particular, we provide a new method for determining whether a propositional formula is a tautology or a contradiction. This method can be automatized by defining a term rewriting system that enjoys confluence and strong normalization. This also suggests an original notion of logical gate and circuit, where propositional variables becomes logical gates and logical operations are implemented by substitution. Concerning formulas with quantifiers, we present a simple algorithm based on factor varieties for reducing first-order classical logic to equational logic. We achieve a completeness result for first-order classical logic without requiring any additional structure.

- **Relational Models for the Call-by-Value Lambda Calculus [3]**: Despite the fact that call-by-value λ-calculus was defined by Plotkin in 1977, we believe that its theory of program approximation is still at the beginning. A problem that is often encountered when studying its operational semantics is that, during the reduction of a λ-term, some redexes remain stuck (waiting for a value). Recently, Carraro and Guerrieri proposed to endow this calculus with permutation rules, naturally arising in the context of linear logic proof-nets, that succeed in unblocking a certain number of such redexes. In the present paper we introduce a new class of models of call-by-value λ-calculus, arising from non-idempotent intersection type systems. Beside satisfying the usual properties as soundness and adequacy, these models validate the permutation rules mentioned above as well as some reductions obtained by contracting suitable λI-redexes. Thanks to these (perhaps unexpected) features, we are able to demonstrate that every model living in this class satisfies an Approximation Theorem with respect to a refined notion of syntactic approximant. While this kind of results often require impredicative techniques like reducibility candidates, the quantitative information carried by type derivations in our system allows us to provide a combinatorial proof.

- **Böhm Trees for the Call-by-Value Lambda Calculus [42]**: The call-by-value λ-calculus can be endowed with permutation rules, arising from linear logic proof-nets, having the advantage of unblocking some redexes that otherwise get stuck during the reduction. In collaboration with Kerinec and Pagani, Manzonetto shows that such an extension allows to define a satisfying notion of Böhm(-like) trees and a theory of program approximation in the call-by-value setting. We prove that all λ-terms having the same Böhm tree are observationally equivalent, and characterize those Böhm-like trees arising as actual Böhm trees of λ-terms. We also compare this approach with Ehrhard's theory of program approximation based on the Taylor expansion of lambda terms, translating each lambda term into a possibly infinite set of so-called resource terms. We provide sufficient and necessary conditions for a set of resource terms in order to be the Taylor expansion of a lambda term. Finally, we show that the normal form of the Taylor expansion of a lambda term can be computed by performing a normalized Taylor expansion of its Böhm tree. From this it follows that two lambda terms have the same Böhm tree if and only if the normal forms of their Taylor expansions coincide.

- **The bang calculus [13]** We study the two Girard's translations of intuitionistic implication into linear logic by exploiting the bang calculus, a paradigmatic functional language with an explicit box-operator that allows both the call-by-name and call-by-value λ-calculi to be encoded in. We investigate how the bang calculus subsumes both call-by-name and call-by-value λ-calculi from a syntactic and a semantic viewpoint.