Jan-Christoph Kassing
Vaalser Straße 140, 52074 Aachen
Kassing@cs.rwth-aachen.de
+49 157 57154946

Graduiertenkolleg UnRAVeL
RWTH Aachen University
Ahornstraße 55, 52074 Aachen

28.06.2026

ANTRAG AUF ANSCHUBFÖRDERUNG — UNRAVEL

Sehr geehrte Leiter des Graduiertenkollegs UnRAVeL,

hiermit beantrage ich für den Zeitraum vom 01.10.2026 bis zum 31.12.2026 eine Postdoc-Anschubförderung (Start-up Funding) im Graduiertenkolleg UnRAVeL.

Seit Oktober 2022 bin ich als Doktorand und wissenschaftlicher Mitarbeiter am Lehrstuhl für Programmiersprachen und Verifikation der RWTH Aachen tätig und seit dieser Zeit zugleich Stipendiat von UnRAVeL.

In meiner Forschung entwickle ich automatische Verfahren, mit denen sich das Verhalten von Computerprogrammen mathematisch überprüfen lässt. Im Mittelpunkt stehen dabei zwei grundlegende Fragen der Informatik: Hält ein Programm garantiert an (*Terminierung*), und wie lange läuft es (*Laufzeit*)? Im Rahmen von UnRAVeL analysiere ich *probabilistische Programme*, die während ihrer Ausführung Zufallsentscheidungen treffen können. Wahrscheinlichkeiten sind für viele moderne Anwendungen zentral, beispielsweise für randomisierte Algorithmen, die Kryptographie oder das maschinelle Lernen. Um derartige Programme zu analysieren, verwende ich *Termersetzungssysteme*: ein einfaches, aber ausdrucksstarkes Berechnungsmodell, das sich besonders gut eignet, um Programmen mit Datenstrukturen zu analysieren.

Meine Dissertation mit dem Titel "Automatically Analyzing Termination and Expected Runtime Complexity of Probabilistic Term Rewriting" werde ich im Juli 2026 einreichen. Sie wird von Prof. Dr. rer. nat. Jürgen Giesl (RWTH Aachen University) als Erstgutachter und von Prof. Dr. Ugo Dal Lago (Universität Bologna) als Zweitgutachter betreut. Die Verteidigung findet voraussichtlich im September oder Oktober 2026 statt.

Während meiner Promotion habe ich gelernt, eigenständig wissenschaftlich hochwertige Arbeiten zu entwickeln und zu veröffentlichen. Dies spiegelt sich in meiner Publikationsliste wider, in der ich überwiegend als Erstautor auftrete. Mein Betreuer gab dabei die allgemeine Forschungsrichtung vor (die Analyse probabilistischer Termersetzung). Die konkreten Ansätze, um diese Analyse zu verbessern, habe ich stets selbstständig erarbeitet. So konnte ich meine im probabilistischen Kontext entwickelten Methoden sogar nutzen, um ein seit Jahrzehnten offenes Problem der klassischen (nicht-probabilistischen) Termersetzung zu lösen: ein *Dependency Pair Framework* für die relative Terminierung von Termersetzungssystemen. Die Anschubförderung würde es mir ermöglichen, diese Selbstständigkeit weiter auszubauen und einen eigenen Forschungsantrag zur Einwerbung von Drittmitteln vorzubereiten.

Für den Förderzeitraum plane ich, die folgenden Projekte abzuschließen und fortzuführen:

- *Decidability Results for Almost-Sure Termination of Probabilistic Term Rewriting*: Aufbauend auf einer ausgezeichneten Bachelorarbeit von Arion Scheid möchte ich untersuchen, für welche Klassen von Programmen sich die Terminierung automatisch entscheiden lässt. Ein Konferenzpapier ist für Ende 2026 geplant.
- *Reachability Analysis in Probabilistic Term Rewriting*: Meine Dissertation betrachtet ausschließlich die Terminierung. Mindestens ebenso wichtig für die Software-Verifikation ist jedoch die Frage nach der Sicherheit eines Programms: Kann das Programm einen unsicheren Zustand erreichen? Hierzu möchte ich erste Resultate zur Erreichbarkeitsanalyse für probabilistische Termersetzung erzielen. Auch hier ist ein Konferenzpapier für Ende 2026 geplant.

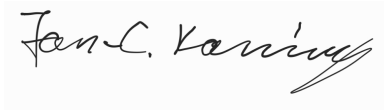
- *Confluence Analysis of Weighted Rewriting* mit Emma Ahrens (Gruppe von Prof. Katoen): Die von uns entwickelte "gewichtete" Semantik für Ersetzungssysteme möchte ich um eine Analyse der *Konfluenz* erweitern: liefert ein Program unabhängig von der Reihenfolge seiner Rechenschritte stets dasselbe Ergebnis und verursacht es dabei stets die selben Kosten?
- *How to Nicely Integrate Formal Verification*: Gemeinsam mit Prof. Tom Beckmann (Kyoto University of Advanced Science) möchte ich der bereits während eines Forschungsaufenthalts am HPI Potsdam begonnenen Frage nachgehen, wie sich formale Verifikation möglichst einfach in den Software-Entwicklungsprozess integrieren lässt.

Darüber hinaus plane ich, wie bereits erwähnt, im Rahmen der Anschubförderung einen Forschungsantrag bei der Deutschen Forschungsgemeinschaft (DFG) vorzubereiten. Konkret strebe ich einen Antrag im *Walter-Benjamin-Programm* der DFG an. Die oben genannten Projekte bilden die inhaltliche Grundlage dieses Antrags.

Über eine positive Rückmeldung zu meinem Antrag und die weitere Zusammenarbeit im Graduiertenkolleg UnRAVeL würde ich mich sehr freuen. Für Rückfragen stehe ich Ihnen jederzeit gerne zur Verfügung.

Anlagen: Lebenslauf mit Publikationsliste

Mit freundlichen Grüßen,



Jan-Christoph Kassing

Jan-Christoph Kassing

jckassing.com

Email: Kassing@cs.rwth-aachen.de
Google Scholar (Link)
DBLP (Link)

Research Experience

- **RWTH Aachen University** Aachen, Germany
  PhD Student: Research and Teaching Assistant *Oct 2022 – Present*
  - **Probabilistic Program Verification**: I develop automatic techniques to analyze the termination and expected runtime of (probabilistic) programs, i.e., programs that make random choices during execution. I study them via *(probabilistic) term rewrite systems*, a functional formalism that is easily able to express data structures. My main contribution is the *annotated dependency pair (ADP) framework* for proving and disproving almost-sure termination and for bounding expected runtimes. All methods are implemented in the tool AProVE.
- **RWTH Aachen University** Aachen, Germany
  Student Assistant *Oct 2018 – Sep 2022*
  - **Assisted in Teaching and Research**: Research focussing on automated methods to analyze integer term rewrite systems, a formalism to express programs containing ordinary integer and arbitrary data structures.

Research Visits

- **Software Architecture Group, Hasso Plattner Institute, Germany** *(2026)*
  Joint research on how formal verification can be integrated into the software-development process and what practitioners actually need from such tools.
- **Chair of Algorithms and Didactics, ETH Zurich, Switzerland** *(2025)*
  Joint research on the decidability of decision problems over matrices.
- **14th International School on Rewriting (ISR), Obergurgl, Austria** *(2024)*
  Deepened my expertise in the theory and applications of term rewriting at this international school.

Education

- **PhD Student in Computer Science** Aachen, Germany
  RWTH Aachen University *Oct 2022 – Expected 2026*
  Thesis: "*Automatically Analyzing Termination and Expected Runtime Complexity of Probabilistic Term Rewriting*" (ongoing)
- **Master of Science in Computer Science** Aachen, Germany
  RWTH Aachen University; Grade: 1.2 (with distinction) *Oct 2020 – Oct 2022*
  Thesis: "*Using Dependency Pairs for Proving Almost-Sure Termination of Probabilistic Term Rewriting*"
- **Bachelor of Science in Computer Science** Aachen, Germany
  RWTH Aachen University; Grade: 1.4 *Oct 2017 – Oct 2020*
  Thesis: "*The Recursive Algorithm for Parity Games*"
- **Abitur (High School Graduation)** Soest, Germany
  Aldegrever Gymnasium; Grade: 1.7 *Oct 2009 – Oct 2017*

Honors & Awards

- **PhD Scholarship – DFG Research Training Group UnRAVeL** *(2022–Present)*
  Doctoral funding within the DFG-funded Research Training Group UnRAVeL at RWTH Aachen University.
- **International Termination and Complexity Competition (termCOMP)** *(2023–Present)*
  The tool AProVE, of which I have been the main developer since 2023, consistently won first place in a large number of categories at the annual termination competition.

- **Springorum Commemorative Coin** (*2022*)
  Awarded to the top 10% of M. Sc. graduates from each RWTH faculty each year.
- **Dean's List** (*2018, 2019, 2021*)
  Awarded to the top 5% of students in each year.

Publications (16)

- **Journal Articles** (Total Number: 2)

  1. **J.-C. Kassing**, J. Giesl. "The Annotated Dependency Pair Framework for Almost-Sure Termination of Probabilistic Term Rewriting". Science of Computer Programming, 2026.
  2. **J.-C. Kassing**, J. Giesl. "From Innermost to Full Probabilistic Term Rewriting: Almost-Sure Termination, Complexity, and Modularity". Logical Methods in Computer Science, Vol. 21(4), 2025.

- **Conference Papers** (Total Number: 7)

  1. **J.-C. Kassing**, H. Nagel, A. Schlecht, J. Giesl. "Disproving (Positive) Almost-Sure Termination of Probabilistic Term Rewriting via Random Walks". IJCAR 2026 (to appear).
  2. **J.-C. Kassing**, L. Spitzer, J. Giesl. "Dependency Pairs for Expected Innermost Runtime Complexity and Strong Almost-Sure Termination of Probabilistic Term Rewriting". PPDP 2025.
  3. E. Ahrens, **J.-C. Kassing**, J. Giesl, J.-P. Katoen. "Weighted Rewriting: Semiring Semantics for Abstract Reduction Systems". FSCD 2025.
  4. **J.-C. Kassing**, G. Vartanyan, J. Giesl. "A Dependency Pair Framework for Relative Termination of Term Rewriting". IJCAR 2024.
  5. **J.-C. Kassing**, S. Dollase, J. Giesl. "A Complete Dependency Pair Framework for Almost-Sure Innermost Termination of Probabilistic Term Rewriting". FLOPS 2024.
  6. **J.-C. Kassing**, F. Frohn, J. Giesl. "From Innermost to Full Almost-Sure Termination of Probabilistic Term Rewriting". FoSSaCS 2024.
  7. **J.-C. Kassing**, J. Giesl. "Proving Almost-Sure Innermost Termination of Probabilistic Term Rewriting Using Dependency Pairs". CADE 2023.

- **Book Chapters** (Total Number: 1)

  1. **J.-C. Kassing**, J. Giesl. "Annotated Dependency Pairs for Full Almost-Sure Termination of Probabilistic Term Rewriting". Principles of Verification (Festschrift), LNCS 15260, 2024.

- **Workshop Papers & Extended Abstracts** (Total Number: 5)

  1. **J.-C. Kassing**, T. Sokolowski. "AProVE25: Confluence Analysis in a Termination Tool". IWC 2025.
  2. F. Frohn, C. Fuhs, J. Giesl, **J.-C. Kassing**, N. Lommen. "AProVE: Becoming Open Source and Recent Improvements". WST 2025.
  3. **J.-C. Kassing**, J. Giesl. "Modularity of Termination in Probabilistic Term Rewriting". WST 2025.
  4. **J.-C. Kassing**, G. Vartanyan, J. Giesl. "A Dependency Pair Framework for Relative Termination of Term Rewriting". WST 2025.
  5. **J.-C. Kassing**, J. Giesl. "Dependency Tuples for Almost-Sure Innermost Termination of Probabilistic Term Rewriting". WST 2023.

- **Reports** (Total Number: 1)

  1. E. Ahrens, **J.-C. Kassing**. "Report on the 10th International Conference on Formal Structures for Computation and Deduction (FSCD 2025)". ACM SIGLOG News 12(4), 2025.

Teaching and Supervision

- **Lecture Courses (Teaching Assistant)**

  1. **Foundations of Functional Programming** (M. Sc., ∼300 participants) (*2024, 2026*)
     Functional programming in Haskell, its semantics, type checking and inference, and the optimization of functional programs. (Nominated for teaching award)
  2. **Foundations of Logic Programming** (M. Sc., ∼300 participants) (*2025*)
     Theory and semantics of logic programming and the language Prolog, including constraint logic programming (CLP(FD)). (Nominated for teaching award)
  3. **Programming Concepts** (B. Sc., ∼800 participants) (*2022–2025*)
     Introduction to imperative (Java) and declarative (Haskell, Prolog) programming and to program verification via the Hoare calculus. (Nominated for teaching award)

- **Seminars (Supervisor, 1–30 students each)**

  1. Advanced Programming Concepts (*2023–2026*)
  2. Satisfiability Checking (*2025, 2026*)
  3. Verification Techniques (*2022–2025*)

- **Student Assistant (during B. Sc. and M. Sc.)**

  1. Complexity Theory (*2021*)
  2. Mathematical Logic (*2021*)
  3. Programming Concepts (*2018, 2019*)
  4. Data Structures and Algorithms (*2019*)
  5. Formal Systems, Automata and Processes (*2018*)

Student Supervision (Total Number: 24)

- **Completed Theses**

  - *Master's:*
    1. Leon Spitzer: "*Analyzing Strong Almost-Sure Termination for Probabilistic Term Rewriting Using Dependency Pairs*" (related published paper)
    2. Jiaqian Chen: "*Integration of New State-of-the-art SMT-Solvers into the Termination Tool AProVE*"
  - *Bachelor's:*
    1. Michelle Dahmen: "*Proving Almost-Sure Termination of Term Rewriting with Non-Constant Probabilities*"
    2. Kiran Monteiro Pai: "*Reachability Analysis for Probabilistic Term Rewriting Systems*" (related paper ongoing)
    3. Tobias Sokolowski: "*Proving Confluence of Term Rewriting within AProVE*"
    4. Arion Scheid: "*Using Stochastic Context Free Grammars to decide Almost Sure Termination for Probabilistic Term Rewriting Systems*" (related paper ongoing)
    5. Ivan Zlatin: "*Analyzing Derivational Complexity via Innermost Derivational Complexity*"
    6. Alexander Schlecht: "*Counting the Probabilities of Loops: Disproving (Strong) Almost-Sure Termination of Probabilistic Rewriting Automatically*" (related paper to appear)
    7. Henri Nagel: "*Refining the Dependency Framework for Basic Start Terms*"
    8. David Weber: "*PReVision - A Visualization Tool for Computations of Probabilistic Term Rewriting*"
    9. Fabian Berkner: "*Defining H-Termination for the Analysis of Haskell Programs*"

10. Jonas Säuberlich: "*Integration of Advanced Interpretation Techniques for Termination Analysis of (Probabilistic) Term Rewriting*"
11. Grigory Vartanyan: "*Using Dependency Tuples for Proving Relative Termination of Term Rewriting*" (related published paper)

- **Ongoing Theses**
  - *Master's:*
    1. Arian Kulmer: "*Improving Termination Analysis of Integer Term Rewriting via Projections*"
  - *Bachelor's:*
    1. Nils Maasch: "*Integrating Lexicographic Combinations of Reduction Pairs in AProVE*"
    2. Alwin Schüßler: "*Improving Automatic Confluence Analysis in AProVE*"
    3. Moritz Heim: "*Confluence of Linear and Non-Overlapping Probabilistic Term Rewriting*"
    4. Moritz van Hettinga: "*Vertex-Disjoint Tree-Packing and Applications in Term Rewriting*"
    5. Thomas Neudörfl: "*Confluence Analysis of Weighted Abstract Rewrite Systems*"
    6. Luca Reinartz: "*Visualization and Analysis of Strategies in AProVE*"
    7. Lucas Ribeiro da Silva: "*Transformational Approaches for Termination Analysis in Probabilistic Rewriting*"
    8. Ole Siemer: "*Integrating new Input Formats into AProVE*"

- **Supervised Student Assistants**

1. Henri Nagel: *Developing and implementing novel techniques to analyze probabilistic term rewriting and working on the open-source release of AProVE* (*2025–Present*)
2. Grigory Vartanyan: *Developing and implementing novel techniques to analyze relative termination of term rewriting within AProVE* (*2023–2024*)

Presentations, Activities, and More...

Selected Presentations

- **Conference Talks**

1. *Dependency Pairs for Expected Innermost Runtime Complexity and Strong Almost-Sure Termination of Probabilistic Term Rewriting*. PPDP 2025, Rende, Italy (Sep 2025).
2. *A Dependency Pair Framework for Relative Termination of Term Rewriting*. IJCAR 2024, Nancy, France (Jul 2024).
3. *A Complete Dependency Pair Framework for Almost-Sure Innermost Termination of Probabilistic Term Rewriting*. FLOPS 2024, Kumamoto, Japan (May 2024).
4. *From Innermost to Full Almost-Sure Termination of Probabilistic Term Rewriting*. FoSSaCS 2024, Luxembourg City, Luxembourg (Apr 2024).
5. *Proving Almost-Sure Innermost Termination of Probabilistic Term Rewriting Using Dependency Pairs*. CADE 2023, Rome, Italy (Jul 2023).

- **Workshop & Invited Talks**

1. *Automatically Analyzing Termination and Expected Runtime Complexity of Probabilistic Term Rewriting*. UnRAVeL Symposium 2026, Aachen, Germany (May 2026).
2. *Automatically Analyzing Probabilistic Programs: Proving and Disproving Almost-Sure Termination of Probabilistic Term Rewriting*. HPI Potsdam, Systems Design Research School Meeting, Potsdam, Germany (Mar 2026).
3. *AProVE: Becoming Open Source and Recent Improvements*. WST 2025, Leipzig, Germany (Sep 2025).
4. *Modularity of Termination in Probabilistic Term Rewriting*. WST 2025, Leipzig, Germany (Sep 2025).
5. *Analyzing Weighted Abstract Reduction Systems via Semirings*. Deduktionstreffen 2025, Stuttgart, Germany (Aug 2025).
6. *Modularity of Termination in Probabilistic Term Rewriting*. UnRAVeL Biweekly Meeting, Aachen, Germany (Nov 2024).
7. *A Dependency Pair Framework for Relative Termination of Term Rewriting*. TeReSe 2024, Amsterdam, Netherlands (Jun 2024).
8. *Proving Almost-Sure Termination of Probabilistic Programs Using Term Rewriting*. ROCKS 2023, Saarbrücken, Germany (Sep 2023).
9. *Dependency Tuples for Almost-Sure Innermost Termination of Probabilistic Term Rewriting*. WST 2023, Obergurgl, Austria (Aug 2023).
10. *Proving Almost-Sure Innermost Termination of Probabilistic Term Rewriting Using Dependency Pairs*. TeReSe 2023, Aachen, Germany (Jun 2023).

Academic Service

- **Workshop Organization**

1. **UnRAVeL Symposium 2026** (*2026*)
   Organized the three-day closing symposium of the DFG Research Training Group UnRAVeL at RWTH Aachen University, with excellent invited speakers from all over the world.
2. **UnRAVeL Autumn Workshop 2023** (*2023*)
   Organized UnRAVeL's annual autumn workshop, inviting alumni who had finished their PhD to share their career experiences.

3. **25th Informal Workshop on Term Rewriting (TeReSe 2023)** (*2023*)
   Hosted the long-running TeReSe series in Aachen: An afternoon of presentations with discussions that fosters exchange within the term-rewriting community.

- **Program Committee**: WPTE 2026 (Workshop on Rewriting Techniques for Program Transformations and Evaluation).
- **Peer Review (Conferences)**: IJCAR 2026, FSCD 2026, TACAS 2026, FroCoS 2025, CADE 2025, IJCAR 2024, LPAR 2024, the Festschrift for J.-P. Katoen 2024, and FroCoS 2023.
- **Peer Review (Journals)**: Logical Methods in Computer Science (2026), Journal of Automated Reasoning (2026), Formal Aspects of Computing (2025) and the Journal of Logical and Algebraic Methods in Programming (2024).

Management & Leadership & Software Development Experience

- **App-Stone GmbH** Soest, Germany
  Founder & Shareholder *Mai 2018 – Present*
  - **Foundation**: Co-founded Capybara Software UG in 2018 and App-Stone GmbH after two years of growth. Both companies specialize in on-demand iOS and Android app development.
  - **Management & Leadership**: Managed a team of up to 10 employees across various departments. Handled business decisions, hiring, project management, planning, and drafting project proposals with price calculations.

  Software Engineer *Mai 2018 – Oct 2022*
  - **Android Development**: Mobile apps in Android Studio (Java)
  - **iOS Development**: Mobile apps in Xcode (Swift)
  - **Hybrid Mobile Development**: Multi-platform apps with Flutter (Dart)
  - **Server Development**: Backends with Django. Dockerized with Postgres, Gunicorn, Nginx. Deployed on AWS
  - **Testing & Debugging**: JUnit testing, error analysis with Firebase Crashlytics
- **RWTH Aachen University Sports (Hochschulsport)** Aachen, Germany
  Handball Trainer *2022 – Present*
  - **Coaching & Leadership**: Plan and lead regular training sessions for the university handball team, coaching players of varying skill levels and fostering teamwork, fitness, and commitment.

Project Highlights

These are projects that I actively co-developed during my career.

- **AProVE**: AProVE (Automated Program Verification Environment) automatically proves termination, runtime complexity, and safety of programs written in languages such as Java, C, Haskell, and Prolog, as well as several term rewriting formalisms. It regularly wins first place in a large number of categories at the annual International Termination Competition. I maintain this project as the main developer since 2023. All my research on probabilistic term rewriting is implemented in AProVE and successfully evaluated.
- **BWL Champion**: BWL Champion is a gamified quiz app for learning business administration, usable both individually and competitively, and is employed in courses at several German universities. Its didactic concept received a best paper award in the teaching track of CARF 2025. It strengthens teaching through interactive, self-paced learning across institutions, and underpins research on gamification and digital learning in higher education.
- **AABC**: African Alphabets of the Bayreuth Cluster (AABC) provides mobiles and desktop PCs (Windows and iOS) with keyboards for all common African languages and scripts.
- **Amsel - Build up your voice**: Amsel is a mobile application for singers of every performance level. It provides many warm-up techniques and exercises to develop a more professional singing voice.