

Sacha-Élie Ayoun

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PhD Student · Research assistant
Supervised by Prof. Philippa Gardner · Imperial College London

Education

Imperial College London

PhD in Computer Science - Under the supervision of Prof. Philippa Gardner

Part of the Verified Trustworthy Software Specification Group. Working on Gillian, a parametric symbolic analysis framework, and instantiating it to C and Rust. See Projects section for more details.

Oct. 2018 - present

London, United Kingdom

Marktoberdorf Summer School on Safety and Security of Software Systems

Student

Link to the summer school program : <https://www2.in.tum.de/mod19/lectures.html>

Aug. 2019

Marktoberdorf, Germany

Imperial College London

MSc in Advanced Computing - with Distinctions

- Reasoning about programs: Complexity (A*), Separation logic (A*), Probabilistic model checking and program analysis(A*), System Verification(A*)
- Security: Advanced security (A), Privacy Enhancing Techniques (A*), Network and Web security(A)
- Other: Software engineering(A), Deep learning (A), Reinforcement Learning (A*)

Oct. 2017 - Sept. 2018

London, United Kingdom

CentraleSupélec, Supélec Curriculum

MSc in Electrical and Computer Engineering

CentraleSupélec is a top-tier French professional school of science and engineering, with partner programs with prestigious universities around the world, such as MIT, Columbia, Oxford, and Imperial College.

- Broad curriculum with over 30 different subjects, ranging from Corporate Law to Electrical Engineering, Networks, and Operating systems. Average 3.7/4.
- Excellent computer science results: Algorithms and Data Structures (4/4), Numerical Methods of Optimisation (4/4), Operating Systems and Networks (4/4), Big Data (4/4), Software Engineering (4/4)
- One of the top engineering school in France, part of highly ranked Paris-Saclay University

Sept. 2015 - Sept. 2018

Gif-Sur-Yvette, France

Classes Préparatoires Charlemagne

French Classes Préparatoires: 2-year elite, intensive program in advanced mathematics, physics and computer science

Accepted at both CentraleSupélec and ENS Lyon in Computer Science

Sept. 2013 - Sept. 2015

Paris, France

Publications

Gillian Part I: A Multi-Language Platform for Symbolic Execution

José Fragoso Santos, Petar Maksimović, Sacha-Élie Ayoun, Philippa Gardner

2020

PLDI - Online

Gillian, Part II: Real-World Verification for JavaScript and C

Petar Maksimović, Sacha-Élie Ayoun, José Fragoso Santos, Philippa Gardner

2021

CAV - Online

Gillian-Rust: Report on a work in progress (Workshop talk)

Sacha-Élie Ayoun

2022

Rust Workshop @ETAPS - Munich, Germany

Gillian-Creusot: Towards end-to-end compositional verification for Rust (Workshop talk)

Sacha-Élie Ayoun, Xavier Denis

2023

Rust Workshop @ETAPS - Paris, France

Symbolic Debugging with Gillian

Nat Karmios, Sacha-Élie Ayoun, Philippa Gardner

2023

DEBT workshop @ECOOP

Compositional Symbolic Execution for Correctness and Incorrectness Reasoning

Andreas Löw, Daniele Nantes, Sacha-Élie Ayoun, Caroline Cronjäger, Petar Maksimović, Philippa Gardner

2024

ECOOP - Vienna, Austria

Matching Plans for Frame Inference in Compositional Reasoning

Andreas Löw, Daniele Nantes, Sacha-Élie Ayoun, Petar Maksimović, Philippa Gardner

2024

ECOOP - Vienna, Austria

Talks

KU Leuven, DistriNet Group Seminar

Gillian: Unified Parametric Compositional Symbolic Execution

July 2023

Leuven, Belgium

Max Plank Institute for Software Systems - Programming Languages and Verification Seminar

Gillian: Unified Parametric Compositional Symbolic Execution

August 2023

Saarbrücken, Germany

ETH Zürich - Programming Languages and Systems Institute Seminar

Gillian: Unified Parametric Compositional Symbolic Execution

September 2023

Zürich, Switzerland

Rust Formal Methods Interest Group Seminar

Gillian-Rust: A Hybrid Approach to end-to-end verification for Rust programs

February 2024

Online

Quarkslab Seminar

Gillian: Unified Parametric Compositional Symbolic Execution

March 2024

Paris, France

Employment

Imperial College London

Research Assistant

Jan. 2023 - present

London, United Kingdom

As my role in the Verified Trustworthy Software Specification group has extended beyond that of a PhD student, I have been promoted to Research Assistant while I finish my thesis.

Amazon Web Services - Kani team

Applied Scientist Intern

June 2022 - Sept 2022

Boston, Massachusetts, USA

The Kani Rust verifier is based on the CBMC tool as a backend. I worked on using Gillian, the tool I am developing for my PhD, as an alternative backend. Doing so unlocked exciting opportunities, and allowed, to our knowledge, the first unbounded proof of unsafe Rust code performed directly on the source code. It also showed promising results regarding Gillian performances, and suggested that the Kani team could explore portfolio reasoning, keeping CBMC as its primary backend, but also use other backends.

Amazon Web Services - CodeGuru team

Applied Scientist Intern

July 2021 - Oct 2021

Remote - California, USA

I was an Applied Scientist intern as part of the CodeGuru team at AWS during the summer. As part of that team, I developed a proof of concepts analysis for Java that could help reduce the number of false positives or reduce the search space in other kinds of analyses without compromising soundness. It was a great and fun experience, and I learned a lot about research in industry. I obtained good feedback from my manager and was offered a return internship.

French Alternative Energies and Atomic Energy Commission (CEA)

Research Intern on Frama-C, a static analyser for the C programming language

Jul. 2017 - Sept. 2017

Saclay, France

Frama-C is a modular static analysis tool based on abstract interpretation. In particular, its EVA (Evolved Value Analysis) module automatically computes sets of possible values for the variables of an analysed program. My role was to develop a new abstract domain that would keep track of the state of every file descriptor.

Projects

Gillan, Gillian-C and Gillian-Rust

Imperial College - Verified Trustworthy Software Specification Group

Oct. 2018 - Present

London, United Kingdom

Gillian is a language-independent framework for the development of compositional symbolic analysis tools. It supports three flavours of analysis: whole-program symbolic testing, full verification, and bi-abduction. For a given language, Gillian requires as input a compiler from the language to our intermediate language GIL and an implementation of the memory model and basic actions for the model. Gillian then provides a complete toolchain for the symbolic analysis of that language. For now, Gillian has been instantiated to:

- Gillian-JS, an analysis tool for JavaScript whose performance is as good as the previous work on JaVert 2.0
- Gillian-C, an analysis tool for C leveraging CompCert, a Coq-certified C compiler developed at Inria with promising initial results for performance;
- Gillian-Rust, an analysis tool which allows for the verification semantic type safety and functional correctness of unsafe Rust code;
- and Gillian-WISL, an analysis tool for a toy while language which we will use for experimentation into error reporting, concurrency

While Gillian-JS was extracted from previous work, Gillian-C, Gillian-Rust and Gillian-WISL are entirely my contributions. In addition, I have also contributed to strengthening the formalism constituting the meta-theory of Gillian itself, and have become lead developer on its implementation. A paper describing the core symbolic execution engine of Gillian has been published at PLDI 2020 and a paper about verifying code written both in C and JS and already deployed in production by Amazon AWS has been published in CAV 2021.

“LinkCS” Project lead: Development of a web and mobile application for campus life

CentraleSupélec - ViaRezo

Sep. 2016 - Sep. 2017

Paris-Saclay, France

CentraleSupélec was recently created by a merger between the Ecole Centrale Paris and Supélec. This merger, coupled with the very active student and societal life in the school, gave rise to the need for an application that would help the students manage their everyday lives inside the campus societies. As project lead, I supervised the creation and development of this application, with its ambitious micro-services architecture and use of (at the time) cutting-edge web technologies, such as NodeJS, ReactJS, and GraphQL. To this day, LinkCS is still used as one of the core components of student life on the CentraleSupélec campus.

Teaching and Supervision

Teaching Assistant

Imperial College London - 6 courses from 1st year to masters level

Oct. 2018 - Present

London, United Kingdom

- Scalable Software Verification (taught by Prof. Philippa Gardner) : Tutorial helper, Coursework marking, Exam and coursework questions design
- Compilers (taught by Prof. Paul Kelly): Coursework marking
- Models of Computation (taught by Dr. Herbert Wiklicky and Dr. Azalea Raad): Tutorial helper, Coursework and Exam marking.
- Python Programming (taught by Dr. Oana Cocarascu): Tutorial helper, Coursework marking.
- High Level Programming (taught by Dr. Thomas Clarke): Tutorial helper, Coursework and Project marking.
- Computational Techniques (taught by Manon Flageat, Viet Pham Ngoc, Luca Grilloti and Dr. Pancham Shukla): Personalized Mathematics Tutor and Coursework marking.

Masters Thesis Supervision

Co-supervisor for 7 projects since 2020

Sep. 2016 - Sep. 2017

Paris-Saclay, France

Between 2020 and 2023, I supervised 7 masters projects related to the Gillian project. Among those, 3 were awarded a distinguished grade (including 2 that received a prize), and 2 were awarded the distinction grade. Projects subjects ranged from improving the real-world applicability of Gillian by enabling continuous and multi-file verification, to reasoning about Rust memory layouts, or extending Gillian with basic concurrency reasoning through fractional permissions. I am particularly proud of a stream of 3 projects from 2020 to 2022 which led to the creation of a symbolic debugger for Gillian, with a small paper published at DEBT2023, ongoing work for a more detailed paper, and discussions with industry actors to integrate our debugging technique in their widely-used tools.

Grants

AWS Research Funding

Co-Investigator

2023

50 000\$

50k\$ funding for my work on Gillian-Rust (the last section of my PhD project), focusing on unbounded verification for unsafe Rust code.

Committees and Panels

Organising committee - POPL 2024

Student volunteer co-chair and Local organiser

January 2024

London, United Kingdom

I am particularly proud to have been a part of the organising committee for POPL 2024, which was held in London. As student volunteer chair, I had the privilege to meet and work with 50 students from all over the world, running up and down to make sure the experience was as smooth as possible for conference attendees. In addition, as local organisers, I helped with several logistical aspects of the conference, including communication with the venue, designers, conference manager etc.

Artifact Evaluation Committee - VMCAI 2022

Reviewer

Sept 2021

Online

Panel at PLMW - Navigating PhD Studies

Panel member

January 2021

PLMW @POPL21

I was a member of the panel addressed to masters students and new PhD students at the Programming Languages Mentoring Workshop co-located with POPL21.