

Frédéric A. HAYEK

Citizenships: Switzerland & Lebanon

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Research Interests

Main interests: Blockchain, cryptography

Secondary interests: Graph theory, complexity theory

Languages

French	Mother tongue
Arabic	Mother tongue
English	Fluent (December 2017 IELTS 7.5/9 ~ C1)
German	Intermediate
Italian	Beginner
American Sign Language	Beginner

Education

- 2021 – now **University Clermont Auvergne (UCA)** – Clermont-Ferrand, France
1st year Ph.D. candidate
Lab: LIMOS
Director: Prof. Pascal Lafourcade
Supervisors: Prof. Pascal Lafourcade, Prof. Ariane Tichit
Topic: Security Analysis of Distributed Ledgers
Description: In the scope of the Ph. D. we work on different projects, including the development of an eco-friendly cryptocurrency, the convergence of local currencies and cryptocurrencies, development of privacy preserving permissioned blockchains...
- 2020 – 2021 **University Grenoble Alps (UGA)** – Grenoble, France
M. Sc. Cybersecurity
- 2019 – 2021 **Grenoble INP - Ensimag** – Grenoble, France
M. E. Information Systems Engineering
- 2018 – 2019 **University of British Columbia (UBC)** – Vancouver, BC, Canada
Exchange Program part of B. Sc. Mathematics and Computer Science (below)
- 2016 – 2019 **University Grenoble Alps (UGA)** – Grenoble, France
B. Sc. Mathematics and Computer Science
- 2015 – 2016 **École Polytechnique Fédérale de Lausanne (EPFL)** – Lausanne, VD, Switzerland
Special Mathematics Course (CMS)

Research Internships

- February 2021 – August 2021 **Design and Analysis of an Eco-friendly Cryptocurrency: EcoMobi-Coin**
Lab: LIMOS - University Clermont Auvergne (Clermont-Ferrand, France)
Mentor: Prof. Pascal Lafourcade
Description: Mainstream cryptocurrencies (and therefore blockchains) are very power hungry. We worked on a public blockchain based cryptocurrency that not only is not power hungry, but also rewards people for their green mobility.

July 2020 – September 2020 **Preventing Malicious Updates in Messaging Layer Security (MLS)**
Company: Wire - Zeta Project (Berlin, BE, Germany)
Mentors: Franziskus Kiefer, Raphaël Robert
Description: Messaging Layer Security (MLS) aims to render robust encryption less computationally expensive in (large) instant messaging groups. Within MLS, we worked on using Zero Knowledge Proofs in order to prevent Denial of Service (DoS) attacks by a malicious group member during key update.

Academic Research Projects

February 2020 – May 2020 **Shortest Transformations Between k -Colourings**
Lab: G-SCOP (Grenoble, France)
Mentor: Moritz Mühlenthaler
Description: A k -colouring of a graph is a graph where each node is given a colour (between k colours) such that no two adjacent nodes have the same colour. A transformation between k -colourings α and β is a sequence of k -colourings that starts with α and ends at β such that any two consecutive terms differ on the colour of exactly one node. The internship's goal was to find the shortest transformation between k -colourings of graphs. A more comprehensive and detailed description can be found [here](#).

Industry Internships

May 2019 - July 2019 **Machine Learning for quality control**
Company: ProcSim – EPFL Innovation Park, Lausanne, VD, Switzerland
Supervisor: Roxanne Tison
Description: Given a dataset of information from production line captors along with client complaints, the goal was to propose machine learning models that predict complaints based on the production line captors, and eventually know what is causing the complaints.

Technical Skills

Programming languages

Proficient in C, Python

Familiar with Java, OCaml, R, bash, ARM assembly, Haskell, Prolog, COQ, Rust, HTML, CSS, UML

Softwares

Git, SageMath, Matlab, Octave, Sci-Lab, OpenSSL

Teaching Experience

- Spring 2022 **Teaching Assistant – University Clermont Auvergne (UCA)**
Network and Security
This is an introductory course to cryptography and computer security for Master 1 students.
- Spring 2022 **Teaching Assistant – University Clermont Auvergne (UCA)**
Mathematical Tools 2
This is a mandatory course for most first years. It comprises multiple variable functions, differential equations, linear systems with matrix calculus, reasoning and an introduction to set theory.
- Spring 2022 **Teaching Assistant – University Clermont Auvergne (UCA)**
Introduction to C programming
This is a mandatory course for computer science first years.
- Spring 2021 **Tutor¹ – University Grenoble Alps (UGA)**
MAT 206 Introduction to mathematical biology and to the dynamics of populations
MAT 206 focuses on one- and two-dimensional, discrete and continuous, linear dynamic systems, with applications to the variation of species' populations.
- Spring 2020 **Tutor – University Grenoble Alps (UGA)**
MAT 201 Introduction to linear algebra
MAT 201 is mandatory for both math and computer science majors, it comprises linear systems, real vector spaces, linear applications, matrices, an application to geometry and ends on a generalization on rings and fields.
- Spring 2020 **Tutor – University Grenoble Alps (UGA)**
INF 201 Algorithmic and functional programming
INF 201 is an introductory course to functional programming using the language OCaml.
- Spring 2020 **Tutor – University Grenoble Alps (UGA)**
INF 203 Systems and programming environments
INF 203 consists of programming in C, shell scripting, makefiles, and an introduction to automatas.

¹Tutors give tutorials in which they go over parts of the lectures again, and do extra exercises for students who need help. Tutorials in France are more or less support sessions and are optional for most students, but mandatory for some.

- Autumn 2020 **Tutor – University Grenoble Alps (UGA)**
 Autumn 2019 **MAT 101 Mathematical language, elementary algebra and geometry**
 MAT 101 is the first math class taken by math and computer science majors; it reviews, formalizes and expands on notions seen in high school.
- Autumn 2020 **Tutor – University Grenoble Alps (UGA)**
 Autumn 2019 **MAP 101 Elementary calculus and introduction to scientific computing**
 MAP 101 is the first applied math class taken by math and computer science majors, it comprises derivation and integration on the one hand, and on the other coding of integers and floats on computers, as well as programming numerical derivation, integration and interpolation on Sci-Lab (a Matlab-like open-source software).
- Autumn 2020 **Tutor – University Grenoble Alps (UGA)**
 Autumn 2019 **INF 101 Computer science methods and programming techniques**
 INF 101 is the first computer science class taken by math and computer science majors, it consists of an introduction to programming using Python3.

Student Internships

- May 2018 – July 2018 **Detection of software vulnerabilities by reverse-engineering ARM assembly code**
 Lab: VERIMAG (Grenoble, France)
 The goal of this internship was to adapt the work of a Ph. D. thesis to one specific application: ARM assembly.
- May 2017 – June 2017 **Prediction Models and Introduction to Machine Learning**
 Lab: Laboratoire d’Informatique de Grenoble (LIG) (Grenoble, France)
 Though officially an internship, this is basically a summer hands-on crash-course on Machine Learning.

Summer Schools

- August 2019 **MATHINFOLY International Summer School – Lyon, France**
 Crash-course in cryptography, logic, and proof verification in COQ.

Personal Projects

Spring 2016 – Present
Information Coding Model: Babel
I came up with an interesting way of coding information in a probabilistic fasion, where a string of size n can be coded in more than 2^{2n-1} different ways. I like to combine it with RSA to render RSA probabilistic without the use of padding. However I have yet to do a rigorous study of its robustness.

Mentorship and Service

2015 - 2016
Maghdouché Emergency Team (First Aid Worker)
The Maghdouché Emergency Team has been set up to have a fast and efficient first response team around Maghdouché, my hometown.

2010 - 2015
Scouts of Lebanon (Unit Chief)

Professional Memberships

January 2022 – Present
Doct'Auvergne (Vice-President)
The Auvergne association of Ph. D. students and young Ph. D. graduates.

November 2021 – Present
Erasmus Student Network (ESN) Worldtop Clermont-Ferrand
A student association organizing integration and tourism events for international students and Erasmus students.

September 2019 – Present
Grenoble INP Magic Club (President)
A magic club run by students of Grenoble INP engineering school. We teach magic to members, and mostly animate events such as cocktail parties of graduation ceremonies or galas.

2011 – 2016
Maghdouché Theatrical Troop
We have re-created many Lebanese plays by the Rahbani brothers.

Other Interests

Hiking, cycling, cinema, litterature, cooking, karate, *etc...*