



# Axel Faes

COMPUTER ENGINEER · ARTIFICIAL INTELLIGENCE EXPERT

Leuven, Belgium

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## Abstract

I am a Msc. Artificial Intelligence and Msc. Computer Science Engineering student at KU Leuven. My main interests include algebraic effect handlers, program optimization, type systems, graph theory, artificial intelligence, neural computing and brain-computer interfaces. I am participating in the Honoursprogramme of the Faculty of Engineering Science (research track) at KU Leuven. I am also a big supporter of Open Source Software.

## Research Interests

<b>Programming Language Theory</b>	Algebraic Effect Handlers, Type Systems and Program Optimization
<b>Artificial Intelligence</b>	Machine Learning, Reinforcement Learning and Virtual Reality
<b>Neuroscience</b>	Neural Computing and Brain Computer Interfaces

## Educational background

### Doctoral Programme in Biomedical Science (PhD) in Computational Neuroscience

KU LEUVEN

Brain-computer interfaces and Neural Engineering

Leuven, Belgium

Sep. 2018 - Sep. 2022

### Advanced Master of Science in Engineering (M.Sc.) in Artificial Intelligence

KU LEUVEN

Engineering and Computer Science

Leuven, Belgium

Sep. 2017 - Jul. 2018

### Master of Science in Engineering (M.Sc.) in Computer Science (Burgelijk Ingenieur - ir.)

KU LEUVEN

Artificial Intelligence & Theoretical Computer Science

Leuven, Belgium

Sep. 2016 - Jul. 2018

### Bachelor of Science (B.Sc.) in Computer Science (79% - Magna Cum Laude)

UHASSELT

Physics and General courses

Hasselt, Belgium

Sep. 2013 - Jul. 2016

### Business Summer School: United in Manchester (0739)

THE UNIVERSITY OF MANCHESTER

International Business

Manchester, UK

Jul. 2015 - Aug. 2015

## Honors & Awards

Mar. 2018 **Finalist**, Cyber Security Challenge

Brussels, Belgium

Oct. 2017 **Honoursprogramme**, of the Faculty of Engineering Science

KU Leuven, Belgium

Sep. 2017 **3rd place**, ICFP 2017 Student Research Competition

Oxford, UK

Jul. 2016 **Bachelor Award**, in Computer Science

U Hasselt, Belgium

May. 2016 **3rd place**, ACM CHI 2016 Student Design Competition (Interaction Design and User Experience.)

San Jose, CA, USA

Feb. 2016 **2nd place**, BeGDC (Belgian Game Development Championship)

Brussel, Belgium

Jan. 2016 **IELTS**, Academic Module (8.0/9.0)

Brussel, Belgium

## Work & Research Experience

### Phd Candidate (FWO-Aspirant Fellowship)

KU LEUVEN

Leuven, Belgium

Oct. 2018 - Current

- Project: "Graph-based model of information diffusion in the human brain for studying event-related potentials"
- Promoter: Prof. Marc van Hulle
- Group: Computational Neuroscience, Laboratory for Neuro-and Psychophysiology, KU Leuven

## Student Job: Creating System Identification course

KU LEUVEN

- Faculty of Engineering Science: ESAT (Electrical Engineering)
- Research group: STADIUS

Leuven, Belgium

Sep. 2017 - Current

## Research Assistant: design of type-&-effect system for Eff based on row polymorphism

KU LEUVEN

- Faculty of Engineering Science: Computer Science
- Research group: DTAI
- Part of the Honoursprogramme of the Faculty of Engineering Science (research track).
- Topic: Development of an row-based type-&-effect system for the Eff programming language

Leuven, Belgium

Apr. 2017 - Oct. 2017

## Research Assistant: efficient compilation of algebraic effect handlers

KU LEUVEN

- Faculty of Engineering Science: Computer Science
- Research group: DTAI
- Part of the Honoursprogramme of the Faculty of Engineering Science (research track). My project is part of the C1 project: Algebraic Effect Handlers: Harnessing the Fundamental Power of Effects. Eff is a functional programming language that uses handlers to handle all kinds of effects. These effects could be I/O, exceptions, user-defined, etc. My task is to design, implement, benchmark and formally proof new optimisations in the Eff compiler. The compiler is written in OCaml.

Leuven, Belgium

Sep. 2016 - Apr. 2017

## Web Performance Research Internship

EXPERTISE CENTRE FOR DIGITAL MEDIA (EDM), UHASSELT

- I worked on the iMinds PRO-FLOW project.
- My work involved creating multiple usecases to measure website performance. The main focus is on the difference between the http versions (http1.1, https, http2).
- During the project, I had to utilise multiple servers, maintain and extend the nodejs framework used to measure website performance, and manually optimize commercial websites using PHP, JS, HTML and CSS.

Hasselt, Belgium

Jul. 2016 - Sep. 2016

## Summer Research Internship Physical Computing

EXPERTISE CENTRE FOR DIGITAL MEDIA (EDM), UHASSELT

- Work on a project which focuses on the interaction between a human entity and a drone, aswell as interaction between the drone and virtual objects. This project is written in C++, used the Optitrack motion capture and a custom created drone.

Hasselt, Belgium

Aug. 2015 - Sep. 2015

# Extracurricular Activities

## KU Leuven

DJANGO GIRLS COACH

- We inspire women to fall in love with programming.
- Django Girls organize free Python and Django workshops, create open sourced online tutorials and curate amazing first experiences with technology.

Leuven, Belgium

Mar. 2018 - Current

## KU Leuven

STUDENT REPRESENTATIVE

- POC of Master Computer Science Engineering
- POC of Advanced Master Artificial Intelligence
- Member of Departmental council of Computer Science
- Member of Department board of Computer Science
- Member of Faculty council of Engineering Science

Leuven, Belgium

Sep. 2017 - Current

## CoderDojo Belgium

COACH

- Teach children how to program utilising Scratch, Python, Minecraft and Lego mindstorm.

Uasselt, PXL

Sep. 2014 - Current

## Student Council

MEMBER

- Member of Board of Education
- Member of Faculty Council
- Member of Board of Student Facilities
- Member of Diversity Commission
- Temporary representative in VWS (Vlaamse Vereniging van Studenten vzw)

UHasselt

Aug. 2015 - Aug. 2016

## Student Council

MEMBER

- Member of Board of Education
- Member of Faculty Council
- Member of Board of Student Facilities

UHasselt

Mar. 2015 - Aug. 2015

- Representing students interests in a Computer Science education context.
- This meant discussing with the university in order to improve teaching, learning, assessment and academic services.
- Representing Computer Science education for high school students

## Natural Languages

**English** Fluent (IELTS: 8.0/9.0)

**Dutch** Mother tongue

**French** Basic Knowledge

## Projects

### An Information Theoretical Approach to EEG Source-Reconstructed Connectivity

Leuven, Belgium

ADVANCED MASTER'S THESIS

Feb. 2018 - Jul. 2018

- This thesis takes an information theoretical approach, which concerns model-free, probability based methods such as Conditional Mutual Information, Directed Information, and Directed feature information. We will investigate how these measures are affected by volume conduction, using as ground truth connectivity between simulated cortical sources in the brainstorm toolbox. In order to validate our methods further, these tools will also be compared with their statistical counterparts such as partial correlation, granger causality and dynamic causal modelling.

### Algebraic Subtyping for Algebraic Effects and Handlers

Leuven, Belgium

MASTER'S THESIS

Feb. 2018 - Jul. 2018

- Extending Algebraic Subtyping to incorporate support for algebraic effects and handlers

### Reinforcement Learning Agent in Google Deepmind's StarCraft II Framework - CSAI

Leuven, Belgium

DEVELOPER

Feb. 2018 - Jul. 2018

- Implement several learning algorithms in PySC2

### Software Architecture course - Project

Leuven, Belgium

DEVELOPER

Feb. 2017 - Jul. 2017

- Project made for the course 'Software Architecture'. The goal was to design a software architecture in UML for a IoT-platform concerning plug-gable sensors. The platform allows storage of customer data and the use of third party applications for data analytics. Final score - 18/20

### ICAL parser for KU Leuven schedules

Leuven, Belgium

LEAD DEVELOPER

Aug. 2016 - Current

- An nodejs application to create an iCalender file for courses at KU Leuven. Allows the creation of a schedule containing courses from different masters and the option to ignore events.

### Machine learning techniques for flow-based network intrusion detection systems

Hasselt, Belgium

BACHELOR'S THESIS

Feb. 2016 - Jul. 2016

- The thesis gives an overview of how machine learning algorithms could be used for intrusion detection using only IP Flows. The system has been used to detect intrusions in Cegeka Hasselt Datacenter network.

### Software engineering: Search and Recommendation System

Hasselt, Belgium

TEAM MEMBER

Feb. 2016 - Jul. 2016

- A search and recommendation system for VoD (Video on Demand) for Androme. The system is currently being used in production in the Nebula project. Both Content-Based Recommendations and Collaborative filtering techniques were implemented. Made in a team of 5 (Pieter Teunen, Luuk Raaijmakers, Brent Berghmans, Axel Faes, Matthijs Kaminski, Wouter Bollaert) utilising Java and the Spring framework. Final score - 15/20

### TTUI: Household Survival

Hasselt, Belgium

RESEARCHER

Sep. 2015 - Dec. 2015

- Project made for the class 'Technologies and Tools for User Interfaces'.
- A tower-defense style game written in Unity utilising Optitrack motion capture. The game combines the virtual world and reality, by allowing users to interact with the virtual world using real-world objects. Made by Brent Berghmans, Axel Faes and Matthijs Kaminski. Final score - 18/20

### Cardinal: scripting language

Hasselt, Belgium

LEAD DEVELOPER

Jan. 2015 - Sep. 2015

- Cardinal is a small, fast, class-based, Object Oriented scripting language written in C. It is built upon the skeleton of an existing scripting language and shows how I can modify and improve existing software, as well as design new components to this software.
- New components include a debugger, an embedding API, multiple inheritance and a new module system.

## United in Manchester

Manchester, UK

### TEAM LEADER

Jul. 2015 - Aug. 2015

- A summer school which focuses on teamwork in cross-cultural and multidisciplinary teams, global product development and entrepreneurship. Our team developed a start-up idea on Food Management/Delivery system. Product pitch took place at the end of the course for feedbacks from professionals and for potential commercialisation. Our team consisted of Axel Faes, Linh Chi Evelyn Phan, Reinaert Van de Cruys and Maria Barouh.

## PSOPV: Visual Programming IDE

Hasselt, Belgium

### DEVELOPER

Feb. 2015 - Jul. 2015

- A Visual programming IDE created by Axel Faes & Matthijs Kaminski for a course of Hasselt University. The purpose of the IDE is to create 'black boxes' which can send events (signals packed with data) to each other. We take the idea of using drag-able blocks in a visual IDE and expand on it. Final score - 17/20

## Publications

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### CONFERENCE PAPERS

- [1] **Robin Marx, Maarten Wijnants, Peter Quax, Axel Faes, Wim Lamotte**, "Web Performance Characteristics of HTTP/2 and comparison to HTTP/1.1", International Conference on Web Information Systems and Technologies, pg 87-114.
- [2] **Robin Marx, Peter Quax, Axel Faes and Wim Lamotte**, "Concatenation, embedding and sharding: Do HTTP/1 performance best practices make sense in HTTP/2?", WEBIST 2017 - Proceedings of the 13th International Conference on Web Information Systems and Technologies.

### EXTENDED ABSTRACTS

- [3] **Axel Faes and Tom Schrijvers**, "Towards a Core Language with Row-Based Effects for Optimised Compilation", International Conference on Functional Programming 2017 Student Research Competition.
- [4] **Kashyap Todi, Brent Berghmans, Axel Faes and Matthijs Kaminski**, "Purpose-Centric Appropriation of Everyday Objects as Game Controllers", CHI EA '16: Extended Abstracts of the SIGCHI Conference on Human Factors in Computing Systems. Late Breaking Work.
- [5] **Kashyap Todi, Donald Degraen, Brent Berghmans, Axel Faes, Matthijs Kaminski and Kris Luyten**, "Household Survival: Immersive Room-Sized Gaming Using Everyday Objects as Weapons", CHI EA '16: Extended Abstracts of the SIGCHI Conference on Human Factors in Computing Systems. Student Game Competition.

### THESIS

- [6] **Axel Faes**, "Algebraic Subtyping for Algebraic Effects and Handlers", Master's Thesis 2018.
- [7] **Axel Faes**, "Machine learning techniques for flow-based network intrusion detection systems", Bachelor's thesis 2016.

### POSTERS

- [8] **Axel Faes and Tom Schrijvers**, "Towards a Core Language with Row-Based Effects for Optimised Compilation", International Conference on Functional Programming 2017 Student Research Competition.

### OTHER PUBLICATION

- [9] **Matija Pretnar, Amr Hany Shehata Saleh, Axel Faes and Tom Schrijvers**, "Efficient compilation of algebraic effects and handlers", 2017 - CW Reports, CW708, 32 pp. Leuven, Belgium: Department of Computer Science, KU Leuven..

### TALKS, PRESENTATIONS AND OTHER MEDIA

- Sep. 19, 2017 "Honours student Axel Faes wins bronze medal in ACM SIGPLAN", KU Leuven, Department of Computer Science.
- Sep. 19, 2017 "Student Axel Faes wins bronze medal in the ACM SIGPLAN Student Research Competition in ICFP conference", KU Leuven, Department of Computer Science, DTAL.