

# Holger Stadel Borum



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I am a PhD student at the IT-University of Copenhagen. I am interested in applying programming language theory such as type systems, code analysis, and transformation to real world problems. This leads to a natural interest for domain specific languages and spreadsheets. I also have an interest in algorithms and computational theory, games, and AI for games.

## Education

**Computer Science, PhD+MSc, ITU, Copenhagen, .** **2018-22**

My project is about designing and implementing DSLs for the pension industry and seek to apply and develop programming language theory in this process.  
Supervisor: Peter Sestoft

**Computer Science, MSc, University of Copenhagen.** **2017-18**

Credits transfered to my combined master and PhD at ITU.

**Games, Master, Not finished, ITU, Copenhagen.** **2016-17**

I did not finish these studies because I was missing computer science.

**Software development, BSc, ITU, Copenhagen.** **2013-2016**

Bachelor thesis about parallelization of a computation on a GPU using the CUDA platform.

## Experience

### *Project work*

**Research programmer, Spreadsheet, Funcalc.** **2016-2018**

Maintaining and developing Funcalc which is a spreadsheet developed by Peter Sestoft in cooperation with others. I implemented a bridge from Excel to Funcalc, looked at minimal recalculations for function modifications, implemented the data structure QuadRopes, and looked at property based testing of the system. <http://www.itu.dk/people/sestoft/funcalc/>

**Application system, Web development.** **2016**

An application system developed for the residence hall Studentergården. The entire process from making the initial offer and requirement elicitation to hosting and maintenance.

**Floralia, Game.** **2013-2018**

Floralia is a large game I have been working on with Malte Burup since 2013. Which unfortunately is unlikely to be finished.

[www.floralia.blaavogn.dk](http://www.floralia.blaavogn.dk)

**Studentergården, Web development.** 2013-2015

Created a new simple CMS-system for the residence hall and made maintenance of an old infrastructure.

**Implemented small video games.** 2012-2016

**11Time, Webdevelopment.** 2011-2012

Part time development in PHP.

### *Teaching*

**Teacher, Programs as data, ITU.** 2018

Held a recap lecture about polymorphic type inference and  $\text{Regex} \rightarrow \text{NFA} \rightarrow \text{DFA}$  transformation. Also responsible for exercise classes and assignment feedback

**Guest Lecture, Systematic Design of User Interfaces, ITU.** 2017

About how I used the methods from the course when designing `ansogning-sg.dk`

**Teaching Assistant, Mobile and Distributed Systems, ITU.** 2015,2016

Responsible for exercise classes, giving feedback on assignments, and creating some assignments.

Introduction to protocols, distributed architectures, consensus & agreement, security and concurrency handling.

Course Manager: Søren Debois

**Teaching Assistant, First-year Project: Map of Denmark: Visualization, Navigation, Searching, and Route Planning, ITU.** 2016

Being a supervisor for groups during their first year project. The project involves searching in graphs, partitioning and visualizing a large data-set, and project planning/execution.

Course Manager: Troels Bjerre

**Teaching Assistant, Systematic Design of User Interfaces, ITU.** 2016

Responsible for exercise classes and giving feedback on assignments.

Course Manager: Søren Lauesen

**Voluntary teacher, Public library.** 2018-2019

Helping often vulnerable primary school students with their homeworks biweekly.

### *Organizational*

**Co-founder of Chill Factor I/S.** 2016

A software company I created with two partners.

**Netgårdmester, Studentergården.** 2014-2015

Resident representative at the board of the hall of residence with different everyday tasks.

### *References*

**Professor Peter Sestoft, `sestoft@itu.dk`.**

**Associate professor Søren Debois, `debois@itu.dk`.**

## Theoretical background

### Computer Science

I am finishing my master in Computer Science with a specialization in programming languages. Concretely I have studied:

- Partial evaluation
- Randomized algorithms
- Functional languages
- Computational and complexity theory

Which I believe to provide me with some background knowledge for the projects about.

- Partial evaluations, the bar construction, and second-order stochastic dominance
- Traversal optics and profunctors
- Complexity classes, computation, and Turing categories

### Category Theory

I have no background in category theory but I am reading "Category Theory for the Sciences".

## PhD information

I am designing and implementing domain specific languages for the pension industry, and I seek to apply and develop programming language theory in this process. The project runs from the summer 2019 to the summer of 2022.

## Project preferences

1. Partial evaluations, the bar construction, and second-order stochastic dominance
2. Traversal optics and profunctors
3. Complexity classes, computation, and Turing categories
4. Formal and experimental methods to reason about dialogue and discourse using categorical models of vector spaces
5. Toward a mathematical foundation for autopoiesis
6. Simplifying quantum circuits using the ZX-calculus

## Funding

I do have funding which can cover at least travel and accommodation.

To whom it may concern

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30 January 2019

### **Holger Stadel Borum's application**

It is my pleasure to recommend my PhD student Holger Borum for the ACT2019 summer school.

I came to know Holger in early 2016 when supervising his bachelor project about using general purpose graphics processors (GPGPU) to numerically solve certain differential equations in the domain of pensions and life insurance. He invented and conducted a range of experiments to pinpoint the performance bottlenecks in such computations.

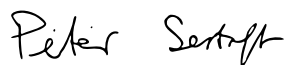
Subsequently he worked as a research programmer in my research project on parallel spreadsheet implementations (on shared memory multicore hardware, very different from GPGPU), in which role he collaborated with other students and maintained a large and complex code base.

Now I am supervising his PhD on domain specific languages in the pension and life insurance industry.

During the time I have worked with Holger, he has been eager to explore the theoretical foundation of programming languages. Becoming more acquainted with category theory is a natural progress in this exploration and useful for his research.

On a more personal note, I know that Holger works well with others on projects, is highly motivated to learn new theory and technology, and also punctual and hard working.

Yours sincerely,



Peter Sestoft  
Head of Department  
Professor, PhD