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Personal Statement

The vast range of the possible applications of mathematics has been my drive throughout my academic career. I'm currently doing my final semester in B.Sc in Mathematics at the University of Iceland.

Generally, my main research interests involve investigating mathematical structures which could reveal a greater truth of the nature of learning algorithms, the human brain and intelligence.

I have sought for different perspectives of how mathematical structures naturally appear through my studies in mathematics and research of the dynamics of quantum systems. I have specifically looked at open quantum systems with focus on how the mathematical structures which I constructed could effectively be transformed into a computational model.

My current long term goal is to obtain a Ph.D. focusing on Deep Learning.

Education

University of Iceland

August 2012 - June 2016

B.Sc. - Major in Mathematics with emphasis on both Physics and Computer Science.

Akureyri Junior College

August 2008 - June 2012

Matriculation Examination, Mathematics (Physics I) Program

Academic & Research Experience

Research in Neural Network Language Models *January 2016 - (Expected) August 2016*

- Introduced the idea along with another student to implement a neural network language model of Icelandic.
- We were offered a grant by Prof. Thomas Philip Runarsson to take the idea further once we had trained a character level LSTM network as proposed by Mr. A. Karpathy and sampled it to do spell checking of OCR-scanned texts from the Icelandic Parliament.
- Currently we are investigating Character Level Neural Networks as well as a Word Level Neural Networks trained as suggested by other researchers. The idea is to make a model which should act as an online grammar-aware and spelling-aware typing assistant.

Our initial implementation of this idea was brought forward by me as a project in a course in Computational Intelligence. I saw the project as a fascinating opportunity to gain an understanding of Deep Learning. As there are no researchers at our faculty involved in research of neural networks the project proved to be a good exercise in self-studying. Although there is still a lot to explore I have become absolutely convinced that I want to pursue further work in the field of Deep Learning. The application of neural networks for natural language processing has a special importance to me as a possible way to help conserve my native language, a language which has less than half a million of speakers.

Research in Open Quantum Many-body Systems*Summer of 2014 - 2016*

- Worked for Prof. Vidar Gudmundsson on investigating, in mathematical and computational terms, the possible steady states of an open quantum system.
- We used a quantum master equation called The Nakajima-Zwanzig equation, an exact formalism which describes the time evolution of our system with the objective of solving it within the many-body Fock-space.
- Seeking the steady-state we made a Markov approximation, which consists of neglecting the influence of the history of the system on its current state, and obtained an equation which proved very difficult to solve within the Fock-space.
- Discovered a set of techniques which allowed to obtain a solution for the equation in a Liouville tensor product space. It was used to prove that some of our previous attempts could not produce a conclusive set of results. The implementation offered significant reduction in computation time.

One of the reasons for our interest in the system was its utility describing time-dependent electron transport through a photon cavity including to high order electron-electron and electron-photon interactions. My discovery consisted of realizing that the transport induces linear functional which describes element-wise nonlinearity of Dirac measures. This discovery explained why our previous attempts in the summer of 2014 were unsuccessful as well as making us realize that an efficient computational model could be implemented by solving the equation in the Kronecker Tensor Space.

Being a part of this project was a life-changing opportunity for me, making me understand that research focused on work in applying mathematics to various domains is what I want to focus on.

I am writing a B.Sc. thesis in physics focusing on the ideas that we've discovered in the project. Furthermore, we will be submitting articles about our findings in scientific journals in the coming months.

The EdBook Project*November 2015 - January 2016*

Web Programmer

- Was part of a small team working for Assistant Prof. Benedikt Steinar Magnusson and Assistant Prof. Sigurdur Orn Stefansson.
- We transformed an existing set of lecture notes into an interactive web page which was also in a printable format.
- This was done by transforming LaTeX code into MathJax and html using the Sphinx package in Python.
- The web page contained embedded applets such as GeoGebra, Sage, Octave and R.
- Website: <https://notendur.hi.is/bsm/edbook/index.php>

Providing teaching material for undergraduate students at the University of Iceland is especially important because of the limited resources available in Icelandic. The objective of the EdBook project is to move forward with how this is conducted. I hope that I can be of further assistance to the visionaries of this project in the future as there are applications for machine learning tools in this domain.

Teaching Experience

Sessional teachers at the department of the Faculty of Physical Sciences at the University of Iceland are responsible for a group of approximately 20-40 students. These teachers conduct problem solving sessions that are designed to be an opportunity for students to discuss how the theory introduced in lectures may be applied to various problems. These teachers are also responsible for grading homework assignments on a weekly basis. Often, mature students that have shown dedication to their studies are offered a post as sessional teachers.

Mathematical Analysis IV

Spring Semester 2016

Sessional Teacher at the University of Iceland

- Attended two classes each week to give guidance to students who would come and ask for help with homework projects given once a week.
- The course is taught by Associate Prof. Birgir Hrafnkelsson and covers Fourier Analysis and Partial Differential Equations as well as computational implementations of the solutions to such equations.

Linear Algebra

Fall Semester 2015

Sessional Teacher at the University of Iceland

- Worked closely with Prof. Jon Ingolfur Magnusson who was in charge of the course.
- The book used was 'Linear Algebra, Theory and Applications' by Cheney and Kincaid.
- Among concepts covered were: Matrices and Determinants, Vector Spaces and Linear Transformations, Eigenvalues and Eigenvectors, Inner Product Spaces and The Spectral Theorem.

Mathematical Structures in Computer Science

Fall Semester 2015

Sessional Teacher at the University of Iceland

- The course was taught by Prof. Snorri Agnarsson using the book 'Discrete Mathematics and its Applications' by Rosen with some additional content written by Prof. Agnarsson on the usage of logic in programming.
- The course provides a brief introduction to the following topics: Mathematical Logic, Set Theory, Number Theory, Probability Theory, Relations, Networks and Trees, Automatas and Regular Languages.

The experience of teaching has provided me with an important insight into the complexity of the task as well as greatly improving my presentation skills.

Teaching first year courses (equivalent to sophomore courses in the U.S. and Canada) is particularly demanding as many students who enter the programs are insufficiently prepared.

A lot of educational theory is employed by Adjunct Prof. Anna Helga Jonsdottir et al. to find ways of helping these students. Her consulting helped to understand and identify different teaching methods that could be used.

Preparatory Class in Mathematics

Summer 2015

Teaching Assistant at the University of Iceland

- Wrote and designed a series of lectures and associated teaching material with three other students.
- The audience were prospective sophomores that had self-registered to prepare for the upcoming academic year.

- The lectures were designed from a bottom-up approach, emphasizing the importance of understanding and appreciating fundamental concepts and results of algebra, theory of functions and calculus.
- The lectures proved to be a big success and we were asked to repeated them in the fall; overall all the lectures reached 191 students in total.
- A study by Adjunct Prof. Anna Helga Jonsdottir is being done to investigate the impact of these lectures. Our work will provide a foundation for a long term project aimed at students with insufficient preparation.

Supporting Classes in Mathematics

September 2011 - May 2012

Teacher & Organizer

- Played a key role in setting up and supervising classes of mathematics where I taught along with fellow classmates at Akureyri Junior College.
- Classes were held twice a week with up to 65 students attending.

Exchange Program

During my second year of university I decided to take a step outside of my comfort zone and do my third year in Bordeaux, France as an Erasmus Exchange student. My motivation for doing this was first and foremost to learn a new language, gain new perspectives and to expand my studies beyond the curriculum in Iceland.

Having taken a few high-school courses in French, and being Canadian I wanted to strengthen my knowledge of the French Language.

After some initial struggles with finding an apartment and settling the year that ensued proved to be one of the most maturing experiences of my life so far. As all the courses were taught in French, I not only had to learn the language but also greatly improve my skills of research, and become a more independent learner.

Erasmus Exchange Student

August 2014 - June 2015

University of Bordeaux

- Amongst the courses taken were Automata and Complexity, Cryptography, An Introduction to Robotics, Measure Theoretic Probability Theory, C Programming and Object Oriented Programming in Java.
- Received an Erasmus grant of 550 Euros per month for a period of ten months.
- Courses were taught in French.

Work Experience

Senior Technical Student

Summer of 2011 & 2013

Toronto Hydro

- Worked for the Department of Capacity Planning and the Department of Power Systems Planning & Logistics.
- Developed several logistics models, using Visual Basic, which performed productivity analysis on system operations.
- Managed to successfully integrate the programs into the business unit to be used as tools for regular reporting.
- Created a detailed, animated presentation on operational response during one of the most extreme Major Event Days for Toronto Hydro, where approx. 320.000 people lost power.

- Did an extensive personal tour with Ben LaPianta the Executive Vice President at Toronto Hydro, where we discussed the inner workings of Toronto Hydro's transmission stations as well as how they are maintained.

Rental Sales Associate

May 2009 - May 2011 & September 2011 - May 2013

Avis Car Rental

- Part time job as well as a summer job. Was responsible for providing service to customers, sometimes during emergencies in the highlands of Iceland.
- Held the position of a station manager in North East Iceland during the whole month of August, the busiest month of the year.

I consider my work ethic to be one of my biggest qualities. I have been financially independent since I was 15 years old when I started working during school breaks and weekends in a local grocery store.

Programming Languages

I have extensive programming experience, I have used a handful of different languages and I am never afraid to try something new. The language of choice always depends on the project.

Lua & Torch: For research in Deep Learning; I am using Lua within the Torch7 framework.

Python: Used for Robotics, web scraping, some data visualization and language processing.

Fortran with OpenMP: Used extensively for doing research in Computational Physics, as performance was essential the code was written with parallelism in mind. All the code was tested on computer clusters maintained by the Faculty of Physics at the University of Iceland.

R: Used for extensive projects in an introductory course in statistics and data visualization projects in an introductory course in Machine Learning. In these courses I've learned to take advantage of R as a functional programming language.

C: Took an introductory course in C and a project course in which I developed algorithms to solve various exercises. The courses greatly enhanced my understanding of pointers, memory allocation and the nature of programming.

L^AT_EX: My typesetter of choice, I have used it extensively for all of my projects for the last 3 years. I have a pretty firm grasp of the various packages available, and a basic knowledge of writing macros in LaTeX.

Java: Took a course which was an introduction to algorithms and programming and a course on object oriented programming.

Git: Used for version control of my projects, I find it essential when I am collaborating with other students in projects.

Vim: My editor of choice, using Vim has increased my efficiency and made me a better programmer.

Bash: Self-taught; to ease the effort of compiling, running programs and transferring data between computers when working on my research at the University of Iceland.

Visual Basic: Developed a computational model to analyze data for the logistics department at Toronto Hydro. At the end of my internship I had successfully automated most of the work that people in the department had previously done by hand.

Octave: I got introduced to programming through Octave where amongst the projects we did was a ray tracing project and a primitive computer game.

Matlab: Used for solving partial differential equations numerically as well as for a few other projects in numerical analysis. Currently I'm teaching students in Mathematical Analysis IV to use Matlab for simple exercises.

Volunteer Work

Mentor for Erasmus Exchange Students

August 2015 - May 2016

University of Iceland

- Was assigned three exchange students to be their go-to person in Iceland and give them a helping hand in getting the information they need.
- Was able to use my own experience as an exchange student in France to make their process of settling in a little bit easier.

Financial Director & Board Member

May 2013 - May 2014

Stigull Student Association

- Elected to the Board of Stigull (one of six members), the student association for undergraduates in Mathematics and Physics.
- We organized events on a weekly basis, as well as maintaining students' rights.

Financial Director & Trip Manager

May 2011 - May 2012

2012 Class of Physics and Mathematics, Akureyri Junior College

- Was in charge of leading the funding of a trip to London with our physics teacher.

Financial Accountant

May 2010 - May 2011

Student's Shop, Akureyri Junior College

- Was responsible for the revenue of the Shop which was used to fund the graduate trip for the class year.

I am a very social person, good at understanding and observing group dynamics. I thoroughly enjoy collaborating with other people.

Languages

Icelandic	Native language.
English	Excellent. Lived and worked in Burlington, Ontario, Canada for the summers of 2011 and 2013. TOEFL iBT score is excellent - 112/120. 28 out of 30 in all sections.
French	Basic. Lived and studied in Bordeaux, France for the academic year 2014-2015. Able to understand written language, especially mathematical language, quite well. Can understand basic spoken French and have simple conversations.

Interests

I'm genuinely interested in music and art, human culture and history, scientific philosophy, mathematics, science, space and technology.

I love conversing about mostly anything that somehow touches upon any of these topics, especially during a long evening cooking with good friends.

I've been playing the guitar (mainly for my own amusement) since I was a kid, I love attending concerts and I have been through some of my happiest and most memorable moments during inspiring concerts.

Aside from learning French and mathematics during my time in Bordeaux I became deeply entranced by the wine culture in the area. Recently I planned my own bicycle trip to Tuscany in Italy, tasting and learning about the wines of meditation being made in Montalcino and Montepulciano whilst cycling the beautiful hills of Tuscany.

I really like travelling and meeting new people, I am an active member of the couchsurfing community.

I played soccer throughout all of my childhood, it is my favorite form of exercise. I also enjoy hiking, cycling and playing badminton.

References**Prof. Vidar Gudmundsson***Faculty of Physics*

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