

Bruno Gavranović

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Glasgow, Scotland, United Kingdom

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PhD student applying category theory to supervised learning, unsupervised learning, and game theory.

Publications

Compositional Game Theory, Compositionally

Applied Category Theory

R. ATKEY, B. GAVRANOVIĆ, N. GHANI, C. KUPKE, J. LEDENT AND F. NORDVALL FORSBERG.

July. 2020.

- Presented a new compositional approach to compositional game theory based upon Arrows
- Used high-level categorical machinery to model how known and previously unknown variants of open games are included in this general formalism

Learning Functors Using Gradient Descent

Applied Category Theory

B. GAVRANOVIĆ

July. 2019.

- Formalized Cycle-consistent Generative Adversarial Networks in the language of Category Theory
- Devised a novel, object-invariant method of adding and removing objects from images in an unsupervised fashion

Education

PhD, Applied Category Theory

Glasgow, UK

DEPARTMENT OF COMPUTER AND INFORMATION SCIENCES, UNIVERSITY OF STRATHCLYDE

2019. - present

- Supervisor: Neil Ghani
- Working on compositional frameworks on the intersection of supervised learning, unsupervised learning, and game theory

Master studies, Computer Science

Zagreb, Croatia

FACULTY OF ELECTRICAL ENGINEERING AND COMPUTING, UNIVERSITY OF ZAGREB

2016. - 2019.

- Supervisor: assoc. prof. dr. sc. Jan Šnajder
- Master thesis - *Compositional Deep Learning*
- Master thesis was accepted into the ACT2019 conference and awarded the following:
 - Special Award of the Rector of the University of Zagreb
 - Stanko Turk award for distinguished master thesis in Computer Science

Master studies, Artificial Intelligence

Madrid, Spain

ETS INGENIEROS INFORMÁTICOS, UNIVERSIDAD POLITÉCNICA DE MADRID

Sept. 2016 - Feb. 2017

- Semester abroad as a part of student exchange

Undergraduate studies, Computer Science

Zagreb, Croatia

FACULTY OF ELECTRICAL ENGINEERING AND COMPUTING, UNIVERSITY OF ZAGREB

2013. - 2016.

- Supervisor: assoc. prof. dr. sc. Jan Šnajder
- Bachelor thesis: *Application of Deep Learning for Sentiment Analysis*
- Diploma Seminar - TensorFlow implementation of the *Differentiable Neural Computer*

Research Experience & Talks

Applied Category Theory - Adjoint School

Oxford, UK

ACCEPTED INTO THE PROJECT LED BY DAVID SPIVAK

July 2019.

- Studied mathematical foundation of autopoiesis
- Culminated in a nCafe blog post on Behavioral Mereology

2nd Symposium on Compositional Structures

Glasgow, UK

ACCEPTED SUBMISSION

Dec. 2018.

- Gave a talk titled "Generative Adversarial Networks, Databases, and Automatic Differentiation"

Petnica Summer School of Machine Learning

Petnica, Serbia

INVITED TALK, MENTORING

2017., 2018.

- Held a lecture and workshop on Generative Adversarial Networks
- Mentored several teams in implementing various neural network architectures

Hackmind

RESEARCH FELLOW

- 3 month paid fellowship in startup building
- Learned details and business side of startup building

Berlin, Germany

Jan. 2018. - April 2018.

TakeLab (Text Analysis and Knowledge Engineering Lab)

PART OF THE NLP RESEARCH GROUP DURING MY CS STUDIES IN ZAGREB

- Organized a deep learning paper reading group

Zagreb, Croatia

2015. - 2019.

Projects

Framework for automatic differentiation

OPEN SOURCE PROJECT

- Developed an efficient, general PyTorch-like framework for backpropagation in Python
- Implemented dynamic computational graphs, higher order derivatives, tensor differentiation and more

Zagreb, Croatia

Mar. 2017. - Jan. 2018.

Reimplemented a dozen of state of the art deep learning papers and frameworks

HIGHLIGHTS INCLUDE

- **Backprop as Functor**: Haskell implementation of a category-theoretic formulation of neural networks
- **Differentiable Neural Computer**: DeepMind's 2016 Nature paper, neural network architecture capable of learning algorithms
- **Generative Adversarial Networks**: DCGAN, Wasserstein GAN, CycleGAN and others
- **Decoupled Neural Interfaces**: a novel approach to distributed training of networks

Zagreb, Croatia

Feb. 2017. - Present

BEST Spring Course (Board of European Students of Technology)

MAIN ORGANIZER

- Organized an international 10-day seminar on technology
- Coordinated a team of 12 people (PR, FR, HR, Logistics, Design, Web)
- 1 ECTS point worth of academic lectures taught by university professors

Zagreb, Croatia

2015.

Working Experience

Strongly Typed Ltd.

BACKEND HASKELL DEVELOPER

- Contributed to the internals of a Haskell codebase for a fleet-management system for restaurant delivery
- Worked with lenses, monad transformers, an effect system, type-level API and template haskell
- Worked on delivery optimization and business logic implementation

Zagreb, Croatia

Sep. 2018. - March 2019.

Misc. Academic Experience

Lab Demonstrator

DEPARTMENT OF COMPUTER AND INFORMATION SCIENCES, UNIVERSITY OF STRATHCLYDE

- CS106 - Computer Systems and Organization
- CS985 - Machine Learning for Data Analytics

Glasgow, UK

Oct. 2019. - April 2020.

FACULTY OF ELECTRICAL ENGINEERING AND COMPUTING, UNIVERSITY OF ZAGREB

- Computer Forensics

Oct. 2017. - Feb. 2018.

Refereeing

DEPARTMENT OF COMPUTER AND INFORMATION SCIENCES, UNIVERSITY OF STRATHCLYDE

- Logic in Computer Science 2020

Additional education, awards & recognition

2019. **Participant**, 6th Symposium on Compositional Structures

Leicester, UK

2019. **Recipient**, Helium Grant (1000\$)

2018. **Participant**, Applied Category Theory workshop

Leiden, Netherlands

2017. **Participant**, 2nd International School on Data Science

Split, Croatia

2013. **Winner**, National award "Oscar of Knowledge"

Zagreb, Croatia

2012. **1st place**, National Astronomy Competition

Rovinj, Croatia

2012. **Honorable mention**, 6th International Olympiad on Astronomy and Astrophysics

Rio de Janeiro, Brazil

Knowledge & Abilities

TECHNICAL SKILLS

- **Programming:** Haskell, Agda, Python, Java, Idris, SQL, C
- **Other:** linux, git, vim, emacs, zsh, PyTorch, TensorFlow

LANGUAGES

- English (C1.1), Spanish (B1), Croatian (Native)

Interests & Activities

Interests Category Theory, Optimizing workflow, Self-improvement, Piano, Guitar

Misc. Alumni of BEST (Board of European Students of Technology)
Member of the winning team in the Red Bull Gravity Challenge

Zagreb, 2015.