Bruno **Gavranović**

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Glasgow, United Kingdom

☐ (+385) 91-755-8798 | ✉ bruno@brunogavranovic.com | ⌂ brunogavranovic.com | ⬡ bgavran | ⬛ brunogavranovic

PhD student applying Category Theory to supervised and unsupervised learning.

Publications

Learning Functors Using Gradient Descent   *Oxford, United Kingdom*

Applied Category Theory Conference   *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   *Berlin, Germany*

Research Fellow   *Jan. 2018. - April 2018.*

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

TakeLab (Text Analysis and Knowledge Engineering Lab) *Zagreb, Croatia*
PART OF THE NLP RESEARCH GROUP DURING MY CS STUDIES IN ZAGREB *2015. - 2019.*

- Organized a deep learning paper reading group

Projects

Framework for automatic differentiation *Zagreb, Croatia*
OPEN SOURCE PROJECT *Mar. 2017. - Jan. 2018.*

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

Reimplemented a dozen of state of the art deep learning papers and frameworks *Zagreb, Croatia*
HIGHLIGHTS INCLUDE *Feb. 2017. - Present*

- **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

BEST Spring Course (Board of European Students of Technology) *Zagreb, Croatia*
MAIN ORGANIZER *2015.*

- 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

Working Experience

Strongly Typed Ltd. *Zagreb, Croatia*
BACKEND HASKELL DEVELOPER *Sep. 2018. - March 2019.*

- 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

Misc. Academic Experience

Lab Demonstrator *Glasgow, UK*
DEPARTMENT OF COMPUTER AND INFORMATION SCIENCES, UNIVERSITY OF STRATHCLYDE *Oct. 2019. - April 2020.*

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

FACULTY OF ELECTRICAL ENGINEERING AND COMPUTING, UNIVERSITY OF ZAGREB *Oct. 2017. - Feb. 2018.*

- Computer Forensics

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.*