Tim Cooijmans

cooijmans.tim@gmail.com
https://cooijmanstim.github.io

I am an ML&AI researcher interested in the **dynamics of learning systems**, including **meta-learning** and **self-improvement**. *Recurrent Batch Normalization* stabilized the inference of recurrent neural networks, dramatically improving training and generalization. I am currently working in the area of **multi-agent reinforcement learning**, where gradient descent fails in a way that I think can teach us something about learning in general. *Meta-Value Learning* renders differentiable games amenable to gradient descent by modeling the learning process.

Employment history

- **DeepMind** (London, UK): research internship with James Martens (2017)
  - Designed variance reduction techniques for approximate forward-mode autodiff
  - Contributed code to the TensorFlow library for HPC&ML (see *Open-source contributions*)
- **Google Brain** (Mountain View, USA): research internship with Douglas Eck & Fred Bertsch (2016)
  - Conceived Waybackprop: BPTT in O(log n) space (blog post)
  - Conceived a generative model of Bach's chorales that later powered Google's first AI Doodle
  - Contributed code to the TensorFlow library for HPC&ML (see *Open-source contributions*)
- **Mila** (Montréal, Canada): research internship with Aaron Courville & Yoshua Bengio (2015-2016)
  - Research into deep neural networks, specifically dynamic capacity networks, recurrent attention for video and batch normalization in recurrent neural networks (see *Publications*)
  - Contributed code to the Theano library for HPC&ML (see *Open-source contributions*)
- **CERN** (Geneva, Switzerland): technical internship (2014-2015)
  - Developed tools around the Monte-Carlo radsim package FLUKA to predict radioactivity in Large Hadron Collider experiment caverns
  - Trained in radiation safety, first aid & the use of fire extinguishers & oxygen self-rescue masks
- **Ideaspool** (Maastricht, The Netherlands): software development (2011-2012, part-time)
  - Helped develop an on-line education platform
  - Developed a smartphone app for the academic hospital
- **Mapscape** (Eindhoven, The Netherlands): software development (2008-2009)
  - Developed tools to manage POI data sources
- **Compram** (Eindhoven, The Netherlands): software development (2006-2008)
  - Equipped time-tested ERP product from the 80s with a web interface
  - Assumed system administration and other all-round technical work
- **NoxLogic** (Gorinchem, The Netherlands): software development (2005)
  - Designed and implemented a billing system in PHP+MySQL
  - Rewrote a bottleneck PHP script of the main webshop product as an Apache module in C

Education history

- PhD in Computer Science at Mila - Quebec AI Institute, Université de Montréal (2016-2023)
  - Research in generative models, recurrent neural nets, credit assignment, differentiable games
  - Reviewed for ICLR, ICML and NeurIPS
  - Internships at Brain and DeepMind (see *Employment history*)
- MSc in Operations Research at Maastricht University in The Netherlands (2013-2016)

    - Cum laude, GPA 8.53 (out of 10)
    - Two 12-month internships at CERN and Mila (see *Employment history*)
- BSc in Knowledge Engineering at Maastricht University in The Netherlands (2009-2013)
    - GPA 8.06 (out of 10)
    - Projects completed in the context of problem-based learning:
        - design and implementation of a realistic billiards simulator and an AI to play it
        - implementation of the board game *Ticket to Ride* and several AI strategies
        - design and implementation of a traffic simulator to study traffic light control
        - application of deep neural nets and reinforcement learning to Nao robot locomotion
    - Dissertation in high-dimensional statistics that won a Thesis Award

Publications

- LOQA: solving **social dilemmas** efficiently by shaping opponent Q-values
  Milad Aghajohari, Juan Augustin Duque, Tim Cooijmans, Aaron Courville. ICLR 2024.
- Meta-Value Learning: solving **social dilemmas** with a novel general **meta-learning** framework
  Tim Cooijmans, Milad Aghajohari, Aaron Courville. Submitted to NeurIPS 2023, accepted at ICML 2023 Frontiers workshop.
- Best-Response Shaping: solving **social dilemmas** by differentiating through the best response
  Milad Aghajohari, Tim Cooijmans, Juan Augustin Duque, Shunichi Akatsuka, Aaron Courville. Submitted to NeurIPS 2023.
- SUNMASK: Mask-Enhanced Control in Step-Unrolled **Denoising Autoencoders**
  Kyle Kastner, Tim Cooijmans, Yusong Wu, Aaron Courville. EvoMUSART 2023.
- MIDI-DDSP: detailed **control** of **musical performance** via **hierarchical** modeling
  Yuson Wu, Ethan Manilow, Yi Deng, Rigel Swavely, Kyle Kastner, Tim Cooijmans, Aaron Courville, Anna Huang, Jesse Engel. ICLR 2022.
- On the Variance of UORO: an analysis of **variance** (**reduction**) for approx **forward-mode autodiff**
  Tim Cooijmans, James Martens. 2018.
- Harmonic Recomposition using **Conditional Autoregressive** Modeling
  Kyle Kastner, Rithesh Kumar, Tim Cooijmans, Aaron Courville. ICML 2018 workshop.
- Coconet: the ML model behind today's Bach Doodle
  Anna Huang, Tim Cooijmans, Monica Dinculescu, Adam Roberts, Curtis Hawthorne. Blog post, 2018.
- Memorization in **Recurrent Neural Networks**
  Tegan Maharaj, David Krueger, Tim Cooijmans. ICML 2017 PADL workshop.
- Counterpoint by Convolution: a **convolutional** model of Bach's chorales and **Gibbs sampling** strategy
  Anna Huang, Tim Cooijmans, Adam Roberts, Aaron Courville, Douglas Eck. ISMIR 2017.
- Waybackprop: unlocking **long-term dependencies** with **BPTT** using only **logarithmic space**
  Tim Cooijmans. Blog post, 2017.
- Recurrent Batch Normalization: the **first successful use** of **normalization** in **RNN** transitions
  Tim Cooijmans, Nicolas Ballas, César Laurent, Çağlar Gülçehre, Aaron Courville. ICLR 2017.
- Dynamic Capacity Networks: models that **dynamically allocate capacity** to salient features
  Amjad Almahairi, Nicolas Ballas, Tim Cooijmans, Yin Zheng, Hugo Larochelle, Aaron Courville. ICML 2016.
- Theano: a Python framework for fast computation of mathematical expressions
  Theano development team. 2016.
- SESAME: **radiation simulation** toolkit to modify geometry between irradiation and decay stages
  Tim Cooijmans, Moritz Guthoff. CERN EDMS, 2015.
- **Monte-Carlo simulations** of the radiation environment for the CMS experiment
  Sophie Mallows, Igor Azhgirey, Igor Bayshev, Ida Bergstrom, Tim Cooijmans, Anne Dabrowski, Lisa Glöggler, Moritz Guthoff, Igor Kurochkin, Helmut Vincke, S Tajeda. Elba2015 13th Pisa Meeting on Advanced Detectors.
- Technical proposal for the phase-II upgrade of the CMS detector
  CMS collaboration. CERN EDMS, 2015.

Open-source contributions

- Meta-Value Learning code repository
- Recurrent Batch Normalization code repository
- MCTS chess engine in C++ (2014)
- TensorFlow: add `stop_gradients` argument to `tf.gradients`
- TensorFlow: fix race condition in `tf.nn.moments`
- Theano: computation graph walker that works across `Scan` boundaries
- Theano: implement various batched products
    - `batched_tensordot` without `Scan`
    - `batched_dot`
    - add CUDA streams path to `batched_dot`
    - sharded batched `GEMM`
    - batched `GEMM` in `gpuarray` backend
- Rclone: enable Google Drive from service accounts
- Ratpoison: make keymaps switchable at runtime