Botos Csaba

Oxford, United Kingdom

Employment

Teaching Advisor, Javne Lauder Community Schools, Budapest, October 2023 – Present

Organiser, Cross-Disciplinary Machine Learning Research Cluster, Oxford, August 2023 – Present

Research Scientist Intern, Intel Labs, Munich, June 2022 – March 2023

Demonstrator, GirlsWhoML, Oxford, March 2021 – October 2021

Research Advisor, Verizon Smart communities, Budapest, October 2019 – May 2022

Research Assistant, Torr Vision Group, Oxford, September 2018 – March 2019

Demonstrator, Center of Scientific Wonders Nonprofit Ltd., Budapest, September2017 – August 2018

Research Intern, Institute of Experimental Medicine (KOKI), Budapest, June 2017 – May 2018

Education

Engineering Science DPhil (PhD), Wolfson College, University of Oxford, April 2021 – Present

- Thesis: Sample Efficient Unsupervised Adaptation Methods.
- Supervised by Adel Bibi & Philip Torr

Bionic Engineer BSc, Pázmány Péter Catholic University, September 2014 - May 2018

- GPA: 3.94, distinction, 6 departmental merit scholarships
- Thesis 1: Domain Partitioning Generative Multi-Adversarial Networks
- Thesis 2: Deep Learning Baseline for Single Lead ECG processing
- Thesis 3: Open-source Face Recognition System Design
- All three theses was presented at the 2018 National Scientific Students' Association Conference and got $1^{\text{st}}, 1^{\text{st}}, 2^{\text{nd}}$ award, respectively

Prizes and Grants

DPhil is funded by: Meta AI Research (FAIR), Engineering and Physical Sciences Research Council (EPSRC) and Multidisciplinary University Research Initiative (MURI) Scholarship.

Erasmus and Erasmus+ grant received to fund internship in Torr Vision Group, Oxford.

Hungarian National Excellence Scholarship (ÚNKP)

1^{st} prize in Optimization Theory, National Scientific Students' Association Conference, 2018

1^{st} prize in Medical SE, National Scientific Students' Association Conference, 2018

2^{nd} prize in Applied Machine Learning, National Scientific Students' Association Conference, 2018

Academic Projects

Label Delay in Continual Learning [1] Online continual learning, the process of training models on streaming data, has gained increasing attention in machine learning. However, a critical aspect often overlooked is the label delay, where new data arrives before its corresponding labels due to slow and costly annotation processes. We introduce a novel continual learning setup that explicitly accounts for label delay, with models trained over time steps with labels shifted from the data streams by some factor. We conduct an extensive array of experiments to find the best possible way to utilise the more recent unsupervised data to improve on the naïve approach of simply just waiting for the labels to arrive.

Learning local experts via Dynamic Routing [2] Given a compute budget constraint, the goal is to find an optimal neural architecture over a set of labeled images that performs the best on a validation set. Our hypothesis is partitioning the training set into sub-sets with strong biases yield better local NAS results than finding a global optimal architecture. I developed a way to find such sub-sets with strong biases in an unsupervised approach by using deep clustering techniques and used Dynamic Routing networks to recognize the sub-set during inference time and assign the corresponding architecture without relying on an external classifier.

Multi-level Knowledge Transfer for Complex Vision Tasks [3] Given a labeled training set that significantly differs in appearance from the evaluation set and an unlabeled set of images that are drawn from the same distribution as the evaluation set, we studied what is the best practice to improve the accuracy on the evaluation set: I) Pixel level adaptation II) Feature level adaptation III) Adaptation by Student-Teacher networks. I conducted an extensive literature review on relevant adaptation methods and developed a united framework under which the three categories can be jointly applied. To better understand the interaction between the techniques, I carried out an ablation study on three different UDA scenarios.

Theoretical work on multi-agent adversarial games [4] Standard adversarial training involves two agents, namely a generator and a discriminator, playing a mini-max game. However, even if the players converge to an equilibrium, the generator may only recover a part of the target data distribution, in a situation commonly referred to as mode collapse. In this work, I proposed a new approach to deal with mode collapse in generative adversarial learning. This project was funded by the Erasmus+ and the Hungarian National Excellence Program.

Automated Tomographic Reconstruction I worked in the Quantitative Functional Anatomy group in the Insitute of Experimental Medicine (KOKI) on various stages of the group projects, from dissecting specimen to writing Arduino code for signal generation in **opto-genetic** behavioral studies. My main project was the quality assurance and automation of TEM tomographic reconstruction of active sites of neural tissues using the IMOD framework.

Domain Partitioning Generative Multi-Adversarial Networks ($1^{\mathbf{st}}$ prize in Optimization Theory) I started working on the theory of mode-collapse in generative models that later was continued in collaboration with University of Oxford as part of an internship. This thesis is summarized in [4].

Deep learning baseline for single lead ECG processing ($1^{\mathbf{st}}$ prize in Medical SE) led a team of 3 engineers and 2 cardiologists to detect cardiac arryhtmia using recordings from a single-channel mobile ECG device. We entered the 2017 Computing in Cardiology (CinC) contest. I worked on the model training, benchmarking an explainability aspects of the project. The summary of this thesis is published in [5].

Open-source face recognition framework ($2^{\mathbf{nd}}$ prize in Applied ML) I led a team of 6 to develop an extension of the security gate at the main entrance, to enable authorization by FaceID. For this project I started from the VGGFace2 dataset and baseline and gradually extended the database with our own data and the framework to include an app where people could sign-up for the FaceID service to review their activity and profile. This thesis is published in [6].

Workshop: Introduction to Computer Vision / Reinforcement Learning I organized a series of Deep Learning workshops (with 1700+ viewers) using live demos from TensorFlow.js in collaboration with Center of Sci. Wonders (CSOPA) targeting a broader audience, with no technical background. The series was successful enough to get a teaser for the final episode + interview on the Hungarian national TV. The resources can be found in the archive: https://csopamedia.blogspot.com/p/csopa-mi-mesterseges-intelligencia.html

Industrial Projects (confidential)

Object segmentation in traffic scenarios Given multiple live camera feeds of cross-sections in crowded urban areas, help designing / evaluating / debugging a stack of predictive models to localize, segment, identify and track vehicles.

Action recognition on 5G time-series Help with setting up the in-lab data collection pipeline, evaluation protocol, tasks, training baseline models for action recognition on single-tower, multi-receiver 5G experiments.

Anomaly detection and data augmentation Use unsupervised methods to detect unexpected events on live-stream feeds using: structured features (object detection + keypoint recognition) + LSTMRaw features from VAE encoder / GAN discriminator

Pose, age and emotion prediction for pedestrian statistics Train and deploy real-time computer vision systems to predict pose, age and emotion in an on-line streaming scenario.

Interests

- Designing Efficient Lifelong Learning Systems at scale.
- Application of Machine Learning to Mathematics and Natural Sciences.
- Formalizing the Generalist vs. Domain expert trade-off in the context of distributed ML systems.

Technical Skills

Coding: Proficient in Python, working knowledge in C++ and JavaScript.

ML-Ops: Conducted large scale studies (>25,000 GPU hours) using SLURM and Weights and Biases. Furthermore, deployed recognition and recommender systems to embedded devices (Jetson-TX2 and Nano).

DevOps: Implemented system monitoring for the in-house resources. Due to lack of IT support, I have written a lightweight replacement for the SLURM scheduler to maintain fair usage across 84 GPUs of our research group.

Personal

Hungarian citizen with Gypsy ancestry.

I regularly organise live music events in Wolfson College and perform with my band at formal events.

I am part of the Wolfson rowing team (and I wrote an auto-scheduler for the captains)

References

[1] Botos Csaba, Wenxuan Zhang, Matthias Müller, Ser-Nam Lim, Mohamed Elhoseiny, Philip Torr, and Adel Bibi. Label delay in continual learning. *arXiv:2312.00923*, 2023.

[2] Botos Csaba, Adel Bibi, Yanwei Li, Philip Torr, and Ser-Nam Lim. Diversified dynamic routing for vision tasks. In *European Conference on Computer Vision*. Springer, 2022.

[3] Botos Csaba, Xiaojuan Qi, Arslan Chaudhry, Puneet Dokania, and Philip Torr. Multilevel knowledge transfer for cross-domain object detection. *arXiv preprint arXiv:2108.00977*, 2021.

[4] Botos Csaba, Adnane Boukhayma, Viveka Kulharia, András Horváth, and Philip HS Torr. Domain partitioning network. *arXiv preprint arXiv:1902.08134*, 2019.

[5] Csaba BOTOS, Tamás HAKKEL, Márton Áron GODA, István REGULY, and András HORVÁTH. Strong deep learning baseline for single lead ecg processing. In *Computer Science Research Conference*, volume 57.

[6] Botos Csaba, Hakkel Tamás, András Horváth, András Oláh, and István Z Reguly. Ppcu sam: Open-source face recognition framework. *Procedia Computer Science*, 159:1947–1956, 2019.