Paul Almasan

PhD Candidate

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Education

2019 – present

Ph.D. at Barcelona Neural Network Center — Universitat Politècnica de Catalunya

- Thesis title: "Leveraging Graph Neural Networks for Optimization and Traffic Compression in Network Digital Twins". To be defended in July 2023.

- Conceptualized, investigated and implemented an algorithm for routing optimization using deep reinforcement learning (DRL), graph neural networks (GNN) and deterministic algorithms. The new method achieves close-to-optimal performance in real-time for realistic routing optimization scenarios (see `https://github.com/BNN-UPC/ENERO`).

- Supervision, conceptualization and design of a time-efficient method for training DRL agents. We proposed to train the neural weights using evolutionary strategies and parallelization, achieving a speed up in training time of 128 for real-world topologies.

- Responsible for the design and implementation of ML models for lossless network traffic compression, outperforming GZIP by $\geq$**50%** in compression ratio.

- Preparation, creation, writing of the technical document and presentation of the final work of multiple research projects.

2017 – 2019

M.Sc. in Innovation and Research in Informatics — Universitat Politècnica de Catalunya

Specialization of **Computer Networks and Distributed Systems**. Thesis title: "Towards network optimization using graph neural networks".

2012 – 2017

B.Sc. in Computer Science — Universitat Politècnica de Catalunya

Specialization of Information Technologies

Erasmus Study Abroad Scholarship (February – July 2016) at the CZECH TECHNICAL UNIVERSITY IN PRAGUE

Professional Experience

Sept. – December 2022

Data Science Intern at Telefónica Research

Conceptualized and implemented spatio-temporal graph neural network models with attention mechanisms for modeling 5G cellular networks, achieving errors of $\approx$15% for time-series forecasting. Wrote code to obtain data statistics and to visualize hundreds of GBs of real-world data, improving the design of ML models.

April – Sept. 2022

Visiting researcher at AGH University of Science and Technology in Kraków, Poland

Responsible for the design and implementation of spatio-temporal graph neural network models to compress network traffic. I also applied my data analytics skills to identify patterns and correlations in time-series data.

February 2019

Visiting researcher at AGH University of Science and Technology in Kraków, Poland

Collaborated with other researchers in the conceptualization of a routing optimization algorithm using GNNs.

June 2017 – April 2019

Research assistant at the Computer Architecture Department from the Universitat Politècnica de Catalunya

- Design and implementation of a novel algorithm for routing optimization. The technical document of the algorithm attracted **more than 100 citations and more than 100 stars** in `https://github.com/knowledgedefinednetworking/DRL-GNN` in a short period of time.
- Reviewed the state-of-the-art literature for solving the packet classification problem on software routers. In addition, I was responsible for the design and implementation of a testbed environment with the intention of testing packet transmission rates using the Vector Packet Processing (VPP) software.

April 2017 – August 2017

Software Developer Internship at I2Cat Foundation

I participated in the development of an open-source software application for multi-cloud deployment. During the internship I became familiar with the Agile methodology and I learned good software development practices.

Grants and Awards

2019 — FI-AGAUR Grant from the Government of Catalonia. 4 years grant to do the PhD in a Catalan University or Research Center

2017 — Everis scholarship to do the Master in Innovation and Research in Informatics at the Universitat Politècnica de Catalunya

EDITORIAL AND REVIEWING ACTIVITIES

2021 – Nowadays — Reviewer for several top tier conferences and journals such as IEEE JSAC, IEEE Access, IEEE Communications Magazine, IEEE TNNLS, Elsevier Computer Networks, LOG Conference 2022 and Expert Systems with Applications.

COMMITTEES MEMBERSHIPS

- Member of the organization committee of the *Graph Neural Networking Challenge 2020* and the *Graph Neural Networking Challenge 2021 Creating a Scalable Network Digital Twin* organized in collaboration with the International Telecommunication Union (ITU).
- Member of the ACM SIGCOMM 2021 Artifact Evaluation Committee.

Extracurricular Activities

July 2021 – January 2022 — Contributing on the development of IGNNITION, an **open-source framework** for fast Graph Neural Network prototyping.

1 – 12 July 2019 — **Reinforcement Learning Summer SCOOL** by Sequel (INRIA Lille-Nord)

May 2019 — Convolutional Neural Networks Coursera MOOC by deeplearning.ai

December 2018 — Improving Deep Neural Networks Coursera MOOC by deeplearning.ai

October 2018 — Neural Networks and Deep Learning Coursera MOOC by deeplearning.ai

August 2018 — Machine Learning Coursera MOOC by Stanford University

2-6 July 2018 — **International Summer School on Deep Learning** at Gdańsk University of Technology

6-9 February 2017 — PRACE Advanced Training Big Data Analytics course at Barcelona Supercomputing Center

26-30 June 2016 — Programming and tuning Massively Parallel Systems Summer School at Barcelona Supercomputing Center NVIDIA GPU center of excellence

Skills

- High proficiency: Python, Keras, TensorFlow, (Spatio-Temporal) Graph Neural Networks, Deep Reinforcement Learning, Attention Mechanisms, Scikit learn, Pandas, Numpy, Networkx
- Intermediate proficiency: Java, JavaScript, Matlab, C/C++, Spark
- Intermediate level experience using Parallelization programming languages: OpenMP, MPI and CUDA
- Intermediate level experience with Amazon Web Services and Dockers
- Good writing and communication skills in English, Spanish and Catalan

Volunteering

2021 – 2023 — Personal blog: https://paulalmasan.github.io/Papers-in-short/

July 2016 – August 2016 — Workaway as English speech teacher at the English Conversation School VELCO in Otsu, Japan

Publications

1. **Almasan, P.**, Ferriol-Galmés, M., Paillisse, J., Suárez-Varela, J., Perino, D., López, D., ... , Barlet-Ros, P. (2022). *Network Digital Twin: Context, Enabling Technologies and Opportunities*. IEEE Communications Magazine.
2. Suárez-Varela, J., **Almasan, P.**, Ferriol-Galmés, M., Rusek, K., ... , Barlet-Ros, P. (2022). *Graph Neural Networks for Communication Networks: Context, Use Cases and Opportunities*. IEEE Network.
3. **Almasan, P.**, Suárez-Varela, J., Rusek, K., Barlet-Ros, P. and Cabellos-Aparicio, A. (2022). *Deep reinforcement learning meets graph neural networks: exploring a routing optimization use case*. Computer Communications, 196, 184-194.
4. Güemes-Palau, C., **Almasan, P.**, Xiao, S., Cheng, X., Shi, X., Barlet-Ros, P., Cabellos-Aparicio, A. (2022). *Accelerating Deep Reinforcement Learning for Digital Twin Network Optimization with Evolutionary Strategies*. NOMS 2022-2022 IEEE/IFIP Network Operations and Management Symposium. IEEE, 2022.
5. **Almasan, P.**, Xiao, S., Cheng, X., Shi, X., Barlet-Ros, P., Cabellos-Aparicio, A. (2021). *ENERO: Efficient Real-Time WAN Routing Optimization with Deep Reinforcement Learning*. Computer Networks.
6. Suárez-Varela, J., Ferriol-Galmés, M., López, A., **Almasan, P.**, ... , Cabellos-Aparicio, A. (2021). *The graph neural networking challenge: a worldwide competition for education in AI/ML for networks*. ACM SIGCOMM Computer Communication Review, 51(3), 9-16.
7. **Almasan, P.**, Suárez-Varela, J., ..., Cabellos-Aparicio, A. (2021, June). *Towards Real-Time Routing Optimization with Deep Reinforcement Learning: Open Challenges*. IEEE 22nd Int'l Conference on High Performance Switching and Routing (HPSR) (pp. 1-6). IEEE.
8. Careglio, D., Spadaro, S., Cabellos, A., Lazaro, J. A., Barlet-Ros, P., Gené, J. M., ... , Solé-Pareta, J. (2021). *Results and Achievements of the ALLIANCE Project: New Network Solutions for 5G and Beyond.* Applied Sciences, 11(19), 9130.
9. Rusek, K., Suárez-Varela, J., **Almasan, P.**, Barlet-Ros, P., Cabellos-Aparicio, A. (2020). *RouteNet: Leveraging Graph Neural Networks for network modeling and optimization in SDN*. IEEE Journal on Selected Areas in Communications, 38(10), 2260-2270.
10. Badia-Sampera, A., Suárez-Varela, J., **Almasan, P.**, Rusek, K., Barlet-Ros, P., Cabellos-Aparicio, A. (2019, December). *Towards more realistic network models based on Graph Neural Networks*. In Proceedings of the 15th International Conference on emerging Networking EXperiments and Technologies (pp. 14-16).
11. Suárez-Varela, J., Carol-Bosch, S., Rusek, K., **Almasan, P.**, Arias, M., Barlet-Ros, P., Cabellos-Aparicio, A. (2019, August). *Challenging the generalization capabilities of Graph Neural Networks for network modeling.* In Proceedings of the ACM SIGCOMM 2019 Conference Posters and Demos (pp. 114-115).