Quoc-Tung Le

Postdoctoral Researcher in Applied Mathematics

quoc-tung.le@tse-fr.eu tung-qle.github.io/
+33 6 64 99 04 30 Toulouse School of Economics, France

Introduction

A former student at **École Normale Supérieure** (ENS), I received my Master **Mathématiques, Vision et Apprentissage** (MVA) from Paris Saclay University in 2020. I did my Ph.D. in computer science at **ENS de Lyon**, under the supervision of **Rémi Gribonval** and **Elisa Riccietti**. The thesis is entitled *Algorithmic and Theoretical Aspects of Sparse Deep Neural Networks*, and was defended in December 2023. Since then, I have been a postdoctoral researcher at **Toulouse School of Economics** (TSE), under the supervision of **Jérôme Bolte** and **Edouard Pauwels**.
My research interest is non-convex (and non-smooth) optimization, which appears in many problems of deep learning, data analysis, and signal processing. My Ph.D. thesis studies the problems of **matrix factorization** and **neural network training**, under sparsity constraints. My postdoctoral research investigates the complexity and algorithms for **bilevel optimization** problems.

Curriculum

Career Path

2024 – **Postdoctoral researcher in Optimisation**
University : *Toulouse School of Economics*
Supervisors : **Jérôme Bolte** and **Edouard Pauwels**

2020 – 2023 **Ph.D. student in Computer Science (financed by CDSN - *Contrat Doctorant Spécifique aux Normaliens*)**
University : *École Normale Supérieure de Lyon*
Supervisors : **Rémi Gribonval** and **Elisa Riccietti**

2017 – 2020 **Students in Computer Science Department**
University : *École Normale Supérieure de Paris*

Education and Academic Qualifications

2020 – 2023 **Ph.D. in Computer Science**
University : *École Normale Supérieure de Lyon*
Laboratory : Laboratoire de l'Informatique du Parallélisme (LIP).
Supervisors : **Rémi Gribonval** (DR) and **Elisa Riccietti** (MCF)
Title : *Algorithmic and theoretical aspects of sparse deep neural networks - Aspects algorithmiques et théoriques des réseaux de neurones profonds parcimonieux*
Jury members : DR **Caroline Chaux** (rapportrice) - IPAL and CNRS IRL, PR **Nicolas Gillis** (rapporteur) - Université de Mons, PR **François Malgouyres** (examinateur) - L'institut de Mathématiques de Toulouse, DR **Gabriel Peyré** (examinateur) CNRS ENS de Paris, MCF **Elisa Riccietti** - ENS de Lyon, et DR **Rémi Gribonval** - INRIA de Lyon.

2020 **Diplôme de l'École Normale Supérieure**
Primary Specialization : **Computer Science**
Secondary Specialization : **Mathematics and Applications**

2019 – 2020 **Master 2 in Mathematics and Applications**
University : *École Normale Supérieure Paris-Scalay* (previously ENS Cachan)
Program : **Mathématiques, Vision et Apprentissage** (MVA)

Curriculum (suite)

2018 – 2019 — **Master 1 in Computer Science**
University : *École Normale Supérieure de Paris*
Program : **Master Parisien de Recherche en Informatique** (MPRI)

2017 – 2018 — **Licence 3 in Computer Science**
University : *École Normale Supérieure de Paris*
Program : **License Sciences, Technologies, Santé, Mention Informatique** (licence delivered by l'Université Paris Diderot)

2014 – 2017 — **Bachelor of Engineering in Computer Science**
University : *Hanoi University of Science and Technology* (HUST), Hanoi, Vietnam
Program : **Talented Engineering of Information and Technology**

Internship

Apr – Aug 2020 — **Multi-layer sparse matrix factorization** – *Internship M2*
Working place : Team DANTE, Ecole Normale Supérieure de Lyon, France
Supervisor : DR **Rémi Gribonval**

Feb – Jun 2019 — **Domain Adaptation and Transfer Learning** – *Internship M1*
Working place : Team MLIA, LIP6, Sorbonne université
Supervisor : PR **Matthieu Cord**

Jun – Aug 2020 — **Quantum computing and optimization** – *Internship L3*
Working place : Team MC2, l'École Normale Supérieure de Lyon, France
Supervisor : DR **Omar Fawzi**

Feb 2016 – May 2020 — **Evolutionary Algorithms and applications in Wireless Sensor Network**
Working place : Modelling, Simulation & Optimization (MSO) Laboratory, Hanoi University of Science and Technology (HUST)
Supervisor : PR **Thi Thanh Binh Huynh**

Publications

Ph.D. thesis

Algorithmic and theoretical aspects of deep sparse neural networks
Author : **Quoc-Tung Le**
Year : 2023

Journal papers

Spurious Valleys, NP-hardness, and Tractability of Sparse Matrix Factorization With Fixed Support
Authors : **Quoc-Tung Le**, Elisa Riccietti, Rémi Gribonval.
Year : 2022
Journal : SIAM Journal on Matrix Analysis and Applications
Scope : International
Type : Article long (44 pages)

Conference papers

1. Structured Support Exploration For Multilayer Sparse Matrix Factorization
Authors : **Quoc-Tung Le**, Rémi Gribonval.
Year : 2021
Conference : ICASSP 2021 - IEEE International Conference on Acoustics, Speech and Signal Processing
Scope : International
Type : Short article (4 pages)

2. Fast learning of fast transforms, with guarantees
Authors : **Quoc-Tung Le**, Léon Zheng, Elisa Riccietti, Rémi Gribonval.
Year : 2023
Conference : ICASSP 2022 - IEEE International Conference on Acoustics, Speech and Signal Processing
Scope : International
Type : Short article (4 pages)

3. Does a sparse ReLU network training problem always admit an optimum?
Authors : **Quoc-Tung Le**, Elisa Riccietti, Rémi Gribonval.
Year : 2023
Conference : NeurIPS 2023 - Thirty-seventh Conference on Neural Information Processing Systems
Scope : International
Type : Long article (34 pages)

4. Can sparsity improve the privacy of neural networks?
Authors : Antoine Gonon, Léon Zheng, Clément Lalanne, **Quoc-Tung Le**, Guillaume Lauga, Can Puoliquen.
Year : 2023
Conference : GRETSI'23 - XXIXème Colloque Francophone de Traitement du Signal et des Images
Scope : National (French)
Type : Short article (4 pages)

5. On the Asymptotic Nonnegative Rank of Matrices and its Applications in Information Theory
Authors : Yeow Meng Chee, **Quoc-Tung Le**, Duy-Hoang Ta.
Year : 2024
Conference : IEEE International Symposium on Information Theory
Scope : International
Type : Short article (4 pages)

6. Towards Better Bounds for Finding Quasi-Identifiers
Authors : Ryan Hildebrant, **Quoc-Tung Le**, Duy-Hoang Ta, Hoa T. Vu.
Year : 2023
Conference : ACM SIGMOD/PODS 2023
Scope : International
Type : Long article (23 pages)

Preprints/working papers

1. Butterfly factorization with error guarantees
Authors : **Quoc-Tung Le**, Rémi Gribonval, Elisa Riccietti, Léon Zheng
Year : 2024
Type : Long article (56 pages)

2. Geometric and computational hardness of bilevel programming
Authors : Jérôme Bolte, **Quoc-Tung Le**, Edouard Pauwels, Samuel Vaiter
Year : 2024
Type : Long article (31 pages)

3. Fast inference with Kronecker-sparse matrices
Auteurs : Antoine Gonon, Léon Zheng, Pascal Carrivain, **Quoc-Tung Le**
Année : 2024
Type : Article long (22 pages)

4. Bilevel gradient methods and Morse parametric qualification
Auteurs : Jérôme Bolte, **Quoc-Tung Le**, Edouard Pauwels, Samuel Vaiter
Année : 2025
Type : Article long (31 pages)

5. Rapture of the deep: highs and lows of sparsity in a world of depths

Auteurs : Rémi Gribonval, Elisa Riccietti, **Quoc-Tung Le**, Léon Zheng
Année : 2025
Type : Article long (25 pages)

Teaching experience

2020 – 2021
2021 – 2022
2022 – 2023

TP Introduction to competitive programming
Course Instructor : **Eric Thierry**.
Level : Licence 3
University : École Normale Supérieure de Lyon
Duration : $32 \times 3 = 96$ hours.

TD Optimisation and Approximation
Course Instructors : **Elisa Riccietti** et **Stéphan Thomassé**.
Level : Master 1
University : École Normale Supérieure de Lyon
Duration : $28 \times 3 = 84$ hours.

Talks/communications without proceedings

Jul 2024 — **Nonconvexity in bilevel optimization is very hard**
Event : 25th International Symposium on Mathematical Programming
Place : Montréal, Canada.

May 2023 — **Sparse Matrix Factorization from an optimization point of view**
Event : SIAM Conference on Optimization (OP23)
Place : Seattle, Washington, U.S.

Jul 2022 — **From hardness to efficiency in sparse deep neural network training**
Event : SNN Workshop, International Conférences on Learning Representation (ICLR)
Place : Online

Mai 2022 — **NP-hardness, Tractability and Landscape of Fixed Support Matrix Factorization**
Event : Journée SMAI-MODE
Place : Limoges, France.

Reviews for journals and conferences

- **Journals** : SIAM Journal on Matrix Analysis and Applications, Mathematical Programming.
- **Conferences** : NeuRIPs, AISTAT, ICLR.

Other skills

Languages

- **English** and **French** : Good level for both general and academic communications. I can teach in both languages.
- **Vietnamese** : Mother tongue

Programming languages

- **Python** : Very good
- **C/C++** and **Java** : Good