

INFORMATION ON DOCTORAL THESIS

1. Full name : Phạm Thị Quỳnh Trang
2. Sex: Female
3. Date of birth: 01/12/1995
4. Place of birth: Nghệ An
5. Admission decision number: 25/QĐ-CTSV Dated 14 January 2022, issued by the Rector of VNU University of Engineering and Technology, Vietnam National University, Hanoi
6. Changes in academic process:
 - Addition of a doctoral thesis supervisor and change of doctoral thesis title pursuant to Decision No. 1312/QĐ-ĐT dated December 21, 2022, issued by the Rector of the University of Engineering and Technology, Vietnam National University, Hanoi. Specifically, Dr. Le Duc Trong was added as a supervisor, and the thesis title was changed from "Research on Pre-trained Language Models and Their Application in Biomedical Text Analysis" to "Pre-trained Language Models in Lifelong Machine Learning and Their Application to Text Data Analysis."
 - Extension of study duration (24 months) pursuant to Decision No. 2833/QĐ-ĐHCN dated December 3, 2024, issued by the Rector of the University of Engineering and Technology. Specifically, the extension period runs from January 1, 2025, to January 1, 2027.
 - Adjustment of the doctoral thesis title pursuant to Decision No. 538/QĐ-ĐHCN dated March 23, 2026, issued by the Rector of the University of Engineering and Technology, Vietnam National University, Hanoi. Specifically, the thesis title was adjusted from "Pre-trained Language Models in Lifelong Machine Learning and Their Application to Text Data Analysis" to "Mitigating Catastrophic Forgetting in Continual Learning Using Memory Replay, Knowledge Transfer, and Dynamic Architecture Methods."

7. Official thesis title: Mitigating Catastrophic Forgetting in Continual Learning via Memory Replay, Knowledge Transfer, and Adaptive Architecture Optimization

8. Major: Information Systems

9. Code: 9480104

10. Supervisors: Assoc. Prof. Dr. Tri-Thanh Nguyen; Dr. Duc-Trong Le

11. Summary of the **new findings** of the thesis:

Research objectives and subjects of the thesis

The thesis targets the following objectives:

- *First*, the thesis develops and evaluates novel memory-based continual learning frameworks integrating prototype augmentation techniques, aiming to achieve significant mitigation of catastrophic forgetting while maintaining computational efficiency comparable to baseline methods.
- *Second*, the thesis studies and implements advanced knowledge transfer mechanisms, specifically contrastive learning and knowledge distillation techniques, to enhance feature preservation capability and facilitate efficient adaptation across sequential tasks, with measurable improvements in forward-transfer performance.
- *Third*, the thesis designs and validates architectural modifications and domain-specific training strategies to achieve sustainable continual learning performance across diverse application domains, with empirical validation on natural language processing tasks and medical image analysis benchmark datasets, achieving performance competitive with independently trained task-specific models.

Research methods used

The thesis employs a combined research methodology comprising qualitative and quantitative research methods. The thesis conducts qualitative analysis of concepts and models drawn from the relevant literature and in-depth research documents consistent with its research objectives. At the same time, the thesis carries out quantitative research through the implementation of corresponding experimental systems and experimental scenarios to evaluate the performance of the proposed techniques and models, thereby verifying and assessing the results of the thesis's proposals.

Main results and conclusions

Contributing to the global research trend on continual learning, the thesis has fulfilled its research objectives through the following three main contributions:

- *First*, the thesis studies memory-based learning methods by developing techniques that can leverage memory without needing to store the original data. These methods estimate the data distribution and randomly generate pseudo-samples, thereby overcoming memory-capacity limitations while also preserving data privacy.

- *Next*, since memory-based methods are difficult to apply in practice, the thesis focuses on knowledge transfer methods that leverage knowledge distillation techniques. Specifically, the research exploits knowledge from previously learned models to support the learning of new tasks, while retaining the knowledge of pre-trained models to make full use of their capabilities. As a result, processing performance is improved on both new tasks and previously learned tasks.
- *Finally*, the thesis proposes dynamic parameter-allocation strategies to effectively manage the model's processing capacity during continual learning. This approach combines a multi-branch processing architecture with adaptive representative-prototype generation mechanisms and parameter-combination techniques. The thesis shows that this method can selectively update parameters and preserve previously learned knowledge while still ensuring computational efficiency when processing sequential tasks. The results show superior performance compared with fixed parameter-allocation methods in overcoming the forgetting of previously learned knowledge.

For each newly proposed model, the thesis conducts experiments and compares the results with the original continual learning models. Through these experimental results, the thesis demonstrates the contribution of each component of the proposed models relative to the original continual learning models.

12. Practical applicability, if any:

13. Further research directions, if any:

14. Thesis-related publications:

(List them in chronological order)

1. **Quynh-Trang Pham Thi**, Anh-Cuong Pham, Ngoc-Huyen Ngo, and Duc-Trong Le. Memory-Based Method using Prototype Augmentation for Continual Relation Extraction. In 2022 RIVF International Conference on Computing and Communication Technologies (RIVF), pp. 1-6. IEEE, 2022. Scopus.
2. Thanh-Hai Dang, **Quynh-Trang Pham Thi**, Duc-Trong Le, and Tri-Thanh Nguyen. Contrastive Learning for Boosting Knowledge Transfer in Task-Incremental Continual Learning of Aspect Sentiment Classification Tasks. VNU Journal of Science: Computer Science and Communication Engineering 40, no. 1 (2024).
3. Duc-Hung Nguyen, Tri-Thanh Nguyen, Thanh-Hai Dang and **Quynh-Trang Pham Thi**. ZeroRFF: A Random Fourier Features and Analytic Learning Method

for Generalized Class Incremental Learning. The 21st International Conference on Advanced Data Mining and Applications 2025. Scopus.

4. **Quynh-Trang Pham Thi**, Duc-Hung Nguyen, Thanh Hai Dang, Duc-Trong Le, Tri-Thanh Nguyen, and Quang-Thuy Ha. “Towards Robust Continual Learning: A Multi-Head Approach with Online Prototype Equilibrium and Adaptive Prototypical Feedback.” In Asian Conference on Intelligent Information and Database Systems, pp. 275-286. Singapore: Springer Nature Singapore, 2024. Scopus.
5. **Quynh-Trang Pham Thi**, Duc-Hung Nguyen, Anh-Duc Nguyen-Tran, Hung-Dung Nguyen, Tri-Thanh Nguyen, Quang-Thuy Ha and Thanh Hai Dang. “Addressing Catastrophic Forgetting in Continual Learning using Multihead Approach and Latent Alignment via Energy-Based Model.” Vietnam Journal of Computer Science. (Accepted). WoS Q3.
6. **Quynh-Trang Pham Thi**, Van-Truong Le, Thanh-Huyen Pham, Thanh-Nga Hoang Thi and Duc-Trong Le. DAKTA: Directional Kolmogorov-Arnold Classifier for Task Arithmetic in Continual Learning. In *International Symposium on Information and Communication Technology*, pp. 339-349. Singapore: Springer Nature Singapore, 2025. Scopus.
7. **Quynh-Trang Pham Thi**, Quang-Dat Mac, Thanh-Ha Nguyen and Duc-Trong Le. SOLoRA: Sparse Orthogonal LoRA for Parameter-Efficient Continual Learning. In 2026 IEEE International Conference on Multimedia and Expo (ICME 2026).

Supervisors

Date:

Signature:

Full name:

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Full name:

Doctoral Candidate

Date:

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