IMLP: An Energy-Efficient Continual Learning Method for Tabular Data Streams

Yuandou Wang [1], Filip Gunnarsson [1], and Rihan Hai [1],

[1] Web Information Systems, EEMCS, Delft University of Technology, The Netherlands
{y.wang-45, r.hai}@tudelft.nl

Tabular data streams are rapidly emerging as a dominant modality for real-time decision-making in multiple fields, such as healthcare, finance, and the Internet of Things (IoT). These applications commonly run on edge and mobile devices, where energy budgets, memory, and compute are strictly limited. Continual learning (CL) addresses such dynamics by training models sequentially on task streams while preserving prior knowledge and consolidating new knowledge. While recent CL work has advanced in mitigating catastrophic forgetting and improving knowledge transfer, the practical requirements of energy and memory efficiency for tabular data streams remain underexplored. In particular, existing CL solutions mostly depend on replay mechanisms whose buffers grow over time and exacerbate resource costs.

We propose a *context-aware incremental Multi-Layer Perceptron (IMLP)*, a compact continual learner for tabular data streams. IMLP incorporates a windowed scaled dot-product attention over a sliding latent feature buffer, enabling constant-size memory and avoiding storing raw data. The attended context is concatenated with current features and processed by shared feed-forward layers, yielding lightweight per-segment updates. To assess practical deployability, we introduce *NetScore-T*, a tunable metric coupling balanced accuracy with energy for Pareto-aware comparison across models and datasets. IMLP achieves up to $27.6\times$ higher energy efficiency than TabNet and $85.5\times$ higher than TabPFN, while maintaining competitive average accuracy. Overall, IMLP provides an easy-to-deploy, energy-efficient alternative to full retraining for tabular data streams.

This presentation abstract is based on our recent research in progress [1].

References

[1] Wang, Y., Gunnarsson, F., & Hai, R. (2025). IMLP: An Energy-Efficient Continual Learning Method for Tabular Data Streams. *arXiv preprint arXiv:2510.04660.*