

Master 2 Internship 2024

Graphical Models for Learning Temporal Dependencies in Event Streams

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Context

With the digital transformation of our societies, more and more domains are interested in the analysis of series of symbolic events, such as Web user behavior analysis, healthcare and patient monitoring or fraud detection in financial transactions. Grasping the dynamics of these data streams requires revealing hidden structures behind them. To this end, Gunawardana and Meek have proposed a novel approach called Graphical Event Models (GEMs), probabilistic models capable of explicitly describing the temporal dependencies between events [GM16]. The PILGRIM software library developed by the DUKe reasearch team at the [LS2N laboratory](#) provides an original implementation of GEMs and of algorithms for learning them from logs – see [ML19, ADL19, SPA] for examples of DUKe’s works on GEMs.

Objective

The goal of this internship is to study GEMs more deeply from both a theoretical and practical point of view, and to develop new methods for learning and using them. Several directions are possible:

- design and implement sampling and inference algorithms ;
- compare GEMs with process mining (log analysis approach [vdA16]) : founding principles, model properties, experiments on data ;
- adapt explainable AI techniques to GEMs.

Possibility of extending into a PhD thesis if the internship is satisfactory.

Tasks

- Bibliography
- Theoretical study, design of new solutions
- Prototype development, experiments on data

To be specified depending on the chosen orientation...
The intern will be integrated into the LS2N DUKe team.

Skills

- Probabilistic graphical models (not mandatory)
- C++ programming

Other information

- **Period** : 1st semester 2024
- **Allowance** : approx. 610 €/month (depending on the number of working days)
- **Location** : LS2N laboratory in Polytech Nantes, rue Christian Pauc 44306 Nantes, France

Application

Send CV, motivation letter and academic results in PDF format to julien.blanchard@univ-nantes.fr.

References

- [ADL19] Dimitri Antakly, Benoit Delahaye, and Philippe Leray. Graphical event model learning and verification for security assessment. In *32th International Conference on Industrial, Engineering, Other Applications of Applied Intelligent Systems (IEA/AIE 2019)*, Advances and Trends in Artificial Intelligence, pages 245–252, Graz, Austria, 2019.
- [GM16] Asela Gunawardana and Chris Meek. Universal models of multivariate temporal point processes. In Arthur Gretton and Christian C. Robert, editors, *Proceedings of the 19th International Conference on Artificial Intelligence and Statistics*, volume 51 of *Proceedings of Machine Learning Research*, pages 556–563, Cadiz, Spain, 09–11 May 2016. PMLR.
- [GMX11] Asela Gunawardana, Christopher Meek, and Puyang Xu. A model for temporal dependencies in event streams. In *Proceedings of the 24th International Conference on Neural Information Processing Systems*, NIPS’11, pages 1962–1970, Red Hook, NY, USA, 2011. Curran Associates Inc.
- [Mee14] Christopher Meek. Toward learning graphical and causal process models. In *Proceedings of the UAI 2014 Conference on Causal Inference: Learning and Prediction - Volume 1274*, CI’14, pages 43–48, Aachen, DEU, 2014. CEUR-WS.org.
- [ML19] Mathilde Monvoisin and Philippe Leray. Multi-task transfer learning for timescale graphical event models. In *15th European Conference on Symbolic and Quantitative Approaches to Reasoning with Uncertainty (ECSQARU 2019)*, Belgrade, Serbia, 2019.
- [SPA] SPARS project : Sequential pattern analysis in robotic surgery. <https://project.inria.fr/spars/>.
- [vdA16] Wil M. P. van der Aalst. *Process Mining: Data Science in Action*. Springer, Heidelberg, 2 edition, 2016.