

Project title: Time Variable Recommender Systems with Reliable Predictions

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Function: Assistant Professor

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Proposal (250 words):

Introduction: Modern study programs are developed around learning goals that raise student competences to the graduation-level. Based on these, a set of didactical units are devised that, according to expert judgment, should guarantee these competence levels for all students. Proving the effectiveness of these didactical units is difficult.

Hypothesis and Objectives: This project aims at methods based on *collaborative filtering* techniques that can produce an objective way of discovering unobservable *competences* and competence development based on *student grades*.

Setting and Methods: Collaborative filtering techniques are known for their ability to find hidden variables that explain user preference, for example in the entertainment sector. The technique unveils unobserved properties of both users (students' competences) and items (educational units' requirements) that explain the user's preference or performance (grade) for the item. No techniques exist however that attach meaning to these properties or allow tracking their evolution under outside influences. To make this possible, the collaborative filtering framework needs to model these influences and the development of the user explicitly, incorporating *time as a dimension* over which the user and his hidden representation are expected to change. To make the results suitable for interpretation, we will integrate *conformal predictions* with collaborative filtering techniques to provide guarantees about the accuracy of the computed model.

Impact: We anticipate the resulting techniques to be useful in *education* and *human resources*, but also in *medical domains*, where patient response-rates to medication depends on previously administered regimes, and in any other domains where user preferences evolve over time.

Requirements candidate: Highly motivated student with good programming and English communication skills and a proactive and resolute attitude.

Keywords: machine learning, recommender systems, collaborative filtering, feature construction

Top 5 selected publications:

1. S. Dzeroski, L. De Raedt and K. Driessens, *Relational reinforcement learning*, Machine Learning 43, pp. 7-52, 2001 (426 citations)
2. K. Driessens, *Relational Reinforcement Learning*, Encyclopedia of Machine Learning (Sammut, Claude; Webb, Geoffrey I., Eds.), 2010 (84 citations)
3. K. Kersting and K. Driessens, *Non-Parametric Policy Gradients: A Unified Treatment of Propositional and Relational Domains*, Proceedings of the 25th International Conference on Machine Learning (ICML 2008), Helsinki, Finland, (A. McAllum. and S. Roweis, Eds.) pp. 456-463, 2008 (67 citations)
4. K. Driessens, J. Ramon and H. Blockeel, *Speeding up relational reinforcement learning through the use of an incremental first order decision tree algorithm*, Proceedings of the European Conference on Machine Learning (ECML 2001), Freiburg, Germany (De Raedt, L. and Flach, P., Eds.), vol 2167, Lecture Notes in Artificial Intelligence, pp. 98-108, 2001 (99 citations)
5. K. Driessens and S. Dzeroski, *Integrating guidance into relational reinforcement learning*, Machine Learning 57, pp. 271-304, 2004 (91 citations)