PhD position, 36-months: Computer Science, Artificial Intelligence, E-Education

Supporting Self-Regulation Learning Using Dynamic Bayesian Networks

Abstract. Self-regulation is a well-established concept for which we already know different learning strategies, including cognitive strategies (reviewing courses, organizing information, memorizing), metacognitive strategies (self-assessment, planning) and strategies for seeking additional information (using documentary resources, asking others for help) [1]. **Many recent studies agree on the relevance of Self-Regulated Learning (SRL), and point out the need for more empirical analysis of learner activities.** One of the main objectives of such research is to reduce the number of drop out students, to enhance learners' motivation and increase learning success [2],[3].

This thesis aims to design and develop a modelling approach based on Dynamic Bayesian Networks (DBN) and Open Learner Models (OLM), to provide students with SRL features and foster their autonomy.

DBNs are used in different domains in decision making [4]. At the intersection between Knowledge representation and Machine Learning in Artificial Intelligence (AI), both the structure and the conditional dependencies of a DBN, can be learned using a variety of possible algorithms or specified by hand [4],[5]. The OLM approach is used to support the learner's reflection process by providing formative feedback on the learning process or even engaging negotiation with the learner [6]. Previous works on OLMs showed interesting effects on engagement with the learning content [7].

Our objective is to implement these approaches as extensions of existing online platforms developed by France-IOI, on one hand, and on existing MOOCs developed by IMT Atlantique, which are available on Edx and Fun platforms, on another hand. **The learning content includes tracks on programming basics and other related topics**, dedicated to students from different levels, starting from the 4th grade in secondary level to undergraduate Higher Education. Based on student interactions with the learning platforms and embedded SRL features, such as perceptions of progress, the designed approach will help students to:

- define specific goals, plan and monitor their activities, and make decisions.
- select strategies, based on the set of available learning resources and their difficulty levels.
- monitor their activities as effectively as possible, to optimize their learning with a high level of autonomy.

The modelling approach will follow these three steps:

1) Define relevant features for predicting students' SRL classifications. This may include theoretical aspects of the SRL process, as well as knowledge about interactions with the learning environment.
2) Design and develop a DBN on the basis of these well-defined features.
3) Design understandable learning visualisations using an OLM approach to allow the user (learner, teacher, ...) for viewing content and making decisions.

These three main steps will guide the development of a predictive model that will be informed from empirical corpus data as well as a theoretical understanding of a self-regulated process.

Keywords. Self-Regulation Learning (SRL), Dynamic Bayesian Network (DBN), Bayesian Knowledge Tracing, Open Learner Models (OLM).

Candidate Profile

The candidate should hold a Master 2 degree or an Engineer degree (Bac+5) in Computer Science, with a good background in Machine Learning and Data Science.
Recruitment requirements:

- Good knowledge in Bayesian Networks or Probabilistic Graphical Models is appreciated.
- Good relational skills.
- High interest for research in Artificial Intelligence and E-Education (AIED) domains.

Location. Lab-STICC UMR CNRS 6285/MOTEL team. IMT Atlantique Bretagne Pays de Loire, Computer Science Department, Technopôle Brest-Iroise CS 29 238 Brest. France.
The candidate will benefit from a multidisciplinary working context. Interactions with different actors from different institutions and disciplines are planned (IMT-Atlantique, Lab-STICC, LS2N, CREAD, France IOI).

Duration. 36 months from the beginning of autumn, 2021

Supervision and Recruitment Contact

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Research Context

This Phd position takes part of the xCALE (eXplaining Competency and Autonomy development in Learning Environments) project (ANR PRC, 2021-2024). Xcale is a Collaborative Research Project, funded by the ANR under the Artificial Intelligence plan, led by the Lab-STICC (Brest) in partnership with LS2N (Nantes) and CREAD (Rennes) labs. This project aims to improve personalisation in online learning environments, with a view to promote learner autonomy and self-regulation. Experiments are planned within an Open Education context (France IOI), as well as IMT MOOCs (EdX, Fun).