College of Engineering and Computer Science
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FLORIDA ATLANTIC UNIVERSITY

Announces the Ph.D. Dissertation Defense of

Anca Muresan

for the degree of Doctor of Philosophy (Ph.D.)

Graph-Based and Uncertainty-Aware Machine Learning for Academic Performance Prediction

March 2nd, 2026, 10:30AM – 12:00PM
Building EE96, Room 405
777 Glades Road
Boca Raton, FL

DEPARTMENT: Electrical Engineering and Computer Science

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ABSTRACT OF DISSERTATION:

Early identification of students at risk of academic failure is essential for timely pedagogical interventions and reducing dropout rates. While Artificial Intelligence (AI) has significantly advanced predictive modeling in education, two primary challenges persist: effectively modeling the complex, evolving relationships within heterogeneous educational data, and ensuring the reliability of model outputs for high-stakes decision-making. This dissertation addresses these challenges by proposing a comprehensive framework for early and continuous student performance prediction applied to the Open University Learning Analytics (OULA) dataset.

First, we introduce a Heterogeneous Graph Neural Network (HGNN) approach that utilizes metapath structures to capture latent interactions between diverse educational entities. By integrating dynamic assessment features, this model achieves a 68.6% F1 score within the first 8% of the semester and reaching up to 89.5% near the semester's end, outperforming traditional machine learning (ML) baselines. Second, we investigate the temporal evolution of student performance by comparing static models against temporal HGNN and ML architectures. To evaluate the impact of different model components, we conduct extensive experiments on the OULA dataset including simple vs. cumulative student performance features, ablation study on feature assignment, and metapath selection. The results indicate that accounting for the cumulative nature of student data yields improvements of up to 10.1% in F1 scores early in the term, confirming the value of temporal feature engineering.

Finally, to bridge the gap between predictive power and practical accountability, we incorporate Conformal Prediction (CP) to quantify model uncertainty. By formulating student success as a temporal multiclass task (Inadequate, Deficient, Satisfactory, and Excellent), we move beyond deterministic point-estimates. We evaluate post-hoc calibration techniques, including Temperature Scaling and Dirichlet Calibration, to refine these prediction sets. Results show that even at 8% semester completion, the framework maintains a class-conditional coverage of at least 88% for a significance level alpha= 0.1, providing a reliable safety net for human-in-the-loop interventions. This statistically valid safety net ensures that even when early semester data is sparse and point-estimates are unstable, the true outcome remains within the predicted set. By transitioning

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from broad sets to precise singletons as the semester progresses, this framework provides a reliable, calibrated trigger for tiered, human-in-the-loop instructional interventions. This work combines graph-based structural learning with temporal dynamics and calibrated uncertainty to propose a robust, trustworthy system for proactive educational support.

BIOGRAPHICAL SKETCH:

Bachelor's degree in Electronics and Telecommunications Engineering, Technical University of Cluj-Napoca, Romania.
Master's degree in Electronics, Telecommunication and Information Technology, Technical University of Cluj-Napoca, Romania.
Ph.D. Computer Science with Minor in Artificial Intelligence, Florida Atlantic University, Boca Raton, Florida, USA.

CONCERNING PERIOD OF PREPARATION
& QUALIFYING EXAMINATION

Time in Preparation: 3 years

Qualifying Examination Passed: Spring 2024

Published Papers:

- **A. Muresan, M. Cardei, and I. Cardei (2025). "Predicting student success with heterogeneous graph deep learning and machine learning models". In *Proc. 18th International Conference on Educational Data Mining* (pp. 265–275). https://doi.org/10.5281/zenodo.15870191**
- **A. Muresan, M. Cardei, and I. Cardei, (2025). "Exploring temporal heterogeneous graph deep learning and machine learning models for predicting student success". In *2025 IEEE International Conference on Artificial Intelligence for Learning and Optimization (ICoAILO)* (pp. 338–344). https://doi.org/10.1109/ICoAILO66760.2025.11155968**
- **A. Muresan, M. Cardei, and I. Cardei (2026). "Calibrated Conformal Prediction of Academic Performance using Machine Learning". *IEEE Access Journal*, under review.**