USE OF DEEP LEARNING TECHNIQUES ON ONLINE LEARNING DATA

Author: Celia González Nespereira.
Thesis Advisors: Rebeca P. Díaz Redondo and Ana Fernández Vilas.
Affiliation: AtlantTIC Research Centre, Department of Telematics Engineering (University of Vigo)

MOTIVATION

- The online learning platforms are increasingly important in education. These platforms not only provide contents to students, but also store a lot of information about the students behavior.
- Data mining and analysis techniques allow studying large amount of data, with the objective of obtain more information about the users behavior and preferences.
- Our main purpose is to use these techniques to analyze the data coming from the e-learning platforms, with the objective of improve:
  - The learning process, improving the way in which students learn and detecting students learning problems at an early stage.
  - The teaching process, improving the teaching techniques and the course organization.

THESIS OBJECTIVES

- Studying of the state of the art of the different data mining algorithms, focusing on machine learning and deep learning techniques.
- Using data mining and analysis techniques to:
  - Study the different courses types and their characteristics, in order to detect what could be improved in the courses organization to increase the number of successful students.
  - Study the different types of students and their habits, in order to predict students' behavior and success.
- Analyzing one or more datasets coming from e-learning platforms. The data analysis is divided into two parts:
  - Collecting and processing the data to retrieve only the information that is useful in the study.
  - Application of deep learning techniques or any other type of data mining algorithms to analyzing the data.

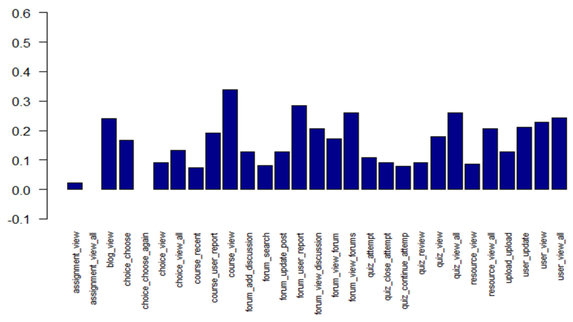
RESEARCH PLAN

- Analyzing the state of the art in learning analytics.
- Analyzing the state of the art in data mining, focusing on deep learning and machine learning.
- Performing different studies to:
  - Improve the learning process:
    - Performing an exploratory analysis of a blended course, studying the relationship between the students' interaction with the e-learning platform and their final mark.
    - Performing a prediction algorithm to detect the students that are in risk of failing a course.
  - Improve the teaching process:
    - Studying and classifying the different type of courses in base of their characteristics.
    - Studying how the variation of some course characteristics (number of professors, variation in the number, dates and types of assignments, etc.) affects students' successful.
- Validating the studies explained above with real data coming from the University of Vigo. Specifically, we use a dataset from the e-learning platform faiTIC.
- Developing some plugins of the e-learning platform to put into practice the studies and algorithms developed in order to:
  - Allow teachers obtain information about how to improve their lessons.
  - Allow students know their performance in the courses and what things they should improve.

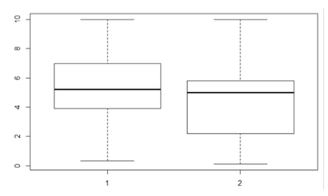
RESULTS

EXPLORATORY ANALISIS OF A BLENDED COURSE

- We studied the data coming from the e-learning platform of one course of the Telecommunications Engineering of the University of Vigo
- Analysis → results:
  1. Calculate the Pearson correlation [1] between students' final grade and their different types of interactions with the e-learning platform → Positive values are obtained
  2. Divide the students in clusters [2] in base of their interactions with the e-learning platforms and represent the final mark of each cluster → The average of students in group 1 passed the course while the average of students in group 2 failed it.



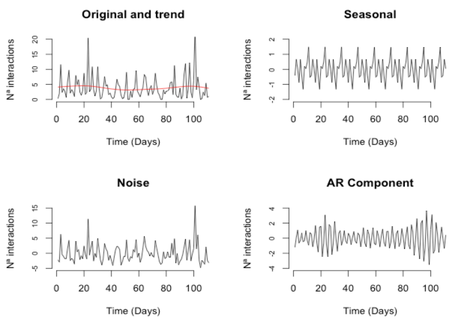
Correlations between type of interactions and final grades.



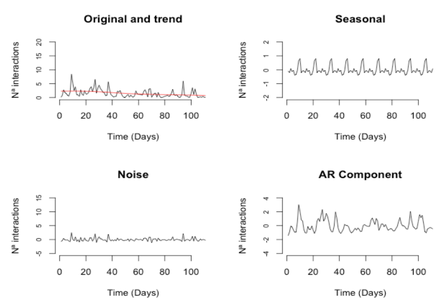
Clustering distribution.

Clustering Distribution	Mean of the final grades
Group 1: 145 students Group 2: 190 students	Group 1: 5.40 Group 2: 4.23

3. Use time series decomposition [3] to study the behavior of students with highest grades and students with lowest grades → Trend component of time series is a good indicator of students' success.



Temporal decomposition of students with highest grades



Temporal decomposition of students with lowest grades

- Publication:

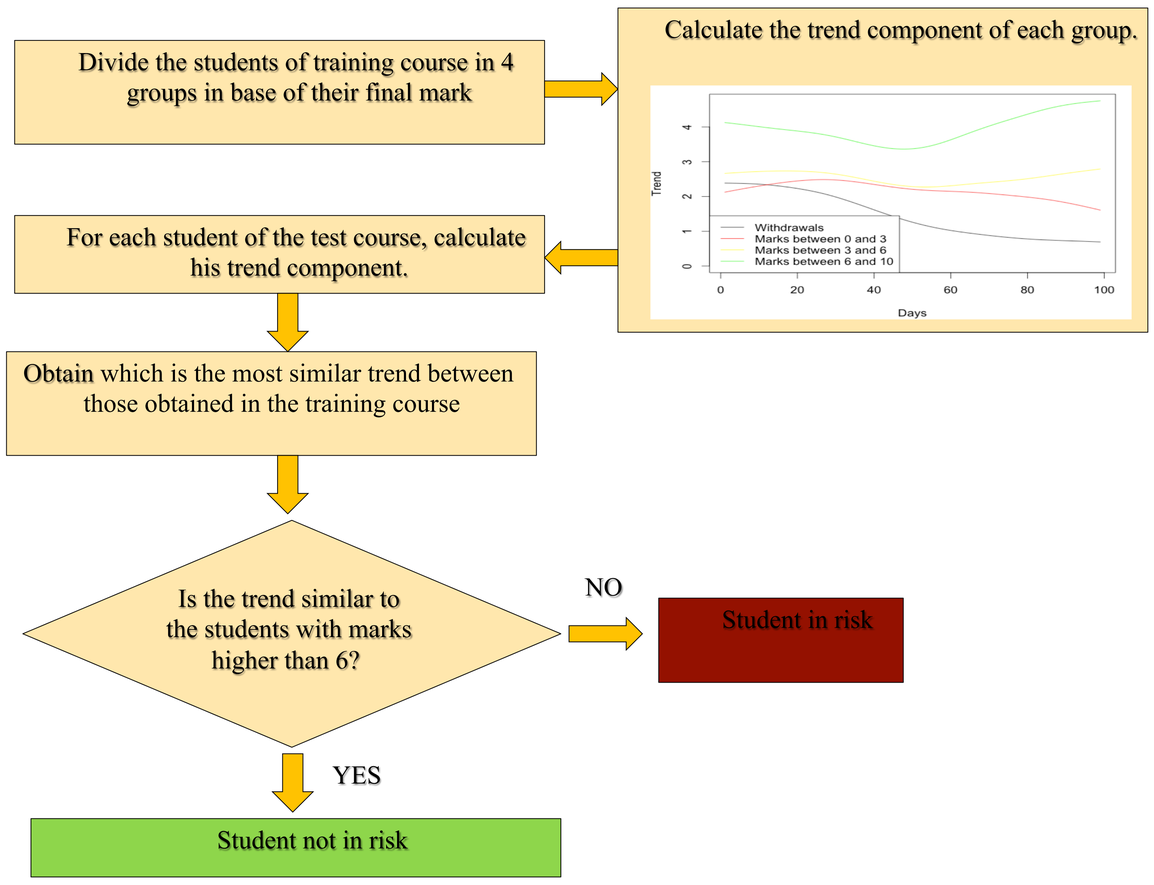
"Is the LMS Access Frequency a Sign of Students' Success in Face-to-Face Higher Education?", published in the Technological Ecosystem for Enhancing Multiculturality 2014 (TEEM'14)

Published

ASSESSING THE RISK OF FAILING

- We developed an algorithm to detect the students in risk of failing a course using time series and warn them and the professors about this situation.
- A conservative approach was used, warning all students that it is predicted that they will obtain less than 6 points.

- Two academic years:
  - Previous year → Training data
  - Current year → Test data
- Three control points along the course



Algorithm to assess the risk of failing.

STUDENTS WHO FAILED	PERCENTAGES		
	1º Control Point	2º Control Point	3º Control Point
Detected	84,37%	92,97%	93,75%
Not detected	15,63%	7,03%	6,25%

- Publication:

"Am I failing this course? Risk prediction for learning platforms", submitted for the Technological Ecosystem for Enhancing Multiculturality 2015 (TEEM'15)

Submitted

NEXT YEAR PLANNING

- Developing a Moodle Plugin to implement the detection risk algorithm.
- Analyzing if the algorithm to detect the risk of failing could be improved using deep learning techniques.
- Improving the risk detection algorithm to detect the control points and the grade thresholds dynamically.
- Analyzing the different courses characteristics, trying to detect what could professors improve to obtain better students' results.
- Publishing our approaches in an international journal.

REFERENCES

[1] Hauke, J. and Kossowski, T. 2011. Comparison of values of Pearson's and Spearman's correlation coefficients on the same sets of data. *Quaestiones geographicae,* 30, 2.
[2] Murtagh, F. and Legendre, P. 2011. Ward's Hierarchical Clustering Method: Clustering Criterion and Agglomerative Algorithm. *arXiv preprint arXiv:1111.6285*.
[3] E. B. Dagum, "Time series modeling and decomposition," *Statistica*, no. 4, 2010.