pGPA: A Personalized Grade Prediction Tool to Aid Student Success

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ABSTRACT
Many educational institutions are starting to make use of their scholastic data to improve the academic experience for their students. To aid in this endeavor we have developed a research prototype implementation of a collaborative filtering-based tool called the personalized Grade Prediction Advisor (pGPA). The goal of this prototype tool is to demonstrate the potential of recommender technology by providing grade predictions for upcoming courses in a student’s academic career to support decision-making for administrators, students, educators, and academic advisors. In this demonstration we briefly describe the underlying technology and potential applications of pGPA. We then present how a user can interact with pGPA to produce and interpret personalized grade predictions for an individual student or group of students.

Categories and Subject Descriptors

General Terms
Algorithms, Design, Experimentation

Keywords
Collaborative filtering, Grade prediction, Student success, Software tool

1. INTRODUCTION
Recently, recommender technology has seen application in many domains including the academic realm [1]. One major problem in the educational sphere that has been the focus of such research is improving the educational experience and success rate of students in higher education. Researchers have used recommender technology to predict the likelihood of student dropout [2], help students select appropriate majors, minors, and classes [3], and identify learning patterns and performance [4].

We set out to design and build our own recommender technology-based tool to help individuals at all echelons of the academic system make appropriate and well-informed decisions. The result of our efforts is a collaborative-filtered recommender system that utilizes past student performance, temporal elements, and contextual information to predict a student’s grades for the upcoming semester. We have developed this concept into a tool we call the personalized Grade Prediction Advisor (pGPA).

The prototype of pGPA is designed to showcase the effectiveness of our approach towards reliably predicting student grades. This prototype allows users to select a subset of students from the dataset we have, determine the semester to predict grades for, configure the prediction properties, and then displays the results to the user. In addition, this prototype provides a means of examining how these predictions could be used by the proposed stakeholders of pGPA to help guide their decision-making.

2. THE pGPA PROTOTYPE
Underlying Technology: pGPA is a collaborative-filtered recommender system that uses an individual’s academic history in the form of grades earned and important temporal and contextual information such as when these grades were earned and how many hours the students carried during each semester to predict a student’s grades. We ultimately chose to implement both user-based and item-based collaborative filtering using the Pearson Correlation Coefficient as the similarity metric in the pGPA prototype. We leave decisions such as the number of items and minimum similarity threshold used for the prediction calculation to the user in order to highlight the impact that different criteria have on the prediction capability of this system and allow for experimentation and tweaking in the future.

Potential Applications: The final version of pGPA is designed to be a software tool that can be adopted and used by academic institutions to help improve decision-making at all levels. We examine some of the potential uses of pGPA for each of our stakeholders to highlight how pGPA’s grade predictions can provide value to Students, Instructors, Academic Advisors, and Administrators.

Students will be able to better manage their time and schedules to account for the amount of work they will likely need to do in order to succeed in the upcoming semester. Additionally, the knowledge of what grade a student may receive in a course could provide motivation to work harder and achieve more in order to push a borderline grade to the next level. Students may also use their grade predictions to add or drop courses in a semester to improve their chances for success.

Instructors can use grade predictions to better understand students’ needs and individual deficiencies to help create personalized assignments for students. They may also be able to identify and recommend additional groups or resources for students that may be able to help the student improve his or her grade.

New academic advisors can benefit from grade predictions for students because these predictions may represent vital information about a student’s chance for success that the advisor may not be aware of without extensive experience. These predictions may also help the advisor to convince a student to...
re-examine his or her schedule in order to improve the chances for success.

Armed with predictions for all students in a program or curriculum, administrators can identify likely dropouts or low performers and intervene before the semester starts. Administrators can also use the predictions made for a set of students in an intervention or study program to identify the effectiveness of such programs and allocate funding accordingly. Lastly, administrators can utilize the fact that they employ pGPA to improve student success rates in their school for marketing purposes.

3. pGPA DEMONSTRATION

To demonstrate pGPA we utilize a dataset that encompasses 10,000 grades earned by 600 Computer Science students in a university over a 20 year time frame. The steps below outline how a user can use this data in pGPA to produce and evaluate grade predictions and what potential advice pGPA may administer for its target stakeholders.

**Step 1: Select student(s) for prediction**

The user selects a set of students to make predictions for. This can be done by selecting a range of student performance and inputting the number of students to make predictions for or by selecting individual students from a list. The user can then examine the selected data to determine if it is acceptable.

**Step 2: Identify period for prediction**

The user then identifies the period to make predictions for. The pGPA prototype then displays general information like the number of students who took courses during that period and the number of courses that this prediction will include.

**Step 3: Configure parameters for prediction**

The user then has the option of changing the parameters of the predictions mechanism chosen. This will include settings like the number of nearest users (user-based) or items (item-based) or the minimum similarity threshold used in the prediction calculation.

**Step 4: View results and explanation**

The user will be presented with several graphics that characterize the predictions. If desired, the user can also view a summarization of the factors that influenced the prediction.

**Step 5: Show recommendations & advice**

The pGPA prototype displays possible advice that could be recommended to the stakeholders such as (in the case of a student) “You should either remove a course from your proposed schedule or make sure you have a lot of study time scheduled so that you can improve your chances for success”.

4. CONCLUSION & FUTURE WORK

We have demonstrated the research prototype tool called pGPA using a real-world academic dataset. This tool can be used to investigate various prediction strategies and it can be developed into a software package that higher education institutions can utilize to improve student success. We plan to test this tool with other datasets, add more features, and refine the prediction mechanism. We will also explore the commercialization and adoption of this tool.

5. ACKNOWLEDGEMENTS

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6. REFERENCES


