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Final Project: Course Selection

HUDK 4051

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Problem Statement

In college, many of us have experienced the situation where the academic advisor threw a list of required and elective courses at us and made us choose on our own. The online registration system only provides brief introductions and inadequate knowledge about the courses. Some students may get confused about the courses, and thus have a hard time making decisions. Many of us might have spent a lot of time reaching out to previous students for advice on course selection and going to "rate my professor" to check the ratings of both the courses and professors. How can the schools take actions to help their students with course selection? Our aim is to offer effective recommendations for students who are disoriented during course registration: not only on mandatory major courses, but also on elective courses.

Previous Project Review

In the previous project, we suggested that by using social network analysis and clustering, we would be able to provide the students with more information that could help them with class selection. We used social network analysis to create lists of classes that are often chosen together and used clustering to give students some ideas about what the classes look like. To provide students with relevant pieces of advice, we need access to the school registration system and the course evaluation database. From the social network analysis, we would be able to detect the

communities of courses commonly chosen together. From clustering, we would get a better idea of how the course is structured - for example - whether the course is engaging or not, is the professor available outside of the classroom, are the courses well-organized, or if you can bring what you learn and apply to real life situations. Based on the communities generated by the social network analysis and the clusters formed by more detailed information, we hoped this model could better serve our students with course selection.

Literature Review

After reviewing many articles related to the course selection system, we think it would be better to build a hybrid recommendation system for course selection. As Unelsrød (2011) stated in the article, "Course selection is not solely based on personal taste or preference, it is heavily influenced by other factors like prerequisites, number of credits, etc." We need to fully consider what factors we want to include before upgrading our existing system. The previous studies suggested collaborative filtering (CF) and content-based filtering (CBF), which helped the school registration system recommend the most suitable courses to their students (Esteban, Zafra, & Romero, 2020). In order to make a good recommendation system for course selection, we think it is important to consider both new students and current students' needs and situations. Content-based filtering can recommend courses that are similar to the ones current students loved in the past. The similarities can include knowledge area, course content, professor, and competence (Esteban, Zafra, & Romero, 2020). For collaborative filtering, such a technique can offer course selection recommendations for new students based upon the history of users with similar tastes. The prior studies provided multiple solutions considering the hybrid multi-criteria system, bringing us a lot of inspiration and reference to the redesign of our recommendation system. A hybrid system that combines several recommendation techniques can offer more accurate recommendations for

different groups of users and prevent "drawbacks (e.g., new item and new user problems) of traditional recommender approaches" (Al-Badarenah & Alsakran, 2016).

Improvement Plan

In the previous project, we were able to provide the students a course list with detailed descriptions. However, students still need to choose based on their own preferences. In the current project, we will collect information from the students and create a tailored recommendation list for them.

As the educational data volume increases, data processing and management becomes more daunting. Recommender systems are considered as a way to deal with the "paradox of choice" (Duval, 2011), a dilemma of determining what information we should use for giving feedback to learners. An idealized recommender system provides a limited number of suggested metrics or new content based on the learner's past behaviors as well as the patterns of all learners in the database. Recommender systems may provide insights based on a comparison of one learner to other learners in the system.

In the Mini Learning Analytics Project, we have designed and created a recommender system for online learning with a limited number of learning modules. The recommender system will be able to make a reasonable suggestion to a new student (with or without background information), as well as give suggestions to a learner based on their prior history.

Data Source

We will use data sources from the registration system and the course evaluation database.

From the **registration system**, we will be able to collect the following data of a specific student: courses taken (session, instructor), course requirement, GPA (specialization and cumulative), final course grade, major, degree, credits taken, and demographic data like gender, age, and disability.

From the **course evaluation database**, these data will be helpful for the analysis: course type (required, optional, or voluntarily), workload, student satisfaction, difficulty level.

In the data preparation process, we will fill or drop missing values in the datasets. We will also recode categorical variables into dummy variables and filter or reset indexes.

Analysis Plan

As for the analytical methods, we decide to establish both content-based recommender and user-based filtering.

Content-based recommender

Content-based recommender suggests courses to students based on their previous learning preferences and ability. This system works mainly for continuing students. We will analyze their course preferences based on their past course evaluation (see Appendix A & B). Variables like satisfaction score of the courses and registration date will be used to indicate a student's academic interest. And variables like course grade and difficulty level from the evaluation will be used to interpret a student's capability. Therefore, we will be able to generate the idea whether the student will like and be able to handle a particular course. In our analyzing process, KNN algorithm will be used to measure the similarity of the courses. The results will be a list of courses that were similar to the course that a student liked the most and performed well on.

<u>User-based filtering</u>

User-based filtering is adopted for new students since there is no previous learning and preference data required. The recommendation is based on the hypothesis that students with similar backgrounds share common interests. Demographic data like age, degree, major, gender, IMD(Index of Multiple Deprivation), and disability could potentially be used to analyze a student's background. KNN (or other distance-based algorithms) can help the new student to find former students with similar backgrounds. Then, a list of courses that former students have taken could be generated based on their interests and preferences.

Discussion

As we are trying to help the students with their course selection, we need to build trust by letting the students know how the system is built. The list is not like what we provided in the previous project which has descriptive information explaining reasons the courses are being grouped together. Instead, it will be a ranked list. Thus, explaining how we came to the final recommendation list and providing debriefing to the students are crucial for the project. The personal recommendation list has improved upon our previous courses recommendation list for it has already taken the students' background and learning history into account, and made the selection for them. With the tailored list and the previous recommendation lists, we are hoping to alleviate the student's pressure facing course selection. Some potential challenges for the recommendation system could include data privacy and confidentiality issues. We need to make sure that the students are all aware of the information we use and have informed consent. For the future implementation, researchers could consider using NLP to analyze student feedback in the course evaluations to get more insight.

References

Al-Badarenah, A., & Alsakran, J. (2016). An automated recommender system for course selection. *International Journal of Advanced Computer Science and Applications*, *7*(3), 166-175.

Duval, E. (2011). Attention please! Learning analytics for visualization and recommendation. In *Proceedings of the 1st international conference on learning analytics and knowledge* (pp. 9-17).

Esteban, A., Zafra, A., & Romero, C. (2020). Helping university students to choose elective courses by using a hybrid multi-criteria recommendation system with genetic optimization. *Knowledge-Based Systems*, *194*, 105385.

Unelsrød, H. F. (2011). *Design and Evaluation of a Recommender System for Course Selection* (Master's thesis, Institutt for datateknikk og informasjonsvitenskap).

Appendices

Appendix A - Courses Evaluation Form Pepperdine University

<u>Professor Rating</u>

The professor shows interest and enthusiasm for teaching the course.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

The professor is available outside of class for consultation if needed.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

The professor is prepared for class and makes good use of class time.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

The professor presents course material in a clear and engaging manner.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

The professor is an excellent teacher.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

<u>Course Rating</u>

The course is well-organized.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

The course textbook and other reading assignments are appropriate in content.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

The course tests and other evaluations are appropriate in content and difficulty.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

The course assignments are reasonable and appropriate in content and difficulty.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

The course is demanding in comparison to other courses.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

The course has increased my knowledge or understanding of the subject.

- Strongly Agree

- Agree
- Neutral
- Disagree
- Strongly Disagree

The course is excellent.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

The overall class experience has enhanced my ability to think clearly, logically, independently, and critically.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

The overall class experience has contributed to the development of my sense of personal values and moral integrity.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

Appendix B - Courses Evaluation Form Teachers College

Student Self-Reflection

1) When I didn't understand something, I asked questions in class

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

2) I completed assignments on time

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

3) I completed assignments thoughtfully and did my best work

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

4) I made an effort to communicate with the course instructor during office hours

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

5) I shared my opinions, answered questions, and generally participated in class sessions

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

6) I made a conscious effort to link the class content to my own interests

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

Course Design, Organization, and Syllabus

7) Course objectives were clearly stated and aligned with course content

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

8) Course requirements were clearly defined

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

9) Course materials included multiple viewpoints and perspectives

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

10) Class size was appropriate for this course

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

11) Class sessions were well organized

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

12) Subject matter was presented effectively

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

13) Reading assignments contribute to my understanding of the subject

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

14) Instructor is responsive to students' questions and/or comments

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

15) Instructor treats all students with respect

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

16) Instructor is accessible to students outside of class

- Strongly Agree

- Agree
- Neutral
- Disagree
- Strongly Disagree

17) Instructor adhered to, and was consistent with, class meeting times

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

18) The instructor used technology effectively to promote student learning (online or in-person)

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

19) The activities in this course encouraged student engagement and participation (online or in-person)

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

20) I was able to access appropriate learning tools and resources for this course (online or in-person)

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

Student Learning and Satisfaction

21) Course assignments were valuable learning experiences

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

22) I would recommend the course to other students

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

23) I would recommend this instructor to other students

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

24) I learned a lot in this course

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

Assessments/Evaluations

25) Evaluations reflected course objectives

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

26) Evaluation/grading criteria were clearly defined

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

27) Sufficient number of opportunities to evaluate my learning

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

28) Instructor provides helpful feedback on assignments

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

Facilities and Technology Support

29) Classroom space / facilities were adequate for the needs of the class

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

30) Equipment and technology support by the College were adequate

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

Demographics

Items in this section are optional: feel free to not respond to any items below if you are concerned with issues of anonymity

31) My degree program is:

- Non-degree
- Master's
- Doctoral

32) I am enrolled at:

- Teachers College
- Other school of Columbia University
- Other college/university

33) This course is:

- required for my degree
- one option in a list of courses that satisfy my requirements
- selected and taken voluntarily

34) The average number of hours I put into this class per week is:

- Less than 2 hours
- 2-4 hours
- 4-6 hours
- 6-8 hours
- More than 8 hours