Ways to improve Course Selection and Recommendation at North Carolina State University

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***Abstract*—There is a great number of graduate students joining NC State University's Computer Science Master's program every fall. All new students have a myriad of decisions to make as newcomers, including picking courses for their very first semester. The decision process for the subsequent semesters is a lot more informed compared to the first one, as students are exposed, and get acquainted to the information available at the University. Perhaps the biggest problem faced by new students is simply a lack of awareness about the information that exists. This paper highlights the most vital factors a typical new student considers when trying to decide a course. It also delves into the problems they have while trying to make a decision based on those factors. The paper presents the data collected through extensive surveys and interviews, and also presents literature review on a few course recommendation systems that make use of data mining techniques as well as adaptive learning to help students decide what courses they should select. Finally, a problem statement is defined for a course recommendation system that targets first semester Computer Science Masters students at North Carolina State University.**

Keywords*—*Course Selection, Course Recommendation, First Semester, Computer Science, Masters, North Carolina State University.

I. Introduction

Every fall, there is a strong number of new admissions to the graduate programs at NC State University with students from all over the world coming in to get their professional degree. Since a majority of the new admissions are international students, they have to go through an arduous process of setting up this new phase of their educational careers. Having a good start is a key as some of these programs are short and require consistency in terms of academic performance. Some of the reasons students fail to do well initially are directly related to the courses they pick. There is a good chance that a new student picks up a course without having complete and comprehensive information about it, and may have to spend the semester going through a class they may have no interest in, or one that does not match their intended specialization profile, or one that they may simply not enjoy because of the difficulty level, a poor balance between the workloads of multiple courses, or even because they cannot develop a liking towards the professor. This leads to immediate dissatisfaction with the course the student picked leading to potential poor grades. We looked into these problems through our surveys and interviews, and came to the conclusion that students are more comfortable and confident with the resources at hand when selecting courses in the semesters following the first one. They have more information available in later semesters. They find their own unique set of criteria to decide what they want to learn and the decision is made easier when they have information that would fulfil this criteria. The surveys and reviews conducted by the team revealed that certain resources are completely inaccessible to incoming students who have not set foot in the University yet. They are lost when it comes to trying to find more information about courses such as their level of difficulty, popularity, or even something as simple as its content. We have compiled our observations and described the exact problems related to these issues.

II. How it works now

Let us look at roughly what an incoming student goes through currently. Once a student is admitted (fall semester) into the Computer Science program, there is usually an email sent (roughly around end of June) out by the Department asking students to enroll in courses. The email contains information about the faculty adviser, links to courses offered, and a link to MyPack portal. Selecting courses is only one of the many formalities to be completed by a student, including registration, VISA formalities, financial declarations, immunizations etc. Through the interviews with many peers, we found that the time is pretty short, and it is very difficult to research deeply into the courses. To add to it, most of the students do not have a solid criteria to choose courses. They tend to figure their own set of criteria in later semesters, after their experience with the first semester. Most tend to contact acquaintances in the University to get suggestions on what courses they want to pick. During Fall 2016 in specific, incoming students were allowed to pick only 3 courses, limiting their option to try out an additional course after coming to campus. Through this user study, we try to evaluate a lot of concerns, such as

1) Is the information provided by the University to incoming students sufficient for them to make well informed choices about courses?
2) If they are consulting seniors in the University, are they connecting with the right people? For instance, if a student is specializing in Software Engineering track, wouldn't a senior whose has taken similar courses be better at suggesting courses? How do you make sure the people you are contacting have had first hand experience, or at least enough information about the courses they are suggesting?

3) What are the major criteria/resources that current students use to select courses. Are incoming students aware of these resources? For instance, does an incoming student know that they can try out as many courses on the first couple of days, and enroll as they wish?

III. Literature Review

While going through the published resources on the material, we found that the issue is not specific to a single University and has been researched quite extensively by various people. Over time, there has been multiple approaches suggested for solving the problem of Course Recommendation. We try to summarize a few of the methodologies below.

A. Community Based Recommendation System

Research paper [1] discusses the issue of course recommendation as the volume of course-related information is ever increasing and the world of Information Technology is rapidly changing the world of academia. The paper is based on a community based recommendation system, 'CourseAgent', used at University of Pittsburg. The paper describes two ways to collect data for recommendations - Explicit and Implicit feedback. Explicit feedback is registered when a user rates an item as interesting or relevant. Implicit feedback is extracted from user actions that indirectly provide some evidence about item quality or relevance - such as link selection, reading time, bookmarking, etc. Community-based systems integrate explicit and implicit feedback provided by the community of users regarding information items and distill the collective wisdom of the community to help individuals. The challenge for the recommendation systems is to encourage users to provide explicit feedback. Explicit feedback is considered the most reliable source of information for personalization; however, users rarely provide it since they dont perceive this activity as essential to their work with the system [4].

The research paper takes into consideration, two main factors for selection of courses - 1. Contribution to students career goals 2. Workload of the course. Comparatively, our study tries to focus on a lot more factors which we found are relevant and important to students at North Carolina State University. If we are building a course recommendation system, we also want to keep the Explicit Feedback to a low level, since a lot of students that finish a course may not want to provide feedback on it and eventually, the system might lose its reliability. We believe implicit feedback is something which can gather more reliable data over time.

B. Data Mining and Graph Based Approaches

Research paper [2] explains the design of a web-based course recommendation system based on students course selection records. The recommendation system takes in the courses the students previously picked and classifies them into certain categories. It then calculates the categories a student would like the most, and recommends courses based on this factor. The research also mentions how students make decisions on what courses they would like to pick based on an array of different factors like class timings, popularity of professors, and the ease of scoring well in the class. The system makes use of extensive data mining theories and incorporates graph theory to come up with potential solutions. Some of the tests run by the research team were incorrect in some phases due to factors that were not considered, but for the most part, the test results seemed to be quite accurate. Given the technique used, this system can be adapted to various levels of education too.

C. Item Response Theory

An additional course recommendation system we looked into [3], made use of item response theory to design personalized course recommendation which provides recommendations based on course content and difficulty. The proposed system has every course item classified into a course unit that has been predefined. The system incorporates a browsing and searching mechanism from which students can retrieve more information about a course based on what course unit it belongs to. This makes looking for courses in a particular unit a lot easier. The system provides a personalized experience after new users answer a given questionnaire. The system makes use of perceptrons and neural networks to produce its results. The results are evaluated based on how well the returned courses satisfied the users requirements. The final evaluation shows results which are very reasonably well produced. The user experience evaluation done by the research states a high success rate in terms of comprehensibility of the provided courses.

IV. SURVEY

Having reviewed the positives and negatives of Explicit Feedback Recommendation, Implicit Feedback Recommendation, Data Mining and Graph related solutions for Course Feedback, we wanted to check what sort of a solution would work best for students at North Carolina State University. Our primary concern was that the system should be easy to implement, easier to maintain, and should provide accurate information to incoming students. After discussions and interviews with peers, we identified a couple of resources/criteria which are important to students while picking courses.

1) Suggestions from Peers/Seniors - This is the mode of information used by most students. They try to make acquaintances through Social Networking and get information about the courses they want to pick.

2) Grade Distribution - The grade distribution from previous semesters give an idea of how easy it is to score on the subject, or the level of difficulty.

3) Course Content - Details about the specific course content.

4) Project/Research Oriented - Whether the course is project oriented or theory based.

5) Job Prospects - Whether the course is valuable after you graduate. Does it provide any skills that would be useful in the industry?

6) Professor Ratings - How good is the professor? What is his teaching style like?

7) Workload - If there is heavy coursework.

8) Frequency of offered courses - There are certain courses that are offered only once in 2 years. So a Masters student expecting to complete the program in 2 years might get only one opportunity to select the course.

9) Pre-requisite information - Where the course has some pre-requisites. Also, if there are courses the student likes to cover during later semester, can they plan to take up the pre-requisites for it in the first semester?

10) Try the courses on the first day of class - This is something a majority of the students do, to check if they are comfortable with the teaching style and contents of a particular course.

We came up with a set of research questions targeting students who are in their later semesters, asking them about

1) Specialization and Career Focus - We are interested in finding out what specializations are popular and how they are related to the choices students make. Can we use this information to provide better recommendations to students?

2) Rate the resources you consider before picking a course - In this questions, we listed several common aspects that most students might consider before they select a course. By knowing what current students value most and less, we are trying to estimate the resources that would be essential for incoming students.

3) How accessible were these resources while picking courses for your first semester? - This is a follow up to the last question. From the answers of this question, we hope to find out which resources are easily accessible and which are not. The idea is to narrow down the list of resources which are lacking, so we could provide better information to incoming students.

4) Do you think the University provided enough information for you to choose courses, prior to joining. - For this question, we hope to figure out whether students are satisfied with the efforts that the University made to guide them to choose courses. With the feedback from students, we intend to focus of things that are lacking, and not the ones that are already provided by the University.

5) Were you satisfied with the courses that you picked? - We intend to get a count of the students, who think a better course suggestion mechanism could have made their semester at the University more fruitful. We also intend to get specific responses from students on how they think the system could be improved.

V. INFERENCE

We got 38 responses from Computer Science Masters students at North Carolina State University. Along with direct interviews with some of the students, we came up with the following inferences.

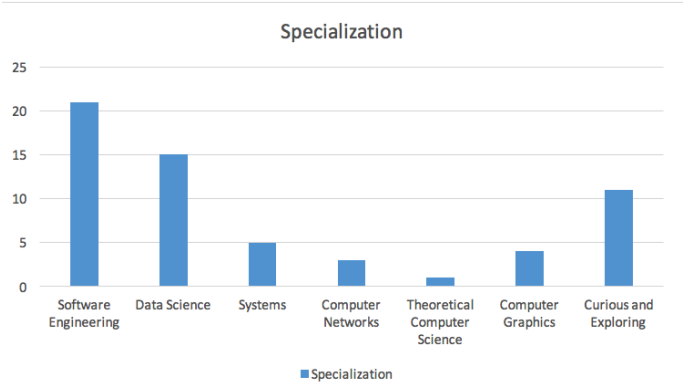

Fig. 1. Specialization

From 38 people, we got close to 60 responses for specialization, indicating that a lot of students come to specialize in multiple topics. Around 25% of the students indicated they are curious and try to explore various topics. This adds weight to the course recommendation criteria outside of the area of specialization.

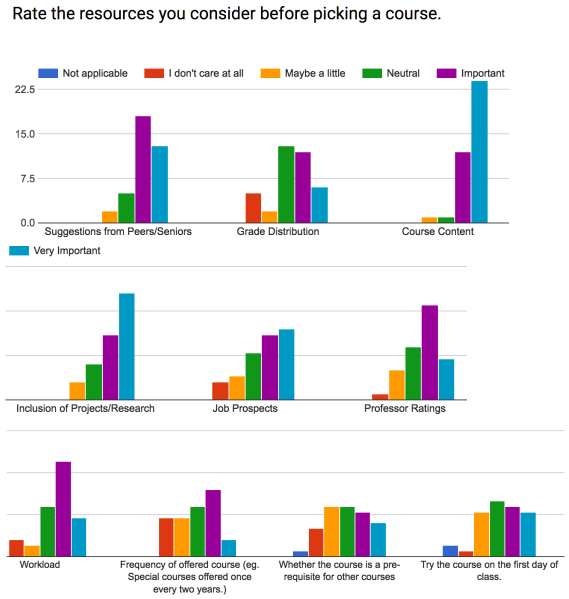

Fig. 2. Rating of Resources

For the most part, all the resources mentioned were important to at least some of the students. Therefore, we tried to split it into 2 groups based on the responses we received.

Suggestions from Seniors/Peers, Project/Research Oriented, Course Content and Workload fall into the very important category. For each of them, over two-third of students think that it is important or very important.

Grade Distribution, Job Prospect, Professor Ratings, Frequency of Offered Course, Pre-requisite information, and the Experience from the First Class seems to be less important factors.

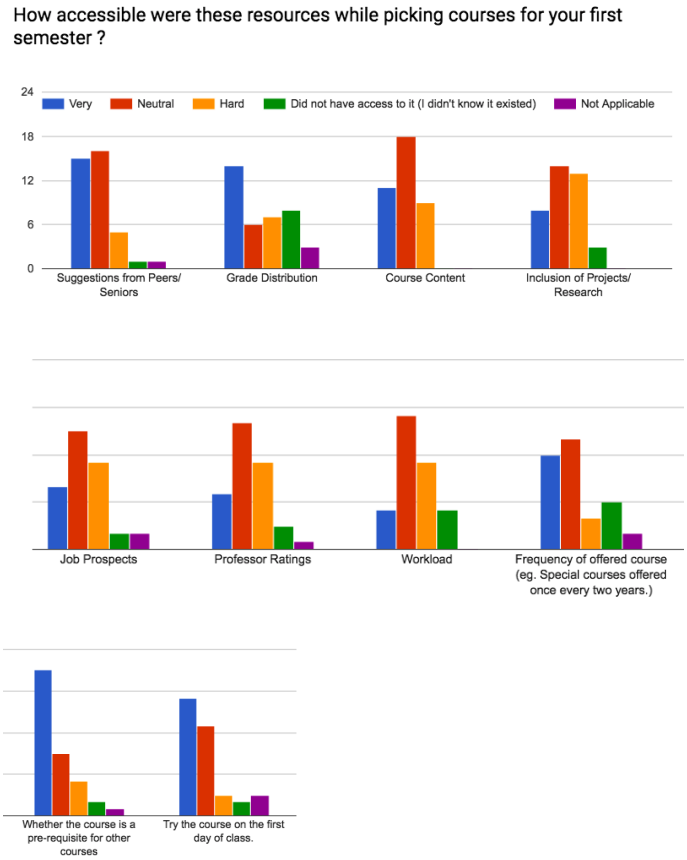

Fig. 3. Accessibility of Resources

From the survey, we tried to identify the resources that students felt were inaccessible during the first semester. However, we found that for all the resources, some students thought it was easily accessible, while others were struggling to find the information, or did not know it existed. It brings out the basic problem in our current system, that the information is not consolidated anywhere for incoming students to access.

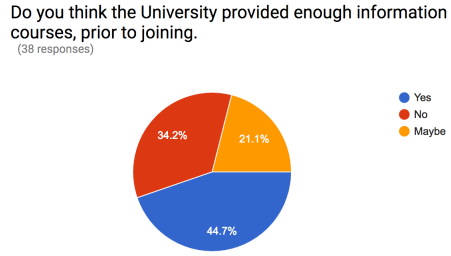

Fig. 4. Has the University provided adequate information?

Unfortunately, only 44.7% of the students thought the University had provided enough information for new students about selecting courses.

We also invited comments from students on this which revealed the majority of issues that exist in this front.

(1) Information is available, but it needs to be more accessible.

(2) Students feel that the details about course-work and workload of the course is not accurate (It is either partially available or not available at all)

(3) There is no system of Course Reviews accessible to students

(4) On-line video lectures are a good way to get a preview of the class. At least one video lecture of courses/professors should be made accessible for students to preview. This could be a good substitute to trying out classes on the first day.

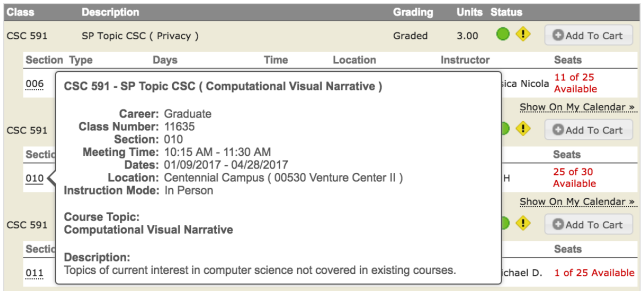

Fig. 5. Screenshot of information in MyPack Portal

In addition, a couple of students pointed out the limitation of information that they can acquire from mypack portal. Students are not able to find the direct link to the course syllabus. What worse, most courses' description are either too ambiguous to understand or do not exist at all, which means students must enroll the course and wait until the first class to form an initial idea of the course.

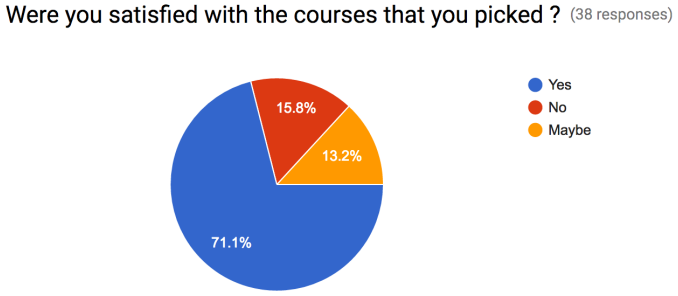

Fig. 6. Satisfaction with picked courses

Even with data suggesting that information is not easily available, 71.1% of the students suggested that they were finally satisfied with the courses that they took in the first semester. It is safe to say that, if the decisions made by the students were made with better information, there would be a higher percentage of satisfied students with the courses that they picked.

VI. Conclusion

From the above survey results and literature review, we have concluded that different students have a variety of different parameters to consider when making decisions in terms of

course selection. Most of these resources are either inaccessible for new students or they lack awareness about their existence. Hence the decisions they make aren't very well informed. Hence, there is good scope to provide more information to the users, and recommend courses based on the factors that they consider to be important.

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VII. CHITS

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