FROSH: AN EXPERT SYSTEM FOR FRESHMAN ADVISEMENT

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ABSTRACT

Saint Peter's College has a formal freshman advisement program, consisting of faculty from many by not all of its 19 academic departments. They are responsible for advising all incoming day students in all 27 majors, including both freshman and transfer students for both semesters of their first year on campus.

Advising freshmen is complicated by three factors: the heterogeneity of the skill levels of the freshman class, who are placed in different classes for the Composition, Math and other required courses based on academic preparedness; the complexity of the core curriculum, which contains ten categories whose precise requirements vary from one major to another; and the fact that all freshman advisors are expected to be able to advise students regardless their prospective major. This frequently can lead to difficulties and delays during freshman registration as well as placing students into courses that do not meet the proper requirements for their prospective major.

FROSH is the first phase of a rule-based expert system that guides the advisor and freshman through planning a first semester's course load. It uses the same information that is available to the freshman advisor at the time that he or she would help a student select courses, which includes placing the student in the proper mathematics and composition course based on SAT and placement test scores and the prospective major. It then places the student in an appropriate first-term program based on the choice of major and the student's academic preparedness. Lastly, it gives the student a choice of one or more additional classes designed to meet Core Curriculum requirement compatible with the choice of major.

A great deal of the development of FROSH was done as part of the Expert Systems course at Saint Peter's College on both the undergraduate and MBA levels. The impact of this on the course is discussed.

A comparison of class programs designed by FROSH and a human advisor follows as well as a discussion of a planned expansion of the system.

INTRODUCTION

It should come as no surprise that management information systems have been developed to aid college administrators in various parts of the course planning process. There have been expert systems written to aid in the advising of upperclassmen[1], data base management system to aid department in tracking the progress of their students[2], and both expert systems and

decision support systems to aid in the planning of departmental and college-wide class schedules[3, 4].

It should be noted that the advising of freshmen differs from that of upperclassmen for several reasons. Firstly, freshman advisors rarely have as much information available to guide them in the proper advisement of the freshmen; there are no college-level grades to use as an indication of the probability that a student will succeed in a given course. Secondly, freshman are less likely to have chosen a major which complicates the task of helping select a first term's course load. Thirdly, faculty members who advise freshman have to handle a more diverse range of student interests than those who advise upperclassmen.

It is the author's own experience as a freshman advisor that led to the development of FROSH. Given that there are 27 majors that incoming freshmen in the Day Session can pursue on the Baccalaureate level, it makes it too easy for an advisor to need assistance that is not always available or even in rare cases to misadvise a student. FROSH was created to avoid problems of this nature.

CORE CURRICULUM AT SAINT PETER'S COLLEGE

Table I shows the Core Curriculum required of all students at Saint Peter's College. In many of the categories of Core Curriculum, more than one course can meet a particular requirement, depending upon the student's choice of major. Additionally, students take placement tests during Freshman Orientation to determine the level of their skills in reading, writing and mathematics. These tests assist in determining the student's placement in the appropriate composition sequence and, if necessary, their placement in the developmental courses Rd 010 (Reading Dynamics), and either Ma 021 (College Algebra) or Ma 001 (Introductory Algebra, a non-credit course). Recently, the College initiated a non-credit developmental course in Composition for students who are not ready to begin one of the Core Curriculum Communications sequences.

Table I Core Curriculum at Saint Peter's College

Curriculum Category	Course Title	Comments
Communications		
Cm 004-115 or Cm 006-117 or Cm 008-119 or Cm 120		Course Placement depends on placement test taken during Freshman Orientation
Mathematics		
Ma 105-106 or Ma 123-124 or Ma 143-144	Finite Mathematics I & II Elementary Calculus I & II Differential & Integral Calculus	Course placement depends on major
Literature		

El 123 and El 134	Poetry and Drama Prose Fiction	Student must finish Communications requirement first
History		
Hs 111-112	Western Civilization I & II	
Social Science		
So 121 Po 110	Introduction to Sociology Perspectives on Politics	Expect for majors in Accountancy, Business Management and Marketing Management, students can substitute either Ec 100 (Intro to Economics) or Ec 101 (Macroeconomic Principles)
Natural Science		
Ns 100 and one course in Biology, Chemistry or Physics and one course in Biology, Chemistry, Physics, Psychology or Computer Science	Scientific Literacy	Biology, Chemistry, Physics and Psychology majors have courses mandated for this required. Student can use a higher level course in lieu of Ns 110
Modern Language		
One year of a modern language		Placement depends on the student's background in the language. It is possible for native speakers of a foreign language to place out of the requirement
Philosophy		
Pl 100-101	Introduction to Philosophy	Normally taken sophomore year or later, except for all-Freshman sections
Fine Arts		

Ar 127 or Ar 128	Introduction to Visual Arts Introduction to Music	
Theology		
Th 110 and Th 120	Religious Faith in the Modern World Christianity in the Contemporary Era	

Choice of major plays a significant role in required mathematics sequences. Science majors are required to take one of two calculus sequences. Chemistry, Physics, and Mathematics majors take the more rigorous sequence of Differential and Integral Calculus. Biology majors and Psychology majors pursuing a BS degree take Elementary Calculus I and II. Computer Science majors take either sequence depending on which one of three options they choose. The Mathematics Department offers a two-credit course entitled "Intermediate Calculus" for students switching into those majors that require the more rigorous sequence.

Psychology majors seeking a BA and students not majoring in the Sciences may take either Calculus sequence or Finite Mathematics I and II. While most choose the Finite Math sequence, the Accountancy Department advises their students to take Calculus if they plan to sit for the CPA exam and the Economics and Management/Marketing Departments advise their students to take Calculus if they are considering graduate school. FROSH includes a warning to that effect.

Mathematics is not the only area where major affects Core Curriculum. Majors in the Business Division, which includes Accountancy, Business Management and Marketing Management, take economics as cognate courses within their majors, not as part of the Core Curriculum; however, other students may choose to use Economics as part of their Core Curriculum Social Science requirement. Majors in Biology, Chemistry, Physics and Psychology all have specific courses that are required for the entire Natural Science requirements while majors in the Business Division and in Mathematics have Computer Science courses that they are required to take as their third Natural Science course.

All of this makes it difficult to advise incoming students properly, given that the College has 22 academic departments offering 32 major fields of study available to undergraduate day students. Freshman advisors are expected to advise students in any of these programs, which can easily lead to mistakes in the advising process.

THE DEVELOPMENT OF FROSH

The current knowledge base of FROSH was written in three separate stages with the assistance of undergraduate Computer Science majors and MBA students enrolled in the "Expert Systems" courses of their respective programs. The original version handled only four majors (Accountancy, Business Management, Philosophy and Computer Science). The following year, it was expanded to include 20 majors that account for over 90% of the undergraduate enrollment. Currently, it can advise students interested in any of the 29 majors available to incoming freshman in the Day Session.

The name FROSH came from the original title screen which contained the phrase "YO, FROSH!!" several times. After undergraduates working on it complained that it was "tacky",

the title screen was revised to recreate the College's Peacock logo as it appears on the title screen of the College's Student Information System.

THE LOGIC OF FROSH

Presently, FROSH ignores scheduling issues, distinctions between different course sections, enrollment limits or time conflicts between courses; this will be discussed below.

FROSH receives as input the same information that freshmen advisors receive, including the student's tentative choice of major, SAT scores, and placement test results. It does not currently recognize the possibility of a student being undecided in major or having more than one choice of major; this too will be discussed below.

Certain decisions in the advisement process are made in a particular order which FROSH emulates to as great a degree as possible, as shown in Table 2. Advisors first decide how heavy a workload to allow the student to take, then place the student in the proper composition and math courses as well as Reading Dynamics if necessary; placement in composition and math courses and in Reading Dynamics are not made by the advisor. Then the advisor will help the student choose the proper course with which to begin study in his/her major and fill the rest of the student's course load with courses that meet other requirements of Core Curriculum.

Table 2 Decisions made in the advisement process

- Determine the maximum number of credits that the student will be allowed to take
- Determine the student's composition course placement
- Determine the student's mathematics course placement
- Determine if the student needs to take Reading Dynamics
- Determine the course with which the student will start his/her study in the major (if the student is ready)
- Help the student choose courses for Core Curriculum to fill the rest of his/her course load

The advisors differ over whether to allow students to take courses in their Freshman year that neither meet degree requirements (for the major or Core Curriculum) nor serve as prerequisites for them. Some advisors will allow one or two classes that meet no specific requirement while others will do so only if scheduling leave no other desirable choices; still others will not allow it under any circumstances. FROSH follows the last philosophy and will not allow a first-term freshman to take any course that does not meet a particular requirement or serve as a prerequisite for one. The author agrees with members of the Freshman Advisement Team who feel that students will have adequate opportunity to explore the College's full range of course offerings later in their undergraduate career and that the most important goal of the first term is to succeed in course work that will be the foundation of the rest of their undergraduate education.

Financial aid guidelines require a student to register for twelve credits in a semester to be a full-time student; the contact hours of non-credit courses count as credits for this purpose only. At the same time, a student must average 32-1/4 credits per year to graduate in four

years. Given that the transition to college is considered rather difficult, most first-term freshman are limited to either twelve or fifteen credits. Students will be allowed to exceed this rule by a credit when taking a four-credit course or a laboratory science course where they register for the laboratory course separately. FROSH considers the number of courses for which a student is registering, not the number of credits. Laboratories are considered part of the lecture course for which the student is registered. Since most courses at Saint Peter's College are three credits, FROSH will allow incoming Freshman either four or five courses. The following rule determines the student's eligibility for a fifth course:

```
RULE COURSE_5
IF     sat_score > 800
AND eng_course < > Cm001
AND eng_course < > Cm004
AND math_course < > Ma001
AND    course_count < 5
AND reading_course < > Rd010
THEN
      Max_courses = 5
BECAUSE
"this will allow the student with a acceptable sat score
and no developmental classes with number of courses
below 5 to choose a fifth class";
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RULE NO_COURSE_5
IF  sat_score < = 800
OR eng_course = Cm001
OR eng_course = Cm004
OR math_course = Ma001
OR reading_course = Rd010
THEN
   Max_courses = 4
BECAUSE
"it is not recommended that a student take more than 5 courses
the first semester and it is not recommended that a student
with a SAT score below 800 or with developmental classes take
a fifth course.";
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Because students with lower SAT scores or who are taking developmental courses are regarded at greater risk, it is considered a good idea not to give them heavier workloads. The only exception is College Algebra (Ma 021); because these students could take Finite Math (Ma 105), this is not regarded as an impediment to their ability to handle a fifth course.

Freshman advisors receive no information on composition class placement beyond the recommended class; therefore, FROSH takes as input the placement level, and assigns student to the corresponding Composition class.

Mathematics course placement depends upon both the student's skills in mathematics and the choice of major, as discussed above. FROSH first determines in which division the student's major is located; for this purpose, all majors are Social Science, Humanities, Business, Theology, Natural Science or Physical Science. While the College makes no distinction between "Natural Science " and "Physical Science", this is helpful in separating the majors that require the two different Calculus sequences. FROSH then determines the proper mathematics course based on the student's SAT scores, math placement test scores and the major division.

Students outside the sciences are placed into Finite Math I (Ma 105) if their SAT scores are 500 or greater or if their placement test scores exceed 19 (out of a maximum score of 40); otherwise they are placed into Introductory Algebra (Ma 001). Students in the sciences and those electing to take Calculus are placed in either Elementary Calculus I (Ma 123) or Differential Calculus (Ma 143) if their SAT scores are 500 or greater or if their placement test scores exceed 25. If this is not the case, but their placement test scores exceed 19, they are placed in College Algebra (Ma 021).

The rules regarding math placement appear below:

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RULE CHOICE_OF_FINITE_MATHBySAT
IF major_type < > Natural_Science AND major_type < > Physical_Science
  AND MathSAT > = 500 AND math_choice = FiniteMath
THEN Math_course = Ma105
BECAUSE
"Student has the option of choosing finite math instead of
calculus";

RULE CHOICE_OF_FINITE_MATH
IF major_type < > Natural_Science AND major_type < > Physical_Science
  AND MathSAT < 500 AND MathScore > 19 AND math_choice = FiniteMath
THEN Math_course = Ma105
BECAUSE
"Student has the option of choosing finite math instead of
calculus";

RULE CHOICE_OF_CALCULUS
IF major_type < > Natural_Science AND major_type < > Physical_Science
  AND MathSAT < 500 AND MathScore > = 26 AND math_choice = Calculus
THEN Math_course = Ma123
BECAUSE
"Student may choose calculus in case they want to go to grad
school";

RULE CHOICE_OF_CALCULUSBySAT
IF major_type < > Natural_Science AND major_type < > Physical_Science
  AND MathSAT > = 500 AND math_choice = Calculus
THEN Math_course = Ma123
BECAUSE
"Student may choose calculus in case they want to go to grad
school";

RULE CHOICE_OF_CollegeAlgebra
IF major_type < > Natural_Science AND major_type < > Physical_Science
  AND MathSAT < 500 AND MathScore < 26 AND MathScore > 19
  AND math_choice = Calculus
THEN Math_course = Ma021
BECAUSE
"Student has the option of choosing calculus instead of finite math
and (s)he is not ready for calculus at this time.";

RULE ChoiceOfIntroAlgebra
IF major_type < > Natural_Science AND major_type < > Physical_Science
AND MathSAT < 500 AND MathScore < = 19
THEN Math_course = Ma001
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BECAUSE "The student is not ready for either Finite Math or College Algebra";

Students reading below grade level 12.9 are placed in Reading Dynamics (Rd 010); this is determined by the last of three placement test administered during Freshman Orientation.

After placing a student in math and composition classes (and Reading Dynamics if applicable), FROSH places the student in the first class in the student's major. In most majors, this first class will be fairly obvious: History majors start with Western Civilization I and Sociology majors with Introduction to Sociology. In many cases, students taking developmental courses will postpone starting classes in their major for once or more semester. For example, freshmen taking developmental math courses are encouraged to postpone taking Principles of Accounting I until they are ready for Finite Math or calculus. Economics and Business Management majors postpone taking Macroeconomic Principles and Introduction to Management respectively if they are taking more than one developmental course.

Some departments recommend that a major start with one or more classes in another discipline. Marketing Management majors are encouraged to start with Introduction to Management to gain a better understanding of the role that marketing plays in the corporate world. Similarly, Physics majors start with a semester of General Chemistry and complete a year of calculus before taking General Physics.

The College offers several interdisciplinary majors. Since students have more than one course with which they can start their studies, FROSH gives them the option of choosing one.

At this point, students will have been placed in as many as four or as few as two courses. FROSH gives them a choice based on subject area, recommending a course in that discipline based on their major and on Core Curriculum requirements. If their choice does not meet a requirement in either their major or Core Curriculum, meets a requirement that they are already fulfilling or is a course for which they are currently registered, it will display an appropriate error message and allow them to make another selection. Finally, FROSH displays their course load on the screen.

The College has a Freshman Faculty program and reserves a number of sections of required courses for freshman only. Similarly, there is an Orientation Seminar program required of all freshman and transfer students who have earned less than 30 credits. These are not incorporated into FROSH at this time.

Saint Peter's College also has an Honors Program, open to student with SAT scores of 1150 or higher. They are required to complete at least 10 Honors Program courses, many of them offered as substitutes for regular courses in Core Curriculum and others that are electives. FROSH will check SAT scores for eligibility. It similarly ensures that the student will not need any of the developmental courses, another requirement of the Honors Program. An Honors student has the option of substituting a given Honors course for the appropriate Core Curriculum entry. Electives were not added because FROSH does not allow student to take elective courses in their first semester.

Examples

While there may be no such thing as a "typical" freshman, below are three examples that are fairly representative of the problems faced in advising freshman:

CASE 1 Mr. Smith
MAJOR: Chemistry

SAT SCORE:	Verbal: 400	Math: 350	Total: 750
ENGLISH SCORE:	Level 2		
MATH SCORE:	18		
READING SCORE:	12.7		

Here are your first semester courses:

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4 courses:
English: Cm 006
Math: Ma 001
Reading: Rd 010
Courses required for major:
Ch 100 and Ch 101

Mr. Smith's SAT score is low enough to limit to 12 credit; even if this were not the case, his placement in Ma 001 would have the same effect. Scoring "Level 2" on his composition test places him in Cm 006 and his reading level, being below 12.9 places him in Reading Dynamics. His math grades also require him to take Introduction to Chemistry and Laboratory Techniques in Chemistry before starting General Chemistry even if he had studied Chemistry in high school. This program leaves no room for any other courses in core Curriculum. Had he scored 23 on the math placement test and taken Chemistry in high school, he could have placed into College Algebra and started with General Chemistry.

CASE 2 Ms. Jones
MAJOR: Computer Science Computer Science option

SAT SCORE:	Verbal: 400	Math: 500	Total: 900
ENGLISH SCORE:	Level 4		
MATH SCORE:	Not applicable		
READING SCORE:	12.9		

Here are your first semester courses:

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5 courses:
English: Cm 120
Math: Ma 143
Reading: Not applicable
Courses required for major:
Cs 230
Course choices:
Pl 100
Ns 110

Ms. Jones' SAT score is higher enough to allow her to take 5 courses and place directly into calculus without taking the Math placement test. The Computer Science option requires Differential Calculus (Ma 143) and her English Score places her into Cm 120, the one-term communications course. Computer Science majors whose math skills allow it and who have some experience with Computers begin their study in the major with Pascal (Cs 230). This still leaves the student enough in her course load for two other Core Curriculum courses, in this case Introduction to Philosophy (Pl 100) and Scientific Literacy (Ns 110).

CASE 3 Mr. Brown
MAJOR: History

SAT SCORE:	Verbal: 600	Math: 600	Total: 1200
ENGLISH SCORE:	Level 4		
MATH SCORE:	Not applicable		
READING SCORE:	12.9		

Here are your first semester courses:

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5 courses:

English: Hp 122
Math: Ma 105
Reading: Not applicable
Courses required for major:
Hp 111
Course choices:
Ar 127
Ec 101

Mr. Brown's SAT scores are sufficient to admit him into the Honors Program; this and his placement score give him the choice of Cm 120 or Hp 122, an Honors course entitled "Expository Writing." Since his major does not require calculus and he does not choose to take it, he is placed into Finite Math I. A History major starts his studies with Western Civilization I but in this case he chooses to take the Honors Seminar in History I (Hp 111). To complete his program, he chose Introduction to Visual Arts (Ar 127) and Macroeconomic Principles (Ec 101). The former has an Honors substitute course, but in this case, the student chose not to take it. If Mr. Brown had advanced placement credit in European history, he would have started with Survey of American History (Hs 231), for which there is no Honors equivalent.

In all three cases above, FROSH produces course loads that are consistent with the approach taken by more conservative members of the Freshman Advising Team.

DISCUSSION

Student advisement is not an exact science. A great deal of important information about the student is discovered only through the interaction between student and faculty advisor. It is not the purpose of FROSH to replace the faculty advisor, but to assist the advisor in ensuring that the student is placed in the correct classes, especially those courses that the student must complete as early as possible.

In teaching Expert Systems to undergraduates majoring or minoring in Computer Science and to MBA students, it is often difficult to compile a list of suggested projects for expert systems that will provide enough variation for the class. Also, students sometimes find it difficult to write an entire feasibility prototype. By providing students with the opportunity to work on part of a larger project, both of these problems are alleviated.

In both undergraduate and graduate classes, students were given the choice of working on part of this project or to create a feasibility project of their own. In the undergraduate class, 17 of 21 students chose to work on FROSH; only 5 of 20 graduate students chose to do so. In most cases, the MBA students, who are part-time students with a wider range of experience, had a few idea for potential projects of their own.

FROSH ignores scheduling issues because this would have required access to a data base continuing the College's class schedule for the semester; this seemed to make the first phases of the project too complex to be solved all at once. Because FROSH was intended for use by faculty advisors, this problem was put aside until other issues could be resolved. Any future expansion of FROSH will include data base access so that schedule-related matters can be included in the program planning process.

The matter of multiple majors and undecided students is also complex. Some combinations of majors work well together, such as Mathematics and Computer Science. Others, such as Business Management and Chemistry, can lead to problems when fitting in required courses for both majors brings the student over his/her maximum number of courses for the first term. In these rare cases, it may be necessary to have the student choose to

postpone a required course in one of the majors for one or two terms. Presumably, it would be easier to postpone studies outside of the sciences or Accountancy where courses can be taken concurrently with fewer problems. This feature will be added to a future version of FROSH.

The information used for most of the rules comes from the author's own experience as a freshman advisor. TO avoid getting too limited a perspective, the author and the students working on this project consulted with members of the faculty and with the Associate Dean to confirm the rules within the knowledge base. Without exception, everyone was extremely cooperative, verifying or correcting rules as necessary.

Anyone wishing a copy of the rule base is invited to contact the author at the above address.

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