Development of a Knowledge Based System for Advising Freshmen Engineering Students

S. Keith Hargrove
Tuskegee University
College of Engineering, Architecture & Physical Sciences

INTRODUCTION

One of the greatest challenges faced by engineering faculty is balancing effective teaching, research, and service with time. Faculty are also responsible for advising students to register for courses in the curriculum and other developmental matters. Probably the most neglected area in engineering education is advising, and research indicates that advising can influence student retention (1). Effective advising consists of providing current information, good listening and communication skills, and good counseling skills.

However, many of the questions they confront by Freshmen engineering students about registration are routine and redundant. If a majority of the entering students have the same educational background, they essentially will register for the same group of courses their Freshmen semester or term. Accessibility can be a problem due to schedule conflicts between faculty and students to obtain advise about course registration. An alternative approach may be computer-assisted registration and advising.

Many universities are using computers to enhance registration through student-independent processes (2). Engineering students typically see their advisor first, and then register at a networked terminal. To further address the problems of accessibility and redundancy, universities may also include computer-assisted advising. Computer-assisted advising provides distinct advantages over the traditional method of advising. These advantages include convenience, availability, accessibility, and accurate information. This paper discusses the development of a computer-aided system for advising Freshmen engineering students. The prototype is currently being tested,
and a later paper will address the results of implementation.

DESIGN OF THE KNOWLEDGE BASED SYSTEM

A knowledge based system/expert system is a computer software tool (program) used to assist human decision making, and most are developed on a PC with the aid of a shell (3). It contains knowledge or experience of a particular domain, and will provide responses to questions based on that knowledge or facts.

Facts are contained in "rules" for the knowledge base, and is the main body of the software program. A rule is essentially a IF/THEN clause. The IF portion of the rule is

known as the rule premise. The THEN portion is considered the rule conclusion. As the program runs, the rule premise is tested. The rule premise can be made more sophisticated by adding AND/OR operators. The collection of facts, and rules about those facts comprise the rule base portion of a knowledge base system. A simple rule is shown below.

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RULE MATH_6
IF CLASSIFICATION = FRESHMEN AND
SEMESTER = SECOND AND
MATH_PASSED = MATH_207
THEN MATH = MATH_208
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The inference engine is the logic or reasoning methodology to solve the problems or questions presented to the knowledge base. It searches through the rule base to find any rule conclusions that satisfy the goal. If a rule conclusion is found that satisfies the goal, that rule premise is tested. The inference engine performs a number of searches to reach a conclusion. Forward and backward chaining are two common approaches to knowledge base reasoning (4). Backward chaining seeks to prove a goal. Forward chaining begins with a group of facts or data, and ends when all the rules are executed. The system under development uses the former. The user interface is another part of the software program used to communicate with the user and display results.

The objective of this project was to develop a computer-assisted program for academic advising for Freshmen engineering students. With computer accessibility, the program will provide Freshmen with advise about registering when their advisor is unavailable. However, the student must still see the advisor for signature approval of the registration schedule. The design and development of the knowledge base system consisted of an advisor (expert), a graduating senior (knowledge engineer), and several Freshmen students (end user). A PC-based expert system was used as the software program shell (4). The domain (subject) was identified with facts and rules for the Freshmen course curriculum. After building the rule base, the program was tested.

The rule base for the knowledge base system contained eight basic groups of rules. Each group was concerned about the determination of one class (course). The maximum number of classes is eight for an engineering student in either of the four disciplines of aerospace, chemical, electrical and mechanical engineering. An example is shown below on how the inference engine searches (traces) the rules of a math course. The student is requested to answer questions about their academic course background, national entrance exams and intended major. After answering several questions, the knowledge base system would recommend the courses to take for that semester. This information is then consulted with the advisor for approval, and the student is registered at the advisor's terminal. The objective is not to eliminate the advisor from the advising process, but simply assist the advisee in preparing their schedule to optimize the registration process. Shown below is an example of the search process for selecting a math course.

```
class1
      Testing CLASS_1
                  CLASSIFICATION
                        (=FRESHMEN)
                  SEMESTER
                        (=SECOND)
      Testing CLASS_2
                  READING_101_PASSED
                        (=YES)
                  MAJOR
                        (=ELECTRICAL)
      (=READING_102)
class2
      Testing CLASS_1
      Testing CLASS_2
                  ENGLISH_101_PASSED
                        (=YES)
      (=ENGLISH_102)
MATH
      Testing MATH_1
      Testing MATH_2
      Testing MATH_3
      Testing MATH_4
      Testing MATH_5
      Testing MATH_7
                  MATH_PASSED
                        (=MATH_207)
      (=MATH_208)
```

CONCLUSIONS

This paper presented a brief review of the design and development of a knowledge based system for advising Freshmen engineering students. Several software trials by Freshmen students concluded that the system would be valuable to the registration process in the College of Engineering. Hence, the program was simply developed to enhanced the registration process, and not eliminate the face-to-face interaction between faculty and student. This program will be further tested and extended to advise other Freshmen in other majors other than engineering.

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S. KEITH HARGROVE, is Assistant to the Dean at The College of Engineering, Architecture and Physical Sciences at Tuskegee University. He completed his B.S. in mechanical engineering from Tennessee State University, and Ph.D. from The University of Iowa. He teaches courses

in mechanical engineering, and conducts research in manufacturing and engineering education.