The Engineering Problems and Programming Course On the Web

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Introduction

The Engineering Problems and Programming course at Iowa State's College of Engineering has undergone many changes since its inception. This brief history will trace back only as far as the early eighties when programming in FORTRAN was first added to the existing problems course. Most of the content has remained unchanged. There are still engineering skills topics such as graphing and report writing being taught, but changes have incorporated computer drawn plots on spreadsheets [1] and the report is now written with a word processor instead of being hand lettered. There are still engineering problems introductory topics such as statistics, engineering economy, and statics, but changes have brought an integrated hands-on and computer applications approach [2]. And, of course, there are still programming topics to learn, but changes in the way all course topics are taught have been made as new teaching tools have been implemented [3,4].

With all of these changes the greatest impact was in a very local environment. Although the improvements were reported on at previous ASEE meetings and appropriate courseware materials were included in the Synthesis Coalition NEEDS Database [5-8], the effects of the changes were almost exclusively seen in a local-area-network of classrooms in the Engineering Fundamentals Division at Iowa State. Access to the courseware from the ISU dorms was difficult, and from off-campus it was impossible. Dissemination in such an environment is difficult as the interested parties meet several roadblocks and become discouraged in attempts to avail themselves of the material.

Throughout all the years of changes, some major and most minor, the course has been taught to a large audience (more than 500 students per semester) by many instructors in multiple sections. This created the need for tracking the uniformity of the learning experience for our students from one section or semester to the next. Common exams and projects are created by the teaching faculty and critiqued at weekly meetings where all aspects of the course are discussed. A recent change which has brought another dimension to our uniformity discussions is the creation of an alternative course utilizing C rather than FORTRAN as the programming language. This course is identical in all aspects except syntax. The same projects are used; the same exams, with some modifications to programming questions are used; and the same schedule is kept. In fact, the weekly faculty meetings are held jointly.

-As we attempt to provide more meaningful hands-on engineering experiences taught in a collaborative, teamed environment , the need for students to have access to courseware from their dorms on a 24 hour basis provided impetus for creating web-based courseware.

Web-based Courseware Development

For several years the Engineering Fundamentals Division has maintained a database of Authorware lessons [2,3]. Figures 1, 2, and 3 are images from this database showing opening menus and a sample slide from one of the lessons. One of the problems with these lessons has been the access to our network to view them. Because of its heavy use, the network is closed to traffic outside of the local classrooms. Students cannot, therefore, access the materials from their dorms. Paper copies of the lessons provide some relief, but nothing completely replaces the ability to view the multimedia lessons "live."

These lessons are also viewable only on windows-based machines leaving Mats and unix workstations, which are prevalent on our campus, out of the loop. With the ability of the world-wide-web to provide cross-platform delivery to any point in the world, many of our problems have been solved. In the summer of 1995, a team of student programmers learned HTML programming and translated the AuthorWare-based lessons to the web. Parallel lessons are available on the web for each AuthorWare-based PC lesson. Figures 4, 5, and 6 show comparable web versions of what was shown in figures 1, 2, and 3.

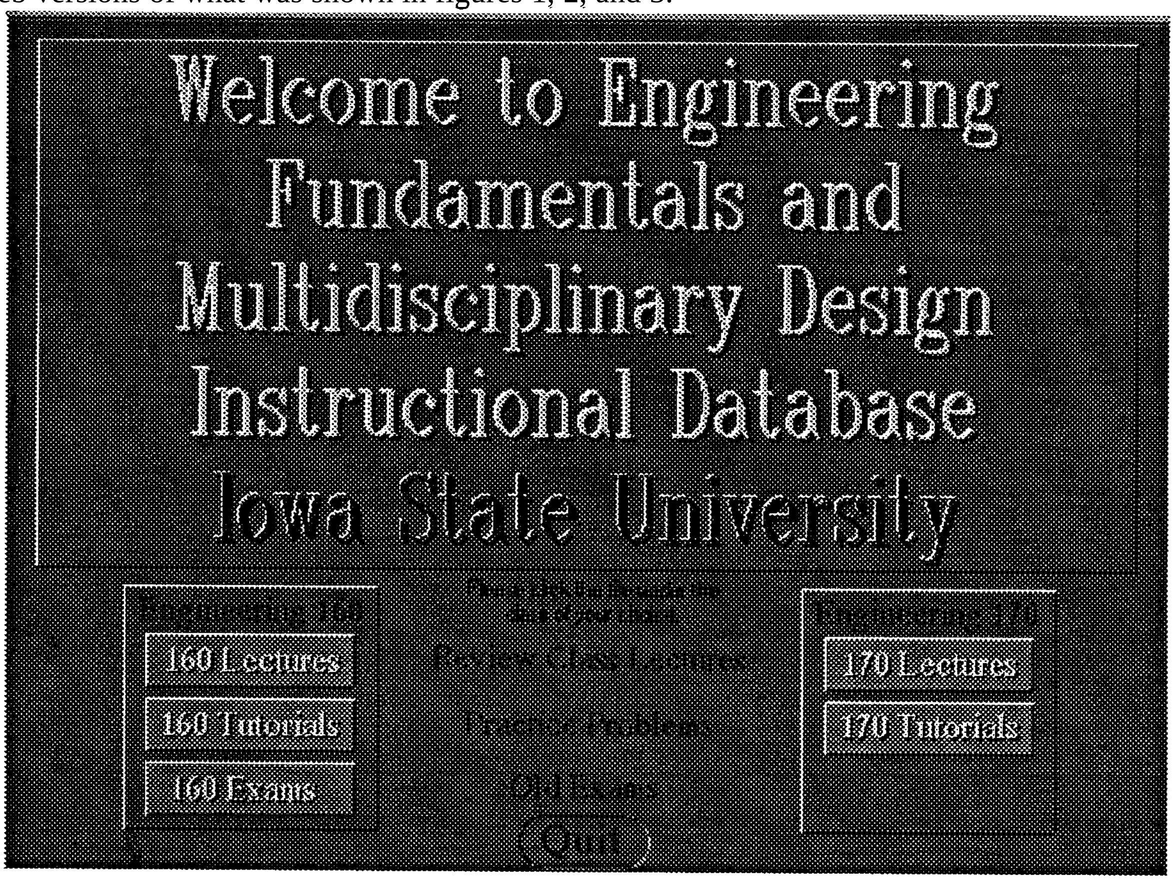


Figure I : Ihe Database Menu

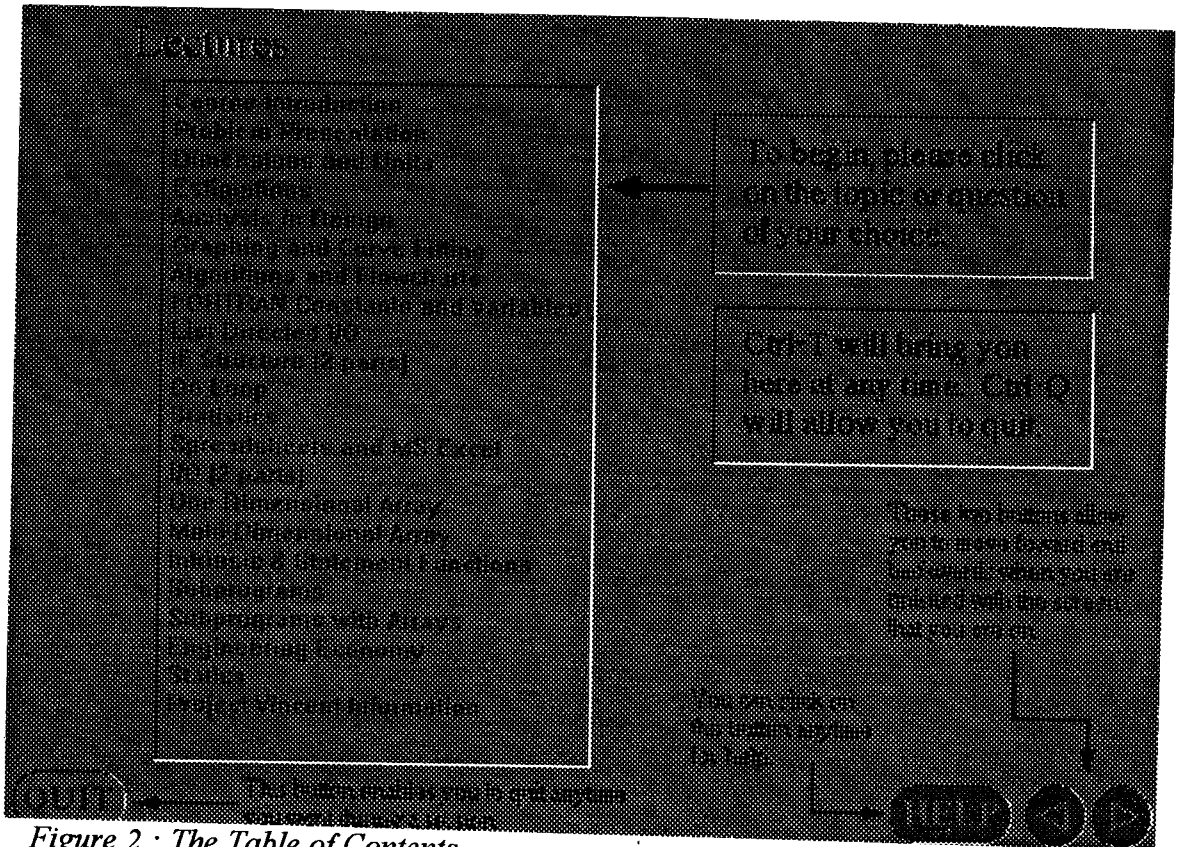


Figure 2 : The Table of Contents

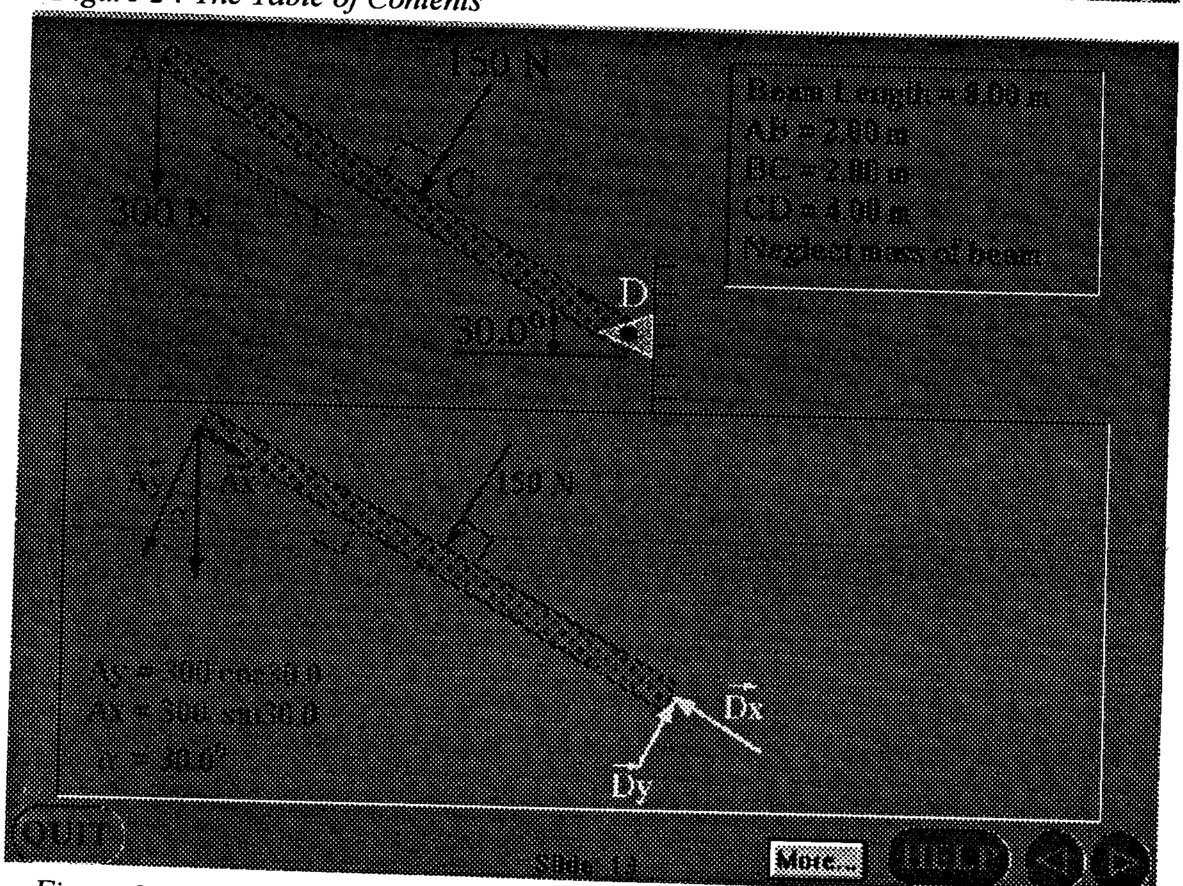


Figure 3 : A Sample Computer Slide

IOWA STATE UNIVERSITY

Engineering Fundamentals and Multidisciplinary Design

Lessons on the World Wide Web

Course	*Lesson Material*
Engr 160	**The FORTRAN Language**
Engr 161	**The C Language**
160 & 161	**Engineering Problems Topics**

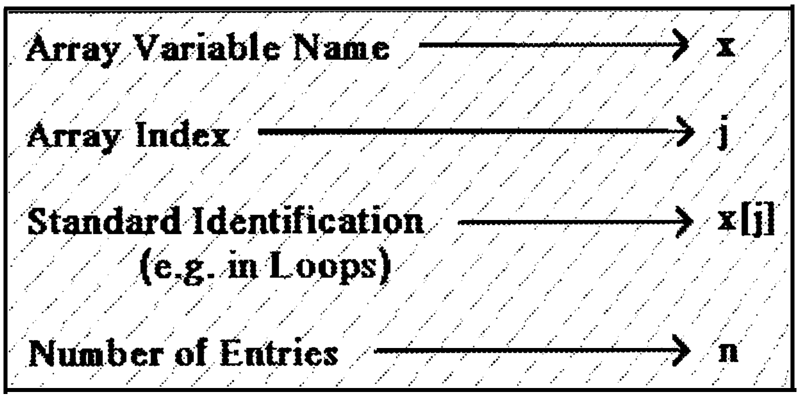
Figure 4: The Database ***Menu: Web Version***

Engineering Problems

- Problem Presentation
- Dimensions and Units
- Estimations
- Analysis in Design
- Graphing and Curve Fitting
  Part I - Part II
- Statistics
- Spreadsheets and MS Excel
- Engineering Economy
- Statics

Figure 5 : The Table of Contents : Web Version

Sample Picture



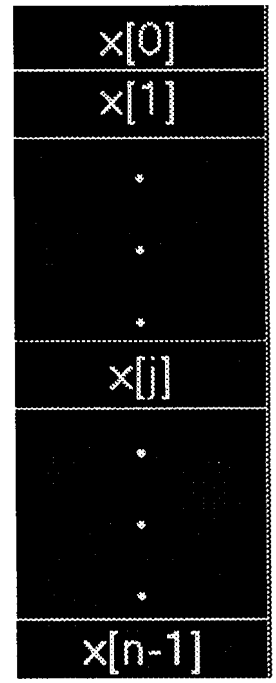


Figure 6: A Sample Computer Slide : Web Version

involved teams of students experimenting with a manual wheelchair. One student team member was weighed and placed in the chair with the brakes locked. Other student team members then attached a cable connected through a pulley system to a weight platform. Student team members than placed weights on the platform until the chair "just" began sliding across the floor. By using various student teams performing the same experiment, a table of chair/occupant weights versus platform loads was developed. The students were encouraged to question the data, the assumptions, and the experimental methods employed. On several occasions, at the insistence of the students, data points and experimental conditions were rechecked.

This data was then used for many applications problems throughout the semester. When graphing was studied, the students plotted their own data and noted data points that seem to be inconsistent with the pattern developing. When statistics were studied, the students calculated the "best" model for their data from linear, power, and exponential choices. When spreadsheets were introduced, the students again employed statistical and graphical methods to analyze their data. When statics was introduced, a free body diagram for the wheelchair experiment was drawn. In all cases the students demonstrated their willingness to take ownership of the data and question its engineering sensibility. The Authorware lessons, delivered in a high-tech learning classroom provided the theory and first examples of how to apply that theory, but the hands-on experiment and its analysis brought that theory to life. The students, anxious to apply analysis tools to their own data, need little instruction in spreadsheet use to get started. Without the motivation of the hands-on experiment, the spreadsheet introduction becomes just another academic exercise (read drudgery) to be performed.

Another hands-on experiment that has been introduced deals with resistor values. A sample of resistors with some nominal resistance is selected for analysis. Each student measures the actual resistance with an ohmmeter and compares it with the color-coded nominal resistance. Again, a table of values is created. This time students write programs to calculate the basic statistics (mean, median, standard deviation) associated with the sample . Once again, a greater degree of student ownership was seen. Measurement questions were raised about some of the data points. The percentage of resistance values falling outside the nominal range was discussed. It was enlightening to see some students who thought it would be "impossible" for a commercially purchased resistor to lie outside the

A team of nine students, including two high school women interns [9] who had just completed a research project on campus, were hired to do the programming. The students provided consulting as to what they, as students, would find useful in the web-based lessons. They also provided boundless energy, endless creativity, and cheap labor.

The lessons provide for the same content coverage as the Authorware lessons for engineering problems, FORTRAN, and C. Since students have free access from anywhere, the faculty can leave more of the content coverage to the students and concentrate the class time on providing more collaborative, hands-on experiences which bring the content to life. In this way a faculty member can be more of a coach ("guide at the side") rather than a lecturer ("sage on the stage"). The students learn by doing and have the courseware, both Authorware and web versions, as reference material.

Another feature of the web-based lessons is the ability to have viewers send messages with suggestions or questions on the material to the author. The web lessons have been set up to count the number of times that the lessons have been accessed ("hits"). It will be interesting to see how much external use is made of this courseware. In conclusion the web-based courseware has provided for uniformity in course content coverage, cross-platform compatibility, and ease of access from remote locations. The lessons can be viewed at http: //surf.eng.iastate.edu/efmd/main.html.

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