THE UNIVERSITY OF OKLAHOMA
GRADUATE COLLEGE

DESIGN AND IMPLEMENTATION OF AN
INTERNET BASED ONLINE KNOWLEDGE HUB
FOR STATICS AND DYNAMICS COURSE

A THESIS
SUBMITTED TO THE GRADUATE FACULTY
in partial fulfillment of the requirements for the
degree of
MASTER OF SCIENCE

By

YELLAMRAJU VIKAS
Norman, Oklahoma
2001
DESIGN AND IMPLEMENTATION OF AN
INTERNET BASED ONLINE KNOWLEDGE HUB
FOR STATICS AND DYNAMICS COURSE

A THESIS APPROVED FOR THE
SCHOOL OF INDUSTRIAL ENGINEERING

By

______________________________
Kurt Gramoll, Ph.D.

______________________________
Thomas L. Landers, Ph.D.

______________________________
Teri Reed Rhoads, Ph.D.
ACKNOWLEDGEMENTS

The quality and success of a Masters thesis research is greatly dependant on the motivation and direction provided by the thesis advisor. It has been my privilege to work under the guidance of Dr. Kurt Gramoll, who introduced me to the world of Internet based research. I wish to thank him for giving me an opportunity to work under him and explore the depths of multimedia. Thanks, Dr Gramoll for your patience, understanding, guidance and freedom given for completing this research. Thanks, for showing me the vision for multimedia and tapping the best out of me. I am extremely thankful to Dr Thomas Landers, Co-Chair and Dr. Teri Rhoads, committee member for their time, efforts and cooperation throughout the thesis. Thanks, for the guidance and the support.

To my family, Amma, Nanna and Vijju, without your constant support, encouragement and prayers from the other side of the globe this work would have been extremely difficult. I am very grateful to god for putting you people in my life. Your continued love, affection and prayers have been my pillars of support. I wish to thank the lord for giving me the right direction and guiding throughout my life.

I am grateful to all my colleagues in the Engineering Media Lab for their cooperation and help. I would like to thank Anupama and Sekhar for their guidance and support throughout my stay in U.S. Special thanks to Rose for being a great friend and sister and helping me at Norman. I wish to extend my heartfelt gratitude to all my friends who helped, guided and supported me and made my stay comfortable and enjoyable at the University of Oklahoma. I would also like to thank all my friends from Machilipatnam back home, as well as in USA for their support and encouragement.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>CONTENTS</th>
<th>PAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>iv</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>x</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>xi</td>
</tr>
<tr>
<td>ABSTRACT</td>
<td>xiv</td>
</tr>
<tr>
<td>CHAPTER 1</td>
<td></td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>1.1 Engine, Hub or Portal</td>
<td>4</td>
</tr>
<tr>
<td>1.2 Idea Behind the Research</td>
<td>5</td>
</tr>
<tr>
<td>1.3 Purpose of Thesis</td>
<td>5</td>
</tr>
<tr>
<td>1.4 Design and Implementation Issues</td>
<td>6</td>
</tr>
<tr>
<td>1.5 Laptop Program and Wireless Technology</td>
<td>8</td>
</tr>
<tr>
<td>1.6 Online Static’s and Dynamics Knowledge Hub</td>
<td>9</td>
</tr>
<tr>
<td>CHAPTER 2</td>
<td></td>
</tr>
<tr>
<td>LITERATURE SURVEY</td>
<td>11</td>
</tr>
<tr>
<td>2.1 Potential of e-Learning</td>
<td>11</td>
</tr>
<tr>
<td>2.2 Convergence of e-Learning and Knowledge Management</td>
<td>12</td>
</tr>
<tr>
<td>2.3 Eight Reasons Why e-Learning Works</td>
<td>13</td>
</tr>
<tr>
<td>2.4 E-learning Trends and Statistics</td>
<td>14</td>
</tr>
<tr>
<td>2.5 E-learning For Corporate Goals</td>
<td>16</td>
</tr>
<tr>
<td>2.6 Comments by Various Author’s on e-Learning Technologies</td>
<td>17</td>
</tr>
<tr>
<td>2.7 Comparison of Leading Course Management Software’s</td>
<td>18</td>
</tr>
<tr>
<td>2.8 Vision of the Project</td>
<td>20</td>
</tr>
<tr>
<td>CHAPTER 3</td>
<td></td>
</tr>
<tr>
<td>MULTIPLE CLASSES FOR AN ONLINE COURSE</td>
<td>22</td>
</tr>
<tr>
<td>3.1 Design of the Portal</td>
<td>22</td>
</tr>
</tbody>
</table>
3.2 Programming Languages

3.2.1 HTML

3.2.2 CGI-Perl Scripting

3.2.3 Perl-DBI

3.2.4 Database

3.2.5 SQL

3.2.6 ODBC

3.2.7 JavaScript

3.3 Multiple Online Classes

CHAPTER 4

ONLINE COURSE MATERIAL

4.1 CD-ROM Technology

4.2 Course Content through CD-ROM

4.3 Streaming Media Technology Analysis

4.3.1 Digital Video

4.3.2 Broadcasting Digital Video

4.3.3 Encoding or Digitizing the Video

4.4 Delivering Streaming Video

4.4.1 Capturing Video in Classroom

4.4.2 Compression Techniques and Video Format

4.4.3 Video Editing Software

4.4.4 Serving and Hosting Streaming Video

4.4.5 Implementation of the Streaming Videos

4.5 Engineering Utilities

4.6 Interaction Between Instructor and Students
CHAPTER 5

ONLINE CLASS MANAGEMENT

5.1 Course Page

5.2 Student Login Information

5.3 Editing Student Information and Accessing Grades

5.4 Problem Generation

5.5 Online Homework Assignments

5.5.1 Assignment Login Page

5.5.2 Assignment Questions Page

5.5.3 Assignment Solutions Page

5.5.4 Student Scores

5.6 Administrative Access to Questions and Solution Pages

5.7 Quizzes/Tests/Examples

CHAPTER 6

ONLINE COURSE MANAGEMENT

6.1 Administrative Login

6.2 Managing Student Information

6.3 Score Report and Log Information

6.4 Homework/Quiz/Tests Management System

6.5 Grade Distribution Management

6.6 Create/Edit Front Page

6.7 Feature for E-Mailing Students

6.8 Password Management

CHAPTER 7

EVALUATION AND FEEDBACK

7.1 Online Survey

7.2 Statistical Analysis
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.2.1</td>
<td>Percentage Response</td>
<td>109</td>
</tr>
<tr>
<td>7.2.2</td>
<td>Wilcoxon Signed Rank Test</td>
<td>112</td>
</tr>
<tr>
<td>8.1</td>
<td>Review of the Project</td>
<td>116</td>
</tr>
<tr>
<td>8.2</td>
<td>Specific Accomplishments of this Research</td>
<td>118</td>
</tr>
<tr>
<td>8.3</td>
<td>Recommendations for Improving Present System</td>
<td>120</td>
</tr>
<tr>
<td>8.3.1</td>
<td>Additional Courses</td>
<td>121</td>
</tr>
<tr>
<td>8.3.2</td>
<td>Random Generation of Problems</td>
<td>121</td>
</tr>
<tr>
<td>8.3.3</td>
<td>Flexibility of Choosing ‘e’ Choice Options</td>
<td>122</td>
</tr>
<tr>
<td>8.3.4</td>
<td>CD-ROM Extension</td>
<td>122</td>
</tr>
<tr>
<td>8.3.5</td>
<td>Course Content through Videos</td>
<td>123</td>
</tr>
<tr>
<td>8.3.6</td>
<td>Introducing Wireless Palmtops in Classes</td>
<td>123</td>
</tr>
<tr>
<td>8.3.7</td>
<td>Digital Signatures</td>
<td>124</td>
</tr>
<tr>
<td>8.3.8</td>
<td>Online Mentoring</td>
<td>125</td>
</tr>
<tr>
<td>8.3.9</td>
<td>Voice Component in e-Learning</td>
<td>125</td>
</tr>
<tr>
<td>8.3.10</td>
<td>Future Assessment and Evaluation</td>
<td>125</td>
</tr>
</tbody>
</table>

REFERENCES........................................................................... 127

APPENDICES........................................................................... 131

APPENDIX A List of all Perl Files................................. 132
APPENDIX B Relationship Diagram for Databases........ 133
APPENDIX C Standard Parameters for Compressing
Movie in Media Cleaner 4.0.......................... 134
APPENDIX D HTML Script for a Question Problem....... 135
APPENDIX E Perl Script to Display Questions/
<table>
<thead>
<tr>
<th>Appendix</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>APPENDIX F</td>
<td>Perl Script to Accept Student Submission and Perform Grading</td>
<td>161</td>
</tr>
<tr>
<td>APPENDIX G</td>
<td>Perl Script for Executing Score Report</td>
<td>169</td>
</tr>
<tr>
<td>APPENDIX H</td>
<td>Perl Script for e-mailing Students</td>
<td>178</td>
</tr>
<tr>
<td>APPENDIX I</td>
<td>Online Survey Document</td>
<td>180</td>
</tr>
<tr>
<td>APPENDIX J</td>
<td>Percentages of Student Response for Online Survey</td>
<td>189</td>
</tr>
<tr>
<td>APPENDIX K</td>
<td>Wilcoxon Signed Rank Test</td>
<td>197</td>
</tr>
</tbody>
</table>
## LIST OF TABLES

<table>
<thead>
<tr>
<th>TABLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1 How people learn</td>
<td>13</td>
</tr>
<tr>
<td>2.2 Analysis of impact of e-learning in educational institutions</td>
<td>15</td>
</tr>
<tr>
<td>2.3 Various commercial online course tools</td>
<td>19</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>PAGE</td>
</tr>
<tr>
<td>-----------------</td>
<td>------</td>
</tr>
<tr>
<td>3.1 Dynamics Course Website</td>
<td>23</td>
</tr>
<tr>
<td>3.2 Navigation Menu Bar</td>
<td>28</td>
</tr>
<tr>
<td>3.3 Instructor Login Set Up Page</td>
<td>29</td>
</tr>
<tr>
<td>3.4 Key Set Up Page</td>
<td>30</td>
</tr>
<tr>
<td>3.5 Login Error Page</td>
<td>31</td>
</tr>
<tr>
<td>4.1 Main menu of Multimedia Engineering Dynamics course CD</td>
<td>35</td>
</tr>
<tr>
<td>4.2 Concept Page in CD-ROM</td>
<td>36</td>
</tr>
<tr>
<td>4.3 Simulation Page in CD-ROM</td>
<td>37</td>
</tr>
<tr>
<td>4.4 Video Lecture Schedule</td>
<td>52</td>
</tr>
<tr>
<td>4.5 Video shot of a topic in the course</td>
<td>53</td>
</tr>
<tr>
<td>4.6 Snapshot of the video lecture</td>
<td>53</td>
</tr>
<tr>
<td>4.7 Utilities page for solving engineering problems</td>
<td>55</td>
</tr>
<tr>
<td>4.8 Structural Analysis Module</td>
<td>56</td>
</tr>
<tr>
<td>4.9 Web-Board for posting questions</td>
<td>58</td>
</tr>
<tr>
<td>4.10 Drawing Board Tool</td>
<td>59</td>
</tr>
<tr>
<td>5.1 Main Course Web Page</td>
<td>61</td>
</tr>
<tr>
<td>5.2 Login Setup Page for Students</td>
<td>63</td>
</tr>
<tr>
<td>5.3 Login Setup Confirmation of student</td>
<td>64</td>
</tr>
<tr>
<td>5.4 Login Setup Error Page</td>
<td>64</td>
</tr>
</tbody>
</table>
ABSTRACT

The Internet has revolutionized the way information and knowledge is shared and used. It is nowhere more evident than in e-based education systems. Online courses and web-based learning management systems are important breakthroughs for students, cost-conscious instructors and education institutions. With rapid technological changes and shift in educational practices, the education system is challenged with providing increased educational opportunities, and generating a process of lifelong learning. Web based learning essentially uses special capabilities of the Internet to reinvent the way that people learn. However the implementation of such medium has been difficult because of lack of proper organization and administration by education institutions. This thesis presents an innovative way of delivering course content over the Internet so that any instructor can have access to the material and implement it in the course.

The work described in this thesis involves the development, and implementation of a scalable system which connects different kinds of resources, and has an integrated system wherein any instructor can personally set up the class, manage the set of students and administer testing and evaluation methods for engineering courses. But unlike similar web systems like Course Tools (WebCT) or Blackboard, this system includes content so that the instructor does not have to develop his or her problems. The system has already been used at the University of Oklahoma in both Dynamics and Statics courses. All students in these courses have their own personal laptop computers, are connected to the Internet through a wireless network, and have access to the course CD-ROM. The system developed gives an opportunity to instructors to set up their own internet class where students can view the lectures online, learn from course material, receive
homework, and complete tests. Each class is independent of the other classes thereby giving different instructors the opportunity to use the system and manage their classes. All information related to instructors and students is stored in an online database. Data is retrieved from the database when requested from the user. A dynamic web page is then created based upon such requests and sent to the user’s browser. Instructors use a common pool of questions in a database library to set up homework assignments. The system then records and stores the information sent by users and grades the responses.

Each instructor has administrative control over his class wherein they can add or delete student accounts, manage student information, manage assignments (homework, quizzes and tests), view score reports, and e-mail students. The system has security features that ensure access to certain administrative pages by the instructor while access is denied to students. The scalable system can handle large numbers of students, instructors and courses and the benefits include instant access to all course material, quick feedback of homework and quizzes, access to course lectures and customized content pages. The purpose of the thesis is to present a viable alternative to traditional training by developing a tool that can be used most effectively to leverage the instructor’s time and energy so that they can spend time doing things that add value to the learning process.
CHAPTER 1

INTRODUCTION

The power of technology is changing the way people learn. E-Commerce, e-mail, e-business and e-learning are no longer mere buzzwords, but part of our daily lives. The Internet is everywhere, and just as it is changing the way people buy books, trade stocks and communicate with each other, it is also revolutionizing the way people learn and get trained at different levels. E-learning, also known as online learning or web based training (WBT), is a computer based distance learning system that is continuously growing past traditional boundaries to encompass new methods and technology to help people learn. E-learning education is an alternative to traditional learning methods, which involves students getting education and knowledge from instructors in an educational institution. The traditional classroom learning system although used for a long time has limitations. These limitations include knowledge sharing with a limited number of people, physical presence of students required in classes and non flexibility in learning information when required. The rapid development of computers and internet has enabled sharing of knowledge and education with many people at the same time without physical boundaries. Information can now be accessible to anyone in the world at the same time and students can have access to knowledge without having to be present physically in a classroom. E-learning is not only being used in educational institutions, but also at corporate level, where many companies are using online training material to educate their employees.

According to Bill Wilken, publisher of Online Learning magazine (Wilken 2000), e-learning will never completely replace instructor-led training, but it will continue to
have a major impact on the overall training industry and will not only be used for online classes, but for virtual collaborations, knowledge management and other types such as data sharing, performance support and job aids. John Chamber’s, CEO of Cisco Systems (www.cisco.com) states that e-learning is the next big killer application and will determine an organization’s success and competitive advantage. Chamber’s believes that e-learning will offer numerous opportunities to learn new skills and exercise new roles and wouldn’t eliminate face-to-face education, but enhance it. He states that classrooms will change, but won’t go away, as classrooms are indeed one important place where students get their information and training.

E-learning has deep roots in educational institutions where the process of distance education and learning process started. Earlier distance education involved students receiving course material via surface mail and instructors used various mediums to communicate with their students who were offsite. But with the development of Internet, networks and multimedia the task of delivering content and knowledge has become much easier. Students now receive information quickly and have instant access to knowledge on their computers through internet. Computers and internet have revolutionized the way information is accessible to people and given a new meaning to distance education.

The most promising feature of multimedia and network-based media is its ability to interactively display complex information or concepts in an accessible and easy-to-understand animated graphical form. One of the more difficult issues to deal within the engineering curriculum, especially at the introductory levels, is the process of abstraction of real and practical situations into mathematical models. An engineering curriculum is filled with analysis courses, where the focus is invariably on the analysis of completely
determined homework problems that represent some implied abstraction from reality (and for which a "unique" answer is available in the back of the book). Due to the rapid technological development, the curriculum is under continual compaction as new topics are added and older material is edged out to maintain a nominal 4-year program. One of the earliest casualties in this process has been the application of engineering principles to practical problems through the mechanism of realistic homework problems, homework and tutorial sessions, project labs, and the like. The result is having engineering graduates with impressive analytical skills, but with little or no understanding of how to apply these skills in an effective manner to solve problems.

Multimedia and network based media technologies have the potential of providing a mean for dealing with these issues in a dynamic, provocative and likely cost-effective manner that not only will increase the effectiveness of the educational program but will also increase the quality of the resulting students (Brooks 1997). Using the new technology features, a dynamic web-based education is required that would cater to the needs of engineering students. A web based online knowledge hub is required that delivers content, course material and interactive simulations that would enrich the learning experience of engineering students. Thus this research thesis was undertaken at University of Oklahoma, Norman to create an online internet based education system in statics and dynamics courses. This thesis report illustrates the various techniques employed in delivering engineering statics and dynamics courses through the use of internet and multimedia tools.
1.1 Engine, Hub or Portal

Rapid development of internet technology and networks has caused tremendous growth in e-learning especially in engineering education. There has been a tremendous spurge in internet sites and search engines. Today one needs a search engine just to search engines and the web-based information craze has spawned a new breed of hubs and portals that specialize in everything from gardening to training dogs. Delivering engineering education through various portals has continually increased over past few years. Various types of internet sites are available and among them is the knowledge hub, a one-stop shop that is said to be the next step for web-based learning. According to Howard Marks, CEO of Yipinet LLC (Fister 2000), a web-based continuing education Company in California “A knowledge hub is a online destination where you can fulfill all your knowledge needs”. Knowledge hub, portals and search engines are similar, but each has a unique characteristics.

A search engine is a software that searches for data based on user request and criteria and may not exactly be a web-based one. The “find” feature in Microsoft word is a type of a search engine. A portal is an entry point to the Internet and may contain search engines and other specific information on specific topics. Sites like Yahoo.com or MSN.com can be classified as portals. Generally a portal can be a gateway to a knowledge hub. A hub is a destination on the web catering to specific audience. Examples like Amazon.com, is a hub for shoppers, Pets.com for pet owners. A knowledge hub is an Internet based learning community that caters to specific audience where one can find courses, get access to Instructors and peers and access and share
knowledge. Knowledge hubs are also known as learning portals and are generally custom built to cater to a certain audience.

1.2 Idea Behind the Research

To create an Internet based knowledge hub that will give an opportunity to present engineering curriculum in an effective manner using multimedia and network based technologies. However, electronic media has its own set of problems and difficulties. The design and implementation of the hub needs to be such that it gives best results and is cost and time efficient as well as scalable and reliable. It should also deliver material that will be beneficial for students to learn. Currently, there are commercial web course software tools that help instructors prepare online courses but most of these companies focus on developing a system that fits a wide variety of disciplines and lacks content. Software companies like Blackboard and World Wide Web Course Tools (WebCT), etc, have good course sites but do not provide actual content. Due to the lack of content for engineering education it was proposed for this thesis to develop and create an online system that will cater to multiple instructors as well as provide content for delivering engineering classes. A comprehensive Internet based knowledge hub was therefore designed and developed in the Engineering Media Lab at the University of Oklahoma, Norman.

1.3 Purpose of Thesis

The primary purpose of this thesis is to focus on examining the design and implementation of an Internet hub and all the different types of electronic media used to develop an online statics and dynamics course. Many of the presently available Internet
portals lack in visualization and presentation material for engineering courses. Apart from lack of proper content, these sites also have less visually appealing graphics. There is also dearth in having collaborative tools for people to interact and communicate engineering problems. The thesis will address to overcome these drawbacks by developing an online course on the web that gives students engineering problem that are easy to understand, solve and have appealing graphics. The web-based system will have all of the electronic media made accessible through the main course page of the instructor, except the basic course theory, which is made available separately on the course CD-ROM (currently being converted to the web). This thesis research paper will give the reader an overview of a typical online course used for students on and off the campus, without the option of a classroom, and traditional teaching methods. The paper will address design of the knowledge hub, the architecture designed and developed to make the online courses and its contents, namely lectures, discussion groups, course management, quizzes, and homework. It gives an overview of the different techniques and methods used to make the hub truly online and, explain the architecture used to allow instructor’s to set up multiple classes.

1.4 Design and Implementation Issues

Statics and dynamics require clear understanding of the fundamentals and involves rigorous problem solving ability. The basic issue was to determine the structure of the system such that course content could be delivered explaining the fundamentals clearly and learning process simplified for students. A system was required such that numerous instructors could setup their own classes and teach students. This requires
personalized information and course content for each instructor. It also requires that web pages be created dynamically to cater to individual user needs. In order to create dynamic web pages scripting languages needed to be implemented and in the case of this hub, if server-based scripting is used, then the programming of the problem database, and online homework management must be developed. Second a database system must be implemented to store all the instructor and student information and keep track of all data and user requests. A system would be required so that the scripts, database information and the web pages could interact and web pages dynamically created based on user request.

The whole process of creating such system would take 1-2 years and involves conceptualizing, designing, constructing, coding, testing and implementing. Therefore the work was divided into two phases, wherein the first phase involved in developing the hub to work for a single instructor for a single course. Thus, one professor was able to use the portal and set up the class and manage a single class. The second phase involved in creating architecture that is scalable and can work for multiple professors and multiple classes. This allowed instructor to setup and manage the content for his or her class.

For each instructor to have personalized pages, the web pages cannot be static. Web pages based on user request need to be created dynamically using coding and scripting. All information and data is required to be stored and retrieved from a database. Content is required to be displayed and used by the professors for homework and quizzes and should be in electronic format. This is not just a simple scanning problems from existing notes or old tests, but constructing the problems from scratch using a computer drawing or CAD program. Other types of media such as lectures and discussion groups
need to be added to the website. The lectures should be digitized video of the actual class lecture and this process is not as simple as running them through a computer. A number of important factors must be met in order to produce a high quality video with useful content, which is outlined in a later chapter. Also, discussion groups using electronic bulletin boards have to be used, to allow students, teaching assistants and instructors to post and answer questions during normal working hours and in the evenings.

1.5 Laptop Program and Wireless Technology

The College of Engineering at the University of Oklahoma, implemented a laptop program in 1998, wherein all students are required to use laptops for their coursework. Hence, the knowledge hub was designed to cater to the needs of the students at the University that have laptops. The University is encouraging the students and the instructors to make use of multimedia-based courseware to maximize the usefulness of the laptops. By providing the course content and assignments over the Internet, students have the opportunity to learn from anywhere on campus. They are not required to be present in the traditional class and listen to lectures. This thesis focuses in bringing the statics and dynamics courses online such that any student has access to lectures, assignments and instructor through the laptop.

A radio-frequency (RF) wireless network connection using Transmission Control Protocol/Internet Protocol (TCP/IP) is being used in conjunction with the laptop program to facilitate students to have access to internet from anywhere in the campus. This program has greatly motivated research in the use of electronic media and internet for creating a better learning environment due to the ease of use and the universal use of
computers in all courses. Furthermore, the RF wireless has a higher data transmission rate (200-300 Kbps) than traditional infrared or modem-based connections, which helps in delivering multimedia applications over the network and minimizes the problems of a low bandwidth connection. The wireless program provides high-speed instant connection anywhere and anytime within a broad campus area and is more stable compared to modem connection. As explained later, the hub was designed not only to cater to high speed broadband connections but also to students with modem connections.

1.6 Online Static’s and Dynamics Knowledge Hub

The basic design of the hub is so any instructor can setup their own class for a static’s and dynamics class. It has no installation requirement, no setup costs, and requires no content development. The services of the hub are completely free, like e-mail service at Yahoo where one just enters and starts using it. In the hub, students of each instructor click on their instructor’s link and are directed to the class web page. All students view the lectures online, access homework or quizzes at the designated time and submit the work through the internet. The instructor control their classes through the Internet by adding and deleting student account, managing assignments and student grades. Instructors have the ability to choose assignment problems from a database and manage the release dates.

In order for students to access the designated assignments they are required to enter their login name and password. Only students of that particular class are given access to the assignments. Once the students have access to the assignments, they solve and submit everything through the Internet. Considerable amount of time of the instructor’s is saved, as grading of assignments is done online and therefore they can
address specific problems of students through online discussion. The instructor can spend more time in delivering specific knowledge on individual basis rather than explaining general concepts to everyone.
CHAPTER 2
LITERATURE SURVEY

2.1 Potential of e-Learning

In the futuristic action thriller movie, “The Matrix” there is a scene where the heroine is required to learn to fly a helicopter out of a jam. She calls the computer programmer, and with the touch of a button, he loads a helicopter flight program into her brain through an online computer. She instantly knows how to fly the helicopter and manages the task with ease. Such a learning method is far from reality, but it shows the potential of instant learning using online technologies. The main driving point behind this example is the growing potential of electronic learning and its impact in today’s life is immense.

According to Kevin Oakes, President and CEO of click2learn.com (click2learn.com), there has been immense growth of education industry, and education through e-learning is the only public sector until few years back that has not really revolutionized by technology as much as other sectors. He states that historically, education has been the one aspect of society that has remained virtually the same for hundreds of years. While corporations and government continue to jump on the Internet wave, the primary source of learning for people still is instructor-led classrooms. However now with the advent of Internet and online technologies, e-learning is changing how people learn.

The growth of e-learning is making most companies and institutions scramble on adopting e-learning tools. Many industries and educational institutions are trying to impart training and education through online classes and move away from traditional
classes. The general trend in the industry to train people quickly, efficiently and cheaply. This is the main reason e-learning is being favored over traditional classroom based education. The general factors that institutions look while implementing e-learning is content, services and delivery management. The learning hub or portal cater to particular needs of the organization and help them control and manage their web site, give access of courses to the users, track their performance and have good operability conditions.

The following sections illustrate the importance of e-learning and the various trends and technologies behind this initiative and various commercial tools available for institutions and organizations to impart education to their students.

2.2 Convergence of e-Learning and Knowledge Management

True pioneers of knowledge management state that knowledge lives with people and not with technology. In the apprenticeship model, an apprentice learns his craft by observing his master and these skills and then knowledge is passed on in the person by observing, doing and applying lessons. For ages, the traditional classroom method has been a good source for knowledge management and distribution of knowledge (Hillman 2000). Development of technology has played a key role in having an effective knowledge management practice, whereby there is sharing and collaboration of information through e-mails, document management systems, data warehouses, online collaboration, consulting services, skill development and coaching. This convergence of knowledge management and e-learning has been a revolutionary change and has led to sharing of intellectual property and helped in knowledge distribution and made learning an ongoing process.
If knowledge is imparted such that people have good view of things, then they can learn better. People learn more through seeing things and as per Table 2.1 where it states that 83 percent of the time people learn through sight. This is where e-learning rewards as an effective tool in delivering content and educating people.

<table>
<thead>
<tr>
<th></th>
<th>How people learn</th>
</tr>
</thead>
<tbody>
<tr>
<td>We learn:</td>
<td></td>
</tr>
<tr>
<td>1.0 % through taste</td>
<td></td>
</tr>
<tr>
<td>1.5 % through touch</td>
<td></td>
</tr>
<tr>
<td>3.5 % through smell</td>
<td></td>
</tr>
<tr>
<td>11 % through hearing</td>
<td></td>
</tr>
<tr>
<td>83 % through sight</td>
<td></td>
</tr>
</tbody>
</table>

Table 2.1 How people learn. (Adapted from Forum presentation: “The blended approach to e-learning: Practical Tips and Examples,” TechLearn 2000)

2.3 Eight Reasons Why e-Learning Works

1) **Inexpensive**: The cost of imparting e-learning is cheaper than learning the traditional way in a classroom. People aren’t required to travel and attend classes and this saves time and effort. The main cost is for developing the online system, which is offset later on when large and multiple number of people use the system.

2) **Convenient**: The ease of use and access of information from anywhere makes e-learning convenient. All information is available and accessible through the web anytime.

3) **Consistent**: E-learning program is consistent in content delivery since the same material is delivered to every recipient. With consistent knowledge available, everybody can work towards a common goal and learn the same material.
4) **Current**: The online courses can be updated anytime due to changes in the content or updating of technology and services. The information can be changed immediately and updated and made accessible to users.

5) **Specific**: E-learning provides enormous selection and can be organized according to the user’s demands. It can be tailored to audience and deliver specific information to the user.

6) **Self-paced**: The user can learn the information at their own pace. Due to time and work constraints, user can self-pace the learning process and choose to learn in small chunks of information.

7) **Private**: User can have access to specific information that is not accessible to other people. People can view material specific to their requirement and get information and results.

8) **Assessment and Feedback**: E-learning systems can keep track of user access and performance and give continuous feedback to enable better learning of the information. It also gives opportunity to correspond with peers and have sharing of information and knowledge.

2.4 **E-learning Trends and Statistics**

According to a 1999 study by Massachusetts-based International data Corporation (IDC), the online learning market is currently generating $600 million in annual receipts and will exceed $10 billion by 2002 and $11.5 billion by 2003. (FORTUNE On-Line Learning Supplement 1999). This statistic shows the expected growth in revenues over the years and the demand of online learning. A study made by Masie Center, a New York
based think tank, suggest that 92 percent of large organizations are implementing some form of online learning in their organization (FORTUNE On-Line Learning Supplement 1999). Almost half of the academic institutions in America are currently offering online learning as part of their curriculum and survey by IDC predicts that 85 percent of the schools will have some form of online learning in place by 2002. (FORTUNE On-Line Learning Supplement 1999). The design and development of the online knowledge hub is to reach to this section of the population and cater to the requirements of academic institutions and schools.

Studies indicate that learning occurs 50 percent faster online than in classroom settings and research by Stanford University indicate from the 15 years worth data that using technology in education is as effective and often more effective than Instructor led learning. (FORTUNE On-Line Learning Supplement 1999). An analysis of impact of e-learning in educational institutions is given in Table 2.2. These findings are based upon article published by PBS Study of Learning.

<table>
<thead>
<tr>
<th>Students attending brick and mortar higher education institutions</th>
<th>13 Million</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students taking higher education courses online</td>
<td>1 Million</td>
</tr>
<tr>
<td>Higher education institutions offering courses on the Internet</td>
<td>25 %</td>
</tr>
<tr>
<td>Expenditure on distance learning equipment in the U.S in 1997</td>
<td>$1 Billion</td>
</tr>
<tr>
<td>Post-secondary students who own personal computer</td>
<td>5.3 million</td>
</tr>
<tr>
<td>Students who obtain class assignments electronically</td>
<td>40 %</td>
</tr>
<tr>
<td>Institutions saying students resistance is an impediment to integrating technology into curricula</td>
<td>2 %</td>
</tr>
<tr>
<td>Institutions saying faculty resistance is an impediment</td>
<td>55 %</td>
</tr>
</tbody>
</table>

**Table 2.2** Analysis of impact of e-learning in educational institutions
Academic institutions are slowly realizing the importance of online education and impact of it on student’s learning. As stated in Table 2.2, only 2 percent of students are against integrating technology in curricula and 40 percent of students obtain assignments electronically. It is therefore important to make courses available to a larger number of students. The objective of the online knowledge hub is to enable more students have access to courses and content and enrich their learning experience.

2.5 **E-learning For Corporate Goals**

Balancing the need to infuse knowledge while satisfying the desire for on-demand training is critical for developing an effective e-learning strategy. E-learning is not only revolutionizing the way people learn at academic institutions but also in corporate organizations. In an effort to engage learners and accelerate learning, organizations are using technology and instructional design expertly to create highly potent self-instructional material.

Although organizations investing in e-learning technology seek to maximize their return on investments, individual employees don’t respond to the format. Training modules are designed such that there is skill enhancement as well as personal benefit to employees and the organizations. With the advent of adaptive learning and simulation training, the relevance of content is maximized for the individual and e-learning allows dynamic inclusion of job specific issues.

The general rationale for e-learning across the corporations is “access above all”. Best practice organizations are moving from perceptions of learning as a cost, to one of learning in order to maximize value. E-learning is seen as a key driver of e-culture,
because it has the greatest power to engage employees and to be part of an overall e-
business strategy and transformation.

2.6 Comments by Various Author’s on e-Learning Technologies

Tony Kotler (Kotler 2000, 46) in his article in e-learning magazine quotes that the
contest is not between e-learning and class-room based training which e-learning has
already won, but is between e-learning content, technology and service providers. The
success of web-based training at the expense of traditional classroom based training is the
result of simple fact that customers are convinced that web-based platform can deliver
training that is of equal or better quality at lower cost.

Havraniak (Havraniak 2001, 48) states that at first it appears e-learning doesn’t
promote social interaction (an essential aspect of learning), but upon careful scrutiny it
does. Student of a web-based learning is able to communicate with the instructor and
other classmates in virtual classrooms. He states that speaking is not crucial, but
communication is and writing can easily replace the spoken words.

Scott Pope (Pope 2001, 41) feels that in today’s knowledge based economy, the
velocity of information coupled with the ephemeral nature of technology renders
conventional training ineffective. He states that flexible, dynamic and adaptable, e-
learning has come a long way since the beginning of web-based training when it was
merely a poor substitute for classroom environment that had rudimentary media
capabilities and little activity.

Many educational institutions have begun to use electronic media to deliver the
course material online. Hillman, A. L. and Wells, D.M. (Hilman) mentioned the
implementation of online courses with WebCT at their university as a experimental project and since then they have started moving towards offering electronic courses. They were amazed with the positive feedback of the students and instructors concerning the online course they developed. Currently, the system is widely used by professors at many universities as a supplementary teaching tool.

Murray Goldberg (Goldberg), a senior instructor at the University of British Columbia and CEO of WebCT Inc., said that the online course system with the real time chat room helps students set up a networking with other students over the world. This statement supports the implementation of online chat room and message conferencing as useful for allowing students to interact among themselves and with the instructors.

Grading tests is a tedious process especially for instructors teaching large classes. Il-Hong Jung et al (LL-Hoang 1997) have developed a Multimedia quizzer that allows the instructors to post the quiz online and the student submission will be automatically graded. In addition, the quizzer will do an interpretation and analysis of student results, item analysis and test refinement, and report test results back to students. These evaluation features provide analysis for both Instructor and students, which is helpful in understanding the overall student performance in the class.

2.7 Comparison of Leading Course Management Software’s

Higher education is experiencing a growing demand for online learning. Reduced costs and increased functionality are allowing more and more academic decision makers to justify technology-mediated learning initiatives. One of the fastest growing areas in the technology mediated educational areas is the use of Internet by colleges and universities
to supplement face-to-face courses with online components and to deliver courses completely online. With the realization of long-term benefits of online learning, educational institutions are beginning to increase support and funding for online learning. Online delivery allows an institution to serve a larger population and to serve students better. Education institutions moving towards online education look for robust course management software that is easy to learn, use, flexible and rich in features for teaching. They look for system that can be easily installed and upgraded within minimum outside help.

There are various commercial software programs available for institutions to choose and administer in their academic programs. These programs are listed in table 2.3. This is a very small list of vendor’s as compared to actual available in the market.

<table>
<thead>
<tr>
<th>Blackboard</th>
<th>Convene</th>
</tr>
</thead>
<tbody>
<tr>
<td>Embanet</td>
<td>ECollege.com</td>
</tr>
<tr>
<td>IntraLearn</td>
<td>Symposium</td>
</tr>
<tr>
<td>Top Class</td>
<td>WebCT</td>
</tr>
<tr>
<td>The Learning Manager</td>
<td>WebMentor</td>
</tr>
<tr>
<td>Lotus Learning Space</td>
<td>Integrated Virtual learning Environment</td>
</tr>
<tr>
<td>Softarc FirstClass</td>
<td>LUVIT</td>
</tr>
<tr>
<td>Milken Educator Virtual Workspace</td>
<td>IMSeries</td>
</tr>
<tr>
<td>Asymetix Librarian</td>
<td>Serf</td>
</tr>
<tr>
<td>Virtual-U</td>
<td>Eduprise.com</td>
</tr>
<tr>
<td>Brainbench</td>
<td>DigitalThink Inc.</td>
</tr>
<tr>
<td>Educational Multimedia Corp.</td>
<td>EMind.com</td>
</tr>
<tr>
<td>KaplanCollege.com</td>
<td>KnowledgeNet</td>
</tr>
<tr>
<td>Technomedia training Inc.</td>
<td>THINQ</td>
</tr>
<tr>
<td>Trainseek.com</td>
<td>Vcampus Corp.</td>
</tr>
</tbody>
</table>

**Table 2.3:** Various commercial online course tools
BlackBoard, WebCT, DigitalThink etc are the most famous commercial software’s available in the market and widely being used at various universities. Even at University of Oklahoma various professors and departments are using these tools. These tools give the luxury for the instructor to set up their accounts and administer classes, but all have a definite drawback which is they lack content. After doing a thorough analysis of the software tools mentioned in Table 2.3, it was observed that all promise great features and tools, but offer very little or no content for the instructor to choose from. Most have tools such as course planning and management, online testing, grading and managing records, but the instructor is required to develop his or her own content for the class. The instructor is required to upload his PDF or Microsoft word file, which is then viewed by students. BlackBoard has content for certain courses, which is minimal as compared to the magnitude of their network. The content is of little help as it is accessible to students of a particular class only and the solutions to the problems are basically scanned images of the textbook. BlackBoard requires instructor to access course cartridges and download them and these content are created by publishing companies that prepare content in the form of books. WebCT has some content available, but only limited to certain topics and prepared by publishers. The content are not interactive since they are just some text and HTML files that lack appeal and graphics. In contrast, the system developed at University of Oklahoma, gives instructor’s direct access to content through video lectures and database of problems.
2.8 Vision of the Project

The vision of the project undertaken at the University of Oklahoma, Norman is to use the Internet to transform the way people learn and create a powerful environment for teaching and learning. With education becoming a dominant factor in the global scenario and rivaling commerce and communication, the idea is to develop a system that would continue bringing education online and set a standard in the education industry. The project creates tools and content that would enable instructors and students embrace online learning with confidence and seamlessly transfer the learning styles and techniques to the Internet from the classroom.

The next few chapters will give an overview of the various tools and techniques utilized to make education and knowledge accessible to all through use of online Internet technologies.
CHAPTER 3
MULTIPLE CLASSES FOR AN ONLINE COURSE

This chapter discusses the methods and techniques that were used for developing multiple classes for an online course. It enumerates the architecture used to build the online courses and discusses the programming languages used in delivering the content through web pages. It explains the system of setting up courses by individual instructors, and illustrates the security features involved in setting up these classes.

3.1 Design of the Portal

The basic design of the portal is such that any instructor can setup his/her own class for the courses in statics and dynamics through a web page on the Internet. The students of the particular instructor click on their instructor’s link and are directed to that course’s web page. Each instructor can have his/her own students view the lectures online, access homework/quizzes at the designated time and submit the work through the Internet. The portal has no installation requirements, no setup costs and requires no problem generation. It’s a true portal, similar to e-mail service at Yahoo where one just enters and starts using it, as the services are free.

The basic layout of web pages was designed in such a way that students can click on links and navigate through their class pages. The site can be accessed at http://www.eml.ou.edu. By clicking on eCourses link, the students are directed to another page giving them an option of choosing their course, currently only dynamics and statics. Upon clicking one of the course links, a script is executed that produces a web page wherein the left frame has a list of all current classes and right frame giving details of the
administrator (Figure 3.1). Students at this stage choose their respective instructor’s link and are directed to another page which is basically their class page wherein they follow lectures, have access to class information, view their homework, quizzes and tests problems and submit them.

Figure 3.1 Dynamics Course Website

3.2 Programming languages

In order to create web pages based on user request, Perl (Program Extraction and Report Language) was extensively used to deliver the web pages. HTML (Hyper Text Markup Language) is the basic code for building web pages and this was embedded into Perl for creating the web pages. All data required to be displayed and processed is stored in a database. Perl-DBI module is used to interact between the Perl and the database. Microsoft Access and Microsoft SQL-Database were used as the main databases. SQL (Sequential Query Language) is utilized and embedded into Perl to query information
from the database. A detailed discussion regarding Perl, Microsoft Access, SQL, Perl-DBI is explained to give an overview of the backend support in developing this architecture.

### 3.2.1 HTML

The World Wide Web (WWW) though originally designed for military is now widely used for e-learning and e-education. The WWW is an ever changing, kaleidoscopic collection of hundreds of millions of documents, all of which reside someplace on the Internet and are written in HTML (Elizabeth Castro, 2000). HTML is the most popular language used for building and publishing static documents on the web and show text, graphics, sound and video to the world. It has two essential features – hypertext and universality. Hypertext means that by creating a link on a web page you can access anything available on the internet and from different locations. Tim Berners-Lee (Wall 96), the creator of web wanted it to work more like a person’s brain and less like a static source of data, such as a book. Universality means that HTML documents can be saved as ASCII or Text Only format, so that virtually any computer can read the web page. HTML can be created either using a text editor or visual HTML editors such as Macromedia Dreamweaver, Symantec Visual Page or Microsoft Front Page. Macromedia Dreamweaver was extensively used for the development of this portal and its contents. All questions for assignments were developed using the same editing tool.

### 3.2.2 CGI-Perl Scripting

In a complicated Internet-based framework developed, not only client-side interactivity was required, but also server-side programs are required to allow the user to
exchange data with the server. The entire on-line system took advantage of CGI (Common Gateway Interface) scripting which is a server-based means of transferring data between a server and a client. In the online system developed, Perl programming language was used for the CGI scripts. Perl is an interpreted language mainly used for managing specified text files, taking information from those text files, and printing reports. Perl scripts allow the user to submit data via a homework, quiz, or test page to be processed on the server. The processed results are then posted through Perl scripts back to the client.

A complex backbone of Perl scripts allows the system to interact with the user and the system database. Perl obtains data from HTML form pages, processes it and then sends the results back to the user. The scripts store information into a database and upon request retrieve information from the database using SQL commands and process it at the server. The scripts then display the information back to the user. Perl scripts are responsible for the entire course management for the system developed.

For the online classes, Perl scripts “dynamically” create web pages through code rather than through links to existing HTML documents. There are no static HTML pages existing anywhere in the system. All web pages are created based on user request. Information retrieved from database is displayed on these dynamic web pages. Dynamic web pages eliminate the necessity of having thousands of HTML pages and static data. A list of all Perl files is given in Appendix A.
3.2.3 Perl-DBI

DBI is the standard database interface for the Perl programming language. It is database independent and works with any database such as Oracle, Sybase, Informix, Access, etc. It provides a unified interface for accessing data stored within database systems and allows Perl code access data without needing to worry about database or platform specific issues. Since Perl processes textual information and databases primarily store textual information, Perl-DBI forms a good choice for database programming, accessing information and processing it.

3.2.4 Database

Microsoft Access Database was the primary database used for storing user, class, instructor and course information. Information is stored in tables and these tables contain specific information regarding the entities. A relationship diagram between various tables is shown in Appendix B. Data is either stored into these tables or retrieved from them to be processed by Perl and shown on web pages.

3.2.5 SQL

Structure Query Language (SQL) allows users to access data in relational database management systems, such as Oracle, Sybase, Informix, Microsoft SQL Server, Access, and others, by allowing users to describe the data they wish to see. SQL statements are used to insert, update or retrieve data from a table in the database.
3.2.6 ODBC

Open Data Base Connectivity (ODBC) is an Application Programming Interface (API) that allows abstracting a program from a database. When writing code to interact with a database, usually one has to add code that talks to a particular database using a proprietary language. If one wants a program to talk to an Access or Oracle databases one has to code the program with different database languages. This can be a daunting task. ODBC relieves this problem by connecting the code with the database. The ODBC Manager figures out how to contend with the type of database that is being targeted. Regardless of the database type being used, all of the calls are to the ODBC API. Since the online system uses a Microsoft Access database, Perl extension module Win32::ODBC is used to access the ODBC API.

3.2.7 JavaScript

Another programming language developed by Netscape and SUN Systems to build interactive web pages is known as JavaScript. It is a cross platform language, which is written as a part of HTML document and thus converts a static web page into a dynamic and fully interactive web page with a real time response (Goodman, 1998). JavaScript is usually used for building mathematical interactive tools on the web page. The browser software interprets the JavaScript commands and statements from the text files in the same way as it interprets HTML tags.
3.3 Multiple Online Classes

In order for students to view their class course page, the instructor must create the class in the system. As soon as the instructor creates the class, a link is created that students use to access their class pages. The instructor can set up classes by using the link Set Up New Course on the web page (Figure 3.2).

![Navigation Menu Bar](image)

**Figure 3.2** Navigation Menu Bar
Figure 3.3 Instructor Login Set Up Page

A login set up page is created dynamically wherein the instructor is required to fill all the information stated on the web page (Figure 3.3). Prior to setting up the class, the instructor is required to contact the administrator for a key number. This key number serves as a security check to deny unauthorized access to others (such as students) to set up courses.

The key number is actually randomly generated by administrator and stored in the database and communicated to the instructor. The administrator allocates the key number through another web page to which only he or she has access. As shown in Figure 3.4 the
administrator enters a key number and information gets stored in the database. A unique identification number known as web number is also generated by the script and is stored in the database along with key number.

![Figure 3.4 Key Set Up Page](image)

When the instructor enters the key number along with other information in login set up page, all the information is stored in the database and the unique web number corresponding to the key number is assigned to the instructor. This web number is the basic identification of the instructor and his or her course. Since instructors with the same name can teach multiple courses, this web number serves the purpose of uniquely identifying the instructor and the course taught. The instructor is required to fill in a Login Name and a Password in the Login Set up page and these serve as access code to instructor’s course administration pages. A detailed discussion about course administration pages is discussed later. The information sent by instructor through the
login set up page is processed to check for empty spaces, improper login and passwords and for the key number. If information doesn’t correspond to the requirements or if permission to set up course is denied an error page (Figure 3.5) shows up.

![Login Error]

**Figure 3.5 Login Error Page**

Upon successful completion of login set up, a verification page gives all the details entered by the instructor and confirms the set up of the course. During this set up process a folder is also created on the server with the instructor’s web number as its name. This unique folder contains all log information of the students, GIF images of the questions and text files related to the instructor. A detailed discussion about this folder and it’s content is described later.

Students of each class are required to enter their login number and password to access, view and submit assignments. Permission to view web pages by unauthorized people is denied. A detailed discussion about student login and security features is described in later chapter. Since students have access to their classes only, it is truly independent of other classes and therefore multiple classes can be created, thereby giving an opportunity for innumerable instructors to set up their classes. The system is so designed that additional courses such as Strength of Materials, Fluid Dynamics, etc. can
be added along with the existing courses. The Perl Scripts are so designed that minimum
effort would be required to add additional constraints to facilitate the addition of new
topics for e-Courses.
CHAPTER 4

ONLINE COURSE MATERIAL

This chapter discusses the resources that were used to deliver information online over the web for the statics and dynamic courses. It enumerates the technologies that were used for delivering course material to the students. All course material is available to students through the web pages except the course content, which was made available through a CD-ROM (currently being converted to the web). Lectures are accessible to students through the course web site and a detailed discussion about capturing, editing and streaming the video lectures is explained in this section. An overview of different utilities useful to students for solving problems is discussed and an online messaging system known as “web board” is also enumerated in this section where students have virtual contact through Internet with the instructor and others.

4.1 CD-ROM Technology

The market for Multimedia and CD-ROM are both undergoing tremendous growth, and the expansion of each is having a direct impact upon the other. The increasing demand for multimedia titles is fueling sales of CD-ROM’s and is making CD-ROM’s an attractive delivery platform for multimedia developers. CD-ROM is certainly not the only delivery platform for multimedia titles; however, its high-storage capacity and cost advantages are making it an attractive delivery platform in the consumer and education markets.

Floppy disk, videodisc, and networks are all multimedia delivery platforms with their own advantages and disadvantages. Floppy disks often are used to distribute smaller
titles or to transport corporate presentations and provide the advantage of a huge installed base of floppy disk drives. The disadvantages include far less storage capacity than CD-ROM and a higher cost per disk. Videodisc is popular delivery platform for movies in the home market and for educational titles requiring high-quality video output. However, use of CD-ROM’s is growing at a far faster rate than videodisc in schools and universities because of the large installed CD-ROM bases. Local and wide area networks are attractive vehicles for the distribution of some multimedia business applications; however, robust network infrastructures must be put in place before networks become a preferred delivery platform for multimedia content.

CD-ROM technology is used increasingly for educational purposes. Its advantages over standard textbooks are multiple. First, the information contained in several large texts can be stored on a single disk and they are small and light enough to be carried in a pocket. In addition, instructional material contained on a CD-ROM disk can make use of the computer's multi-media capabilities, including animated diagrams, video, and sound. Also, material on a CD-ROM is often searchable, allowing the user to locate desired instructional sections quickly. Finally, material on a CD-ROM disk can be interactive, allowing the learner to practice using the material in simulations or testing situations. The computer can thus give the learner feedback on the degree of mastery of the material, enhancing further study.

The major objection to CD-ROM has been poor performance and lack of an installed base. Both of these objections are being dispelled with the introduction of drives at lower prices and the rapid growth in the installed base. CD-ROM is expected to continue its strong growth as the multimedia delivery vehicle of choice during the next
three to four years with the recent introductions of triple- and quadruple-speed drives.

Primarily the home market drives the growth in CD-ROM for multimedia, as more personal computers in the home have CD-ROM drives and as multimedia applications become more appealing. Growth is also expected to be strong in the education market, as CD-ROM offers a less expensive alternative to videodisc and networks. There is also a growing convergence between on-line services and CD-ROM publishing, with multimedia CD-ROMs providing easy access to reference data, and on-line services providing the latest real-time news, prices, or other current information about a product or service.

4.2 Course Content through CD-ROM

Although the online course web site developed has homework’s, quizzes, tests, syllabus, utilities, and lectures-on-demand, the students need core theory and examples. For each course of statics and dynamics, instead of using the regular textbook, the theory and examples are delivered to the student on an interactive multimedia CD-ROM developed by Engineered Multimedia Inc and authored by Gramoll et al (Gramoll 97). Students are required to purchase the course CD-ROM, each costing approximately $30. The CD-ROM is cheaper than a standard textbook with just text and diagrams. The CD-ROM, which is presented in a case study approach, contains all relevant theory for statics and dynamics courses. Each major topic is introduced through the use of a typical engineering problem. Each case is fully worked out and supported by the appropriate theory. Case-based learning has a number of benefits, such as the ability to hold a
student's attention and provide an application for abstract fundamental concepts [Flori R.E., 1997, 61-67].

The CD-ROM contains topics in the form of cases, each illustrating a specific concept that required to be conveyed to the student. The main menu of the dynamics CD-ROM is shown in Figure 4.1. Each case or example is presented in four parts: Introduction, Theory, Solution, and Simulation. Each part incorporates graphics, audio components, animations, videos, and hypertext.

![Figure 4.1 Main menu of Multimedia Engineering Dynamics course CD](image-url)
The first part introduces a problem to the user. The second part presents specific concepts that are required to solve the problem (Figure 4.2). The third part actually walks through the solution. The fourth part allows the student to experiment with a computer-generated simulation that explores the parameters of the problem.

Figure 4.2 Concept Page in CD-ROM
The simulation, as shown in Figure 4.3, allows students to change a few parameters of the problem and view the results instantaneously. The CD-ROM has efficiently made use of multimedia capability in presenting engineering ideas. The use of 3D animations, simulations, sounds, and interactivity help increase the excitement of the learning experience. Reference materials for engineering courses are also accessible through the appendices.

Due to the large amount of material on the CD-ROM, it is difficult to place it on the web because the download times for the animations are too large. However, by making the main course content available on the CD, the students are able to access the course material even if they were not connected to the Internet. The CD serves the same...
purpose in the course as a textbook in a traditional classroom oriented course, in that it presents the main source of theory and examples. The students enjoyed learning from the CD and were not limited to only textbooks, but had opportunity to explore the world of statics and dynamics.

4.3 Streaming Media Technology Analysis

Streaming refers to synchronized video, audio, graphics, and animations sent over Internet or over networks, where personal computers play the media streams directly, without having to first download the entire file. Successful delivery of multimedia in a large array of educational settings has witnessed an explosive growth and has had impact on distance learning education with the emergence of the web. In light to what constitutes effective engineering teaching, the lecture falls short as the student listens to lecture only one time in a traditional teaching class. But the video lectures can be viewed as many times as required to learn and understand the content. As an instructional technology, streaming media in the form of videos is an important delivery method in engineering education.

4.3.1 Digital Video

The simplest definition of digital video is the representation or encoding of an analog video signal in digital bits for storage, transmission and display. At the end of 1998, networked digital video was a work in progress. Digital video files could be created, shared and stored but not in the robust, transparent manner that computer users expect and receive for other applications. Digital video client/server systems supported
modest implementations but did not scale to adequately support high-bandwidth traffic or
shared services among multiple locations. Moving files from one system to another
required re-encoding of videos, or at the very least, re-authoring of web pages providing
access to the videos. File format support required specific encoder systems and decoders
at the user end. But with the development of video, Internet and streaming technologies
over the years today end user’s are able to view videos much clearer and are able to
download videos at a faster rate. Good networks and storage devices are ensuring better
deliverance of videos over the Internet.

Digital video touches every aspect of the teaching and learning process in higher
education, from the classroom, to the library and lab, and to the student dormitory.
Instructors are incorporating more graphical and visual elements into their digital course
materials, sometimes delivering them simultaneously to students both in classroom and at
remote locations. Libraries are digitizing images for archival storage and video-on-
demand services and collaborative groups are depending on video conferencing for
internet-based communication, teaching, and exchange of information. With the
simultaneous development of video conferencing technology and Internet there has been
an enormous implications for engineering education, especially distance learning. Using
synchronized streaming media, educators are able to send interactive multimedia
presentations to students anywhere in the world, in real time.

4.3.2 Broadcasting Digital Video

Broadcasting Digital Video encompasses both live broadcast and video-on-
demand. Live broadcast works similarly to current television news broadcasting. Content
is captured live and transmitted to a user who is watching passively from a box located anywhere. With video-on-demand, the content has been created and uploaded so that the user can choose when he or she is going to view it. While similar, the methods for creating live broadcast versus video-on-demand have some differences. Both require the same equipment: a camera, a computer with a large hard disk storage, a high-speed connection, and an end user. Live broadcast content is captured on-camera and dumped onto a server and simultaneously it is then encoded into a readable format (MPEG2, Real, QuickTime 4) and then transmitted over a network to be viewed by end user. With video-on-demand, the content is recorded, then captured (i.e. stored into a computer), processed using software like Adobe Premiere, Apple iMovie, MediaCleaner and then encoded and finally played over the network when the requested by the user.

Within these two types of broadcasting are the two ways of receiving the media namely streaming and non-streaming. Streaming technology is the single most important Internet technology to be developed in the past few years. Streaming media, which can include audio, video, animations, and scrolling text, begins playback of the media on the client computer as soon as enough of the video has loaded to begin and sustain playback at a continuous rate. Cache is established from Random Access Memory (RAM) on the client desktop and is used to receive the file, insure that frames are in the correct order, establish timing, refresh compressed frames and check for dropped packets. The video file continues to download into the client cache even as the beginning of the video is being viewed. By comparison, non-streaming media files download completely before they begin to play and are usually stashed on the user’s hard drive. Streaming videos may be served as multicast or unicast streams. Video-on-demand generally refers to unicast,
where a single video file is requested by a user and streamed to the user's computer for playback. Multicast involves transmission of a single digital video file to multiple users in a scheduled environment.

4.3.3 Encoding or Digitizing the Video

Encoding is a simple concept in which the analog video signal is encoded, or represented, in digital bits that can be read and operated upon by a computer processor. All digital files whether a textual document, an image, a program, or a video are representations of information in bits.

One meaningful element in graphical digital media is the pixel, or picture element, which is a two-dimensional base unit of programmable color, also represented in bits. A pixel is a logical element, so that its representation can vary based on factors such as bit depth and screen resolution. The color expressed by a pixel is a blend of some component of the red, green or blue color spectrum. The human eye has photoreceptor cone cells that respond to color in the three spectra, so three mathematical representations of color namely red, green, and blue are all that are needed for digital color reproduction. Like all other digital information, bits represent colors. More bits (8-bit, 16-bit, 24-bit, etc.) allow more precise definition of the exact blend or hue from the red, green, blue color spectrum. Analog colors are translated to pixels in the RGB digital color space. Digital video uses a non-linear variation of RGB called YCbCr, where Cb represents luminance, or brightness, and Cr represents chrominance (chromaticity), or "pure" color, in the absence of brightness. The number of pixels displayed on a computer screen, along the horizontal axis and the vertical axis, is defined as the spatial resolution.
Video is more than color, however. Video requires multiple frames showing redundant information and fractional changes to create the illusion of motion across time and space. At some point in childhood, one would have probably duplicated the illusion of motion by drawing stick figures on cards and flipping them to create a "cartoon." The more redundancy between frames, the smaller the changes from one frame to the next, the smoother and more continuous the illusion of motion on your television or movie screen. Video encoding algorithms take advantage of this redundancy to compress video, encoding only the difference between frames. This process is known as temporal compression.

In order to process the recorded information a video-encoding card is required that accepts analog inputs from a video camera and converts the analog format into a digital video file. Encoding hardware and software vary in cost and therefore support a wide range of functionalities, including, as the cost increases, higher quality output, separate input for video and audio, faster encoding, multiple file and batch file processing. At the present time various range of encoding formats are available, including M-JPEG, MPEG-1, editable MPEG, MPEG-2, Video for Windows/ActiveMovie, and QuickTime.

In the past few years, digital video cameras have become available, in commercial and consumer-quality models. Digital video cameras are being commonly used for shooting videos and recording educational material. With the prices of these cameras being affordable, more and more Instructor’s are relying on them in delivering their content. With the development of video technology there has been an influx of various
video-editing packages. Video editing packages allows to make changes to digital video, such as adding credits or special effects, cutting or adding frames, merging digital video clips, and outputting the created movie to a range of digital file formats. Through the use of incorporated software or plug-ins, these packages allow for playback in a variety of ways. These packages such as Adobe Premiere, Media Cleaner 4 not only allow downloading the videos from digital video cameras and processing them but also help in compression. Compression reduces redundant information so that meaning is not lost but file sizes are reduced to manageable form. Moving Picture Experts Groups, known collectively as MPEG, are responsible for developing and maintaining digital video and audio encoding standards to address a wide range of commercial and educational needs.

In order to transfer information from the video camera to the computer, a high performance serial bus, IEEE P1394, popularly known as FireWire (developed by Apple Computer) is commonly used. It supports data transfer rates of 100, 200 or 400 Mbps. These high transfer rates mean that digital video can be transported directly from the digital source (camera, DVD, etc.) into the computer with no processing delays. FireWire transfer speeds, currently at 100-400 Mbps, will increase to 800 Mbps/multi-Gbps in couple of years.

In the past, different client players were required for different file types. Currently, many standard client players have extended their client capabilities to recognize multiple standard file types, such as MPEG-1 (.mpg), ActiveMovie/Video for Windows (.avi), QuickTime (.mov) and RealVideo (.rm and .ram). Progressive Networks' G2 Real Player, with plug-in extensions, and Microsoft's Windows Media Player can open and playback multiple digital video file formats, for example.
4.4 Delivering Streaming Video

A detailed analysis of various techniques used in delivering streaming videos to students is enumerated below with emphasis on capturing, digitizing and delivering the videos. The purpose of the course lectures through streaming video was not to simply show existing CD-ROM content, but to explain the concepts from a different viewpoint. This allowed the students to have another perspective on the theory and problem solving process.

4.4.1 Capturing Video in Classroom

In order to develop streaming videos, the lectures need to be first recorded. The video lectures were recorded on a digital camera and stored on a mini-DV tape. The quality of the video and sound captured is important for reproducing quality streaming video. There were several issues taken into consideration while capturing the video lectures such as the lighting in the classroom, the contrast of the board and the writings, and the distance of the camcorder from the chalkboard. A Cannon Optura digital video camera was utilized for recording the lectures.

The lecture recorded was of a 50-minute period and the camera was placed on a tripod stand at the back of the classroom with the focus of the camera towards the blackboard. The blackboard was divided into two fixed regions and the camera was focused to each region so that there was minimal movement of the camera. Since the action of a professor in the class is less important than equations and diagrams written on the board, therefore the camera was on focus on the board at all times, and not on the professor. Each fixed areas on the blackboard was of the breadth of the view of the camera, so that the professor doesn’t write outside the camera view area. Also the
professor could move to next fixed area and the camera can be easily focused on that area without readjusting the focus of the camera and with minimal disturbances.

The writing surface of the blackboard caused some problems while recording the videos. Since general blackboards are white, black or dark green in color, writing on them is a daunting task to be clearly visible on videos. It was observed that writing with chalk on dark green blackboards gave a good contrast while viewing text on videos. White blackboards gave a lot of glare of classroom light thereby making the videos unviewable. Another problem encountered while writing with white chalk on dark green boards were the white smear marks on the board once text was erased. If after erasing the text something else was written, the smear mark would also show up making text unreadable. Using a wet sponge instead of a regular eraser for cleaning the board solved this problem. The professor would erase the blackboard part completely with a wet sponge and waited 30-45 seconds for it to completely dry.

Although, most video cameras have a built-in microphone, they are generally of low quality and do not clearly capture voice recording with background noises that are common in a large classroom. This is due to the relatively long distance between the professor and the video. In addition, student voices are also recorded when the cameras microphone is used. As a solution, a small, inexpensive remote microphone was used as the sound input device instead of the built-in microphone. It is small and can be clipped onto the professor’s tie or collar. The remote microphone is connected to a pocket-size transmitter, which then sends the signal back to a receiver. The output of the receiver was then connected to the camcorder as an external microphone. The sound quality is excellent when even using inexpensive wireless microphones.
Due to file size of the raw data being too large to be downloaded onto the computer, the lectures of the professor for a 50 minute class was divided into 8-12 minutes sections and within that time period the professor taught a particular topic. The reason the topics were divided into 8-12 minute interval is explained in detail in the next section. The professor taught a particular topic on one side of the blackboard within that 8-12 minute interval with minimum movement. Since the emphasis was on the topic written on the board and not on the professor, the professor is less seen in the videos. As explained previously, if there is minimum movement of the subject on the video there is better compression of the movie. With trial and error of compressing the videos it was also observed that if the professor wore a light solid color shirt preferably white, there is little contrast with the background and better clarity of the videos. It was also observed that if the video camera was not moved during video recording, the compression of the videos came out better and the video lectures were viewable with minimum movement and fading of the text on the screen. The professor ensured that he was not blocking the view of the blackboard and not moving around the class.

4.4.2 Compression Techniques and Video Format

After the lectures were recorded in a live class, they were transferred to computer. A Firewire capture board installed on the computer was used for transferring the data from the video camera onto the computer. Generally the common formats videos are saved are Audio/Video Interleaved (.avi) and QuickTime (.mov). It was observed that saving videos as QuickTime movies is more beneficial as compared to .avi files because of file size, streaming technology and compression.
There are two types of compression techniques that can be followed. One is compressing the files as the data is being transferred from the video camera onto the computer, while the other technique is to fully download the raw data onto the computer and then use some software to process and compress the data. The former technique is not that useful since although the quality being good, the file size is large and compression and decompression schemes (codecs) are not common to other playback systems. When the file size is large it is difficult to stream it over the network and the student are not able to download the streaming file fast. Since one can transfer only 300 kbps over the wireless Internet, the file size needs to be small. In addition, for viewing the compressed video, the viewer needs to have the similar codecs and the plug-ins or players installed. Hence, the common codecs for audio and video needs to be used which is possible with recompression in software. Using software for compression turns out to be a good solution for reducing the file size and conforming to the codecs.

All raw data from the digital camera was downloaded to the computer using the IEEE P1394 Firewire. Adobe Premiere 5.5 software was used to download the raw data from the camera. The standard movie size captured in digital format was 720x480 (3:2 ratio) and the movie was captured at 30 frames per second. Since the movie was captured in an uncompressed form, the file size of the movie was large. A 10 minute long raw data movie occupied a 2 Gigabytes (Gb) of the hard disk space. In order to download all the data, which was about 10-12 Gb, a bigger hard disc was required. These large hard discs provide data rate problem, which was countered by use SCSI interface with hard drive. SCSI helps to increase the data transfer rate. These hard drives also served the purpose of matching the speed of the capturing the video by the capture board. If there is a lag
between the rate of downloading by the capture board and the rate at which data is stored on the hard drives, there is loss of data and there would be drop of certain frames causing problems to the video.

Currently, there are several software tools available on the market that can be used to produce streaming video. However, the most common video compression software are Net show Encoder, Real Publisher, Apple QuickTime with Sorenson codec, and Vivo Active Producer. Net show and Real Publisher movies can be encoded only on the Windows NT platform while the Vivo Active and QuickTime movies can be encoded on both Macintosh and Windows NT. Since Macintosh computer was used for producing the streaming video, QuickTime video format was found to be best suitable and was used in producing these videos. The movie size of 320x240 pixels and a frame rate of 10 frames per second were found to be sufficient to be able to view equations and diagrams. The audio settings were set at the minimum audible level, so that the streaming rate for audio could be minimized. Audio settings used were 11kHz and 8 bits mono voice quality. A detailed discussion on the editing software used to produce the QuickTime movies is discussed in next section.

4.4.3 Video Editing Software

There are several features that need to be taken into consideration while choosing software to process the digital video. It needs to compress the videos such that file size is small while having good quality. The streaming technology should conform to universal standards and students should able to download the final movie easily. As described earlier the lectures were recorded in chunks of 8-12 minute sections and total of 5-6 sections per lecture need to be compressed. Also QuickTime has good navigation features
and a slider or seek-bar to move to any part of the video. It also has features to save videos, so that students can download videos onto their local machines and avoid repeated access of the videos over the Internet. In order to get the best quality QuickTime movie with good compression, MediaCleaner Pro was selected. This software had a capacity to process videos in batches. Each 10-minute section movie took 2-3 hours to compress to desired standards and requirements. Appendix C refers to the standards that were set to get a compressed movie. Since all sections of the lecture were put for processing in a batch, minimum human assistance was required. Generally it was observed that it took 1-2 hours to download the raw data from the camera to the computer and 12-14 hours to compress all the sections of the lecture.

4.4.4 Serving and Hosting Streaming Video

A major concern in configuring a server for hosting streaming videos is the network bandwidth. It was important to figure what bandwidth that the user’s internet connection can handle so that the streaming video is continuous. If the streaming rate is set higher than the maximum data rate a user can receive, then the video will pause half of the time and the student won’t be able to see continuous videos. Generally a telephone line has a bandwidth of only 56 kbps and therefore the streaming video was designed for low bandwidth (100 kbps or lower) capabilities on campus. Wireless connection provided by the College of Engineering at the University of Oklahoma can transfer up to 1.5 Mbps for each transceiver, which are installed around the College of Engineering as the signal transmitter and receiver. The target-streaming rate was set to 100 kbps and it was also found that the data rate was reasonable to deliver audio and video.
There are two ways of serving out streaming video. The first one is streaming it from a regular web server without any special software and the other is to use a video-streaming server. For serving only a few videos, a basic web server works well. However, if the number of videos and viewers increase to over 30 of 40, a dedicated streaming server becomes necessary. Since all students do not access the videos at the same time, a regular server was used. All streaming videos were tested on a web server running Microsoft Windows NT Server 4.0. The processed videos were placed on the server and then linked by HTML code to the video on the server. This required no special streaming software on the server. If the number of visitors is large, then a multicasting technique can be used to minimize the number of streams at any given moment. This technique requires a dedicated server and special server software, which can be costly.

The equipment that was used to produce the streaming video for the courses was relatively inexpensive. The digital camera along with computer, digital video capture board and an Ultra Wide SCSI hard drive installed was around $4000. Additional accessories such as remote microphone, tripod, and compression software cost were another $1000. The above figures do not include the cost for internet connection, the cost of setting up server, and or the time needed to tape the video or process it for serving on the web. The benefit of the system was that the videos once recorded can be organized properly and reused in subsequent semesters and thus save time, money, and effort.

The whole process for preparing a streaming video was done by a single person. Once the initial video was set up and developed, the whole process of taping a 50-minute lecture, processing the tape, and placing the final files on the server took approximately 2 hours. The video compression can be done automatically in batches and thus the actual
operator time was minimal. For processing a regular 50-minute video lecture, the total computer time required was about 10-12 hours, of which only 1-2 hours of actual operator time was needed.

### 4.4.5 Implementation of the Streaming Videos

The videos are accessible to students through the course web page. All videos were organized according to topics and lectures taught in class. Students also have access to site where they can download the plug-ins required for viewing the videos. The students click on a particular week in the course menu page and are redirected to a HTML page where they have access to the videos. The topic for each week is all listed on this page in different segments. Figure 4.4 shows a web page for a particular week of videos. Each video is identified by the topic and duration of that video gives the student the idea of the length of the video. The advantage of keeping videos by topic gives the student the ability of choosing a particular topic and having direct access to it rather than listening to the whole lecture. This saves time and effort, reduces boredom for the student.
Video Lecture: Week 4

<table>
<thead>
<tr>
<th>Video</th>
<th>Time</th>
<th>Snapshots on board</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Energy &amp; Work (Particles)</td>
<td>Video 1</td>
<td>12 min</td>
</tr>
<tr>
<td></td>
<td>Picture 1</td>
<td></td>
</tr>
<tr>
<td>b. Basic Work / Energy Example</td>
<td>Video 1</td>
<td>11 min</td>
</tr>
<tr>
<td></td>
<td>Picture 1</td>
<td></td>
</tr>
<tr>
<td>c. Conservative Force and Potential Energy</td>
<td>Video 1</td>
<td>5 min</td>
</tr>
<tr>
<td></td>
<td>Picture 1</td>
<td></td>
</tr>
<tr>
<td>d. Conservation of Energy Example</td>
<td>Video 1</td>
<td>6 min</td>
</tr>
<tr>
<td></td>
<td>Picture 1</td>
<td></td>
</tr>
<tr>
<td>e. Two Part Work Problem Example</td>
<td>Video 1</td>
<td>12 min</td>
</tr>
<tr>
<td></td>
<td>Picture 1</td>
<td>Picture 2</td>
</tr>
<tr>
<td>f. Power &amp; Efficiency</td>
<td>Video 1</td>
<td>10 min</td>
</tr>
<tr>
<td></td>
<td>Picture 1</td>
<td></td>
</tr>
<tr>
<td>g. Power Example</td>
<td>Video 1</td>
<td>7 min</td>
</tr>
<tr>
<td></td>
<td>Picture 1</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 4.4 Video Lecture Schedule**

When the student clicks on a particular video link under the topic, a QuickTime movie comes up (Figure 4.5). The videos are the streaming videos, which the student can view, and these videos explain the complete concept about the topic. The students also have the ability to see the complete formulas and text for each topic by clicking on the link under the snapshot. Figure 4.6 shows a snapshot of the topic.
Engineering Utilities

Four utilities were developed and implemented on the web site to help students solve engineering problems and can be accessed through the “Utilities” link on the course menu bar. The purpose of these utilities was to minimize the time needed to solve basic problem tasks such as finding unit vectors. Also, these utilities were used as prototypes to show what could be done to demonstrate the capabilities of internet-based applications.
The utilities, as shown in Figure 4.7 and Figure 4.8, are a 3x3-matrix solver, a unit vector calculator, a cross product calculator, and a structural analysis module.

The 3x3-matrix solver is a convenient tool for students when solving three unknowns with three equations. It helps students get familiar with organizing equations into the matrix form and they only need to key in the coefficients of the three equations to solve for the three unknowns. The unit vector calculator is used for calculating unit vectors since unit vector calculation for every single question is very tedious, especially, if a student is required to repeat the same fundamental procedure for solving hundreds of questions a semester. The cross product utility solves the cross product for two vectors and saves time and effort on student’s part. The last utility structural analysis module helps to create a simulate truss structures, compute stresses and displacements in Structures.
Shockwave plug-in required to use these utilities

**3 x 3 Matrix Solver**

\[
\begin{bmatrix}
0 & x1 + & 0 & x2 + & 0 & x3 = & 0 \\
0 & x1 + & 0 & x2 + & 0 & x3 = & 0 \\
0 & x1 + & 0 & x2 + & 0 & x3 - & 0 \\
\end{bmatrix}
\]

\[x1 = \quad 0 \quad \quad x2 = \quad 0 \quad \quad x3 = \quad 0\]

[Reset all values]

---

**Unit Vector Calculator**

Direction Vector

\[1 \mathbf{i} + 1 \mathbf{j} + 1 \mathbf{k}\]

Unit Vector

\[0.5774 \mathbf{i} + 0.5774 \mathbf{j} + 0.5774 \mathbf{k}\]

Total Vector

Magnitude = 1

\[0.5774 \mathbf{i} + 0.5774 \mathbf{j} + 0.5774 \mathbf{k}\]

---

**Cross Product \(A \times B\)**

\[
A \times B = \begin{bmatrix}
1 & 1 & 1 \\
1 & 0 & -1 \\
i & j & k
\end{bmatrix}
\]

\[A \times B = -1.0000 \mathbf{i} + 2.0000 \mathbf{j} -1.0000 \mathbf{k}\]

**Figure 4.7** Utilities page for solving engineering problems
STRUCTURAL ANALYSIS MODULE

Click [here](#) to create and simulate Truss Structures and Compute Stresses and Displacements in Structures.

![Figure 4.8 Structural Analysis Module](image)

The utilities were developed in Macromedia Director and then exported as a Shockwave file, which is a web-based application format that allows delivery over the Internet. Macromedia Director provides wide varieties of functions through the use of a scripting language known as Lingo that allows creation of useful web based application. These utilities give students an opportunity to quickly find solutions and solve equations.

4.6 Interaction Between Instructor and Students

Interaction between instructors and students is an important criterion in learning course material. In online courses this interaction is limited, as there is very little face-to-face communication. Although students can contact instructor during his office hours if
the student is on-campus, but if the students are off-campus as is the case with distance education, they are limited to communicate through telephone, fax, and e-mail. Instructors can certainly cater to individual needs, but it would be a tedious process answering the same questions again and again if any of the mentioned communication medium is used. Secondly, students also wish to communicate with their peers and collectively address various issues about the course. To compensate these deficiencies, an online message conferencing was used. As a result, web-board, a commercial software, was chosen to be a channel for conferencing between instructors and students.

Web-Board (Figure 4.9), developed by O’Reiley Publications, is a web-based conferencing program that instructors and students can communicate via the Internet. Both students and instructor can access the web-board 24 hours a day and hence it increases the communication between students and instructor. Students do not have to wait for office hours that are only two or three times a week to meet with the instructor. Students can also answer their classmate’s questions, which saves time for both students and the instructor. Web-Boards also allow the students to work as a team and help each other to solve problems. The web board functions like a virtual office hours for the instructor and helps students clarify doubts.
In addition to the web-board, a vector-based, multi-user drawing board was developed by the Engineering Media Lab that helps students present their ideas through the Internet. Although students can upload graphics on the web-board, the only drawback is they cannot draw in it. The drawing board developed allows students to draw and explain engineering diagrams. Multiple users can log into the system and view the same figure being drawn and explained. This vector based drawing program allows user to edit individual object in the picture, while being drawn by someone else. User can change the properties such as color, thickness, border, shape, and size of each of the objects in the drawing. An interface of the drawing program is shown in Figure 4.10. This vector-based
drawing board thus helps in communicating engineering figures and issues over the internet.

Figure 4.10 Drawing Board Tool
CHAPTER 5
ONLINE CLASS MANAGEMENT

Testing the knowledge of the student is the most traditional form of assessing the learning capability of the student. Hence, a good homework and test system is very important in providing useful practice and evaluation for students. This chapter will focus on the dynamic creation of the course pages and various features available to students to get information about their class. It also discusses the online homework and testing system that allows the students to view and submit assignments online through the Internet. Various security features of the online testing system are also enumerated.

5.1 Course Page

As mentioned in Chapter 3, when students click on an instructor’s course number (as shown in Fig 3.1) link, they are directed to their class course page. Figure 5.1 shows a typical class course page, which the students of dynamics course would see. This web page is the main location for students to view all their homework’s/quizzes/tests questions, submit their work online and check solutions and scores. Students have access to their class information such as syllabus, grade information, course information, etc. through this page. The left menu selection of Figure 5.1 lets students choose their options and view the relevant pages. The right section gives information about the instructor and other class details. This page forms the main web page for the students of that class. The menu bar is also the source for students to check the streaming videos of their class. They also have access to various utilities and web board through this menu bar. The menu bar of Figure 5.1 is the basic navigation tool bar for the whole course and doesn’t disappear.
upon clicking different links. All the links on the menu bar have links to other pages, which are displayed based upon the request and the parameters passed.

**Figure 5.1 Main Course Web Page**

Figure 5.1 is a dynamically created page and both the menu bar page and the title page are created based upon the information stored in the database. Since multiple professors have the facility to set up their own classes, information relating to that professor only is pulled from the database and pages are dynamically created. When the instructor views the main class course web page for the first time, a different web page
appears giving instruction on how to set up his or her class information and other features. Once the instructor follows those instructions, web page as shown in Figure 5.1 appears. The instructor always has the facility to go back and change his or her information that shows up on the title page. The instructor can also post current news or announcements on the course title page. These features are discussed in detail in the next chapter.

5.2 Student Login Information

For students to be able to access the web pages relating to homework and tests, they must enroll or register for the class. Only authorized students are given access to the web pages. Since multiple professors’ can set up classes, class assignments are accessible to students of that particular class only. As login and password are required to access the web pages, students not in the class are not able to access assignments of the class. Unless the instructor has given permission (by adding the student to the class), the students do not have the authority to access the assignments and tests. In order to be given authority to access the assignments the instructor needs to add the students Identification Number (I.D. No) into the database. The feature of adding students to the database is explained in chapter 6 in detail. Once the student receives permission to set up their account in the class, they need to enter their names, email address and password by clicking on the link “Login Setup” on the course menu bar.
When the student clicks on the Login Setup link, a dynamically created page (Figure 5.2) is displayed, where the student fills the information. The student needs to fill the information only once during setup and all information is stored in the database. When the student enters his I.D No along with other information the Perl script checks the I.D.No provided by the student to the I.D. No provided by the instructor in the database. If both the numbers match and other information provided conform to requirements, then all the information is stored in the database and a confirmation page comes up (Figure 5.3). If the I.D.No provided by the student is not available in the database, an error page shows up denying him the permission to set up the account (Figure 5.4). Once all the information has been stored the student has access to the assignments and tests.

**Figure 5.2 Login Setup Page for Students**

1. You are required to fill up all information.
2. All the entries are case sensitive.
3. You need to be enrolled before you can setup a login account.
4. Avoid putting any special character in names.
5. Contact your instructor if you can not setup a login account.

```
First name:  
Last name:   
Email address:  
I.D #:  i.e. (000273369)
Password:  (maximum 8 characters)
Confirm password: 
```

Create  Reset all entries
5.3 Editing Student Information and Accessing Grades

The student can change their personal information and password anytime by clicking on the link “Students” on the main course menu bar. Upon clicking, a dynamically created page is displayed (Figure 5.5) giving them the option of changing their personal information, password or checks their present grades. Since the student is
required to enter his login name and password, security features are implemented and unauthorized person cannot change the information. The student upon accessing his information can edit it and the newly edited one is stored in the database. A Perl script actually performs the operation and old information is overwritten with the new data. A confirmation page is displayed upon completion of information editing.

When a student checks his grade, the total grade upto that moment is dynamically created and displayed. Since all information relating to the student’s grades are stored in the database, a Perl script fetches them and the current course grades are displayed. As shown in Figure 5.6, the grade information shows scores up to Homework 6 and Quiz 2 since those assignments have been submitted by the student and are due in the class. The student can track at any given time their scores and the letter grade they are making in the class. This feature allows students to know their grades in the class. This reduces student anxiety and saves instructor’s time in constantly telling them about their grades. This page also displays the number of students who are getting the different letter grades. It informs the student his or her position in the class relative to other students. It has been observed that students put in more effort in homework, quizzes and tests if they are made aware of their current grade.
Grade report for
ID # : 111111111111

Homework

<table>
<thead>
<tr>
<th>Homework</th>
<th>Score</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>92</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>92</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>84</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>89.6</td>
<td>Lowest score is dropped</td>
</tr>
</tbody>
</table>

Quiz

<table>
<thead>
<tr>
<th>Quiz</th>
<th>Score</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>90</td>
<td>Lowest score is dropped</td>
</tr>
</tbody>
</table>

Test

<table>
<thead>
<tr>
<th>Test</th>
<th>Score</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Overall grade

\[
(\text{Average} \times 20 + 90 \times 36)/(20 + 36) = 89.85
\]

Current grade

A

A = 90+, B = 80+, C = 70+, D = 60+, F = <60

Click [here](#) to go back

Figure 5.6 Student Grades page
5.4 Problem Generation

Most instructors that use a conventional textbook to teach a class assign questions from it. The online system uses similar approach except the questions and solutions are kept in a database and are in an electronic format. To allow the instructor to assign problems to students over the web, a database of web-based questions pertaining to that course was developed. The problems were generated in the form of GIF images in order for them to be easily loaded onto the web page. Each problem was developed and constructed in electronic form. This involved a regimented process of deriving a question, creating diagrams, transferring the problem and solution to HTML format, and adding various system manipulations.

Initially, all problems were fill-in the blank but this required manual grading which eliminated some of the advantages of an online course since the students could not get immediate feedback and it increased the instructor's time devoted to the course. The decision to use only multiple-choice increased the initial developing time for the problems, but made grading easier. It also paved the way for automated problem generation and grading. Wrong solutions were developed to closely match possible mistakes that the students would make. However, the correct answer is always one of the choices listed, so that the student had the opportunity to work toward the correct answer. Over the course of three semesters, over 400 problems for both statics and dynamics were electronically developed with the intent of being web-based.

A single Perl program is executed to generate a single page with various questions all questions are in a uniform format. The homework page when accessed by student contains 2 major columns. The left column is set at 240 pixels width for a GIF or a JPEG
picture while on the right is set at 320 pixels wide for the problem statement and answer choices. Therefore, the diagram graphic is restricted to 240 pixels width only. While creating graphic images care was taken to conform to this standard. The height of the graphic or the problem statement wasn’t relevant but the width needed to conform to the desired dimensions. Figure 5.7 shows the question format.

![Diagram of turbine with angular velocity](image)

**Figure 5.7 Question Format in Dreamweaver Software Tool**

The turbine is rotating about a fixed axis coincident with the line OA. The angular velocity of the rotating turbine is 1000 rad/s. Determine the velocity of a point on the turbine with coordinates (3, 2, 2) m.

- a. 108.5i - 201.7k m/s
- b. 122.4j - 252.9k m/s
- c. 222.4j - 222.4k m/s
- d. 213.5j - 236.4k m/s

In order to maintain some order, folders were created according to chapters, topics and problems are stored in them. Each folder consists of sub-folders where problems are placed according to difficulty. These sub folders consists of the actual problems and their related material. Each problem was created in an HTML format using Dreamweaver software. The graphics for the problem were drawn using FreeHand (a vector-based graphic drawing tool). Figure 5.8 shows an example of a graphical figure drawn using the tool.
Dreamweaver does not have certain features of showing complex equations and integrals. In order to explain solutions, this drawback was overcome using another tool called MathType. MathType has the capability to make mathematical abbreviations, trigonometric, log, and calculus terms. The mathematical equations were exported as GIF images and embedded into the HTML pages. SnagIt was utilized for capturing images of web pages. This tool was used for making GIF images of the solution. All GIF images related to problems and solutions are stored in the organized folders so that Perl programs extract images and put them onto the web page.

As each questions is stored in different folders of the database, the mechanism for retrieving a particular question from the database and posting them onto the web page is done using Perl. Once students successfully logs onto the homework page, a Perl program reads a set of question numbers that are preset by the instructor and retrieves the individual HTML files from the folders. Since the Perl program understands only basic HTML code, unique tags were included in each question so that they can be retrieved and posted in multiple-choice format. There were 5 special tags embedded into each question namely <start>, <pic>, <endpic>, <submission form>, and <end>. These tags,
developed for each question are indicators for the Perl program to perform certain functions. First the program reads through the HTML code line by line and searches for <start> tag. Then, the program starts printing the HTML codes in the remaining of the HTML file (refer to Appendix D for an example of HTML file) onto the browser and continues to do so until it finds <pic> and <endpic> tags. These tags tell the program to print a graphic image from the designated folder onto the page. The Perl script then continues to read each line until it finds the <submission form> tag, where the multiple choice form tags as shown in Figure 5.9 are printed. Finally, the <end> tag in the HTML source code stops the reading process and moves on to the next question until all the questions are printed. The reason these special tags were inserted into each question was to embed special features such as GIF images and submission buttons. Also it gives a feature of moving the database to another location without worrying about the links of the images to HTML files.

A force of 100 N is used to pull a cart up a 30 degree incline over the distance d. Find the work done by the force.

a. 2000 J  
   b. 4400 J  
   c. 1800 J  
   d. 3600 J

a.  
   b.  
   c.  
   d.  

**Figure 5.9** A typical question with a submission tag
5.5 **Online Homework Assignments**

An important benefit in the use of electronic media for a course is convenient access to course materials from a CD, and to problems and solutions over the Internet. As described earlier, instructors select questions from a database of questions and assign them over the web, which reduces the time to setup a class and quickens the access to material to an unlimited number of students. In addition to the course content being delivered electronically via a CD-ROM, the homework and quizzes were designed and delivered in an electronic format and facilitated better learning of theory and concepts. The web-based testing system was implemented wherein all the answers submitted by students are automatically graded and results immediately available.

Traditionally, partial credit is given to students in engineering courses due to the difficulty in solving problems and frequency of simple errors such as algebra and sign errors. Even though partial credit is not possible with fill-in-the-blank or multiple-choice questions, an instructor can minimize the effects of its absence by asking more questions and directing each question to deal with only a single concept or step. However, the system developed still allowed giving partial credit by deducting only partial points even if the student answered the question wrong. This model also correlates with the various testing methods used outside the university, such as the professional engineering exams.

The following sub-sections explain the different features that were implemented, for students to do online homework’s and submissions.

5.5.1 **Assignment Login Page**

For students to access homework assignments, they are required to click on link the “Hw/Soln/Score/Check” under the Homework section in the course menu bar. This
dynamically creates a login page (Figure 5.10) on the right frame with login and password fields. It also displays a schedule for the assignments. Students choose a particular assignment number and problems relating to the assignment.

As seen in Figure 5.10 the student has the option of selecting questions, solution, score and review submission. The student accesses the questions for an assignment and submits it online before the due time as per the schedule. They can view the solutions after it is posted and check scores for that assignment. The student can also check the choices he or she has answered for an assignment by reviewing the submission. If the authorization is denied, or the assignment is not due to be released, or the instructor has not selected problems for that assignment, an error page is displayed giving the reason for denial.

Students need to be registered in the class and set up their account to view their assignments. Once the student enters his login name (I.D. No), password and chooses an assignment, a Perl script is executed that verifies the information provided by the student and the information stored in the database about the student. If the information matches and that particular assignment selected is due to be open, a new dynamically created web page is printed onto the screen.
Homework assignments are released based upon the time schedule on the login page. When the student requests for access to an assignment, the Perl script checks the release date and time stored in the database and with the actual local time on the server. If the release date and time are later than the actual local time, the script isn’t executed and an access denial page is shown (Figure 5.11). Similarly if the student wants to access the solution or scores before they are to be released, permission is denied. The instructor needs to be careful in setting up the time schedule for release of assignments. A
discussion in the next chapter will enumerate the system of setting up the time schedule by the instructor.

**Figure 5.11** Permission Denial Page for Homework’s

Another feature implemented in the online system was keeping record of student access to these pages. Every time a student accesses questions page, submits his assignment, checks solutions and scores and reviews his submission, the system records the transaction in a log file in the system. Data stored in the log files comprises of date and time, I.D. No and the activity performed by the student.

**5.5.2 Assignment Questions Page**

The questions page consists of problem statements with graphics and multiple-choice options. The student solves the problems and chooses one of the choices and submits the complete assignment. As explained earlier and shown in Figure 5.12, the question page has 2 columns, namely a 240 pixels width problem graphic and a 320 pixels wide problem statement.
Problem 2.1

A quarterback throws a football with a velocity $v_o$ at an angle of 45° with the horizontal. At the same instant a receiver standing 20 ft in front starts running down the field at 15 ft/s and catches the ball. What is the distance of the receiver from the quarterback when the ball is caught. Assume the ball is thrown and caught at same height above the ground.

a. 49.8 ft  
b. 45.1 ft  
c. 34.3 ft  
d. 24.9 ft

Problem 2.2

A particle moves along a wire that follows the curve $y = 1/x$ at a constant velocity of 4 m/s. What is the acceleration of the particle when $x = 0.75$ m?

a. 6.14 m/s²  
b. 4.73 m/s²  
c. 3.94 m/s²  
d. 11.32 m/s²

Figure 5.12 Homework page with questions and choices

A web page created upon user request does not exist in any directory, but is dynamically created as all the problem graphics and statements are retrieved by a Perl code and displayed onto the web page. Appendix E shows the Perl code that is executed to display on web page. Upon user request and authorization clearance, the code determines the course number by the unique web number of the instructor, and then
based on assignment number requested, opens the database and picks up information of problems assigned from the database table. The code then accesses the directories where the actual problem statement in HTML form is available. It reconstructs the HTML onto the web page and therefore the questions page is basically 8-10 HTML pages on a single web page. The benefit of creating problem pages dynamically is the instructor has the freedom to choose different problems and recreate the page upon request.

When HTML files are retrieved from the actual directories, the problem images are copied to another folder related to the instructor and retrieved from that folder only. This was done to ensure security of the images and deny information about the actual path of the images. It was observed that by doing a “right mouse click” on the images, the student could get the complete path of the images and could copy this path onto a browser to get access to problem images. Since the solution graphic and solved solution images are also located in the same folder, the student would access the image by modifying the path names. To avoid access to main directory, the images are moved to another location. To avoid presence of multiple copies of the same image in this special folder, the Perl code tests the availability of images initially in this special folder. If the image is available in the folder then script retrieves and displays it on the web page, otherwise it goes to actual directory, retrieves it, makes a copy and saves it into the special folder. After copying the image into the folder, the script renames it by a randomly-generated name. By renaming the file with a random name and changing the location of the image, the student is not able to guess the name of the image and have access to solution graphic or solved solution image. The images get moved to another folder the first time anyone triggers the Perl code.
After a student views the question page, and submits their answers, a Perl script (see Appendix F) is executed that retrieves student I.D. No, class web number, assignment number and their answer choices. This information is then stored into the database. Before writing the information into the database, the script checks the correct answer choice of the question to the choice answered by the student and calculates the score. Based on the points to be removed for wrong answer as set by the instructor, the code calculates the total score and records it under the student I.D. No. Figure 5.13 shows a part of the database table wherein the student information and score is recorded.

Even before the student response is saved in the database, the code checks for the deadline date and time for that assignment. If the submission is before the due date and time the student is authorized to submit, the student is denied submission and the submission is not recorded in the system. The student can submit even after the due date and time, but loses additional points. The system denies submission of the assignment if the solutions for that assignment have been released. Another feature implemented with the submission page, was giving a delay time once the submission was due. This was done to allow a grace period for network or hardware problems. This grace period is decided by the instructor while setting up the assignment and is generally 2-3 minutes.
Students have an opportunity to submit partial work at any time and come back and solve the rest before the deadline. A student can choose to work on certain problems and submit the work that gets recorded in the database. When the student accesses the assignment again, his or her answer choices are retrieved from the database and all radio buttons of the questions answered are pre selected and shown on the web page along with the question. This system does not require the student to remember their previous choices. The student can then work on his unanswered problems and mark the choices and submit work again. The student can also change the choices for the problems they had answered earlier. Upon submission and based on authorization, the new set of answers are overwritten over the previous answers. The system recognizes the last submission as the final submission and doesn’t keep a record of all previous submissions. If the student decides not to answer a particular question, the choice is written into the database as a blank and points are deducted for not answering the question. The benefit of the system is giving student the luxury to answer questions at their leisure and still get access to their previous answered choices without having to remember them. The only care that needs to be taken is to submit the work before the deadline date and time.

Once the information has been stored, a confirmation page is dynamically created informing the student of successful completion of the transaction. Figure 5.14 shows a confirmation page. This page contains the answer choices submitted by the student and also gives the date and time of the submission. If the student is late for a particular submission, a note is also displayed informing the student about being late and the points deducted. This confirmation page gives the student an opportunity to check if their submission was on time and also verify the answer choices recorded in the system.
Submission for Homework 7 is successful!

The following information have been submitted:
ID no = 11111111111

1 : a
2 : b
3 : d
4 : a
5 : c
6 : b
7 : d
8 : b

Homework 7 submitted on 3/5/2001 at 1:04am.

Please save a copy of this page for later verification if necessary. Click here to return to menu.

Figure 5.14 Student Submission Feedback Page

The student can check their submission at any given time by selecting the “Review Submission” link on the assignment login page. The page gives information about assignment submission and the time of submission.

5.5.3 Assignment Solutions Page

The solutions pages give students the methodology used in arriving at an answer and give them the opportunity to check their solutions and mistakes. Similar to questions page, the solutions page is also created dynamically.
Problem 6.2

A spacecraft is in an elliptic orbit around a large asteroid. The acceleration due to gravity of the asteroid is not known. The closest distance between them is 4 km, and the velocity at that moment of time is 2 m/s. If the farthest distance between the spacecraft and the asteroid is 9 km, what is the velocity of spacecraft at that point?

a) 0.889 m/s
b) 0.359 m/s
c) 1.01 m/s
d) 4.50 m/s

Solution

Using the conservation of angular momentum principle,
\[ r \times v = r \sin \theta = \text{constant} \]

In above two cases, viz. closest and farthest, angle \( \theta = 90^\circ \) and \( r_A v_A = r_B v_B \)

\[ v_A = r_B v_B/ r_A = 4(2)^{1/9} \]

\[ v_A = 0.889 \text{ m/s} \]

Figure 5.15 Homework Solution Page

Figure 5.15 shows a solution page created based upon user request. This page opens up only when the solutions posting date and time are due. The Perl script checks for due dates and times based upon the compliance and pages are created. Appendix E shows the Perl script that is executed to make the solution web page. Once the authorization to access the web page is given, the code accesses the database to get information about the problems assigned for the particular assignment. The solution page
not only consists of the question statement and the graphic associated with it, but also consists of the graphic explaining the solution and the solved solution itself that are in a GIF format. The graphic explaining the solution and the solved solution are both saved as GIF image for easy use than a web page. These graphic images are copied from original folder and renamed in the instructor’s folder. The graphics are moved to instructor’s folder only after the solutions posting time is due. Since the graphics does not exist in the instructor’s folder beforehand, no one can get access to them even by typing the complete path on the browser. This leads to increased security from students getting access to solutions even before they are released.

5.5.4 Student Scores

The most dreaded part of an assignment, for a student is the score report. Students are eager to know their scores as soon as they turn it in. The system developed grades the student’s assignment when it is submitted. The student can access to the grades once the due date and time is past. Since grading is done completely online and instantly, the students can view the solutions and the scores immediately upon the release.
Submission for Homework 2

The following is your graded homework
IDNo: 22222222222222

1: b
2: c
3: d
4: c
5: d
6: d
7: d
8: d
9: d - 0 Correct answer is a

Homework 2 submitted on 1/22/2001 at 7:48pm

Notes:
The total score for this Homework is 92

Class Score Distribution For Homework 2

Figure 5.16 Student Score Report

Figure 5.16 shows a typical score sheet of a student for an assignment. This page is dynamically created by the Perl code. Appendix E gives the detailed code that is executed to dynamically create the page. The code not only checks for authorization to view pages, but also retrieves information for that student from the database and converts
it into web format. The code basically accesses five tables from the database to get all information and constructs the score report page.

The score report page displays the student’s choices for that assignment and states if the problems were answered incorrectly and the corresponding correct answer. The date and time of submission along with status of submission is also displayed. The total point scored by the student is finally displayed.

Once all details regarding the student’s assignment are printed, a histogram showing the performance of the entire students in the class for that particular assignment is displayed. This histogram is basically a Flash generated image. This image is also dynamically created by the system. The image gives student a comparative analysis between their score and the score of all students in the class. The histogram is divided into intervals of ten and gives a rough estimate to students where they stand in the class with regards to that assignment. The system retrieves scores for that assignment from the database. It then manipulates the data and stores the information into a text file in the system. A Flash plugin is embedded in the Perl code, which accesses the information from the text file and using Flash Generator constructs the histogram onto the web page.

5.6 Administrative Access to Questions and Solution Pages

The student can access the questions and solutions page only when the assignment date and time is past. If the instructor wishes to view the pages before they are opened to the students, the instructor can enter a login name and password that gives him or her authority to access the pages. This special login name and password is set in the administrative portion of the website. The process of selecting user name and password is described in the next chapter. The Perl script actually matches the entered user name and
password to that available in the database and opens up the desired pages without checking for the date and time of release of the assignment. By providing this additional feature in the system, the instructor can check the content of the assignment before releasing it to the student. Also if any typing or calculation errors are involved in the assignment, they can be reported and rectified before the assignment is released to students.

5.7 Quizzes/Tests/Examples

The quizzes and tests also form an integral part of the curriculum. These are also administered similar to the homework assignment is administered. The instructor chooses the problems to be given and also sets up the time for release of the quiz and the test. The quizzes and tests also consist of problems and solutions. After submission the student can view his scores and see performance compared to others. For quizzes and tests the time period to solve is very limited and students have to finish within stipulated time. Since all timings for access and submissions are based upon server clock, a small window showing the actual server time is displayed. This pop up window is opened through a link on the main menu bar. Figure 5.17 shows the server time that students view.

![Figure 5.17 Server Clock](image)
Examples are helpful to assist students to better understand basic concepts. They aid in student learning and can help students understand different techniques and methodology. Examples are available in this system to students through the main menu bar. Since students just need to view problems and solutions and not submit them, the login page has just one button for solution.

All the login pages for homework/quiz/tests/examples are executed through a single Perl script. Appendix E gives the actual code that was implemented. Different parameters are passed to the code, and depending upon the variables passed, the webpage is created. Similarly, a single Perl script is executed for showing the questions, solutions, score and review submission page.
CHAPTER 6

ONLINE COURSE MANAGEMENT

This section focuses on the administrative management of the course by the instructor, and the dynamic creation of the administration pages for the instructor to manage the class. The section shall enumerate the various features designed to allow an instructor to add students to class, edit their information, create assignments, assign problems, manage submission deadlines and control points removal. As an administrator of the course, the instructor can also change student scores and manage class grades. Various features like e-mailing to students, editing personal information and setting up passwords are also discussed.

6.1 Administrative Login

The instructor has access to the administrative site through a link on the main course page. Figure 6.1 shows the login page for the instructor where they enter their login name and password. The instructor chooses this login name and password during initial set up of the class. The information entered is tallied with the corresponding information for the instructor in the database. Further access is denied if the information does not collaborate and thus the security feature denies unauthorized access of administrative site to other users. To increase security of the administrative site, the login name and password are passed as variables to every script executed in the administrative site. The password is in an encoded format and access to administrative pages is denied if anyone tries to run the script through the browser.
Upon successful login in, a two frame web page is created, where the left frame of the web page is the administrative menu bar or the navigation bar and the right frame is the body of the administrative site. Figure 6.2 shows the administrative web page of the
instructor. Both frames are dynamically created from two different Perl scripts. The menu bar and student information page are the default pages.

6.2 Managing Student Information

Student information page can be accessed through the link “Account” on the administration menu bar. This page allows instructor to add students to the class and edit their information, scores and also delete their accounts.

Students are added to a class by entering their Identification Number (I.D. No) in the “Add New Student” section of the page (Figure 6.2). The instructor is required to add all the I.D. No’s into the system for all students before they can set up their student account. A Perl script writes the information into the database and automatically refreshes the page to show the student I.D. No in the Current students column. When the student is added, their I.D. No only shows up with no other information. Adding an I.D. No to the system gives the student permission to set up their account in the Student Login Setup page. After the student enters personal information, the administrative site shows the same information. All students I.D. No’s in the administration page get arranged according to last name. The system allows innumerable students to be added to the site and all information is stored in the database. Once the student is added to the system and his account setup, the students can access the assignment page and submit work.

In order to edit student information, the instructor is required to select the student’s name from the Current Student’s column and choose “Edit Student Information” option (Figure 6.2). A single Perl script is executed while performing the various options on the page. Once the instructor selects the option, a dynamically created
page (Figure 6.3) is displayed. This page displays student information in an editable format and any changes required are implemented and information is updated in the database. A confirmation page is then displayed informing the instructor of the changes made.

![Changing Student Information for 222222222222](image)

<table>
<thead>
<tr>
<th>First name</th>
<th>Vikas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Last name</td>
<td>Yellamraju</td>
</tr>
<tr>
<td>Email address</td>
<td><a href="mailto:vikas@hotmail.com">vikas@hotmail.com</a></td>
</tr>
</tbody>
</table>

| Change | Undo all changes |

1. You are required to fill up all information.
2. All the entries are case sensitive.
3. Avoid putting any special character in names.

Click [here](#) to cancel the changes and go back to the student administration page.

**Figure 6.3 Editing Student Information Page**

Similar to changing student information, the instructor can also change student password and delete student account. The instructor can overwrite student password by assigning a new password if the student forget their password. Deleting student account not only removes personal information from the database but also removes all submissions made by the student. A JavaScript is executed to seek confirmation from instructor with regard to deleting a student from the system.

It is common for a student to request a change in their scores due to various reasons. The instructor, as an administrator, has the capacity to change the scores through the Edit Student Score option. Figure 6.4 shows the page when the script accesses one of
the student's scores. This web page shows all the scores of the student that have been released. The Perl script retrieves all student information and assignments from the database and constructs a page with all scores and notes option as editable fields. The instructor can change the required assignment score. Only one score can be changed at a time. All information is again written back to the database for further reference. A confirmation page is displayed once that score has been changed.
Grade report: ID # : 222222222222

<table>
<thead>
<tr>
<th>Homework</th>
<th>Score</th>
<th>Notes</th>
<th>Change</th>
<th>Reset</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>92</td>
<td></td>
<td>Change</td>
<td>Reset</td>
</tr>
<tr>
<td>3</td>
<td>84</td>
<td></td>
<td>Change</td>
<td>Reset</td>
</tr>
<tr>
<td>4</td>
<td>92</td>
<td></td>
<td>Change</td>
<td>Reset</td>
</tr>
<tr>
<td>5</td>
<td>84</td>
<td></td>
<td>Change</td>
<td>Reset</td>
</tr>
<tr>
<td>6</td>
<td>100</td>
<td></td>
<td>Change</td>
<td>Reset</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>468</strong></td>
<td><strong>Lowest score is dropped.</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

You can only change one hw or qz at a time.

<table>
<thead>
<tr>
<th>Quiz</th>
<th>Score</th>
<th>Notes</th>
<th>Change</th>
<th>Reset</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>90</td>
<td></td>
<td>Change</td>
<td>Reset</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
<td><strong>Lowest score is dropped.</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Test</th>
<th>Score</th>
<th>Notes</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Overall grade</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework (20 %) :</td>
<td>468/500 * 20 = 18.72</td>
</tr>
<tr>
<td>Quiz (36 %) :</td>
<td>100/100 * 36 = 36</td>
</tr>
<tr>
<td>Current total (56 %) :</td>
<td>54.72</td>
</tr>
<tr>
<td>Current grade :</td>
<td>(54.72/56) * 100 = 97.7 A</td>
</tr>
</tbody>
</table>

A = 90+, B = 80+, C = 70+, D = 60+, F = <60

Click [here](#) to go back

*Figure 6.4 Student Score Edit Page*
6.3 Score Report and Log Information

Instructors like to view scores and averages for their class after an assignment has been turned in and graded. A spreadsheet format for grades is created when the Score Report link is chosen in the administrator menu bar. Figure 6.5 shows an example of the page that is created dynamically by the Perl script. This page enables instructor to have a comprehensive listing of all the students with their scores and class averages.

### Class performance

<table>
<thead>
<tr>
<th>No.</th>
<th>Univ. ID</th>
<th>Last Name</th>
<th>HW (20%)</th>
<th>Quiz (36%)</th>
<th>Total</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>123456789</td>
<td>Baker</td>
<td>100</td>
<td>92</td>
<td>84</td>
<td>76</td>
</tr>
<tr>
<td>2</td>
<td>234567891</td>
<td>Douglas</td>
<td>92</td>
<td>76</td>
<td>92</td>
<td>100</td>
</tr>
<tr>
<td>3</td>
<td>345678912</td>
<td>Martin</td>
<td>92</td>
<td>100</td>
<td>84</td>
<td>76</td>
</tr>
<tr>
<td>4</td>
<td>456789123</td>
<td>Smith</td>
<td>100</td>
<td>100</td>
<td>92</td>
<td>92</td>
</tr>
<tr>
<td>5</td>
<td>567891234</td>
<td>Thames</td>
<td>100</td>
<td>100</td>
<td>76</td>
<td>100</td>
</tr>
</tbody>
</table>

**Figure 6.5** Score Report Page

Appendix G gives the complete code that is executed to create the score report page. As described earlier in other sections, student information, along with their assignment scores, is obtained through the SQL statements. Since this page shows all assignments, quizzes and tests, that are already released, the instructor has complete listing of student scores. Analysis can then be made with respect to class performance and changes to be done in further assignments.

Log information gives record of all transactions performed by the student. Since all information is stored in a single text file, it is cumbersome to find information relating to a particular student. To help access the log files, an instructor can view them at the administrative site. Since log files have date and time at which students access the web pages, it is easy to track any problems encountered by student while accessing the
assignment web pages. Since all assignments are time based and have to be turned in before a deadline, the instructor can check for any student submitting after the deadline. Figure 6.6 shows a log report for a particular student.

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Id No</th>
<th>Info</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>02 02 2001</td>
<td>08:40</td>
<td>111111111111</td>
<td>question 1</td>
<td></td>
</tr>
<tr>
<td>02 02 2001</td>
<td>09:10</td>
<td>111111111111</td>
<td>question 1</td>
<td></td>
</tr>
<tr>
<td>02 02 2001</td>
<td>10:15</td>
<td>111111111111</td>
<td>question 1</td>
<td></td>
</tr>
<tr>
<td>02 02 2001</td>
<td>12:25</td>
<td>111111111111</td>
<td>question 1</td>
<td></td>
</tr>
<tr>
<td>02 02 2001</td>
<td>08:40</td>
<td>111111111111</td>
<td>question 2</td>
<td></td>
</tr>
<tr>
<td>02 02 2001</td>
<td>09:18</td>
<td>111111111111</td>
<td>question 1</td>
<td></td>
</tr>
<tr>
<td>02 02 2001</td>
<td>10:15</td>
<td>111111111111</td>
<td>question 1</td>
<td></td>
</tr>
<tr>
<td>02 02 2001</td>
<td>12:25</td>
<td>111111111111</td>
<td>question 1</td>
<td></td>
</tr>
</tbody>
</table>

Click [here](#) to go back to the student administration.

6.4 Homework/Quiz/Tests Management System

A key feature to the online web based knowledge hub was the homework management system. This feature allows instructor to add assignments, choose problems from a database of questions, schedule release dates and delete assignments. The homework system is explained in detail in this section and similar methodology was used for quizzes, tests and examples.

When the instructor clicks the Homework Link on the administrative menu page a dynamically created page is displayed on the right frame listing all homework for the class (Figure 6.7). If a particular homework does not exist in the system then the
instructor can add homework under “Add new Homework Set”. Once the Instructor submits the information, a Perl script adds the Homework number in one of the tables of the database. The homework number added also gets displayed on the Homework management page. Once the homework has been added, the instructor can add problems to it, set the release schedule and manage point’s removal for wrong answer.

**Dynamics Administration Page**

<table>
<thead>
<tr>
<th>Current Homework Sets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework 1</td>
</tr>
<tr>
<td>Homework 2</td>
</tr>
<tr>
<td>Homework 3</td>
</tr>
<tr>
<td>Homework 4</td>
</tr>
<tr>
<td>Homework 5</td>
</tr>
<tr>
<td>Homework 6</td>
</tr>
<tr>
<td>Homework 7</td>
</tr>
<tr>
<td>Homework 8</td>
</tr>
<tr>
<td>Homework 9</td>
</tr>
<tr>
<td>Homework 10</td>
</tr>
<tr>
<td>Homework 11</td>
</tr>
<tr>
<td>Homework 12</td>
</tr>
<tr>
<td>Homework 13</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Homework Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edit Homework Set</td>
</tr>
<tr>
<td>Edit Homework Schedule</td>
</tr>
<tr>
<td>Delete Homework Set</td>
</tr>
<tr>
<td>Homework Score Distribution</td>
</tr>
<tr>
<td>Recalculate Student Score's</td>
</tr>
<tr>
<td>Delete Problem Graphics</td>
</tr>
</tbody>
</table>

**Add New Homework Set**

Please select a new Homework number

Homework 14 ▼ Add

![Figure 6.7 Homework Administration Page](image)

Instructors have the ability to choose from a database of over 400 problems for the homework sets in both statics and dynamics classes. The advantage of this system is that instructor does not need to develop their electronic-based problems. Avoiding content development by the instructor saves time and effort. Figure 6.8 gives a view of
the dynamically generated homework problems setup page. This page is a three-frame structure, wherein the left frame gives access to topic areas. The right top frame gives access to problems for that particular topic and the right bottom frame gives a summary of the problems chosen in the homework assignment. The instructor has a flexibility of choosing different topics from different topic areas.

Figure 6.8 Homework Problem Selection Page
On choosing a topic area and difficulty level, the instructor views all problems pertaining to that section. The right top frame gives instructor information of the problem statement and the problem graphic. The instructor can then add a problem into the homework set by clicking the “Add the question” button. A Perl script writes the information into the database and records the order of the problem added. When the problems are added to the homework set, the right bottom frame is dynamically generated showing all the problems that have been added. Once a particular problem has been chosen for an assignment, the system remembers the allocation of the problem to a particular set of assignments. Once a problem has been used it can’t be re-used again for that class by the same instructor.

The benefit of the system is that different instructors can use the same problems. All information is tied to a unique class number and the problem selected by one instructor won’t be applicable to another instructor. By choosing a problem for a homework set, the system is basically storing the location of the file in the database and then the student references the actual location of the file when the assignment is accessed. The instructor can view solutions for a particular problem by choosing the View solution option. Questions can be deleted from an assignment by choosing option in the bottom right frame of the web page. Upon execution of a Perl script, the updated list of problems is displayed in the frame with the problems being renumbered.

Once the homework assignment has been set up and problems added to it, the instructor is required to set up release or due dates. On choosing Edit Homework Schedule option on the homework administration page, the instructor views dynamically created web page giving him or her the choice of setting up release dates and time. Figure
6.9 shows the Edit schedule page. The web page displays a list of all homework assignment for the class in a tabular format with corresponding dates and time. Only the homework number chosen by the instructor can be changed. The instructor is required to properly choose release date and time, due date and time, and release date and time for the solutions for the homework. If any of these are not in proper sequence then the system will reject the dates. An option for allowing a grace period is also implemented to give some leave way for late submissions.

<table>
<thead>
<tr>
<th>Homework</th>
<th>Posting Date</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Month</td>
<td>Date</td>
</tr>
<tr>
<td>Homework 1</td>
<td>Jan</td>
<td>15</td>
</tr>
<tr>
<td>Homework 2</td>
<td>Jan</td>
<td>22</td>
</tr>
<tr>
<td>Homework 3</td>
<td>Jan</td>
<td>29</td>
</tr>
<tr>
<td>Homework 4</td>
<td>Feb</td>
<td>05</td>
</tr>
<tr>
<td>Homework 5</td>
<td>Feb</td>
<td>12</td>
</tr>
<tr>
<td>Homework 6</td>
<td>Feb</td>
<td>19</td>
</tr>
<tr>
<td>Homework 7</td>
<td>Feb</td>
<td>26</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Due date</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Month</td>
<td>Date</td>
</tr>
<tr>
<td>Jan</td>
<td>22</td>
</tr>
<tr>
<td>Jan</td>
<td>29</td>
</tr>
<tr>
<td>Feb</td>
<td>05</td>
</tr>
<tr>
<td>Feb</td>
<td>12</td>
</tr>
<tr>
<td>Feb</td>
<td>19</td>
</tr>
<tr>
<td>Feb</td>
<td>26</td>
</tr>
<tr>
<td>Mar</td>
<td>05</td>
</tr>
</tbody>
</table>
The number of points to be deducted for wrong answer and for delay in submission can be done through another web page (Figure 6.10) which is accessed by selecting the Homework Score Distribution option. Default values of 8 points off for wrong answer and 20 points off for late submission is preset. The instructor can keep these default values or select his own numbers. Student’s loose points based upon these values set by the instructor. This page also gives an option to instructor to add additional points to all students in the class. If a particular homework is found difficult, then the instructor can add points to all students. Similar to giving points, the instructor can also take off points.

Figure 6.9 Homework Schedule Edit Page
The instructor always has the facility to delete homework from the system. When the instructor deletes a homework set, a Perl script not only removes details of the homework from the database, but also deletes all schedule times, all problems assigned to that homework and all student submissions. All questions related to the homework can now be assigned to other assignments and student’s submissions records are not available to be graded.

Two features were implemented to overcome system limitations. One feature was to recalculate student scores and the other was to delete problem graphics. Recalculating student scores feature was implemented to overcome errors on the part of the administrator. Since the questions selected for assignments are developed in electronic form, there are chances of overlooking errors. Sometimes the answer does not conform to
one of the listed choices in the questions. It is then required to change the answer choice saved in the database. Since all final scores of the students are calculated at the time of submissions, it is not feasible to change the score of each student separately. Once the mistake has been rectified and answer choice is changed in the database the instructor is required to recalculate the student scores. Once the Perl script is executed, it again compares the student answers with the correct answers in the database and recalculates the scores and saves the information in the database. A confirmation screen is displayed upon successful completion of the task. This process eliminates the laborious process of physically changing each student score.

Another feature implemented was deleting problem graphics. As explained earlier, graphic files are copied from the actual directory to the instructor’s directory folder in order for students to view their assignment pages. If any graphic file is changed in the original folder, then these revised graphic files are not transferred into instructor’s folder. In order to move new graphic files, the old files existing in the instructor’s folder need to be removed. This is accomplished at the administrative level. When the instructor selects Delete Graphic files in the homework management page, all graphic files relating to the homework chosen are removed from the instructor’s folder. Now when anyone accesses the homework assignment again, a fresh set of graphic files is copied over.

6.5 Grade Distribution Management

Testing and assessment is the main source for judging the learning capacity of the students. Grades are an integral part of any curriculum and students are assessed based on these. In a traditional classroom environment, the instructor would manually tabulate all
the scores of the assignment for the students and find relative percentages and assign grades. If there was any discrepancy, they are required to recalculate the grades. In an online environment, where scores are automatically calculated, grades distribution becomes an easy task.

The instructor on entering the administrative site for the first time is required to allocate score distribution for assignments. A web page is created when the instructor clicks on the Grades Distribution link on the administrative menu bar. When the Instructor accesses the administrative site for the first time a default grades distribution page as shown in Figure 6.11 shows up. The default page has certain percentages allocated to homework’s, quizzes and tests and also percentage distribution cut offs for letter grades are displayed. The instructor has an option of accepting the default values or changes the mentioned values. Upon submitting the pages and on verification, the values are stored in the database. The instructor then can come back and change the values whenever required and his pre-entered values are retrieved from database and displayed. The grade distribution page has an option for instructors to drop lowest scored homework or quizzes of the student. The page gives facility to the instructor to give a cumulative percentage for the homework and quizzes, but individual percentages for tests. Since the default page has a provision to assign percentages for two tests only, the instructor has to add more tests to be able to assign percentages. When the instructor adds more tests to the system, the grade distribution page dynamically creates columns to provide percentages for them.
The benefit of the system is that instructors can instantly manipulate the requirements of the course and change grade distribution and percentages. Since all student grades are calculated based upon the values in the database, new grades are instantly calculated. The grade distribution page also gives instructors the flexibility to curve the overall grades of students by changing the percentages of the letter grade distribution.
The knowledge hub is designed in such a way that each instructor can teach their own class and gives their own information. In order for the class course pages to display instructor’s information, dynamic pages are created which are customizable and show the required information. Through the administrative page, the instructor can enter
information pertaining to the class and display details. Upon clicking Create/Edit Front Page link in the administrative menu bar a dynamic page is created giving access to the instructor to fill the class information. Figure 6.12 shows an illustration of the page. The instructor fills his personal information and class information like timings, room numbers etc to be displayed on the main course page. The instructor can also display announcements and other messages on the main course page.

6.7 Feature for E-Mailing Students

The feature for E-mailing students is implemented in the system to enable instructor to communicate with the students. Figure 6.13 shows the dynamically created web page giving instructor the ability to e-mail students. The students e-mail addresses are retrieved from the database and displayed along with instructor e-mail, date and time. The instructor writes the content in the body of the page and sends the e-mail to multiple recipients at the same time. This eliminates the instructor in maintaining a separate account or using an external e-mailing agency to communicate with the students. Appendix H explains the code that is executed for sending e-mails to all students using the basic Perl language.
**Figure 6.13** E-Mail Page for the Instructor

**Figure 6.14** Login/Password Changing Page
6.8 Password Management

Passwords are the main security features that deny access of information to unauthorized people. Since security of information is critical to the system, passwords were incorporated at different stages.

In order for instructor to access administrative site they are required to enter login name and password. The instructor chooses the login name and password during initial set up of the course. If the instructor decides to modify them, then they can do so through the administrative site. Figure 6.14 shows the page where instructor can modify the login name and password. An additional security is implemented wherein instructor is required to enter the old login name and password in order to modify to a new set of values. Permission is denied if values do not collaborate. This additional feature was implemented to prevent anybody from changing the instructors login name and password as knowledge of old login name and password is required.

In order for the instructor to view homework’s, quizzes and tests before the release dates they are required to enter a different set of login names and password. As explained earlier these values overwrite the release date and time restrictions and give the instructor or Teaching Assistant access to the web pages before the assignment is due. In order to have access to these pages, the instructor enters the login name and password into the database. This can be done at the administrative site, wherein the instructor creates an account and modifies it when required. Figure 6.15 shows these pages.
<table>
<thead>
<tr>
<th>Create Login / Password for Teaching Assistant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Login Name/ID No:</td>
</tr>
<tr>
<td>Password:</td>
</tr>
<tr>
<td>Confirm:</td>
</tr>
</tbody>
</table>

| Change | Clear |

<table>
<thead>
<tr>
<th>Change Login / Password for Teaching Assistant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Old Login Name:</td>
</tr>
<tr>
<td>Old Password:</td>
</tr>
<tr>
<td>New Login Name:</td>
</tr>
<tr>
<td>Password:</td>
</tr>
<tr>
<td>Confirm:</td>
</tr>
</tbody>
</table>

*Use old login name if required

**Figure 6.15** Teaching Assistant Login and Password Creation and Modification Page
CHAPTER 7

EVALUATION AND FEEDBACK

Evaluation and feedback are an integral part of any development and design of any project. User feedback enables the assessment of the system and establishing quality control. The response from the users can help in evaluating the drawbacks in the system and find possible solutions. Feedback from users is generally done in the form of surveys which includes personal contact with the user by telephone, Internet, bulletin boards, paper format, etc. The most commonly used medium of survey is through the web or paper format.

7.1 Online Survey

A web based survey was conducted in spring 2000 for both the statics and dynamics courses at the University of Oklahoma, Norman. Students submitted an online survey at the end of the semester. The survey was based on questions relating to the course content, quality of videos and general use of technology. Appendix I shows the sample copy of the survey conducted. The survey was answered by 76 students in dynamics course and 58 students of Statics course. Users opinion on various issues relating to the course and technology and then statistically analyzed.

A total of 45 questions were answered by each student and the survey is divided into different sections. Each section addresses particular key issues relating to the class and technology. There are 4 choices for each question and response on each question was not mandatory. All responses from the students are stored in a text file and later retrieved for statistical analysis.
The survey was divided into 4 sections. Each section addresses a particular issue about the online class and use of technology. The first section deals with the usefulness of webboard, online lectures, laptops. The second section is about ease of use of submissions, CD-ROM and web navigation. The third section asks students to compare CD-ROM with traditional textbook and the final section deals with use of laptops and electronic media.

Statistical analysis of the data is important in ascertaining the effectiveness of any system. The data provided helps in finding the likes and dislikes of the student and addresses issues in which students face difficulty. Professional statistical tool MINITAB was used in performing the analysis. MINITAB was extensively used in analyzing the complete data and analysis was done based on the results. A detailed discussion about the analysis is given in next section.

7.2 Statistical Analysis

Two different types of statistical analysis were performed on the data accumulated. One analysis was done to determine the percentage of students for each response in a survey question. The other analysis was done to determine the One sample Wilcoxon Signed Rank Test of the median to calculate corresponding estimate and confidence interval.

7.2.1 Percentage Response

Students were required to choose one of the 4 alternatives for every question in the survey. Using Microsoft EXCEL, student response data was organized and tabulated.
For each question the number of students who choose different options were added. Number of students who choose not to answer a particular question were also added. Based upon total number of students who answered a particular question, percentages were calculated. Appendix J shows a tabulated format of the percentage distribution of student response for each question. Separate tabulation was done for the statics and the dynamics classes.

Students found doing homework through web and having solutions on the web very useful. 84.9% of students in statics and 81.9% of students in dynamics class found doing homework through web either very useful or useful. 92.6% of students in statics and 97.2% of students found homework solutions on the web either very useful or useful. Nearly 70-80% of students found other features like web board, video lectures, submissions and scores very useful or useful. Students of both statics and dynamics found theory and examples on the CD less useful. Only 37% of statics and 39% of dynamics students found theory and examples on CD very useful or useful. Overall there was high percentage of students who found web based features like course syllabus, submissions, homeworks, lectures, etc., useful.

Students of both courses were required to have laptops. The web based knowledge hub was designed to aid students learn the course material and have easy access to lectures and assignments. A high percentage of students found laptops useful during tests for referencing material than using laptops in class during lectures. This is in fact justifiable as students are required to listen to the instructor than follow the videos on the laptop during classes. Since all tests were open book exams, students were encouraged to use laptops and other course material for reference.
All students of statics and around 98% of dynamics students found accessing and submitting homework on web either easy or very easy. Most of the students also agreed that the web board discussion, participation and downloading video lectures on the web was also very easy. Almost all students also agreed that the system logon, web navigation, verifying submissions and scores very easy. The main idea of the system was to make all the online material very easy to access and use. The response from students verify the same.

The survey analysis also shows that compared to previous courses with textbooks, student found the CD based course content easier to use, understand, enjoyable and convenient. 60% of students in statics and 45% of students in dynamics found the layout and organization of material on CD better. 54% in statics and 45% in dynamics agree that graphics and simulations explained the material better, while only 16% in both classes disagree on the same issue. When students were asked whether they would prefer CD to a text book, majority of students disagreed on it and showed preference of traditional text book over CD.

On the use of laptops and electronic media, nearly 80% of students agreed that laptops were useful for viewing videos of the course and useful for the coursework. Similarly 80% agreed to prefer homework submission electronically than paper. Around 25% of students had difficulty in downloading the images and videos over the network and had difficulty in accessing the network when required. Nearly 80% of students in statics and 65% of students responded that they would prefer to take another laptop based course at the University.
The survey established that students overall enjoyed and like the online web based education and showed interest in enrolling into similar courses. Web Content and online assignment submissions was appreciated more than the traditional teaching method. Although students had difficulty with network connectivity and access to internet, they did show more enthusiasm to the web based knowledge hub.

### 7.2.2 Wilcoxon Signed Rank Test

Many problems in engineering require whether to accept or reject a statement about a parameter [Montgomery 1999]. The statement is called a hypothesis and the decision-making procedure about the hypothesis is called hypothesis testing [Montgomery 1999]. Hypothesis testing uses the principle of comparing the mean of a population to a specified value. In general

\[
\begin{align*}
H_0 & : \mu = \mu_0 \quad (1) \\
H_1 & : \mu \neq \mu_0 \quad (2)
\end{align*}
\]

where \( \mu \) is the mean value of the sample and \( \mu_0 \) is mean value of population. If statement \( H_0 \) is true, then it is called a null hypothesis and if statement \( H_1 \) is true then it is called the alternate hypothesis. Since the alternate hypothesis values of \( \mu \) can be greater or less than \( \mu_0 \) it is called a two sided alternate hypothesis. In some cases one sided alternate hypothesis is also done such that

\[
\begin{align*}
H_0 & : \mu = \mu_0 \\
H_1 & : \mu < \mu_0 \\
H_1 & : \mu > \mu_0
\end{align*}
\]

One sided hypothesis gives critical region based on the value of \( H_1 \). If the alternate hypothesis is \( H_1: \mu > \mu_0 \), the critical region lies in the upper tail of distribution
of the test statistic, whereas if the alternate hypothesis is $H_1: \mu < \mu_o$, the critical region lies in the lower tail of the distribution.

The Wilcoxon signed rank test is a non parametric equivalent of the paired t-test. It is used to test the hypothesis that two paired samples have come from the same population. Because it is non parametric no assumptions about the distribution of the data. It is used to calculate the corresponding point estimate and confidence interval. It applies to the case of symmetric continous distribution and under this assumption, the mean equals the median, and used to test the null hypothesis that $\mu = \mu_o$.

The test involves computing the difference between each value of the sample to the mean(or median) of the population. Then all calculated absolute values are ranked in an ascending order and the ranks are given signs of their corresponding differences. Then sum of all positive ranks is defined by $W^+$ and absolute value of the sum of negative ranks is defined as $W^-$. Based on these 2 values, a minimum of $(W^+,W^-)$ is calculated. Using statistical tables critical value $w_{\alpha}$ is calculated for deduced value of $W$.

For a one sided test, if the alternate is $H_1: \mu > \mu_o$ then one rejects $H_0: \mu = \mu_o$ if $w^- \leq w_{\alpha}$ and if alternate is $H_1: \mu < \mu_o$, then reject $H_0: \mu = \mu_o$ if $w^+ \leq w_{\alpha}$. The value of $\alpha$ for one sided can be 0.05,0.025,0.01,0.005.

Statistical analysis tool MINITAB was used for doing the Wilcoxon Signed Rank Test. The analysis was done to test the sample median less than value of 3. The confidence interval value $\alpha$ was assumed to be 0.05. Analysis on statics and dynamics class was done separately and results tabulated as shown in Appendix K.

Analysis of dynamics data shows that for question 22 of the survey we accept the null hypothesis since $\mu = 3$ and $\alpha > 0.05$. Question 22 of the survey asked students if they
felt CD based coursework was easier to understand compared to courses with textbooks. Therefore we fail to reject the null and we have a weak conclusion. More data is required to make a strong conclusion about question 22. Therefore we cannot say whether students really found the CD based coursework easier to understand. We either need to change our confidence interval or change the null hypothesis to give a strong conclusion about the result.

For question 30 of the survey where students respond to whether they would prefer CD over textbook, we fail to reject the null. In this case also the value of $\mu = 3$ and $p > 0.05$. Similarly for question 31 and 35 of the survey we fail to reject the null. In all cases we have a weak conclusion and we can’t say with 95% confidence interval that the students response can be generalized for a population. More data is required to make a strong statement about the response of the student answers.

For rest of questions in the dynamics class survey the value of $\mu < 3$ and $p < 0.05$ was satisfied. We therefore reject the null and accept the alternative. We have strong conclusion and can say with 95% confidence that the students response can be generalized for a population.

Wilcoxon signed rank test on statics class data also showed similar results. We fail to reject the null for question 22, 30, 32 and 42. Question 22 of the survey addressed the same issue as in dynamics survey. Students were asked if they felt CD based coursework was easier to understand compared to courses with textbooks. Since $\mu = 3$ and $\alpha > 0.05$ for this question we have a weak conclusion and we need more data or change our test statistic to make a statement. Question 32 and 42 are related to quality of the video and downloading these videos over the internet. In both cases we are unable to
make a strong conclusion about the student response. For rest of the questions in the statics survey we reject the null and therefore can draw strong conclusion that students response can be generalized.

Comparing the analysis of statics and dynamics courses one can conclude that more data collection and analysis needs to be done for addressing the issue of use of CD over textbooks by students. Around 25% of students in both classes showed preference of using CD over a text book and 38% of students found CD easier to use over a text book. For rest of the questions of the survey the percentage distribution of students and the wilcoxon signed rank test showed positive results.

Students of both classes found online courses useful, easy to access and enjoyable. Online content through videos was appreciated and submissions of homework through web very useful. Use of laptop and internet for courses was also found very useful. Students expressed preference to take another course at the laptop based course at the university.
CHAPTER 8

CONCLUSION AND RECOMMENDATIONS

Statics and dynamics knowledge hub was designed and developed at the University of Oklahoma to cater to the needs of engineering students and help in addressing the issue of imparting education through the web. The students benefited by learning the course material at their convenience and pace. But as any system, development is never complete and there is always room for improvement and changes. This section summarizes the research in developing the online system and suggests recommendations for improvement.

8.1 Review of the Project

One of the main reasons for this project was to develop a system to show that the use of electronic media and online e-learning can be an effective medium for engineering education. By moving away from traditional classroom based education, the online system provided access to knowledge and information to students at O.U and has the potential to anyone in the world. The system was also designed to help reach millions of people at the same time rather than a small group. With little effort and time, instructors can reach students anywhere in the world.

The system gives immediate and comprehensive access of course material to the students. With access to CD-ROM, video lectures, class notes, web discussions and assignments on the web, the students learn material at their own pace and at their convenience. This reduces anxiety and pressures of attending traditional classes and keeping track of notes and lectures.
Although, the development process of this online course system was time consuming, the system requires minimal maintenance. Initially the hub was available to only one instructor and served the purpose of teaching the online classes at the university. However with the implementation of the system for multiple instructors, the same course is now available to unlimited students. The developed system is not only beneficial to students, but also to instructors as little time is required to setup the classes. Since the online course system is designed for other engineering courses as well, the administrator only needs to develop relevant contents to make a new course.

Overall it took 6-7 man-years to completely develop the online knowledge hub that includes CD based content development, video lecture processing, homework question generation, and Perl programming. The cost of implementation is very low when compared with reach of the material. Most of the software, such as the Perl compiler, web servers, and plug-ins are available for free on the web.

Although use of high technology does help in making learning process more efficient and an exciting experience for students, however, the lack of face-to-face interaction is a major concern. Survey from students shows that having the course in electronic format was a good concept, but the desire to have more interaction with instructor was necessitated.

The implementation of WebBoard and DrawingBoard help offset the requirement for more interaction. With the WebBoard, the students posted their queries and replies quickly. This offsets the requirement of meeting the instructor personally in office hours and gave students opportunity to discuss issues with peers. Since the students generally
finish assignments at the last moment and have little time in clarifying their questions, the WebBoard performed the medium of communication between instructor and students.

As for the instructor, the implementation of the on-demand video lecturing and automated homework grading system is of tremendous help. Generally the instructors spend enormous time in preparing lectures and grading homework’s, but by utilizing the system the time is minimum. Basically the time required in administering the class would be setting up the class and assigning problems to assignments. In addition, the instructor need not worry about the bookkeeping process of recording the student grades as the system automatically grades assignments and records them.

The system has been case tested and successfully implemented at University of Oklahoma, Norman for over 3 semesters wherein basic courses in statics and dynamics has been taught to students using laptop wireless computers. The system has been case tested for multiple instructors and is open to use for free.

8.2 Specific Accomplishments of this Research

Initial development of the online system involved in creating the content on the CD-ROM for both statics and dynamics courses. The knowledge hub was initially developed such that, only one instructor could use the system and manage classes. All data was written and retrieved from text files. The system was used for a period of over 3 semesters at O.U. The current online knowledge hub was subsequently designed, developed and implemented such that multiple instructors can use the same system to administer multiple classes. Following are the major accomplishments of this research for the online knowledge hub.
• A new architecture was designed and implemented such that various instructors for multiple courses can use the system.

• The architecture developed is scalable and can be used to add additional courses such as strength of materials, fluid mechanics, etc. This enables setting up of various courses by multiple instructors.

• The hub was designed such that storage and retrieval of information was from a database instead of text files. The Perl scripts uses Perl-DBI module to communicate with the database.

• An online Internet based course setup system was implemented, wherein instructors can setup their classes in statics and dynamics.

• Dynamic display of information was implemented based on user request for course front page, grade information page, etc.

• Lectures for the dynamics class were video-captured and processed. Streaming videos was made accessible to students through the class course page.

• Security features for the homework/quiz/test pages were improved. Students with proper login and password only have access to their assignment pages.

• Gif images on assignment pages are displayed with a random generated name and stored in a different folder. This was done to ensure security of the images and eliminate access to gif images from actual folders through the browser.

• When students re-enter to submit their homework/quiz/test pages, they have access to their previously answered choices. The system retrieves their previously answered choices and displays them on the web page.
• Various problems for dynamics course were developed over a period of 1 year. This involved conceptualizing the problem, making a HTML format, and creating gif graphics.

• Graphical representation of grades for the students was implemented.

• Security for access to administrative pages was improved with the inclusion of login name and password to all related Perl scripts. This feature ensured that scripts are not executable, when path of the Perl file is entered directly in the browser.

• A system to view student log information was created and implemented.

• Feature to setup grade distribution for the course was introduced. A feature to add or remove points for all students for a particular assignment was also implemented.

• Features like editing grade distribution, course front page, administrative information, passwords, etc., was also implemented.

8.3 Recommendations for Improving Present System

There is always a need for improvement and changes for any learning system, especially with electronic media with its rapidly changing technology. Following are the recommendations, which when implemented would make the online system better and more efficient.

8.3.1 Additional Courses

The system presently has courses for statics and dynamics only. Additional engineering and non-engineering courses can be added to the system. The system as
developed can be used for innumerable courses and the architecture of the system can enable many courses to be set up and used by different instructors. For the new courses, problems for homework and assignments are required to be developed. Also, the lectures for that course need to be recorded and processed.

8.3.2 Random Generation of Problems

Presently, the system has a database of 400 questions each for statics and dynamics courses. These questions are in static HTML and GIF formats. The values in these questions are constant and cannot be changed unless the problems are changed completely. To obtain question with randomn values, a template is required to be developed that allows certain parameters to vary. This would allow instructors to assign a particular template and give the same question to all students with different values. By doing so the instructor can reduce the sharing of information by students during quizzes and tests. The system should also allow the order in which problems appear to vary and the order in which the choices appear also vary. This would minimize or even eliminate people from collaborating on quizzes and tests. Such templates can be created using Flash and Flash Generator.

8.3.3 Flexibility of Choosing ‘e’ Choice Options

Presently the assignment page for students lists out only 4 choices. If instructor wishes to add an ‘e’ choice as “None of the above” option, then the administrator has to manually change each problem. A system in the course administration site can be developed giving the instructor the flexibility of adding choice ‘e’ on the web pages. The
request for ‘e’ option can be stored in the database and displayed upon student request for an assignment. Initially it can be implemented for the complete assignment and then later on for each individual question selection.

8.3.4 CD-ROM Extension

Since the course material is presently accessible through a CD-ROM, students are required to purchase the CD-ROM. Therefore access of course material is limited through the CD only. When multiple instructors set up their courses, then they are required to ask their students to obtain the CD. Although CD can be made available to all students, some limitations can arise with respect to access of CD-ROM at stores. To address the issue, all the content of CD-ROM can be converted into tutorials and made available on the web itself. This would eliminate the requirement of a separate CD-ROM for students and integrate the content with the online system. An online learning system can be implemented tying with the database wherein a track record of topics covered by each student can be monitored. This will enable instructors to check whether students actually read through the chapters. This work has started at the University of Oklahoma for statics and dynamics courses.

8.3.5 Course Content through Videos

Although all videos are accessible to students through the web, there are still problem with respect to network connections and streaming of the videos over the network. Students sometimes have to wait for the videos to stream over the network. There should be overall development in the network connections so that videos can stream faster. If the numbers of users increase then video-streaming servers should be
utilized and simultaneous streaming of videos to multiple users should be done using the broadband connections. Research should be done in areas such as Tele-immersion and interactive simulation, which allow user to actually interact with what they view and is already being used in medicine and hospitals. Tele-immersion involves doctors at hospitals diagnose patients at remote clinics or at patients home with the patient never leaving his location. Tele-immersion involves virtual reality, full motion video, animation and user interaction. Such technique would help better interaction between various Instructors and students.

8.3.6 Introducing Wireless Palmtops in Classes

Presently all online classes are accessible through desktops or laptops. The next generation in wireless technology is the use of palm devices. These devices cost $300-500 whereas laptops cost $1000-$1500. With the growth of palm devices, the online classes should also be developed and addressed for running on the palm devices. Additional efforts can be put for creating the present online system to cater to this segment of the market. Infact already a project has been started at University of Oklahoma addressing this issue to make classes available to students through palm devices.

8.3.7 Introducing Wireless Palmtops in Classes

The present system requires implementation of better security features such as monitoring the students and ensuring that actual students take the course. Although, other than checking physically each student, the instructor cannot ensure whether the student
registered in the course is in fact taking the actual exam. Randomly generating the questions can limit collaboration between the students, but still instructors cannot monitor who is taking the exams. To address the issue, the system should have digital signatures, also known as e-Signature. People can give their account information and password to other people to access the exam pages. They can even forget or lose their passwords, but a person’s signature, voice or fingerprints cannot be changed or tampered. If digital signature is implemented then many of security issues can be solved.

Commercial companies such as OnSign.com distributes digital signature software for free. The underlying technology uses digital signature, but a bitmap of a traditional signature is also affixed to the document. Two other companies Communication Intelligence Corp and Cyber-Sign have developed digital signature verifications wherein as a person signs on a pressure sensitive tablet, the software records character shape, writing speed, stroke order, off tablet motion, pen pressure and timing. These characteristics uniquely identify a person and cannot be mimicked or stolen.

**8.3.8 Online Mentoring**

It is a new trend that is developing wherein an online course is coupled with a live mentor. This enables students to learn information through online course and simultaneously have access to a live talking head. Using video conferencing, streaming video technology, web-boards and chat rooms interaction between instructor and student is possible.
8.3.9 Voice Component in e-Learning

Voice delivered over the Internet can help students in learning knowledge effectively. Although voice is available through the streaming videos, it does not allow student to talk back. Currently, when a student has any questions on a particular topic, all they receive is a text document in the WebBoard. If a voice component is added to the system then student can have a clear idea of what is being explained. “When you add a live voice component, it makes the message more robust and intimate experience” explains Jeremy Verbal, President of California based HearMe [Jones, 2000] company that delivers real time voice collaboration over the Internet. Similar to Internet text-based conferencing, live voice can be recorded and sent as streamed data. When a user receives the data, it is translated back to voice.
REFERENCES


U.R.L http://www.marshall.edu/it/cit/webct/compare/comparison.html

U.R.L http://www.roth.net/perl/odbc/faq
U.R.L  http://www.perl.com

U.R.L  http://www.symbolstone.com


Video Development Initiative., 1999, Digital Video for the next millennium.


Yellamraju Vikas, Tony Romanello and Kurt Gramoll, 2000, “Teaching Dynamics
Online with only Electronic Media on Laptop Computers,” Proceedings of the
ASEE Annual Conference, St Louis, Missouri, June 2000.
APPENDIX

Appendix A  List of all Perl Files.
Appendix B  Relationship Diagram for databases
Appendix C  Standard parameters for compressing movie in Media Cleaner
Appendix D  HTML code for a question problem
Appendix E  Perl code to display Questions/Solution/Score page in an assignment
Appendix F  Perl code to accepts students submission and perform grading
Appendix G  Perl code for executing Score Report
Appendix H  Perl code for e-mailing students
Appendix I  Online Survey Document
Appendix J  Percentages of Student Response for Online Survey
Appendix K  Wilcoxon Signed Rank Test
Appendix A

List of all Perl Files

Add_instr.pl  Addnewst.pl
Adlogin.pl    Admin_chngpasswd.pl
Admin_menu.pl Admin_course_titlepage.pl
Adminlgpage.pl Adminstudentacc.pl
Change_score.pl Checksol.pl
Course_dist.pl Course_dist_change.pl
Course_home.pl Course_menu.pl
Course_titlepage.pl Encryp.pl
Instr_setup.pl Keyinfo.pl
Keyno.htm     Modify_titlepage.pl
Navigation.pl Navigation_menu.pl
Prob_addnew.pl Prob_addq.pl
Prob_admin.pl Prob_adminpl.pl
Prob_deleteq.pl Prob_editsche.pl
Prob_grading.pl Prob_lgpage.pl
Prob_login.pl  Prob_qset.pl
Prob_question.pl Prob_scoredis.pl
Scheduling.htm Score_report.pl
Sendmail.pl    Serverclock.pl
Sndml_htm.pl   Stchangepwd.pl
Stcreate.pl    Stdinfo.pl
Stdlgpage.pl   Stdlogadmin.pl
Steditinfo.pl  Database_pat.pl
Error_info.pl  Readpath.pl
Readscores.pl  Studentchangelib.pl
Appendix B

Relationship Diagram for Databases
Appendix C

Standard parameters for compressing movie in Media Cleaner 4.0

<table>
<thead>
<tr>
<th>Output</th>
<th>QuickTime (.mov), Flatten/cross-platform/fast-start, Compress movie headers, Auto-play-in window</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tracks</td>
<td>Process video (display high quality), Process audio</td>
</tr>
<tr>
<td>Adjust</td>
<td>Manual crop, Display at 300x240, Noise reduce</td>
</tr>
<tr>
<td>Image</td>
<td>Brightness -18, Contrast 1</td>
</tr>
<tr>
<td>Compress</td>
<td>Sorenson Video(TM) Compressor, Millions of colors, 10 fps, Keyframe every 1:20, 12.0 KBytes/s video</td>
</tr>
<tr>
<td>Audio</td>
<td>QDesign Music, 2.0 KBytes/s, 16-bit mono samples at 11.025 kHz, adjust volume to 80%, low pass 20.000 kHz, noise removal</td>
</tr>
<tr>
<td>Begin/End</td>
<td>high-quality first/last</td>
</tr>
<tr>
<td>Alternate</td>
<td>ISDN, quality 9, QuickTime 3</td>
</tr>
</tbody>
</table>
Appendix D

HTML code for a question problem

<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 3.2//EN">
<html>
<head>
  <meta http-equiv="Content-Type" content="text/html; charset=iso-8859-1">
  <meta name="GENERATOR" content="Visual Page 2.0 for Windows">
  <title>Dynamics</title>
</head>
<body text="black" bgcolor="white">
  <p>
    An object consisting of two identical bars each of 5 ft long and 10 lb, are welded together. If they are released from the position shown, what is the angular acceleration?<br>
    <table border="0" cellpadding="0" cellspacing="0" width="300">
      <tr>
        <td valign="top">
          a. 24.44 rad/s<sup>2</sup>
        </td>
      </tr>
      <tr>
        <td valign="top">
          b. 66.83 rad/s<sup>2</sup>
        </td>
      </tr>
      <tr>
        <td valign="top">
          c. 16.36 rad/s<sup>2</sup>
        </td>
      </tr>
      <tr>
        <td valign="top">
          d. 41.54 rad/s<sup>2</sup>
        </td>
      </tr>
    </table>
  </p>
</body>
</html>
Appendix E
Perl code to display Questions/Solution/Score page in an assignment

# prob_login.pl This perl is activated when students click on either problem/solution/score/review submission.

use CGI qw/:standard/;
use CGI;
use Win32::ODBC;

# Fetch action definition, homework, quiz or test
$query=new CGI;
$class  = $query->param('course');   # from HTML page link
$sta_in  = $query->param('status');   # from HTML page link
$username = $query->param('id');
$passwordin = $query->param('password');
$num_no = $query->param('number');
$functions = $query ->param('selection');
$webno = $query->param('webno');

# Read in the paths from the library, different paths for each class
require "eCourses/cgi-bin/lib/readpath.pl";   ######  Open libraries for reading the paths
&symbol;  ###### reads the subroutine in readpath.pl to get access to all paths
require "eCourses/cgi-bin/lib/database_path.pl";    ######  Open libraries for reading the paths
&db_path; # reads the subroutine in database_path.pl to get access to all paths

# Main Program
$code=EML;
$passwordin=crypt($passwordin,$code);
$passwordin=substr($passwordin,2,11);
$prob_qset = "$Sta_title $num_no";
read_ta_encryption_code();

if (!($db=new Win32::ODBC($DSN)))
{
    &db_error_1;
}

$SqlStatement = "SELECT description,postingdate,postingtime,duedate,duetime,solnpostingdate,solnpostingtime FROM course_setup_info WHERE webno ="$webno' AND description = "$Sta_title $num_no"";
if ($db->Sql($SqlStatement))
{
    &db_error_2;
} else
{
while($db->FetchRow())
{
    %Data = $db->DataHash();
    $number = $Data{"description"};
    $postdate = $Data{"postingdate"};
    $posttime = $Data{"postingtime"};
    $duedate = $Data{"duedate"};
$duetime =$Data{"duetime"};
$solndate =$Data{"solnpostingdate"};
$solntime =$Data{"solnpostingtime"};

$db->Close();

if ($functions eq "question")
{
    if (($username eq $testacc) && ($passwordin eq $testaccpw))
    {
        login_check();
    }
    else
    {
        login_check();
        $checkdatefor=2;
        checkdate();
    }
    checkearlier_submission();
gotoproblempage();
write_log();
}

if ($functions eq "solution")
{
    if ($username eq $testacc)
    {
        login_check();
    }
    else
    {
        login_check();
        $checkdatefor=3;
        checkdate();
    }
    solution();
write_log();
}

if ($functions eq "score")
{
    if ($username eq $testacc)
    {
        login_check();
    }
    else
    {
        login_check();
        $checkdatefor=3;
        checkdate();
    }
    readstudent_scores();
generator();
viewmyscore();
write_log();
}

if ($functions eq "review")
{
    login_check();
    reviewsubmission();
    write_log();
}
# check date for 1 = solution and score.
# check date for 2 = question and review
#
sub read_ta_encryption_code
{
    if (!($db=new Win32::ODBC($DSN)))
    {
        &db_error_1;
    }
    $SqlStatement = "SELECT ta_lgname,ta_encppasswd FROM prof_classinfo WHERE webno ="$webno";"
    if ($db->Sql($SqlStatement))
    {
        &db_error_2;
    }
    else
    {while($db->FetchRow())
        {
            %Data = $db->DataHash();
            $testacc = $Data{"ta_lgname"};
            $testaccpw = $Data{"ta_encppasswd"};
        }
    }
    $db->Close();
}
#
sub login_check
{
    if (!($db=new Win32::ODBC($DSN)))
    {
        &db_error_1;
    }
    $SqlStatement = "SELECT std_idno,std_encryppasswd FROM std_info WHERE webno ="$webno' AND std_idno ="$username")
    if ($db->Sql($SqlStatement))
    {
        &db_error_2;
    }
    else
    {while($db->FetchRow())
        {
            %Data = $db->DataHash();
            $std_id = $Data{"std_idno"};
            $std_encryp = $Data{"std_encryppasswd"};
        }
    }
    $db->Close();
    $torf="no";
    $checkdatefor=0;
    $datecheck="no";
    if ($username eq $testacc)
if ($passwordin eq $testaccpw)
{
    $torf="yes";
    #print header();
}

elsif ($username eq "guest")  ##  check for guest
    { $torf="yes"; }
elsif ($username eq $std_id)
{
    if ($passwordin eq $std_encryp)
    {
        $torf="yes";
    }
}

if ($torf eq "no")
{
    print "Content-type: text/html\n\n"
    print <<redirection;
<html>
<TABLE BORDER="0" CELLPADDING="0" CELLSPACING="0" WIDTH="500"
BGCOLOR="#000099">
<TR>
    <TD COLSPAN="3"><B><FONT COLOR="white " FACE="Arial, Helvetica, MS Sans
serif">Login Error</FONT></B></TD>
<TR>
    <TD BGCOLOR="#FFCC99"><FONT SIZE="2" FACE="Arial, Helvetica, MS Sans
serif">
<br><P ALIGN="CENTER">
<b>Your login is incorrect.  --  $username </b>
<br><br>
If you do not have a login account please contact your instructor.<br>
<P ALIGN="CENTER">
If you have created a login, you may choose to re-type <br> your login information
<br><br>
<P ALIGN="CENTER">
Click <a href="javascript:history.back()">here</a> to go back to login page.</font>
<BR>
</TD>
</TR>
</TABLE>
</html>
redirection
exit();
}

####################################################
# Checks if there has been an earlier submission by student for that particular assignment
####################################################
sub checkearlier_submission
{
    if (!$db=new Win32::ODBC($DSN))
    {
        &db_error_1;
    }
}

$SqlStatement = "SELECT std_answers FROM std_submission_info
    WHERE (webno='$webno' AND std_idno='$username')AND description='$prob_qset';"
if ($db->Sql($SqlStatement))
{
    &db_error_2;
} else
{while($db->FetchRow())
{ %Data = $db->DataHash();
    $array_values = $Data("std_answers");
}
}$db->Close();
if ($array_values eq "")
{
    $subm_exist="no";
} else
{
    $subm_exist ="yes";
}
$array_choices= split(/,/$array_values);

##################################################
##  Set up page with problems
##################################################
sub gotoproblempage
{
    $startreading="no";
    $tester="no";
    if ($prob_qset eq $number)
    {
        $startreading="yes";
        $tester="yes";
    }
    if ($startreading eq "yes")
    {
        if (!$db=new Win32::ODBC($DSN))
        {
            &db_error_1;
        }
        $SqlStatement = "SELECT probinfo,probnumber,probencryp FROM course_prob_info WHERE description='$prob_qset' AND webno ='$webno' ";
        $count =0;
        if ($db->Sql($SqlStatement))
        {
            
        }
}
&db_error_2;
else
{while($db->FetchRow())
{
  %Data = $db->DataHash();
  @prob_info[$count] = $Data{"probinfo"};
  @prob_numb[$count] = $Data{"probnumber"};
  @prob_encryp[$count] = $Data{"probencryp"};
  $count++;
}
}
printquestion(); # add each question
}
if ($startreading eq "yes")
{
$startreading="no";
if ($solutiononoff ne "yes")
{
  print "<INPUT TYPE="HIDDEN" NAME="totalquestion" VALUE="$questiono">"
  print "<INPUT TYPE="HIDDEN" NAME="hwno" VALUE="$num_no">"
  print "<INPUT TYPE="HIDDEN" NAME="idno" VALUE="$username">"
  print "<INPUT TYPE="HIDDEN" NAME="course" VALUE="$class">"
  print "<INPUT TYPE="HIDDEN" NAME="status" VALUE="$sta_in">"
  print "<INPUT TYPE="HIDDEN" NAME="webno" VALUE="$webno">"
  if ($prob_info[0] eq "")
  {
    print <<redirection;
    <html>
    <TABLE BORDER="0" CELLPADDING="0" CELLSPACING="0" WIDTH="500"
    BGCOLOR="#000099">
    <TR>
    <TD COLSPAN="3"><B><FONT COLOR="white" FACE="Arial, Helvetica, MS Sans serif">Information</FONT></B></TD>
    </TR>
    <TR>
    <TD BGCOLOR="#FFCC99"><FONT SIZE="2" FACE="Arial, Helvetica, MS Sans serif">$Sta_title $num_no questions are not selected. Please check with your instructor</FONT></TD>
    </TR>
    <TR>
    <TD BGCOLOR="#FFCC99"><FONT SIZE="2" FACE="Arial, Helvetica, MS Sans serif">Click <a href="javascript:history.back()">here</a> to go back to login page.</FONT></TD>
    </TR>
    </TABLE>
    redirection
    exit();
  }
else
  {

if ($username ne "guest")  ## check for guest, if guest don't print submit button
{
  if (($username eq $test acc) && ($password in eq $testaccpw))
  {
  }
  else
  {
    print "<INPUT TYPE="SUBMIT" NAME="Submit" VALUE="Submit"/>";
  }
}
else
{
print "<INPUT TYPE="RESET" NAME="Reset" VALUE="Clear"/>"><form>

if ($tester eq "no")
{
  print <<redirection;
  <html>
  <TABLE BORDER="0" CELLPADDING="0" CELLSPACING="0" WIDTH="500"
  BGCOLOR="#000099">
  <TR>
    <TD COLSPAN="3"><B><FONT COLOR="white" FACE="Arial, Helvetica, MS Sans
  serif">Information</FONT></B></TD>
  </TR>
  </TD>
  <TR>
    <TD BGCOLOR="#FFCC99"><FONT SIZE="2" FACE="Arial, Helvetica, MS Sans
  serif">&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&n...
{ print "<br><br><b><font size="3" font color="#red">NOTE: You may consider Option 'e' if your answer is more than 2% different from the listed choices.</b><br><br>
}
for ($c=0;$c<$count;$c++)
{ ## start of first for loop
($chapter,$subchapter,$difficulty,$question)=split(/_/,$prob_info[$c]);
$topic = "$chapter".".""$subchapter";
$startprint="no";
$questn = $ddb.$topic.".""$difficulty.".""$question.".htm";
$diff_hint = substr($difficulty,0,1);   # just first letter, e or h
$ddb_imagepath = "eCourses/"."$class_title."."instructor":";
$questiono = "$prob_numb[$c]";
$radio_check = "$array_choices[$c]";
$questnname = "$topic".".""$difficulty".".""$question";
open(quest_htm_file,$questn);
@hwarr=<quest_htm_file>;</b><br><br>
foreach $lines (@hwarr)
{ ## start of first foreach loop
$temp=$lines;
chop($temp);
if (($temp =~ /<end>/) && ("$solutiononoff eq "yes") ) # if solution is picked, then add solution
  pics
  {
    $dupabsimagenameright = $ddb.$topic.".""$difficulty.".""graphics.".""$question.".ar.gif";
    $dupabsimagenameleft = $ddb.$topic.".""$difficulty.".""graphics.".""$question.".al.gif";
    $absimagenameright = $ddb_imagepath.".""$webno.".""$question.".ar.gif";
    $absimagenameleft = $ddb_imagepath.".""$webno.".""$question.".al.gif";
    $check_imageright = $ddb_imagepath "$prob_encrypt[$c]".".ar.gif";
    $check_imageleft = $ddb_imagepath "$prob_encrypt[$c]".".al.gif";
    if ("$copy_permission eq "yes")
    {
      if (-e "$check_imageleft")
      {}
      elsif (-e "$dupabsimagenameleft")
      {
        use File::Copy;
        copy($dupabsimagenameleft,$absimagenameleft);
        $filename="$prob_encrypt[$c]".".al.gif";
      };
      rename($absimagenameleft,$ddb_imagepath "$webno."."$filename")
      if (-e "$check_imageright")
      {
        elsif (-e "$dupabsimagenameright")
        {
          use File::Copy;
          copy($dupabsimagenameright,$absimagenameright);
          $filename="$prob_encrypt[$c]".".ar.gif";
        };
        rename($absimagenameright,$ddb_imagepath "$webno."."$filename")
      };
    }
  };
};
<TD WIDTH="45"><INPUT TYPE="RADIO" NAME="$questiono" VALUE="a"></TD>
<TD WIDTH="15">b.</TD>
<TD WIDTH="45"><INPUT TYPE="RADIO" NAME="$questiono" VALUE="b"></TD>
<TD WIDTH="15">c.</TD>
<TD WIDTH="45"><INPUT TYPE="RADIO" NAME="$questiono" VALUE="c"></TD>
<TD WIDTH="15">d.</TD>
<TD WIDTH="45"><INPUT TYPE="RADIO" NAME="$questiono" VALUE="d"></TD>
</TR></TABLE>

submission_form

if (($temp =~ /<submission_form>/) && ($solutiononoff ne "yes")&&($subm_exist ne "no"))
{
    if ($radio_check eq "a")
    {
        print "<INPUT TYPE="hidden" Name="$num_no.$questiono" Value="$questnname">
<TABLE BORDER="0" CELLPADDING="0" CELLSPACING="0" WIDTH="300">
<TR>

    <TD WIDTH="15">a.</TD>
    <TD WIDTH="45"><INPUT TYPE="RADIO" NAME="$questiono" VALUE="a" CHECKED></TD>
    <TD WIDTH="15">b.</TD>
    <TD WIDTH="45"><INPUT TYPE="RADIO" NAME="$questiono" VALUE="b"></TD>
    <TD WIDTH="15">c.</TD>
    <TD WIDTH="45"><INPUT TYPE="RADIO" NAME="$questiono" VALUE="c"></TD>
    <TD WIDTH="15">d.</TD>
</TR></TABLE>

}
else if ($radio_check eq "b") ##### IMPORTANT : Keep the space in "b". Somehow that space is created in database########
{
    print "<INPUT TYPE="hidden" Name="$num_no.$questiono" Value="$questnname">
<TABLE BORDER="0" CELLPADDING="0" CELLSPACING="0" WIDTH="300">
<TR>

    <TD WIDTH="15">a.</TD>
    <TD WIDTH="45"><INPUT TYPE="RADIO" NAME="$questiono" VALUE="a"></TD>
    <TD WIDTH="15">b.</TD>
    <TD WIDTH="45"><INPUT TYPE="RADIO" NAME="$questiono" VALUE="b" CHECKED></TD>
    <TD WIDTH="15">c.</TD>
    <TD WIDTH="45"><INPUT TYPE="RADIO" NAME="$questiono" VALUE="c"></TD>
    <TD WIDTH="15">d.</TD>
</TR></TABLE>

}

submission_form

}
<TD WIDTH="15">d.</TD>
<TD WIDTH="45"><INPUT TYPE="RADIO" NAME="$questiono" VALUE="d"></TD>
</TR></TABLE>


elsif ($radio_check eq " c")
##### IMPORTANT : Keep the space in " c". Somehow that space is created in database########
{
    print <<submission_form;
    <INPUT TYPE="hidden" Name="$num_no.$questiono" Value="$questnname">
    <TABLE BORDER="0" CELLPADDING="0" CELLSPACING="0" WIDTH="300">
    <TR>
        <br>
        <TD WIDTH="15">a.</TD>
        <TD WIDTH="45"><INPUT TYPE="RADIO" NAME="$questiono" VALUE="a"></TD>
        <TD WIDTH="15">b.</TD>
        <TD WIDTH="45"><INPUT TYPE="RADIO" NAME="$questiono" VALUE="b"></TD>
        <TD WIDTH="15">c.</TD>
        <TD WIDTH="45"><INPUT TYPE="RADIO" NAME="$questiono" VALUE="c" CHECKED></TD>
        <TD WIDTH="15">d.</TD>
        <TD WIDTH="45"><INPUT TYPE="RADIO" NAME="$questiono" VALUE="d"></TD>
    </TR></TABLE>
    submission_form
}
    elsif ($radio_check eq " d")
    ##### IMPORTANT : Keep the space in " d". Somehow that space is created in database########
{
    print <<submission_form;
    <INPUT TYPE="hidden" Name="$num_no.$questiono" Value="$questnname">
    <TABLE BORDER="0" CELLPADDING="0" CELLSPACING="0" WIDTH="300">
    <TR>
        <br>
        <TD WIDTH="15">a.</TD>
        <TD WIDTH="45"><INPUT TYPE="RADIO" NAME="$questiono" VALUE="a"></TD>
        <TD WIDTH="15">b.</TD>
        <TD WIDTH="45"><INPUT TYPE="RADIO" NAME="$questiono" VALUE="b"></TD>
        <TD WIDTH="15">c.</TD>
        <TD WIDTH="45"><INPUT TYPE="RADIO" NAME="$questiono" VALUE="c"></TD>
        <TD WIDTH="15">d.</TD>
        <TD WIDTH="45"><INPUT TYPE="RADIO" NAME="$questiono" VALUE="d" CHECKED></TD>
    </TR></TABLE>
    submission_form
}
    elsif ($radio_check eq " z")
    ##### IMPORTANT : Keep the space in " z". Somehow that space is created in database########
{
    print <<submission_form;
<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>b.</td>
<td>c.</td>
<td>d.</td>
<td>e.</td>
</tr>
</tbody>
</table>

```html
<INPUT TYPE="hidden" Name="$num_no.$questiono" Value="$questname">
<TABLE BORDER="0" CELLPADDING="0" CELLSPACING="0" WIDTH="300">
  <TR>
    <br>
    <TD WIDTH="15">a.</TD>
    <TD WIDTH="45"><INPUT TYPE="RADIO" NAME="$questiono" VALUE="a"></TD>
    <TD WIDTH="15">b.</TD>
    <TD WIDTH="45"><INPUT TYPE="RADIO" NAME="$questiono" VALUE="b"></TD>
    <TD WIDTH="15">c.</TD>
    <TD WIDTH="45"><INPUT TYPE="RADIO" NAME="$questiono" VALUE="c"></TD>
    <TD WIDTH="15">d.</TD>
    <TD WIDTH="45"><INPUT TYPE="RADIO" NAME="$questiono" VALUE="d"></TD>
    <TD WIDTH="15">e.</TD>
    <TD WIDTH="45"><INPUT TYPE="RADIO" NAME="$questiono" VALUE="e"></TD>
  </TR>
</TABLE>
```
<table>
<thead>
<tr>
<th>a.</th>
<th>b.</th>
<th>c.</th>
<th>d.</th>
<th>e.</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="radio_a" /></td>
<td><img src="image" alt="radio_b" /></td>
<td><img src="image" alt="radio_c" /></td>
<td><img src="image" alt="radio_d" /></td>
<td><img src="image" alt="radio_e" /></td>
</tr>
</tbody>
</table>

**Important:** Keep the space in "b". Somehow that space is created in database.

**Important:** Keep the space in "c". Somehow that space is created in database.
<TD WIDTH="45"><INPUT TYPE="RADIO" NAME="$questiono" VALUE="a"></TD>
<TD WIDTH="15">b.</TD>
<TD WIDTH="45"><INPUT TYPE="RADIO" NAME="$questiono" VALUE="b"></TD>
<TD WIDTH="15">c.</TD>
<TD WIDTH="45"><INPUT TYPE="RADIO" NAME="$questiono" VALUE="c" CHECKED></TD>
<TD WIDTH="15">d.</TD>
<TD WIDTH="45"><INPUT TYPE="RADIO" NAME="$questiono" VALUE="d"></TD>
<TD WIDTH="15">e.</TD>
<TD WIDTH="45"><INPUT TYPE="RADIO" NAME="$questiono" VALUE="e"></TD>
</TR></TABLE>

elsif ($radio_check eq " d") ##### IMPORTANT : Keep the space in "d". Somehow that space is created in database#####
{
    print <<submission_form;
    <INPUT TYPE="hidden" Name="$num_no.$questiono" Value="$questnname">
    <TABLE BORDER="0" CELLPADDING="0" CELLSPACING="0" WIDTH="300">
        <TR>
            <br>
            <TD WIDTH="15">a.</TD>
            <TD WIDTH="45"><INPUT TYPE="RADIO" NAME="$questiono" VALUE="a"></TD>
            <TD WIDTH="15">b.</TD>
            <TD WIDTH="45"><INPUT TYPE="RADIO" NAME="$questiono" VALUE="b"></TD>
            <TD WIDTH="15">c.</TD>
            <TD WIDTH="45"><INPUT TYPE="RADIO" NAME="$questiono" VALUE="c"></TD>
            <TD WIDTH="15">d.</TD>
            <TD WIDTH="45"><INPUT TYPE="RADIO" NAME="$questiono" VALUE="d" CHECKED></TD>
            <TD WIDTH="15">e.</TD>
            <TD WIDTH="45"><INPUT TYPE="RADIO" NAME="$questiono" VALUE="e"></TD>
        </TR>
    </TABLE>

elsif ($radio_check eq " e") ##### IMPORTANT : Keep the space in "e". Somehow that space is created in database#####
{
    print <<submission_form;
    <INPUT TYPE="hidden" Name="$num_no.$questiono" Value="$questnname">
    <TABLE BORDER="0" CELLPADDING="0" CELLSPACING="0" WIDTH="300">
        <TR>
            <br>
            <TD WIDTH="15">a.</TD>
            <TD WIDTH="45"><INPUT TYPE="RADIO" NAME="$questiono" VALUE="a"></TD>
            <TD WIDTH="15">b.</TD>
<TD WIDTH="45"><INPUT TYPE="RADIO" NAME="$questionno" VALUE="b"></TD>
<TD WIDTH="15">c.</TD>
<TD WIDTH="45"><INPUT TYPE="RADIO" NAME="$questionno" VALUE="c"></TD>
<TD WIDTH="15">d.</TD>
<TD WIDTH="45"><INPUT TYPE="RADIO" NAME="$questionno" VALUE="d"></TD>
<TD WIDTH="15">e.</TD>
<TD WIDTH="45"><INPUT TYPE="RADIO" NAME="$questionno" VALUE="e" CHECKED></TD></TR></TABLE>

submission_form

else if ($radio_check eq " z") ##### IMPORTANT : Keep the space in " z".
Somehow that space is created in database#####
{
    print <<submission_form;
    <INPUT TYPE="hidden" Name="$num_no.$questionno" Value="$questnname">
    <TABLE BORDER="0" CELLPADDING="0" CELLSPACING="0" WIDTH="300">
    <TR>
    <br>
    <TD WIDTH="15">a.</TD>
    <TD WIDTH="45"><INPUT TYPE="RADIO" NAME="$questionno" VALUE="a"></TD>
    <TD WIDTH="15">b.</TD>
    <TD WIDTH="45"><INPUT TYPE="RADIO" NAME="$questionno" VALUE="b"></TD>
    <TD WIDTH="15">c.</TD>
    <TD WIDTH="45"><INPUT TYPE="RADIO" NAME="$questionno" VALUE="c"></TD>
    <TD WIDTH="15">d.</TD>
    <TD WIDTH="45"><INPUT TYPE="RADIO" NAME="$questionno" VALUE="d"></TD>
    <TD WIDTH="15">e.</TD>
    <TD WIDTH="45"><INPUT TYPE="RADIO" NAME="$questionno" VALUE="e"></TD>
    </TR></TABLE>
    submission_form
}
}
if ($startprint eq "yes")
    {print $lines;}
if ($temp =~ /<endpic>/)
    {$startprint="yes";}
if ($temp =~ /<start>/)
    {$startprint="yes"}
}

###########################################################
# Print question + solution
###########################################################
sub solution {

$solutiononoff="yes";
gotoproblempage();
print "<br><FONT SIZE="2" FACE="Arial, Helvetica, MS Sans serif">Click <a href="javascript:history.back()">here</a> to return to menu.<br>
#
####################################################
# Date and time checking
####################################################
sub checkdate
{
$inorout = "out";
($title,$numb)= split(/ /,$number);
($pmonth,$pdate,$pyear)= split(/ /,$postdate);
($phour,$pmin)= split(/ /,$posttime);
($dmonth,$ddate,$dyear)= split(/ /,$duedate);
($dhour,$dmin)= split(/ /,$duetime);
($lmonth,$ldate,$lyear)= split(/ /,$solndate);
($lhour,$lmin)= split(/ /,$solntime);
if ($numb == $num_no)
{
if ($checkdatefor == 1)
{
$mint=$dmin;
$hourt=$dhour;
$datet=$ddate;
$montht=$dmonth;
$yeart=$dyear;
# print " $duemonth $duedate $dueyear $duehour $duemin";
}
elsif ($checkdatefor == 2)
{
$mint=$pmin;
$hourt=$phour;
$datet=$pdate;
$montht=$pmonth;
$yeart=$pyear;
}
elsif ($checkdatefor == 3)
{
$mint=$lmin;
$hourt=$lhour;
$datet=$ldate;
$montht=$lmonth;
$yeart=$lyear;
$copy_permission="yes";
}
else
{
print "Content-type: text/html\n\n";
print <<redirection;
<html>
<TABLE BORDER="0" CELLPADDING="0" CELLSPACING="0" WIDTH="500"
BGCOLOR="#000099">
<TR>
Error Information

Information of $Sta_title $num_no is not available from the database. Please contact your administrator.

Click <a href="javascript:history.back()">here</a> to go back to Login page.

### perform comparison.

```perl
if ($year > $yeart) {$inorout="in";}  
if (($year == $yeart) and ($month > $montht)) {$inorout="in";}  
if (($year == $yeart) and ($month == $montht) and ($date > $datet)) {$inorout="in";}  
if (($year == $yeart) and ($month == $montht) and ($date == $datet) and ($mul >= $totalmins)) {
  $inorout="in";
}  
if ($inorout eq "out")  
  {
    print "Content-type: text/html\n\n";  
    print "\n\n";  
  }  
</html>
<TABLE BORDER="0" CELLPADDING="0" CELLSPACING="0" WIDTH="500" BGCOLOR="#000099">
  <TR>
    <TD COLSPAN="3">$Sta_title Information</TD>
  </TR>
  <TR>
    <TD COLSPAN="3" BGCOLOR="#FFCC99"><p align="center">Click <a href="javascript:history.back()">here</a> to go back to Login page.</p></TD>
  </TR>
</html>
```
$Sta_title # $num_no is not available at the moment <br>Please check back later.
</b><br>
</FONT></TD><br>
</TR>
<tr>
<TD COLSPAN="3" BGCOLOR="#FFCC99">
<br><P ALIGN="CENTER"><FONT SIZE="2" COLOR="#990000" FACE="Arial, Helvetica">
Click <a href="javascript:history.back()">here</a> to go back to Login page.</font>
</TD>
</TR>
</TABLE>
</html>
redirection
exit();
}

)))))))))))))))))))
# Code to get student students scores
))))))))))))))))))))))
sub readstudent_scores
{
if (!($db=new Win32::ODBC($DSN)))
{
 &db_error_1;
}
$sqlStatement = "SELECT total FROM std_submission_info WHERE webno ="$webno' AND description = 'sprob_qset";
$numb=0;
if ($db->Sql($sqlStatement))
{
 &db_error_2;
}
else
{while($db->FetchRow())
{
 %Data = $db->DataHash();
 @std_totalscore[$numb] = $Data{"total"};
$numb++;;
}
}$db->Close();
}

)))))))))))))))))))))))))))))))))))))))))))))))))))))))))))))))
# Code for executing the generator subroutine
))))))))))))))))))))))))))))))))))))))))))))))))))))))))))))))))))))))))))))))))))))))))))))))
sub generator
{
$count0 = 0;
$count1 = 0;
$count2 = 0;
$count3 = 0;
$count4 = 0;
$count5 = 0;
$count6 = 0;
$count7 = 0;
$count8 = 0;
$count9 = 0;
$count10 = 0;
$gen = _gen;
$score_text="eCourses/cgi-bin/gen_dev/data/".$sta_in.$gen.".eml";
if (open (gentext,$score_text))
{
for($idc=1;$idc<$numb+1;$idc++)
{
    $value="$std_totalscore[$idc-1]";
    if (($value >=0)and ($value <=9))
        {$count0 += 1;}
    elsif (($value >=10)and ($value <=19))
        {$count1 += 1;}
    elsif (($value >=20)and ($value <=29))
        {$count2 += 1;}
    elsif (($value >=30)and ($value <=39))
        {$count3 += 1;}
    elsif (($value >=40)and ($value <=49))
        {$count4 += 1;}
    elsif (($value >=50)and ($value <=59))
        {$count5 += 1;}
    elsif (($value >=60)and ($value <=69))
        {$count6 += 1;}
    elsif (($value >=70)and ($value <=79))
        {$count7 += 1;}
    elsif (($value >=80)and ($value <=89))
        {$count8 += 1;}
    elsif (($value >=90)and ($value <=99))
        {$count9 += 1;}
    elsif ($value eq 100)
        {$count10 += 1;}
} else{print "Can't open text for Generator";}
print gentext "Color,Hlabel,Value'n;
prient gentext "#0066ff,0-9,$count0'n;  
prient gentext "#33cc33,10-19,$count1'n;     
prient gentext "#3366ff,20-29,$count2'n;    
prient gentext "#cc66cc,30-39,$count3'n;   
prient gentext "#6666ff,40-49,$count4'n;    
prient gentext "#669900,50-59,$count5'n;   
prient gentext "#ff3333,60-69,$count6'n;    
prient gentext "#33cc66,70-79,$count7'n;    
prient gentext "#0066ff,80-89,$count8'n;    
prient gentext "#9999ff,90-99,$count9'n;    
prient gentext "#00cc66,100,$count10'n;   
}

######################################
## Score View
######################################
sub viewmyscore
{

}
#########################################################
# bringing student answers,total,notes,time of submission
#########################################################
{
if (!$db=new Win32::ODBC($DSN))
{
    &db_error_1;
}
$sqlStatement = "SELECT std_answers,time_of_submission,notes,total
 FROM std_submission_info WHERE (webno='$webno' AND std_idno='$username') AND description = '$prob_qset';
if ($db->{Sql($sqlStatement))
{
    &db_error_2;
} else
{while($db->{FetchRow())
{
    %Data = $db->{DataHash();
    $answers = $Data{"std_answers"};
    $time_of_submis= $Data{"time_of_submission"};
    $notes = $Data{"notes"};
    $std_total= $Data{"total"};
}
$db->Close();
@std_answers=split(/,,$answers);
}
if (!$db=new Win32::ODBC($DSN))
{
    &db_error_1;
}
$sqlStatement = "SELECT probinfo,probnumber FROM course_prob_info WHERE description = '$prob_qset' AND webno = '$webno'";
$countc =0;
if ($db->{Sql($sqlStatement))
{
    &db_error_2;
} else
{while($db->{FetchRow())
{
    %Data = $db->{DataHash();
    @prob_info[$countc] = $Data{"probinfo"};
    @prob_numb[$countc] = $Data{"probnumber"};
    $countc++;;
}
$db->Close();
for($d=0;$d<$countc;$d++)
{
    ($chapter[$d],$subchapter[$d],$difficulty[$d],$question[$d])= split(/_/,$prob_info[$d]);
    $topic[$d] ="chapter[$d]".""."subchapter[$d];
}
for($d=0;$d<$countc;$d++)
{
    $compare[$d] = "$topic[$d]"."_$difficulty[$d]"."_$question[$d]";
    if (!$db = new Win32::ODBC($DSN))
    {
        &db_error_1;
    }
    $SqlStatement = "SELECT answer
FROM answerfile WHERE probinfo = "$compare[$d]";”;
    if ($db->Sql($SqlStatement))
    {
        &db_error_2;
    } else
    {
        while($db->FetchRow())
        {
            %Data = $db->DataHash();
            $correct_ans[$d] = %Data{"answer"};
        }
    }
}$db->Close();

if (!$db = new Win32::ODBC($DSN))
{
    &db_error_1;
}
$SqlStatement = "SELECT pointsremoval
FROM course_setup_info WHERE webno = "$webno" AND description = "$prob_qset";”;
    if ($db->Sql($SqlStatement))
    {
        &db_error_2;
    } else
    {
        while($db->FetchRow())
        {
            %Data = $db->DataHash();
            $scoredis = %Data{"pointsremoval"};
        }
    }
$db->Close();
if ($answers ne "")
{
    print header();
    print "<B><FONT SIZE="3" FACE="Arial, Helvetica, MS Sans serif">Submission for $Sta_title
$num_no</FONT></B><br><br>
"; The following is your graded homework";
    print "<br><FONT SIZE="2" FACE="Arial, Helvetica, MS Sans serif">IDNo:
$username<br><br>
";
    for($d=1;$d<$countc+1;$d++)
There is a space in correct answer value, keep this space between this variable "Correct_ans[$d-1]" equivalent to "spaceCorrect_ans[$d-1]". In an earlier subroutine when splitting of student answers was done an additional space came by $Temp_ans = " x";
if (($std_answers[$d-1] eq $space_correct_ans[$d-1]) || ($space_correct_ans[$d-1] eq $temp_ans))
{
    print "$d: std_answers[$d-1]<br>
};
else
{
    if($std_answers[$d-1] eq " z")
    {
        print "$d: x -scored is Correct answer is Correct_ans[$d-1]<br>
    } else
    {
        print "$d: std_answers[$d-1] -scored is Correct answer is Correct_ans[$d-1]<br>
    }
}
print "<br>";
print "$prob_qset submitted on $time_of_submis<br>
print "Notes: $notes<br>
print "The total score for this $Sta_title is $std_total<br>
print "<EMBED SRC="$gen_template" BORDER="0" WIDTH="400" HEIGHT="300" CLASS="$class_title" WEBNO="$webno" >";
print "Click <a href="javascript:history.back()">here</a> to return to menu.";
"} else
{
    print <<redirection;
<html>
<TABLE BORDER="0" CELLPADDING="0" CELLSPACING="0" WIDTH="500" BGCOLOR="#000099">
<TR>
    <TD COLSPAN="3">$Sta_title Information</TD>
</TR>
<TR>
    <TD BGCOLOR="#FFCC99">$Sta_title Information</TD>
</TR>
</html>

Your submitted $prob_qset page is not found.
Please contact the instructor.
<TR>
<TD COLSPAN="3" BGCOLOR="#FFCC99">
<br><P ALIGN="CENTER"><FONT SIZE="2" COLOR="#990000" FACE="Arial, Helvetica">
Click <a href="javascript:history.back()">here</a> to go back to Login page.</font></P>
</TD>
</TR>
</TABLE>
</html>
redirection
exit();
}

######################################
## Review Submission Page
######################################
sub reviewsubmission
{
print header();
{
if (!($db=new Win32::ODBC($DSN)))
{
&db_error_1;
}
$SqlStatement = "SELECT std_answers,time_of_submission,notes
FROM std_submission_info WHERE (webno='$webno' AND std_idno='$username') AND description = '$prob_qset'';
if ($db->Sql($SqlStatement))
{
&db_error_2;
}
else
{while($db->FetchRow())
{
%Data = $db->DataHash();
$rev_answers = %Data{"std_answers"};
$time_of_submis= %Data{"time_of_submission"};
$notes = %Data{"notes"};
}
}$db->Close();
@std_rev_ans=split(\,,$rev_answers);
$sarr_length=@std_rev_ans;
}
if ($rev_answers ne '')
{
print "<B><FONT SIZE="3" FACE="Arial, Helvetica, MS Sans serif">Submission for $prob_qset</FONT><br>
The following information have been submitted'';
for ($c=1;$c<$arr_length+1;$c++)
{
if($std_rev_ans[$c-1] eq "z")
    {
        print "$c: &lt;br\n";
    }
else
    {
        print "$c: $std_rev_ans[$c-1]<br\n";
    }
}
print "&lt;br\n";
print "$prob_qset submitted on $time_of_submis&lt;br\r
";
print "Notes: $notes&lt;br\n";
print "Click &lt;a href="javascript:history.back()">here&lt;/a&gt; to return to menu.";
}
else
    {
    print "Content-type: text/html\n\n";
    print &lt;redirection;
&lt;html&gt;
&lt;TABLE BORDER="0" CELLPADDING="0" CELLSspacing="0" WIDTH="500" BGcolor="#000099"&gt;
&lt;TR&gt;
    &lt;TD COLSPAN="3"&gt;&lt;FONT COLOR="white" FACE="Arial, Helvetica, MS Sans serif">$prob_qset Information&lt;/FONT&gt;&lt;/TD&gt;
&lt;/TR&gt;
    &lt;TR&gt;
        &lt;TD BGColor="#FFCC99"&gt;&lt;FONT SIZE="2" FACE="Arial, Helvetica, MS Sans serif"&gt;
        Your submitted $prob_qset page is not found.
        Please contact the administrator.
        &lt;/b&gt;&lt;br&gt;
    &lt;/TD&gt;
&lt;/TR&gt;
&lt;/TABLE&gt;
&lt;/html&gt;
redirection
exit();
}

#--------------------------------------------------
sub write_log
{
    $logfile="">$.logfile;
    if (open(timelog,$logfile))
    {
        @timelist = localtime(time());
        &lt;TABLE BORDER="0" CELLPADDING="0" CELLSspacing="0" WIDTH="500" BGcolor="#000099"&gt;
        &lt;TR&gt;
            &lt;TD COLSPAN="3"&gt;&lt;FONT COLOR="white" FACE="Arial, Helvetica, MS Sans serif">$prob_qset Information&lt;/FONT&gt;&lt;/TD&gt;
        &lt;/TR&gt;
        &lt;TR&gt;
            &lt;TD BGColor="#FFCC99"&gt;&lt;FONT SIZE="2" FACE="Arial, Helvetica, MS Sans serif"&gt;
            Your submitted $prob_qset page is not found.
            Please contact the administrator.
            &lt;/b&gt;&lt;br&gt;
        &lt;/TD&gt;
        &lt;/TR&gt;
        &lt;/TABLE&gt;
        &lt;/html&gt;
        redirection
    exit();
    }
}
$year = 1900+$timelist[5];
$month = $timelist[4]+1;
if ($month <10)
   {$month="0".$month;}
$date = $timelist[3];
if ($date <10)
   {$date="0".$date;}
$hour = $timelist[2];
if ($hour <10)
   {$hour="0".$hour;}
$min = $timelist[1];
if ($min <10)
   {$min="0".$min;}
select(timelog);
صديق outp_timelog=
write;
select(STDOUT);
close(timelog);
}
format outp_timelog=
$month,$date,$year,$hour,$min,$username,$functions,$num_no
#hwgrading.pl This Perl file grades students submission
use CGI qw/:standard/;
use CGI;
use Win32::ODBC;

# Fetch action definition, homework, quiz or test
$status=new CGI;
$query=new CGI;
$class = $query->param('course');
$sta_in = $query->param('status');
$qno=$query->param('totalquestion');
$idno=$query->param('idno');
$hwno=$query->param('hwno');
$webno=$query->param('webno');

# Read in the paths from the library, different paths for each class
require "eCourses/cgi-bin/lib/readpath.pl";    ######  Open libraries for reading the paths
&symbol; ######## reads the subroutine in readpath.pl to get access to all paths
require "eCourses/cgi-bin/lib/database_path.pl";    ######  Open libraries for reading the paths
&db_path; # reads the subroutine in database_path.pl to get access to all paths

for($c=1;$c<$qno+1;$c++)
{
    $question_name=$hwno.".".$c;
    $questiono[$c]=$query->param($question_name);
    $answer[$c]=$query->param($c);
    
    if (!($db=new Win32::ODBC($DSN)))
    {
        &db_error_1;
    }
    $SqlStatement = "SELECT probinfo,answer FROM answerfile WHERE probinfo="$questiono[$c]";  
    if ($db->Sql($SqlStatement))
    {
        &db_error_2;
    }  
    else
    {while($db->FetchRow())
    {
        %Data = $db->DataHash();
        $prob_info[$c] = $Data{"probinfo"};
        $correct_ans[$c] = $Data{"answer"};
    }
    }
    $db->Close();
}
# Main Program

```
print header();
$assignment="$Sta_title $hwno";
$totalscore=100;
checkdate();
checkearlier_submission();
if ($zero_boolean eq "no")
{
    if ($subm_exist eq "no")
    {
        writetodbs_firsttime();
    }
    else
    {
        writetodbs_again();
        writeanswer();
        write_log();
        print "<br>Please save a copy of this page for later verification if necessary.<br>
        print "Click <a href="prob_lgpage.pl?status=$sta_in&course=$class&webno=$webno">here</a> to return to menu.<br></B>";
    }
else
{
    $message="Attempt after Scores due";
    write_log();
    if ($subm_exist eq "yes")
    {
        print "<redirection>
        <html>
        <TABLE BORDER="0" CELLPADDING="0" CELLSPACING="0" WIDTH="500"
        BG Sicolor="#000099">
        <TR>
        <TD COLSPAN="3"><B><FONT COLOR="white" FACE="Arial, Helvetica, MS Sans serif">Submission Error</FONT></B></TD>
        </TR>
        <TR>
        <TD BGCOLOR="#FFCC99"><FONT SIZE="2" FACE="Arial, Helvetica, MS Sans serif">Submission for $Sta_title $hwno failed!<br><br>You have made a submission before. <br>The $Sta_title $hwno is already due and the scores have been released.<br>Please go to score at the main menu.</FONT></B>.<br>
        </TD>
        </TR>
        </TABLE>
        </html>
        redirection
    }
    else
    {
        print "<redirection;";
        }
    }<html>
```
<TABLE BORDER="0" CELLPADDING="0" CELLSPACING="0" WIDTH="500"
BGCOLOR="#000099">
  <TR>
    <TD COLSPAN="3"><B><FONT COLOR="white" FACE="Arial, Helvetica, MS Sans serif">Submission Error</FONT></B></TD>
  </TR>
  <TR>
    <TD BGCOLOR="#FFCC99"><FONT SIZE="2" FACE="Arial, Helvetica, MS Sans serif">
<br>P ALIGN="CENTER">
Submission for $Sta_title $hwno failed!<br>Your submission is late<br>The $Sta_title $hwno is already due the scores have been released.<br></TABLE>
</html>
redirection
exit();

### Checks if there has been an earlier submission by student for that particular assignment

sub checkearlier_submission
{
  if (!$db=new Win32::ODBC($DSN))
  {
    &db_error_1;
  }
  $SqlStatement = "SELECT std_answers FROM std_submission_info
           WHERE (webno='$webno' AND std_idno='$idno')AND description='$assignment';"
  if ($db->Sql($SqlStatement))
  {
    &db_error_2;
  } else
  {while($db->FetchRow())
   {
     %Data = $db->DataHash();
     $array_values = $Data{"std_answers"};
   }
  }
  $db->Close();
  if ($array_values eq"")
  {
    $subm_exist="no";
  } else
  {
    $subm_exist="yes";
  }
}

# Write submission of students to database for the first time
sub writetodbs_firsttime
{
    for ($c=1;$c<$qno+1;$c++)
    {
        if ($prob_info[$c] eq $questiono[$c])
        {
            if ($answer[$c] ne $correct_ans[$c])
            {
                $totalscore=$totalscore-$scoredis;
            }
            if (!$answer[$c])
            {
                $value = "z,;"
                push (@ans_array,$value);
            }
            else
            {
                $value = "$answer[$c],;"
                push (@ans_array,$value);
            }
        }
    }
    $space="";
    unshift (@ans_array, $space);
    if ($min <10)
    {
        $min="0".$min;
    }
    if ($hour<12)
    {
        $ampm="am";
    }
    elsif ($hour eq 12)
    {
        $hour = 12;
        $ampm="pm";
    }
    else
    {
        $ampm="pm";
        $hour=$hour-12;
    }
    $timer=$month."/".$date."/".$year. "at ".$hour.":".$min.$ampm;
    ## Check for late submission
    if ($late_boolean eq "yes")
    {
        $message = "Late";
        $notes = "$notes - "penalty";
        $totalscore=$totalscore-$penalty;
    }
    else
    {
        $notes = "",
        $message="Ontime";
    }
    if (!($db=new Win32::ODBC($DSN)))
    {
        &db_error_1;
    }
    $SqlStatement = "INSERT INTO std_submission_info
VALUES ('$webno','$idno','$assignment','@ans_array','$timer','$notes','$totalscore');"
    if ($db->Sql($SqlStatement))
    {
        &db_error_2;
    }
}
$db->Close();
#
#####################################################
# Write submission of students to database if there is an earlier submission
#####################################################
sub writetodb_again {
  for ($c=1; $c<=$qno+1; $c++)
  {
    if (@prob_info[$c] eq $questiono[$c])
    {
      if (@answer[$c] ne $correct_ans[$c])
      {
        $totalscore=$totalscore-$scoredis;
      }
      if (!@answer[$c])
      {
        $value = "z,";
        push (@ans_array,$value);
      }
      else
      {
        $value = "$answer[$c],";
        push (@ans_array,$value);
      }
    }
  }
  $space="";
  unshift (@ans_array,$space);
  if ($min<10)
  {
    $min="0".$min;
  }
  if ($hour<12)
  {
    $ampm="am";
  }
  elsif ($hour eq 12)
  {
    $hour = 12;
    $ampm="pm";
  }
  else
  {
    $ampm="pm";
    $hour=$hour-12;
  }
  $timer=$month."/".$date."/".$year." at ".hour."".$min.$ampm;
  ## Check for late submission
  if ($late_boolean eq "yes")
  {
    $message = "Late";
    $notes = "Late penalty: -$penalty";
    $totalscore=$totalscore-$penalty;
  }
  else
  {
    $notes = "";
    $message="Ontime";
  }

  if (!($db=new Win32::ODBC($DSN)))
  {
    &db_error_1;
  }
$SqlStatement = "UPDATE std_submission_info
    SET std_answers='@ans_array',
        time_of_submission
    notes = '$notes',
    total = '$totalscore'
WHERE (webno='$webno' AND std_idno='$idno')AND description ="$assignment";
if ($db->Sql($SqlStatement))
    {
        &db_error_2;
    }
$db->Close();

####################################################
# Writes the students submission onto the screen
####################################################

sub writeanswer
{
    print "<B><FONT SIZE="3" FACE="Arial, Helvetica, MS Sans serif">Submission for $Sta_title $hwno is successful!</FONT></B>
<br>"
    print "The following information have been submitted:<br>
    ID no = $idno
<br>
    for ($c=1;$c<$qno+1;$c++)
    {
        print "$c : $answer[$c]<br>
    }
    print "Assignment submitted on $timer.<br>
    ## Check for late submission
    if ($late_boolean eq "yes")
    {
        print "Notes: Late submission. Score to be taken off from the total: -$penalty<br>"
    }
}

####################################################
# Date and time checking
####################################################

sub checkdate
{
    @timelist = localtime(time());
    $year = 1900+$timelist[5];
    $month = $timelist[4]+1;
    $date = $timelist[3];
    $hour = $timelist[2];
    $min = $timelist[1];
    $mul=$hour*60+$min;
    $late_boolean="no";
    $zero_boolean="no";
    $inorout = "out";
    if (!(db=new Win32::ODBC($DSN)))
    {
        
$166
$SqlStatement = "SELECT
description,postingdate,postingtime,duedate,duetime,solnpostingdate,solnpostingtime,delaytime,latepenalty,pointsremoval
WHERE webno = "$webno" AND description = "$assignment";"
if ($db->Sql($SqlStatement))
{
    &db_error_2;
} else
{while($db->FetchRow())
{
    %Data = $db->DataHash();
    $number = $Data["description"]; 
    $postdate = $Data["postingdate"]; 
    $posttime = $Data["postingtime"]; 
    $duedate = $Data["duedate"]; 
    $duetime = $Data["duetime"]; 
    $solndate = $Data["solnpostingdate"]; 
    $solntime = $Data["solnpostingtime"]; 
    $delaymin = $Data["delaytime"]; 
    $penalty_score = $Data["latepenalty"]; 
    $scoredis = $Data["pointsremoval"]; 
}
$db->Close();
}
$title=$numb= split(/ /,$number); 
$pmonth=$pdate=$pyear= split(/ /,$postdate); 
$phour=$pmin= split(/ /,$posttime); 
$dmonth=$ddate=$dyear= split(/ /,$duedate); 
$dhour=$dmin= split(/ /,$duetime); 
$lmonth=$ldate=$lyear= split(/ /,$solndate); 
$lhour=$lmin= split(/ /,$solntime); 
if ($assignment == $number)
{
    $mint=$lmin; 
    $hourt=$lhour; 
    $datet=$ldate; 
    $montht=$lmonth; 
    $yeart=$lyear; 
    $totalmins=60*$hourt+$mint; 
    $penalty_score=$penalty_score; 
    #### perform comparison. 
    if ($year > $yeart) {$zero_boolean="yes";} 
    if (($year == $yeart) and ($month > $montht)) {$zero_boolean="yes";} 
    if (($year == $year) and ($month == $montht) and ($date > $datet)) {$zero_boolean="yes";} 
    if (($year == $year) and ($month == $montht) and ($date == $datet) and ($mul >= $totalmins)) {$zero_boolean="yes";} 
} 
if ($zero_boolean ne "yes")
{
    $mint=$dmin+$delaymin; 
    $hourt=$dhour;
$datet=$ddate;
$montht=$dmonth;
$yeart=$dyear;
$totalmins=60*$hourt+$mint;

### perform comparison.
if ($year > $yeart) {
    $late_boolean="yes";
} else {
    if (($year == $yeart) and ($month > $montht)) {
        $late_boolean="yes";
    } else {
        if (($year == $yeart) and ($month == $montht) and ($date > $datet)) {
            $late_boolean="yes";
        } else {
            if (($year == $yeart) and ($month == $montht) and ($date == $datet) and ($mul >= $totalmins)) {
                $late_boolean="yes";
            }
        }
    }
}

# print "$year--$yeart******$month--$montht****$date--
$datet****$min--$mint****";
}

sub write_log {
    $logfile=">$logfile;
    if (open(timelog,$logfile)) {
        @timelist = localtime(time());
        $year = 1900+$timelist[5];
        $month = $timelist[4]+1;
        if ($month <10) {
            $month="0".$month;
        }
        $date = $timelist[3];
        if ($date <10) {
            $date="0".$date;
        }
        $hour = $timelist[2];
        if ($hour <10) {
            $hour="0".$hour;
        }
        $min = $timelist[1];
        if ($min <10) {
            $min="0".$min;
        }
        select(timelog);
        $~="outp_timelog";
        write;
        select(STDOUT);
        close(timelog);
    }
    format outp_timelog=
    @< @< @<<<<    @<:@<<   @<<<<<<<<<<<<  @<<<<<<<< @<<
    @<<<<<<<<<<<<<<<<<<<<<<<<<
    $month,$date,$year,$hour,$min,$idno,"hwsubmit","hwno","message".
}

168
Appendix G
Perl code for executing Score Report

#score_report.pl. This Perl file prints score report for the whole class

$| = 1;    # set buffer end, each lib has 1 at the end to identify the end
use CGI qw/:standard/;
use CGI;
use Win32::ODBC;

# Fetch action definition, Class type
$squery = new CGI;
$iclass = $query->param('course');
$username = $query->param('login');
$pass = $query->param('password');
$webno = $query->param('webno');

# Read in the paths from the library, different paths for each class
require "eCourses/cgi-bin/lib/readpath.pl";    ######  Open libraries for reading the paths
&symbol; ######## reads the subroutine in readpath.pl to get access to all paths
require "eCourses/cgi-bin/lib/database_path.pl";    ######  Open libraries for reading the paths
&db_path; # reads the subroutine in database_path.pl to get access to all paths
require "eCourses/cgi-bin/lib/readscores.pl";    ######  Open libraries for this module
&read_duetime;  # subroutine to read due times when homework, quizzes, tests are to be submitted, it's a
library file under readscores.pl
&grading_info;  # Collect information about grading system

# Main Program
readnames();
print header();
score_report_spread_sheet();

# Print score report spread sheet

sub score_report_spread_sheet
{
$hwcolspan=$numberofhw+1; ## average columns
$qzcolspan=$numberofqz+1; ## average columns
$tscolspan=$numberofts;
for($counter=1;$counter<$numberofqz+1;$counter++)
{
    $alltotalgrade=$quizgrade[$counter]+$alltotalgrade;
}

$alltotalgrade=$hwgrade+$alltotalgrade;
$style_bgnd_nm = "style='background-color: #CCFFFF'";  ##  color used in table to as column heading
$style_bgnd_hw = "style='background-color: #CCCCFF'";  ##  color used in table to as Homework column
heading colors
$style_bgnd_qz = "style='background-color: #FFCCFF'";  ##  color used in table to as Quiz column
heading colors
$style_bgnd_ts = "style='background-color: #FFFFCC'";  ##    color used in table to as Test column
heading colors
$style_bgnd_gd = "style='background-color: #CCFFCC'";
## color used in table to as Final grade column heading colors

$style_bgnd_ave = "style='background-color: #FFFFFF'";
## color used in table to as Final grade column heading colors

## Print scoring sheet, uses styles to reduce the amount of text in the HTML file (gets very large 80k+)
print <<tableXY;

<html><head>
<style type="text/css">
    <!--[if IE ]><!-->
    body { font-family: Arial, Helvetica, sans-serif; font-size: 8pt}
    td { font-family: Arial, Helvetica, sans-serif; font-size: 8pt; background-color: #FFFF99}
    -->
    <style></head><body>

<B><FONT SIZE=3 COLOR="blue">Class performance</FONT></B>
<TABLE BORDER="1" CELLPADDING="0" CELLSPACING="0">
    <TR>
        <TD WIDTH="25" $style_bgnd_nm>&nbsp;</TD>
        <TD WIDTH="60" $style_bgnd_nm>&nbsp;</TD>
        <TD WIDTH="90" $style_bgnd_nm>&nbsp;</TD>
    </TR>
    <TD WIDTH="25" $style_bgnd_nm>&nbsp;</TD>
    <TD WIDTH="60" $style_bgnd_nm>&nbsp;</TD>
    <TD WIDTH="90" $style_bgnd_nm>&nbsp;</TD>
</tableXY

if ($numberofhw > 0)  { print "<TD COLSPAN="$hwcolspan" $style_bgnd_hw><p
    align="center"><B>HW ($hwgrade%)</FONT></B></TD>";  

if ($numberofqz > 0)  { print "<TD COLSPAN="$qzcolspan" $style_bgnd_qz><p
    align="center"><B>Quiz ($qzgrade%)</FONT></B></TD>";  

## Column for each test
for ($tsc=1;$tsc<$numberofts+1;$tsc++)
    { print "<TD WIDTH="40" $style_bgnd_ts><p align="center"><B>Test
$tstlist[$tsc]<FONT></B></TD>";  

## Column for each homework
for($hwc=1;$hwc<$numberofhw+1;$hwc++)
    { print "<TD WIDTH="30" $style_bgnd_hw><p
    align="center"></B>$hwlist[$hwc]<FONT></B></TD>";  

if ($numberofhw > 0)  ## no average homework column if no homework
    { print "<TD WIDTH="30" $style_bgnd_hw><p
    align="center"></B>Avg</FONT></B></TD>";  

## Column for each quiz
for ($qzc=1;$qzc<$numberofqz+1;$qzc++)
    { print "<TD WIDTH="30" $style_bgnd_qz><p
    align="center"></B>$qzlist[$qzc]<FONT></B></TD>";  

if ($numberofqz > 0)  ## no homework column if no homework
    { print "<TD WIDTH="30" $style_bgnd_qz><p
    align="center"></B>Avg</FONT></B></TD>";  

## Column for each test
for ($tsc=1;$tsc<$numberofts+1;$tsc++)

</html>
```php

// Column for grades
print "<TR><TD WIDTH="35" $style_bgnd_gd><p align="center"><B>Tot</B></TD>
<TD WIDTH="25" $style_bgnd_gd><p align="center"><B>Grd</B></TD></TR>

###############################################
## list each Student in class
$GradeAllSum = 0;
$HwAllSum = 0;
$SqzAllSum = 0;
@hwAllAssign = ();
@qzAllAssign = ();
@tsAllAssign = ();
$gpaAllSum=0;

for($idc=1;$idc<$numberofstd;$idc++)
{
$counter=0;
print "<TR><TD WIDTH="25">
<P ALIGN="CENTER">$idc</TD>
<TD WIDTH="60">&nbsp;$idnumber[$idc]</TD>
<TD WIDTH="90">&nbsp;$names[$idc]</TD></TR>

## Homework scores and averages
for ($hwc=1;$hwc<$numberofhw+1;$hwc++)
{
    $hwscores[$hwlist[$hwc]]= -1;
    if (!($db=new Win32::ODBC($DSN)))
    {
        &db_error_1;
    }
    $SqlStatement = "SELECT total FROM std_submission_info WHERE (webno ="$webno' AND description = "$hwname[$hwc-1]' )AND std_idno='$idnumber[$idc]";
    if ($db->Sql($SqlStatement))
    {
        &db_error_2;   
    }
    else
    {
        while($db->FetchRow())
        {
            %Data = $db->DataHash();
            $hwscores[$hwlist[$hwc]] = $Data{"total"};
            $total="$hwscores[$hwlist[$hwc]]";
            $hwAllAssign[$hwc] = $hwAllAssign[$hwc] + $total;   # used for average score at bottom
        }
    }
$db->Close();
    if ($hwscores[$hwlist[$hwc]] ne -1)
    {
        print "<TD WIDTH="20" P ALIGN="right">$hwscores[$hwlist[$hwc]]</TD>
```

if ($numberofhw > 0)       ## Don't put anything if no homework
{
    # Calculate homework average
    $minimum=1000;
    $totalhwscore=0;
    for($hwc=1;$hwc<$numberofhw+1;$hwc++)
    {
        if ($hwscores[$hwlist[$hwc]] < $minimum)
            {$minimum=$hwscores[$hwlist[$hwc]];
            $totalhwscore=$totalhwscore+$hwscores[$hwlist[$hwc]];
            }
    }
    $save_no_hw=$numberofhw;
    if ($drop1hw == yes)
    {
        if  ($numberofhw > 1)
        {
            $totalhwscore=$totalhwscore-$minimum;
            $save_no_hw=$numberofhw-1;
            $hwdropmessage="Lowest score is dropped.";
        }
        else
        {
            # If only one or none homework or quiz, don't drop (does not make sense with
            grade report)
            $hwdropmessage="Lowest score not dropped, must be > 2";
        }
    }
    $hwaverage=$totalhwscore/$save_no_hw;
    $hwAllSum  = $hwAllSum + $hwaverage;
    $temp = int(10*$hwaverage)/10;
    ## Homework totals
    print <<homework_ave;
    <TD WIDTH="30"><B><P ALIGN="center">$temp</B></TD>
    homework_ave
}
&db_error_2;
} else {
while($db->FetchRow()) {
    %Data = $db->DataHash();
    $qzscores[$qzlist[$qzc]] = $Data{"total"};
    $total="$qzscores[$qzlist[$qzc]]";
    $qzAllAssign[$qzc] = $qzAllAssign[$qzc] + $total; # used for average score at bottom
}
$db->Close();
if ($qzscores[$qzlist[$qzc]] ne -1) {
    print <<table3;
    <TD WIDTH="20"><P ALIGN="right">$qzscores[$qzlist[$qzc]]</TD>
    table3
} else {
    $qzscores[$qzlist[$qzc]]=0;
    print " <TD WIDTH="20"><P ALIGN="right">0</TD>";
}
if ($numberofqz > 0)       ## Don't put anything if no homework
{
    # Calculate quiz average
    $minimum=1000;
    $totalqzscore=0;
    for($qzc=1;$qzc<$numberofqz+1;$qzc++){
        if ($qzscores[$qzlist[$qzc]] < $minimum)
            {$minimum=$qzscores[$qzlist[$qzc]];}
        $totalqzscore=$totalqzscore+$qzscores[$qzlist[$qzc]];
    }
    #print "xxxxx = $minimum<br>";
    $save_no_qz=$numberofqz;
    if ($drop1qz eq "yes") {
        if ($numberofqz > 1) {
            $totalqzscore=$totalqzscore-$minimum;
            $save_no_qz=$numberofqz-1;
            $qzdropscore="Lowest score is dropped.";
        } else {
            # If only one or none homework or quiz, don't drop (does not make sense with grade report)
            $qzdropscore="Lowest score not dropped, must be > 2";
        }
    }
    $qzaverage=$totalqzscore/$save_no_qz;
    #print "yyyyyy quiz average $qzaverage<br>";
    #print "vvvv total score $qzaverage<br>";
}
#print "nnnnn Average number of quiz $ave_no_qz<br>
$QzAllSum = $QzAllSum + $Qzaverage;
Temp = int(10*$Qzaverage)/10;
## Quiz totals
print "<TD WIDTH="30"">"<B><P ALIGN="center">Temp</B></TD>"
}
### Test scores
for ($tsc=1;$tsc<$numberofts+1;$tsc++)
{
    $Tsscores[$Tsslist[$tsc]] = -1;
    if (!($db=new Win32::ODBC($DSN)))
    {
        &db_error_1;
    }
    $SqlStatement = "SELECT total FROM std_submi ssion_info WHERE (webno ="$webno' AND description = "$Tsn ame[$tsc-1']")AND std_idno="$Idnumber[$idc]' ";
    if ($db->Sql($SqlStatement))
    {
        &db_error_2;
    } else
    {
        while($db->FetchRow())
        {
            %Data = $db->DataHash();
            $Tsscores[$Tsslist[$tsc]] = $Data{"total"};
            $total="$Tsscores[$Tsslist[$tsc]]";  
            $TssAllAssign[$tsc] = $TssAllAssign[$tsc] + $total;  # used for average score at bottom
        }
    }
    $db->Close();
    if ($Tsscores[$Tsslist[$tsc]] ne -1)
    {
        print "<<table_t s1;
        TD WIDTH="40">"<P ALIGN="center">$Tssscores[$Tsslist[$tsc]]</TD>
    table_t s1
        }
    else
    {
        $Tssscores[$Tsslist[$tsc]]=0;
    print "<<table_t s2;
    TD WIDTH="40">"<P ALIGN="center">0</TD>
    table_t s2
    }
}  # Grade calculation
$TotalGrade[$idc]=0;
$TotalPoss=0;
if ($numberofhw > 0)
{
    $TotalGrade[$idc]=$TotalGrade[$idc]+$hwaverage*$hwgrade;
    $TotalPoss=$TotalPoss+$hwgrade;
} if ($numberofqz > 0)
{
    $TotalGrade[$idc]=$TotalGrade[$idc]+$qzaverage*$qzgrade;
```php
$TotalPoss = $TotalPoss + $qzgrade;
}
if ($numberofts > 0)
{
    for($counter=1;$counter<$numberofts+1;$counter++)
    {
        $TotalGrade[$idc] = $TotalGrade[$idc] + $tsscores[$tslist[$counter]] * $testgrade[$tslist[$counter]];
        $TotalPoss = $TotalPoss + $testgrade[$tslist[$counter]];
    }
}
if ($TotalPoss == 0)
{
    $TotalPoss = 1;
}
$overall_score = $TotalGrade[$idc] / $TotalPoss;
$GradeAllSum = $GradeAllSum + $overall_score;
$temp = int(10 * $overall_score) / 10;  # round numbers to fit column
if ($overall_score + .5 >= $gradea)
    { $currentgrade = "A";
        $gpaAllSum = $gpaAllSum + 4;
    } elseif ($overall_score + .5 >= $gradeb)
    { $currentgrade = "B";
        $gpaAllSum = $gpaAllSum + 3;
    } elseif ($overall_score + .5 >= $gradec)
    { $currentgrade = "C";
        $gpaAllSum = $gpaAllSum + 2;
    } elseif ($overall_score + .5 >= $graded)
    { $currentgrade = "D";
        $gpaAllSum = $gpaAllSum + 1;
    } else
    { $currentgrade = "F";
        $gpaAllSum = $gpaAllSum + 0;
    }
print <<spacing_a2;
    <TD WIDTH="35"><P ALIGN="center"><b>$temp</b></TD>
    <TD WIDTH="25"><P ALIGN="center"><b>$currentgrade</b></TD>
</TR>
spacing_a2
}
##### Bottom totals  ####################
print <<totals1;
    <TR>
        <TD WIDTH="25" &$style_bgnd_nm>&nbsp;</TD>
        <TD WIDTH="60" &$style_bgnd_nm>&nbsp;</TD>
        <TD WIDTH="90" &$style_bgnd_nm><P ALIGN="center"><b>Totals</b></TD>
    </TR>
if ($numberofstd > 0)
{
    $numberofstd = $numberofstd - 1;
    $HwAve = int(10 * $hwAllSum / $numberofstd) / 10;
    $qzAve = int(10 * $qzAllSum / $numberofstd) / 10;
    $GradeAve = int(10 * $GradeAllSum / $numberofstd) / 10;
    $gpaAve = int(10 * $gpaAllSum / $numberofstd) / 10;
}
## Column for each homework
for($hwc=1;$hwc<$numberofhw+1;$hwc++)
```
$AveTemp = int(10*$hwAllAssign[$hwc]/$numberofstd)/10;
print "<TD WIDTH="20" $style_bgnd_hw><p align="center">$AveTemp</TD>";
}
if ($numberofhw > 0) ## no average homework column if no homework
{  print "<TD WIDTH="30" $style_bgnd_hw><p align="center"><B>$HwAve</B></TD>";  }
## Column for each quiz
for($qzc=1;$qzc<$numberofqz+1;$qzc++)
{
    $AveTemp = int(10*$qzAllAssign[$qzc]/$numberofstd)/10;
    print "<TD WIDTH="20" $style_bgnd_qz><p align="center">$AveTemp</TD>";
}
if ($numberofqz > 0) ## no average homework column if no homework
{  print "<TD WIDTH="30" $style_bgnd_qz><p align="center"><B>$qzAve</B></TD>";  }
## Column for each test
for($tsc=1;$tsc<$numberofts+1;$tsc++)
{
    $AveTemp = int(10*$tsAllAssign[$tsc]/$numberofstd)/10;
    print "<TD WIDTH="40" $style_bgnd_ts><p align="center">$AveTemp</TD>";
}
print <<table2end;
<TD WIDTH="35" $style_bgnd_gd><P ALIGN="center"><b>$GradeAve</b></TD>
<TD WIDTH="25" $style_bgnd_gd><P ALIGN="center"><b>$gpaAve</b></TD>
</TR>
</table2end>
print "</TR></TABLE>";
print <<ending;
<br><FONT SIZE="2" COLOR="blue">The total score is the prorate score. </FONT>
<br><FONT SIZE="2" COLOR="blue">Homework note: $hwdropmessage </FONT>
<br><FONT SIZE="2" COLOR="blue">Quiz note: $qzdropmessage </FONT>
</body>
</html>

Ending

# Read student names
### generate student's name
sub readnames
{
if (!$db=new Win32::ODBC($DSN))
{
   &db_error_1;
}
$SqlStatement = "SELECT std_idno, std_fname, std_lname FROM std_info WHERE webno ="$webno' ORDER BY std_lname";
$numberofstd=1;
if ($db->Sql($SqlStatement))
{
   &db_error_2;
}
else
{while($db->FetchRow())
{
    %Data = $db->DataHash();
    @idnumber[$numberofstd] = $Data{"std_idno"};
    @names[$numberofstd] = $Data{"std_lname"};
    @firstnames[$numberofstd] = $Data{"std_fname"};
    $numberofstd++;
}
$db->Close();
}
Appendix H
Perl code for e-mailing students

#sendmail.pl
use Mail::Sendmail;
use CGI qw/:standard/;
use CGI;
# Fetch action definition, Class type
$query = new CGI;
$class  = $query->param('course');
$subject=$query->param('subject');
$content=$query->param('content');
$inst_email=$query->param('inst_email');
$inst_name=$query->param('inst_name');
$email_list=$query->param('email_list');
$send_inst=$query->param('sendinst');

# Read in the paths from the library, different paths for each class
require "eCourses/cgi-bin/lib/readpath.pl";    ######  Open libraries for reading the paths
&symbol; ######## reads the subroutine in readpath.pl to get access to all paths
# Main Program
print header();
@email_ind=split(/,/,$email_list);
foreach $email_add (@email_ind)
{
    sendmailnow();
}
if ($send_inst eq "yes")
{
    %mail = (To => "$inst_email",
             From => "$inst_name <$inst_email>",
             Subject => "Instructor's copy. Title: "$subject",
             'X-Mailer' => "Mail::Sendmail version $Mail::Sendmail::VERSION",
                   );
    $mail{Smtp} = "$serv_smtp";
    $mail{'X-custom'} = 'New header should appear';
    $message="Attempted sending message to: 
$email_list 

 Content: 
$content"
    if ($err_email)
    {
        $message=$message."\n\nError sending mail to $err_email";
    }
    $mail{'message : '} = "$message";
    $mail{Date} = Mail::Sendmail::time_to_date( time());
    if (sendmail %mail)
    {
        print "<FONT SIZE="2" FACE="Arial, Helvetica, MS Sans serif">";A copy of email has been sent to the instructor at $inst_email.<br><br/></FONT>";
    }
    else

{ print "Error sending mail: $Mail::Sendmail::error \n<br>");
} print "<FONT SIZE="2" FACE="Arial, Helvetica, MS Sans serif"><b>Click <a href="javascript:history.go(-2)">here</a> to return to administration page.</b></FONT>");
} sub sendmailnow
{
%mail = (
 To => "$email_add",
 From => "$inst_name <$inst_email>",

 Subject => "$subject",
 'X-Mailer' => "Mail::Sendmail version $Mail::Sendmail::VERSION",
);
$mail{Smtp} = "$serv_smtp";
$mail{'X-custom'} = 'New header should appear';
$mail{'message : '} = "$content";
$mail{Date} = Mail::Sendmail::time_to_date( time());

if (sendmail %mail)
{
 print "<FONT SIZE="2" FACE="Arial, Helvetica, MS Sans serif">Mail to $email_add sent.<b></b></FONT><\n<br>";
}
else
{
 print "<FONT SIZE="2" FACE="Arial, Helvetica, MS Sans serif">Error sending mail: $Mail::Sendmail::error.";
 print "Please check on this $email_add address! </FONT><\n<br>";
$err_email=$err_email.$email_add."
};
}
Appendix I
Online Survey Document
Appendix J

Percentages of Student Response for Online Survey

STATICS 2000

STUDENT RESPONSE FOR SURVEY

Given below are percentages of students who responded for each option in the question.

Number of Students in the survey = 58

SURVEY PERCENTAGES

(A) Rank the usefulness of the following items
   (1 = Very Useful, 2 = Useful 3 = Not Useful 4 = Never Used)

A = Percentage of students who responded “Very Useful”.
B = Percentage of students who responded “Useful”.
C = Percentage of students who responded “Very Useful and Useful”.
D = Percentage of students who responded “Not Useful”.
E = Percentage of students who responded “Never Used”.
F = Percentage of students who didn’t respond

<table>
<thead>
<tr>
<th>S.NO</th>
<th>Question Statement</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Discussion and asking questions on Web Board.</td>
<td>13.0</td>
<td>59.3</td>
<td>72.2</td>
<td>13.0</td>
<td>14.8</td>
<td>6.9</td>
</tr>
<tr>
<td>2</td>
<td>Video Lectures on the web</td>
<td>32.7</td>
<td>46.2</td>
<td>78.8</td>
<td>17.3</td>
<td>3.8</td>
<td>10.3</td>
</tr>
<tr>
<td>3</td>
<td>Lecture on the web - Still Pictures</td>
<td>22.2</td>
<td>40.7</td>
<td>63.0</td>
<td>22.2</td>
<td>14.8</td>
<td>6.9</td>
</tr>
<tr>
<td>4</td>
<td>Doing Homework through Web</td>
<td>52.8</td>
<td>32.1</td>
<td>84.9</td>
<td>15.1</td>
<td>0.0</td>
<td>8.6</td>
</tr>
<tr>
<td>5</td>
<td>Homework Solutions on the Web</td>
<td>63.0</td>
<td>29.6</td>
<td>92.6</td>
<td>7.4</td>
<td>0.0</td>
<td>6.9</td>
</tr>
<tr>
<td>6</td>
<td>Use of Laptop in class during Lectures</td>
<td>20.8</td>
<td>30.2</td>
<td>50.9</td>
<td>34.0</td>
<td>15.1</td>
<td>8.6</td>
</tr>
<tr>
<td>7</td>
<td>Use of Laptop during tests for referencing material</td>
<td>51.9</td>
<td>25.9</td>
<td>77.8</td>
<td>16.7</td>
<td>5.6</td>
<td>6.9</td>
</tr>
<tr>
<td>8</td>
<td>Theory and examples on CD</td>
<td>11.1</td>
<td>25.9</td>
<td>37.0</td>
<td>42.6</td>
<td>20.4</td>
<td>6.9</td>
</tr>
<tr>
<td>9</td>
<td>Verification of Submissions and scores</td>
<td>61.1</td>
<td>31.5</td>
<td>92.6</td>
<td>5.6</td>
<td>1.9</td>
<td>6.9</td>
</tr>
<tr>
<td>10</td>
<td>Course Syllabus on the web</td>
<td>61.1</td>
<td>29.6</td>
<td>90.7</td>
<td>3.7</td>
<td>5.6</td>
<td>6.9</td>
</tr>
</tbody>
</table>
(B) Rank the ease of use for the following items
(1 = Very Easy,  2 = Easy  3 = Hard  4 = Did not Use)

A = Percentage of students who responded “Very Easy”.
B = Percentage of students who responded “Easy”.
C = Percentage of students who responded “Very Easy and Easy”.
D = Percentage of students who responded “Hard”.
E = Percentage of students who responded “Did not Use”.
F = Percentage of students who didn’t respond

<table>
<thead>
<tr>
<th>S.No</th>
<th>Question Statement</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>Web Board discussion and participation</td>
<td>34.6</td>
<td>36.5</td>
<td>71.2</td>
<td>5.8</td>
<td>23.1</td>
<td>10.3</td>
</tr>
<tr>
<td>12</td>
<td>Accessing and downloading lectures on the web</td>
<td>40.4</td>
<td>34.6</td>
<td>75.0</td>
<td>25.0</td>
<td>0.0</td>
<td>10.3</td>
</tr>
<tr>
<td>13</td>
<td>Accessing Homework on the web</td>
<td>71.2</td>
<td>28.8</td>
<td>100.0</td>
<td>0.0</td>
<td>0.0</td>
<td>10.3</td>
</tr>
<tr>
<td>14</td>
<td>Submission of Homework on the web</td>
<td>68.6</td>
<td>31.4</td>
<td>100.0</td>
<td>0.0</td>
<td>0.0</td>
<td>12.1</td>
</tr>
<tr>
<td>15</td>
<td>Understanding Homework solutions on the web</td>
<td>17.6</td>
<td>51.0</td>
<td>68.6</td>
<td>31.4</td>
<td>0.0</td>
<td>12.1</td>
</tr>
<tr>
<td>16</td>
<td>Using laptop in class for lecture/CD/Videos</td>
<td>21.2</td>
<td>38.5</td>
<td>59.6</td>
<td>25.0</td>
<td>15.4</td>
<td>10.3</td>
</tr>
<tr>
<td>17</td>
<td>Laptop during tests for reference and submission of work</td>
<td>26.9</td>
<td>57.7</td>
<td>84.6</td>
<td>11.5</td>
<td>3.8</td>
<td>10.3</td>
</tr>
<tr>
<td>18</td>
<td>Theory and examples on the CD</td>
<td>9.6</td>
<td>40.4</td>
<td>50.0</td>
<td>32.7</td>
<td>17.3</td>
<td>10.3</td>
</tr>
<tr>
<td>19</td>
<td>Verifying submissions and scores</td>
<td>61.5</td>
<td>28.8</td>
<td>90.4</td>
<td>5.8</td>
<td>3.8</td>
<td>10.3</td>
</tr>
<tr>
<td>20</td>
<td>Web Navigation and Logon</td>
<td>62.7</td>
<td>33.3</td>
<td>96.1</td>
<td>2.0</td>
<td>2.0</td>
<td>12.1</td>
</tr>
</tbody>
</table>
(C) Compared to previous courses with textbooks, the CD-based course content was
(1 = Strongly Agree,  2 = Agree,  3 = Disagree  4 = Strongly Disagree)

A = Percentage of students who responded “Strongly Agree”.
B = Percentage of students who responded “Agree”.
C = Percentage of students who responded “Strongly Agree and Agree”.
D = Percentage of students who responded “Disagree”.
E = Percentage of students who responded “Strongly Disagree”.
F = Percentage of students who didn’t respond

<table>
<thead>
<tr>
<th>S.No</th>
<th>Question Statement</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>Easier to use</td>
<td>12.0</td>
<td>38.0</td>
<td>50.0</td>
<td>28.0</td>
<td>22.0</td>
<td>13.8</td>
</tr>
<tr>
<td>22</td>
<td>Easier to understand</td>
<td>6.0</td>
<td>32.0</td>
<td>38.0</td>
<td>40.0</td>
<td>22.0</td>
<td>13.8</td>
</tr>
<tr>
<td>23</td>
<td>More Enjoyable</td>
<td>24.0</td>
<td>32.0</td>
<td>56.0</td>
<td>22.0</td>
<td>22.0</td>
<td>13.8</td>
</tr>
<tr>
<td>24</td>
<td>More Convenient</td>
<td>25.0</td>
<td>37.5</td>
<td>62.5</td>
<td>27.1</td>
<td>10.4</td>
<td>17.2</td>
</tr>
<tr>
<td>25</td>
<td>Layout and organisation of material was better</td>
<td>10.0</td>
<td>50.0</td>
<td>60.0</td>
<td>22.0</td>
<td>18.0</td>
<td>13.8</td>
</tr>
<tr>
<td>26</td>
<td>Theory and Examples well explained</td>
<td>4.1</td>
<td>44.9</td>
<td>49.0</td>
<td>34.7</td>
<td>16.3</td>
<td>15.5</td>
</tr>
<tr>
<td>27</td>
<td>Graphics and Simulations explained the material better</td>
<td>16.0</td>
<td>54.0</td>
<td>70.0</td>
<td>16.0</td>
<td>14.0</td>
<td>13.8</td>
</tr>
<tr>
<td>28</td>
<td>Lacking material</td>
<td>28.6</td>
<td>30.6</td>
<td>59.2</td>
<td>34.7</td>
<td>6.1</td>
<td>15.5</td>
</tr>
<tr>
<td>29</td>
<td>Incomplete and insufficient</td>
<td>20.4</td>
<td>26.5</td>
<td>46.9</td>
<td>42.9</td>
<td>10.2</td>
<td>15.5</td>
</tr>
<tr>
<td>30</td>
<td>Would prefer CD to a text book</td>
<td>12.2</td>
<td>16.3</td>
<td>28.6</td>
<td>32.7</td>
<td>38.8</td>
<td>15.5</td>
</tr>
</tbody>
</table>

(D) Rank the overall course for use of Laptops and Electronic Media.
(1 = Strongly Agree,  2 = Agree,  3 = Disagree  4 = Strongly Disagree)

A = Percentage of students who responded “Strongly Agree”.
B = Percentage of students who responded “Agree”.
C = Percentage of students who responded “Strongly Agree and Agree”.
D = Percentage of students who responded “Disagree”.
E = Percentage of students who responded “Strongly Disagree”.
F = Percentage of students who didn’t respond

<table>
<thead>
<tr>
<th>S.No</th>
<th>Question Statement</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>31</td>
<td>Video Camera made me</td>
<td>15.4</td>
<td>61.5</td>
<td>76.9</td>
<td>13.5</td>
<td>9.6</td>
<td>10.3</td>
</tr>
<tr>
<td>32</td>
<td>The video quality on the web was readable</td>
<td>9.1</td>
<td>11.4</td>
<td>20.5</td>
<td>40.9</td>
<td>38.6</td>
<td>24.1</td>
</tr>
<tr>
<td>33</td>
<td>The still images of video lectures were clear enough to read</td>
<td>26.5</td>
<td>59.2</td>
<td>85.7</td>
<td>8.2</td>
<td>6.1</td>
<td>15.5</td>
</tr>
<tr>
<td>34</td>
<td>Chalk Board example problems were useful</td>
<td>30.8</td>
<td>57.7</td>
<td>88.5</td>
<td>5.8</td>
<td>5.8</td>
<td>10.3</td>
</tr>
<tr>
<td>35</td>
<td>The electronic content was easier to understand than a book</td>
<td>11.5</td>
<td>30.8</td>
<td>42.3</td>
<td>38.5</td>
<td>19.2</td>
<td>10.3</td>
</tr>
<tr>
<td>36</td>
<td>The computer projection onto screen was easy to see</td>
<td>10.4</td>
<td>60.4</td>
<td>70.8</td>
<td>20.8</td>
<td>8.3</td>
<td>17.2</td>
</tr>
<tr>
<td>37</td>
<td>The computer projection in class helped in understanding</td>
<td>14.3</td>
<td>61.2</td>
<td>75.5</td>
<td>18.4</td>
<td>6.1</td>
<td>15.5</td>
</tr>
<tr>
<td>38</td>
<td>The laptop in class allowed me to follow the lesson</td>
<td>14.3</td>
<td>40.8</td>
<td>55.1</td>
<td>30.6</td>
<td>14.3</td>
<td>15.5</td>
</tr>
<tr>
<td>39</td>
<td>The laptop was useful for viewing videos of the course</td>
<td>39.2</td>
<td>43.1</td>
<td>82.4</td>
<td>11.8</td>
<td>5.9</td>
<td>12.1</td>
</tr>
<tr>
<td>40</td>
<td>The laptop was useful for coursework out of the class</td>
<td>50.0</td>
<td>34.0</td>
<td>84.0</td>
<td>8.0</td>
<td>8.0</td>
<td>13.8</td>
</tr>
<tr>
<td>41</td>
<td>For this course, I had difficulty in accessing the network when required</td>
<td>5.8</td>
<td>17.3</td>
<td>23.1</td>
<td>57.7</td>
<td>19.2</td>
<td>10.3</td>
</tr>
<tr>
<td>42</td>
<td>I had difficulty in downloading images and videos</td>
<td>11.5</td>
<td>15.4</td>
<td>26.9</td>
<td>53.8</td>
<td>19.2</td>
<td>10.3</td>
</tr>
<tr>
<td>43</td>
<td>I would prefer homework submission electronically than paper</td>
<td>53.8</td>
<td>25.0</td>
<td>78.8</td>
<td>9.6</td>
<td>11.5</td>
<td>10.3</td>
</tr>
<tr>
<td>44</td>
<td>I would like to take another laptop based course at O.U</td>
<td>35.3</td>
<td>45.1</td>
<td>80.4</td>
<td>7.8</td>
<td>11.8</td>
<td>12.1</td>
</tr>
<tr>
<td>45</td>
<td>I learnt more in this course due to laptop compared to traditional teaching</td>
<td>13.7</td>
<td>27.5</td>
<td>41.2</td>
<td>41.2</td>
<td>17.6</td>
<td>12.1</td>
</tr>
</tbody>
</table>
DYNAMICS2000
STUDENT RESPONSE FOR SURVEY

Given below are percentages of students who responded for each option in the question.

Number of Students in the survey = 78

SURVEY PERCENTAGES

A = Percentage of students who responded “Very Useful”.
B = Percentage of students who responded “Useful”.
C = Percentage of students who responded “Very Useful and Useful”.
D = Percentage of students who responded “Not Useful”.
E = Percentage of students who responded “Never Used”.
F = Percentage of students who didn’t respond

<table>
<thead>
<tr>
<th>S.NO</th>
<th>Question Statement</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Discussion and asking questions on Web Board.</td>
<td>40.0</td>
<td>38.6</td>
<td>78.6</td>
<td>11.4</td>
<td>10.0</td>
<td>10.3</td>
</tr>
<tr>
<td>2</td>
<td>Video Lectures on the web</td>
<td>48.6</td>
<td>27.8</td>
<td>76.4</td>
<td>11.1</td>
<td>12.5</td>
<td>7.7</td>
</tr>
<tr>
<td>3</td>
<td>Lecture on the web - Still Pictures</td>
<td>50.0</td>
<td>29.2</td>
<td>79.2</td>
<td>11.1</td>
<td>9.7</td>
<td>7.7</td>
</tr>
<tr>
<td>4</td>
<td>Doing Homework through Web</td>
<td>50.0</td>
<td>31.9</td>
<td>81.9</td>
<td>15.3</td>
<td>2.8</td>
<td>7.7</td>
</tr>
<tr>
<td>5</td>
<td>Homework Solutions on the Web</td>
<td>76.4</td>
<td>20.8</td>
<td>97.2</td>
<td>1.4</td>
<td>1.4</td>
<td>7.7</td>
</tr>
<tr>
<td>6</td>
<td>Use of Laptop in class during Lectures</td>
<td>18.1</td>
<td>13.9</td>
<td>31.9</td>
<td>44.4</td>
<td>23.6</td>
<td>7.7</td>
</tr>
<tr>
<td>7</td>
<td>Use of Laptop during tests for referencing material</td>
<td>32.4</td>
<td>31.0</td>
<td>63.4</td>
<td>14.1</td>
<td>22.5</td>
<td>9.0</td>
</tr>
<tr>
<td>8</td>
<td>Theory and examples on CD</td>
<td>11.1</td>
<td>27.8</td>
<td>38.9</td>
<td>44.4</td>
<td>16.7</td>
<td>7.7</td>
</tr>
<tr>
<td>9</td>
<td>Verification of Submissions and scores</td>
<td>58.3</td>
<td>30.6</td>
<td>88.9</td>
<td>6.9</td>
<td>4.2</td>
<td>7.7</td>
</tr>
<tr>
<td>10</td>
<td>Course Syllabus on the web</td>
<td>48.6</td>
<td>43.1</td>
<td>91.7</td>
<td>5.6</td>
<td>2.8</td>
<td>7.7</td>
</tr>
</tbody>
</table>
(B) **Rank the ease of use for the following items**  
(1 = Very Easy,  2 = Easy  3 = Hard  4 = Did not Use)

A = Percentage of students who responded “Very Easy”.  
B = Percentage of students who responded “Easy”.  
C = Percentage of students who responded “Very Easy and Easy”.  
D = Percentage of students who responded “Hard”.  
E = Percentage of students who responded “Did not Use”.  
F = Percentage of students who didn’t respond

<table>
<thead>
<tr>
<th>S.No</th>
<th>Question Statement</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>Web Board discussion and participation</td>
<td>39.4</td>
<td>38.0</td>
<td>77.5</td>
<td>7.0</td>
<td>15.5</td>
<td>9.0</td>
</tr>
<tr>
<td>12</td>
<td>Accessing and downloading lectures on the web</td>
<td>33.3</td>
<td>36.1</td>
<td>69.4</td>
<td>19.4</td>
<td>11.1</td>
<td>7.7</td>
</tr>
<tr>
<td>13</td>
<td>Accessing Homework on the web</td>
<td>72.2</td>
<td>25.0</td>
<td>97.2</td>
<td>2.8</td>
<td>0.0</td>
<td>7.7</td>
</tr>
<tr>
<td>14</td>
<td>Submission of Homework on the web</td>
<td>77.8</td>
<td>20.8</td>
<td>98.6</td>
<td>1.4</td>
<td>0.0</td>
<td>7.7</td>
</tr>
<tr>
<td>15</td>
<td>Understanding Homework solutions on the web</td>
<td>36.6</td>
<td>39.4</td>
<td>76.1</td>
<td>21.1</td>
<td>2.8</td>
<td>9.0</td>
</tr>
<tr>
<td>16</td>
<td>Using laptop in class for lecture/CD/Videos</td>
<td>26.4</td>
<td>26.4</td>
<td>52.8</td>
<td>20.8</td>
<td>26.4</td>
<td>7.7</td>
</tr>
<tr>
<td>17</td>
<td>Laptop during tests for reference and submission of work</td>
<td>38.9</td>
<td>36.1</td>
<td>75.0</td>
<td>12.5</td>
<td>12.5</td>
<td>7.7</td>
</tr>
<tr>
<td>18</td>
<td>Theory and examples on the CD</td>
<td>16.7</td>
<td>29.2</td>
<td>45.8</td>
<td>41.7</td>
<td>12.5</td>
<td>7.7</td>
</tr>
<tr>
<td>19</td>
<td>Verifying submissions and scores</td>
<td>63.4</td>
<td>33.8</td>
<td>97.2</td>
<td>2.8</td>
<td>0.0</td>
<td>9.0</td>
</tr>
<tr>
<td>20</td>
<td>Web Navigation and Logon</td>
<td>63.9</td>
<td>30.6</td>
<td>94.4</td>
<td>5.6</td>
<td>0.0</td>
<td>7.7</td>
</tr>
</tbody>
</table>
(C) Compared to previous courses with textbooks, the CD-based course content was
(1 = Strongly Agree, 2 = Agree, 3 = Disagree 4 = Strongly Disagree)

A = Percentage of students who responded “Strongly Agree”.
B = Percentage of students who responded “Agree”.
C = Percentage of students who responded “Strongly Agree and Agree”.
D = Percentage of students who responded “Disagree”.
E = Percentage of students who responded “Strongly Disagree”.
F = Percentage of students who didn’t respond

<table>
<thead>
<tr>
<th>S.No</th>
<th>Question Statement</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>Easier to use</td>
<td>14.3</td>
<td>24.3</td>
<td>38.6</td>
<td>34.3</td>
<td>27.1</td>
<td>10.3</td>
</tr>
<tr>
<td>22</td>
<td>Easier to understand</td>
<td>8.6</td>
<td>25.7</td>
<td>34.3</td>
<td>34.3</td>
<td>31.4</td>
<td>10.3</td>
</tr>
<tr>
<td>23</td>
<td>More Enjoyable</td>
<td>24.3</td>
<td>34.3</td>
<td>58.6</td>
<td>17.1</td>
<td>24.3</td>
<td>10.3</td>
</tr>
<tr>
<td>24</td>
<td>More Convenient</td>
<td>31.0</td>
<td>26.8</td>
<td>57.7</td>
<td>18.3</td>
<td>23.9</td>
<td>9.0</td>
</tr>
<tr>
<td>25</td>
<td>Layout and organisation of material was better</td>
<td>15.5</td>
<td>29.6</td>
<td>45.1</td>
<td>28.2</td>
<td>26.8</td>
<td>9.0</td>
</tr>
<tr>
<td>26</td>
<td>Theory and Examples well explained</td>
<td>11.3</td>
<td>33.8</td>
<td>45.1</td>
<td>28.2</td>
<td>26.8</td>
<td>9.0</td>
</tr>
<tr>
<td>27</td>
<td>Graphics and Simulations explained the material better</td>
<td>19.7</td>
<td>46.5</td>
<td>66.2</td>
<td>15.5</td>
<td>18.3</td>
<td>9.0</td>
</tr>
<tr>
<td>28</td>
<td>Lacking material</td>
<td>42.9</td>
<td>30.0</td>
<td>72.9</td>
<td>24.3</td>
<td>2.9</td>
<td>10.3</td>
</tr>
<tr>
<td>29</td>
<td>Incomplete and insufficient</td>
<td>30.0</td>
<td>34.3</td>
<td>64.3</td>
<td>34.3</td>
<td>1.4</td>
<td>10.3</td>
</tr>
<tr>
<td>30</td>
<td>Would prefer CD to a text book</td>
<td>7.0</td>
<td>16.9</td>
<td>23.9</td>
<td>35.2</td>
<td>40.8</td>
<td>9.0</td>
</tr>
</tbody>
</table>

(D) Rank the overall course for use of Laptops and Electronic Media.
(1 = Strongly Agree, 2 = Agree, 3 = Disagree 4 = Strongly Disagree)

A = Percentage of students who responded “Strongly Agree”.
B = Percentage of students who responded “Agree”.
C = Percentage of students who responded “Strongly Agree and Agree”.
D = Percentage of students who responded “Disagree”.
E = Percentage of students who responded “Strongly Disagree”.
F = Percentage of students who didn’t respond
<table>
<thead>
<tr>
<th>S.No</th>
<th>Question Statement</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>31</td>
<td>Video Camera made me uncomfortable during class</td>
<td>10.0</td>
<td>5.7</td>
<td>15.7</td>
<td>40.0</td>
<td>44.3</td>
<td>10.3</td>
</tr>
<tr>
<td>32</td>
<td>The video quality on the web was readable</td>
<td>14.3</td>
<td>67.1</td>
<td>81.4</td>
<td>14.3</td>
<td>4.3</td>
<td>10.3</td>
</tr>
<tr>
<td>33</td>
<td>The still images of video lectures were clear enough to read</td>
<td>27.8</td>
<td>61.1</td>
<td>88.9</td>
<td>8.3</td>
<td>2.8</td>
<td>7.7</td>
</tr>
<tr>
<td>34</td>
<td>Chalk Board example problems were useful</td>
<td>33.3</td>
<td>40.3</td>
<td>73.6</td>
<td>20.8</td>
<td>5.6</td>
<td>7.7</td>
</tr>
<tr>
<td>35</td>
<td>The electronic content was easier to understand than a book</td>
<td>5.6</td>
<td>19.4</td>
<td>25.0</td>
<td>41.7</td>
<td>33.3</td>
<td>7.7</td>
</tr>
<tr>
<td>36</td>
<td>The computer projection onto screen was easy to see</td>
<td>8.6</td>
<td>61.4</td>
<td>70.0</td>
<td>21.4</td>
<td>8.6</td>
<td>10.3</td>
</tr>
<tr>
<td>37</td>
<td>The computer projection in class helped in understanding</td>
<td>5.9</td>
<td>54.4</td>
<td>60.3</td>
<td>27.9</td>
<td>11.8</td>
<td>12.8</td>
</tr>
<tr>
<td>38</td>
<td>The laptop in class allowed me to follow the lesson</td>
<td>8.7</td>
<td>26.1</td>
<td>34.8</td>
<td>42.0</td>
<td>23.2</td>
<td>11.5</td>
</tr>
<tr>
<td>39</td>
<td>The laptop was useful for viewing videos of the course</td>
<td>27.9</td>
<td>48.5</td>
<td>76.5</td>
<td>10.3</td>
<td>13.2</td>
<td>12.8</td>
</tr>
<tr>
<td>40</td>
<td>The laptop was useful for coursework out of the class</td>
<td>33.8</td>
<td>46.5</td>
<td>80.3</td>
<td>8.5</td>
<td>11.3</td>
<td>9.0</td>
</tr>
<tr>
<td>41</td>
<td>For this course, I had difficulty in accessing the network when required</td>
<td>12.7</td>
<td>14.1</td>
<td>26.8</td>
<td>56.3</td>
<td>16.9</td>
<td>9.0</td>
</tr>
<tr>
<td>42</td>
<td>I had difficulty in downloading images and videos</td>
<td>15.3</td>
<td>18.1</td>
<td>33.3</td>
<td>47.2</td>
<td>19.4</td>
<td>7.7</td>
</tr>
<tr>
<td>43</td>
<td>I would prefer homework submission electronically than paper</td>
<td>48.6</td>
<td>21.4</td>
<td>70.0</td>
<td>10.0</td>
<td>20.0</td>
<td>10.3</td>
</tr>
<tr>
<td>44</td>
<td>I would like to take another laptop based course at O.U</td>
<td>35.2</td>
<td>29.6</td>
<td>64.8</td>
<td>8.5</td>
<td>26.8</td>
<td>9.0</td>
</tr>
<tr>
<td>45</td>
<td>I learnt more in this course due to laptop compared to traditional teaching</td>
<td>11.3</td>
<td>28.2</td>
<td>39.4</td>
<td>31.0</td>
<td>29.6</td>
<td>9.0</td>
</tr>
</tbody>
</table>
### Appendix K

**Wilcoxon Signed Rank Test**

**STATICS 2000**

Test of median = 3.000 versus median < 3.000

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>N for Missing</th>
<th>Wilcoxon Statistic</th>
<th>Estimated Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>54</td>
<td>4</td>
<td>164.0</td>
<td>2.000</td>
</tr>
<tr>
<td>2</td>
<td>52</td>
<td>6</td>
<td>27.0</td>
<td>2.000</td>
</tr>
<tr>
<td>3</td>
<td>54</td>
<td>4</td>
<td>124.0</td>
<td>2.500</td>
</tr>
<tr>
<td>4</td>
<td>53</td>
<td>5</td>
<td>0.0</td>
<td>1.500</td>
</tr>
<tr>
<td>5</td>
<td>54</td>
<td>4</td>
<td>0.0</td>
<td>1.500</td>
</tr>
<tr>
<td>6</td>
<td>53</td>
<td>5</td>
<td>100.0</td>
<td>2.500</td>
</tr>
<tr>
<td>7</td>
<td>54</td>
<td>4</td>
<td>27.0</td>
<td>1.500</td>
</tr>
<tr>
<td>8</td>
<td>54</td>
<td>4</td>
<td>143.0</td>
<td>3.000</td>
</tr>
<tr>
<td>9</td>
<td>54</td>
<td>4</td>
<td>9.5</td>
<td>1.500</td>
</tr>
<tr>
<td>10</td>
<td>54</td>
<td>4</td>
<td>30.0</td>
<td>1.500</td>
</tr>
<tr>
<td>11</td>
<td>52</td>
<td>6</td>
<td>192.0</td>
<td>2.000</td>
</tr>
<tr>
<td>12</td>
<td>52</td>
<td>6</td>
<td>0.0</td>
<td>2.000</td>
</tr>
<tr>
<td>13</td>
<td>52</td>
<td>6</td>
<td>0.0</td>
<td>1.000</td>
</tr>
<tr>
<td>14</td>
<td>51</td>
<td>7</td>
<td>0.0</td>
<td>1.500</td>
</tr>
<tr>
<td>15</td>
<td>51</td>
<td>7</td>
<td>0.0</td>
<td>2.000</td>
</tr>
<tr>
<td>16</td>
<td>52</td>
<td>6</td>
<td>116.0</td>
<td>2.500</td>
</tr>
<tr>
<td>17</td>
<td>52</td>
<td>6</td>
<td>33.0</td>
<td>2.000</td>
</tr>
<tr>
<td>18</td>
<td>52</td>
<td>6</td>
<td>139.5</td>
<td>2.500</td>
</tr>
<tr>
<td>19</td>
<td>52</td>
<td>6</td>
<td>18.0</td>
<td>1.500</td>
</tr>
<tr>
<td>20</td>
<td>51</td>
<td>7</td>
<td>9.5</td>
<td>1.500</td>
</tr>
<tr>
<td>21</td>
<td>50</td>
<td>8</td>
<td>170.5</td>
<td>2.500</td>
</tr>
<tr>
<td>22</td>
<td>50</td>
<td>8</td>
<td>154.0</td>
<td>3.000</td>
</tr>
<tr>
<td>23</td>
<td>50</td>
<td>8</td>
<td>154.0</td>
<td>2.500</td>
</tr>
<tr>
<td>24</td>
<td>48</td>
<td>10</td>
<td>60.0</td>
<td>2.000</td>
</tr>
<tr>
<td>25</td>
<td>50</td>
<td>8</td>
<td>157.5</td>
<td>2.500</td>
</tr>
<tr>
<td>26</td>
<td>49</td>
<td>9</td>
<td>124.0</td>
<td>2.500</td>
</tr>
<tr>
<td>27</td>
<td>50</td>
<td>8</td>
<td>122.5</td>
<td>2.000</td>
</tr>
<tr>
<td>28</td>
<td>49</td>
<td>9</td>
<td>28.5</td>
<td>2.000</td>
</tr>
<tr>
<td>29</td>
<td>49</td>
<td>9</td>
<td>47.5</td>
<td>2.500</td>
</tr>
<tr>
<td>30</td>
<td>49</td>
<td>9</td>
<td>266.0</td>
<td>3.000</td>
</tr>
<tr>
<td>31</td>
<td>52</td>
<td>6</td>
<td>95.0</td>
<td>2.000</td>
</tr>
<tr>
<td>32</td>
<td>44</td>
<td>14</td>
<td>195.5</td>
<td>3.000</td>
</tr>
<tr>
<td>33</td>
<td>49</td>
<td>9</td>
<td>49.5</td>
<td>2.000</td>
</tr>
<tr>
<td>34</td>
<td>52</td>
<td>6</td>
<td>51.0</td>
<td>2.000</td>
</tr>
<tr>
<td>35</td>
<td>52</td>
<td>6</td>
<td>135.0</td>
<td>2.500</td>
</tr>
<tr>
<td>36</td>
<td>48</td>
<td>10</td>
<td>68.0</td>
<td>2.000</td>
</tr>
<tr>
<td>37</td>
<td>49</td>
<td>9</td>
<td>51.0</td>
<td>2.000</td>
</tr>
<tr>
<td>38</td>
<td>49</td>
<td>9</td>
<td>98.0</td>
<td>2.500</td>
</tr>
<tr>
<td>39</td>
<td>51</td>
<td>7</td>
<td>39.0</td>
<td>2.000</td>
</tr>
<tr>
<td>40</td>
<td>50</td>
<td>8</td>
<td>44.0</td>
<td>1.500</td>
</tr>
<tr>
<td>41</td>
<td>52</td>
<td>6</td>
<td>100.0</td>
<td>3.000</td>
</tr>
<tr>
<td>42</td>
<td>52</td>
<td>6</td>
<td>95.0</td>
<td>3.000</td>
</tr>
<tr>
<td>43</td>
<td>52</td>
<td>6</td>
<td>60.0</td>
<td>1.500</td>
</tr>
<tr>
<td>44</td>
<td>51</td>
<td>7</td>
<td>90.0</td>
<td>2.000</td>
</tr>
<tr>
<td>45</td>
<td>51</td>
<td>7</td>
<td>108.0</td>
<td>2.500</td>
</tr>
</tbody>
</table>

189
Wilcoxon Signed Rank Test  
(DYNAMICS 2000)

Test of median = 3.000 versus median < 3.000

<table>
<thead>
<tr>
<th>N</th>
<th>Missing</th>
<th>N for Test</th>
<th>Wilcoxon Statistic</th>
<th>P</th>
<th>Estimated Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>70</td>
<td>8</td>
<td>62</td>
<td>122.5</td>
<td>0.000</td>
</tr>
<tr>
<td>2</td>
<td>72</td>
<td>6</td>
<td>64</td>
<td>135.0</td>
<td>0.000</td>
</tr>
<tr>
<td>3</td>
<td>72</td>
<td>6</td>
<td>64</td>
<td>101.5</td>
<td>0.000</td>
</tr>
<tr>
<td>4</td>
<td>72</td>
<td>6</td>
<td>61</td>
<td>26.0</td>
<td>0.000</td>
</tr>
<tr>
<td>5</td>
<td>72</td>
<td>6</td>
<td>71</td>
<td>8.5</td>
<td>0.000</td>
</tr>
<tr>
<td>6</td>
<td>72</td>
<td>6</td>
<td>40</td>
<td>238.0</td>
<td>0.011</td>
</tr>
<tr>
<td>7</td>
<td>71</td>
<td>7</td>
<td>61</td>
<td>312.0</td>
<td>0.000</td>
</tr>
<tr>
<td>8</td>
<td>72</td>
<td>6</td>
<td>40</td>
<td>198.0</td>
<td>0.002</td>
</tr>
<tr>
<td>9</td>
<td>72</td>
<td>6</td>
<td>67</td>
<td>39.0</td>
<td>0.000</td>
</tr>
<tr>
<td>10</td>
<td>72</td>
<td>6</td>
<td>68</td>
<td>34.0</td>
<td>0.000</td>
</tr>
<tr>
<td>11</td>
<td>71</td>
<td>7</td>
<td>66</td>
<td>214.5</td>
<td>0.000</td>
</tr>
<tr>
<td>12</td>
<td>72</td>
<td>6</td>
<td>58</td>
<td>140.0</td>
<td>0.000</td>
</tr>
<tr>
<td>13</td>
<td>72</td>
<td>6</td>
<td>70</td>
<td>0.0</td>
<td>0.000</td>
</tr>
<tr>
<td>14</td>
<td>72</td>
<td>6</td>
<td>71</td>
<td>0.0</td>
<td>0.000</td>
</tr>
<tr>
<td>15</td>
<td>71</td>
<td>7</td>
<td>56</td>
<td>31.0</td>
<td>0.000</td>
</tr>
<tr>
<td>16</td>
<td>72</td>
<td>6</td>
<td>57</td>
<td>370.5</td>
<td>0.000</td>
</tr>
<tr>
<td>17</td>
<td>72</td>
<td>6</td>
<td>63</td>
<td>162.0</td>
<td>0.000</td>
</tr>
<tr>
<td>18</td>
<td>72</td>
<td>6</td>
<td>42</td>
<td>139.5</td>
<td>0.000</td>
</tr>
<tr>
<td>19</td>
<td>71</td>
<td>7</td>
<td>69</td>
<td>0.0</td>
<td>0.000</td>
</tr>
<tr>
<td>20</td>
<td>72</td>
<td>6</td>
<td>68</td>
<td>0.0</td>
<td>0.000</td>
</tr>
<tr>
<td>21</td>
<td>70</td>
<td>8</td>
<td>46</td>
<td>351.5</td>
<td>0.020</td>
</tr>
<tr>
<td>22</td>
<td>70</td>
<td>8</td>
<td>46</td>
<td>451.0</td>
<td>0.165</td>
</tr>
<tr>
<td>23</td>
<td>70</td>
<td>8</td>
<td>58</td>
<td>357.0</td>
<td>0.000</td>
</tr>
<tr>
<td>24</td>
<td>71</td>
<td>7</td>
<td>58</td>
<td>314.5</td>
<td>0.000</td>
</tr>
<tr>
<td>25</td>
<td>71</td>
<td>7</td>
<td>51</td>
<td>389.5</td>
<td>0.005</td>
</tr>
<tr>
<td>26</td>
<td>71</td>
<td>7</td>
<td>51</td>
<td>418.0</td>
<td>0.011</td>
</tr>
<tr>
<td>27</td>
<td>71</td>
<td>7</td>
<td>60</td>
<td>305.5</td>
<td>0.000</td>
</tr>
<tr>
<td>28</td>
<td>70</td>
<td>8</td>
<td>53</td>
<td>24.0</td>
<td>0.000</td>
</tr>
<tr>
<td>29</td>
<td>70</td>
<td>8</td>
<td>46</td>
<td>13.0</td>
<td>0.000</td>
</tr>
<tr>
<td>30</td>
<td>71</td>
<td>7</td>
<td>46</td>
<td>609.0</td>
<td>0.775</td>
</tr>
<tr>
<td>31</td>
<td>70</td>
<td>8</td>
<td>42</td>
<td>558.0</td>
<td>0.910</td>
</tr>
<tr>
<td>32</td>
<td>70</td>
<td>8</td>
<td>60</td>
<td>76.5</td>
<td>0.000</td>
</tr>
<tr>
<td>33</td>
<td>72</td>
<td>6</td>
<td>66</td>
<td>47.0</td>
<td>0.000</td>
</tr>
<tr>
<td>34</td>
<td>72</td>
<td>6</td>
<td>57</td>
<td>68.0</td>
<td>0.000</td>
</tr>
<tr>
<td>35</td>
<td>72</td>
<td>6</td>
<td>42</td>
<td>468.0</td>
<td>0.584</td>
</tr>
<tr>
<td>36</td>
<td>70</td>
<td>8</td>
<td>55</td>
<td>150.0</td>
<td>0.000</td>
</tr>
<tr>
<td>37</td>
<td>68</td>
<td>10</td>
<td>49</td>
<td>184.0</td>
<td>0.000</td>
</tr>
<tr>
<td>38</td>
<td>69</td>
<td>9</td>
<td>40</td>
<td>280.0</td>
<td>0.041</td>
</tr>
<tr>
<td>39</td>
<td>68</td>
<td>10</td>
<td>61</td>
<td>193.5</td>
<td>0.000</td>
</tr>
<tr>
<td>40</td>
<td>71</td>
<td>7</td>
<td>65</td>
<td>168.0</td>
<td>0.000</td>
</tr>
<tr>
<td>41</td>
<td>71</td>
<td>7</td>
<td>31</td>
<td>138.0</td>
<td>0.016</td>
</tr>
<tr>
<td>42</td>
<td>72</td>
<td>6</td>
<td>38</td>
<td>196.0</td>
<td>0.006</td>
</tr>
<tr>
<td>43</td>
<td>70</td>
<td>8</td>
<td>63</td>
<td>210.0</td>
<td>0.000</td>
</tr>
<tr>
<td>44</td>
<td>71</td>
<td>7</td>
<td>65</td>
<td>389.5</td>
<td>0.000</td>
</tr>
<tr>
<td>45</td>
<td>71</td>
<td>7</td>
<td>49</td>
<td>441.0</td>
<td>0.044</td>
</tr>
</tbody>
</table>