

AC 2007-913: UTILIZING VIRTUAL SOFTWARE TO PROVIDE HANDS-ON EXPERIENCE WITH SYSTEMS AND APPLICATIONS SOFTWARE FOR IS STUDENTS

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Professor Mariga teaches in the Department of Computer and Information Technology (CIT) at Purdue University, in West Lafayette, IN. Her areas of interest include virtual technologies and increasing the number of women students within CIT. CIT offers degrees in both information systems development and network engineering technology. She has co-authored a textbook, edited a second textbook, and written five chapters for other texts. She has published two journal articles and over twenty referred articles and has written or co-authored numerous grants aimed at increasing the number of women students in CIT. She serves as an Associate Editor for the International Journal of Information and Communication Technology Education. She has been the recipient of numerous teaching awards at the department, college, and university levels. She is actively involved in the academic alliance for the National Center for Women & Information Technology (www.ncwit.org), served as a co-chair of the Birds of a Feather session and on the Program Committee for the 2006 Grace Hopper Women in Computing Conference. She is on the Academic Advisory Committee as well as the Panels, Workshops, & Presentations Committee for the 2007 Grace Hopper Women in Computing Conference. Finally, she serves on the Curriculum Writing Committee for the ACM SIG Information Technology Educators (www.sigite.org)

Utilizing Virtual Software to Provide Hands-On Experience with Systems & Applications Software for IS Students

Abstract

As information technology continues to evolve, analysis of material presented in a curriculum requires constant monitoring. Courses in information technology have been in high demand in educational institutions nationwide. In light of these demands information systems programs have identified a critical need to incorporate more systems and network administration into their curricula. The students who are progressing towards a B.S. in Information Systems Technology (IST) are the primary audience of the course detailed in this paper.

The increasing use of virtual technologies by companies across multiple industries has made it extremely important for IT programs to provide students with experience using virtual technologies. As the virtual technology market evolves, it is important to monitor and report the changes through course material.

Due to the growth in networking and virtual technologies and the need for undergraduate students in non-networking majors to understand and learn about network protocols, network operating system fundamentals, network operating systems, database and web servers and directory services, a course for IST students was developed. To meet the practical objectives of the course, students require dedicated computers on which to install operating systems and applications. However, providing each lab group a dedicated machine would be space and cost prohibitive. By using VMware as the platform, students are able to gain hands-on laboratory experience that emphasizes networking and systems software problem solving and troubleshooting skills through installation and configuration of network operating systems as well as application software.

The course laboratory activities currently include one-week on VMware orientation, three-weeks on Windows XP Pro and Windows 2003 Server, three-weeks on SQL Server 2005 and Internet Information Server (IIS), three-weeks on Exchange Server 2003, and the last five-weeks of the semester cover Linux and Apache Web Server.

This paper will discuss the course design including lecture and laboratory activities, the challenges associated with the laboratory activities, as well as the pros and cons with using VMware.

Introduction

Computer & Information Technology Department

The Computer & Information Technology (CIT) department at Purdue University currently offers two baccalaureate degrees. The first is a B.S. in Information Systems Technology (IST) and the second degree offering is a B.S. in Network Engineering

Technology (NET). Each of these degrees accounts for roughly half of the student population of the department which is currently at 550 students. Additionally, there are several areas of specialization within each degree that allow students to concentrate their studies on a specific focus within the information technology field. This breakdown can be seen below.

	CIT	
B.S. Degrees	IST	NET
Areas of Specialization	Database Administration Systems Integration Application Development	Wireless Networking Network Security & Forensics

Figure 1 - CIT Degrees and Specializations

The Need for the Course

Due to the growth in networking and virtual technologies and the need for undergraduate students in non-networking majors to understand and learn about network protocols, network operating system fundamentals, network operating systems, database and web servers and directory services, a course for IST students was developed. The course also was a result of feedback given to CIT by their Industrial Advisory Board (IAB). Prior to ABET creating an information technology accreditation for IT programs, CIT relied on the IAB for feedback on ways to improve the curriculum and facilities. In 2000, one of the main action items given to CIT from the IAB was that IST students needed to have hands-on experience with installing and configuring software and needed to have experience with Linux.

Why Virtualization

Since many companies are integrating virtual servers into their IT infrastructures and since CIT did not have enough non-production computers for each lab group to use, the solution implemented by CIT was to use virtual software to allow the students to meet the course objectives. As a result of this decision, CIT students were not only able to meet the course objectives but they were exposed to virtual software. Since 2000, more companies are implementing some form of virtual software so CIT students are better qualified to help from day one since they have used virtual software.

Virtualization – the science of creating multiple self-contained application environments on a single physical server – is altering the way businesses manage computing resources and changing the skills they expect from their IT staffs. Virtualization is delivering on the promise of efficient hardware utilization, better resource allocation, flexible application services, and lower costs. There are pitfalls that need to be considered before moving to a virtualized environment such as cost and security is a wildcard, application performance can suffer and vendor support for virtualized applications can be problematic.¹ Virtual technology has let organizations decrease the number of physical servers they run and increase the number of applications they support - all while boosting performance and availability, and even easing the overall administrative workload.²

Course Design

The course is C&IT 276 and is a required course for students earning their degree in Information Systems Technology. The course is offered every semester and is offered as a class 2, lab 2 pattern. The course description is:

Introduction to a wide range of topics in the networking field. Topics include: systems and network administration support practices, desktop and server support, security, disaster recovery, ethics, change management, help desks, networks, network operating systems, and directory services. The students will gain hands-on experience in the laboratory with installing and configuring network operating systems and application software.³

Lecture Overview

The course was first offered in 2001 and since that time has undergone restructuring on the lecture portion of the class. The course moved away from being LAN centric and has moved to cover systems administration topics. The lecture textbook used is *The Practice of System and Network Administration*. The book is a trade textbook and was published in 2002 but the faculty have not been able to identify an academic textbook or more recent trade textbook to adopt. The topics covered in the lecture portion of the class are outlined below.

- Desktops
- Servers
- Network Services
- Namespaces
- Directory Services
- Security Policy
- Disaster Recovery and Data Integrity
- Ethics
- Change Management and Revision Control
- Centralization and Decentralization
- Helpdesks
- Data Centers

- Networks
- Email Services
- Remote Access Services

In addition to the topics above, articles from recent IT magazines are used in lecture to bring in current information as well as let students know that IT is a profession in which they will be life long learners.

Lab Overview

The course laboratory activities currently include one-week on VMware orientation, three-weeks on Windows XP Pro and Windows 2003 Server, three-weeks on SQL Server 2005 and Internet Information Server (IIS), three-weeks on Exchange Server 2003, and the last five-weeks of the semester cover Fedora Linux and Apache Web Server. The students are given a lab manual at the beginning of each semester that outlines the course policies, lab expectations, and laboratory report expectations. For the complete lab manual go to the CIT 276 website at <http://www2.tech.purdue.edu/cit/Courses/CPT276/>. Each lab is broken into primary objectives, secondary objectives, check off, and then they submit a lab report discussing the lab activity. The primary and secondary objectives for Windows XP Professional and Windows 2003 Server are listed below.

Primary Objectives

- Install network operating systems (Windows 2003 Server)
- Update the network operating system (NOS) with the current updates and patches
- Configure networking on the NOS to support the default network and transport layer protocols (TCP/IP)
- Install and configure Active Directory Services
- Create and configure network users and groups with Active Directory Services
 - Create several users and at least 3 different groups, and assign users into different groups
- Create user home directories and roaming profiles, and implement appropriate security (i.e. Only Administrators, System and the specific user can have the full control of user's Home Directory)
- Configure Group Policy (At least one Policy)
 - Make changes in User Configuration for a group of users
- Configure the NOS to share resources, set up shared folders for users and groups, and enable appropriate rights and permissions for different users or groups
- Install and configure Print Services on the Windows 2003 Server
 - Use LPT1 as the Printer Port
 - Share the printer and grant different permissions to different groups of users
 - Add a network printer on the Windows 2003 Professional

Secondary Objectives

- Install the following client operating systems and configure them to access shared resources from the Windows 2003 Server:
 - Windows XP Professional

- Configure the client (Windows XP Professional) to run an application from the Windows 2003 Server.
- Get familiar with the components in the Administrative Tools (Briefly describe how to use the following)
 - Component Services
 - Computer Management
 - Configure Your Server
 - Event Viewer
 - Licensing
 - Performance
 - Routing and Remote Access
 - Services
 - DNS
 - Domain Controller Security Policy
 - Domain Security Policy
- Managing and setting disk quotas
 - Enable disk quotas and enforce disk quota warnings and limits for at least one individual user
- Establish, configure, and properly protect a remote desktop connection to the 2003 Server using terminal services
- Configure File Encryption

At the end of each lab project, the students are required to write a laboratory report documenting their experiences with the software installation and configuration. The students do not like having to do this activity but as IT professionals they must be able to communicate technical information in a non-technical way. By providing them with the experience of writing lab reports they get some exposure of having to write technical reports. Many students take the course during their second semester sophomore year or sometime during their junior year and many students have come back and informed the faculty that having to write the lab reports was a very valuable experience and it helped them complete their documentation requirements on their various internship experiences. The basic outline of the lab report is shown below.

Cover Page

Name of laboratory experience
 Lab group number
 Names of group members
 Due date
 Who the report is submitted to

Table of Contents

Include all major sections and appendices and their page numbers

Executive Summary

This is a brief executive summary written for a non-technical audience. Include only the bare facts about the report and the final conclusion. A good technique is to write

the executive summary at the level you would explain the project to a parent (assuming neither of parent is a networking professional.) The executive summary should be no longer than two paragraphs and should fit on half of a page.

Background / Business Scenario

Create a business scenario describing the sequence of events that lead up to the initiation of the project and the overall purpose of the project. Ensure the business scenario is appropriate for the project. Be sure to detail the purpose of the project: What are you trying to determine or prove through the project? A good way to develop this section is to use the top down model to detail the environment into which the technology will be installed.

Procedures

How did you complete the project? Provide a stepwise narrative of the sequence of actions undertaken. The key is to provide a reader with an appropriate background and enough detail to re-create your work. However, it is not necessary to provide "cookbook" directions.

Results

Detailed configuration information should be presented to help the reader understand what was accomplished over the course of the project. The key information to include is the configuration information that will vary from installation to installation. This can be done effectively through the use of tables as well as network diagrams.

One method to provide good documentation of configuration information is to use screen shots of the configuration screens. This technique is especially effective if the configuration process is complex or rarely used.

Problem Solving and Troubleshooting

The development of troubleshooting and problem solving skills is one of the main objectives of the lab portion of CIT 276. Therefore, each problem encountered throughout the course of the project report should be addressed. A short description of the problem, the knowns, unknowns, assumptions, processes used to arrive at a solution, and findings/conclusions should be documented.

Conclusions and Recommendations

Close the report by answering the issues raised in the background/business scenario section of the report. Include any recommendations that you would give to someone who might be attempting to duplicate your work.

Bibliography

List the sources of any and all information used to complete the project. Examples would be the software manuals, web sites, your lab instructor, members of other groups, etc. There is never an instance where you do not use any resources. Students quite frequently say that they did these themselves and had no outside intervention.

This is not true – they did not run into any major snags, where they needed much help, but they asked another group for help, or asked for a disk. These are all resources that need to be stated in the bibliography.

Conclusion

This has become an extremely important course for the IST students since it provides them the opportunity to gain hands-on experience with installing, configuring, and administrating network operating systems and application software. Another important aspect they learn is how to document how and what they accomplished during lab.

The students that have completed the class comment using VMWare has been very beneficial because they use it later in the curriculum, but also many of them are asked to use VMWare upon graduation. The students that take this course do not go into networking type positions but are often asked by their company to be the first line of support within their given department. Many alumni have told the course instructor that their companies are using VMWare and they are thankful they learned what it is and how to use it. The students have stated that using VMWare is an advantage over actually installing and configuring the software on an actual system.

In the future, other virtual software will be used in the course so students can become familiar with software other than just VMWare. Since many students have indicated they enjoy this course, a selective course may be developed which will allow the students to use other virtual technologies and gain experience with other software they may encounter in their career.

The lab portion of this class has encountered some problems such as not having enough memory or hard drive space on the physical computers. It is recommended that the physical computers have at least 1 GB of memory and at least 80 GB hard drive. Finally, the server where the virtual images are stored needs to have enough storage space. There is not an exact amount that can be given since it depends on the number of students in the class and the software that is installed virtually. Generally, CIT 276 has approximately 30 to 50 students per semester with the students working in a group of two. As the course moved towards newer versions of network operating systems and application software, the server housing the images has grown. The server we currently use is 175 GB and the course is about to outgrow that capacity.

References

- ¹ Babcock, C. (2006). *Virtual payoff in the real world*. InformationWeek, December 18/25, 2006, pp.39-48.
- ² Cummins, J. (2006). *A virtual breeze: Five tips that will have you sailing through your server virtualization projects*. Network World website:
<http://www.networkworld.com/supp/2006/ndc5/082106-ndc-server-virtualization-tips.html?ndc>
- ³ Computer and Information Technology CIT 276 course website, (2007),
<http://www2.tech.purdue.edu/cit/Courses/CPT276/>