A Tutorial on Setting up Ubuntu Linux Virtual Machines

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1 Installing *VMware Player*

*VMware Player* is a free utility for creating and running VMware Virtual Machines (VMs). It can run multiple VMs concurrently therefore supporting a computer cluster on a single PC. *VMware Fusion* is the counterpart of VMware Player for MacBook but you need to buy a license to use it (around $80). There are *VMware Player* versions for both Linux and Windows, and you can download them directly from [http://www.vmware.com/download/player/](http://www.vmware.com/download/player/). Here I explain how to set up *VMware Player* on a Windows PC using a copy of *VMware Player* I prepared for you.

- If you have installed *VMware Player* versions earlier than V3.1, uninstall it and reboot your PC.
- In your PC, create a folder “C:\VM” with *Windows Explorer*.
- Use a web browser to visit [http://csis.pace.edu/lixin/ubuntu](http://csis.pace.edu/lixin/ubuntu), and double-click on the file of pattern “VMware-player-xxx.exe” (“xxx” representing any string, and I use “3.1.3-324285” as an example). Save the file in folder “C:\VM” of your PC.
• Double click on the downloaded file in Windows Explorer to install VMware Player with default values.
• Reboot your PC.
• Start VMware Player, and you will see a window like the following.

![Image of VMware Player interface]

• Click on menu item “File|Player Preferences…”

![Image of menu options in VMware Player]
In the “Preferences” window, uncheck for software updates, and click on the “Download All Components Now” button so you can later install VMware Tools in your new VMs without Internet access. This step is optional.

With this same “Preferences” window you can also set close behavior (when you click on the VM’s close icon, should the VM suspend or power off the VM, and whether you need to provide a confirmation), and whether VMware Player should download all available optional components now or on demand.

Click on the OK button to close the “Player Preferences” window.

Click on the “File|Exit” menu item to exit the “VMware Player” application.

If you are using this tutorial to learn how to install Ubuntu and applications on a Ubuntu VM, then VMware Player is the only software that you need to install on your PC. Your software installation on the VM will have no impact on your PC’s work environment.
2 Deploying and Using a Completed Ubuntu Virtual Machine

2.1 Overview

This section guides you to download and install a fully-loaded Ubuntu V10.10 VMware virtual machine (VM) named ubuntu1010. This fully-loaded VM is a good tool for you to learn Linux and web technologies. In the following sections you will learn how to set up a basic Ubuntu V10.10 VM named ubuntu1010basic, and install applications on ubuntu1010basic to reproduce ubuntu1010 yourself.

Before you can run a VM, you must have installed the latest VMware Player or its equivalent (VMware Workstation or VMware Fusion). If you have not installed VMware Player, refer to the last section to install it first.

2.2 Downloading the Completed Version of Ubuntu V10.10 Linux VM on Windows

- In your PC, create a folder “C:\VM” with Windows Explorer.
- Use a web browser to visit http://csis.pace.edu/lixin/ubuntu/ubuntu1010.exe, and save the downloaded file in “C:\VM”.

![Image of downloading Ubuntu VM](http://csis.pace.edu/lixin/ubuntu/ubuntu1010.exe)
In a Windows Explorer, double-click on file “C:\VM\ubuntu1010.exe” to run it, and the execution will generate a folder “C:\VM\ubuntu1010”.

File “C:\VM\ubuntu1010\readme.txt” contains important technical information for the VM including the user names and passwords. This VM has user name “user” and password 123456. Save file “C:\VM\ubuntu1010.exe” for later regenerating the VM folder if the VM gets compromised.

If you cannot see the same file icons below, then you have not installed VMware Player or its equivalent yet. Please do so now.
• If you cannot see file extensions in the last screen capture, click on “Start|Control Panel|Folder Options” to launch the Folder Options window below, and uncheck “Hide extensions for known file types”. All computing professionals should make file extensions visible.

2.3 Installing the Completed Version of Ubuntu V10.10 Linux VM on MacBook

1. You need have VMware Fusion installed on your MacBook. You can get more information about VMware Fusion and get it at http://www.vmware.com/products/fusion/.
3. Drag my file “ubuntu1010.exe” on top of “Stuffit Expander”, and the file will be extracted into a folder “ubuntu1010” in the same folder as “ubuntu1010.exe”.
4. Double–click on file “ubuntu1010/Ubuntu1010.vmx” to launch the Ubuntu1010 VM.

As an alternative you can also unzipping “ubuntu1010.exe” on a PC to generate a PC folder “ubuntu1010”, and then use a USB flash disk to copy the folder to your MacBook. File “ubuntu1010.exe” is basically a 7z zip file with optional unzip Windows code attached; and you can treat it as a normal zip file.

2.4 Launching and Logging on the VM

In folder “C:\VM\ubuntu10”, file “readme.txt” tells you some information about this VM including the user names and passwords for this VM. There is one pre-set user “user” having password “123456”. To try out the features of this VM, you must logon as “user”. User “root” is by default not created as a good practice for reducing security issues. But you could easily create the “root” account yourself following my instructions in Section 3.4.

To launch the VM with VMware Player, double-click on file “Ubuntu10.vmx” (if you could not see the file name extension “.vmx”, then look for the icon of three partially overlapping blue squares). This file is
the configuration file of the VM. Since it is a text file, you could open it with a text editor and make some simple changes, like increasing the memory size for the VM (only if you have more than one GB of physical memory).

If this is your first time to launch the VM, you may see the following screen:

![VMware Player prompt](image)

It is better to check the checkbox for “I copied it” and then click on the OK button. If you check for “I moved it”, the virtual hard disk would keep its unique virtual disk signature used for the licensing of some software as well as its unique virtual MAC (Media Access Control) address of your virtual network card. If you check “I copied it”, the virtual hard disk would have a new unique virtual hard disk signature thus may invalidate some software licenses. Since we only install open-source software, they don't make differences for us. If you plan to run multiple VMs concurrently, then each of the VMs must have a unique virtual MAC address so it could get a unique IP address from your DHCP (Dynamic Host Configuration Protocol) server.

After a few seconds you will see the following Ubuntu window ready for use.

![Ubuntu window](image)

If you click on the person icon in the right-bottom corner, you could set up some user interface details with the following popup window.
If you click on the power button in the right-bottom corner, then you would have options to suspend, restart or shut down the VM.

Click on user name “user” (coincident), and enter 123456 as password, you will see the following screen. If you have created other user accounts on this VM, then you could click on “Other” and type other user names for login.

If you maximize the *VMware Player* window, the VM will take over the complete display. If you put your mouse cursor close to the top middle margin, the *VMware Player* menu bar will show up for you to use, as shown below.
To log out, restart, or shut down the VM, you can click on icon  and then you will be presented with the following choices.

If you prefer the VM to log in as “user” automatically at VM launch time, click on menu item “System|Administration|Login Screen”
and you will see the following “Login Screen Settings” window:

Click on the Unlock button and you will see an “Authenticate” window. Enter password 123456 and click on the Authenticate button. The “Authenticate” window should disappear. You may need to click on the Unlock button again to be able to change the settings as below:
Here I have chosen to give the user 10 seconds to type in a different user name before the VM automatically log in as “user”. Click on the Close button and you are done with this task. When you restart your VM, you will see a login screen as below:

![Login Screen]

You will be logged in as “user” automatically if you don’t type another user name within 10 seconds.

2.5 Changing Mouse Focus and Exchanging Files between VM and PC

At any time, if you need to use the mouse cursor in the VM, just click anywhere in the VM window; and if you need to use the mouse outside of the VM window, type key combination “Ctrl+Alt”.

There are four ways for exchanging data between your VM and your hosting PC.

2.5.1 Dragging-and-Dropping

At any time you can use the left mouse button to drag-and-drop files and folders between your physical PC and your VM. This is the simplest way to share files between your PC and VM.

2.5.2 Using a USB Portable Disk.

If you are working in the VM window and you plug in a USB device, the USB device will be recognized by your VM. On the other hand if you are working outside of the VM, then your PC will take over the USB device. You can also use VMware Player’s menu “Virtual Machine|Removable Devices” to disconnect a USB disk drive, DVD drive or floppy drive from the VM so it could be recognized and used by the PC, or disconnect a drive from your PC so it could be recognized and grabbed by your VM.
Therefore we could use a USB disk as a bridge for exchanging files between the PC and the VM.

By the way in the last screen capture, you can also see a *VMware Player* menu item “Send Ctrl+Alt+Del”, which is how we generate the Ctrl+Alt+Del key combination, an important key combination for launching the task manager of *Windows* VMs.

### 2.5.3 Shared Folders

I have set up a shared folder “/mnt/hgfs/C” on this VM and you can use it to access your PC’s entire “C:\” drive. When you launch the VM for the first time, you may need to enable it by clicking on *VMware Player* menu item “Virtual Machine|Virtual Machine Settings…”, choosing the “Options” tab, selecting “Shared Folders” in the left pane, and making sure that the checkbox for “Always enabled” is checked and the folder “C” for “C:\” is checked, as shown below (if you cannot check “Always enables”, you need to reinstall VMware Tools; read the end of Section 3.2):

If you click on Ubuntu menu item “Places|Computer”,

![Virtual Machine Settings](image-url)
you will see the following file browser window. Click on “File System” in the left pane.

If you double-click on “mnt” (mount), then the embedded “hgfs”, you will see a folder “C”. Double-click on it and you will have access to all of your PC’s drive “C:\”, as shown below. If you cannot see folder “C” under “hgfs”, you need to enable this shared folder as described earlier in this subsection.


2.5.4  *Coping and Pasting Text between VM and PC*

You can use the familiar copy-and-paste to copy text between your PC and VM. Remember the following exceptions:

- In a *Ubuntu* terminal window, you can select text by just highlighting the text.
- In a *Ubuntu* terminal window, you use key combination Ctrl+Shift+c to copy the selected text, and Ctrl+Shift+v to paste text into it, instead of the familiar key combination Ctrl+c and Ctrl+v on Windows.
- For other *Ubuntu* tools you can try Ctrl+c and Ctrl+Shift+c to see which combination work for copying text, and try Ctrl+v and Ctrl+Shift+v to see which combination work for pasting text.

2.6  **Using Basic *Ubuntu* Tools**

2.6.1  *Launching a Terminal Window*

To open a terminal window to run some Linux commands, you can double-click on menu item “Applications|Accessories|Terminal”: 
You can open multiple terminal windows.

2.6.2 Launching a Firefox Web Browser

You can click on the top Firefox icon to launch a Firefox web browser.

2.6.3 Launching a Nautilus File Browser

Ubuntu menu “Places” lets you browse files in various places of the file system with a Nautilus file browser.
For example, if you double-click on the “Places|Home Folder” menu item, you will see the following file browser:

In the left “Places” pane, “user” is the current user user’s home folder “/home/user”, which is also represented by symbol ~ in file/folder paths; and “File System” is the entire Linux file system “/”. Folder “/home/user/Desktop” holds all items on your Ubuntu desktop. When you use Firefox web browser to download files, the downloaded files will be saved in folder “/home/user/Downloads”.

2.6.4 Launching a Text Editor

You can use Ubuntu menu item “Applications|gedit text Editor” to launch a gedit text editor.
2.6.5 Using Synaptic Package Manager

Ubuntu menu “System” contains important administrator tools for managing the system. Menu item “System|Administration|Synaptic Package Manager” allows you to use a GUI to install, update or remove software packages (in this document we will use a lower-level command tool “aptitude” for performing the same functions).

2.6.6 Customizing Ubuntu Application Menu

Menu item “System|Preferences|Main Menu” lets you customize the top-left Applications menu.
2.7 Finding Out Your Gateway/Router, PC and VM’s IP Addresses

Your home gets Internet access through a gateway connected to your phone or cable service line. Your gateway has a unique IP address visible on the Internet, and this address by default is dynamically assigned when you power up the router. If you run a home business on the Internet, you may want to upgrade to a static IP address service so your clients can easily access your online services. Your gateway also has a unique local area network (LAN) IP address (not visible outside of your home), which is normally called the gateway address. Your gateway normally also functions as a wired/wireless router to support communications among the PCs in your LAN as well as accessing the Internet by your LAN PCs. Each PC in your LAN has a unique local IP address of form 192.168.x.y. Each message (IP packets) on the network has its destination IP address. An Internet message for any of your local PCs will use your gateway’s external IP address as its destination, and the router will use a routing table to forward the message to your particular PC which may have requested for that message. When one of your PCs sends a message to another PC in your LAN, the router will also use its routing table to forward the message to the right PC. All PCs in your LAN as well as the router must use the same subnet mask, normally in form of “255.255.255.0”, and their local IP addresses must have the same value for the first three integers, like 192.168.0.x, where x means any integer. To put it simple, a subnet mask defines an IP address pattern for all PCs in the same LAN, and only PCs whose IP address follows this pattern is considered part of the same LAN. You could have multiple LANs in your home if your PCs use multiple subnet mask values.

Your router normally also runs a DHCP (Dynamic Host Configuration Protocol) server. When a PC is connected to your router, the PC will send over its network card’s MAC (Media Access Control) address, which is supposed to be unique world-wide with high probability. The router will assign a unique local IP address for this PC and send this address back to the PC. A local IP address is of form “192.168.x.y” and it can only be used in your LAN for PCs to access each other.

The above is a concise review, not accurate introduction, of the main networking concepts relevant to our discussion. You can search textbooks or the web for more detailed explanations.
To find out what is your Internet gateway/router’s IP address, start a web browser in your PC, and visit address [http://www.whatismyip.com](http://www.whatismyip.com). The following is a sample screen showing that my router’s current external IP address is 67.85.138.191.

To find out the local IP address of your Windows PC or VM, run “Start|All Programs|Accessories|Command Prompt” to launch a DOS window, and run command “ipconfig” in the DOS window. For example, the following is part of my `ipconfig` session, and it tells me that my local IP address is 192.168.0.254 (IPv4 Address), my subnet mask is 255.255.255.0, and my default gateway has IP address 192.168.0.1. Ignore the information for VMnets because they are for the virtual network adapters.

To find out the local IP address of your Linux PC or VM, start a terminal window and run command “sudo ifconfig”. You will be asked to enter your Linux password. After you enter your password, you
will see a lot of information about your LAN, including your local IP address (inet addr: 192.168.232.129) and subnet mask (Mask: 255.255.255.0). You only need to read the “eth1” section. The “lo” section is information for networking within this PC or VM. All Windows and Linux computers have a special local loopback IP address 127.0.0.1. If a message is sent to this address, it will never leave the computer that generates this message, and the message will be sent back to the same computer. This address is useful to test servers on the same computer. For example, if we run a web server on a computer, we may want to test it by launching a web browser on the same computer. You can now enter 127.0.0.1 as the URL of the server computer. For your convenience most computers have defined a domain name localhost as nickname for 127.0.0.1.

2.8 Changing Network Connection Method

Before reading this section, you should first read subsection “Finding Out Your Gateway/Router, PC and VM’s IP Addresses”.

There are three popular methods to connect your VM to your host PC and the Internet:

1. Bridged. With this method, your VM will contact directly your local DHCP (Dynamic Host Configuration Protocol) server and apply for a unique local IP address in your LAN (local area network). Your VM can then access the Internet and all resources available in your LAN, and other PCs in your LAN can access resources on your VM. For example, if you run a web server on this VM, any other PCs or VMs in your LAN can access it with this VM’s local IP address.

2. NAT (network address translation). With this method, your VM can access the Internet as if it is its host PC (the VM share the host PC’s local IP address), access other VMs running on the same host PC with NAT method, and its host PC can access services or data on this VM. But the other PCs in your LAN will not be able to access this VM.
3. Host-only. This method is the same as NAT except the VMs cannot access the Internet. The VMs running on the same host PC and using the same host-only method can access each other’s services.

You can change your VM’s networking connection method with *Ubuntu* menu item “Virtual Machines|Virtual Machine Settings…”. The following “Virtual machine Settings” window will pop up. Select its *Hardware* tab, then select “Network Adapter” in the left pane. Now you can choose which network connection method to use in the right pane. This example uses the NAT method. After you change the method and click on the *OK* button, you will lose network access for a few seconds before it comes back. Sometimes you need to restart the VM to get network access back. The VM will remember its network connection method.

![Virtual Machine Settings](image)

### 2.9 Running a Cluster of VMs on a Single Computer

Before reading this section, you should first read subsection “Changing Network Connection Method”.

To run multiple VMs on a single PC concurrently, following the following steps:

1. Make sure that each VM has its unique virtual network card MAC (Media Access Control) address. You can do so by moving the VM to a new file system location or changing the VM folder name, and answer “I copied it” when you launch the new copy of the VM.

2. Use a text editor to modify the value of “memsiz” (memory size for the VM) of the VM configuration files so the total memory size used by all of your VMs to run together is at least 512 MB less than your total available physical memory (512 MB for your PC to use). Each VM should have 256 MB or more. The exact minimal memory size for each VM depends on type of OS for the VM and what applications have been installed on it, so you need to test the best memory sizes for the VMs. You should not try to run multiple VMs concurrently unless you have 2 GB or more physical memory.
3. Launch each of the VMs, and make sure that all the VMs to run concurrently on the same PC use the same network connection method: bridged, NAT or host-only (the host-only method will not provide Internet access to the VMs). Read subsection “Changing Network Connection Method” for their differences.

4. When each VM runs, use “sudo ifconfig” on Linux VM or “ipconfig” on Windows to find out the local IP address for each of the VMs in the cluster. Refer to subsection “Finding Out Your Gateway/Router, PC and VM’s IP Addresses” for details.

5. Now you are ready to treat the cluster as a local area network and emulate a complete enterprise IT infrastructure.

By now you have learned the essence of what is very hot in the industry now: IT system virtualization technologies.

2.10 Learning Basic Linux Commands

Now you can launch terminal windows, you can use the rich online tutorials to learn and practice Linux commands. The following are just a few starting points for you to gain Linux command line proficiency:

- [http://www.linfo.org/command_line_lesson_1.html](http://www.linfo.org/command_line_lesson_1.html)
- [http://www.tuxfiles.org/linuxhelp/](http://www.tuxfiles.org/linuxhelp/)
- [http://linuxcommand.org/learning_the_shell.php](http://linuxcommand.org/learning_the_shell.php)
- [http://linuxcommand.org/](http://linuxcommand.org/)
- [http://www.ee.surrey.ac.uk/Teaching/Unix/](http://www.ee.surrey.ac.uk/Teaching/Unix/)

In the next edition of this tutorial I will add sections on basic concepts in Linux and the introduction of each command used in this tutorial.

2.11 Technical Summary of Ubuntu V10.10 and Installed Applications

2.11.1 Major Installed Web Architecture Components

A typical web application involves four tiers as depicted below: web browsers on the client side for rendering data presentation coded in HTML, a web server program that generates data presentation in HTML, an application server program that computes business logic and generates data, and a database server program that provides data persistency. The three types of server programs may run on the same or different server machines.
Our ubuntu10 VM has installed one or more components in each of the four web tiers. Firefox works as a web browser in tier 1 on the client machine. Apache with Perl and PHP CGI extensions, Tomcat, and GlassFish support tier 2 as web servers. GlassFish is also an enterprise-quality application server featuring EJB technologies. The VM has two database server systems installed: MySQL and Derby. For your reference, IBM’s WebSphere and BEA’s WebLogic (now owned by Oracle) are both organized like GlassFish supporting both web server and application server functions.

Our ubuntu1010 VM supports both NetBeans and Eclipse, the most popular IDEs, for developing applications on each of the above four web tiers.

### 2.11.2 Installation Credentials and Technical Summary

**Ubuntu V10.10:**
- Super User: root Password: 123456
- Normal User: user Password: 123456

**Java JDK V1.6.0_23**
- Installation folder: /home/user/tools/jdk1.6.0_23
- Shared by all users through “/etc/profile”

**Tomcat Web Server V7.0.8:**
- Installation folder: ~/tomcat
- Web doc root: ~/tomcat/webapps
- Home page: http://localhost:8080
- Tomcat starts automatically at system boot-up time.
- To manually start: run “tomcat-start”
- To manually stop: run “tomcat-stop”

**Apache Web Server V2.2:**
- Installation folder: /etc/apache2
- Web doc root: ~/www (/var/www)
- Home page: http://localhost
- Apache starts automatically at system boot-up time.
- To manually restart Apache, run “sudo apache2ctl restart”
- Apache supports Perl v5.10.1, PHP v5.3.3 and MySQL v5.1.
- Perl script folder: ~/www/cgi-bin
MySQL Database Server V5.1:
Username: root
Password: 123456
Launch MySQL admin console: run “mysql -u root -p123456”

Eclipse IDE Helios V3.6.1:
Installation folder: /home/user/tools/eclipse
To start Eclipse, run “eclipse”, or use menu item “Applications|Programming|Eclipse”
Default project home: /home/user/EclipseWorkspace
Servers supported by Eclipse: Tomcat v7 and GlassFish v3

NetBeans IDE V6.9.1:
Installation folder: /home/user/tools/netbeans-6.9.1
To start NetBeans, run “netbeans”, or use menu item “Applications|Programming|NetBeans IDE”
Default project home: /home/user/NetBeansProjects
Servers supported by NetBeans: Tomcat v7 and GlassFish v3

GlassFish Application Server Open Source V3.0.1 (including web server):
Installation folder: /home/user/tools/glassfish-3.0.1
Admin console: http://localhost:4848
Username: admin
Password: [not defined]
Start GlassFish server: run “glassfish-start”
Stop GlassFish server: run “glassfish-stop”

Derby Database Server V10.5.3.0
Installation folder: /home/user/tools/glassfish-3.0.1/javadb
Start Derby server: run “derby-start”
Stop Derby server: run “derby-stop”
Launch Derby admin console: run “ij”

Drupal Contents Management System v7.0:
URL: http://localhost/drupal
Doc root folder: ~/www/drupal
Username: admin
Password: 123456
MySQL database drupal, user “root”, password 123456

WordPress Contents Management System v3.0.5
URL: http://localhost/wordpress
Doc root folder: ~/www/wordpress
Username: admin
Password: 123456
MySQL database wordpress, user “wordpress”, password 123456

SMF (Simple Machines) Forum System v1.1.13
URL: http://localhost/forum
Doc root folder: ~/www/forum
Username: admin
Password: 123456
MySQL database smf, user “smf”, password 123456

Sample Tomcat web applications:
- http://localhost/examples/servlets
- http://localhost/examples/jsp
- http://localhost/survey
- http://localhost/surveyJsp
- http://localhost/surveyCss
- http://localhost/surveyJs
- http://localhost/demo
- http://localhost/html
- http://localhost/tripler
- http://localhost/testCookie
- http://localhost/bookstoreServlet
- http://localhost/bookstoreJsp
- http://localhost/axis
- http://localhost/bareJsp
- http://localhost/guessNumber

Sun Java Tutorials:

Java Tutorial 2010-10-18
Base folder: /home/user/JavaTutorial
Tutorial: use web browser to visit “/home/user/JavaTutorial/index.html” to read the tutorial in web browser.

Java EE 6 Tutorial
Base folder: /home/user/tools/glassfish-3.0.1/glassfish/docs/javaee-tutorial
Tutorial: use web browser to visit “/home/user/tools/glassfish-3.0.1/glassfish/docs/javaee-tutorial/doc/index.html” to read the tutorial in web browser.
Tutorial PDF version is available at “/home/user/tools/glassfish-3.0.1/glassfish/docs/javaee-tutorial/doc/javaetutorial6.pdf”.

First Cup Tutorial for Java EE v2.0
Base folder: /home/user/tools/glassfish-3.0.1/glassfish/docs/firstcup-2.0
Tutorial: use web browser to visit “/home/user/tools/glassfish-3.0.1/glassfish/docs/firstcup-2.0/doc/index.html” to read the tutorial in web browser.
PDF version of the tutorial is “/home/user/tools/glassfish-3.0.1/glassfish/docs/firstcup-2.0/doc/firstcup.pdf”.
3
Setting Up a Basic Ubuntu Virtual Machine

In this section we create a basic Ubuntu V10.10 virtual machine using VMware Player v3.1.3.

For brevity, when we say to run "command", we mean to start a terminal window (one way is to use Ubuntu menu item “Applications|Accessories|Terminal”), and type command in that terminal window followed by an Enter key, to run the command. When we say to visit “http://url”, we mean to use a web browser to visit the web page with URL (Uniform Resource Locator) http://url. When we say to click/double-click on a file or folder, we mean to click/double-click the file or folder in a file explorer. When we say to click on menu item “A|B”, we mean clicking on menu “A” to see its popup menu, and then further clicking on menu item “B” on the popup menu.

3.1 Downloading Ubuntu


- If you get browser security warning, right-click on the security warning immediately below the tools menu, and choose “Download File…”. In either case you will see the following “File Download” window.
• Save file “ubuntu-10.10-desktop-i386.iso” in “C:\VM”. The file has 709 MB and may take 20 minutes to download.

3.2 Creating a Ubuntu Virtual Machine

• In “C:\VM”, create a new folder “ubuntu1010basic”.

• Launch VMware Player.
• Click on the link for “Create a New Virtual Machine”.

• Check for “Installer disc image file (iso)”, and browse for your downloaded Ubuntu v10.10 iso file (C:\VM\ubuntu-10.10-desktop-i386.iso). Click on the Next button.
In the popup “New Virtual Machine Wizard” window, enter “user” for full name and user name, and 123456 for password and confirm. Then click on the Next button.

Use “Ubuntu10” as the virtual machine name, and “C:\VM\ubuntu1010basic” as the location value. Then click on the Next button.
• Enter 20 for maximum disk size, and check for “Split virtual disk into multiple files” so we could later easily save the VM on DVD disks. Then click on the Next button.

• Review the settings for the new VM. Click on the “Customize hardware…” button to review what you can further customize. Notice that by default the new VM uses 512 MB physical memory. Since your PC’s OS also needs physical memory, your PC needs to have one GB memory to work well. If you have more than one GB memory, you could increase the VM’s memory size so it could work smoother. If you plan to run multiple VMs at the same time, make sure the total memory used by these VMs and your PC would not exceed your available physical memory size. You may let a VM work with only 256 MB memory.
- Click on the OK button to exit the “Hardware” window. Click on the “Finish” button to start the Ubuntu installation process. The installation may take 30 minutes.
- If you see that the VMware Player is installing VMware Tools and let you login to use the new VM at the same time, you don’t need to do anything. Wait until the installation is complete and you will then see the following screen:
• Click on “user”, and enter 123456 as password. You will see the following screen. You are now logged in your new VM.

• Click on menu item “System|Administration|Update Manager”.

• Now you see the following “Update Manager” window.
- Click on “Install Updates” to install all available system updates. You will be asked to enter your password 123456. Wait until the system update is complete, then click on “Restart Now to restart the VM. Get back to the Update Manager window and scroll down to the bottom of the window.

- Click on the “Settings…” button. Enter password 123456 upon request.
• Uncheck for “Check for updates” so the VM will not always try to download system updates. This is because every time the Ubuntu OS gets updated, we may need to reinstall VMware Tools, and we try to avoid this trouble. Click on the Close button to shut down the “Software Sources” window, and click on the Close button again to shutdown the “Update Manager” window.

By now you have successfully set up your own copy of Ubuntu 10.10 VM. But due to the installation configuration your VMware Tools installation is not complete yet. To use shared folders you need to update VMware Tools. Click on menu item “Virtual machines|Reinstall VMware Tools…”.

You will now see the following screen: the disk image for “VMware Tools” is mounted and opened for you.
Right-click on file “VMwareTools-8.4.5-324285.tar.gz” and select "Extract To..." and extract its contents to "Documents". In file browser, open "Documents", and you will see a new folder "vmware-tools-distrib". Use menu item “Applications|Accessories|Terminal” to launch a terminal window. Run “cd /home/user/Documents/vmware-tools-distrib/” to make “vmware-tools-distrib” the working folder. Run “sudo /vmware-install.pl” to run the Perl script for installing VMware Tools. Enter password 123456 upon request.

Upon installer questions, always accept the default choice by typing the Enter key. At the end the installer will run Perl script "/usr/bin/vmware-config-tools.pl". Always accept the default choice by typing the Enter key.
You can now delete folder “vmware-tools-distrib” in “Documents” by right-click on the folder and choose “Move to Trash”. By now you have successfully reinstalled *VMware Player*.

### 3.3 Creating Shared Folder C

- Click on menu item “Virtual Machine|Virtual Machine Settings…”.

- Click on the “Options” tab of the “Virtual machine Settings”, and then select “Shared Folders”
• On the right side, check the “Always enabled” checkbox, and click on the “Add…” button.

• You will see the following window.
• Click on the Next button. Enter “C:\” for Host Path, and “C” for Name.

• Click on the Next button.
- Make sure “Enable this share” is checked. Click on the *Finish* button to shut down the “Add Shared Folder Wizard”.
- Click on the *OK* button to shut down the “Virtual Machine Settings” window.
- Now we are ready to check out the shared folder. Click on menu item “Places|Computer”.

- Click on “File System” in the left pane.
Click on \texttt{mnt}, then \texttt{hgs}, and then \texttt{C} to see all your files and folders on your PC’s drive “C:\”.

Congratulations and your shared folder is working.

3.4 Creating Password for Administration Account \textit{root}

For security reason, by default \textit{Ubuntu} doesn’t create password for super user \textit{root}. We’d like to create a password for \textit{root}. Click on menu item “Applications|Accessories|Terminal” to launch a terminal window. In the terminal window, run “\texttt{sudo passwd root}”. When asked for your password, enter 123456. Then type 123456 twice as \textit{root}’s password.
Now you have a working Ubuntu V10.10 VM. In the next section you will learn how to install various tools and servers in this VM so it can function as a powerful learning tool for all kinds of information technologies.
4 Installing Applications on a Basic Ubuntu Virtual Machine

4.1 Overview

This section teaches you how to set up most popular Linux tools and server applications on a basic version of Ubuntu V10.10 VMware virtual machine (VM), ubuntu1010basic, which we learned to set up in the last section. The resulting VM will be the same as the completed version downloadable at http://csis.pace.edu/lixin/download/ubuntu1010.exe. It is recommended that you first follow my instructions in Section 2 to test drive ubuntu1010 before you try to install the same set of tools and applications yourself.

Even though my instructions are on the installation of applications on a VMware virtual machine, they apply to the case when you install the applications on an Ubuntu/Linux installation on a physical PC. Therefore when we refer to a VM, we also implicitly refer to a physical PC if you are actually doing application installation on a physical Linux PC.

Since Linux, utility and application versions change all the time, you need to adjust the URLs, installer file names, installation folder names/paths accordingly when necessary. All the instructions are valid on February 5, 2011. The instructions will be revised when necessary.

In Ubuntu there are three popular utilities for installing applications: apt-get, aptitude, and Synaptic. Utilities apt-get and aptitude are both terminal commands and very concise and flexible, while Synaptic has a graphic user interface (GUI) but is less flexible. In this guide we mainly use aptitude to install applications, which is a wrapper of apt-get but with some enhancement. Utility aptitude also performs functions that traditionally were handled by many “apt” family utilities. Run “man aptitude” and “man apt-get” to learn more about aptitude and apt-get. In Linux, if you need to know how to use a command cmd, you can try to run “man cmd” to read cmd’s manual pages, or “cmd --help” for a short usage explanation.

While this guide uses Ubuntu V10.10 as the base Linux system, most of the instructions apply to other flavors of Linux too, including Red Hat, Fedora (a community version of Red Hat) and Debian. On Red Hat Linux systems, the application installers are normally in the form of RPM format, and utility yum is used instead of aptitude or apt-get.

By now you should have installed VMware Player. Otherwise please refer to Section 1 to do so.

4.2 Downloading Basic Version of Ubuntu V10.10 Linux VM

You can use the VM “C:\VM\ubuntu1010basic” that we created together in Section 3 as the base of application installation in the remainder of this section. In this case we suggest that you make a copy of folder “ubuntu1010basic” in “C:\VM” and rename the new copy “ubuntu1010”. If you for reason prefer to skip Section 3 and work directly on this section, you can download the basic VM ubuntu1010basic,
which is the VM that we should have completed in Section 3, as the foundation VM for this section. To download this completed basic VM, follow the following steps.

- On your PC, create a folder “C:\VM” with Windows Explorer.
- Use a web browser to visit http://csis.pace.edu/lixin/ubuntu/ubuntu1010basic.exe, and save the downloaded file in “C:\VM”. The downloaded file “ubuntu1010basic.exe” should have 1,252,001KB.
- In a Windows Explorer, double-click on file “C:\VM\ubuntu1010basic.exe” to run it, and the execution will generate a folder “C:\VM\ubuntu1010basic”.
- Rename folder “C:\VM\ubuntu100basic” to “C:\VM\ubuntu1010”.

If you are using a MacBook, refer to section 2.3 for how to unzip file “ubuntu1010basic.exe”.

It is highly recommended that you make a copy of this VM so later you could roll back to it if you face some irresolvable problems. You could make a new VM copy (with different folder name) after you complete a major installation in this section so you could easily roll back to the latest good VM version. This section takes over five hours to complete, and the key of success is to follow my instructions to the letters and dots. Use copy-and-paste if possible. You can always shut down your VM after any software installation and resume your work at another time.

When you complete all installations in this section, you should have created exactly the same VM as the ubuntu1010 VM that you downloaded from my web site in Section 2.

4.3 Launching the VM

In folder “C:\VM\ubuntu1010”, you will see the following files. If you are using my ubuntu1010basic VM, file “readme.txt” tells you some information about this VM including the user names and passwords for this VM. There are two pre-set users “root” and “user”, both having password “123456”.

![VM folder content]
Before we start software installation, we use menu item “Applications|Accessories|Terminal” to launch a terminal window, and run the following commands to create a new folder “/home/user/tools” (“~/tools”) and “home/user/bin” (“~/bin”). We install major software packages as “user” in its own disk space “~/tools” so we avoid a lot of accessibility problems. When you are more proficient in Linux, you can learn how to install these software as super user root and make the software available to all users of your Linux PC. Folder “~/bin” by default is on Linux PATH (a list of folders; Linux will find executable files in these folders in the same order that you list them in PATH) so any executable files on PATH (in one of the folders listed on PATH) are executable by “user” from any working folder.

```
cd
mkdir tools
mkdir bin
```

If you copy commands from this guide and paste them into VM terminal window, you need to paste the command in VM terminal window by right-clicking on the terminal window and then choosing item “Paste” on the pop-up menu. You can use the same method to paste text into text editors including gedit and nano.

File “~/.dmrc” is mainly used to remember your Linux user interface language setting. It must be owned by the current user and has 644 as its access code. Folder “/home/user” should not be writable by other users. You may get error messages when you log in if these two conditions are not true. Run the following commands to make sure that “~/.dmrc” and “/home/user” have the correct access rights:

```
chmod 700 /home/user
chmod 644 /home/user/.dmrc
```

### 4.4 Installing Linux Package Manager aptitude

We will use Linux package manager aptitude to install multiple applications. Run “sudo apt-get install aptitude” to install aptitude. If you are prompted for your password, enter 123456. To make sure your VM’s aptitude has the most updated information on from which online Linux repository server to download the installers for the applications that you install, run “sudo aptitude update” in a terminal window now. If you are prompted for your password, enter 123456.

### 4.5 Adding Menu Item “Open in Terminal” to Nautilus File Browser Popup Menu

Often you need to open a terminal window, change folder (directory) to a specific folder with command “cd” (change directory), and run commands there. If would be nice if we could right-click on a folder in the Nautilus file browser, click on an “Open in Terminal” menu item in the popup menu, and have a terminal window launched in that folder. This section shows you how to add such an “Open In Terminal” menu item to the file browser popup menu.

- Start a terminal window by clicking on menu item “Applications|Accessories|Terminal”.
- To install software, you normally need be a super user, and “root” is the primary super user. You run command “su -” to request entering super user mode. Upon request, enter root password “123456”. Notice that the command prompt changes from $ to #.
- Type
aptitude install nautilus-open-terminal
to start the installation.

Reboot the VM to see the new function. In the following example, I opened the filer browser with “Places|Home Folder”. The right pane shows folders and files in the home folder “/home/user” of the current user “user”. If you right-click on any folder or the blank space in this right pane, you will see a new menu item “Open in Terminal”, as shown below. You click on this menu item and a new terminal window will pop up with that folder as the current working folder.

Congratulations and you have installed your first application in Linux!
4.6 Installing Emacs Text Editor

Ubuntu comes with three basic text editors: vi, gedit and nano. Editor vi is a must for IT staff because it is part of Linux core and thus always available on any Linux installation. But its usage is not intuitive. Here we install a much more powerful text editor Emacs, which features multiple editing windows, running programs and keeping long execution logs directly in the editor (if you have experienced “I lost early part of my program output and the terminal window only kept the last section of it”, then you will appreciate this feature), and sending emails.

Most software installations should be conducted as super user root. In the last section we used “su” to login as root before the software installation. Here I show the second approach: using “sudo” before the actual command to run the command as root. Start a new terminal window. In this particular example we install Emacs with command

```
sudo aptitude install emacs
```

You will be first prompted for your (“user” instead of “root”) password. Type “123456” as your password.

You can use command “locate emacs” to find where are Emacs files installed. You can use command “which emacs” to find out which executable is actually executed when you type “emacs” in a terminal window. The following are partial printout of the above two commands.

```
user@ubuntu:~$ locate emacs
/etc/emacs
/etc/emacs/site-start.d
/etc/emacs/site-start.d/50dictionaries-common.el
/etc/speech-dispatcher/clients/emacs.conf
......
user@ubuntu:~$ which emacs
```
To launch *Emacs* and edit a new file “test.txt”, type in terminal window command “emacs test.txt”. Use menu item “Help|Emacs Tutorial” to learn how to use *Emacs* later when you really need it. After you type in a terminal window command “emacs test.txt”, that terminal window cannot be used until the editor is shut down. If you want to continue to use the terminal window while the *Emacs* editor is running, launch *Emacs* with commands like “emacs test.txt&”. Ending a command with & is a general way to run the command in background (not being able to interact with the user) and use the same terminal window to run other commands.

### 4.7 Running Command *sudo* without Needing Password

Many programs need be installed or run as super user *root*, but we don’t want to share *root*’s password with other people, even if we believe them. Command “*sudo*” allows a user to run programs as the super user *root*. For example, “*sudo* ls –alg” may ask you for your Linux password (*sudo* remembers your password for 15 minutes in a terminal window), and then run “ls –alg” as *root*.

File “/etc/sudoers” defines who can assume *root*’s privilege and whether these people need to enter their Linux passwords when they use “*sudo*”. You edit file “/etc/sudoers” by running command “visudo”. To allow Linux user “*john*” to use “*sudo*” to run commands as *root*, add line “*john* ALL=(ALL) ALL” in file “sudoers”. When user “*john*” uses “*sudo*”, he may be prompted to enter his Linux password. If we have instead used line “*john* ALL=(ALL) NOPASSWD: ALL”, then user “*john*” can use “*sudo*” without being prompted for his Linux password. You can find more information on “*sudo*” at [http://www.unixtutorial.org/?s=sudoers](http://www.unixtutorial.org/?s=sudoers).

Since we will use *sudo* often to run commands as *root*, we don’t want to type our password each time we use *sudo*. We can avoid entering password for using *sudo* by running command “*sudo* visudo” to use
editor *nano* to edit file "/etc/sudoers". Use “Page Down” key to reach the end of the file, and insert the following line:

```
user  ALL=(ALL)  NOPASSWD: ALL
```

Type key combination Ctrl+O and then key *Enter* to write the modified file (/etc/sudoers.tmp) out, and type key combination Ctrl+X to exit the editor (the basic *nano* editing commands are listed at the bottom of the editor window, where ^ means the Ctrl key). This new line in file “/etc/sudoers” specifies that user “user” can run *sudo* without providing his/her password. Now you can test by typing “*sudo* ls –alg” to run as *root* to list attributes of the files and folders in the current folder, and you will not be prompted to enter your password.

### 4.8 Installing 7z

7z and *rar* are popular file zipping/unzipping data formats and algorithms. To get the 7z and *rar* support in a Linux PC, run “*sudo* aptitude install p7zip-full”. Run command “7z” to see how to use 7z.

### 4.9 Installing Java JDK, JRE and Java Plugin

Here I show you another software installation method on Linux. You can have more controls of which version of software you want to install, and the installed software files will be centralized in the installation base folder. In this subsection we install the Java JDK (Java Development Kit) package, and Java JRE (Java Runtime Environment) and Java plugin for web browsers are both part of Java JDK.

#### 4.9.1 Downloading Java JDK

- Launch VM’s *Firefox* web browser and visit [http://java.oracle.com](http://java.oracle.com).
- In the right “Software Downloads” area, click on “Java SE”.

- In the “Java SE Downloads” area, click on the Download JDK button of the latest Java JDK. By February 6, 2011, the latest version is JDK 6 Update 23. The following window shows up.
• Choose “Linux” in the Platform combo box, check the “I agree ....” checkbox, and then click on button Continue.

• In the “Available Files” area, click on file “jdk-6u23-linux-i586.bin” (or a similar file) to download it. Make sure the file name should not have “rpm” (rpm version is for Red Hat Linux).
Choose “Save File”, and click on the OK button. The installer has around 80 MB for downloading. The downloaded file “jdk-6u23-linux-i586.bin” will be in folder “/home/user/Downloads”.

4.9.2 Installing Java JDK

When you are logged in as “user”, in a terminal window,

- Run “cd ~/Downloads” to move the working folder to Desktop.
- Run “ls -alg” to check out attributes of files or folders in the current folder.
- Run “chmod +x jdk-6u23-linux-i586.bin” to make the file executable.
- Run “ls -alg” to confirm that the file is executable.
- Run “./jdk-6u23-linux-i586.bin”.

- Use Space key to read through the license agreement, and answer Yes to the agreement. Then the installation starts. At the end, type Space key and Enter key again to complete the installation.
You can ignore the JDK registration. You will see that Java JDK has been installed in folder “jdk1.6.0_23” under folder “~/Downloads”.

- Run “mv jdk1.6.0_23 ~/tools” to move the Java JDK installation folder to “/home/user/tools”.
- You could run “rm jdk-6u23-linux-i586.bin” to delete it from folder “~/Downloads”.
- Run “echo $PATH” to see the current definition of environment variable PATH.
- Run “sudo gedit /etc/profile” to add the following two lines to the end of file “/etc/profile”. They define an environment variable JAVA_HOME pointing to the installation folder of Java JDK, and add the “bin” (folder for binary executable commands) of Java JDK on the PATH so any user of this Linux PC can run those commands from any terminal window. Environment variable JAVA_HOME is needed by many Java based applications to find the Java installation on your computer. Every time the Linux PC reboots, the definitions in file “/etc/profile” will be executed/processed.

```bash
export JAVA_HOME=/home/user/tools/jdk1.6.0_23
export PATH=$JAVA_HOME/bin:$PATH
```

- Save the revised file and reboot your Linux PC.
Run “echo $PATH” to see the revised definition of environment variable PATH.
Run command “java -version” to see the version of your Java JDK.
Run command “javac” to see how to use this Java compiler.

4.9.3 Installing JRE Plugin for Firefox

For Firefox web browser to support Java applets, we need to install Java JRE Plugin, which is already part of Java JDK installation, for Firefox. Run the following commands in a terminal window (if your Firefox is a different version you need to adjust folder name “firefox-3.6.13”).

```
> cd /usr/lib/firefox-3.6.13/plugins
> sudo ln -s ~/tools/jdk1.6.0_23/jre/plugin/i386/ns7/libjavaplugin_oji.so
```

The second command creates a symbolic link, or a shortcut, from “/usr/lib/firefox-3.6.13/plugins/libjavaplugin_oji.so” to “~/tools/jdk1.6.0_23/jre/plugin/i386/ns7/libjavaplugin_oji.so”.

4.10 Installing Apache Tomcat

Apache Tomcat, later simply called Tomcat, is an open-source web server featuring a Java servlet container for using Java technologies, including servlets, JavaServer Pages (JSP) and JavaServer Faces (JSF), to create HTML files upon client requests over the Internet. It lacks some general web server features like security settings and virtual hosts. On the other hand, Apache web server has richer basic
web server functions for serving pre-authored (static) HTML files as well as using the older CGI
technologies like Perl and PHP to generate HTML files on-the-fly. For a typical enterprise web server,
Apache web server usually works at front-end serving clients at its default port 80, and if the client
request needs be processed by Java technologies, Apache would forward (delegate) the request to a
Tomcat web server behind it. By default Tomcat works normally at port 8080.

Before you can install Tomcat, you must have installed Java JDK or JRE.

4.10.1 Downloading Tomcat Installer

- Open Firefox web browser and visit [http://tomcat.apache.org](http://tomcat.apache.org). In the left Download area, click on
the latest Tomcat version. In February 2011, it should be “Tomcat 7.0”.

- In the Core section of the Binary Distributions area, click on “tar.gz” link to download the
Tomcat installer.

- In our case the installer is named “apache-tomcat-7.0.8.tar.gz”. The following window will pop up.
Check the “Save File” checkbox, and then click on the OK button. The installer will be saved in “/home/user/Downloads”. The installer has 6.8 MB.

4.10.2 Installing Tomcat

- Run in a terminal window “cd ~/Downloads” and then “ls -alg” to review the downloaded Tomcat installer.
- Run “tar xzvf apache-tomcat-7.0.8.tar.gz -C ~/tools” to install Tomcat in “/home/user/tools/apache-tomcat-7.0.8”.
- You could now run “rm apache-tomcat-7.0.8.tar.gz” to delete the downloaded Tomcat installer.
- For convenience, we make a symbolic link or shortcut from user’s home folder to the Tomcat installation folder. We run “cd ~” and “ln -s ~/tools/apache-tomcat-7.0.8 tomcat” to create the link “tomcat” in user’s home folder.

- Run “gedit ~/.bashrc” to use gedit to insert the following two lines of alias definitions at the end of file “~/.bashrc” (strings to the right of # are comments):

```bash
alias tomcat-start='bash ~/tomcat/bin/startup.sh'   # Start Tomcat
alias tomcat-stop='bash ~/tomcat/bin/shutdown.sh'   # Shutdown Tomcat
```
Run “source ~/.bashrc” or reboot the VM.

From now on, you can run “tomcat-start” to start the Tomcat web server, and run “tomcat-stop” to stop the Tomcat web server.

Run “tomcat-start” to start the Tomcat web server. Launch Firefox to visit http://localhost:8080. You will see the start page of Tomcat as shown below:

If you need to shut down Tomcat, run “tomcat-stop”.

4.10.3 Tomcat File Organization

Our Tomcat installation base folder is “/home/user/tools/apache-tomcat-6.0.20”. The following discussion is relative to this folder.
All web applications deployed on Tomcat are in their own folders under folder “webapps”.
- The script files for start/stop Tomcat are in folder “bin”.
- Tomcat configuration files are in folder “conf”. File “conf/server.xml” is the main configuration file with which you can change the default port 8080.
- Tomcat logging files are in folder “logs”. You can read file “logs/catalina.out” to see Tomcat startup/stop and error messages. If you print any (debugging) message in your web applications’ Java code, the message will be printed to this file. Therefore you can use Java print statements and this file to do simple debugging of your web applications.
- Your web applications’ JSP files will be converted to Java servlet source code under folder “work/Catalina/localhost” and organized as web application folders.

4.10.4 Changing Tomcat Default Port 8080

This is an optional step. Suppose you need to change Tomcat’s default port 8080 to 8090. Run “gedit /home/user/tools/apache-tomcat-6.0.20/conf/server.xml” to edit Tomcat configuration file “server.xml”. Change the following line

```xml
<Connector port="8080" protocol="HTTP/1.1"
```

To

```xml
<Connector port="8090" protocol="HTTP/1.1"
```

Restart Tomcat and you can use Firefox web browser to visit http://localhost:8090 to verify that Tomcat now runs at port 8090. For this tutorial make sure you change Tomcat port back to 8080 to be consistent with our later installation guide.

4.10.5 Starting Tomcat at Linux Boot-Up Time

This is an optional step. If you need to start up Tomcat automatically at Linux boot up time, you need to install it as a Linux service.

- Run “cd /etc/init.d”
- Run “sudo gedit tomcat” to use gedit to create a new script file “tomcat”.
- Copy and paste the following contents in file “tomcat” (you may need to adjust the Java installation base folder path or the Tomcat installation base folder path; don’t change tabs; replacing a tab by space could invalidate the file):

```bash
# Tomcat auto-start
#
# description: Auto-starts tomcat
# processname: tomcat

export JAVA_HOME=/home/user/tools/jdk1.6.0_23
case $1 in
  start)
    sh /home/user/tools/apache-tomcat-7.0.8/bin/startup.sh
  ;;
  stop)
    sh /home/user/tools/apache-tomcat-7.0.8/bin/shutdown.sh
```

Run “sudo chmod 755 tomcat” to make script file “tomcat” executable.
- Run the following two commands to create symbolic links to script file “tomcat” in “/etc/rc1.d” and “/etc/rc2.d”:

```
sudo ln -s /etc/init.d/tomcat /etc/rc1.d/K99tomcat
sudo ln -s /etc/init.d/tomcat /etc/rc2.d/S99tomcat
```

When Linux boots up, all scripts in “rc2.d” with “S” as name initial are executed to start some services. Therefore Tomcat gets launched when Linux starts. When Linux shuts down and just loses its network access (run level 1), all scripts in folder “rc1.d” with “K” as name initial are executed to shut down some services. Therefore Tomcat shuts down immediately before the Linux halts. You can learn more about Linux run level at [http://www.networkclue.com/os/Linux/run-levels.aspx](http://www.networkclue.com/os/Linux/run-levels.aspx). You can learn more about Linux startup process at [http://floppix.ccai.com/rc.html](http://floppix.ccai.com/rc.html).
- Reboot the VM, and launch Firefox web browser to visit [http://localhost:8080](http://localhost:8080). You should see that Tomcat is running.
- Later, in case you don’t want Tomcat to start at boot-up time, just remove the two links “/etc/rc1.d/K99tomcat” and “/etc/rc2.d/S99tomcat”.

### 4.11 Installing Apache Web Server and Its CGI Plugins

#### 4.11.1 Installing Apache 2

Apache web server is the most popular open-source web server. This subsection explains how to install it.
- Run “sudo aptitude install apache2” to download and install Apache. If you see 404 error messages, make sure you update your VM’s aptitude information by running “sudo aptitude update” and then try this step again.
- Run “sudo gedit /etc/apache2/httpd.conf” and insert the following line in it:

```
ServerName localhost
```

- Run command “ln -s /var/www /home/user/www” to create a symbolic link or shortcut “/home/user/www” to “/var/www”, the document root folder for Apache. Each web site of yours on Apache will be in a folder under “/var/www”. The Apache web server’s installation folder is “/etc/apache2”.

```
user@ubuntu:~$ sudo aptitude install apache2
Reading package lists... Done
Building dependency tree
Reading state information... Done
```
Reading extended state information
Initializing package states... Done
The following NEW packages will be installed:
apache2 apache2-mpm-worker apache2-utils apache2.2-bin
apache2.2-common libapr1 libaprutil1 libaprutil1-dbd-sqlite3
libaprutil1-ldap
0 packages upgraded, 9 newly installed, 0 to remove and 0 not upgraded.
Need to get 2,088kB of archives. After unpacking 6,939kB will be used.
Do you want to continue? [Y/n/?] y

user@ubuntu:~$ sudo gedit /etc/apache2/httpd.conf
user@ubuntu:~$ ln -s /var/www /home/user/www
user@ubuntu:~$ ls
bin      Documents examples.desktop Pictures Templates tools www
Desktop Downloads Music             Public    tomcat     Videos
user@ubuntu:~$ cd www
index.html
user@ubuntu:~/www$ more index.html
<html><body><h1>It works!</h1>
<p>This is the default web page for this server.</p>
The web server software is running but no content has been added, yet.</body></html>
user@ubuntu:~/www$ cd /etc/apache2
user@ubuntu:/etc/apache2$ ls
apache2.conf httpd.conf mods-available sites-available
conf.d httpd.conf~ mods-enabled sites-enabled
envvars magic ports.conf
user@ubuntu:/etc/apache2$

- Launch Firefox web browser and visit http://localhost. You will see a screen similar to the following one. Firefox is rendering HTML file “/var/www/index.html”. Apache has been installed as a Linux service and it will automatically start at Linux boot-up time.

- At any time, you can restart Apache web server by running “sudo apache2ctl restart”.
- Another way to restart Apache is to run “sudo /etc/init.d/apache2 restart”. For convenience, run “gedit ~/.bashrc” and insert the following line at the end of the file:

```
alias apache='sudo /etc/init.d/apache2'
```
Run “source ~/.bashrc”. From now on you can also use “apache restart” to restart Apache.

4.11.2 Installing PHP

PHP is a CGI (Common Gateway Interface) technique for dynamically generating HTML files based on clients’ HTTP requests. It is more powerful than Perl. To install PHP v5 on Apache, run the following commands:

- Run “sudo aptitude install php5 libapache2-mod-php5” to install PHP5 on your Linux system.

```
user@ubuntu:~$ sudo aptitude install php5 libapache2-mod-php5
```

Reading package lists... Done
Building dependency tree
Reading state information... Done
Reading extended state information
Initializing package states... Done
The following NEW packages will be installed:
apache2-mpm-prefork(a) libapache2-mod-php5 php5 php5-common(a)
The following packages will be REMOVED:
apache2-mpm-worker(a)
0 packages upgraded, 4 newly installed, 1 to remove and 0 not upgraded.
Need to get 2,929kB of archives. After unpacking 6,304kB will be used.
Do you want to continue? [Y/n/?] y
```
user@ubuntu:~$ apache restart
```

- Run command “apache restart” to restart Apache web server.
- Run “sudo chown -R user /var/www” to give “user” the right to work in Apache folders as their owners.
- To test your PHP5 installation, run command “gedit ~/www/testphp.php”, and insert the following contents into the file:

```
<?php phpinfo(); ?>
```

- Save the file, and use Firefox to visit http://localhost/testphp.php. If you see a screen similar to the following one, you have succeeded in installing PHP5 in Apache.
To find out what other PHP5 modules that you can install with “sudo aptitude install php5-module”, run command “aptitude search php5”.

4.11.3 Installing Perl

Perl is a more primitive form of scripting language used for earlier CGI support. It is mainly used by technicians and students to write simple test web applications. The following steps show how to set up Perl support in Apache.

- Run “sudo aptitude install libapache2-mod-perl2” to download and install Perl for Apache.
- Run “sudo mkdir ~/www/cgi-bin” to create a folder “cgi-bin” under Apache document root folder for holding Perl scripts.
- Run command “sudo gedit /etc/apache2/sites-enabled/000-default” and update file “000-default”’s contents section containing “/cgi-bin/” so it reads as below (we actually only need to update the path of “cgi-bin” in the first two lines, and insert the 7th line below). This update tells Apache that if a client HTTP request URL contains substring “/cgi-bin/file-name” where the “file-name” has file name extension “.cgi” or “.pl”, Apache would run script “/var/www/cgi-bin/file-name” to process this HTTP request.

```
ScriptAlias /cgi-bin/ /var/www/cgi-bin/
<Directory "/var/www/cgi-bin"/>
  AllowOverride None
  Options +ExecCGI -MultiViews +SymLinksIfOwnerMatch
  Order allow,deny
  Allow from all
</Directory>
```

- Run command “apache restart” to restart Apache.
- To test your Perl installation, run command “sudo gedit ~/www/cgi-bin/perltest.pl” to create a new file “perltest.pl” in “/home/user/www/cgi-bin”, and insert the following contents in this file:

```
#!/usr/bin/perl -w
print "Content-type: text/html\n\n"
print "Hello there!<br/>
Just testing .<br/>
```

for ($i=0; $i<10; $i++)
{
    print $i."<br />
;
}

• Save the file, and run “sudo chmod a+x ~/www/cgi-bin/perltest.pl” to make the file executable by all users.
• Now open Firefox web browser at http://localhost/cgi-bin/perltest.pl, and you will see a screen similar to the following one:

4.11.4 Integrating Apache with Tomcat

Before working on this subsection, you must have installed Tomcat.

The following steps configure Apache and Tomcat so Apache will delegate a chosen set of web applications for Tomcat to process. As a result the remote users can access these Tomcat web applications without using port 8080.

• Use a text editor to check whether file “~/tools/apache-tomcat-6.0.20/conf/server.xml” has a line similar to the following one. If it has, then Tomcat is ready and we don’t need to do anything for it (the new Tomcat releases are all ready). Otherwise insert such a line nested inside the “<Service name="Catalina">” element. Our Tomcat installation already has a similar line “<Connector port="8009" protocol="AJP/1.3" redirectPort="8443" />” so we don’t need to do anything here. This line enables AJP connections from Apache (or another web server) to port 8009 of your Tomcat server.

    <Connector port="8009" enableLookups="false" redirectPort="8443"
    protocol="AJP/1.3" />
- Run “sudo gedit /etc/apache2/sites-enabled/000-default” to add in file “000-default” the following lines just before </VirtualHost> for the default Tomcat web applications that you need delegate by Apache (for each of your Tomcat web application that you need Apache to delegate, add a similar pair of ProxyPass and ProxyPassReverse declarations):

```bash
ProxyPass /examples/servlets ajp://localhost:8009/examples/servlets
ProxyPassReverse /examples/servlets ajp://localhost:8009/examples/servlets
ProxyPass /examples/jsp ajp://localhost:8009/examples/jsp
ProxyPassReverse /examples/jsp ajp://localhost:8009/examples/jsp
ProxyPass /docs ajp://localhost:8009/docs
ProxyPassReverse /docs ajp://localhost:8009/docs
```

- Run command “cd /etc/apache2/mods-available” to change working folder to the folder holding all available Apache modules.
- Run command “sudo a2enmod proxy” and “sudo a2enmod proxy_ajp” to enable Apache modules proxy and proxy_ajp.
- We need to disable file “/etc/apache2/mods-enabled/proxy.conf”. Run the following commands:

```bash
cd /etc/apache2/mods-enabled
sudo mv proxy.conf proxy.conf.disable
```

- Restart Apache by running command “sudo apache2ctl restart” (don’t use other ways of restarting Apache).
- To test your configuration, launch Firefox to visit http://localhost:8080/examples/jsp. If the page doesn’t show up, run “tomcat-start” to start Tomcat. Otherwise remove the port number 8080 and observe that http://localhost/examples/jsp also shows the same page, as shown below. This confirms that Apache is delegating the user request to Tomcat.
4.12 Installing MySQL Database Server

MySQL community version is a popular open-source database server from Oracle. This guide shows how to install it on our VM.

- Run command “sudo aptitude install mysql-server” to download and install the current MySQL server prepared for Linux. At the time of writing it installs MySQL 5.1.
- When asked for password for root (MySQL account root; it is different from Linux’s super user root), enter 123456 (make sure you use this password because some of our example web applications use it; you can change the password later after you are proficient in Linux).
- MySQL will be installed as a Linux service, and it will start automatically at system boot up time.
- Many of our example web applications will use a database named “test”. For security reason our installer doesn’t create this “test” database for us. We now create it with MySQL’s administrator console.
  - Run command “mysql -u root -p123456” to login MySQL admin console with root as user and 123456 as password.
  - After the MySQL command prompt “mysql>”, use command “create database test;” to create database “test”, use command “show databases;” to view a list of available databases, use command “use test;” to use database “test” as the current one so the following commands apply to it, use “show tables;” to list the tables in the current database, and use “quit;” to quit the MySQL admin console.
  - If you have a file of SQL statements named, say “survey.sql”, in the current working folder, when you are still in MySQL admin console, you can use “source survey.sql;” to run the SQL statements in file “survey.sql” and apply them to the current database.

The following screen capture shows these steps’ execution (we will show “source” example when we deploy example web applications in Tomcat).

```bash
user@ubuntu:~$ sudo aptitude install mysql-server
Reading package lists... Done
Building dependency tree
Reading state information... Done
Reading extended state information
Initializing package states... Done
The following NEW packages will be installed:
  libdbd-mysql-perl[a] libdbi-perl[a] libhtml-template-perl[a]
  libnet-daemon-perl[a] liblprpc-perl[a] mysql-client-5.1[a]
  mysql-server mysql-server-5.1[a] mysql-server-core-5.1[a]
0 packages upgraded, 9 newly installed, 0 to remove and 0 not upgraded.
Need to get 20.4MB of archives. After unpacking 48.8MB will be used.
Do you want to continue? [Y/n/] y
Writing extended state information... Done
......
user@ubuntu:~$ mysql -u root -p123456
Welcome to the MySQL monitor. Commands end with ; or \g.
Your MySQL connection id is 40
Server version: 5.1.37-1ubuntu5 (Ubuntu)

Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.
```
Mysql> create database test;
Query OK, 1 row affected (0.03 sec)

mysql> show databases;
+--------------------+
| Database           |
+--------------------+
| information_schema |
| mysql              |
| test               |
+--------------------+
3 rows in set (0.00 sec)

mysql> use test;
Database changed
mysql> show tables;
Empty set (0.00 sec)

mysql> quit;
Bye
user@ubuntu:~$

4.13 Installing NetBeans and Sun’s Java EE Bundle

Before we can install NetBeans, we must have installed Java JDK.

NetBeans is a popular open-source Java IDE that can be used to develop software projects in multiple languages. NetBeans is from Sun Microsystems, and it features a quality What-You-See-What-You-Get (WYSWYG) visual graphic user interface designer. Since NetBeans is also implemented in Java, you must install Java JDK or JRE first.

Instead of installing the basic NetBeans IDE, we will install Sun’s Java EE (Enterprise Edition) bundle that includes Netbeans IDE, Sun’s GlassFish application server, and example projects and documentation all integrated into a single package. Sun’s GlassFish application server includes both a web server and an application server, and it will allow us to learn the advanced Java EE technologies based on Enterprise JavaBeans (EJBs).

4.13.1 Installing Java EE Bundle

• Click on the “Java EE and GlassFish” link in the “Software Downloads” pane.

• Click on the Download button at the bottom of the “NetBeans IDE 6.9” column.
Choose “Linux (x86/x64)” in the *Platform* combo box. Click on the *Download* button for *All* (266 MB).

Check the “Save File” checkbox, and click on the *OK* button to start downloading the installer “netbeans-6.9.1-ml-linux.sh” to “~/Downloads”.

Start a terminal window, and run “cd ~/Downloads” to change working folder.

Run command “chmod +x netbeans-6.9.1-ml-linux.sh” to make the installer executable.

Use command “./netbeans-6.9.1-ml-linux.sh” to run the installer.
• Click on the bottom Next button of the “NetBeans IDE Installer” window.

• Check the “I accept …” checkbox, and click on the Next button.
• Use “/home/user/tools/netbeans-6.9.1” as the NetBeans IDE installation folder, and click on the Next button.

• Use “/home/user/tools/glassfish-3.0.1” as “GlassFish 3.0.1 Installation” folder, and click on button Next. The installation starts.
• By default *GlassFish* server will have default admin username “admin”, password “adminadmin”, HTTP Port 8080 (since *Tomcat* also runs at port 8080, you should stop *Tomcat* before you can launch GlassFish server.), HTTPS port 8181, and Admin Port 4848.

• Click on the *Finish* button to complete the installation. The installer will add a “NetBeans IDE 6.9.1” shortcut on the Desktop.

• After the installation wizard comes to the end, you may delete the installer by running command “rm netbeans-6.9.1-ml-linux.sh” in “~/.Downloads”.

• Run “sudo gedit /etc/profile” to update the PATH definition as below (all on the same line; no line breaks) to add “/home/user/glassfish-3.0.1/javadb/bin”, “/home/user/glassfish-3.0.1/glassfish/bin” and “/home/user/glassfish-3.0.1/bin” to PATH.

```
PATH=$PATH:/home/user/tools/glassfish-3.0.1/bin
PATH=$PATH:/home/user/tools/glassfish-3.0.1/glassfish/bin
PATH=$PATH:/home/user/tools/glassfish-3.0.1/javadb/bin
export PATH
```
• Run command “gedit ~/.bashrc” to define an alias (nickname) for NetBeans and define a new variable DERBY_HOME (Sun database), as shown below:

```
export DERBY_HOME=~/tools/glassfish-3.0.1/javadb
alias netbeans='~/tools/netbeans-6.9.1/bin/netbeans&'
```

• Reboot the VM.
• Now you can run command “netbeans” to launch NetBeans IDE. You can also use menu item “Applications|Programming|NetBeans IDE 6.9.1” to launch NetBeans IDE (you will see this option after you have restarted your VM). As the third option you can also double-click on the “NetBeans IDE 6.9.1” shortcut on Desktop to launch NetBeans IDE.

4.13.2 Developing a Test Java Program

• If you have not launched NetBeans IDE yet, start it by executing command “netbeans” in a terminal window.
• Click on menu item “File|New Project ...” to launch the “New Project” window. Make sure Categories selection chooses “Java”, and Projects selection chooses “Java Application”, as shown below.
Click on the Next button and see the “New Java Application” window. Type “Test” in the “Project Name” text field, as shown below. Make sure that the checkboxes for “Create Main Class” and “Set as Main Project” are checked.

Click on the Finish button, and you will see a screen similar to the following one:
- In the body of method main, enter "System.out.println("Hello");", as shown below.

- In the left-upper project pane, right-click on file “Main.java” and choose “Run File” on the popup menu, as show below:
The program will be saved to hard disk, compiled into a bytecode file, and executed. The execution output is displayed under the “Output” tab, as shown below:

Click on menu item “File|Close Project” to close this project, and use “File|Exit” to shut down NetBeans IDE.

Your NetBeans projects are saved under “/home/user/NetBeansProjects”.
4.13.3 Starting/Stopping GlassFish Application Server and Derby Database Server

- To start GlassFish application server, run “asadmin start-domain --verbose domain1”. If the server failed to start, maybe your Tomcat is running, and you can run “tomcat-stop” to stop Tomcat first. The terminal window should seem hang and not usable when the server is running. It is normal. The server error/debug messages and printout from the server applications will be printed in this terminal window. Don’t shut down this window; instead minimize it. Otherwise the server would shutdown. You can use the web browser to visit http://localhost:8080 to check whether GlassFish is running.
- To stop GlassFish application server, run “asadmin stop-domain domain1” from another terminal window.
- To start Derby database server, run “asadmin start-database”
- To stop Derby database server, run “asadmin stop-database”.

If you use NetBeans IDE to develop web applications, these two servers will start and stop automatically as needed.

For convenience, let us define some aliases for starting and stopping GlassFish and Derby servers.

- Run “gedit ~/.bashrc” to add the following lines at the end of file “~/.bashrc”:

  ```bash
  alias glassfish-start='asadmin start-domain --verbose domain1'
  alias glassfish-stop='asadmin stop-domain domain1'
  alias derby-start='asadmin start-database'
  alias derby-stop='asadmin stop-database'
  ```

- Run “source ~/.bashrc” or reboot your Linux PC.
- From now on you can run “glassfish-start” to launch GlassFish application server, run “glassfish-stop” to stop it; run “derby-start” to launch Derby database server, and run “derby-stop” to stop it.

4.13.4 Adding Tomcat Server to NetBeans

To use NetBeans to develop web applications on our Tomcat web server, we need to add the Tomcat to NetBeans.

- Launch NetBeans by running “netbeans”.
- Click on menu item “Tools|Servers” to launch the “Servers” window. If you don’t see this menu item, use menu item “File|New Project…|Java Web|Web Application” to launch the “New Web Application” wizard, and then cancel this wizard process.
Check the “Enable HTTP Monitor” checkbox for GlassFish. Click on the “Add Server” button to launch the “Add Server Instance” window.
Choose “Tomcat 6.0” in the “Choose Server” pane. Click on the Next button.
• Use Browse to enter “/home/user/tools/apache-tomcat-7.0.8” for Catalina Home (Tomcat installation base folder), “user” for Username, and “123456” for Password, check the “Create user if it does not exist” checkbox, and click on the Finish button.

• Check the checkbox for “Enable HTTP Monitor” in the “Servers” window, and click on the Close button to complete the adding server operation.

• Now you are ready to use NetBeans IDE to develop web applications on our Tomcat server as well as on GlassFish application server.

4.14 Installing Eclipse

Before we can install Eclipse, we must have installed Java JDK.

Eclipse is another IDE (Integrated Development Environment) for developing software projects, mainly for Java and Java-based web applications. Since Eclipse is implemented in Java itself, Java JRE or JDK must be installed before this step.

4.14.1 Downloading Eclipse Installer

• Launch Firefox web browser and visit http://eclipse.org/downloads. Under the Eclipse Packages tab, in the section for “Eclipse IDE for Java EE Developers (205MB)”, click on the link for “Linux 32 bit” to download the installer.
• Click on the big green download arrow on the next screen capture to start downloading the installer to your folder Downloads.

• Check the “Save File” checkbox, and click on the OK button to save the installer to your folder Downloads.
4.14.2 Installing Eclipse

- Launch a terminal window, and run “cd ~/Downloads” to open a terminal window in “~/Downloads”.
- Run command “tar xvzf eclipse-jee-helios-SR1-linux-gtk.tar.gz -C ~/tools” to unzip the installer contents in “~/tools”. The Eclipse installation folder is “/home/user/tools/eclipse”.
- You could delete the installer by running command “rm eclipse-jee-helios-SR1-linux-gtk.tar.gz” in “~/Downloads”.
- Run command “gedit ~/.bashrc” to insert the following line at the end of file “~/.bashrc” to define an alias “eclipse” for launching Eclipse.

```
alias eclipse='/home/user/tools/eclipse/eclipse&'
```

- Run command “source ~/.bashrc” to process the definitions in “~/.bashrc”.
- To run Eclipse, just run command “eclipse”.

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4.14.3 Developing a Sample Java Program

- When you run Eclipse the first time, use "/home/user/EclipseWorkspace" as the default project workspace, and check the checkbox for “Use this as the default and do not ask again”.

- Let us create a simple Java project, first choose “File|New|Other”, then choose “Java Project” to switch to Java Perspective and add “Java Project” to the New Project menu.
Click on the Next button to get the following view, and enter “Test” in “Project Name” text field. Let the “JRE” and “Location” panes keep their default values.

Click the Finish button to create the “Test” Java project. You will then see the following screen:
Check the “Remember my decision” checkbox, and click on the Yes button. From now on you have “Java Project” on your “File|New” menu.

Click on “File|New|Class” menu item to create a new Java class source file.

In the following “New Java Class” window, enter “Welcome” as the class name. Check the “public static void main” checkbox to create the “main” method in the class.
• Click on the Finish button and you will have the following view:

• In the body of method “main”, replace the TODO comment with Java statement “System.out.println("Hello!");” as shown below. (If you see a red cross to the left of the print
statement it means the line has syntax error. Delete the line and type, instead of paste, it in Eclipse.)

- Click on menu item “Run|Run As|Java Application” to compile and run the project.

- Eclipse now asks you to confirm to save and launch the project. Check both of the two checkboxes as shown below:
Click on the OK button, and Eclipse save the modified source file, compile it and run it. The execution output is under the “Console” tab, as shown below:

You can use “File|Close” to close the current project, and “File|Exit” to shut down the Eclipse IDE.

4.14.4 Adding Tomcat Server to Eclipse

- Run “eclipse” to launch Eclipse IDE
- Choose “File|New|Other...”, and then choose Server wizard in the server category of the New window, as shown below:
• Click on the *Next* button. Choose “Tomcat v7.0 Server” as shown below. If you don’t see the server type list, make the server type window longer.

• Click on the *Next* button, enter “/home/user/tools/apache-tomcat-7.0.8” (you can browse for it) in the “Tomcat installation directory” text filed, and choose “jdk1.6.0_23” for JRE.
Click on the Finish button to complete the addition of our Tomcat in Eclipse. You can right-click on the Tomcat server item under the “Servers” tab and use the popup menu to control the start and stop of the Tomcat web server for testing web applications inside Eclipse (you may not be able to use the Tomcat outside of Eclipse). If Tomcat is running outside of Eclipse, you need to run “tomcat-stop” to stop it before you can start Tomcat in Eclipse.
4.14.5 Adding GlassFish Server to Eclipse

GlassFish application server is installed when we install the Java EE bundle including NetBeans as described in the last section. Make sure you have installed the Java EE bundle by now so GlassFish is already installed.

- Run “eclipse” to launch Eclipse IDE
- Choose “File|New|Other…”, and then choose Server wizard in the server category of the New window, as shown below:

![Server Wizard](image)

- Click on the Next button, and click on the “Download additional server adapters” link as shown below. (You may not see the link if your window is too small.)
- Choose “Oracle GlassFish Server Tools” and then click on the Next button.

- Accept the terms and click on the Finish button.
• Click on the OK button to start downloading and installation of the GlassFish adapter for Eclipse.

• The process may take 1 minute.
· At the end of the installation you will see the following. Click on the Restart Now button to restart Eclipse.
After Eclipse starts again, choose “File|New|Other…”, and then choose Server in the server category to launch the “New Server” wizard. Make sure that your window is large enough to see the same user interface as the one below. Choose “GlassFish Server Open Source Edition 3 (Java EE 6) and click on the Next button.

- Browse for “/home/user/tools/glassfish-3.0.1/glassfish” as the application server directory, and click on the Next button.

- In the following New Server window enter “adminadmin” as GlassFish admin password, and keep the default value “/home/user/tools/glassfish-3.0.1/glassfish/domains/domain1” for domain directory.
• Click on the Finish button. The process is now complete.
• Now you can use the popup menu of the GlassFish v3.0.1 application server under the Server tab to start/stop the GlassFish application server.

• When you start GlassFish server you may be prompted for user name and password. The user name is “admin”, and there is no password (leaving it empty string).

Congratulations and you have completed the installation and setup of Eclipse with the capacity to develop both Java projects and Java EE web applications.
As an optional step, you can add Eclipse to the Ubuntu’s “Applications|Programming” menu. To do so, click on Ubuntu menu item “System|Preferences|Main Menu”:

Choose “Programming” in Menus, and click on the “New Item” button.
Fill in Name “Eclipse” and Command “/home/user/tools/eclipse/eclipse”. Click on the OK button. Shut down the “Main Menu” window. Mission accomplished. Now you can use menu item “Applications|Programming|Eclipse” to launch Eclipse.

4.15 Installing Java Tutorials

Before we can use the Java tutorials, we must have installed Java JDK.

4.15.1 Oracle Java Tutorials

This section shows how to download Oracle’s Java tutorial for basic client-side Java programming.

• Click on the link.

• Click on the Tutorials link.
• Click on the “Java Tutorial” link.

• Click on the “Download the latest Java SE Tutorials bundle” link.
• Check the “I agree to …” checkbox, and then click on the Continue button.

• Click on the “tutorial_10_18_2010.zip” link to download the file. Save the file to your folder Downloads.
• In a file browser, right-click on file “tutorial_10_18_2010.zip” and choose “Extract Here” to generate folders “tutorial”.
• Move folder “tutorial” to “/home/user”, and rename it as “/home/user/JavaTutorial”.
• You can now access Java tutorial text by direct web browser to file:///home/user/JavaTutorial/index.html. All example project folders are under “/home/user/JavaTutorial”.

4.15.2 Java EE Tutorial and Your First Cup: An Introduction to the Java EE Platform

This section explains how to download and set up Oracle’s “Java EE Tutorial” and “Your First Cup: An Introduction to the Java EE Platform” tutorial.
You must have installed GlassFish v3.1 before you can work on this section.
Conduct a web search for “Java Developer Tutorials and Training”, and choose a web page with address similar to http://www.oracle.com/technetwork/java/index-jsp-135888.html.

- Click on the link.

- Click on the Tutorials link.
• Click on the link for “Java EE Tutorials and Resources”.

• Click on the “The Java EE 6 Tutorial” link to read and download Oracle’s Java EE 6 Tutorial.

• Click on the “Your First Cup: An Introduction to the Java EE Platform” link to read and download the tutorial with the same name.

• Run “updatetool” in a terminal window. Answer “y” for install Update Tool.
Run “updatetool” again to see the following “Update Tool” window.
- Click on the “Available Add-ons” link.
Check the checkboxes for “Apache Ant Build Tool”, “First Cup 2.0 for Java EE 6” and “Java EE 6 Tutorial”. Click on the “Install” button under the menu bar. Click on “Accept” button upon request. When the installation completes, shut down the Update Tool.

To read “Java EE 6 Tutorial”, load file:///home/user/tools/glassfish-3.0.1/glassfish/docs/javaee-tutorial/doc/index.html in your web browser.

“Java EE 6 Tutorial” example project folders are under “/home/user/tools/glassfish-3.0.1/glassfish/docs/javaee-tutorial/examples”.

To read the tutorial “Your First Cup: An Introduction to the Java EE Platform”, load file:///home/user/tools/glassfish-3.0.1/glassfish/docs/firstcup-2.0/doc/index.html in your web browser.

“Your First Cup: An Introduction to the Java EE Platform” example project folders are under “/home/user/tools/glassfish-3.0.1/glassfish/docs/firstcup-2.0/example”.

Run “sudo gedit /etc/profile” to insert the following line just before “export PATH”. This will add Ant’s bin to PATH.

```
PATH=$PATH:/home/user/tools/glassfish-3.0.1/ant/bin
```
4.16 Deploying Example Web Applications on Apache

First let us give “user” the full access to Apache and Tomcat folders. In a terminal window, run the following commands:

```
    cd
    sudo chown -R user tools
    cd /var
    sudo chown -R user www
```

Command “chmod -R user folder” enables “user” to have the same access rights as the owner of folder “folder” when “user” accesses folder “folder” and folders nested under it.

Many applications use PHP PDO driver for MySQL to access the MySQL databases. Run command “sudo aptitude install php5-mysql” to install PDO support for MySQL.
4.16.1.1 Installing PHP5-GD

These steps install GD image library support for PHP5 and the Postfix module for your Linux PC to send emails.

- Run “sudo aptitude install php5-gd” to install the module supporting GD image library in PHP5.

- Reboot the VM.

4.16.2 Installing Drupal

Drupal is one of the most popular open-source content management platforms for developing advanced web applications for social networking, blogging, forums, and conference management. This subsection shows you how to install Drupal on our Apache web server.

- Run “wget http://drupal.org/files/projects/drupal-7.0.tar.gz” in “~/Downloads” to download Drupal v7.0 installer “drupal-7.0.tar.gz”
- Run “tar -zxvf drupal-7.0.tar.gz” to unzip the file into folder “drupal-7.0”.
- Rename the folder as “drupal”. Move it to “~/www”. You can now delete file “drupal-7.0.tar.gz”.
- Run “cd ~/www/drupal/sites/default” to change working folder.
- Run “cp default.settings.php settings.php” to make a copy of file “default.settings.php” and name it “settings.php”.
- Run “chmod a+w settings.php” to give the web server write privileges (666 or u=rw,g=rw,o=rw) to the configuration file.
- Run “cd ..” to move working folder up one level. Then run “chmod a+w default” to give the web server write privileges to the default folder.
- Run “mysql –u root –p123456” to launch the MySQL admin console.
- Run “create database drupal;” in the console to create database “drupal”.
- Run “GRANT SELECT, INSERT, UPDATE, DELETE, CREATE, DROP, INDEX, ALTER, CREATE TEMPORARY TABLES, LOCK TABLES ON drupal.* TO ‘root’@’localhost’ IDENTIFIED BY ‘123456’;” in the console to give a “root” process the various rights to access the database “drupal”.

```bash
user@ubuntu:~$ mysql -u root -p123456
Welcome to the MySQL monitor. Commands end with ; or \g.
Your MySQL connection id is 37
Server version: 5.1.49-1ubuntu8.1 (Ubuntu)

mysql> create database drupal;
Query OK, 1 row affected (0.00 sec)

mysql> GRANT SELECT, INSERT, UPDATE, DELETE, CREATE, DROP, INDEX, ALTER, CREATE TEMPORARY TABLES, LOCK TABLES ON drupal.* TO 'root'@'localhost' IDENTIFIED BY '123456';
Query OK, 0 rows affected (0.01 sec)

mysql> quit;
Bye
user@ubuntu:~$
```
- Launch web browser to visit http://localhost/drupal/

- Make sure “Standard” is selected. Click on “Save and continue”.

- Click on “Save and continue” to accept “English” as the default language.

- Review the requirements verification page. Resolve any problems reported on this page. Then click on “Save and continue”.

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- Enter “drupal” as database name, “root” as database user, and 123456 as database password. Then click on “Save and continue”.

- In the Site Information section of “Configure site pane, keep “localhost” as site name, your valid email address as site email address. In the Site maintenance Account section, enter “admin” as user name, and 123456 as password.
• In the Server Settings section, fill in appropriate information, and then click on “Save and continue”.

• Click on the “Visit your new site” link. Your Drupal installing is now complete.
• Run “chmod a-w ~/www/drupal/sites/default/settings.php” to make file “settings.php” not writable. Otherwise you will see security warning in Drupal.
• Run “chmod a-w ~/www/drupal/sites/default” to make folder “default” not writable. Otherwise you will see security warning in Drupal.
• You can learn how to use Drupal to develop various web sites with documentation at [http://drupal.org/start](http://drupal.org/start).

4.16.3 Installing WordPress

WordPress is also a popular web site builder and contents management system. This sections shows how to set it up on your VM.

• Use web browser to visit [http://wordpress.org/download](http://wordpress.org/download).

• Click on the Download .tar.gz link under the “Download WordPress 3.0.5” button.
• Save file “wordpress-3.0.5.tar.gz” in “~/Downloads”.
• In a file explorer right-click on file “wordpress-3.0.5.tar.gz” and choose “Extract Here”. A new folder “wordpress” is created.
• Move folder “wordpress” to “~/www” so you can see path “~/www/wordpress”.
• Run “cd ~/www/wordpress” to change working folder. Run “cp wp-config-sample.php wp-config.php” to make a copy of the sample configuration file and name the copy “wp-config.php”. Run “chmod 666 wp-config.php” to make the configuration file writable by the web server.
Run “mysql –u root –p123456” to launch MySQL admin client. Follow the instruction below to create a new database “wordpress” and assign proper access rights to it for a new MySQL user “wordpress” with password 123456.

```bash
user@ubuntu:~$ mysql -u root -p123456
Welcome to the MySQL monitor. Commands end with ; or \g.

mysql> create database wordpress;
Query OK, 1 row affected (0.04 sec)

mysql> GRANT SELECT, INSERT, UPDATE, DELETE, CREATE, DROP, INDEX, ALTER, CREATE TEMPORARY TABLES, LOCK TABLES ON wordpress.* TO 'wordpress'@'localhost' IDENTIFIED BY '123456';
Query OK, 0 rows affected (0.08 sec)

mysql> quit;
Bye
```

Run “gedit ~/www/wordpress/wp-config.php” to edit the configuration file, enter “wordpress” for database name and database user, and 123456 for database password.
• Use web browser to visit http://localhost/wordpress to install WordPress.

• Enter 123456 as WordPress admin password. Enter a valid email address for admin. At the bottom of the welcome page, click on the “Install WordPress” button.
• Click on the *Log In* button.

• Enter admin for user name and 123456 for password, then click on the Log In button.
Now you see the WordPress admin dashboard. If you visit [http://localhost/wordpress](http://localhost/wordpress), you will see your first WordPress site.

Congratulations and you have succeeded in installing WordPress. You may start learning WordPress by visiting this tutorial at [http://codex.wordpress.org/First_Steps_With_WordPress](http://codex.wordpress.org/First_Steps_With_WordPress).

### 4.16.4 Installing Simple Machine Forum (SMF)

This section will guide you in setting up SMF, a popular community forum software.

- Use a web browser to visit [http://download.simplemachines.org/](http://download.simplemachines.org/).
Click on the tar.gz link to download the SMF 1.1.13 installer “smf_1-1-13_install.tar.gz”. Save the installer in “~/Downloads”.

In a file explorer, right-click on file “smf_1-1-13_install.tar.gz” and choose “Extract Here” to generate a new folder “smf_1-1-13_install”. Rename the folder to “forum”. Move folder “forum” to “~/www” so you can see path “~/www/forum”.

While “~/www/forum” is the working folder, run “chmod -R 777 *” to make all files writable.

Run “mysql –u root –p123456” to launch MySQL admin client. Follow the instruction below to create a new database “smf” and assign proper access rights to it for a new MySQL user “smf” with password 123456.

```
user@ubuntu:~$ mysql –u root –p123456
Welcome to the MySQL monitor. Commands end with ; or \g.

mysql> create database smf;
Query OK, 1 row affected (0.04 sec)

mysql> GRANT SELECT, INSERT, UPDATE, DELETE, CREATE, DROP, INDEX, ALTER, CREATE TEMPORARY TABLES, LOCK TABLES ON smf.* TO smf@'localhost' IDENTIFIED BY '123456';
Query OK, 0 rows affected (0.08 sec)

mysql> quit;
Bye
```

Use web browser to visit http://localhost/forum.
In the top Basic Settings section, enter a proper forum name. Check “Use UTF-8” if some people may post in other languages.

In the bottom MySQL Server Settings section, enter “smf” for MySQL username and database name, and 123456 for MySQL password. Then click on the Proceed button.
Enter “admin” for username, 123456 for password and MySQL database password, and a valid email address for email address. Then click on the **Finish** button.

Run “rm ~/www/forum/install.php” to delete the install script file.

Click on the link “your newly installed forum” or just visit [http://localhost/forum](http://localhost/forum).
Congratulations and you have succeeded in setting up an SMF forum. You can visit http://www.simplemachines.org/ to learn more about SMF.

4.16.5 Installing Sample Tomcat Web Applications

This sub-section shows how to download and deploy a set of sample web applications of mine for you to deploy in our Tomcat web server, and how to let Apache delegate HTTP requests for these applications to Tomcat. These sample web applications are frequently used in our future tutorials on web architectures and how to develop and secure Java web applications.

- Use Firefox to visit http://csis.pace.edu/lixin/download/TomcatWebApps.7z and save the file to your Linux folder “~/.Downloads”.
- In file browser, right click on file “TomcatWebApps.7z”, and click on menu item “Extract Here” to create folder “~/.Downloads/TomcatWebApps”.
- Run “cd ~/.Downloads” to change the working folder to Downloads.
- Run “sudo chmod -R a+rw TomcatWebApps” to recursively make folder “TomcatWebApps” and all files and folders under “TomcatWebApps” readable and modifiable by all users on this Linux PC.
- Run “sudo mv ~/.Downloads/TomcatWebApps ~/tomcat/webapps” to move the new folder to “webapps/TomcatWebApps”.
- Run “cd ~/tomcat/webapps” to change working folder.
Run “cp TomcatWebApps/*.war .” to copy all files with file name extension “.war” (Web Archive) from folder “TomcatWebApps” one level up to “webapps”.

Run commands

```
sudo cp -r ~/tomcat/webapps/TomcatWebApps/endorsed ~/tools/jdk1.6.0_23/jre/lib
sudo chmod -R 777 ~/tools/jdk1.6.0_23/jre/lib/endorsed
```

to copy folder “endorsed”. All jar files in folder “~/tools/jdk1.6.0_16/jre/lib/endorsed” are automatically accessible by Java programs during their compilation or execution. This step is mainly for supporting the development of Axis web service applications as well as compiling Java servlets in terminal windows.

If Tomcat is not running, start it by running command “tomcat-start”. You will notice that one new folder is created under “webapps” for each WAR file under “webapps”. This is the automatic web application deployment.

Run “tomcat-stop” to shut down Tomcat.

Run “rm ~/tomcat/webapps/*.war” to delete all WAR files in folder “webapps”. If you have not correctly shut down Tomcat before you delete the WAR files, the web applications folders generated earlier from these WAR files will be deleted too.

From now on you can safely modify my example web applications.

To work on Lixin's web service lab, start a terminal window in default folder ~, run “wget http://csis.pace.edu/lixin/download/webServiceLab.7z”, right-click on the downloaded file “webServiceLab.7z” and choose “Extract Here” to generate folder “webServiceLab”. Now you can delete file “webService.7z”.

4.16.5.1 Creating MySQL Database Tables for Tomcat Sample Web Applications

Now we need to create a database table for the two bookstore sample projects.

- Open terminal window and run “cd ~/tomcat/webapps/bookstoreServlet” to change the working folder.
- Run “mysql -u root -p123456” to log in MySQL admin console.
- Run “use test;” after the “mysql>” prompt to change the current database to “test”.
- Run “source books.sql;” after the “mysql>” prompt to create a table and populate sample book data in the table in database “test”.
- Run “quit;” after the “mysql>” prompt to quit the MySQL admin console.

The following is copied from my terminal window when I ran the above steps.

```
user@ubuntu:~/tomcat/webapps/bookstoreServlet$ mysql -u root -p123456
Welcome to the MySQL monitor. Commands end with ; or \g.
Your MySQL connection id is 57
Server version: 5.1.37-1ubuntu5 (Ubuntu)
Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.

mysql> use test;
Database changed
mysql> source books.sql;
Query OK, 0 rows affected, 1 warning (0.00 sec)
```
• Now we need to create a database table for the *survey* sample projects
  
  o Open terminal window and run “cd ~/tomcat/webapps/survey” to change the working folder.
  o Run “mysql -u root -p123456” to login *MySQL* admin console.
  o Run “use test;” after the “mysql>” prompt to change the current database to “test”.
  o Run “source survey.sql;” after the “mysql>” prompt to create an empty table for survey data in database “test”.
  o Run “quit;” after the “mysql>” prompt to quit the *MySQL* admin console.

The following is copied from my terminal window when I ran the above steps.

```
user@ubuntu:~/tomcat/webapps/survey$ mysql -u root -p123456
Welcome to the MySQL monitor. Commands end with ; or \g.
Your MySQL connection id is 57
Server version: 5.1.37-1ubuntu5 (Ubuntu)
Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.

mysql> use test;
Database changed
mysql> source survey.sql;
Query OK, 0 rows affected, 1 warning (0.00 sec)
Query OK, 0 rows affected (0.01 sec)
mysql> quit;
Bye
user@ubuntu:~/tomcat/webapps/survey$
```

Letting *Apache* Delegate Sample *Tomcat* Web Applications

• Run “sudo gedit /etc/apache2/sites-enabled/000-default” to edit file “/etc/apache2/sites-enabled/000-default”, and add the following at its end, just before </VirtualHost>, for *Apache* to delegate HTTP requests to the sample *Tomcat* web applications to *Tomcat* (removing the same lines we inserted earlier so there would be no duplicate lines):

```
ProxyPass /examples/servlets ajp://localhost:8009/examples/servlets
ProxyPassReverse /examples/servlets jp://localhost:8009/examples/servlets

ProxyPass /examples/jsp ajp://localhost:8009/examples/jsp
ProxyPassReverse /examples/jsp ajp://localhost:8009/examples/jsp

ProxyPass /docs ajp://localhost:8009/docs
```
ProxyPassReverse /docs ajp://localhost:8009/docs
ProxyPass /survey ajp://localhost:8009/survey
ProxyPassReverse /survey ajp://localhost:8009/survey
ProxyPass /surveyJsp ajp://localhost:8009/surveyJsp
ProxyPassReverse /surveyJsp ajp://localhost:8009/surveyJsp
ProxyPass /surveyCss ajp://localhost:8009/surveyCss
ProxyPassReverse /surveyCss ajp://localhost:8009/surveyCss
ProxyPass /surveyJsf ajp://localhost:8009/surveyJsf
ProxyPassReverse /surveyJsf ajp://localhost:8009/surveyJsf
ProxyPass /demo ajp://localhost:8009/demo
ProxyPassReverse /demo ajp://localhost:8009/demo
ProxyPass /tripler ajp://localhost:8009/tripler
ProxyPassReverse /tripler ajp://localhost:8009/tripler
ProxyPass /testCookie ajp://localhost:8009/testCookie
ProxyPassReverse /testCookie ajp://localhost:8009/testCookie
ProxyPass /bookstoreServlet ajp://localhost:8009/bookstoreServlet
ProxyPassReverse /bookstoreServlet ajp://localhost:8009/bookstoreServlet
ProxyPass /bookstoreJsp ajp://localhost:8009/bookstoreJsp
ProxyPassReverse /bookstoreJsp ajp://localhost:8009/bookstoreJsp
ProxyPass /axis ajp://localhost:8009/axis
ProxyPassReverse /axis ajp://localhost:8009/axis
ProxyPass /bareJsp ajp://localhost:8009/bareJsp
ProxyPassReverse /bareJsp ajp://localhost:8009/bareJsp
ProxyPass /guessNumber ajp://localhost:8009/guessNumber
ProxyPassReverse /guessNumber ajp://localhost:8009/guessNumber
ProxyPass /html ajp://localhost:8009/html
ProxyPassReverse /html ajp://localhost:8009/html

Reboot your VM. Now you can use Apache to visit the sample Tomcat web applications in the next subsection without using port number specification. We can bypass Apache and visit these applications directly on Tomcat by adding the port number 8080 specification, as in http://localhost:8080/demo”.

4.16.5.3 Testing Sample Tomcat Web Applications

Use Firefox to visit the following URLs to test the web applications that we deployed in the last step:

- http://localhost/examples/servlets
- http://localhost/examples/jsp
- http://localhost/survey
- http://localhost/surveyJsp
- http://localhost/surveyCss
- http://localhost/surveyJsf
- http://localhost/demo
- http://localhost/html
- http://localhost/tripler
- http://localhost/testCookie
- http://localhost/bookstoreServlet
- http://localhost/bookstoreJsp
- http://localhost/axis
- http://localhost/bareJsp
- http://localhost/guessNumber