

Operating Systems Exercises week 2.

Tutorial questions.

1. What is the purpose of the command interpreter? Why is it usually separate from the kernel?
2. What is the purpose of a scheduler?
3. What is an operating system model?
4. What is the purpose of system calls? Why are they necessary?
5. What is the purpose of system programs?
6. What is the main advantage of the layered approach to system design?
7. Why is the separation of mechanism and policy a desirable policy?

Practical exercises.

Introduction to Operating Systems – Windows Practical.

Virtual machines.

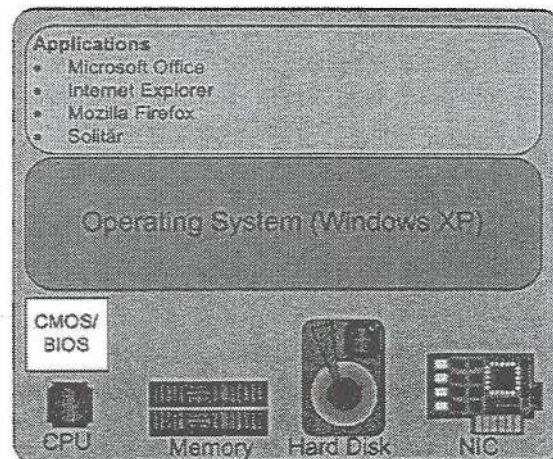
We are going to use virtual machines to run Windows and Linux operating systems. Traditionally a virtual machine is a piece of software that runs on a host machine and simulates another computer. Programs could be loaded and executed on the virtual machine just as if it was a real computer. All instructions were simulated in the software environment of the virtual machine. The various hardware components were represented by software components and instructions manipulated those components to produce the simulation.

So the program instructions being executed on the virtual machine were executed by software and therefore are very slow.

Modern virtual machine technology is much more powerful. Instead of having a piece of software to simulate instructions, the virtual machine technology implements a layer of software (virtualization layer and virtual machine monitor) by which user mode instructions are simply directly executed on the host machine and only system calls need to be intercepted and processed by the virtual machine software. When the software running on the virtual machine needs to access hardware the virtual machine

software translates the access into access to the real hardware (mouse, keyboard, screen, removable media CDs/DVDs, floppies, USB sticks, etc). The exception is the hard disk which is represented by a file that resides on the real hard disk and so is a virtual hard disk.

The illustration below represents a normal layout of a machine with an operating system and applications running on the operating system (figure 1).*



This illustrations below represent a virtual machine that itself runs as application software on a host operating system/hardware (figure 2)* and how access to virtual hardware is transformed into access to real hardware (figure 3).*

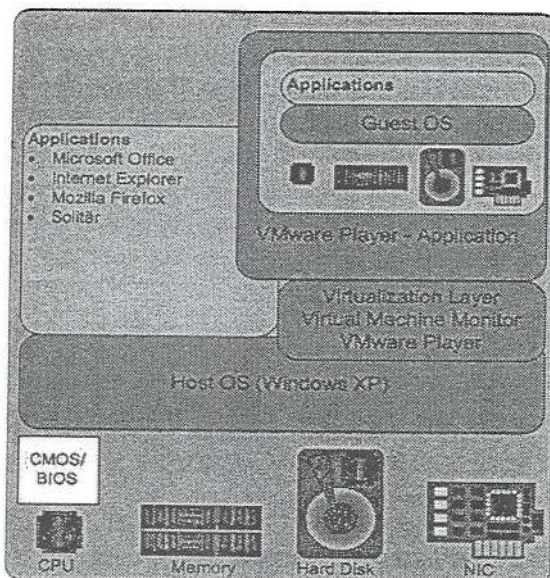


Figure 2.

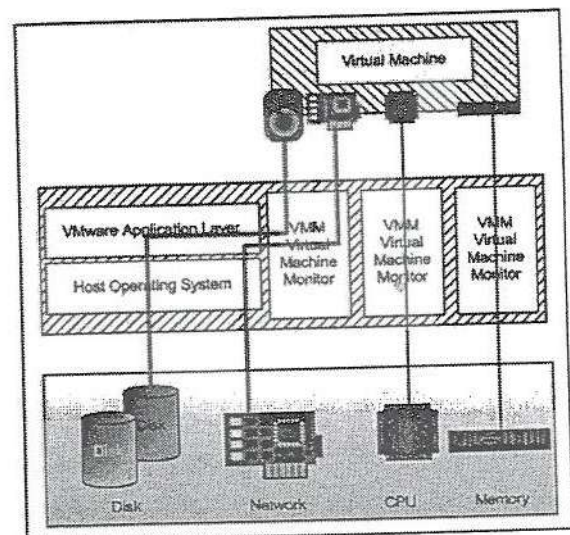


Figure 3.

* Diagrams courtesy of VMware Server and VMware Player, by Dennis Zimmer.

As a result of running most instructions on the host machine modern virtual machines can run at speeds very close to that of the underlying host machine.

Software can be loaded onto the virtual machine and, in particular, operating systems can be loaded onto a virtual machine. Such an operating system that runs on a virtual machine is often called a **Guest operating system** (as opposed to the **host operating system** which is the operating system that runs on the host machine).

We are using guest operating systems running on virtual machines because we can safely give you administrative rights on the operating system we are going to use, whereas we would not be allowed to give you administrative rights on the host operating system (against University IT policies).

Running virtual machines using VMPlayer.

The virtual machine software that we are going to use is known as VMware Player. This software, as the name suggests, plays or runs virtual machines.

1. To run VMware player go to Start then VMware then VMware Player. This will bring up the VMware Player window, click Open and this will bring up a familiar File Open box. Go to Local Disk C:, then the Virtual machines folder and then the Windows XP Professional folder and then select and Open the Windows XP Professional.vmx file. This will load up a virtual machine with the Windows XP operating system. The vmx file is the file that defines the configuration of the virtual machine.

If it is the first time you run VMPlayer with a new virtual machine, a dialog box will appear asking whether or not you moved or copied the virtual machine. Copied is selected by default and is the correct selection. So if you get this dialog box, click on OK.

The operating system will then continue to load and eventually you will have a window with Windows running in it. You may have noticed but the loading sequence should be very similar to your experience of starting up a PC with Windows running on it. It will take a minute to load up (just like a normal PC).

If you have any USB devices attached to a USB port in the host PC than a dialog box will appear which refers to the presence of the USB drive(s) and tells you that you may connect these devices to the virtual machine by going to the Devices menu on the status bar of VMPlayer and you can then use the USB drive with the operating system on the virtual machine. If you ever get this message then simply click OK to indicate that you have seen the message.

2. We need to understand what is to be found in the VMPlayer window.

On the bottom bar, on the left, you will see a little box with some instructions that tells you how to toggle (switch) between the host PC receiving your keyboard input and mouse clicks/movement (by pressing CTRL+ALT) and the virtual machine receiving the keyboard input and mouse clicks/movement (by pressing CTRL+G).

On the bottom bar, on the right, you will see a series of icons which represent the various virtual devices. Those that are unshaded are available. There is a hard disk icon which has a light which flickers when hard disk accesses are occurring. CD/DVD icon for when there is a CD/DVD in the CD/DVD drive, a floppy disk icon, Network adapter, sound card and USB devices if any are present.

On the top bar, you see the name of the virtual machine, and then 2 menus – called VMware Player and Devices.

Go to the VMPlayer menu. Select Preferences. A dialog box will come up. Under Exit behaviour, check that Power off the virtual machine has been selected. If not then select it. We need to select this as without it VMPlayer will save the state of the OS when you exit and we don't want it to do that. Also deselect/turn off Check the web for updates.

The Devices menu shows the devices that are currently attached to the virtual machine. These are the real I/O devices that the operating system and the virtual machine can use. If you go to the Devices menu the ticks are against hardware devices on the host computer that can be connected to the virtual machine. In this case you should see CD/DVD, floppy, Network adapter and sound card. You will also notice no ticks against any USB device. If you ever want your USB stick to be connected to the virtual machine all you need to do is put it in the USB port as normal and then after it has been recognised by the host operating system, click on the device on the Device menu and it will be disconnected from the host machine and made available (connected) to the virtual machine.

On the top bar, on the far right you will see conventional icons for windows maximisation, minimisation, etc. When working with the virtual machine as you would a conventional operating system it is best to maximise the window. Do that now. The top bar of VMPlayer remains, but otherwise it is now Windows XP running on a virtual PC.

Stopping the virtual machine.

When it comes time to stop the virtual machine from running, then simply turn it off as you would a normal machine – go to Start and then Turn Off Computer and then Turn Off as normal.

One of the nice things about using virtual machines is that we can make the virtual hard disk non-persistent, which means that any changes that you make to the operating system are discarded when you power the virtual machine down. This means that if you make a mess with anything, you can just power down the virtual machine and start over again. It also means that any exercises that you might do that

would change the operating system will not be available to students in classes that follow yours.

You may have noticed a bubble has come up saying that your computer might be at risk as there is no antivirus software installed. Just click on the x to get rid of the bubble. Other messages might appear, just as normally happens when loading up Windows.

Remember to press CTRL+G to direct input to the virtual machine and CTRL+ALT to direct it to the host computer.

Exercises using Windows.

1. Go to Start, then Control Panel, then Help and then About Windows. This gives you information about what version of Windows you are running.

- a) What is the version number?
- b) What is the Build number and the Service Pack number?

Exit the Control Panel.

2. Start a window running cmd.exe (select Start then Run then type cmd.exe). This brings up a simple text window with a command prompt showing.

3. At the command prompt type

hostname

this tells you the name of the computer you are working on.

4. At the command prompt type

winmsd.exe

This brings up a window of system information. It might take a little time to load up. You will be looking at the summary information screen. Note this also contains information on the operating system version number, Build number and Service Pack.

a) What is the type and speed of the CPU in your machine? This is actually the type and speed of the host machine.

b) How much physical memory is configured into your machine and how much is available?

c) Look at Components and then Storage and then Drives. What is the size of the (virtual) hard disk and the size of the free space?

d) Look at Software Environment. Look at the Services. This is a complete list of all the services that are running. If you look you will find the print spooler (remember from lectures what a spooler does) and net logon (we will talk about this in a later lecture).

5. Terminate winmsd.exe and start perfmon.exe (Performance monitor). Click the + icon above the chart. This allows you to add new performance measures to the chart. You will see an Add Counters box. Add counters for interrupts/second, privileged time, processor time, and user time (all from Processor counter set). Leave this tool running until you have finished question 6.

Close the Add Counters box.

a) What do the plots represent?

b) What operations can you perform using cmd.exe, the mouse, and/or the keyboard to make the number of interrupts/second be as large as possible?

c) What operations can you perform using cmd.exe, the mouse, and/or keyboard to make the amount of privileged time be as large as possible?

d) What operations can you perform using cmd.exe, the mouse, and/or keyboard to make the amount of processor time be as large as possible?

6. Start the Task Manager by pressing Ctrl+Shift+Esc.

a) What applications are currently running?

b) Look at the processes display. The PID field is the process' internal identifier. If the PID is not showing then you can add it to the display by going to View and then select columns and selecting PID.

c) Add thread count to the display.

d) Look at the performance display. How many CPU usage history windows are there? Why is this?

e) How many handles are currently open in the entire system?

f) How many threads exist in the system?

g) How many processes exist in the system?

h) What do you think the idle process does?

i) Go to View and select show kernel times. The display will now show in red the time spent by the processor executing in kernel mode rather than user mode.

j) Change the size of the window so you can the plot more clearly. You should see the red plot of kernel execution times. Try doing something – moving the mouse around changing the window size again and you might see the kernel times increasing while Windows deals with this.

7. Close down the virtual machine by going to Start and Turn Off Computer, etc, as normal. Windows will close down and then VMPlayer will exit.