

Operating Systems Fundamentals

User Interface and Interaction

User Interface

- The interface is the first interaction a user has with a computer
- The operating system provides a user interface that enables the user to interact with software and hardware.
- User Interface aims to help the user use the computer system productively
- We need to provide consistent user interface services to application programs to **lower learning curves** and **increase productivity**
- User interface choice depends on the kind of user
 - Writing programs vs. running applications
 - Power User vs. Novice

Linux – 3 different interfaces

Three methods of interaction with a computer:

- Graphical User Interface (GUI)
- Touchscreen Interface
- Command Line Interface (CLI)



Ubuntu GUI interface



Ubuntu running on the Nexus S smartphone

```
root@ubuntu:~# cat /etc/passwd | grep bash | cut -d: -f1,7 | sort -n
root:x:0:0:root:/root:/bin/bash
daemon:x:1:1:daemon:/usr/sbin:/usr/sbin/nologin
bin:x:2:2:bin:/bin:/usr/sbin/nologin
sys:x:3:3:sys:/dev:/usr/sbin/nologin
games:x:5:12:games:/usr/games:/usr/sbin/nologin
uucp:x:10:10:uucp:/var/spool/uucp:/usr/sbin/nologin
lp:x:7:7:lp:/var/spool/lpd:/usr/sbin/nologin
nfsnobody:x:65534:65534:nfsnobody:/var/lib/containers/overlay-containers/nfsnobody:/usr/sbin/nologin
root@ubuntu:~#
```

Screenshot of a sample Bash session. GNOME Terminal 3, fedora 15

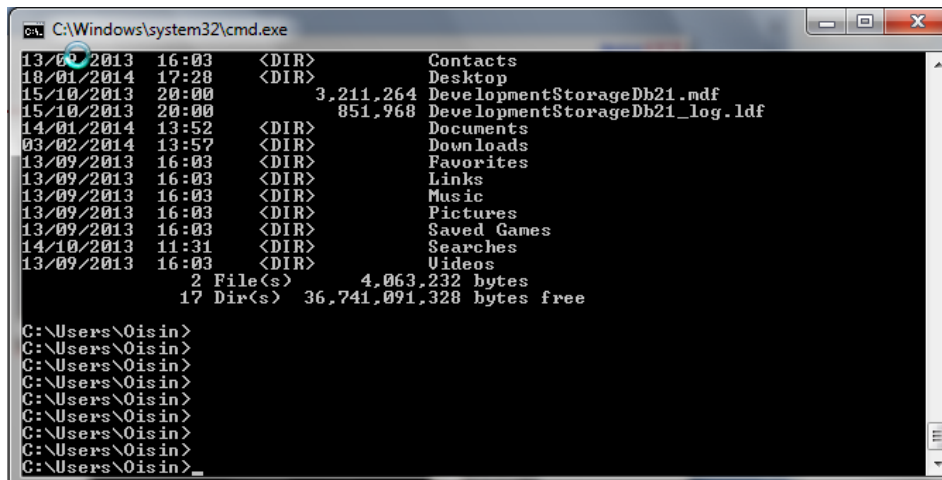
More GUIs



Ipad touchscreen Interface



Windows GUI



Windows Command Line Interface

Graphical User Interface

- The Graphical User Interface (GUI) allows users to interact with a computer through graphical icons and visual indicators (rather than text commands)

GUI interfaces common features

□ Mouse and icon-based

- Based on idea of Point-and-Click
- Interact with menus, images in the form of buttons, icons
- Event Driven

□ Windows

- Are allocated to the use of a particular program or process
- Contain a title bar, menu bar, and widgets

- GUI's are starting to resemble Web applications
 - Forward, back buttons and location
- Easy to use as all options are laid out

Touchscreen Interface

- More a hardware advance than an OS advance
 - Screen is now an interface
- Uses GUI interfaces
- Requires more computing power but becoming the main interface method, especially for small portable devices



Command Line Interface

- A Command Line Interface allows a user to interact with a computer system by typing in commands.
- Any command which is entered must be typed in the correct syntax to perform the operation.
- Many commands are given to the operating system by control statements which deal with:
 - Process creation and management , I/O handling, Secondary-storage management, Main-memory management, File-system access, Protection, Networking
- The **program** that reads and interprets control statements is called the:
 - **command-line interpreter**
 - **shell** (in UNIX)

Advantages and Disadvantages of CLIs

Advantages

- Faster than using Menus and Icons on a GUI interface
- Less memory required – no graphics on interface
- Experienced users can use this system faster than others
- Complex commands can be entered to customise the operating system for a particular user

Disadvantages

- People with limited knowledge of the command-line language may find the interface confusing and hard to use
- Errors in commands can cause the operation to fail and can be very time consuming
- Any errors in typing may require the user to re-type the command. This is time consuming and frustrating
- Commands have to be learnt, (UNIX/Linux has hundreds)
- The interface is not attractive compared to a GUI interface


```

login01.fos.auckland.ac.nz - PuTTY
sman063@login01.fos.auckland.ac.nz's password:
Linux login01.fos.auckland.ac.nz 2.6.32-5-amd64 #1 SMP Mon Jan 16 16:22:28 UTC 2
012 x86_64

Welcome to login01.fos.auckland.ac.nz

login01.fos - $HOME is mounted from AFS (FoS students & staff)
login02.fos - $HOME is mounted from files.fos (staff & phd only)

Your new "H: drive" (aka echome, SONAS) can be access in
/mnt/YOUR_UPI/sonas

Last login: Mon Jun 11 14:00:30 2012 from redsox.tcs.auckland.ac.nz
sman063@login01% cd ..
sman063@login01% ls
city/ echome/ tmk/ unixhome/ WapServer/ Windows/
sman063@login01% cd echome/
sman063@login01% cat > hello.cpp
#include <iostream>
int main() { std::cout << "hello world\n"; return 0; }
sman063@login01% g++ hello.cpp
sman063@login01% ./a.out
hello world
sman063@login01%
  
```

Unix

UNIX is a multi-tasking multi-user operating system written in the C programming language.

```

shrikant@kerneltalks:~
login as: shrikant
!!!! Welcome to KernelTalks test server !!!!
This server is meant for testing Linux commands and tools. If you are
not associated with kerneltalks.com and not authorized please dis-connect
immediately.
shrikant@13.126.41.155's password:
W E L C O M E
Welcome to the testing environment of kerneltalks.
Feel free to use this system for testing your Linux
skills. In case of any issues reach out to admin at
info@kerneltalks.com. Thank you.
[shrikant@kerneltalks ~]$
  
```

Linux

Created by Finnish student Linus Torvalds.

Also written in C but developed by thousands of volunteers.

CLIs continued

- Command Languages
 - Provide a mechanism to combine sequences of commands together. These pseudo-programs are known as **scripts in Unix** or **batch files in MS DOS**.
 - Used for startup files – OS configuration, user preferences, start frequently used applications.

Features of Command Languages

- Can accept input from the user and can output messages to I/O devices
- Provide ability to create and manipulate variables
- Include the ability to branch and loop
- Ability to specify arguments to the program command and to transfer those arguments to variables within the program
- Provide error detection and recovery

Example CLI Commands

- Like processors, different CLI use different command structures
- Unix/Linux aims to use 2 letters for most commands
- Windows aims to be descriptive on what the command will do

| MS-DOS / Windows | UNIX / Linux | |
|----------------------------|--------------|---|
| dir | ls | List a directory of files or get information about files |
| copy | cp | Copy a file from one place to another |
| move | mv | Move a file from one place to another |
| del or erase | rm | Delete (remove) a file |
| type | cat | Type a file out to the screen (or redirected to a printer) |
| mkdir | mkdir | Attach a new subdirectory to the tree at this tree junction |
| rmdir | rmdir | Delete a subdirectory |

GUI Vs CLI

GUI

- Advantages
 - Easy to learn and use
 - Little training
 - Amenable to multi-tasking
- Disadvantages
 - Harder to implement
 - More HW/SW requirements
 - Requires lots of memory
 - Software is complex and difficult to write

CLI

- Advantages
 - More flexible and powerful
 - Faster for experienced users
 - Can combine commands
- Disadvantages
 - More difficult to learn and use
 - Training required to get best performance from CLI

Menu Driven CLI

- With a menu driven interface the user interacts with the computer by selecting options from a menu.
 - Think of taking money out of an ATM
 - No need to memorize commands
 - Menus can be nested -picking an option
Opens a new Menu list
- Low data requirements

```

MAIN                                Main Menu                                System SYS 00300

Select one of the following:
    1. User tasks
    2. Office tasks
    3. General system tasks
    4. Files, libraries, and folders
    5. Programming
    6. Communications
    7. Define or change the system
    8. Problem handling
    9. Display a menu
   10. User support and education
   11. PC support tasks
   90. Sign off

Selection or command
===>

F3=Exit F4=Prompt F9=Retrieve F12=Cancel F23=Set initial menu
  
```

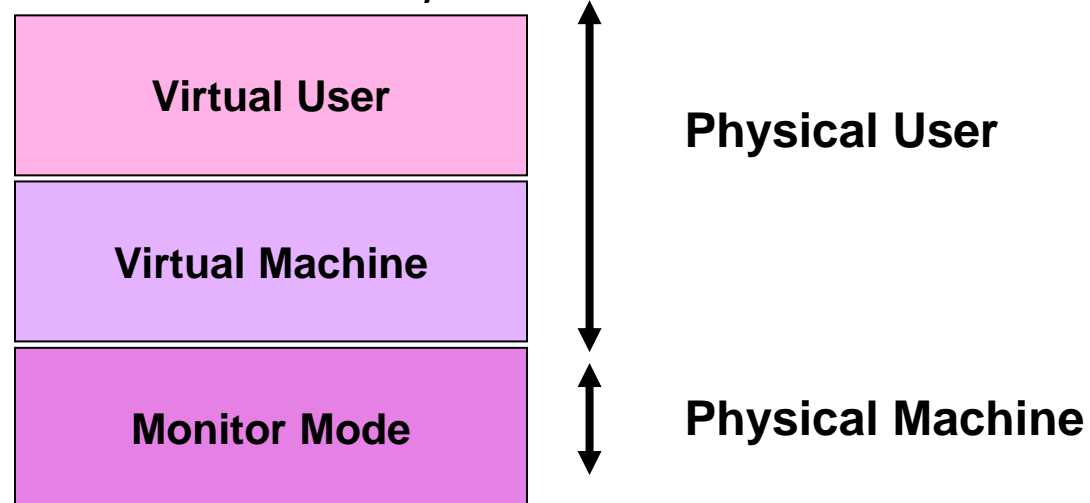
Virtual Machine / Computer

- Typically a single Operating System runs on a computer at any one time
 - Single OS installed or
 - Dual Boot where you choose the OS to load
- A **virtual machine (VM)** is a "completely isolated guest operating system installation within a normal host operating system".
- The underlying Operating System is unaware of the virtual environment and runs as though it is in control of the computer
 - An underlying Operating System is required to manage Virtual Machines
- Virtual Machines allow Operating Systems run on wide range of hardware not originally supported
 - Windows running on Apple Operating System (MacOS)
 - Linux running on Windows Operating System (eg: using virtualBox)

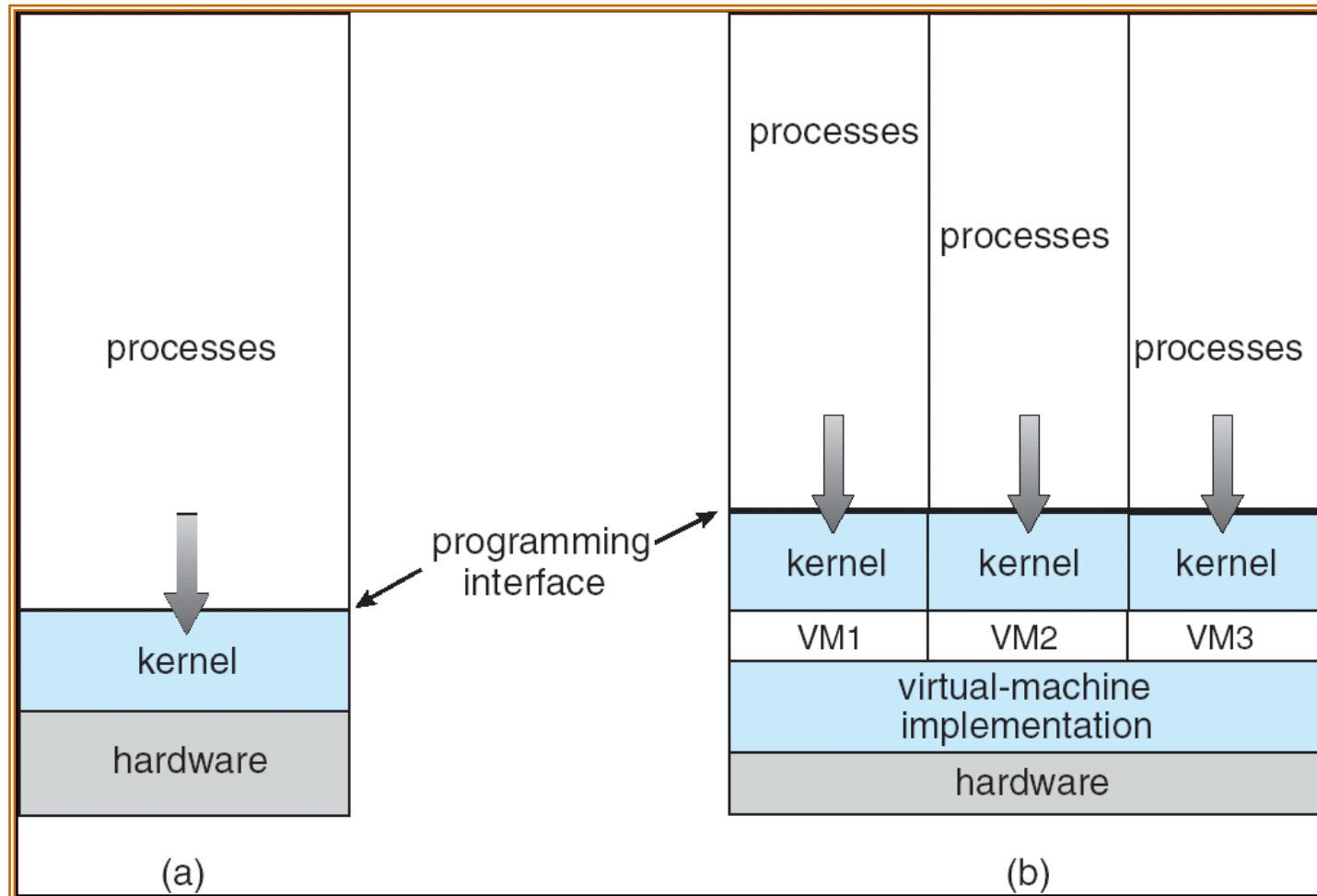
Virtual Machine

- ❑ In a Virtual Machine - each process "seems" to execute on its own processor with its own memory and devices.
 - The resources of the physical machine are shared. Virtual devices are sliced out of the physical ones. Virtual disks are subsets of physical ones.
 - Useful for running different OS simultaneously on the same machine.

- Protection is paramount



Virtual Machine



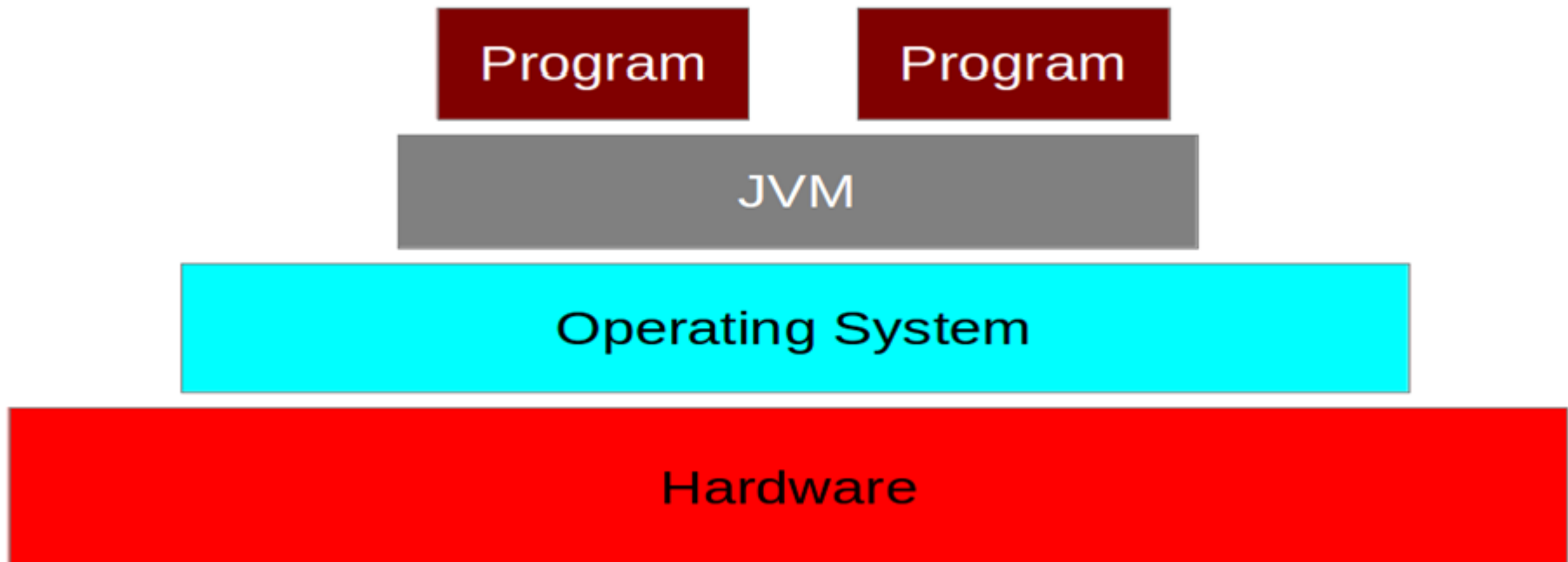
Non-Virtual

Virtual

Virtual Machine

Example: Java Virtual Machine (JVM)

The Java Virtual Machine allows Java code to be portable between various hardware and OS platforms.



Java Virtual Machine

