

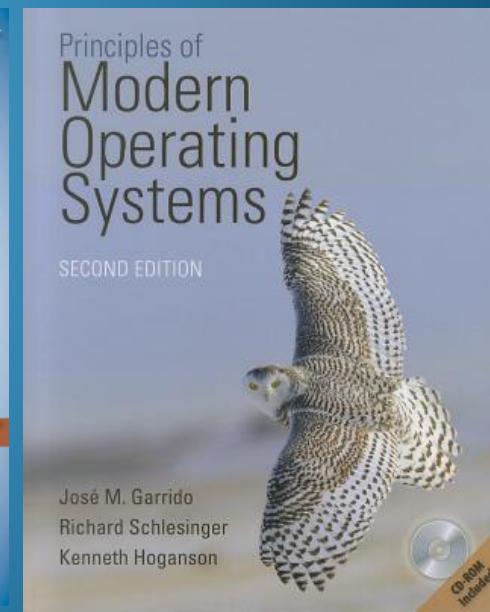
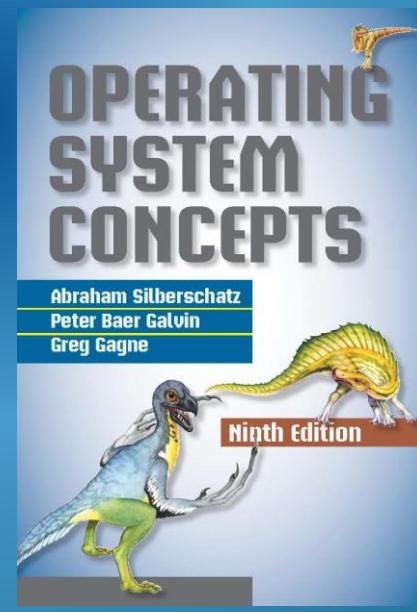
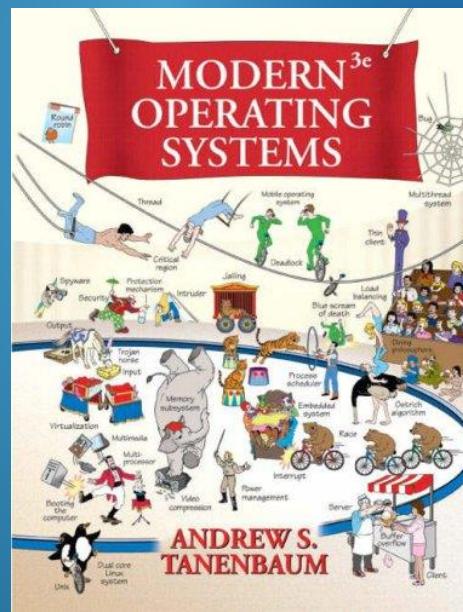
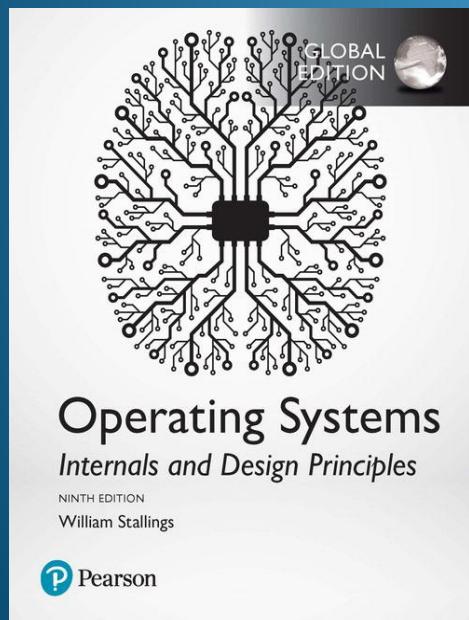
# Operating Systems, Communications and Concurrency



Lecturer: Ting Bi  
[ting.bi@mu.ie](mailto:ting.bi@mu.ie)

# Operating Systems, Communications and Concurrency

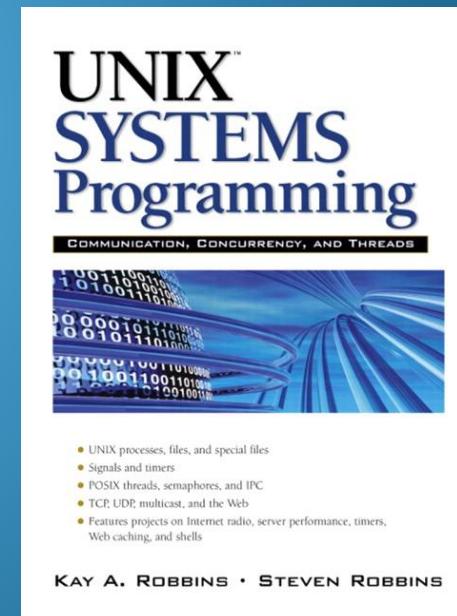
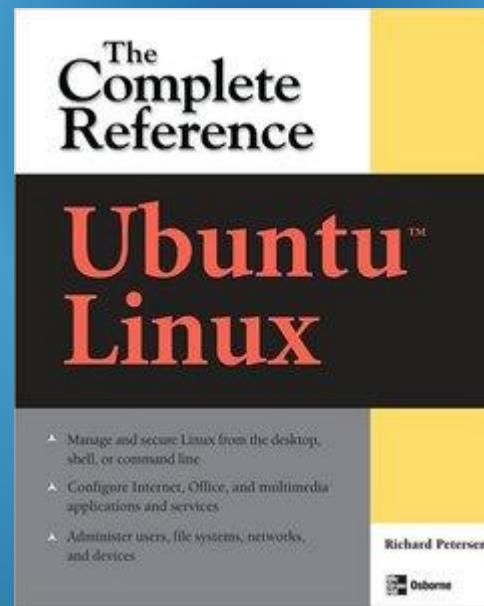
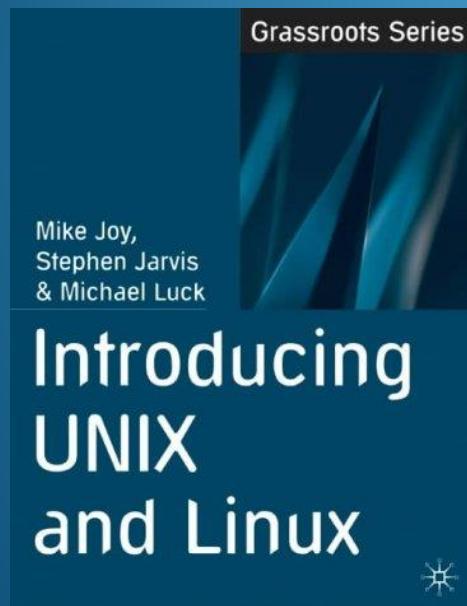
Lecture Notes and Slides will be available on Moodle, see also external links for related material.



Reading for Theoretical Topics

# Operating Systems, Communications and Concurrency

Lecture Notes and Slides will be available on Moodle



Reading for Practicals using Unix

# Operating Systems, Communications and Concurrency

## Assessment

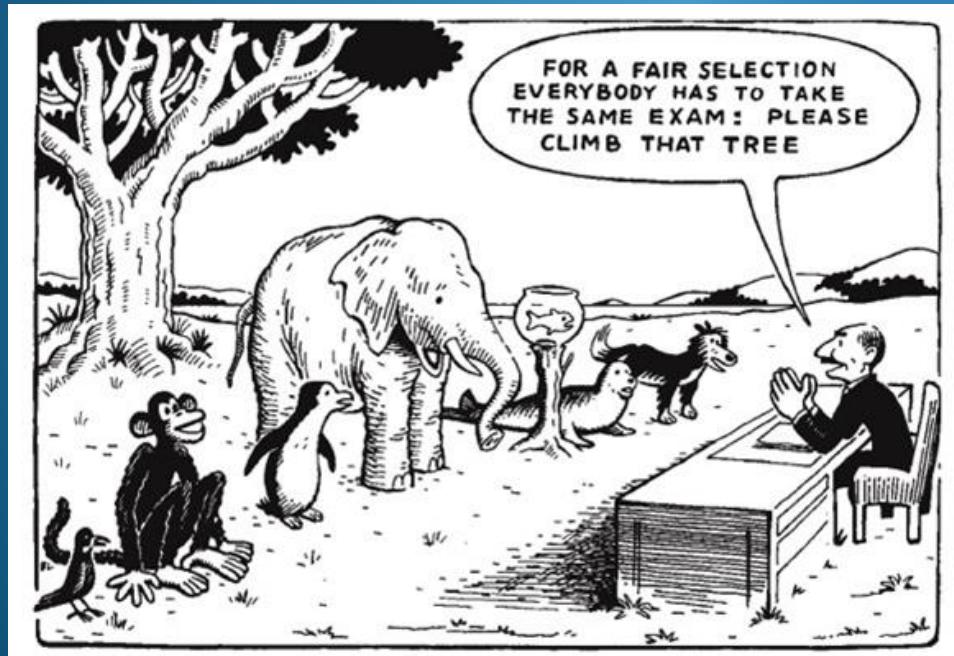
Continuous assessment from practical work will amount to 30% of the total mark for the course with the other 70% from the written exam in June/July.

A 2-hour practical(3 classes) activity will take place each week over the semester in the labs.

# Operating Systems, Communications and Concurrency

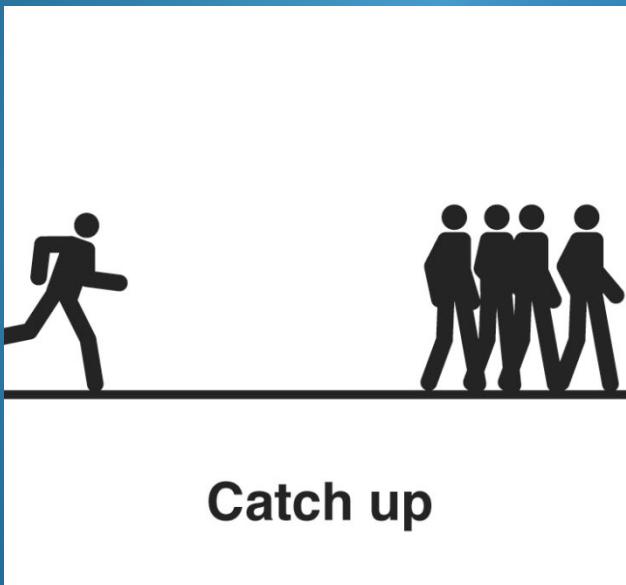
## Assessment

Practicals are scheduled and assessed once only during the academic year and cannot be repeated in the same year.



Therefore it is of the utmost importance that you attend practicals and submit the required work within the designated times.

# Operating Systems, Communications and Concurrency



## Assessment

In the last week of term, there will be a catch-up lab session where you can take any SINGLE practical that you may have missed during the semester.

If you miss more than one lab session you will not be able to receive marks for more than one.

# Operating Systems, Communications and Concurrency

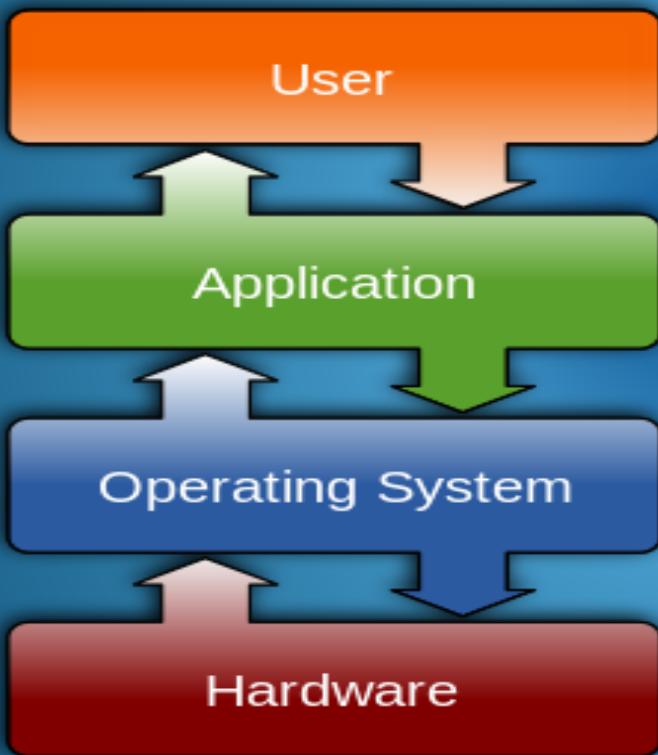


Email: ting.bi@mu.ie

## Finally....

Please don't hesitate to contact me, preferably by email in the first instance, for any reason but particularly if you are experiencing difficulties with any aspects of the course, practical work, materials or schedule and I will endeavour to assist you in any way that I can.

# Operating Systems, Communications and Concurrency



## What Is An Operating System?

An operating system (OS) is a large and complex software system which **manages** all of the hardware resources of a computer and makes it easy to use.

# Operating Systems, Communications and Concurrency

Every configuration is different – need standardised interface.

Boots machine into a useable state.

Provides a layer of abstraction for portable application development.



Provides common services for application software to use processing resources, memory space, disk storage, input/output devices and network communication functions of the underlying hardware.

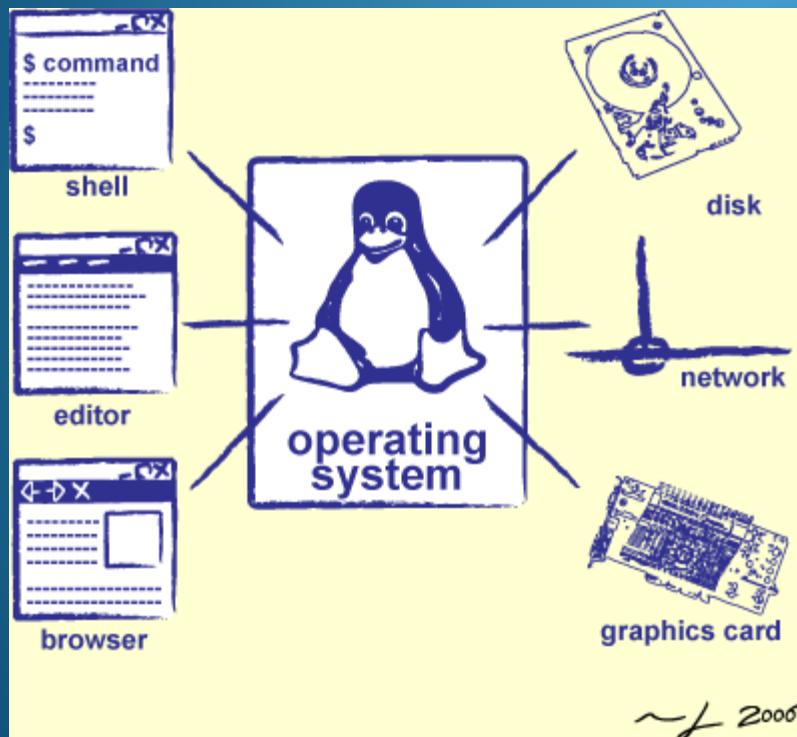
# Operating Systems, Communications and Concurrency

Executable programs are operating system specific

Applications interact with the operating system through a collection of Application Programming Interfaces (APIs) and System Calls, which define a set of commonly required functions (and associated parameters) that the operating system components can perform.

Applications are therefore written for specific operating systems. The operating system is a programming platform. The availability of the operating system APIs lessen the development effort required to get an application running on the hardware.

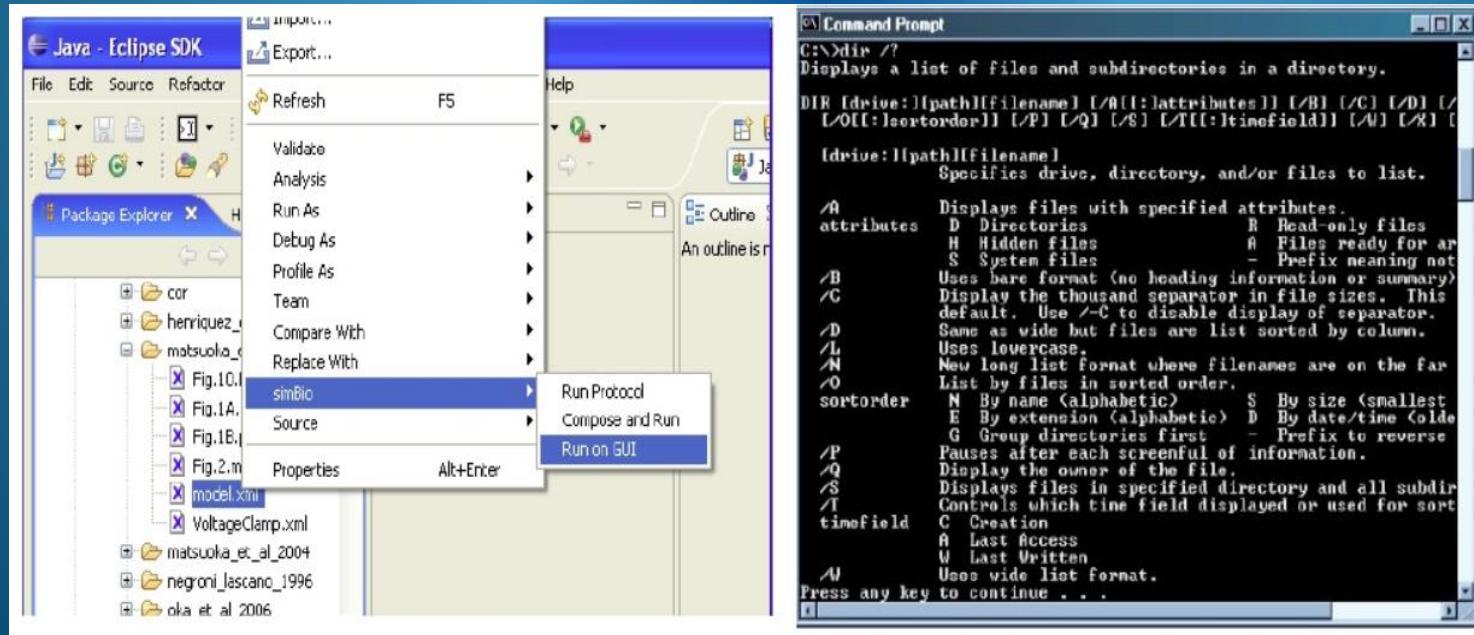
# Operating Systems, Communications and Concurrency



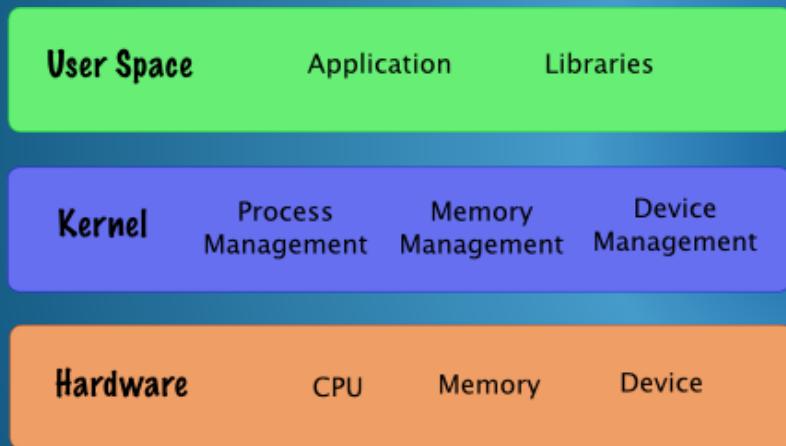
It is a **concurrent environment** where numerous tasks and events must be handled at the same time and the **coordination** of these tasks must provide for the most **efficient** and best use of available resources.

# Operating Systems, Communications and Concurrency

User interaction with the operating system is typically done through a **graphical user interface** or through a text based command-line interface.



# Operating Systems, Communications and Concurrency



## Definition

The **Kernel** of an operating system refers to the **core set of services** associated with managing the CPU, the electrical memory, basic interprocess communication and low level hardware devices. The kernel executes in a privileged mode on the processor where additional instructions and permissions are available.

The Kernel is common to various Operating System Distributions.

# Operating Systems, Communications and Concurrency

An Operating System Distribution will have additional components to the Kernel such as a File System, a Database Engine, Network Communication Suite, Graphics and Media functions, a Web Server, a User Interface GUI, Security and Authentication elements, Device Drivers for various external I/O devices, and Utilities for configuring the system.

The packages chosen for a particular distribution might be tailored for different target environments like desktop machines, servers or mobile devices, home or business use.

# Operating Systems, Communications and Concurrency

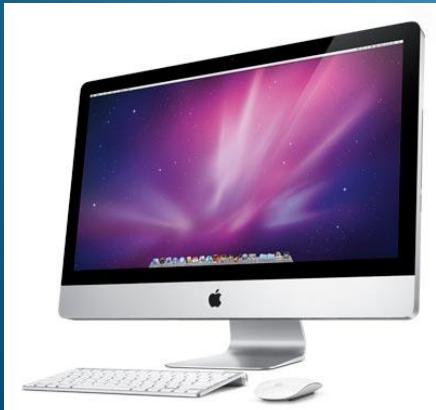


## Example Operating Systems

Desktops/Laptops represent ~ 40% of device types. (Jan 2020)

Most Desktop/Laptop PCs use Microsoft Windows of some kind (88%)

Apple Computers use (Mac) OS (9.4%)



Many Server environments use Unix based operating systems like Linux and Free-BSD. (~ 2%)

Source: <https://netmarketshare.com/>

# Operating Systems, Communications and Concurrency

## Example Operating Systems

Mobile devices and tablets represent over 59% of device types. (Jan 2020)



Mobile devices and other sophisticated devices like Wireless Access Points, set top boxes also run operating systems.

Mobile devices are capable of hosting a broad range of applications.

# Operating Systems, Communications and Concurrency

## Main players for Mobile Devices



Android is an operating system based on Linux designed for touchscreen mobile phones and other devices. Over 2.5 billion devices use Android.

~70% Mobile Market Share (Jan 2020)

Apple's iPhones use the iOS operating system. 29% Mobile Market Share

Microsoft's Windows Phone operating system <0.04% Market Share



# Operating Systems, Communications and Concurrency

## Example Operating Systems

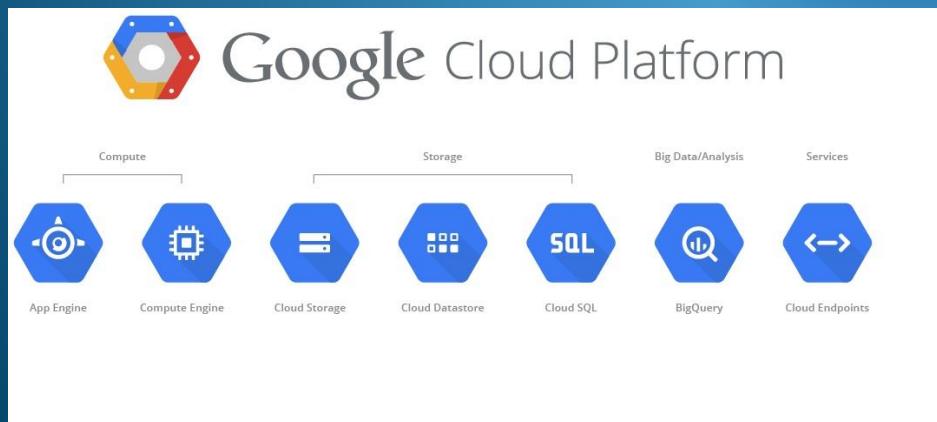
### **Cloud Operating System**

Data and/or applications are hosted remotely at data centres belonging to different companies on the Internet rather than residing within your own computer.

You “rent” the software, storage or computational resources of these systems and access them using Web based browsers as the user interface or using a web based API.

# Operating Systems, Communications and Concurrency

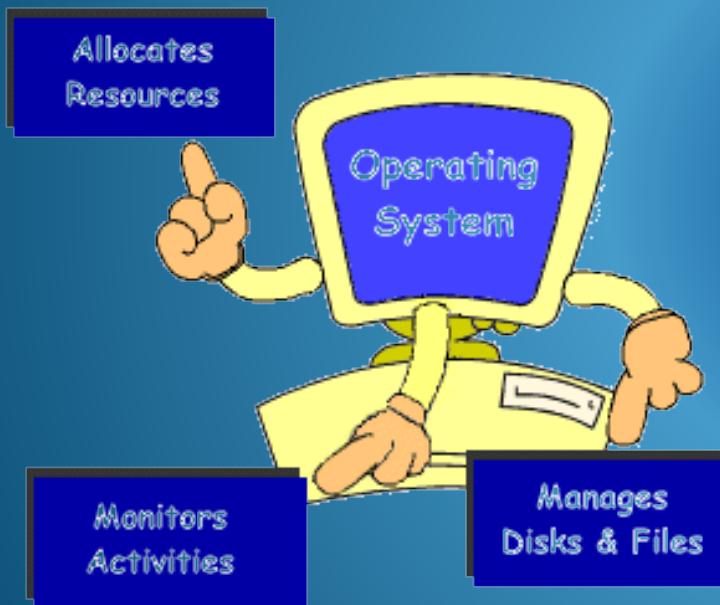
## Example Operating Systems



Cloud computing is seen as a highly reliable, highly available, cost effective, scaleable, **high performance** means of being able to access your data and applications from **anywhere in the world**.

Amazon, Microsoft, Google, Salesforce and Adobe are some of the market leaders in Cloud software, platform and infrastructure services.

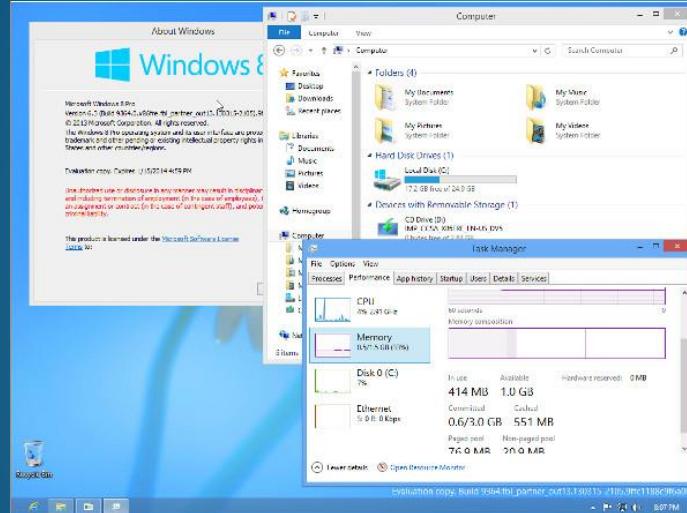
# Operating Systems, Communications and Concurrency



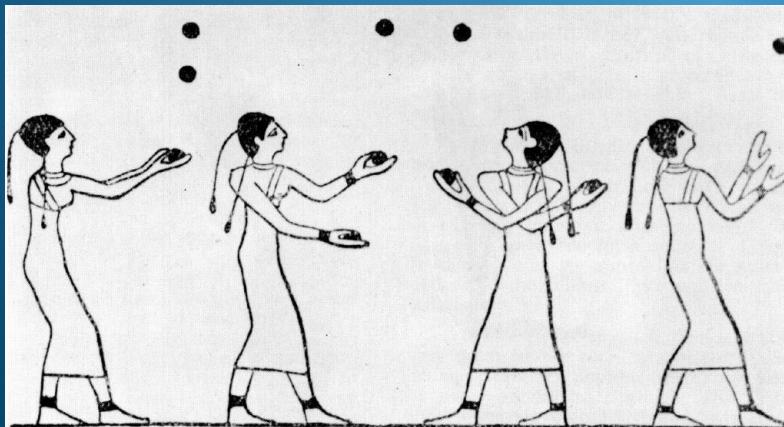
Summary of the tasks an operating system must perform are:-

- (i) Allocation and Management of Resources among competing user processes.
- (ii) Maximising Resource Utilisation with the goal of improving overall system throughput.

# Operating Systems, Communications and Concurrency

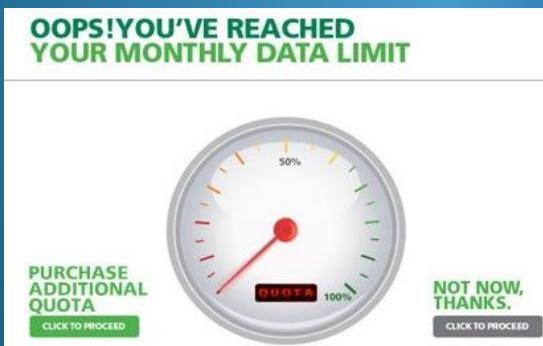


(iii) Providing a user interface and an application interface to the machine.



(iv) Coordinating the many concurrent activities and devices, handling input and output from attached hardware and ensuring correct synchronisation and communication is achieved.

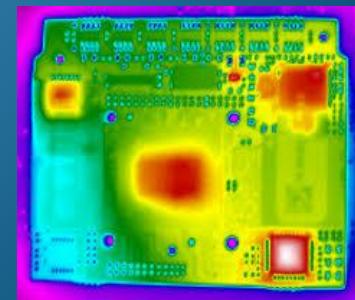
# Operating Systems, Communications and Concurrency



(v) Acting as a Resource Guardian to protect various resources of the computer system from malicious or accidental misuse.

(vi) Accounting for periods of resource usage by user processes, enforcing quotas or restrictions as appropriate.

(vii) Power and Thermal Management.



# Operating Systems, Communications and Concurrency

## Course Overview

### **Process Management**

*Processes and Threads*

*Scheduling Theory & Process Scheduling Algorithms*

*Process Synchronisation*

*Classical Coordination Problems*

*Deadlocks*

### **Interprocess Communication**

*Message Passing, Stream Communication,  
Remote Procedure Call*

# Operating Systems, Communications and Concurrency

## Course Overview

### **Memory Management and Virtual Memory**

*Space allocation, paged architectures, demand paging and replacement*

### **File Systems**

*Disk operation, space allocation, hierarchical directory structures*

# Operating Systems, Communications and Concurrency

## Operating Systems Course Overview

### Protection & Security

*Specifying and implementing authentication, authorisation and enforcement*

*Maintaining the integrity of information in the system*