

# ET0023 Operating Systems

## 1: Introduction

## About Your Lecturer

- Name:
- Office:
- Tel : :
- Email:

## ET0023 OS Overview

- OS Overview
- Computer Organization
- Processes and Threads
- Inter-process Communication (IPC)
- Memory management
- File storage and systems
- Device management

## ET0023 Practical

- Introduction to Linux
- Process control and management
- Memory management and monitoring
- File systems and storage
- Device I/O and management
- System services

## Assessment

Topic	Percentage	Method
General Performance	10%	Assignment/Participation
Lab Test	15%	Linux usage
PBIL Project	15%	System Services & monitoring
Mid-Semester Test	20%	Online
Semestral Exam	40%	Written Paper

## Why study OS?

- Manage resources and coordination
- Simplify programming
- Enforce policies e.g. memory, power
- Security and protection
- Portability
- Efficiency

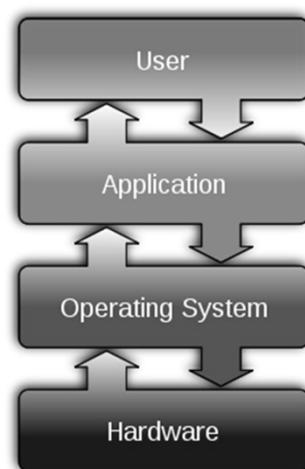
## What is an OS?

- An operating system (OS) is a set of programs that manages computer hardware resources, and provides common services for application software.
- The operating system is the most important type of system software in a computer system. Without an operating system, a user cannot run an application program on their computer, unless the application program is self booting.

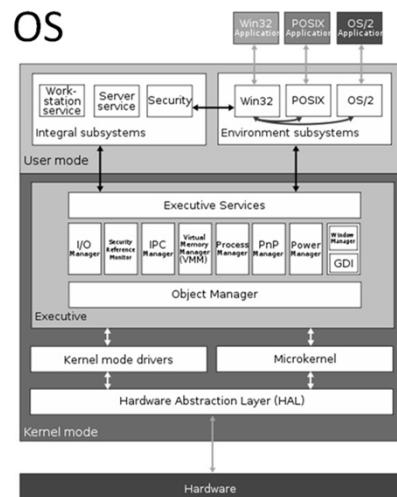
[http://en.wikipedia.org/wiki/Operating\\_system](http://en.wikipedia.org/wiki/Operating_system)

## What is an OS?

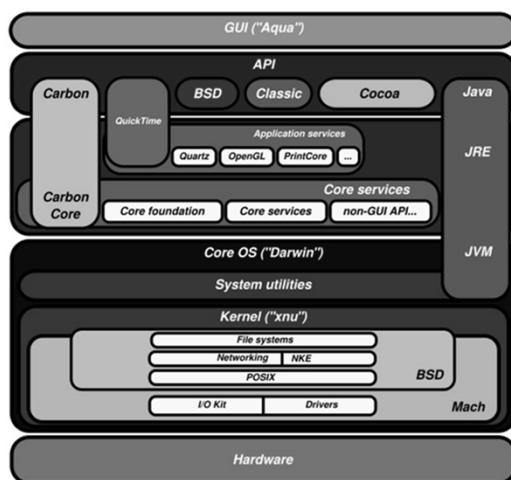
- OS is a Software System  
(Systems Software)
  - Many components
  - Complex interaction between component
  - Multiple goals and conflicting purposes
  - Messy, complicated
  - Dependent on hardware



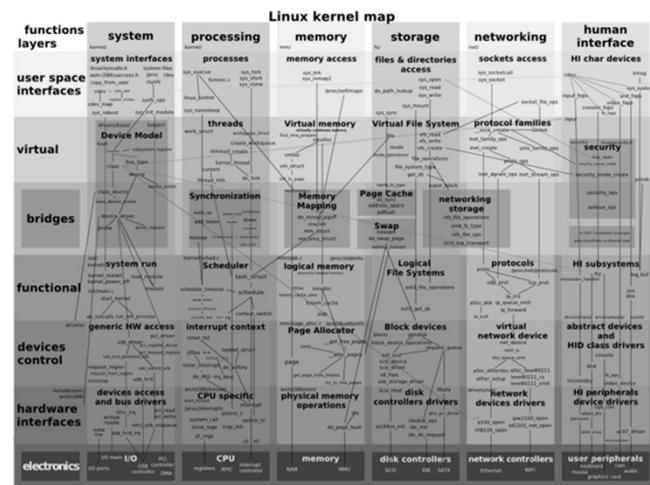
## Windows OS



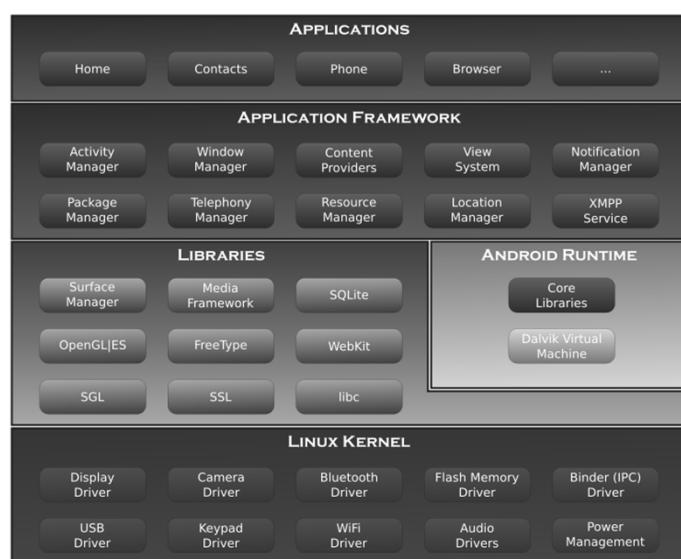
## Mac OSX

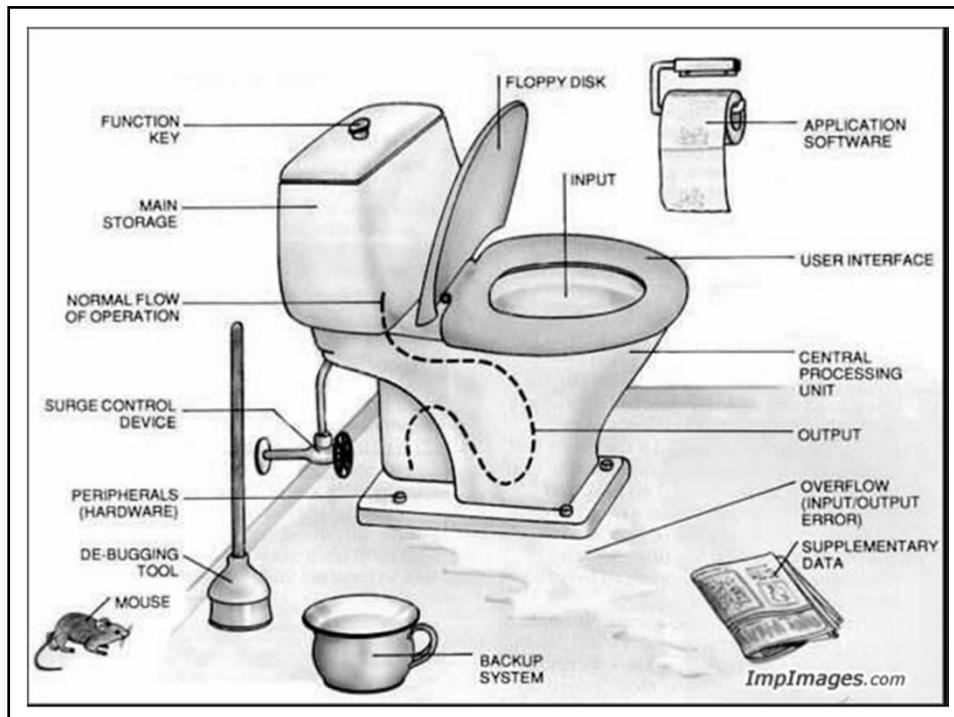


## Linux OS



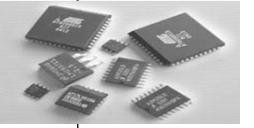
## Android's architecture diagram

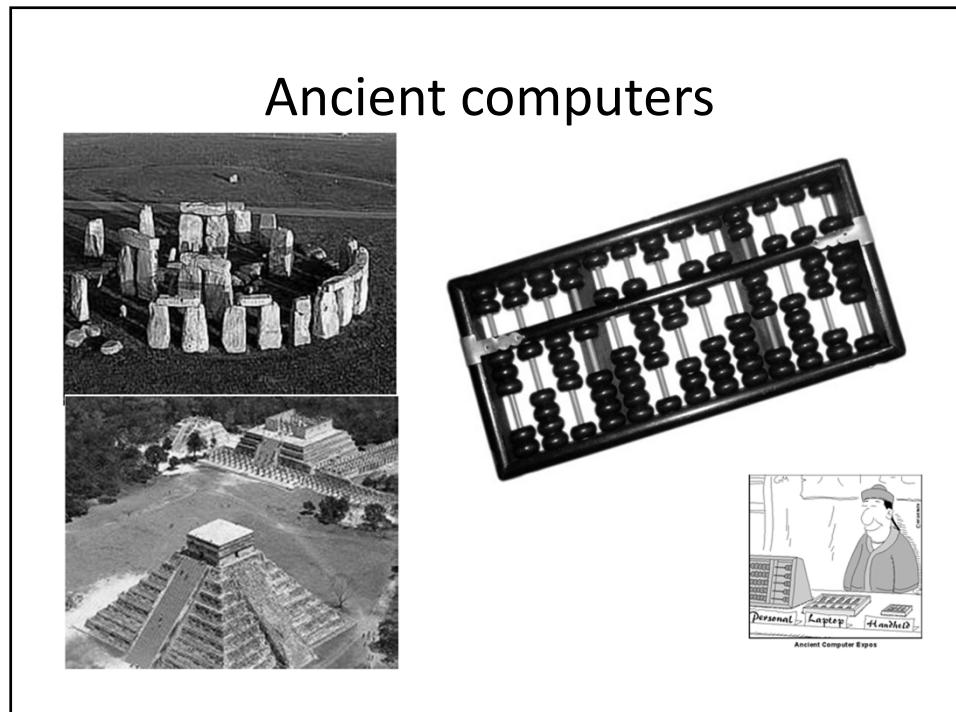




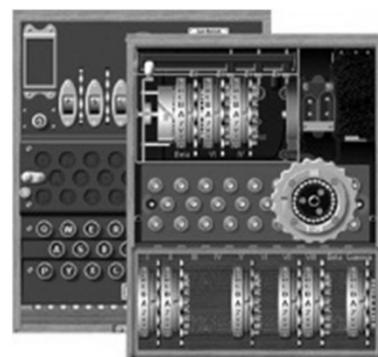
## A Brief History

- We need to look at the history of computers to understand the evolution of OS
  - Why OS? What OS? Which OS?
  - Shows the development of Computer Systems with Operating Systems
  - Compare different types of OS
  - Matching technology trends

	1st Generation	2nd Generation	3rd Generation	4th Generation
Period	1940-1956	1956-1963	1964-1980	1981 – present
Build Tech	Vacuum Tubes 	Transistors 	Integrated Circuits 	VLSI
Construction	Large buildings ENIAC 1	Mainframes	Minicomputers	Personal Computers & Workstations
OS Type	Embedded, Single purpose	Batch processing systems	Multi-user, multi-tasking	Multi-user, Multi-tasking



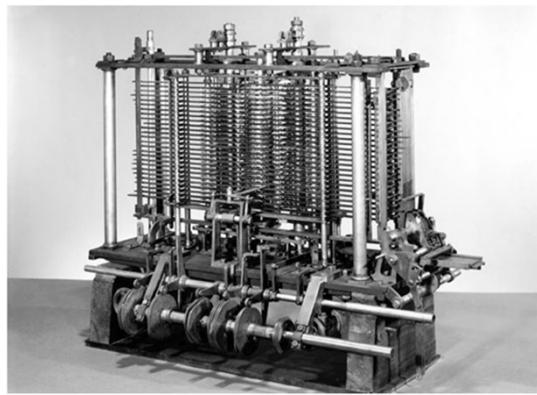
## Analog Computers



[www.youtube.com/watch?v=HwNGF6te\\_6A](https://www.youtube.com/watch?v=HwNGF6te_6A)

## First "True" Computer

- Babbage Analytical Engine
- The Analytical Engine incorporated an arithmetical unit, control flow in the form of conditional branching and loops, and integrated memory,
- Making it the first Turing-complete design for a general-purpose computer



[https://en.wikipedia.org/wiki/Analytical\\_Engine](https://en.wikipedia.org/wiki/Analytical_Engine)

## Harvard Mark 1

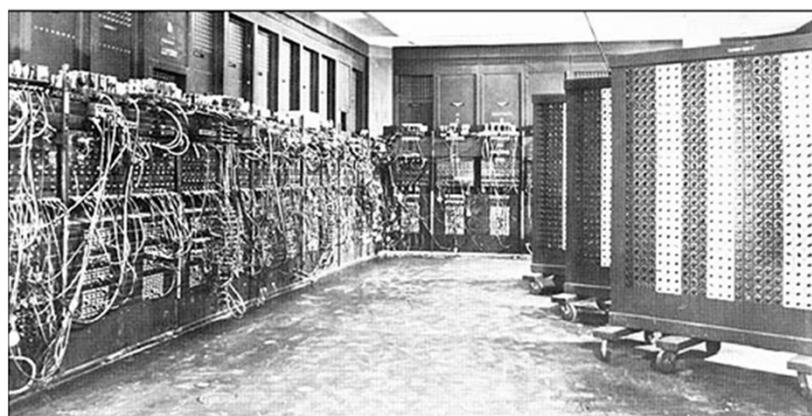


Grace Hopper  
One of the first  
programmers .  
Conceived  
"debugging"

1944

The IBM Automatic Sequence Controlled Calculator (ASCC), called the Mark I by Harvard University, was an electromechanical computer.

## Eniac



Among the first assignments given to Eniac, first all-electronics digital computer, was a knotty problem in nuclear physics. It produced the answer in two hours. One hundred engineers using conventional methods would have needed a year to solve the problem

First general purpose computer (1946)

- US \$0.5 Million
- 0.005mips

<http://en.wikipedia.org/wiki/ENIAC>

## Mainframe Systems



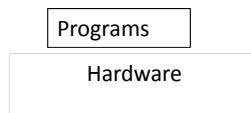
[http://www-03.ibm.com/ibm/history/exhibits/mainframe/mainframe\\_PP2050.html](http://www-03.ibm.com/ibm/history/exhibits/mainframe/mainframe_PP2050.html)

- IBM 360 General Purpose commercial computer
- Common architecture, instructions, OS
- Most expensive computer US\$5M (1964)
- Can be used for business, military, scientific

## Checkpoint Questions

- Q1. Which of the following is not true?
  - a) A computer is a mechanical or electronic device.
  - b) A computer can efficiently store, retrieve and manipulate large amount of information.
  - c) A computer must be able to communicate over the Internet.
  - d) A computer must work at high speed with great accuracy.
- Q2. What technological inventions led to the creation of the world's first personal computer?

## What OS? No OS!



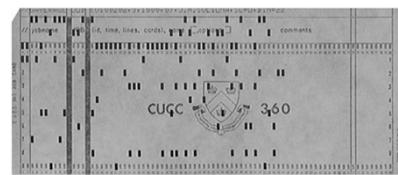
- Programs ran directly on hardware
  - One computer – One job
  - Every program has to deal with hardware, memory, devices
  - Re-programming was done physically
    - Rewiring, new electrical connections
    - Change in the design
- [The History Of Operating Systems](#)

## Batch Systems



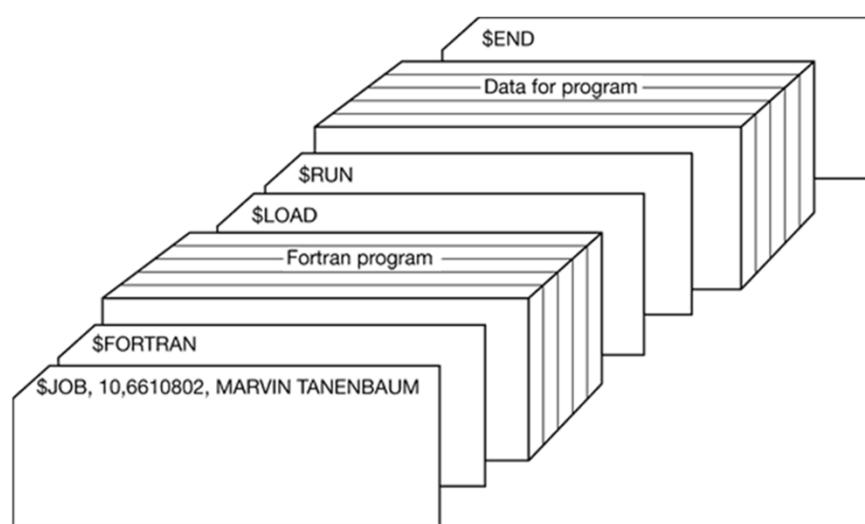
- OS runs 1 job at a time
- Programs are input serially (from punched cards/tape)
- OS handles
  - Input of information
  - Specifications of job, resources needed
  - Scheduling of process/job
  - Output

## Punched Cards



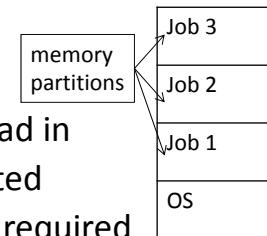
- Each card holds a single command.
- Groups of cards form a program
- The secret is in the "holes"

## Structure of a Job



## Multi-programmed Batch OS

- Batch processing is inefficient
  - One job at a time
  - CPU idle when jobs are being read in
  - CPU idle when output is generated
  - Each job "knows" the resources required
- Multiprogramming loads multiple jobs and runs other jobs when I/O is needed
- Runs multiple jobs, each in its own environment

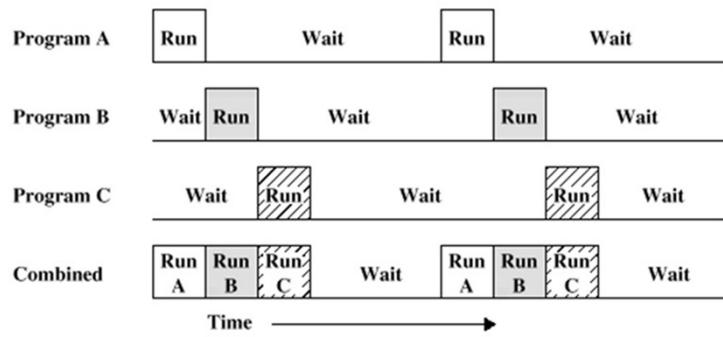


## Magnetic Storage

- Punch cards and tape were slow
- Magnetic components e.g. tape, floppies and hard disk drives improved I/O



## Timesharing



- Allows multiple users to interact with the machine using terminals
- Each user "time-slices" a slot of the CPU's attention.
- Requires scheduling of user jobs, management of memory, Illusion of concurrency

## Minicomputers

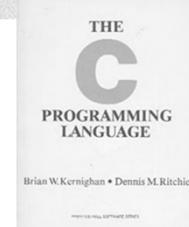


Digital Equipment Corp (PDP-8)

- Cheaper than mainframes
- Smaller in size
- Efficient and fast, they were the work horses of the 70s-80s



## C & Unix



- Developed on DEC/PDP minicomputers
- C programming language (K & R)
- Unix OS

## The Personal Computer



**The First Microcomputer  
Altair 8800**

- First publicly available computer (sold as a kit)
- Used toggle switches and LEDs
- Did nothing, but changed sounds on a radio
- Later ran Basic interpreter by Bill Gates & Paul Allen
- Innovations:
  - 8080 Microprocessor
  - S-100 Bus

## Apple



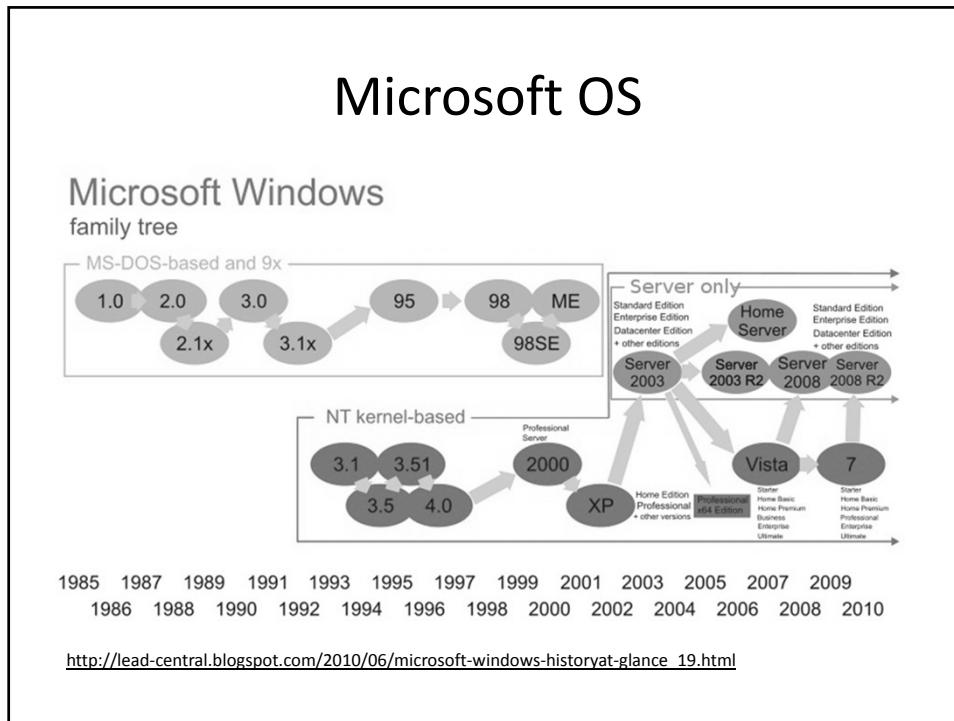
- Apple I, II designed by Steve Wozniak
- First successfully produced mass computer
- Apple founded by Jobs and Wozniak
- General purpose DOS

## IBM PC



- First generic PC
  - Common components
  - Multiple OS
  - Multiple peripherals
- Backed by the "Giant"
- Debut of the Personal Computer and Workstations

[http://www-03.ibm.com/ibm/history/exhibits/pc25/pc25\\_PH01.html](http://www-03.ibm.com/ibm/history/exhibits/pc25/pc25_PH01.html)



## Windows Development Complexity

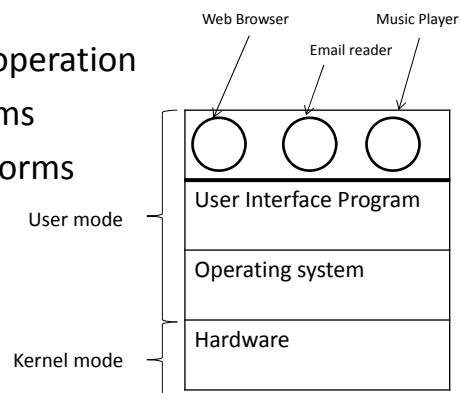
- Single user command line MS-DOS
- Single user GUI systems MS Windows 1
- Multiprogram OS MS Windows 3
- Multiprogram, multi user MS Windows NT

MS Windows 2000 (shipped 1999)

- Development Team Size: 1400
- 180 Source Projects
- Full Source Base about 50Gb of disk space
- Complete build time: 8 hours on PIII Xeon 550, 50Gb HD, 512K Ram
- Stress test on ~1000 Systems

## Modern Operating Systems

- Multitasking concurrent execution of programs
- Single/Multiprocessor operation
- Single/Multi user systems
- Runs on variety of platforms



## Linux Operating System

- The kernel is the nerve centre at the heart of Linux OS
- The kernel is the software interface to the computer's hardware.
- It communicates with the CPU, memory and other devices on behalf of any software running on the computer.
- It is the lowest level component of software stack.

## Not inside notes

### Linux Operating System

- The Linux kernel is a monolithic kernel where all the main OS services run in the kernel
  - In a microkernel, most of the services is done by external processes, with the kernel doing little more than coordinating.
- The Linux kernel is modular, the **core functions are in the kernel file (/boot/vmlinuz-version)**
- The optional drivers are built as required in separate modules in /lib/modules (as .ko file).
- Kernel space is memory that can only be accessed by the kernel, no user programs can write to the Kernel space .
- User space can be access by any program with the appropriate privileges.

## Real Time OS (RTOS)

- Some systems have time constraints, periodicity, deadlines, response rates
- Critical systems e.g. Aircraft flight systems, nuclear power plants, radar systems
- Consumer Appliance e.g. mobile phones, video players

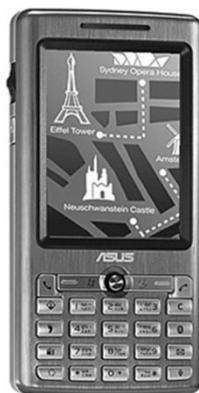
## Embedded OS

- Specialised devices and applications
- Potential restrictions
  - Power requirements
  - Physical size
  - Specific purpose
  - Real time requirements
  - Memory limitations

## OS Thin Line



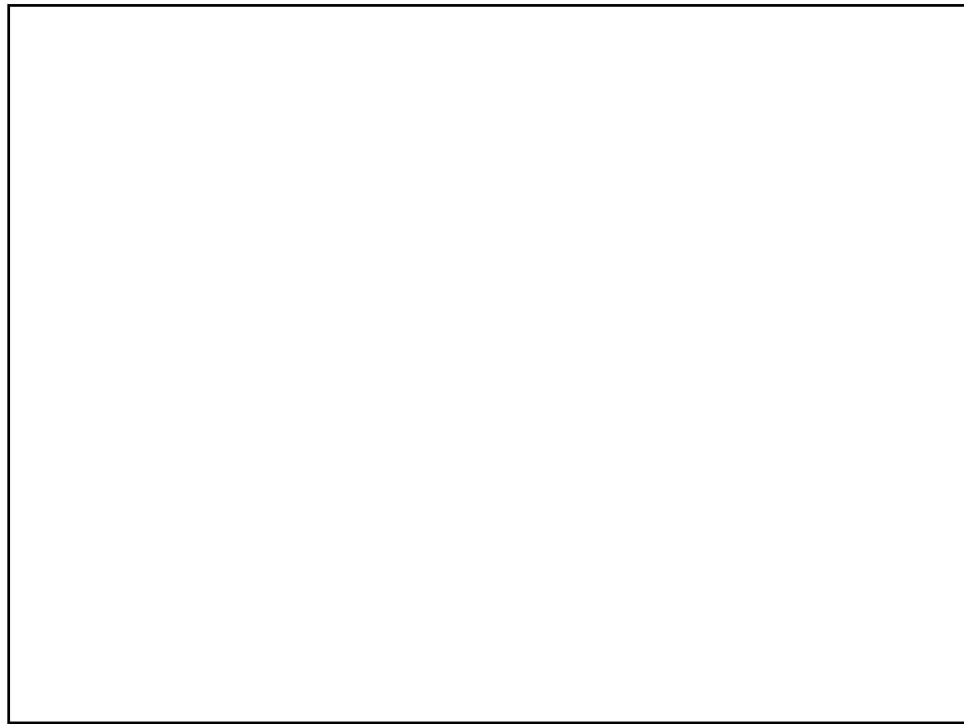
MP3  
Embedded OS



Smart Phone  
RTOS



iPhone  
General Purpose OS



QUESTIONS?

