So far we have briefly discussed

1. OS definition
2. OS evolution
3. The computer structure managed by OS
4. OS services

OS Structure

OS Structure

1. Simple structure
2. Layered structure
3. Combination of 1 and 2
4. Virtual machines

OS Structure: Simple Structure

Simple Structure

Lack of a well defined structure

Examples:

Original MS-DOS and UNIX

OS Structure: Simple Structure

Original UNIX Structure:

Kernel was one large program that included

a- Interfaces

- kernel interface to the kernel
  (Terminal Controllers, Device Controllers, and Memory Controllers, . . .)
- system calls interface to the kernel
  (Signal handling, File system, CPU scheduling, page replacement, page demand, . . .)

b- Device drivers

OS Structure: Layered structure

Layered Structure

Kernel is made of N layers.

Functions in Layer N → Founded on → Functions in Layer N-1

Examples

Windows NT (1st version)

THE

OS Structure: Layered structure

Layered Structure

Advantages

- **Modularity**
- **Error Containment**
- **Easy to Debug**
- **Easy to Expand**

OS Structure: Layered structure

Layered Structure

Disadvantages

- **Definition of a layer in terms of functionality.**
- **Less Efficient**

OS Structure: Layered structure

Combination of 1 and 2

Example:

OS/2

Windows NT 4.0

OS Structure: Virtual machines

Virtual machine

is a software that provides illusion that each user has his/her own virtual: CPU, Memory, and disk.

Example: CMS

(A single-user interactive OS with its own virtual user mode, virtual privileged mode)

OS Structure: Virtual machines

Virtual machine

Advantages

- **Protection**
- **A Research Vehicle for OS**

OS Structure: Virtual machines

Virtual machine

Disadvantages

- **Lack of Sharing**
  - **Solution**
    - **Use of mini-disk**
    - **A network of VMs**

OS Structure: Virtual machines

Virtual machines are coming back for:

Solving System Compatibility Problem.

Examples

Running programs on a platform that initially not designed for.

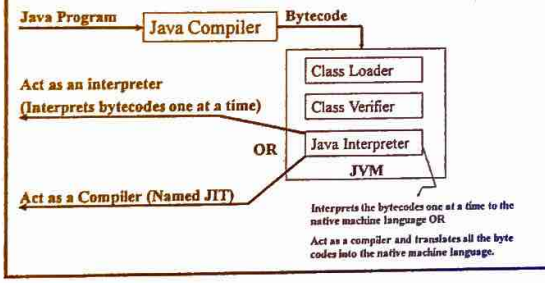
Java Virtual Machine (JVM)

OS Structure: Virtual machines

JVM includes:

- Class Loader
- Class Verifier
- Interpreter

OS Structure: Virtual machines



OS Design and Implementation

Design goals are influenced by :

1. Type of Hardware
2. Type of Desired OS
3. User Goals
   - Easy to use, easy to learn, safe, reliable, and fast
4. Crew Team goals
   - Easy to design, easy to implement, easy to maintain, Should be flexible, Should be reliable, Should be error-free, Should be efficient.

OS Design and Implementation

Notes:

1. Differentiate between *Mechanism (how to build a feature)* and *Policy (how to use the feature).*
2. Select a language for writing the OS
   - Assembly Language
   - High level languages