Chapter 1
Types and Structure of Operations Systems

-- By R.G.B

FUNCTIONS OF OPERATING SYSTEM

- Process management
- I/O device management
- Memory management
- File management

OPERATING SYSTEM STRUCTRE

Follows → *Principle of Concerns*

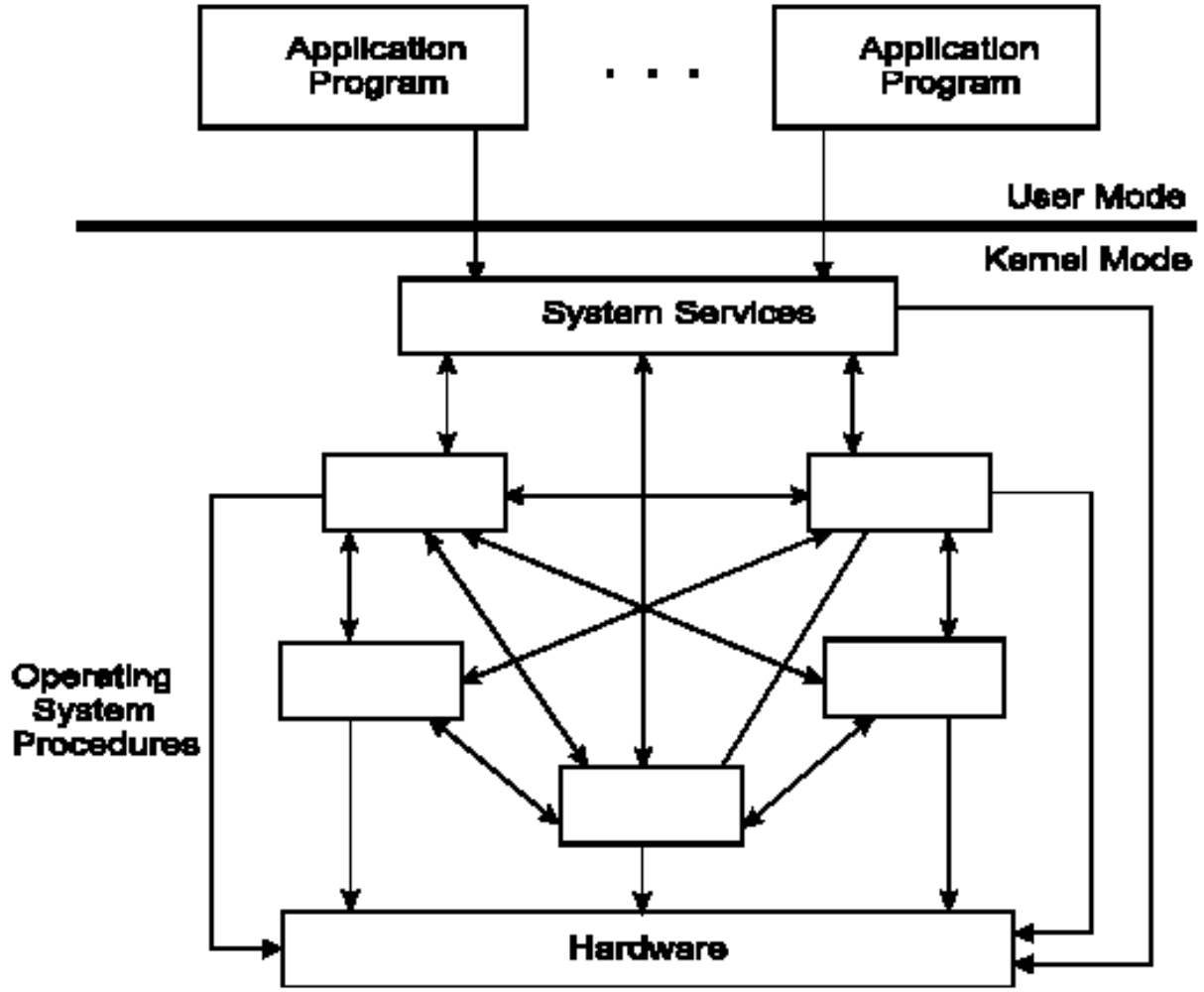
This principle suggests *structuring the operating system into relatively independent parts that provide simple individual features, thus keeping the complexity of the design manageable.*

1. Monolithic systems
2. Layered systems
3. Virtual machines
4. Client-server systems

MONOLITHIC SYSTEM

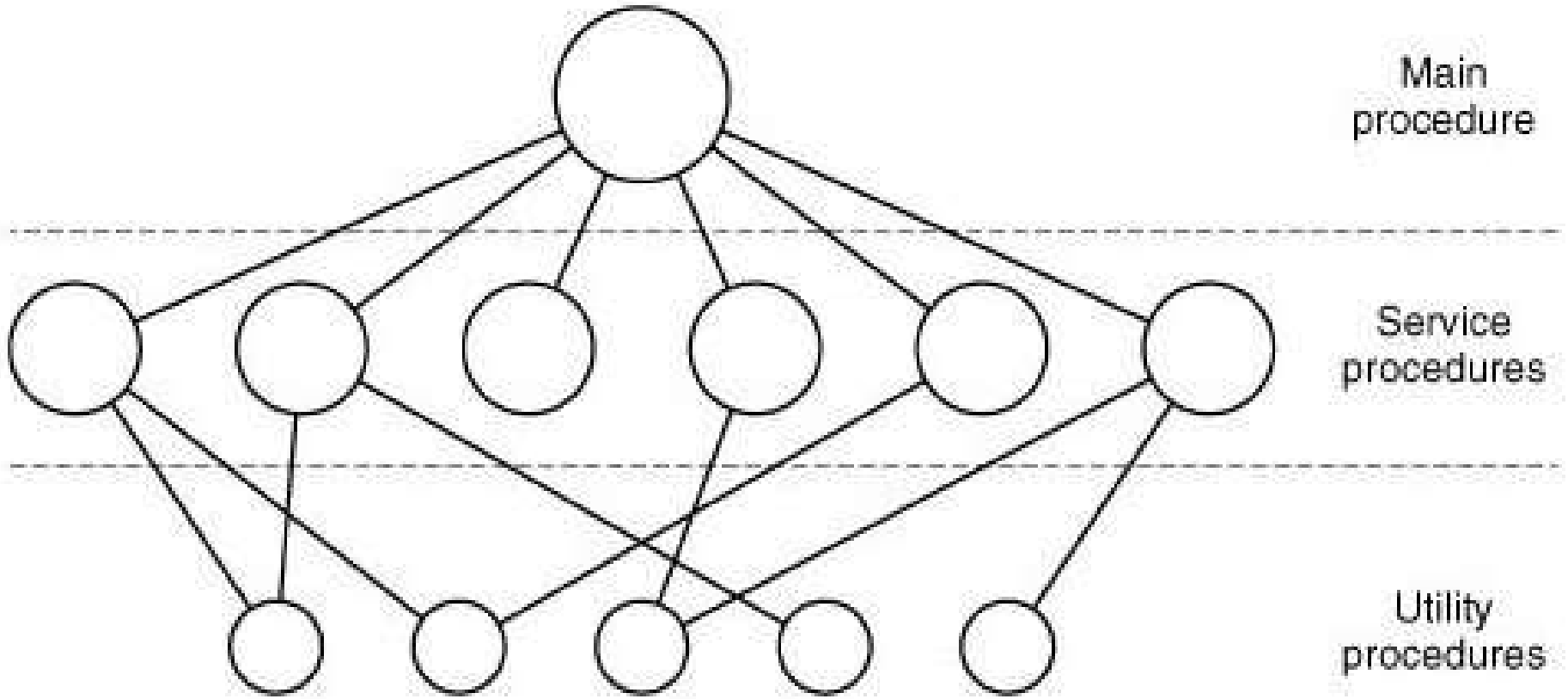
- Often called as **"The Big Mess."** (Like use and throw pen)
- The operating system is written as a collection of procedures
- Any procedure can call any of the other ones whenever it needs to(No reservation)
- **Privileged processor mode**(Kernel mode) - operating system
  - access to system data and hardware
- **Non privileged processor mode** (user mode) – Application program
  - limited set of interfaces available and with limited access to system data
- Example Systems: **CP/M and MS-DOS**

MONOLITHIC SYSTEM…



MONOLITHIC SYSTEM…

A simple structuring model for a monolithic system



MONOLITHIC SYSTEM…

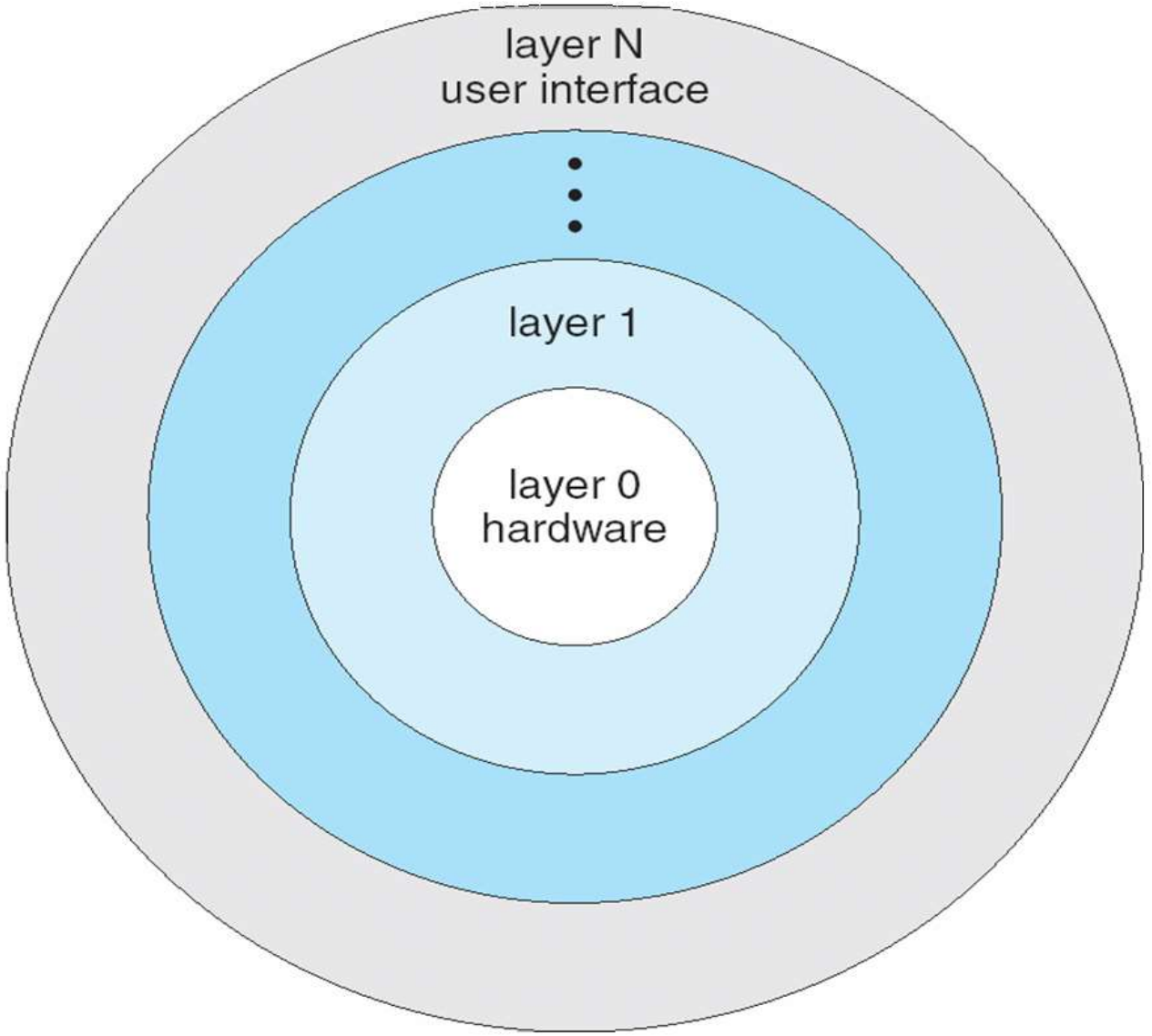
This organization suggests a basic structure for the operating system:

1. A main program that invokes the requested service procedure.
2. A set of service procedures that carry out the system calls.
3. A set of utility procedures that help the service procedures.

LAYERED SYSTEM

Last Layer - User Interface

First Layer - Hardware



LAYERED SYSTEM

- Breaking the operating system into the number of layers(level)
- Each built on the top of lower layers

Layer	Function
5	The operator
4	User programs
3	Input/output management
2	Operator-process communication
1	Memory and drum management
0	Processor allocation and multiprogramming

LAYERED SYSTEM…

LAYER 0

- Allocation of the processor
- Switching between processes when interrupts occurred or timers expired

LAYER 1

- It allocated space for processes in main memory and on a
- 512K word drum used for holding parts of processes (pages) for which there was no room in main
- memory

LAYERED SYSTEM…

LAYER 2

- Handles the communication between each process and the operator console

LAYER 3

- Manages the I/O devices and buffering the information streams to and from them

LAYER 4

- Layer 4 was where the user programs were found. They did not have to worry about process, memory, console, or I/O management

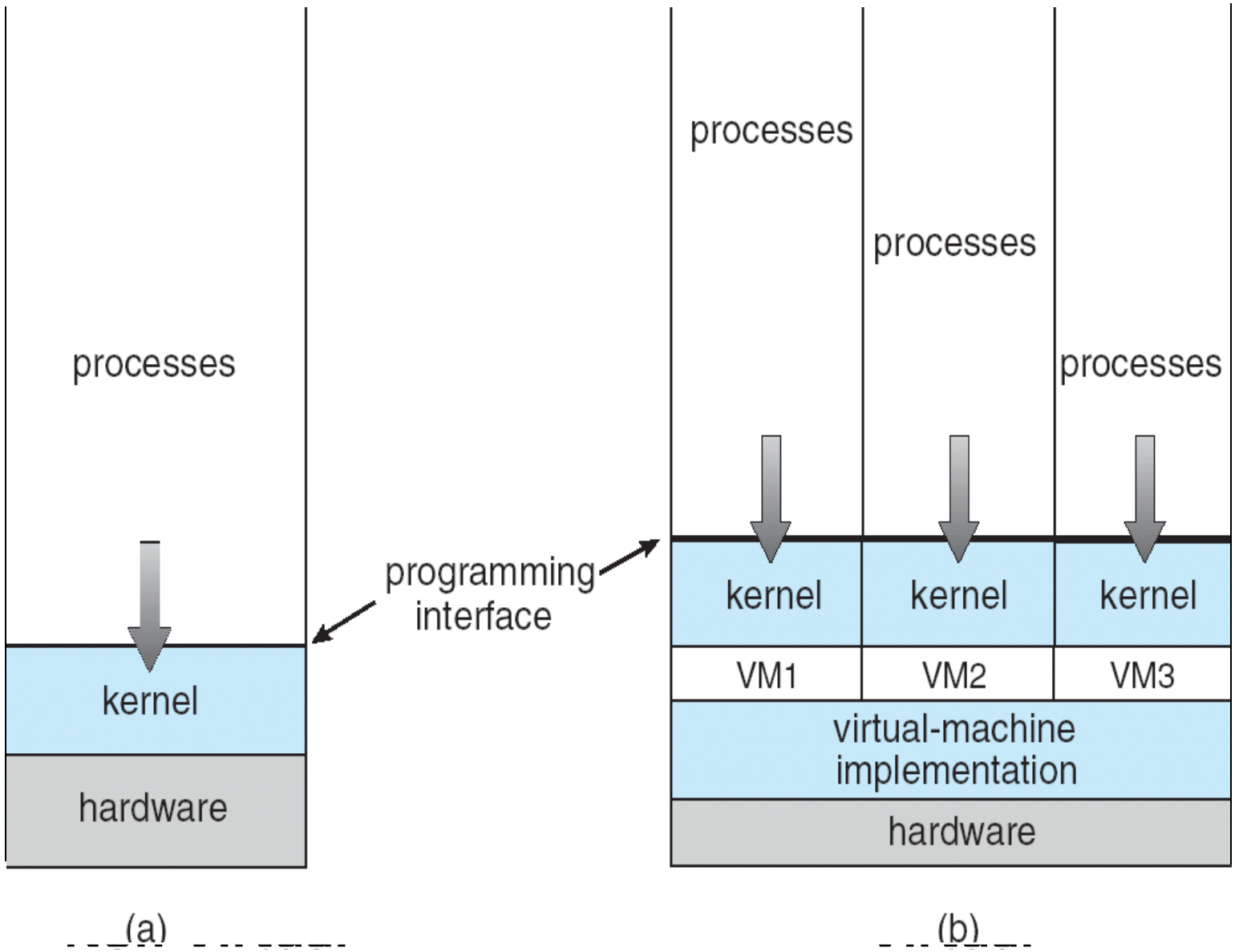
LAYER 5

- The system operator process was located in layer 5

VIRTUAL MACHINES

- Virtual machine approach provides an **interface** that is identical to the **underlying hardware**
- The resources of the physical computer are **shared**(Hardware shared)
- **CPU scheduling** is used to share CPU
- Its very difficult to implement

VM


processes
kernel
hardware
programming interface
processes
processes
processes
kernel
kernel
kernel
VM1
VM2
VM3
virtual-machine implementation
hardware
(a)
(b)

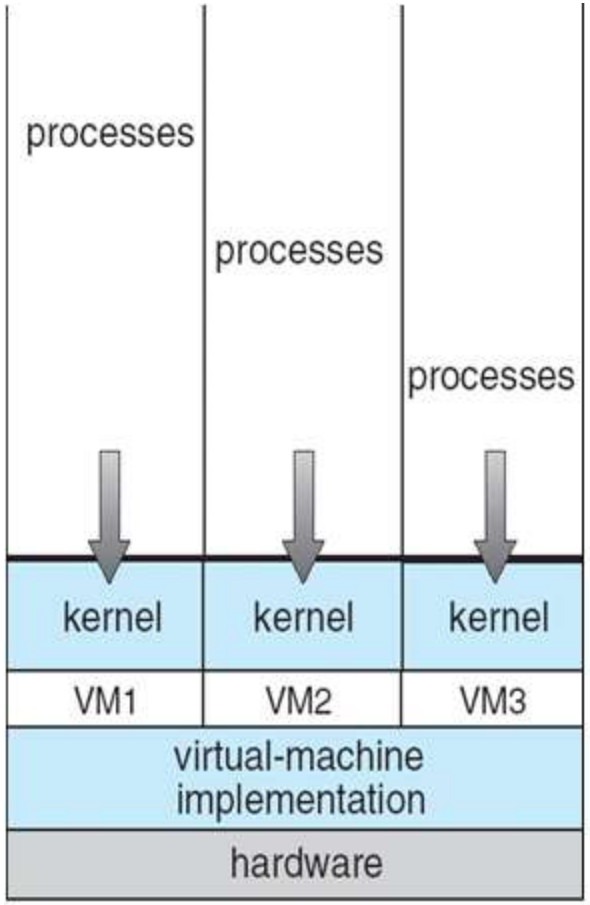
Virtual Machine On Host OS

- Different architectures are as Follows

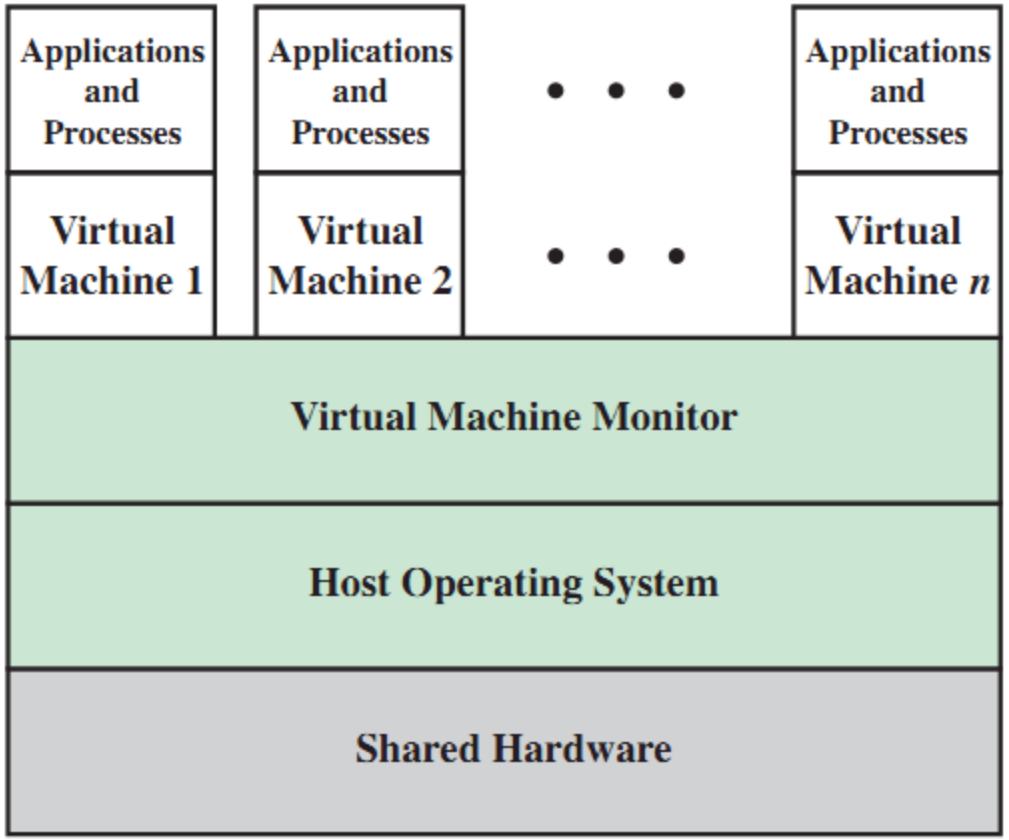
1. On Bare Machine-VM Directly implemented above hardware
2. Above a Host OS- VM Directly implemented above another OS (OS is directly above hardware)

- Combination of above is also possible

Virtual Machine On Host OS

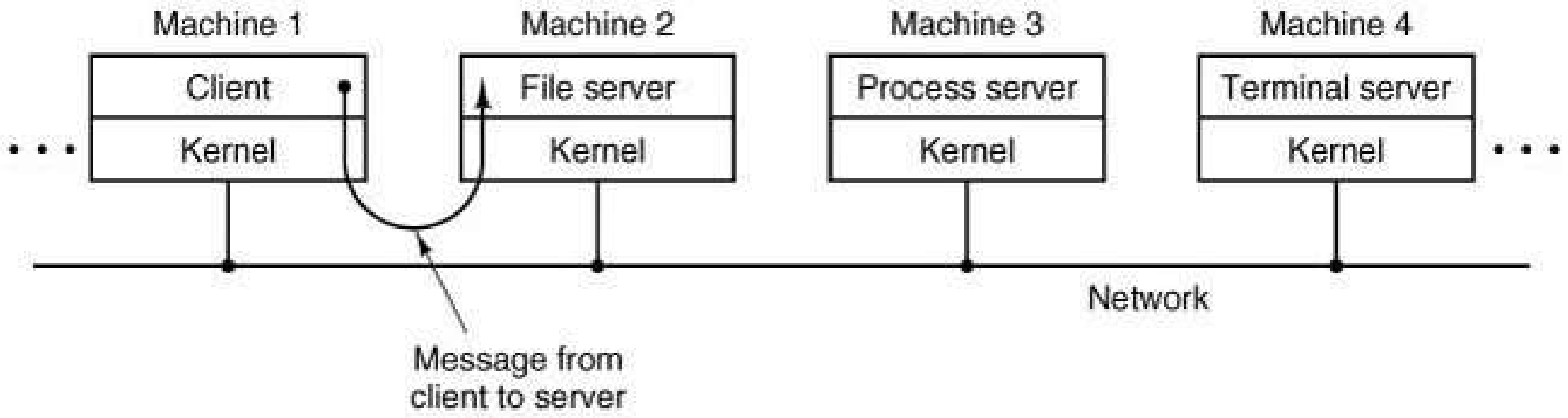


Virtual Machine On Host OS



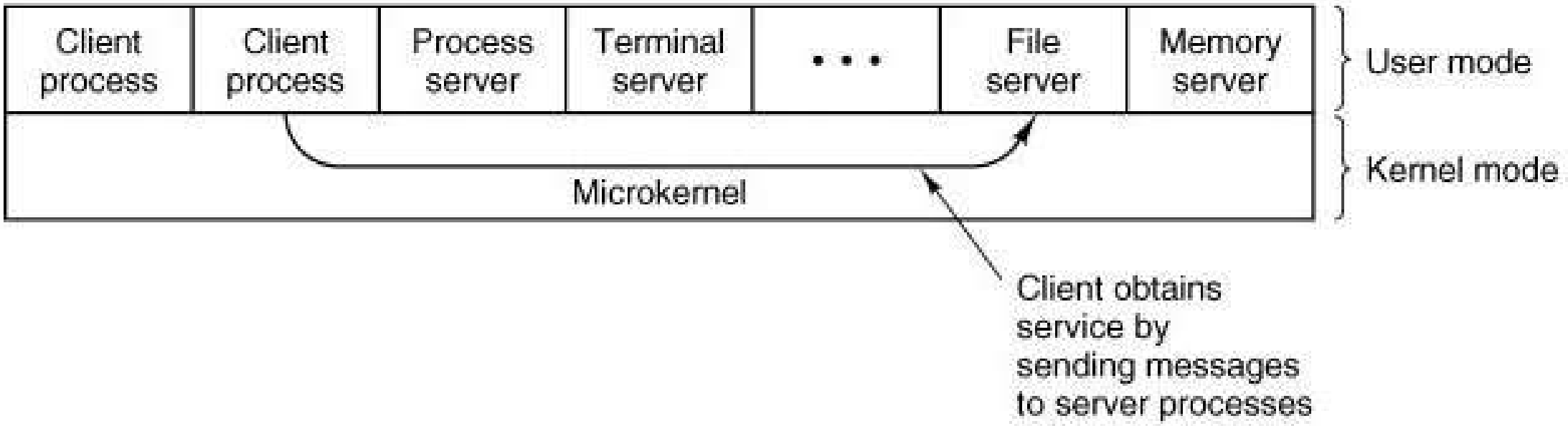
CLIENT SERVER/MICROKERNEL

- Each server runs in user mode, provides services to the requested client
- The client, which can be either another operating system component or application program, requests a service by sending a message to the server



CLIENT SERVER/MICROKERNEL…

- An OS kernel (or microkernel) running in kernel mode delivers the message to the appropriate server; the server performs the operation; and microkernel delivers the results to the client in another message



EVOLUTION OF OPERATING SYSTEM

1. Serial processing
2. Batch processing
3. Multiprogramming
4. Multitasking or time sharing System
5. Network Operating system
6. Distributed Operating system
7. Multiprocessor Operating System
8. Real Time Operating System

SERIAL PROCESSING

- programmer interacted directly with the computer hardware.
- They don't have OS.
- Every computer system is programmed in its machine language.
- Uses Punch Card, paper tapes and language translator

These system presented two major problems.

1. Scheduling
2. Set up time

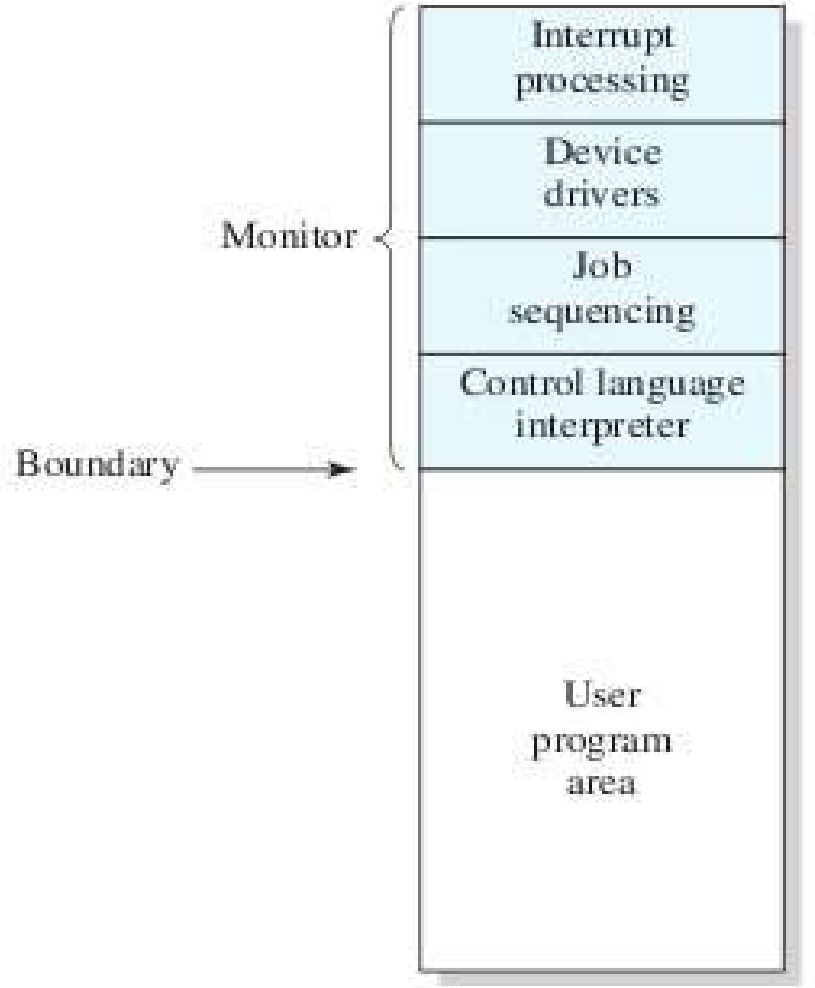
BATCH PROCESSING

- To improve utilization, the concept of a batch operating system was developed.
- Batch is defined as a group of jobs with similar needs.
- Jobs as single process
- Computer executes each batch sequentially

BATCH PROCESSING…

- **Monitor** – software
- No direct access to processor--**User**
- **Go back** to monitor

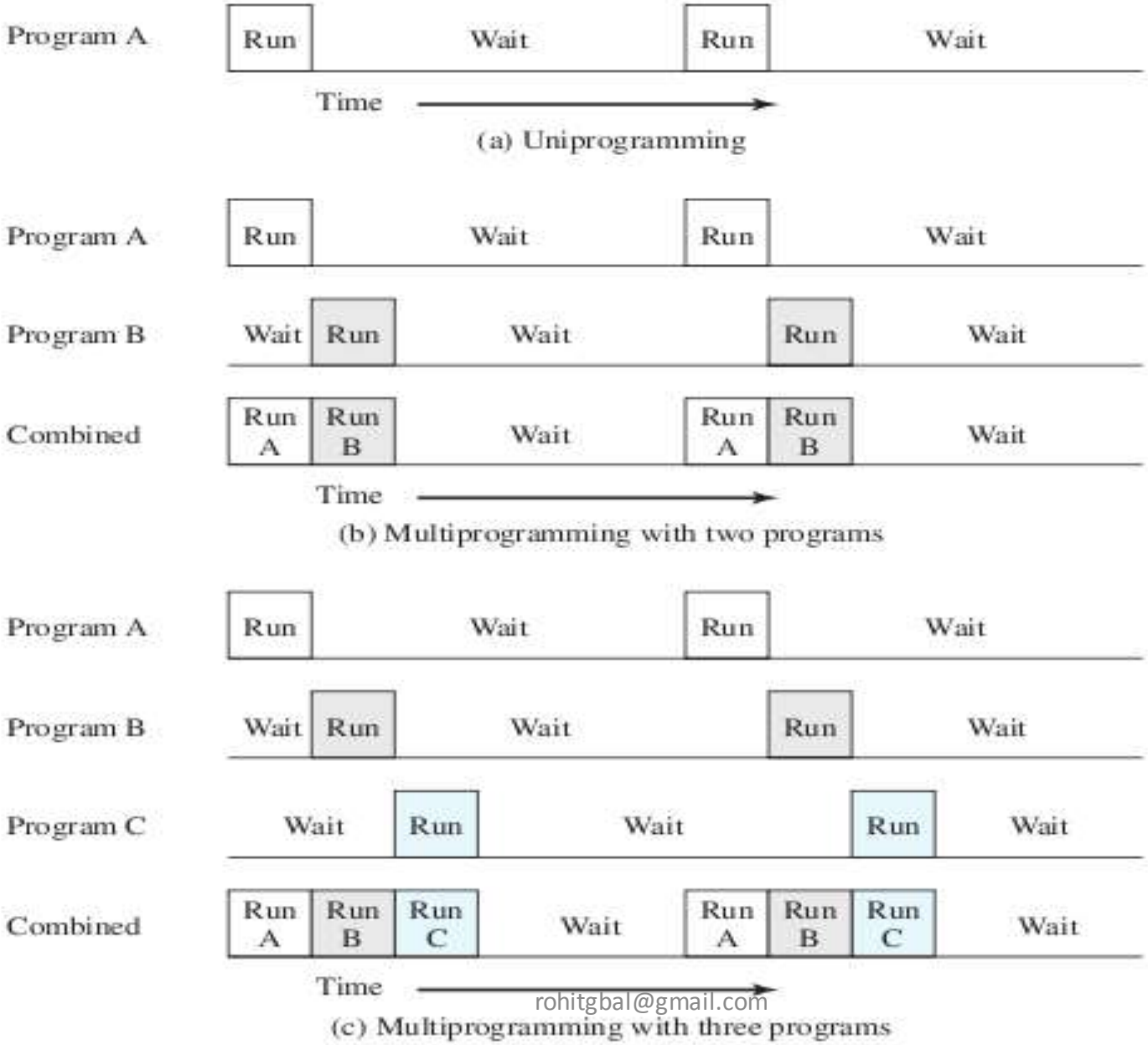
Memory Layout



MULTI-PROGRAMMED BATCH SYSTEM

- A single program cannot keep either CPU or I/O devices busy at all times.
- Multiprogramming increases CPU utilization by organizing jobs in such a manner that CPU has always one job to execute.

MULTI-PROGRAMMED BATCH SYSTEM



MULTITASKING OR TIME SHARING SYSTEM

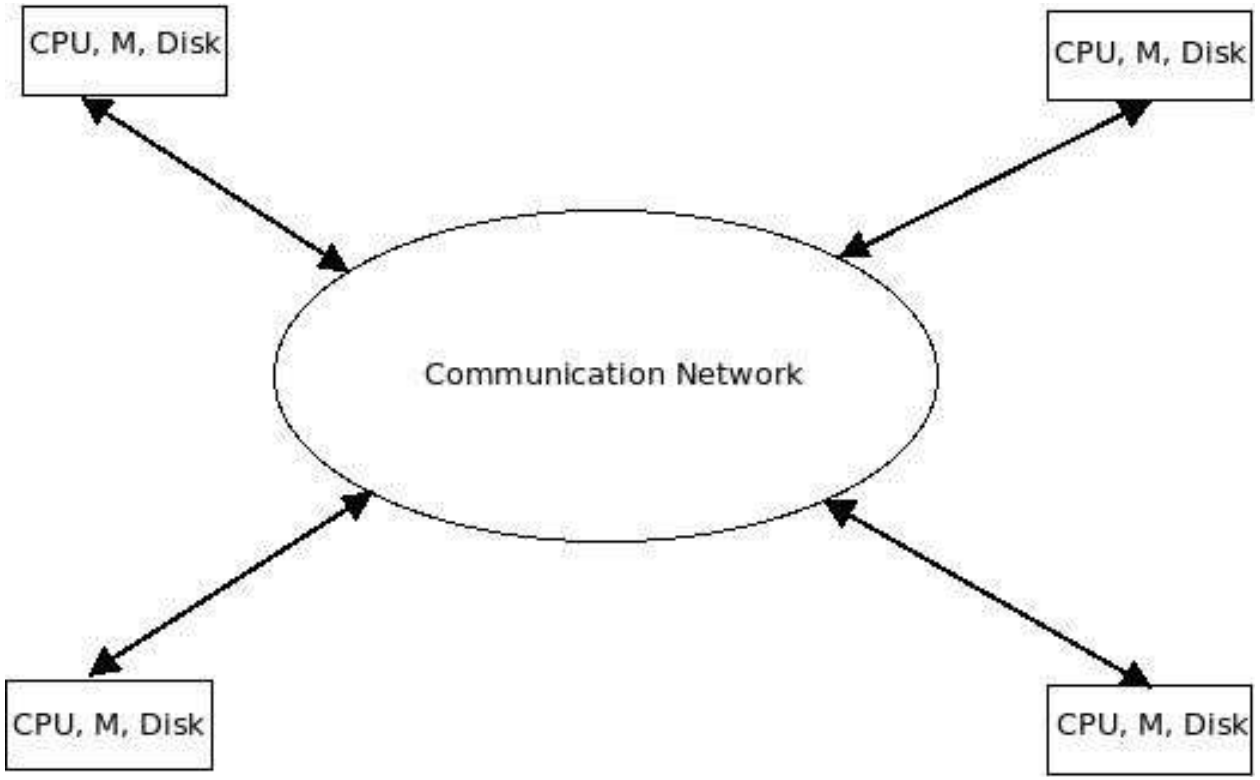
- There are more than one user **interacting the system at the same time**
- The switching of CPU between two users is so fast
- CPU bound is divided into different **time slots**(users)
- Processor time is **shared** among multiple users
- Multitasking are more complex than multiprogramming and must provide a mechanism for jobs **synchronization and communication**

NETWORK OPERATING SYSTEM

Software that implements an operating system of some kind that is oriented to computer networking

The network operating system is designed to allow shared file and printer access among multiple computers in a network, typically a local area network (LAN), a private network or to other networks.

DISTRIBUTED OS



DISTRIBUTED OS…

- Each processor has its own local memory.
- The processors communicate with one another through various communication lines such as computer network
- Controls and manages the hardware and software resources of a distributed system
- **Location** is unaware

MULTI PROCESSOR OS

- Two or more CPUs for a computer system
- Its the logical connection of the CPUs.
- Multiprocessor system have more than one processing unit sharing memory/peripherals devices.
- They have greater computing power and higher reliability.
- Multiprocessor system can be classified into two types:

1. Tightly coupled
2. Losely coupled

REAL TIME OS

- **Primary objective** – quick response
- User convenience and resource utilization- **secondary**
- **Applications:** Rocket launching, flight control, robotics, real time simulation, telephone switching equipment etc…
- Two categories:
  1. **Soft Real time System:** If certain deadlines are missed then system continues its working with no failure but its performance degrade.
  2. **Hard Real time System:** If any deadline is missed then system will fail. This system guarantees that critical task is completed on time.

- **SYSTEM CALL**
- **System call** is how a program requests a service from an operating system's kernel
- System calls provide the interface between a process and the operating system.
- Many of today's operating systems have hundreds of system calls. For example, Linux has over 300 different calls.
- System calls can be roughly grouped into five major categories:
    1. Process Control
    2. File management
    3. Device Management
    4. Information Maintenance
    5. Communication.

1. Process Control.

- load
- execute
- create process
- terminate process
- get/set process attributes
- wait for time, wait event, signal event
- allocate, free memory

2. File management.

- create file, delete file
- open, close
- read, write, reposition
- get/set file attributes

3. Device Management.

- request device, release device
- read, write, reposition
- get/set device attributes
- logically attach or detach devices

4. Information Maintenance

- get/set time or date
- get/set system data
- get/set process, file, or device attributes

5. Communication

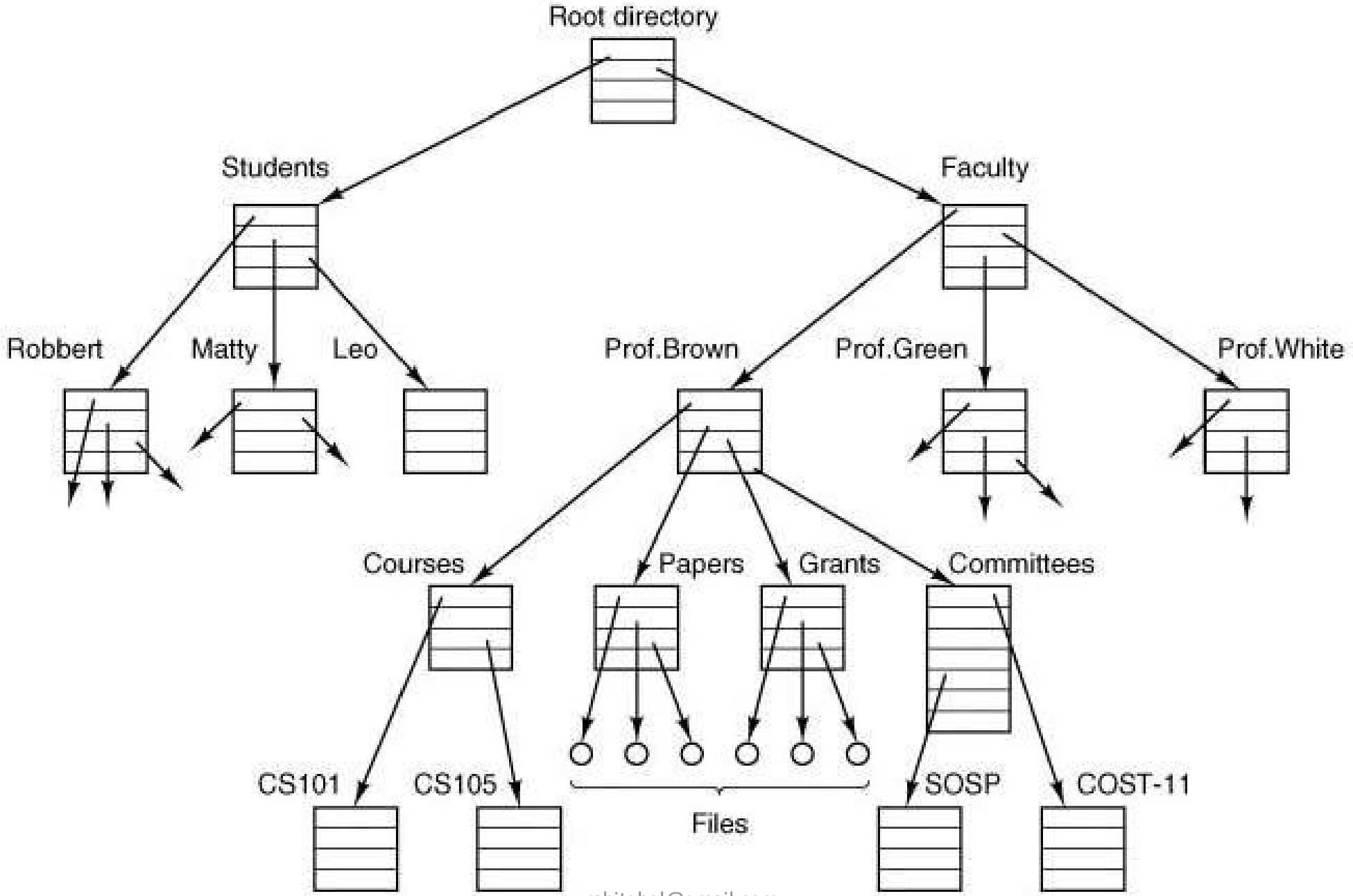
- create, delete communication connection
- send, receive messages
- transfer status information
- attach or detach remote devices

FILES

- Files are an **Abstraction Mechanism**.
- **Abstraction** in the sense it will hide the complexity of the machine
- They provide a way to **store information** on the disk and read it back later.

DIRECTORY

- To provide a place to keep files, most operating systems have the concept of a **directory** as a way of grouping files together


Root directory
Students
Faculty
Robbert
Matty
Leo
Prof.Brown
Prof.Green
Prof.White
Courses
Papers
Grants
Committees
CS101
CS105
Files
SOSP
COST-11

PROCESS

- A process is basically **a program in execution**
- **Address space**(a list of memory)
- **locations** from some minimum (usually 0) to some maximum which the process can read and write.
- The address space contains the executable program, the program's data, and its stack
- **Registers**, including the **program counter**, **stack pointer**, and other hardware registers

- **SHELL**
- **Shell** is a user interface for access to an operating system's services
- Command Line Interface (CLI)
- It is also the primary interface between a user sitting at his terminal and the operating system
- Eg: *csh*, *ksh*, *zsh*, *bash*

- **KERNEL**
- **kernel** is the main component of most computer operating systems
- it is a **bridge** between applications and the actual data processing done at the hardware level.
- responsibilities include **managing the system's resources**
- i.e communication between hardware and software components