# MM PG College Fatehabad

## Introduction to Operating System (OS)

Class B.Sc. CS

2nd Year/4th Sem.

# Initial Objectives

- To describe the basic organization of computer systems and operating systems.
- To give an overview of the many types of computing environments.
- To explore varied types of operating systems.
- To provide a grand tour of the major components of operating systems.
- To describe the services an operating system provides to users, processes, and other systems.
- To discuss the various ways of structuring an operating system.

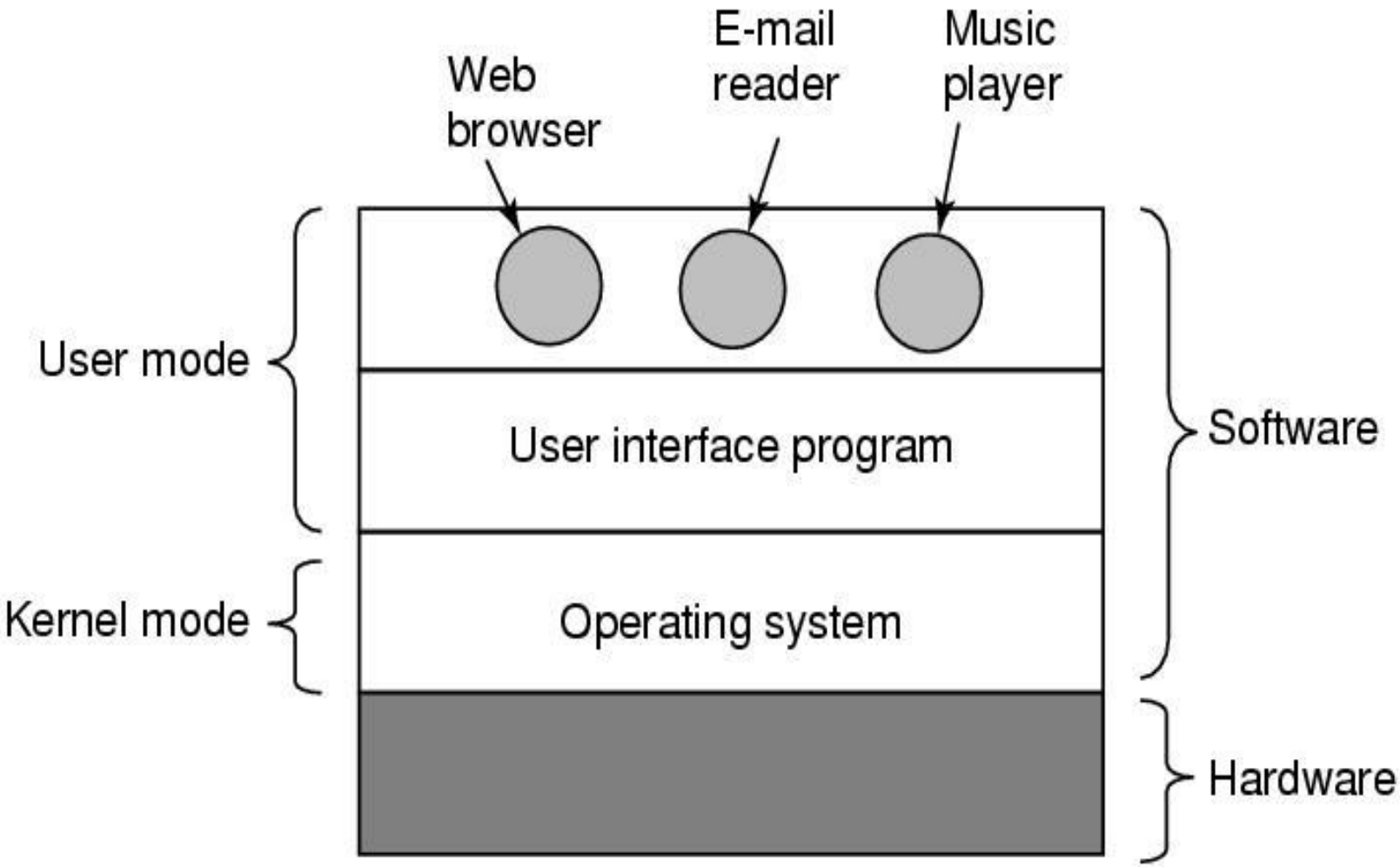
# What is an Operating System (1)?

- A modern computer consists of:
  - One or more processors
  - Main memory
  - Disks
  - Printers
  - Various input/output devices.
- Managing all these varied components requires a layer of software – the **Operating System (OS).**

# What is an Operating System (2)?

- An Operating System is a program that acts as an intermediary/interface between a user of a computer and the computer hardware.
- OS goals:
  - Control/execute user/application programs.
  - Make the computer system convenient to use.
  - Ease the solving of user problems.
  - Use the computer hardware in an efficient manner.

# Where does the OS fit in?



# Services provided by an OS

- Facilities for program creation
  - editors, compilers, linkers, debuggers, etc.
- Program execution
  - loading in memory, I/O and file initialization.
- Access to I/O and files
  - deals with the specifics of I/O and file formats.
- System access
  - resolves conflicts for resource contention.
  - protection in access to resources and data.

# Why are Operating Systems Important?

- Important to understand and know how to correctly use when writing user applications.
- Large and complex systems that have a high economic impact and result in interesting problems of management.
- Few actually involved in OS design and implementation but nevertheless many general techniques to be learned and applied.
- Combines concepts from many other areas of Computer Science: Architecture, Languages, Data Structures, Algorithms, etc.

# Course Syllabus (1)

- **Motivation for Operating Systems (OS)**
- **Introduction**
  - What's an Operating System?
  - Computer/Operating System Overview
  - Evolution of Operating Systems
  - Functional/Protection Aspects
  - Operating System Structures

# Course Syllabus (2)

- **Concurrent Processes**
  - Process Models and Management
  - Process Description and Control
  - Task/Thread Description and Control
  - Concurrency: Mutual Exclusion and Synchronization
  - Concurrency: Deadlock and Starvation

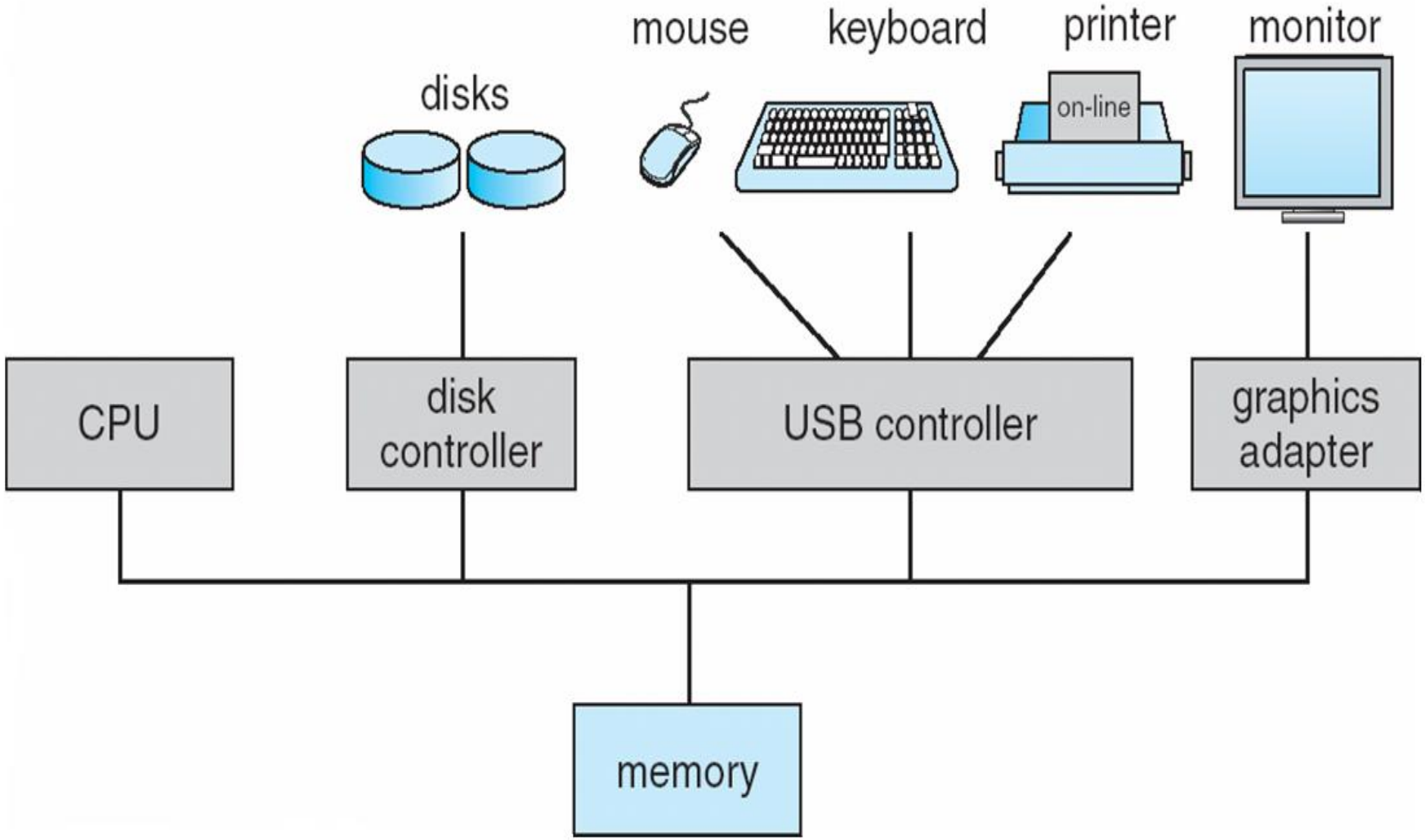
# Course Syllabus (3)

- **Memory Management**
  - Real Memory Management
  - Motivation for Virtual Memory (VM)
  - Paging and Segmentation
  - Page Fetch, Placement and Replacement

# Course Syllabus (4)

- **Uniprocessor Scheduling**
  - Levels of CPU Scheduling
  - Process Scheduling
- **External Storage Management**
  - File Systems/Management
  - Directories
  - File Allocation
  - Disk Scheduling

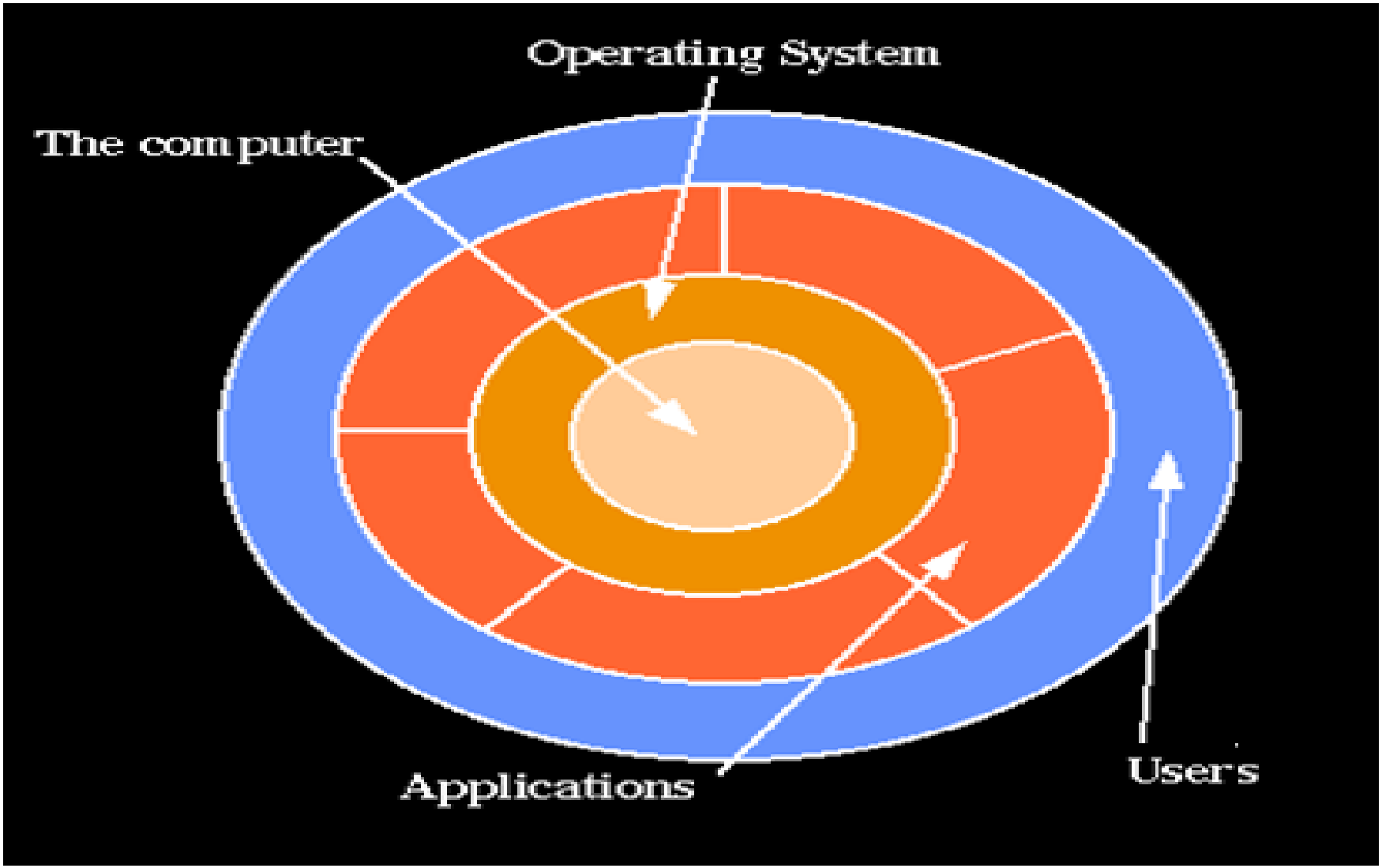
# Computer Hardware Organization



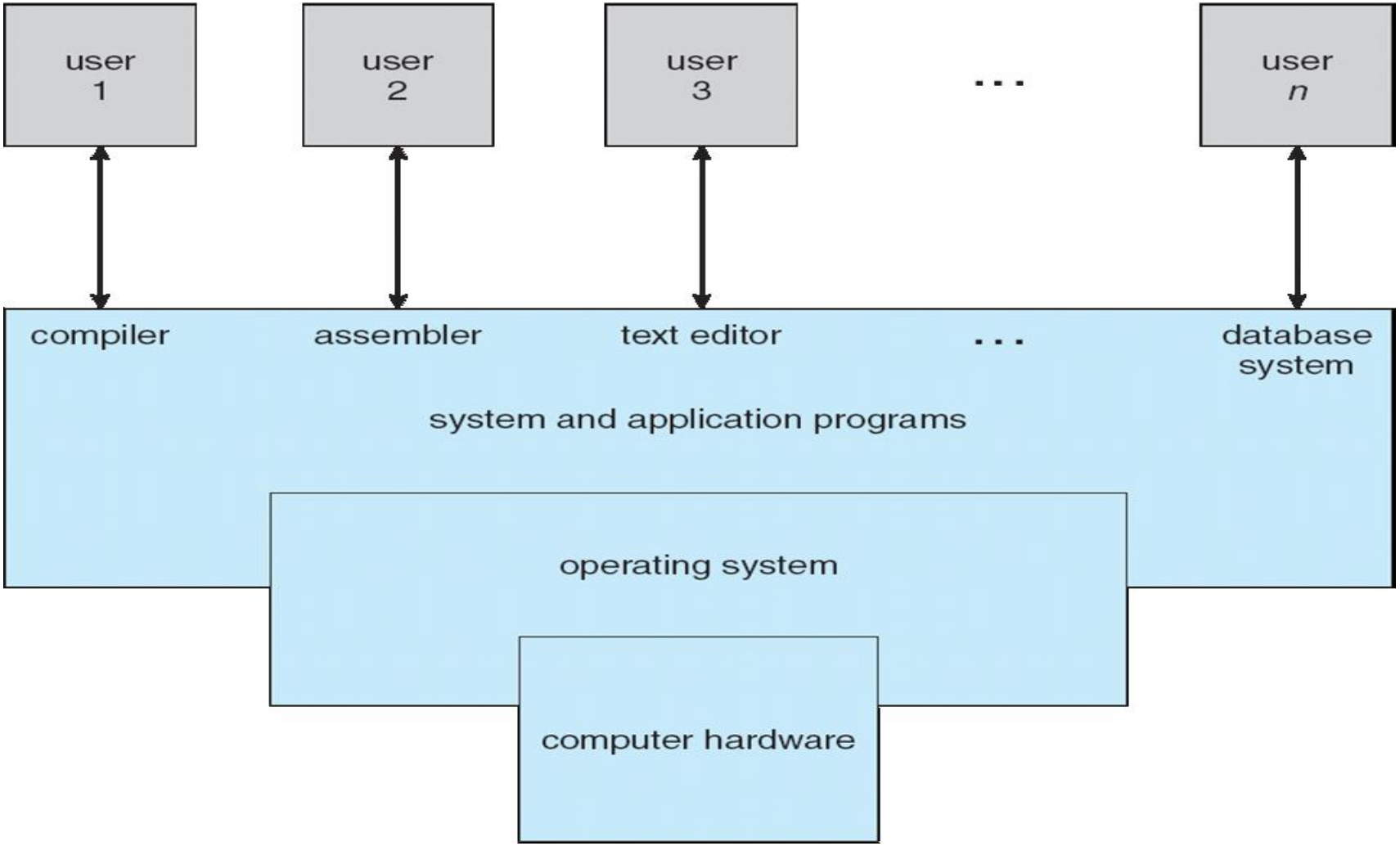
# Computer System Components

1. Hardware – provides basic computing resources (CPU, Memory, I/O devices, Communication).
2. Operating System – controls and coordinates use of the hardware among various application programs for various users.
3. System & Application Programs – ways in which the system resources are used to solve computing problems of the users (Word processors, Compilers, Web browsers, Database systems, Video games).
4. Users – (People, Machines, other computers).

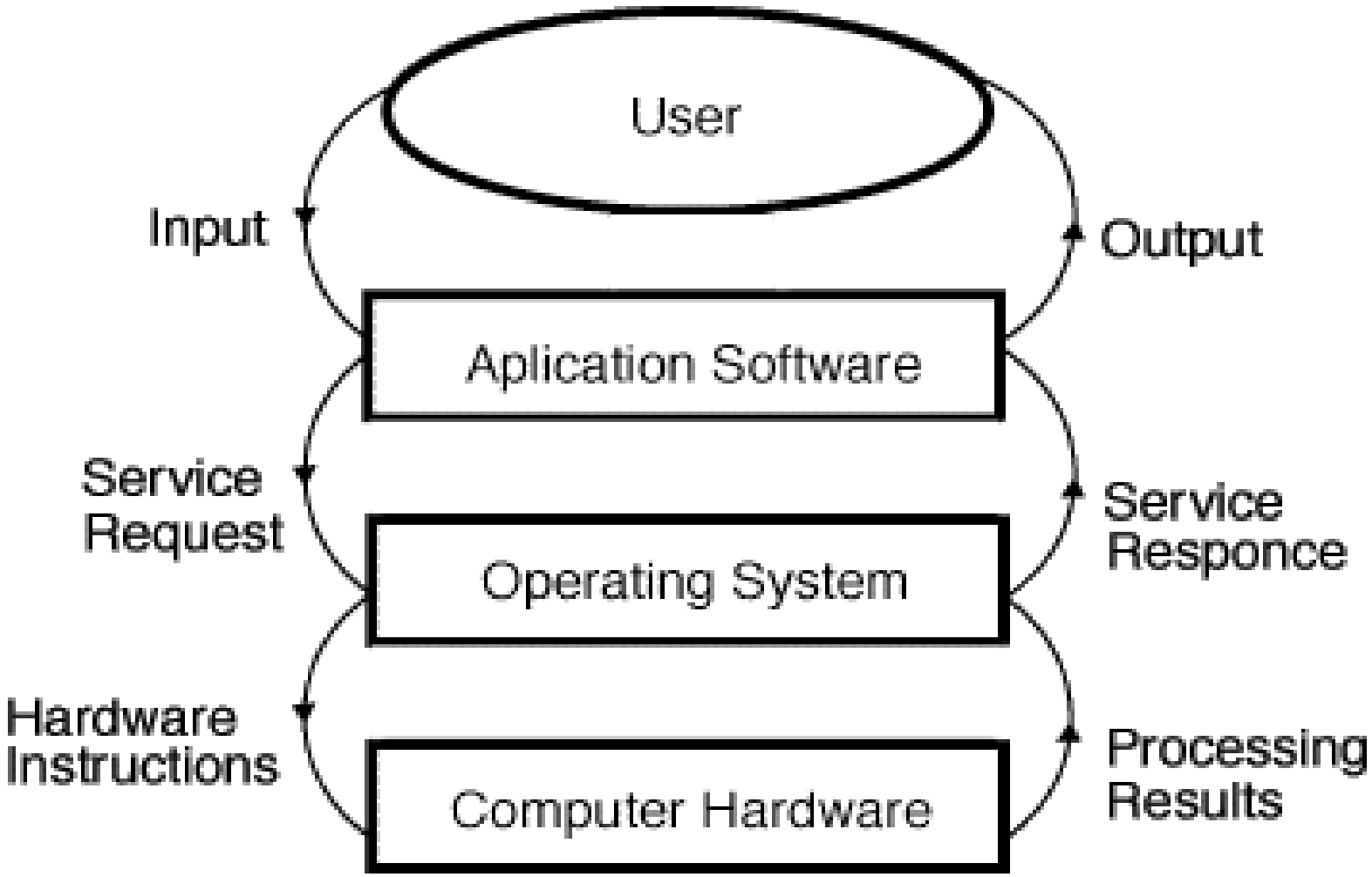
# Hierarchical view of computer system



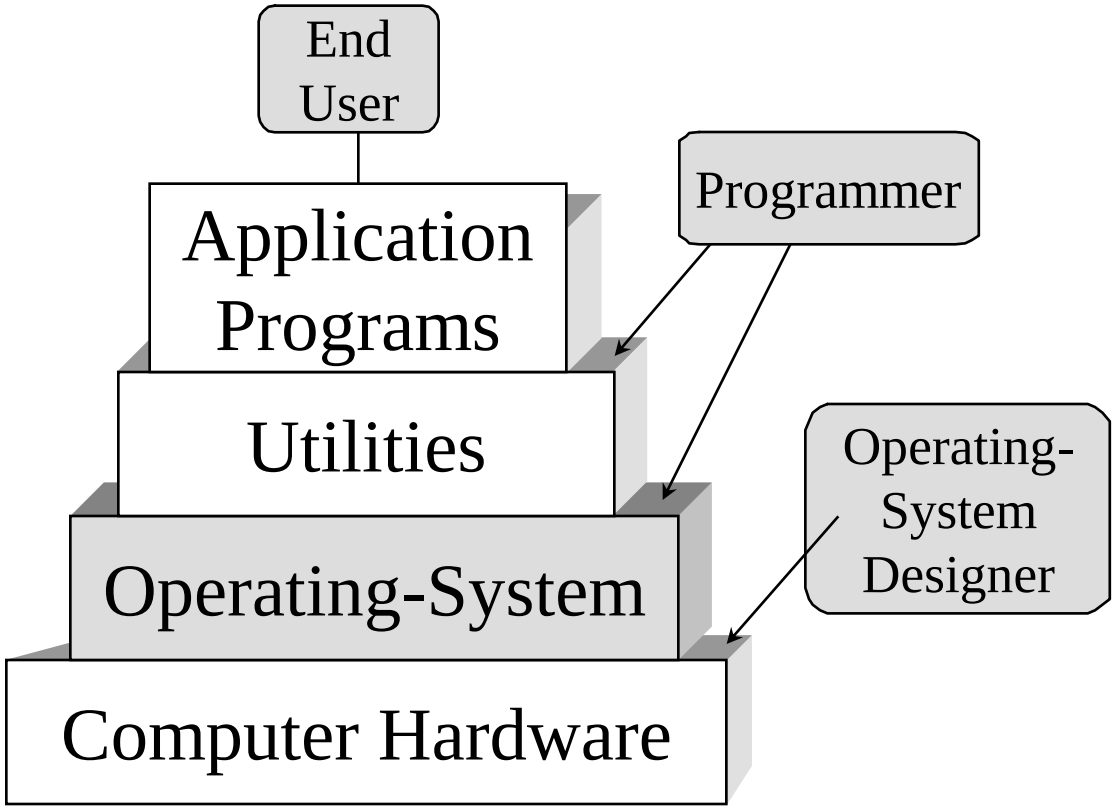
# Static View of System Components



# Dynamic View of System Components



# Layers of a Computer System



# What Operating Systems Do

- Depends on the point of view.
- Users want convenience, ease of use and good performance
  - Don’t care about resource utilization.
- But a shared computer such as mainframe or minicomputer must keep all users happy.
- Users of dedicate systems such as workstations have dedicated resources but frequently use shared resources from servers.
- Handheld computers are resource poor, optimized for usability and battery life.
- Some computers have little or no user interface, such as embedded computers in devices and automobiles.

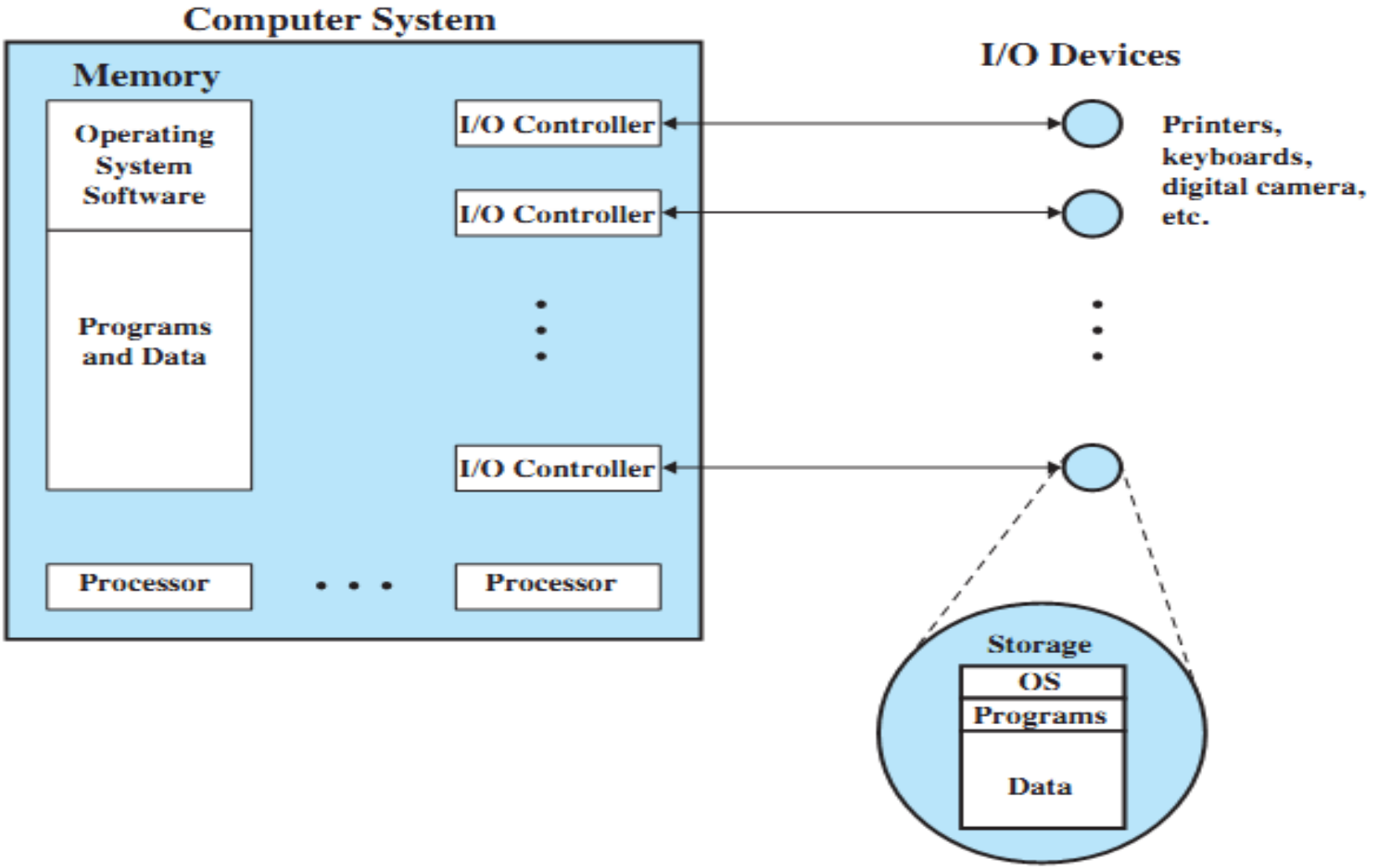
# Views of an Operating System

- There are three classical views (in literature):
  1. Resource Manager – manages and allocates resources.
  2. Control program – controls the execution of user programs and operations of I/O devices.
  3. Command Executer – Provides an environment for running user commands.
- But one more modern view: the Operating System as a Virtual Machine.

# 1. Resource Manager

- Resource Manager:
  - Manages and protects multiple computer resources: CPU, Processes, Internal/External memory, Tasks, Applications, Users, Communication channels, etc…
  - Handles and allocates resources to multiple users or multiple programs running at the same time and space (e.g., processor time, memory, I/O devices).
  - Decides between conflicting requests for efficient and fair resource use (e.g., maximize throughput, minimize response time).
- Sort of a bottom-up view.

# OS as a Resource Manager

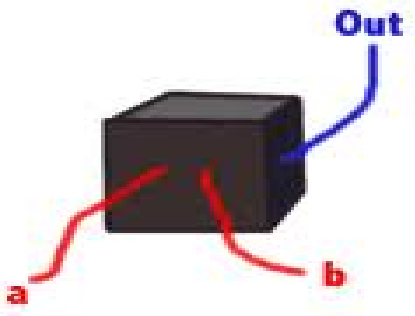


# Resource Manager oriented OS names

- DEC RSX – Resource Sharing eXecutive
- MIT Multics – MULTiplexed Information and Computing Services
- IBM MFT/MVT – Multiple Fixed/Variable Tasks
- IBM MVS – Multiple Virtual Storage
- DEC VMS – Virtual Memory System
- MVS TSO – Time Sharing Option
- CTSS – Compatible Time Sharing System
- IBM VM – Virtual machine

# 2. Control Program

- Control Program:
  - Manages all the components of a complex computer system in an integrated manner.
  - Controls the execution of user programs and I/O devices to prevent errors and improper use of computer resources.
  - Looks over and protects the computer: Monitor, Supervisor, Executive, Controller, Master, Coordinator ….
- Sort of a black box view.



# Control program oriented OS names

- Unisys MCP – Master Control Program
- DR CP/M – Control Program/Microcomputer
- IBM VM/CP – VM Control Program
- IBM AIX – Advanced Interactive eXecutive
- DEC RSX – Resource Sharing eXecutive

# 3. Command Executer

- Command Executer:
  - Interfaces between the users and machine.
  - Supplies services/utilities to users.
  - Provides the users with a convenient CLI (Command Language Interface), also called a Shell (in UNIX), for entering the user commands.
- Sort of a top-down view.

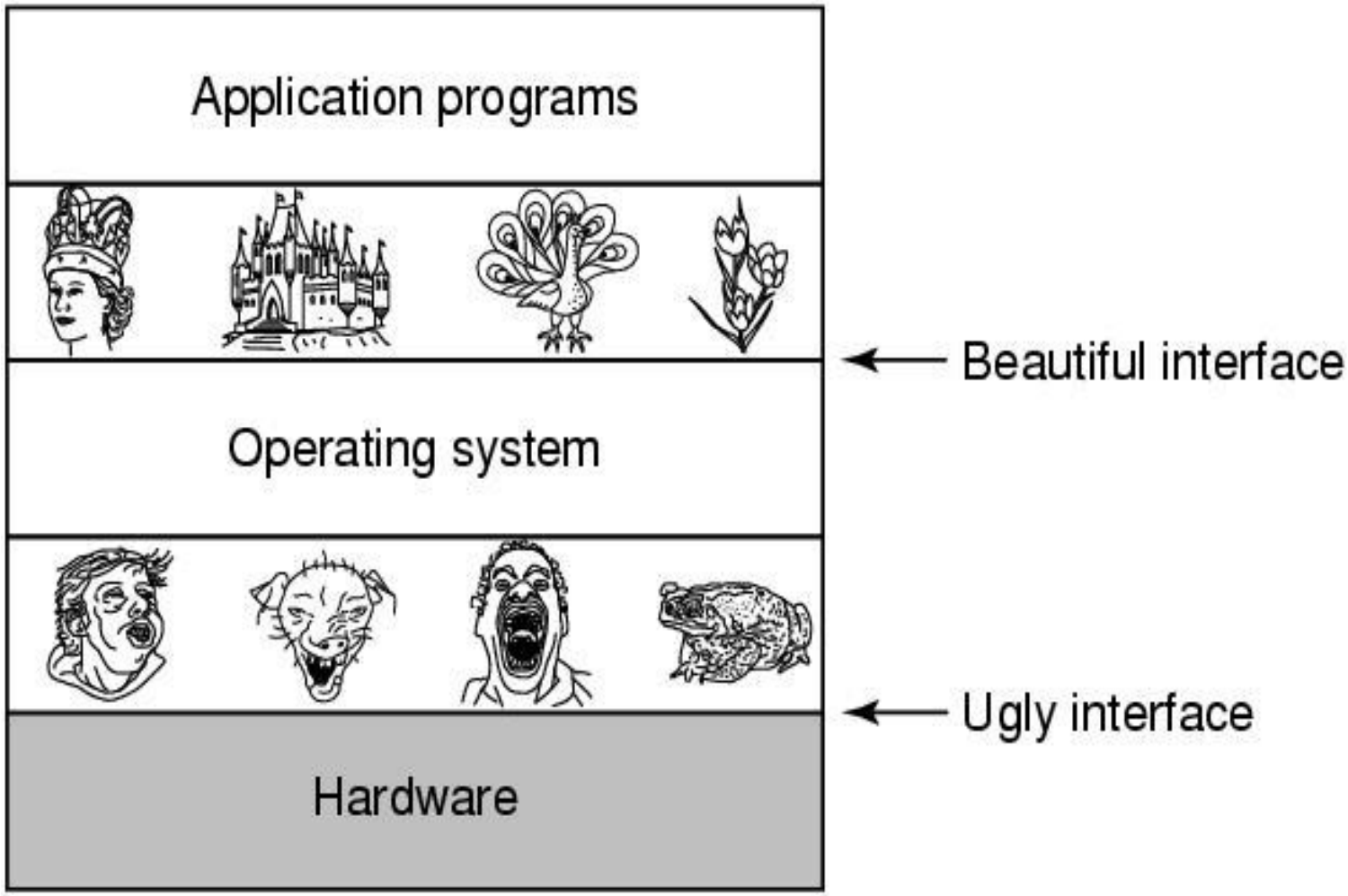
# Command Executer oriented OS names

- IBM AIX – Advanced Interactive Executive
- IBM VM/CMS – Conversational monitor System

# Modern view: Virtual Machine (1)

- Operating System as a Virtual Machine:
  - An interface between the user and hardware that hides the details of the hardware (e.g., I/O).
  - Constructs higher-level (virtual) resources out of lower-level (physical) resources (e.g., files).
  - **Definition**: OS is a collection of software enhancements, executed on the bare hardware, culminating in a high-level virtual machine that serves as an advanced programming environment.
    - virtual machine = software enhancement = extended machine = abstract machine = layer = level = ring.

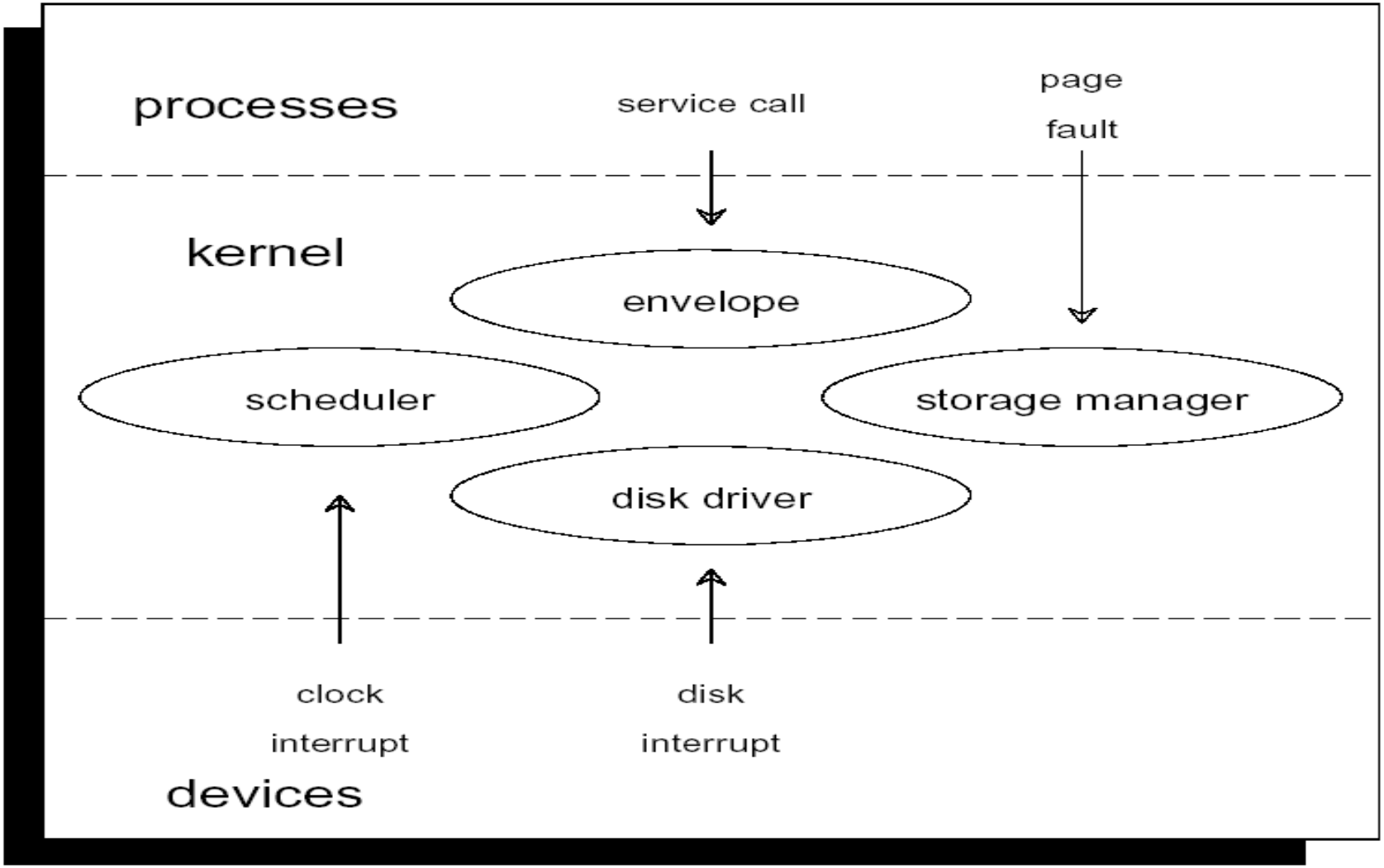
# Modern view: Virtual Machine (2)



# Definition of Operating System

- There is no universally accepted definition.
- “Everything a vendor ships when you order an operating system” is good approximation but varies widely.
- “The one program running at all times on the computer” is the **Kernel.**
- Everything else is either a system program (ships with the operating system) or an application program.

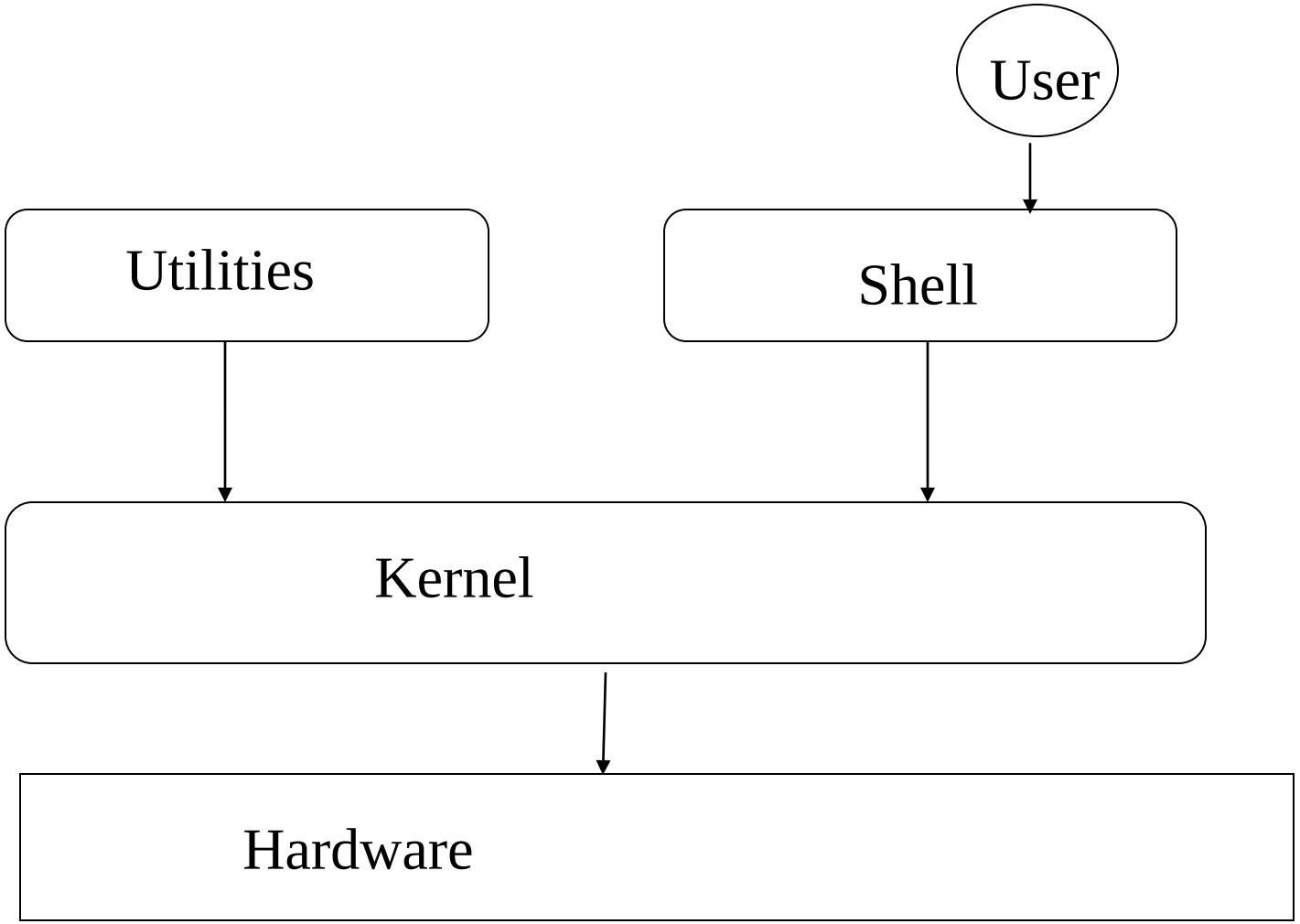
# One Kernel Point of View



# What is the OS/Kernel?

- Is the Operating System just the Kernel (not the utilities and application programs)?!
- The Command Line Interface (CLI) (or command layer/interpreter or shell) allows direct command entry by the user.
- The shell used to be in the kernel but now is a (first between equals) utility outside of it:
  - Easy to change/debug
  - Many of them (sh, bsh, csh, ksh, tcsh, wsh, bash)
  - Possible to switch between them (chsh)

# UNIX Shell and Utilities

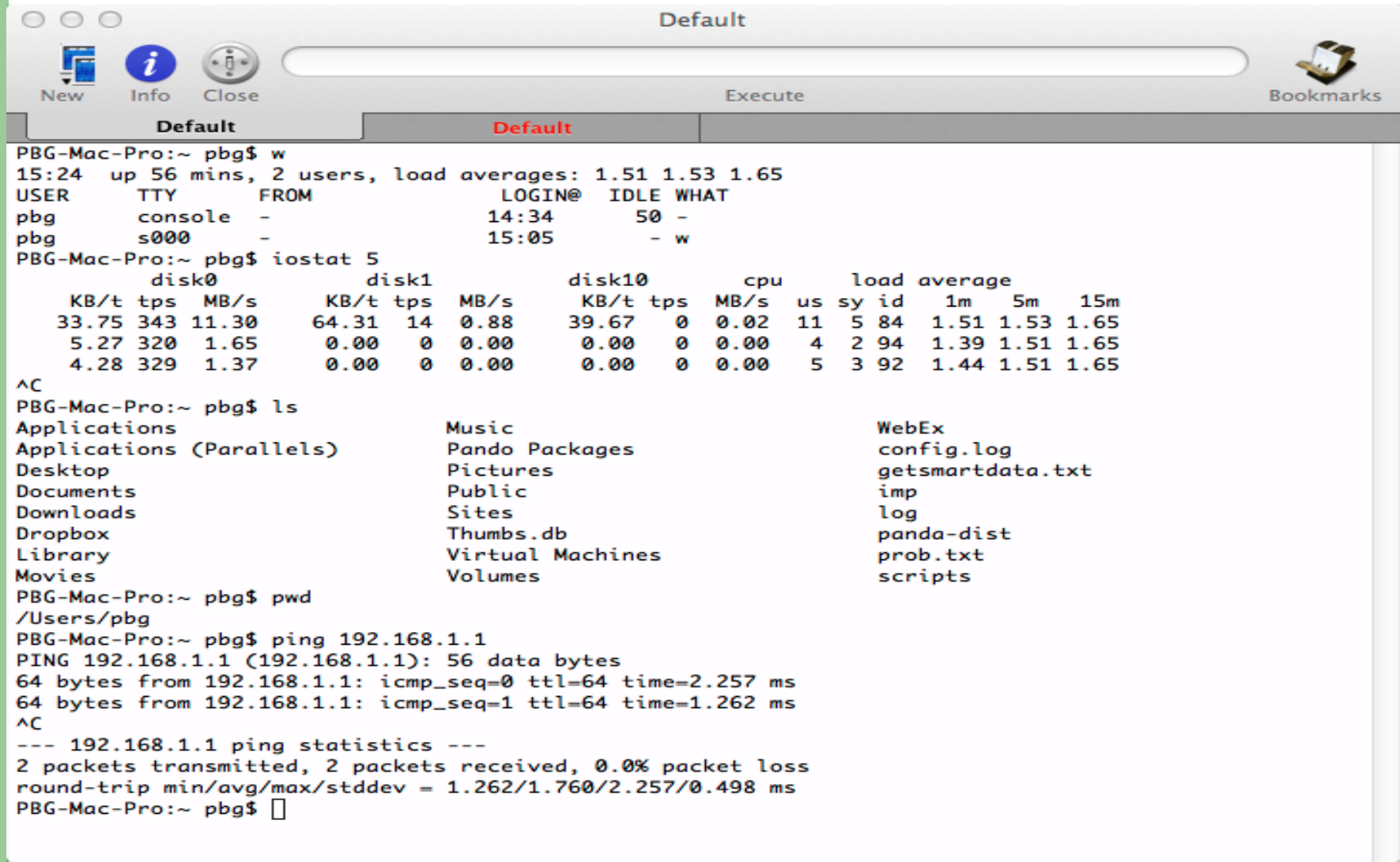


# CLI is the User OS Interface

CLI allows direct command entry:

- Sometimes implemented in kernel, sometimes by systems program.
- Sometimes multiple flavors implemented – shells.
- Primarily fetches a command from user and executes it.
- Sometimes commands built-in, sometimes just names of programs; if the latter, adding new features doesn’t require shell modification.

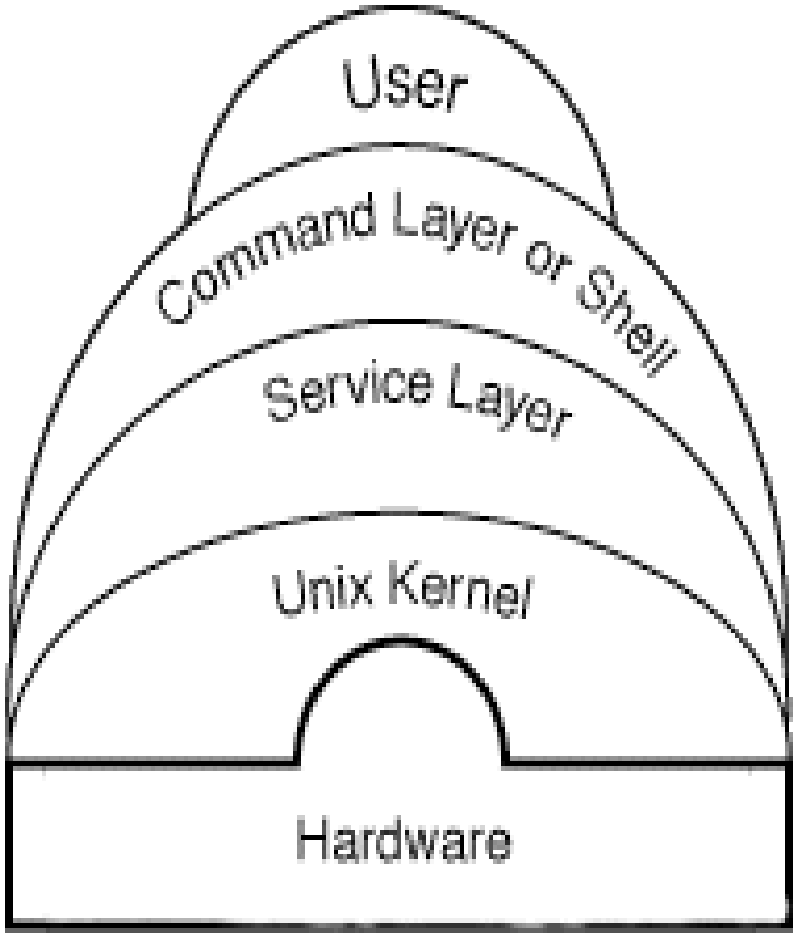
# Bourne Shell (bsh)



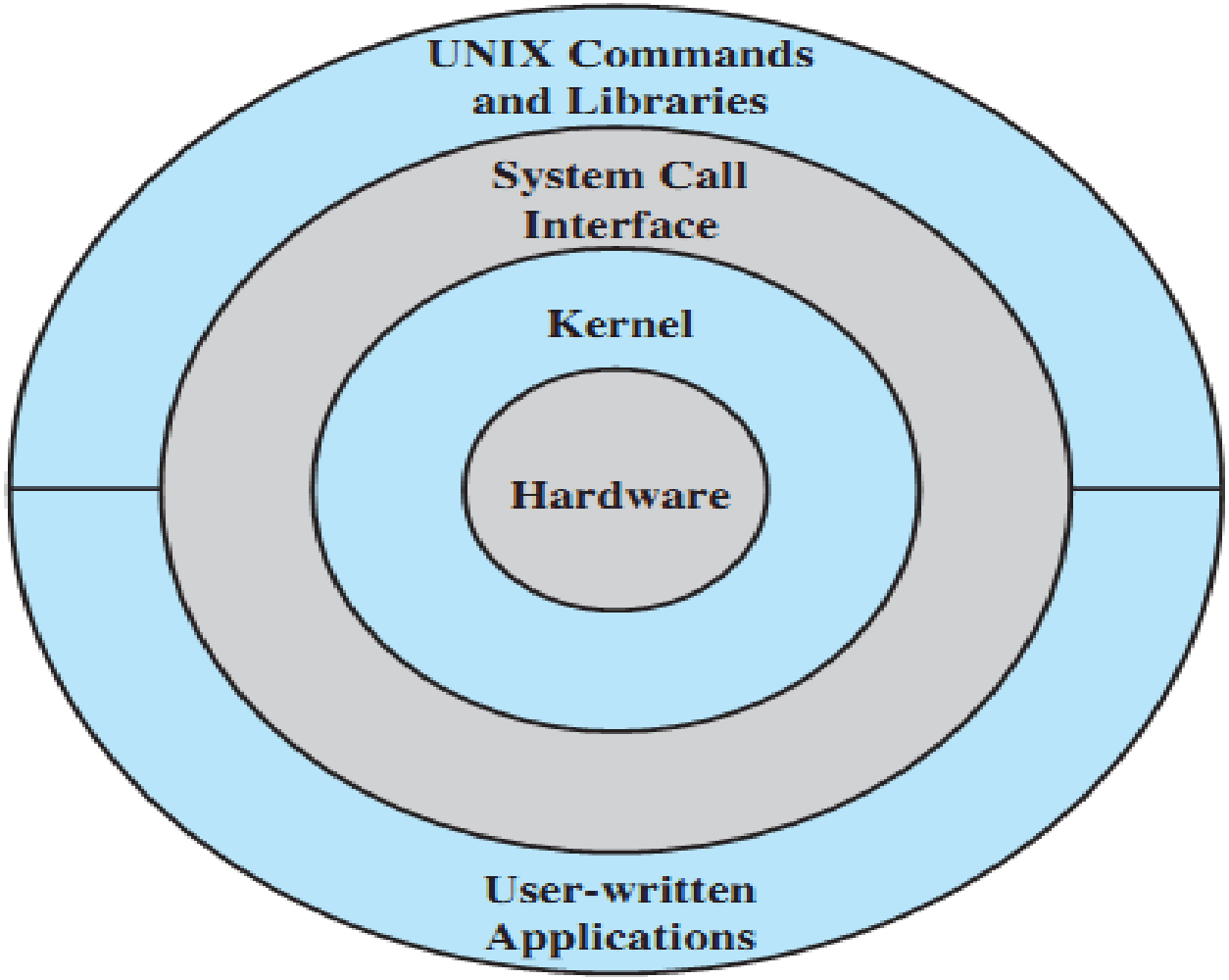
# A very simplified Shell

```
#define TRUE 1

while (TRUE) {                                  /* repeat forever */
        type_prompt( );                         /* display prompt on the screen */
        read_command(command, parameters);      /* read input from terminal */

        if (fork( ) != 0) {                     /* fork off child process */
            /* Parent code. */
            waitpid(-1, &status, 0);            /* wait for child to exit */
        } else {
            /* Child code. */
            execve(command, parameters, 0);     /* execute command */
        }
}
```

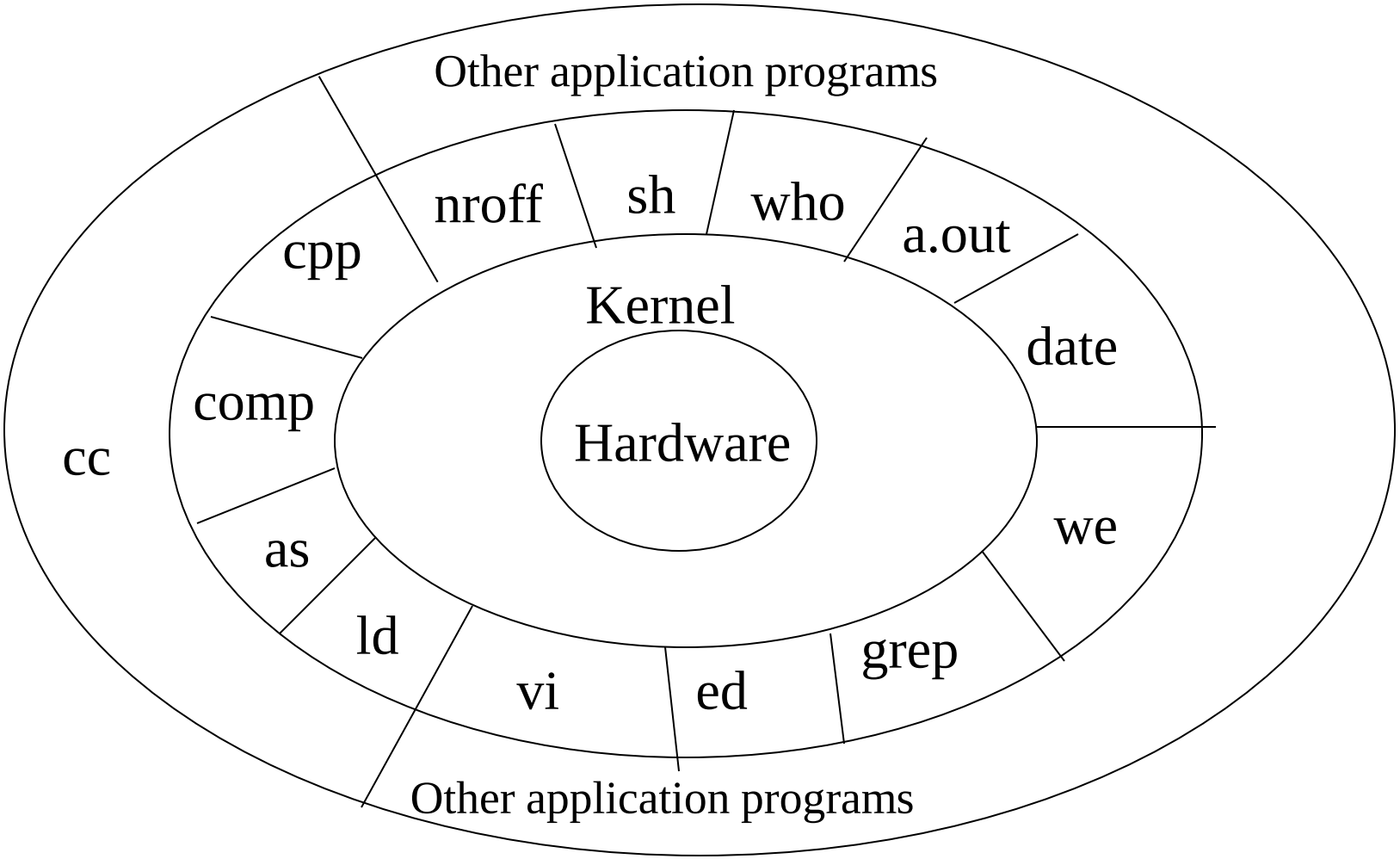
# UNIX System Layout



# General UNIX Architecture (1)



# General UNIX Architecture (2)



# Thank You