

# Operating Systems

Introduction to  
Operating System (OS)



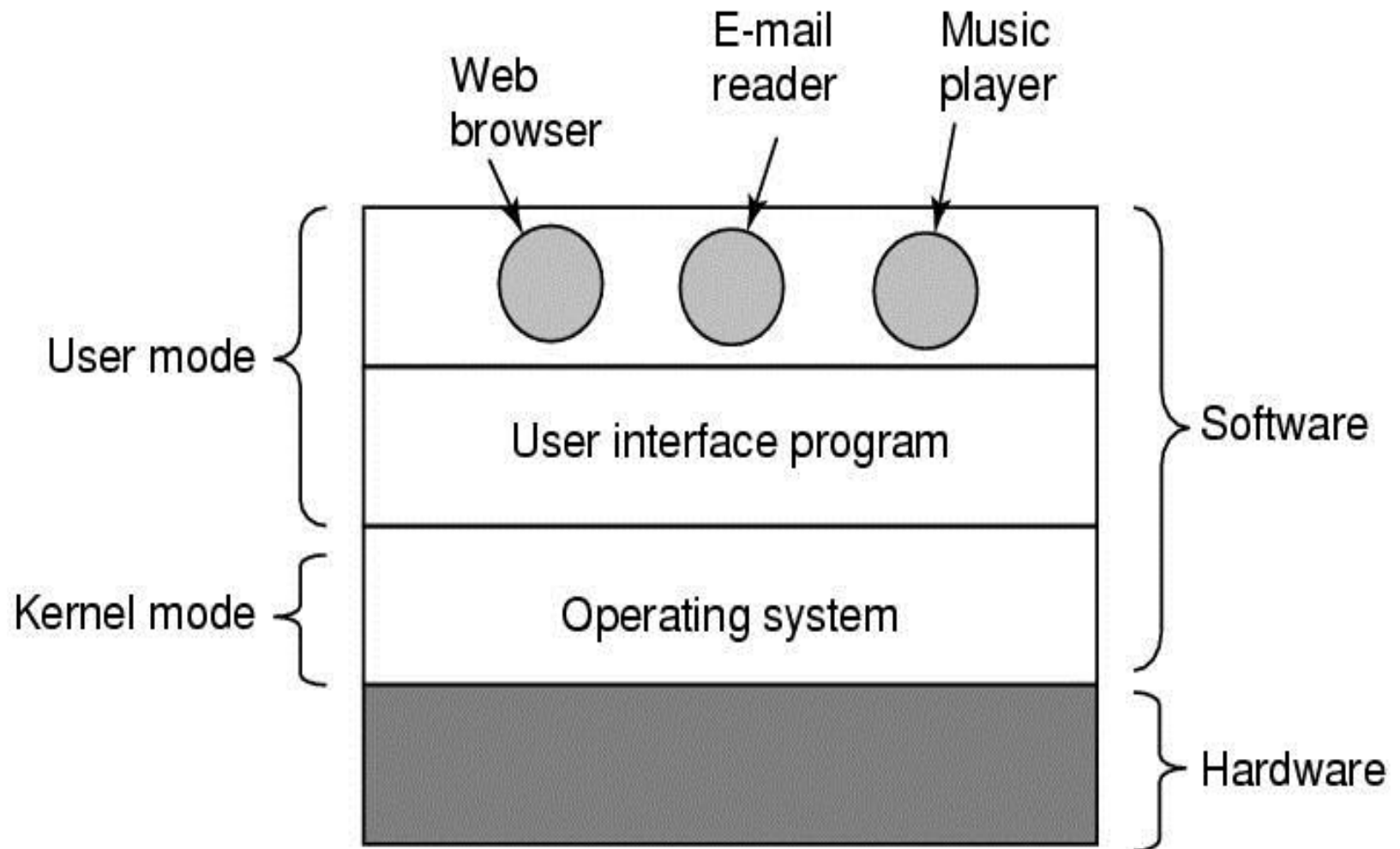
# What is an Operating System (1)?

- 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?



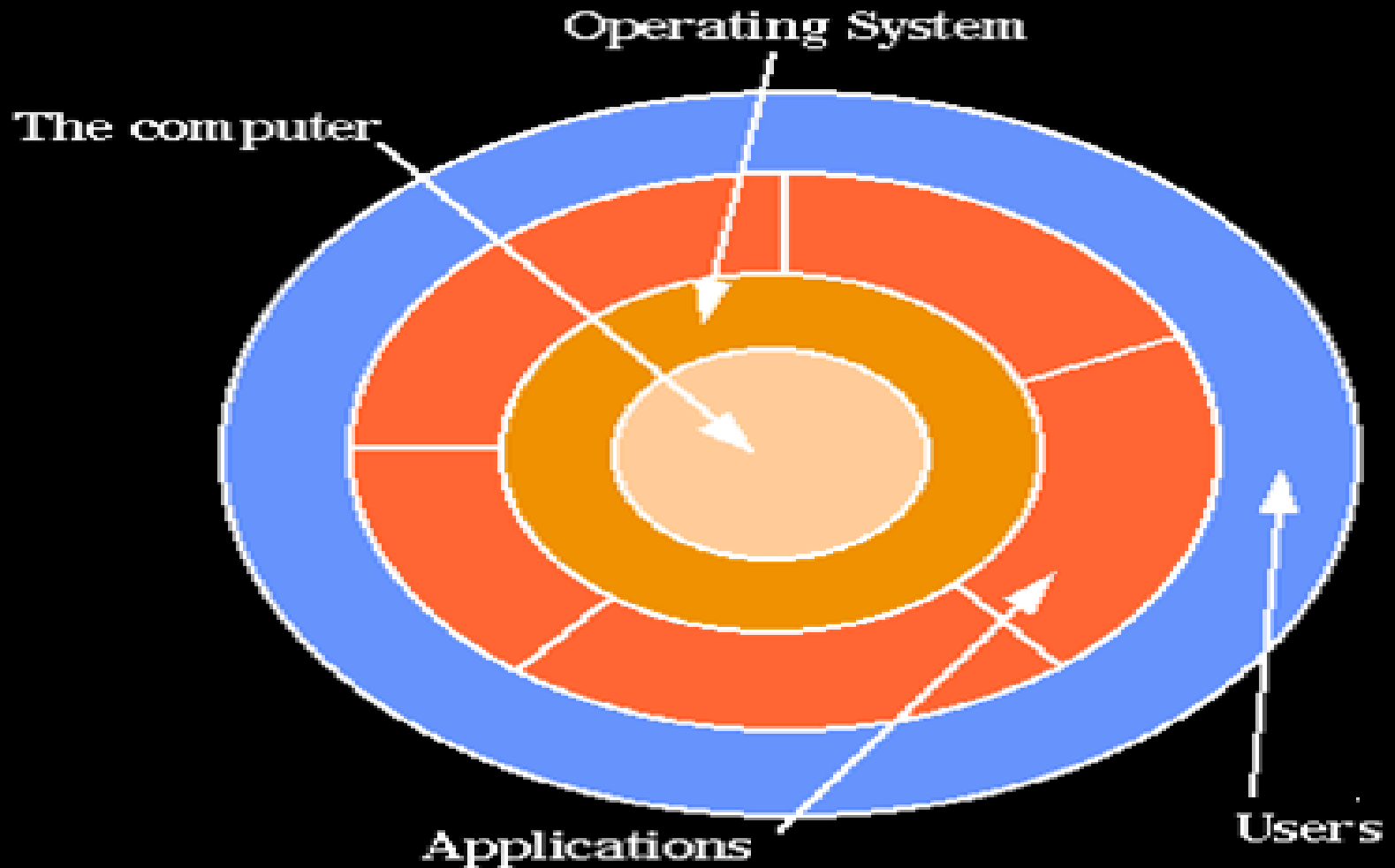
# Services provided by an OS

- 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.

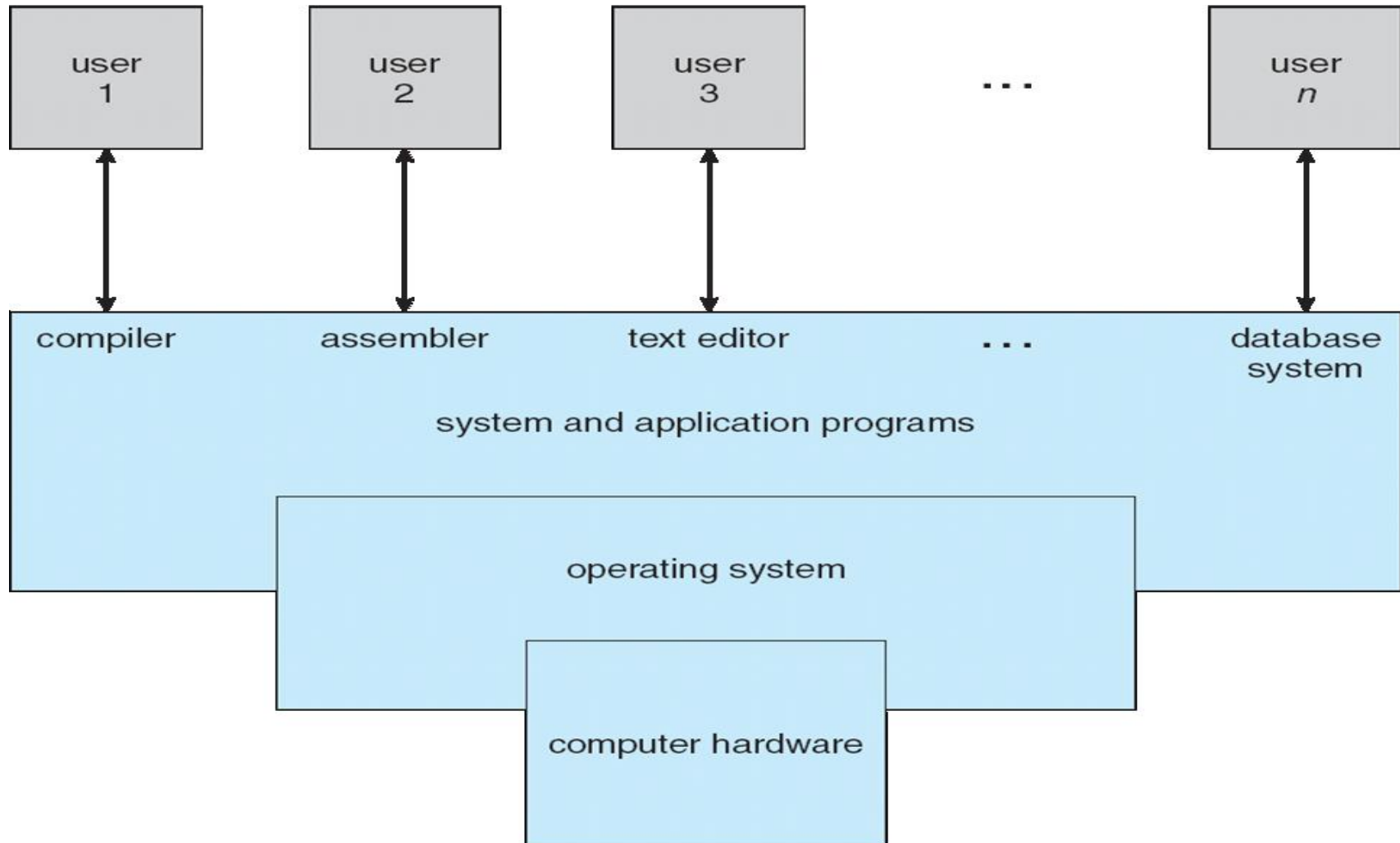
# Why are Operating Systems Important?

- 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.

# Hierarchical view of computer system

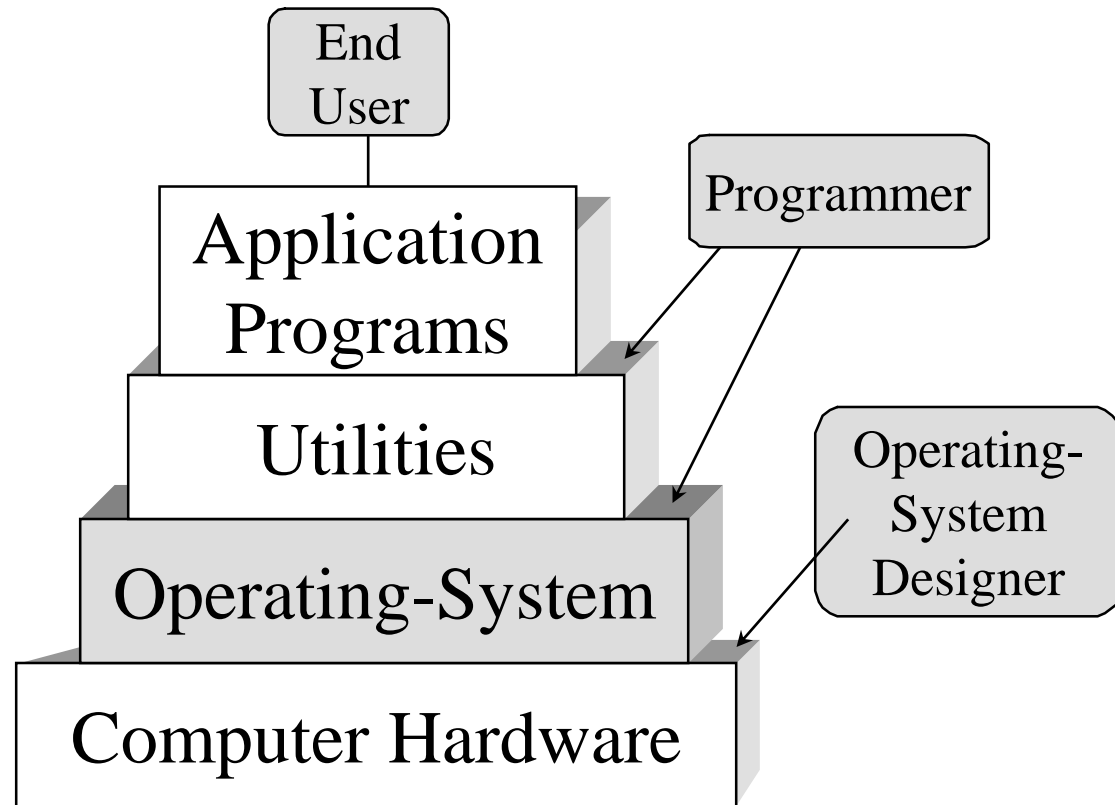


# Static View of System Components

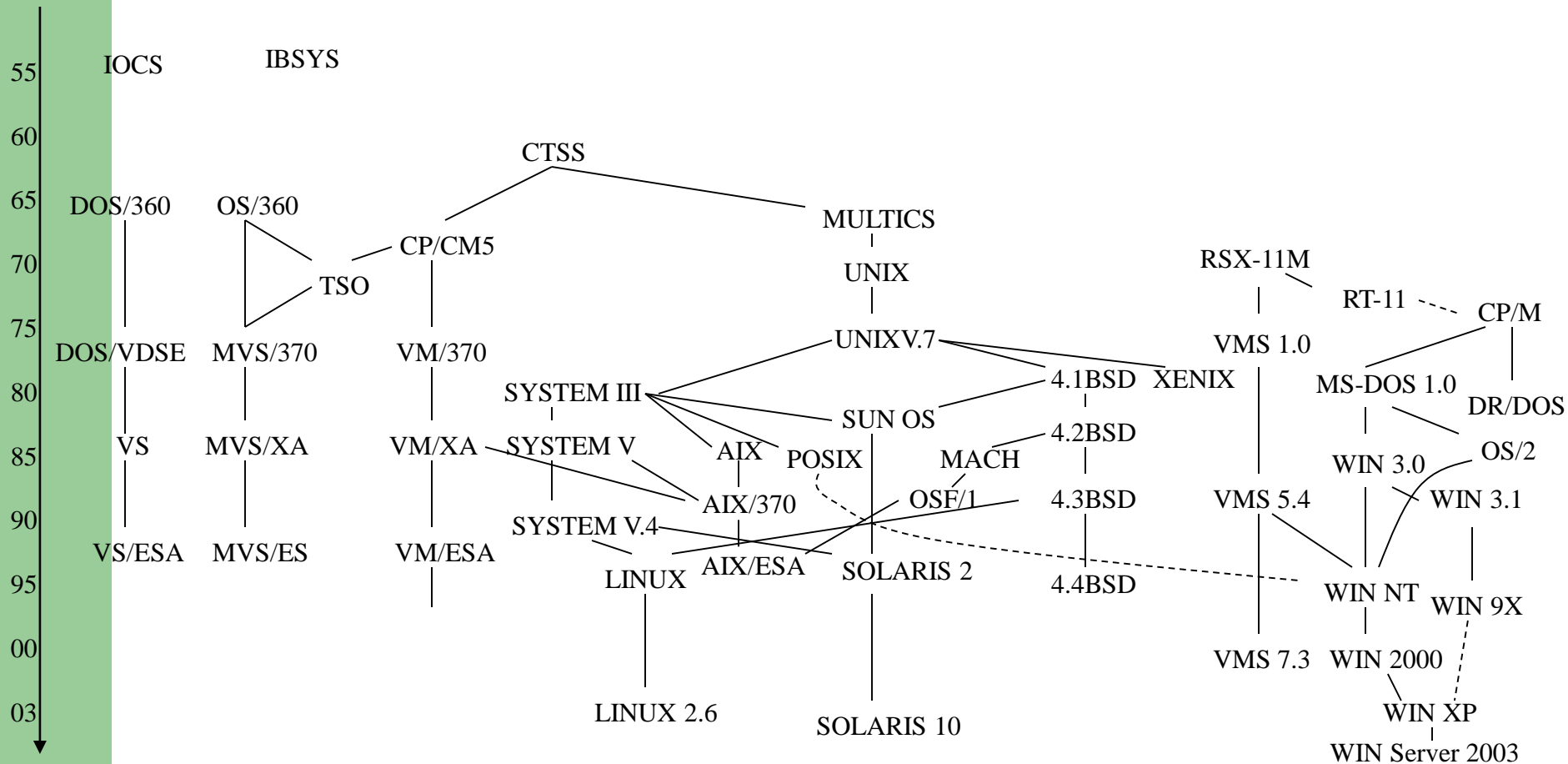




# Layers of a Computer System



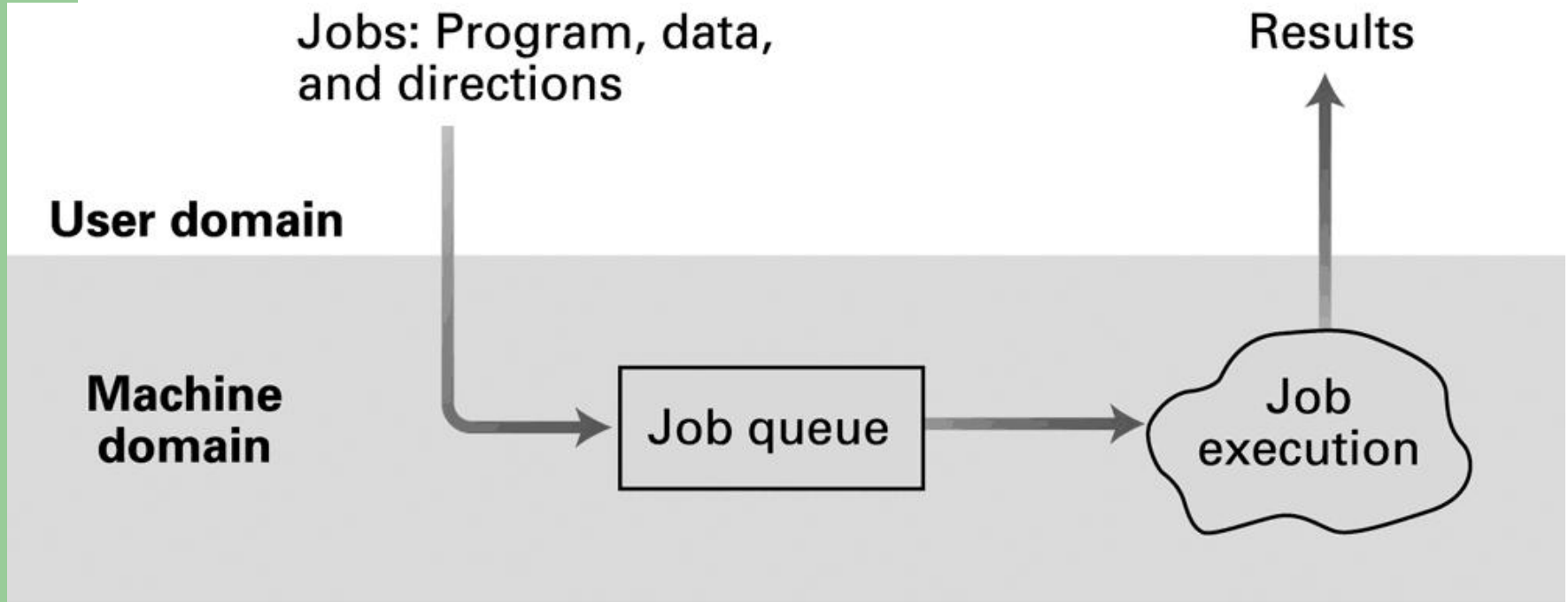
# Operating Systems Evolution



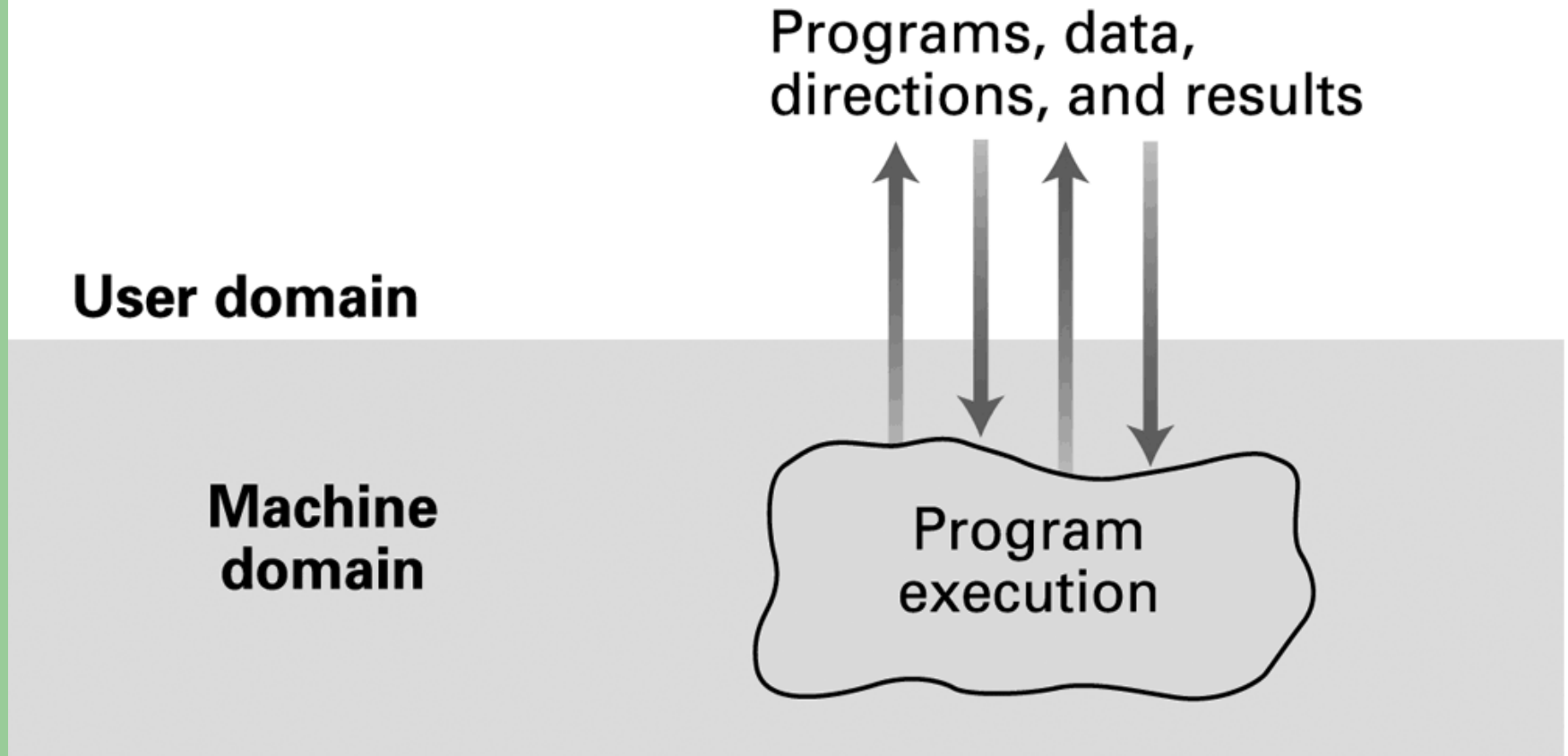
# Evolution of Operating system

- Batch processing OS
- Interactive processing (Real time)
  - Requires real-time processing
- Time-sharing/Multitasking
  - Implemented by Multiprogramming
- Multiprocessor machines
- Embedded OS

# Batch processing



# Interactive processing



# Time Sharing / Multitasking

- Users seeking services from same machine at the same time – **time sharing**
  - Implemented using a technique called **multiprogramming** (time is divided into multiple intervals, execution of one job is limited to a single time interval)
- Multiple terminals connected to same machine
  - Driven by the fact that in the past computers were very expensive
- When multiprogramming is applied to single-user environments is usually called multitasking

# Multiprocessor Operating Systems

- Provide time sharing/multi-tasking capabilities by assigning different tasks to different processors as well as sharing the time of one single processor
- Problems to solve:
  - **Load balancing** – dynamically allocating tasks to the various processor so that all of them are used efficiently
  - **Scaling** – breaking tasks into sub-tasks compatible with the number of processors available
- Trend to develop a network wide operating system rather than networks of individual operating systems

# Embedded Operating Systems

- Used in hand held devices (PDAs), mobile phones, cars, etc...
- Limited data storage and power conservation are the big challenges
- Examples: VxWorks, Windows CE (Pocket PC), Palm OS, Symbian, ThredX, RomDOS, etc...



# Tasks of an Operating System

- **Processor management - Scheduling**
  - Fairness
  - Non-blocking behavior
  - Priorities
- **Memory management**
  - Virtual versus physical memory, memory hierarchy
  - Protection of competing/concurrent programs
- **Storage management – File system**
  - Access to external storage media
- **Device management**
  - Hiding of hardware dependencies
  - Management of concurrent accesses
- **Batch processing**
  - Definition of an execution order; throughput maximization