Operating Systems

Introduction to Operating System (OS)

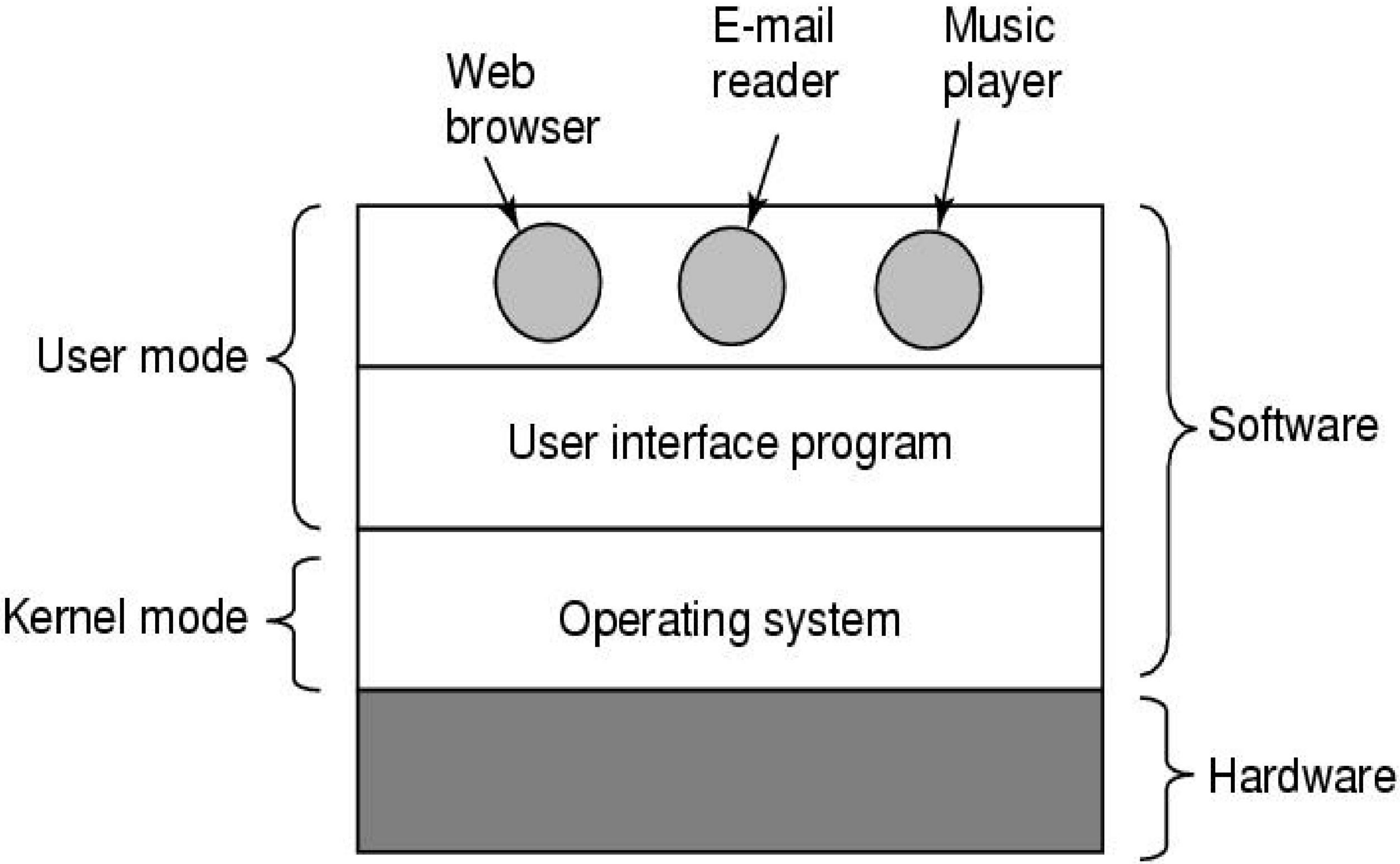
What is an Operating System (1)?

- 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?



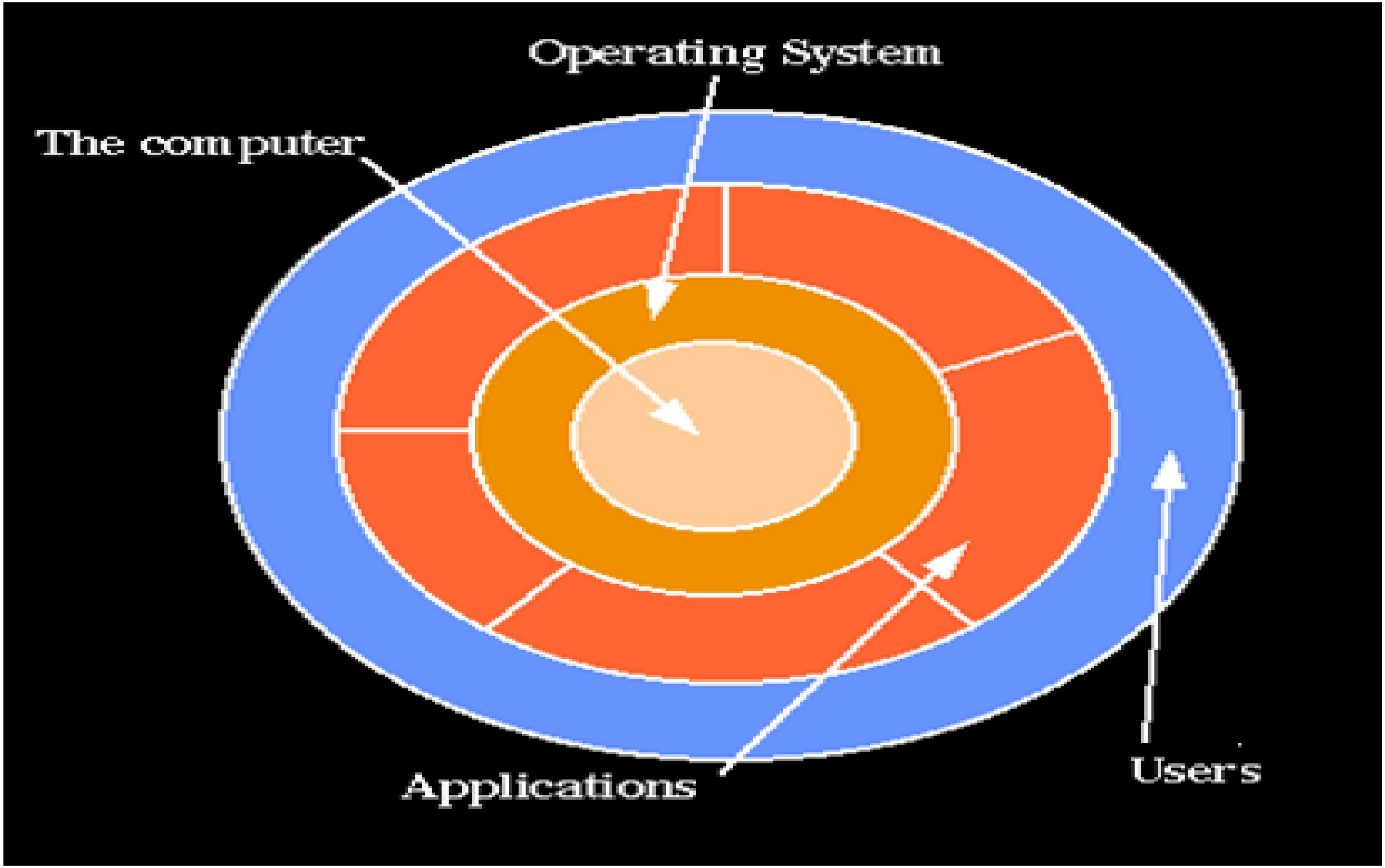
Services provided by an OS

- 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.

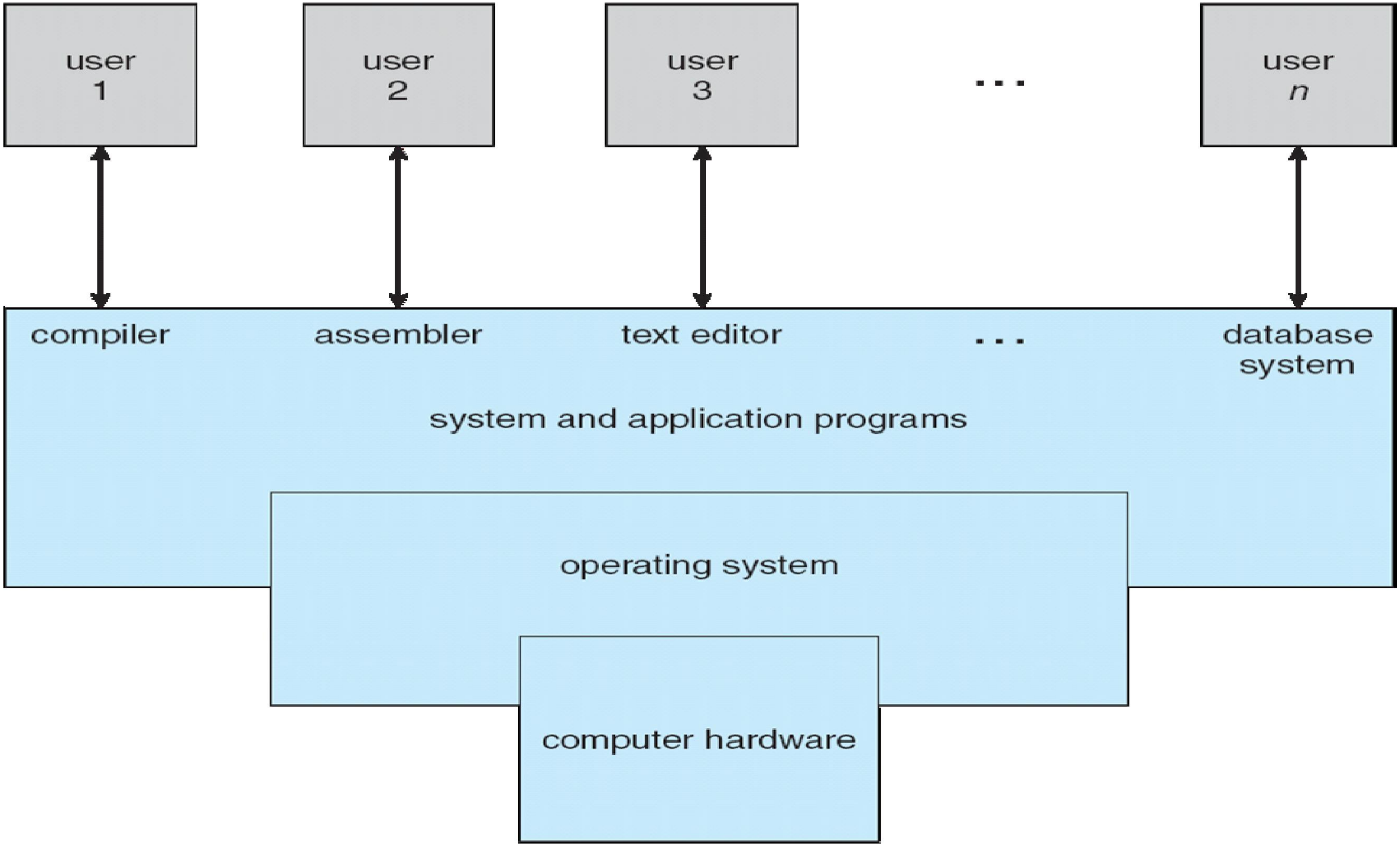
Why are Operating Systems Important?

- 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.

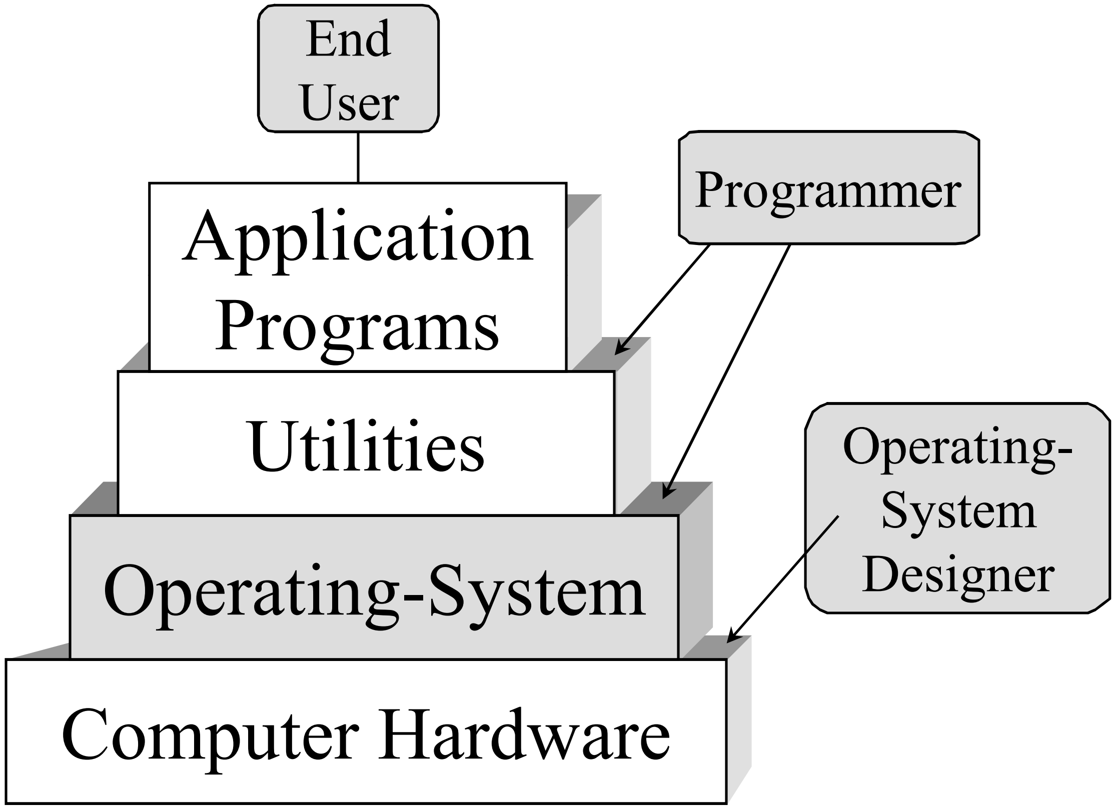
Hierarchical view of computer system



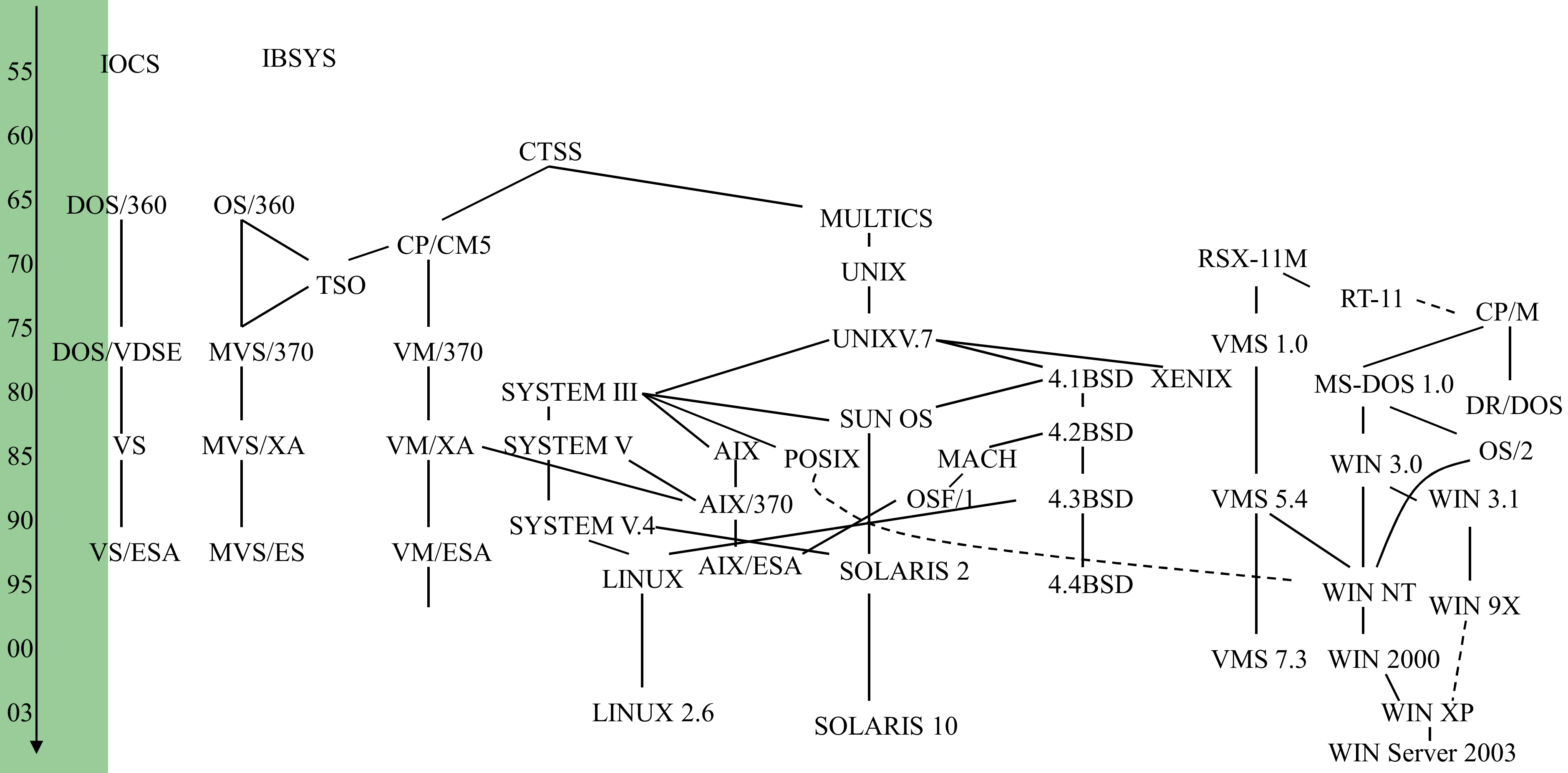
Static View of System Components



Layers of a Computer System



Operating Systems Evolution



55 IOCS IBSYS

60

CTSS

65 DOS/360 OS/360 MULTICS

70 CP/CM5 TSO UNIX RSX-11M

RT-11 CP/M

75 DOS/VDSE MVS/370 VM/370 UNIXV.7 VMS 1.0

80 SYSTEM III 4.1BSD XENIX MS-DOS 1.0 DR/DOS

SUN OS

85 VS MVS/XA VM/XA SYSTEM V AIX POSIX MACH 4.2BSD WIN 3.0 OS/2

90 AIX/370 OSF/1 4.3BSD VMS 5.4 WIN 3.1

SYSTEM V.4

VS/ESA MVS/ES VM/ESA AIX/ESA SOLARIS 2

95 LINUX 4.4BSD WIN NT WIN 9X

00 VMS 7.3 WIN 2000

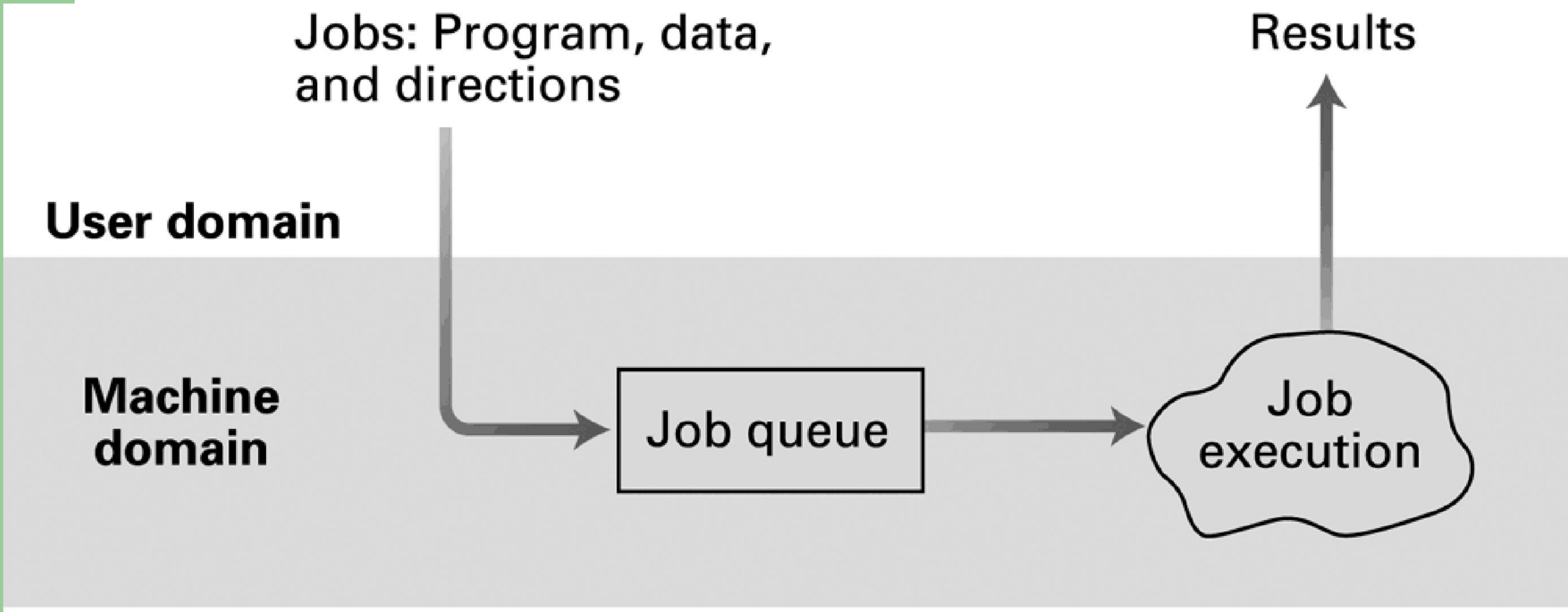
03 LINUX 2.6 SOLARIS 10 WIN XP

WIN Server 2003

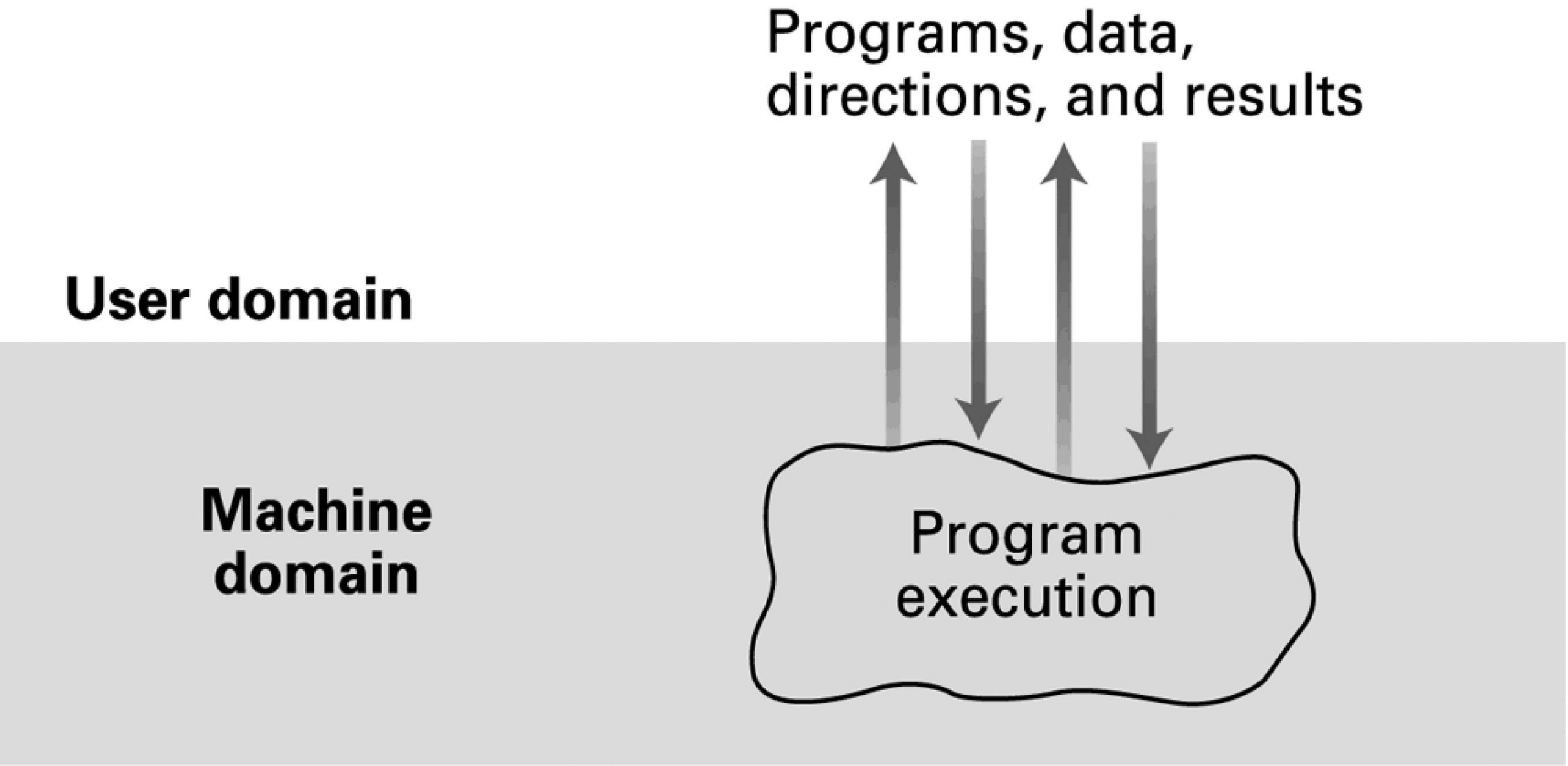
Evolution of Operating system

- 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, Symbinan, 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/conurrent 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