Chapter 1

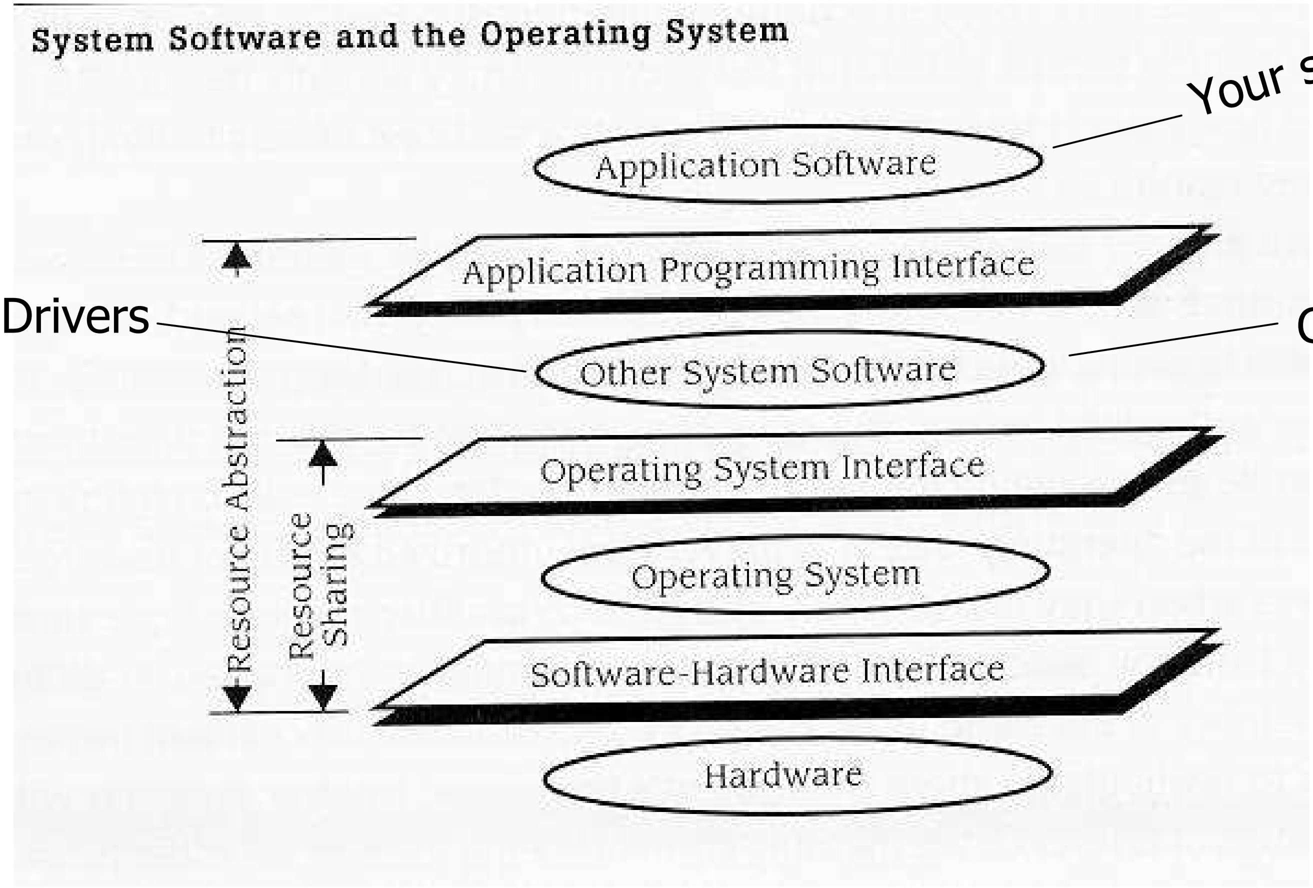
CS 3204: Introduction

What is an Operating System (OS) ?

- Definition 1:
  - An OS is the *interface* between the hardware and the software environment, equivalent to an *extended* or *virtual* machine
- Definition 2:
  - An OS is a *resource manager* – provides “resource abstraction”

- In fact, it achieves 1 through 2.
- Therefore, both definitions are applicable at some times.

System Software and the OS interface



System Software and the Operating System

Your software

Drivers

Editors
Compilers
Loaders

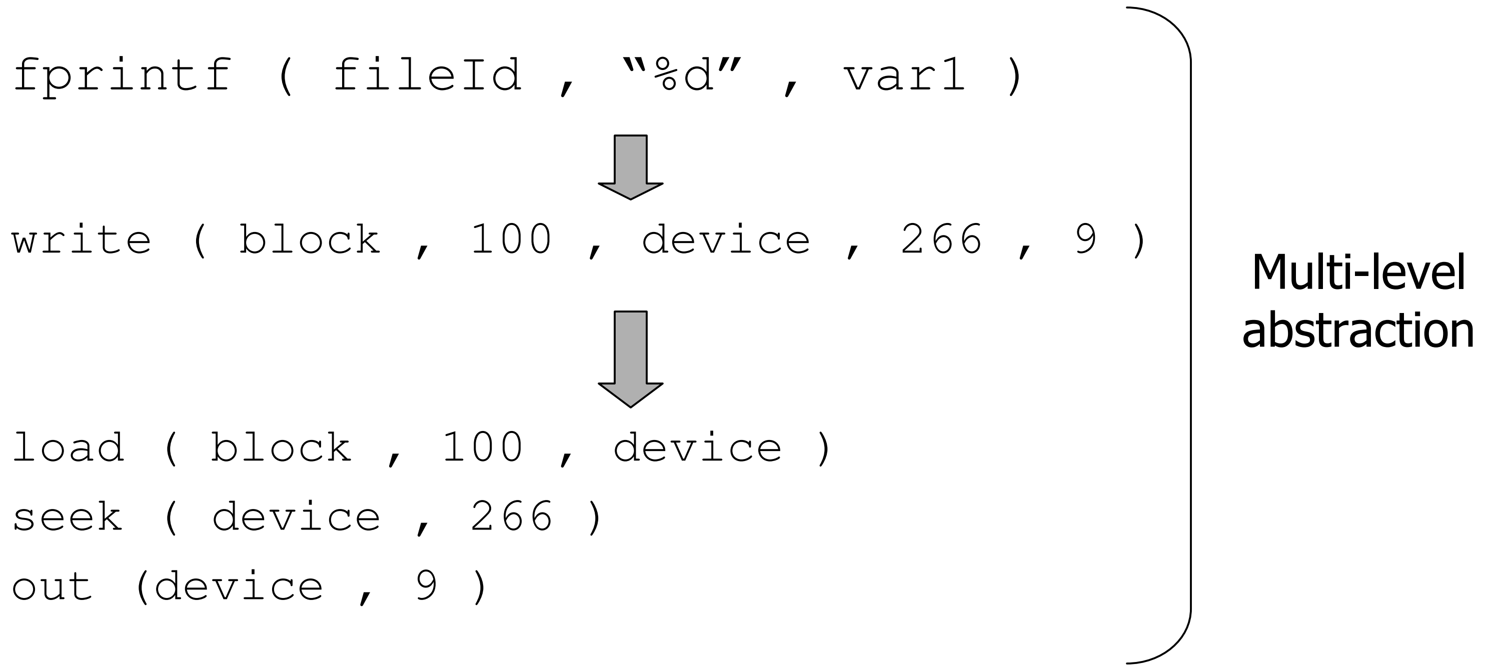
from the textbook

Resource Abstraction

- How does the OS “manage resources” ?
  - By providing *Resource Abstraction* to the other system software and applications
- What is Abstraction ?
  - Abstraction hides the details
- *Resource Abstraction*
  - hides the “nitty-gritty” details of the underlying resource

Resource Abstraction … an example

(Consider the C language statement `fprintf`)



```
fprintf ( fileId , “%d” , var1 )

write ( block , 100 , device , 266 , 9 )

load ( block , 100 , device )
seek ( device , 266 )
out (device , 9 )
```

Multi-level abstraction

Resource Abstraction

- Typical resource abstractions
  - Memory
  - Disk
  - Keyboard
  - Monitor

Resource Sharing

- Managing resources through abstractions implies the ability to *'share resources'*

- Types of Sharing:
  - Space Multiplexed
    - Divided into 2 or more distinct units of resource
    - Example: disk, memory
  - Time multiplexed
    - Exclusive control for a short period of time
    - Example: processor

Resource Sharing

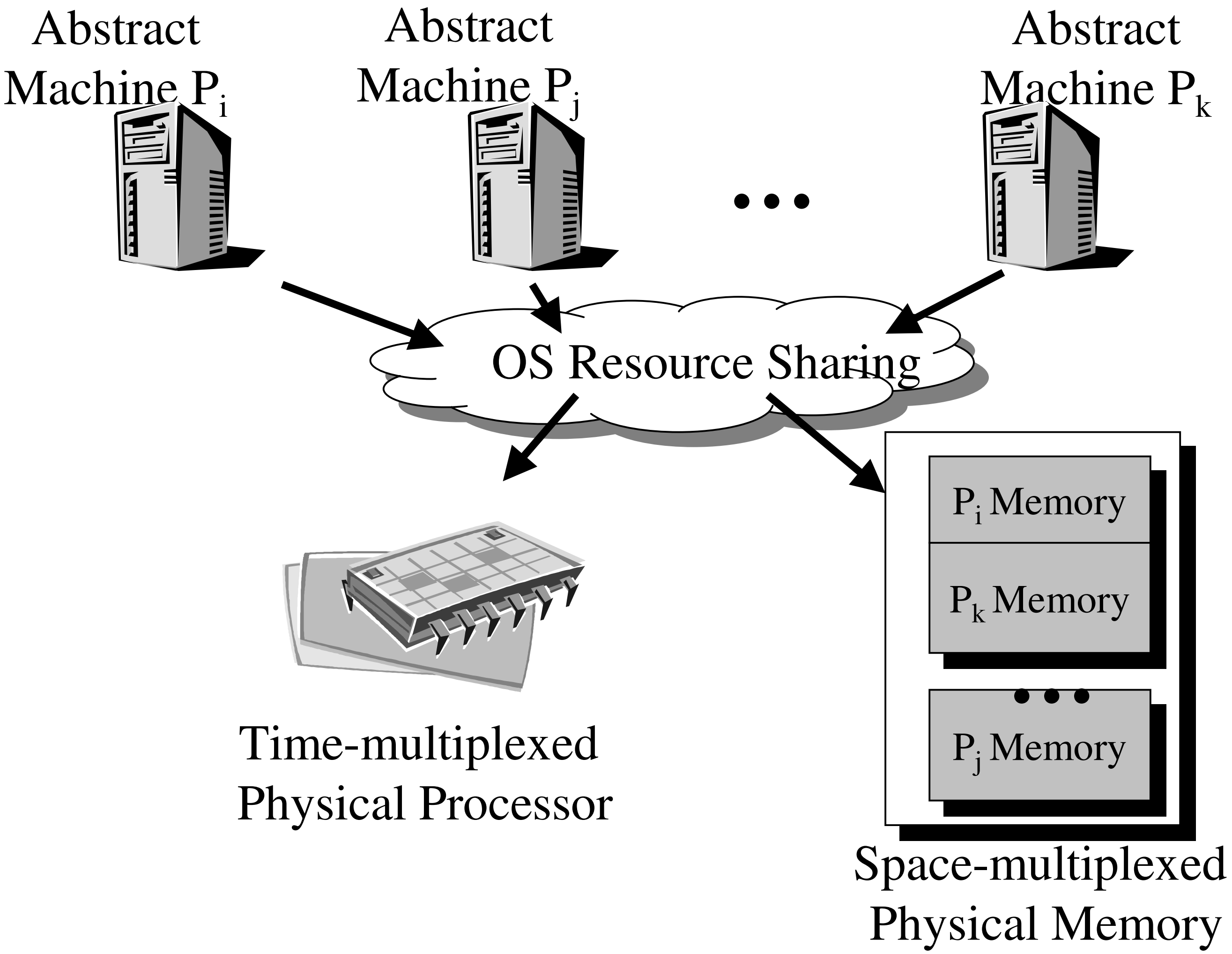
- Multiple processes accessing *same* resource concurrently
- Isolation: only one processor has access at any given time

Terminology

- Concurrency
  - The simultaneous execution of different programs
  - Types of Concurrency

    Problems:
    - **Physical** – multiple processors → Simultaneous access to memory
      - Example: CPU, I/O
    - **Logical** – interleaved execution → Lost updates
      - Example: processes
- Multiprogramming
  - The concurrent execution of multiple programs on a single processor
  - Could be space-multiplexed into memory and time-multiplexed in processors

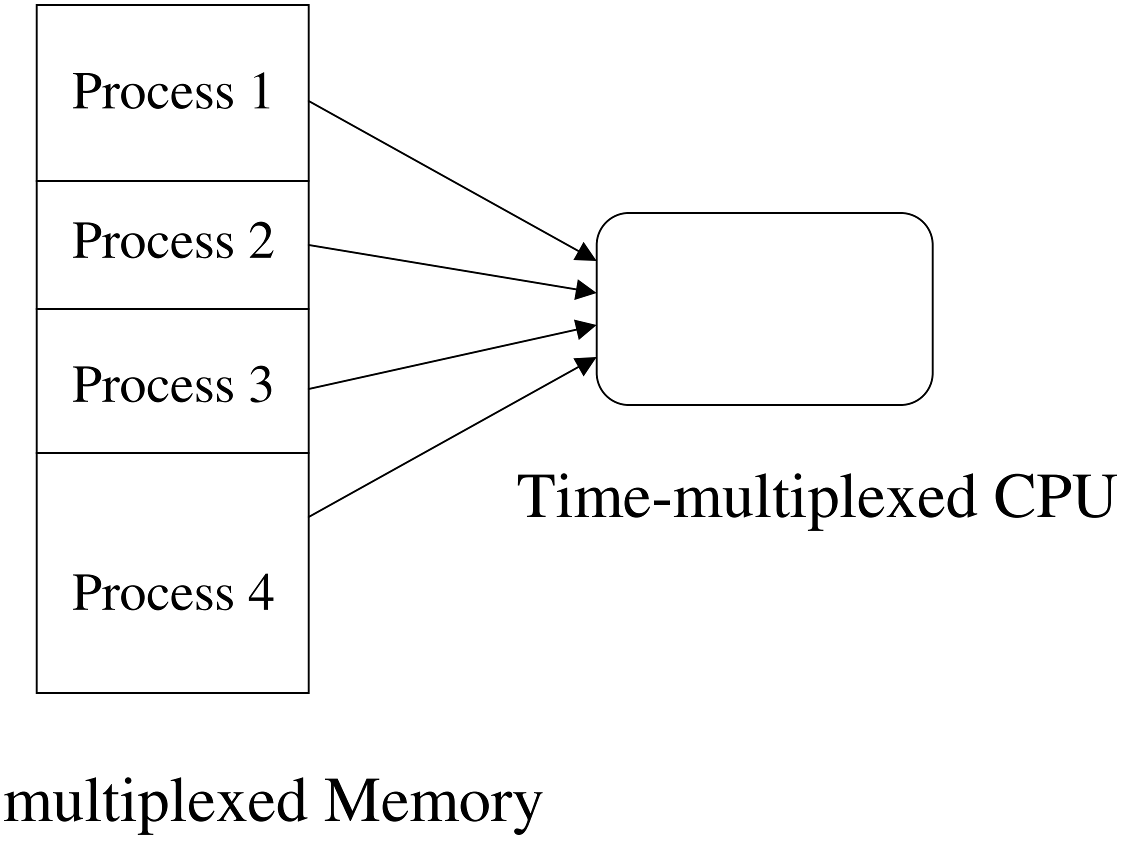
Multiprogramming



Multiprogramming(2)

- Technique for *sharing* the CPU among *runnable* processes
  - Process may be *blocked* on I/O
  - Process may be *blocked* waiting for other resource, including the CPU
- While one process is blocked, another might be able to run
- Multiprogramming OS accomplishes CPU sharing “automatically” – *scheduling*
- Reduces time to run all processes

How Multiprogramming Works



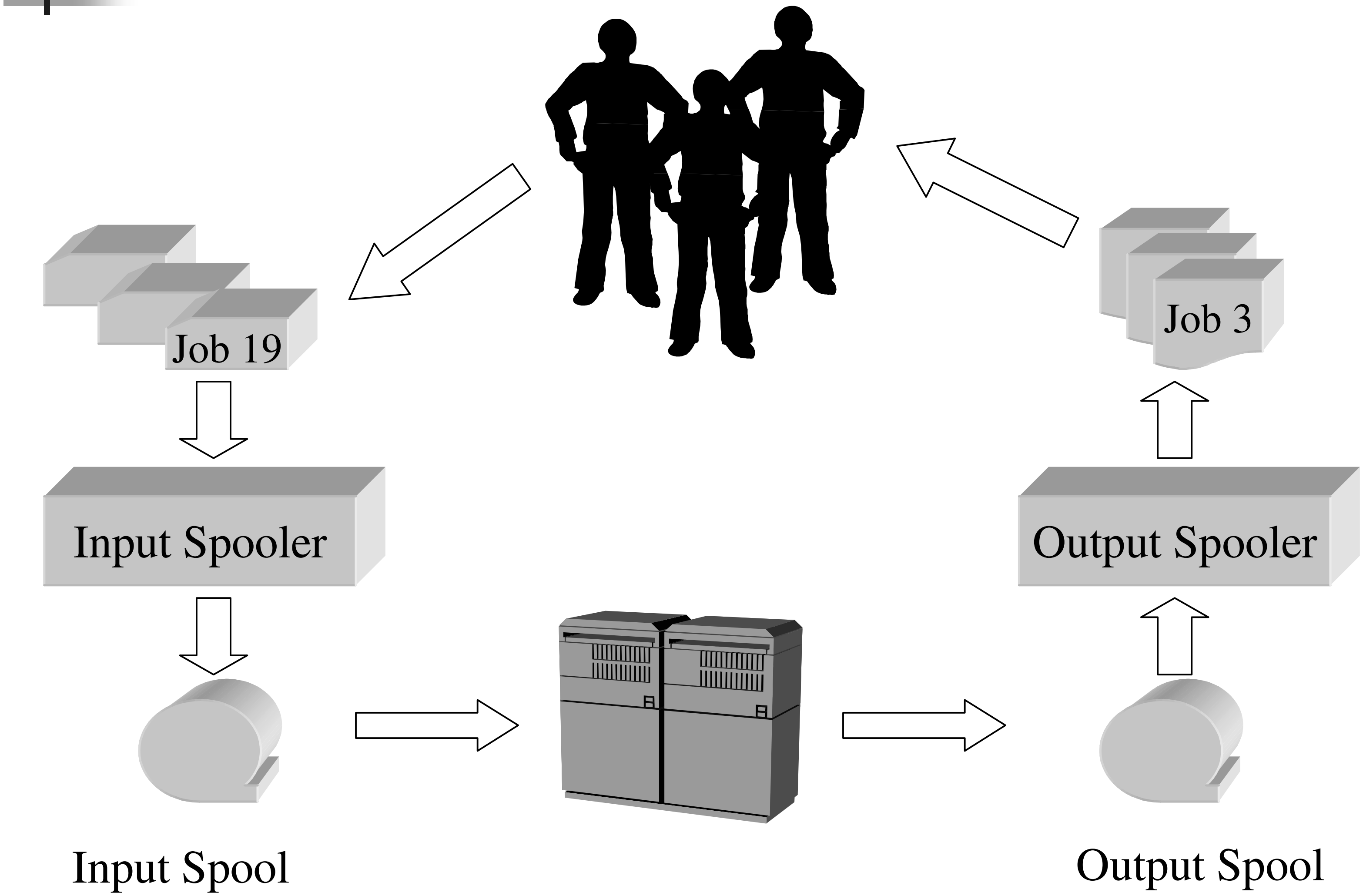
OS Strategies for Providing Services

- Batch
- Time share
- PCs and Workstations
- Process Control & Real-time systems
- Networked
- Distributed
- Small computers

Batch processing systems

- Sequentially loaded set of jobs
- Supported multiprogramming
- Jobs compete for Resources
  - 1st: memory
  - 2nd: processor
  - 3rd: ???
- No “real time” interaction between user and computer
- Current examples include .bat files under DOS – Windows, shell files under Unix/Linux

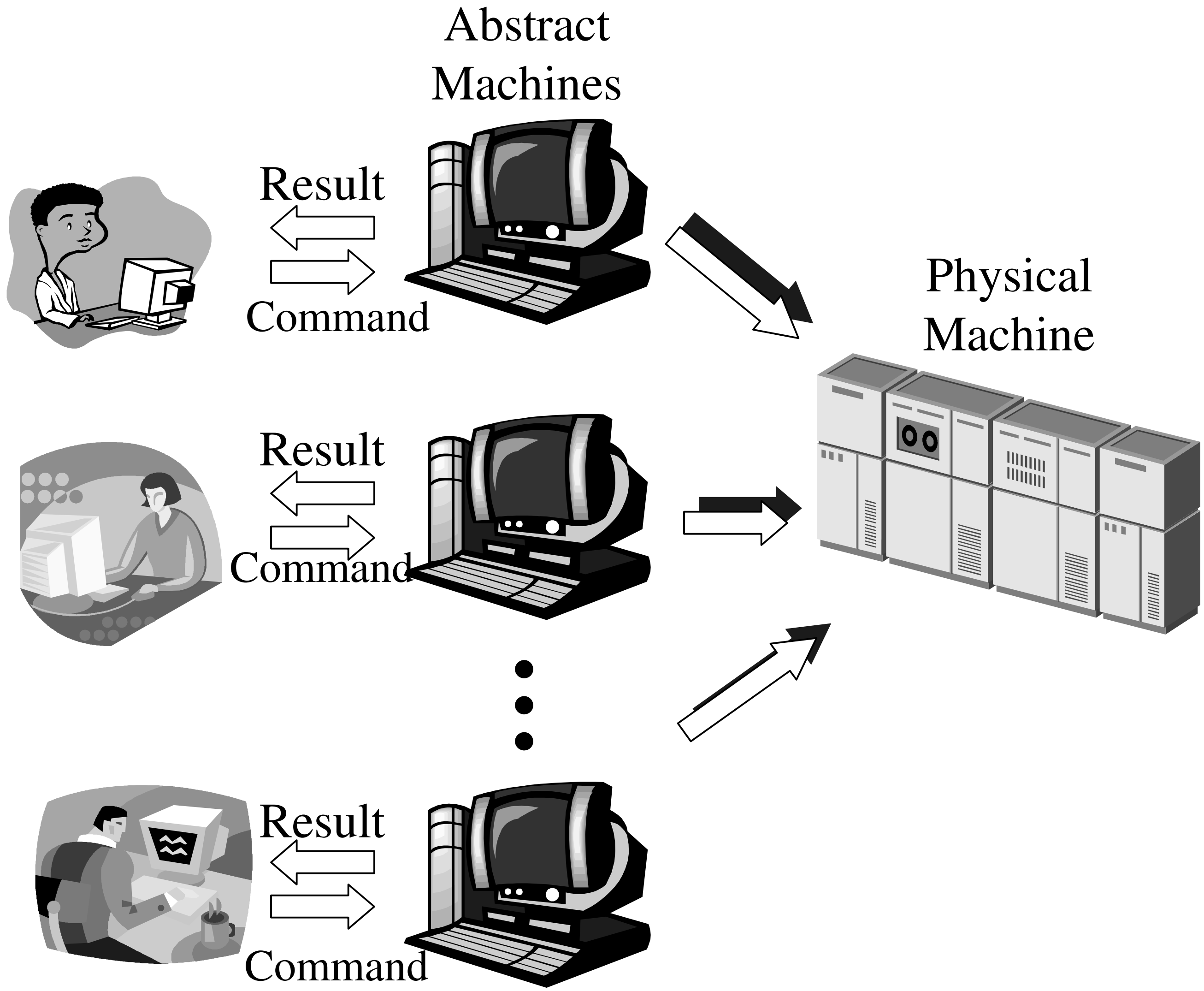
Batch Processing



Time share (1970s)

- Multiprogramming environment
- Multiple interactive users
- Why time-share (TS) ?
  - To spread the cost of large machine
  - To fully utilize computing power
- TS provides each user with his/her own Virtual Machine

Time share system…



Time share… ctd.

- TS eventually supported multitasking
  - Multitasking:
    - A time share system that support multiple processes per user, where.
    - A process is a “program in execution

- TS elevated the importance of
  - Need for barriers and safeguards among users and there processes - User/User & Process/Process
    - Memory protection
    - File Protection

Personal Computers (PCs) & Workstations

- Originally
  - Single User
  - Single Processor
- Now
  - Single or Multiple Users
  - Multiprogrammed

PCs Workstations… Evolution

- Earlier machines
  - Too large, too expensive, and too fast for one person

↘

- Mini-computers
  - Smaller versions (like DEC PDP), yet they too grew in size

↘

- Micro-computer
  - Single chip processor

↘

- Workstation
  - Multiple user
  - Multiprogrammed
  - Multitasking

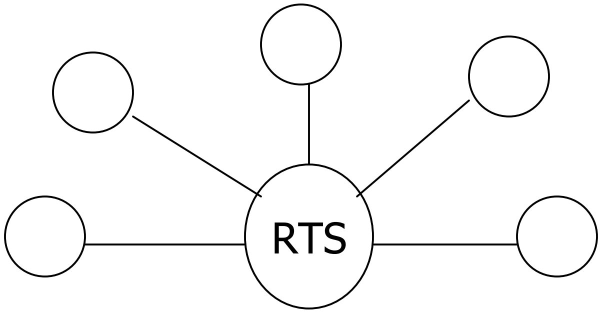
PCs & Workstations… Contribution

- Contributed to the growth of
  - Networking
    - Email
    - File server
  - Point and click interface
    - Like that in Mac and Windows

Process Control & Real time Systems

- Process Control Systems (PCS)
  - Single application monitoring one process
  - Example: System to monitor the heat of a liquid

- Real Time Systems (RTS)
  - Tied together Process Control Systems



Real Time Systems… type

- Hard RTS
  - Had timing constraints that COULD NOT be missed
  - Example: Chemical processes, Nuclear power plants, Defense systems

- Soft RTS
  - Make best effort to accommodate time constraints
  - Example: Transaction processing (ATM)

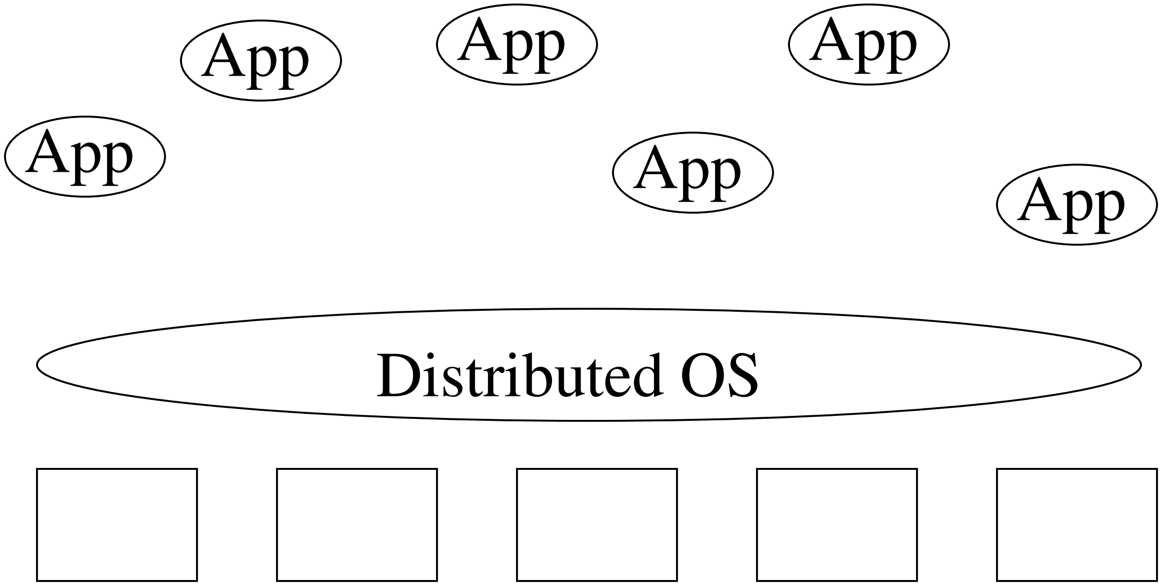
RTS: Tradeoff of generality of operations/functionality
to ensure that deadlines can be made

Networks of Computers

- Problem is too large
  - Partition it among machines
- Communication exchange
  - Email
  - File transfers
- Servers
  - File
  - Printer
  - Database
- Provide access to non-local resources
  - LAN, WAN
  - Client / Server

Distributed OS

- Wave of the future



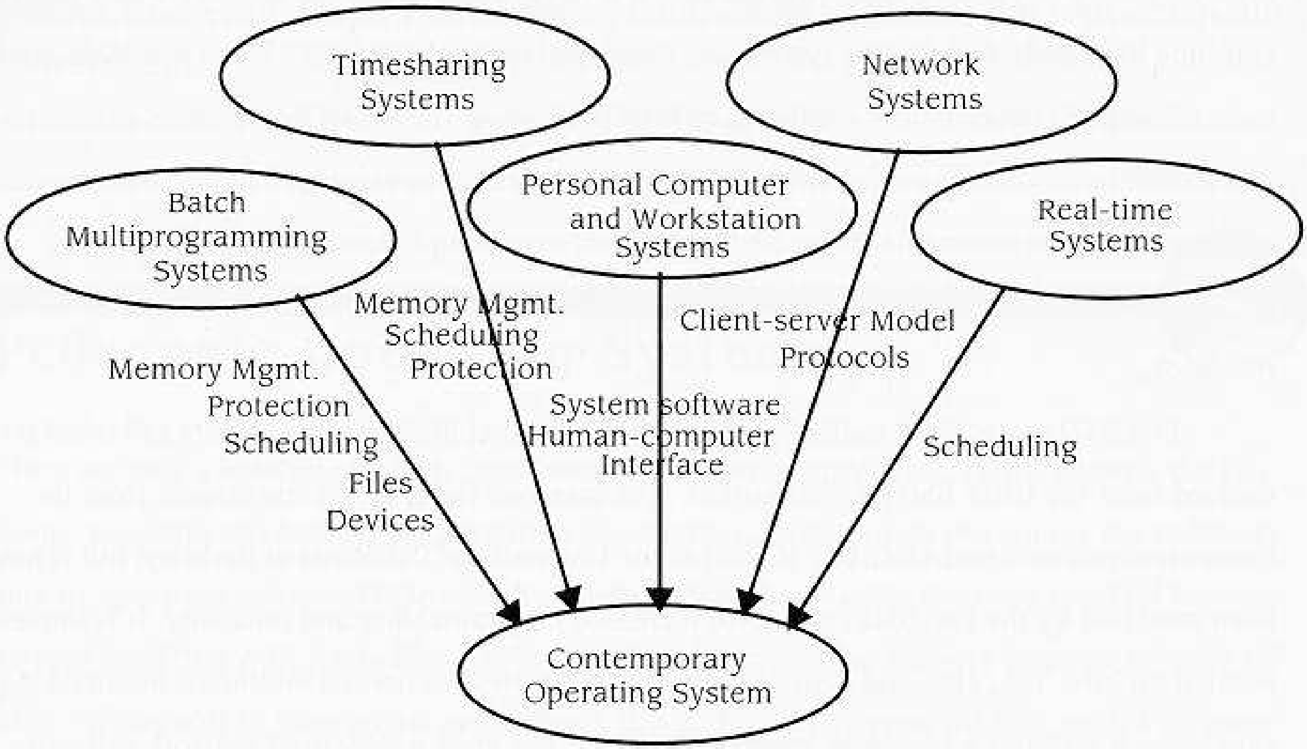
Multiple Computers connected by a Network

Small Computers

- PDAs, STBs, embedded systems became commercially significant
- Have an OS, but
  - Not general purpose
  - Limited hardware resources
  - Different kinds of devices
    - Touch screen, no keyboard
    - Graffiti
  - Evolving & leading to new class of Oses
- PalmOS, Pocket PC (WinCE), VxWorks, …

Summary

The Evolution of Modern Operating Systems


Timesharing Systems
Network Systems
Batch Multiprogramming Systems
Personal Computer and Workstation Systems
Real-time Systems
Memory Mgmt. Scheduling Protection
Client-server Model Protocols
Memory Mgmt. Protection Scheduling Files Devices
System software Human-computer Interface
Scheduling
Contemporary Operating System

from the text book

Examples of Modern OS

- UNIX variants (e.g. Linux) -- have evolved since 1970
- Windows NT/2K -- has evolved since 1989 (much more modern than UNIX
  - Win2K = WinNT, V5
- Research OSes – still evolving …
- Small computer OSes – still evolving …