CSci 3753: Systems

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General Information

- Focus is on operating systems
  - Complies with ACM & IEEE courses
  - Prerequisites: CSci 2270 & ECEN 2220
- Recitations will have new material in them
- Do your work in the NT Lab -- ECCS 123
- No late homework!
- OK to discuss assignments, but:
  - Must develop your own code
  - Cannot look at other’s code
  - Cannot use code in a book

General Information (cont)

- Course grade
  - There will be about ~9 programming assignments
  - (Assign #1 is due September 1)
  - Midterm (15%) -- Tentatively on October 20
  - Final (25%) -- Dec 15@7:30 am
- Office hours: M & T, 3:30-5:00 -- ECOT 521
- Get all information from web page

`http://www.cs.colorado.edu/~nutt/CS3753/base.html`

Introduction

Why Study OS?

- Understand *model of operation*
  - Easier to see how to use the system
  - Enables you to write efficient code
- Learn to design an OS
- Even so, OS is pure overhead of real work
- Application programs have the real value to person who buys the computer

System Software

- Independent of applications, but common to all
- Examples
  - C library functions
  - A window system
  - A database management system
  - Resource management functions

Purpose of an OS (What is Resource Management?)

- Process: An executing program
- Resource: Anything that is needed for a process to run
  - Memory
  - Space on a disk
  - The CPU
- “An OS creates resource abstractions”
- “An OS manages resource sharing”

Resource Abstraction

```
load(block, length, device);
seek(device, 236);
out(device, 9)
```

Resource Abstraction

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seek(device, 236);
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```
write(char *block, int len, int device,
                  int track, int sector) {
   ...
  load(block, length, device);
  seek(device, 236);
  out(device, 9);
   ...
}
```

Resource Abstraction

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```
write(char *block, int len, int device,int addr);
```

Resource Abstraction

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load(block, length, device);
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write(char *block, int len, int device,
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  load(block, length, device);
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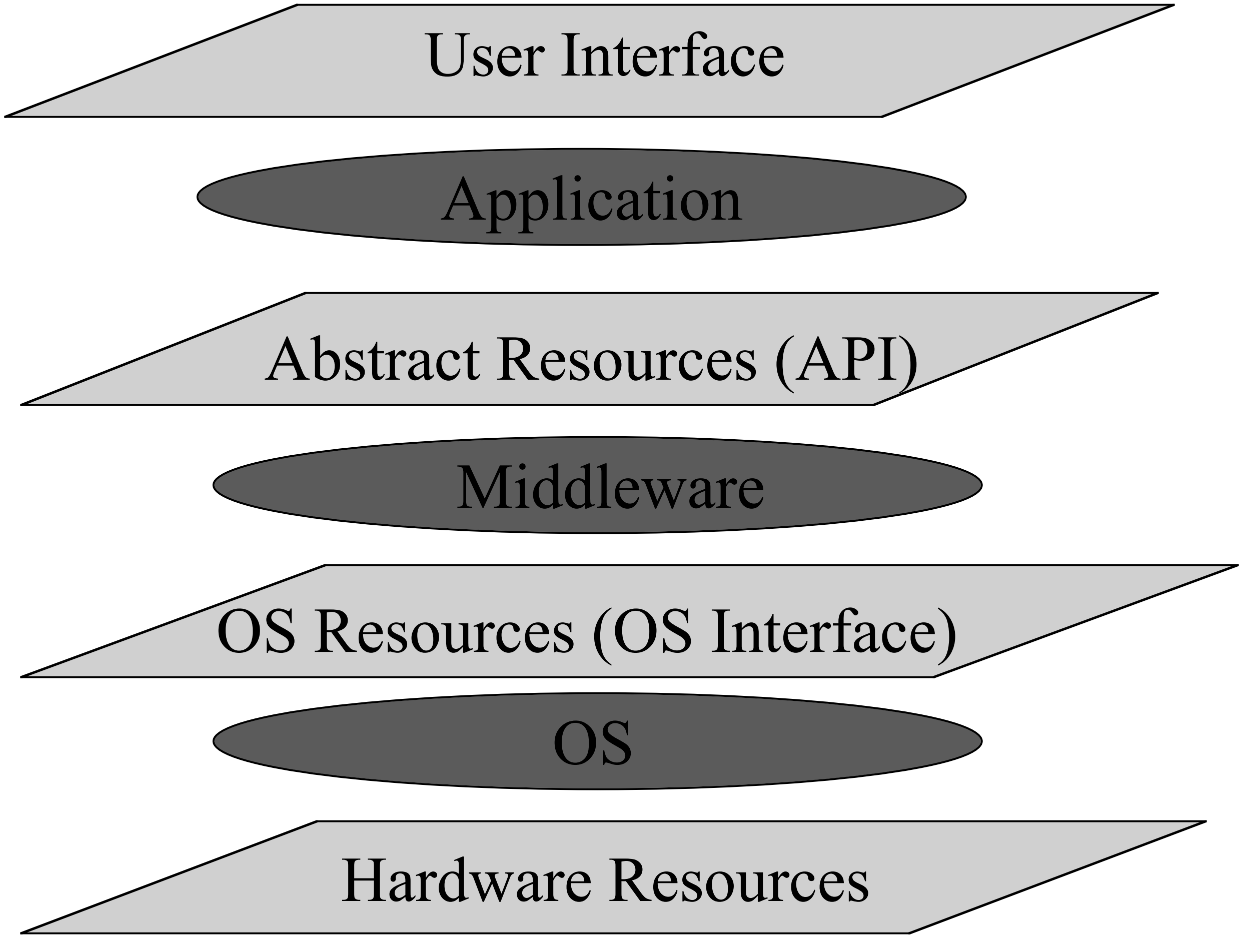
   ...
}
```

```
write(char *block, int len, int device,int addr);
```

```
fprintf(fileID, “%d”, datum);
```

Abstract Resources



User Interface

Application

Abstract Resources (API)

Middleware

OS Resources (OS Interface)

OS

Hardware Resources

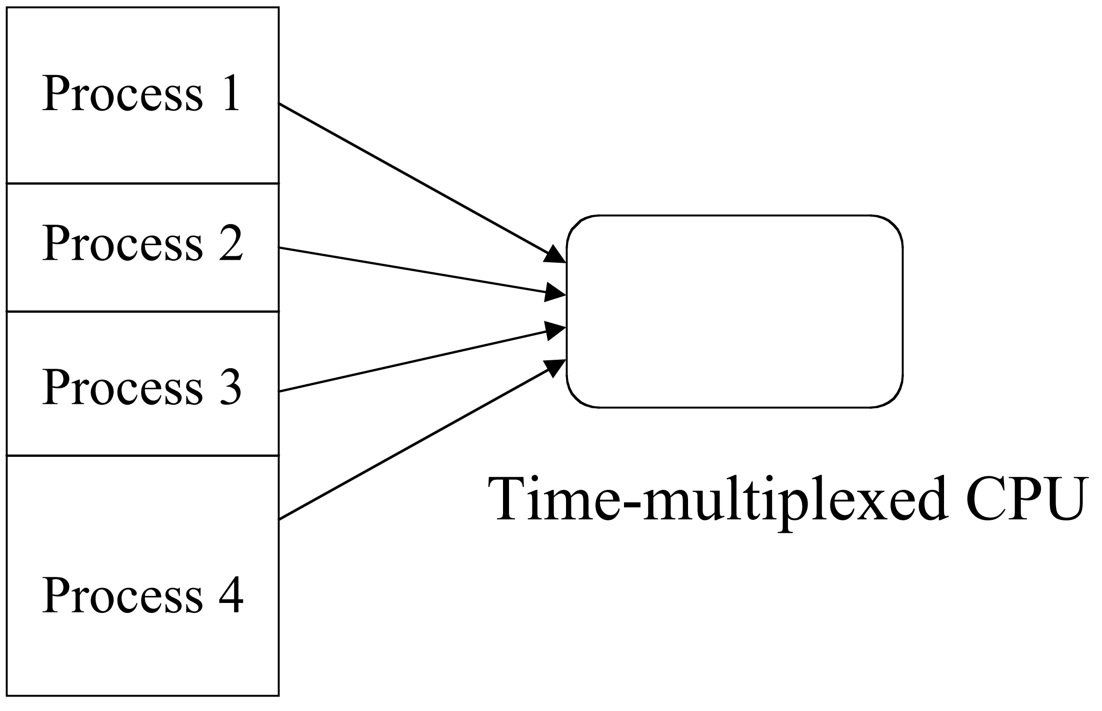
Resource Sharing

- Space- vs time-multiplexed sharing
- To control sharing, must be able to *isolate* resources
- OS usually provides mechanism to isolate, then selectively allows sharing
  - How to isolate resources
  - How to be sure that sharing is acceptable
- Concurrency

Multiprogramming

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

How Multiprogramming Works



Space-multiplexed Memory

OS Strategies

- Batch processing
- Timesharing
- Personal computer & workstations
- Process control & real-time
- Network
- Distributed

Batch Processing

- Uses multiprogramming
- *Job* (file of OS commands) prepared offline
- Batch of jobs given to OS at one time
- OS processes jobs one-after-the-other
- No human-computer interaction
- OS optimizes resource utilization
- Batch processing (as an option) still used today

Timesharing

- Uses multiprogramming
- Support interactive computing model (Illusion of multiple consoles)
- Different scheduling & memory allocation strategies than batch
- Tends to propagate processes
- Considerable attention to resource isolation (security & protection)
- Tend to optimize response time

Personal Computers

- CPU sharing among one person's processes
- Power of computing for personal tasks
  - Graphics
  - Multimedia
- Trend toward very small OS
- OS focus on resource abstraction
- Rapidly evolved to "personal multitasking" systems

Process Control & Real-Time

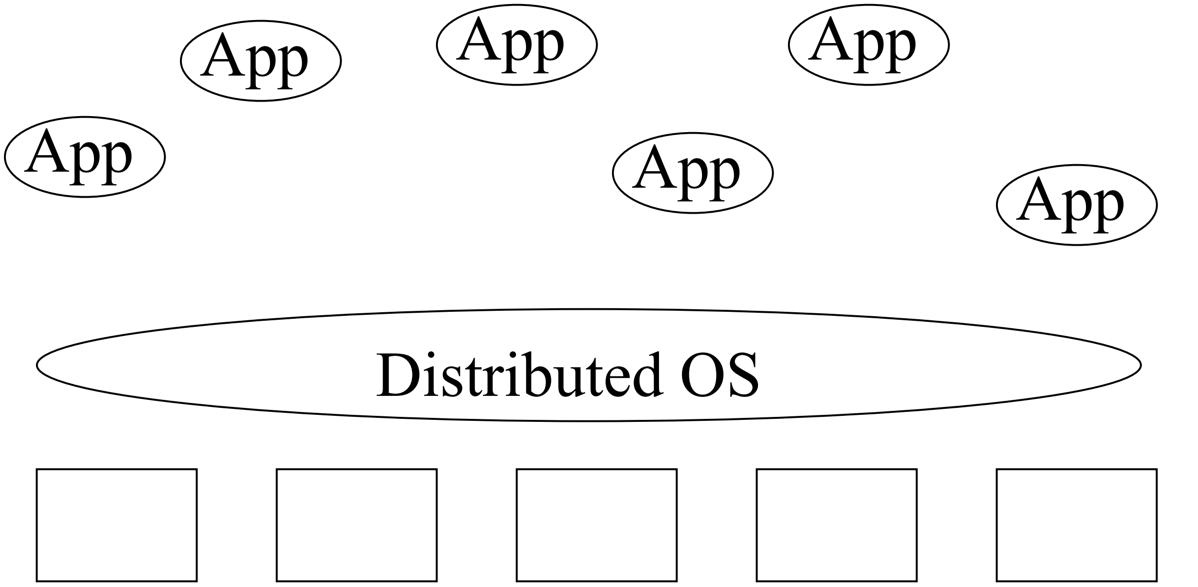
- Computer is dedicated to a single purpose
- Classic embedded system
- Must respond to external stimuli in fixed time
- Continuous media popularizing real-time techniques
- An area of growing interest

Networks

- LAN (Local Area Network) evolution
- 3Mbps (1975) -> 10 Mbps (1980)->100 Mbps (1990)
- High speed communication means new way to do computing
  - Shared files
  - Shared memory
  - ???

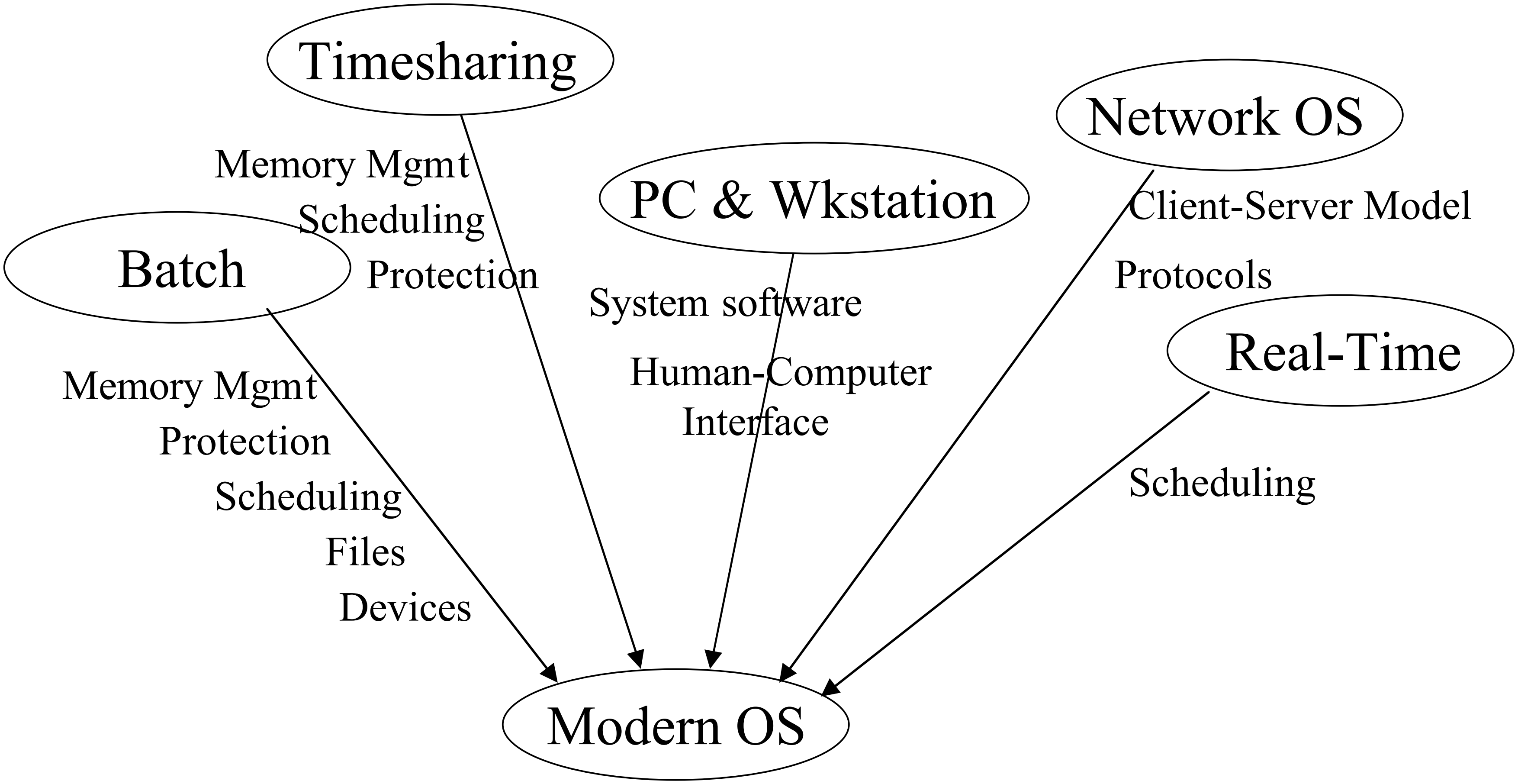
Distributed OS

- Wave of the future



Multiple Computers connected by a Network

Evolution of Modern OS

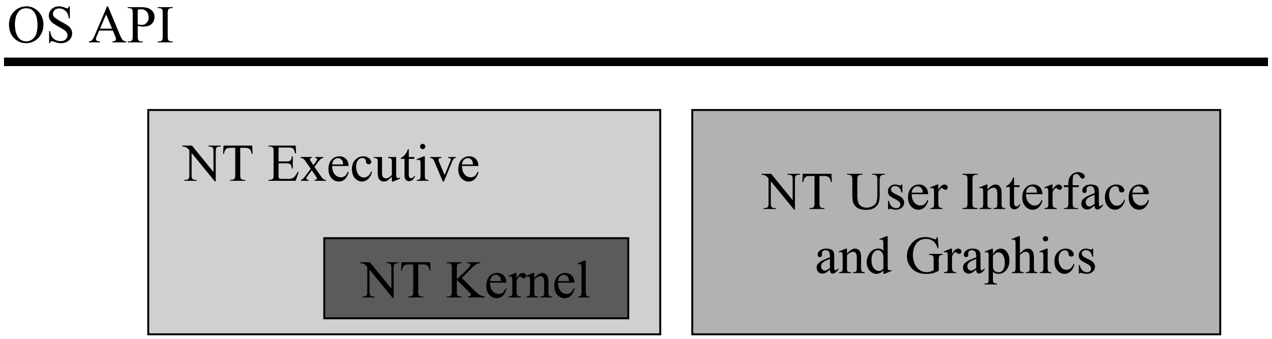


Examples of Modern OS

- UNIX variants -- have evolved since 1970
- Windows NT -- has evolved since 1989 (much more modern than UNIX)
- Research OS -- still evolving …
- Book uses Linux as main example
- This course will use Windows NT as the main example
  - Lab exercises will use NT
  - Supplementary materials will be made available

Microsoft Windows NT

- Heavily window-oriented
- Foundation behavior is windows-independent
  - We will focus on the foundation
  - Use only the "MS-DOS prompt" -- `cmd.exe`



Windows NT (cont)

- OS API has text orientation (like UNIX)
- Object-oriented implementation
- Heavy use of threads
- Broad spectrum of synchronization tools
- Modern I/O system