

CS1550 Fall 2015

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Chapter 1

Overview

A brief overview of the course.

1.1 Operating Systems Manage Resources and Abstract Details

Resources: CPU Time, Memory, I/O Devices, Security

- Operating system needs its own resources to make decisions
- A layered structure between request and resources

Detail Abstraction: Sharing

- device context and method calling
- unified interface for application devices
- exclusive access 1 process on a constrained computer (virtual memory)

Different types of OS open up choices in scheduling algorithms, etc depending on load, tasks, resources

- Mainframes
- Realtime Has dealines on tasks
 - **Soft** - (Can miss dealines) A dvd player and its FPS
 - **Hard** - if a deadline is missed, might as well have not tried (nuclear plant auto-pilot)
- Embedded A Car, A linking library to abstract I/O
- Server Linux is still a server class OS

We will look at medium sized systems since they are constrained enough so we can't be naive, but they have enough resources so that we can share.

In computer science, often the same problem will be solved, historically, twice - Paradigm shifts

Computer time is expensive

Von Neumann Architecture - data and code occupied a unified memory.

We will start with so few resources that we can't share.

Chapter 2

Begin Multiprogramming

Or juggling processes

2.1 How to support multiprogramming

Can I divide RAM?

- A process could access an address that is not in its RAM block
- Protect a block and check?

Where is the best place to do checks? **Hardware can help perform OS tasks** Do I pack tightly in memory? Many Processes but there are issues with **dynamic allocation**

2.2 A Process's Address Space

INSERT FIGURE OF ADDRESS SPACE

All address in range are your process's. None belong to another process.

A large region to support dynamic allocation.

Exclusive Access (This is not real)

- Does not make sense for same reason as dividing RAM – we don't have enough resources
- **The lie of virtual memory**

The OS is a layer between user and resources. Insert CS0449 Diagram. We make system calls from userspace to kernel space. All requests for a resources must go through the OS – you should **not** be able to side step OS.

- Hardware provides us with a Partioned Instruction Set (Some for Userspace, Some for Kernel Space)
- Some instructions are safe (add int)
- Some instructions are priveleged (kernel mode) – Idea of a **mode bit**

If you try a priveleged instruction in user mode, an **exception** is raised and OS sends a **signal** and terminates the process.

Syscalls are mechanistically different than function calls – mode changes. Can't jump and link to our different address space.

A syscall is an interrupt. In x86 you put a trap in `eax`. These are **software interrupts**. Later we will talk about **hardware interrupts**.

Interrupt Vector – Indexed by ints. When interrupt occurs, goes to correct index. Gets address (to syscall handler?)

Syscall table – grab new address for code of the syscall

OS only needs privileged mode to change machine state. Not everything in OS is privileged.

The OS is not the same as other processes. It does not compete for CPU time. It does not schedule itself. It is basically **pure overhead**.

The OS does not need to exist, but we are afraid a process may misbehave. As a result, the OS exists out of practical necessity. We don't really want this, but we have code (OS) and it needs resources. However, the OS only runs when it needs to: Reacting to events. This takes time.

Think back to CS0447 and assembly. On a function call, everything had to be returned to the original state. A clean up needed to be done. Similarly, the OS needs to make room for its code. The **caller context** state will have to be saved and restarted. **A context switch**.

A syscall does not save context. **The OS does it before the syscall**. Context will be saved to RAM and put at the top of the caller's stack.

- Safe
 1. Code was interrupted (caller) – can't execute until OS returns
 2. RAM is a shared resource as a whole – address space abstraction, pieces of memory are mine

We believe that a single context switch is **optimized** (from a hardware/software end). Only way to go faster is to have fewer context switches. If we have two solutions and one uses **fewer** context switches, we will say it goes **faster**.

Resources to protect and share:

- CPU Time – Preemption
- Memory – Virtual Memory
- I/O – Spooling
- Security – *'Tis black magic...' (Cyrus)*

Memory trade off – cost, speed, capacity

There are also hardware interrupts. However the actual action is that of a software interrupt. Think about a **bus signal**. It has some basic steps that allow the OS to react.

2.3 OS Design Schemes

There are two big types of OS Designs: **Monolithic** and **Microkernel**