CMPT 300 — Operating Systems I

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Segment 1:

Overview and History

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What *is* an Operating System?

A Programmer's Toolkit

Provide useful functionality to programs:

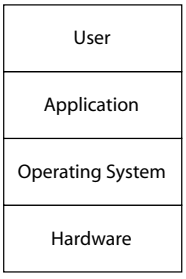
- Prevent duplicated work
- Promote reuse

What *is* an Operating System?

An Abstraction Layer

Make the machine "nicer", easier to program, higher level…

- Hide some of the idiosyncrasies of the machine
- Provide functionality the underlying machine doesn't have



What *is* an Operating System?

A Protection Layer

Make the machine more robust—less scope for a bug to have devastating consequences.

- The operating system does everything programs can't be trusted to do

What *is* an Operating System?

A Policy Enforcer

A machine has various policies: the operating system is the core component in enforcing those policies.

What *is* an Operating System?

A Control Program

Provide the rules for the how the machine will operate:

- Control the operation of the I/O devices
- Ensure smooth running of the machine

What *is* an Operating System?

A Virtual Machine

The operating system provides an *environment*. This environment can be seen as a "new machine"…

- Hardware — physical machine
- + Core OS — virtual machine
- + OS Libraries — virtual machine
- + OS Utilities — virtual machine
- + Application — virtual machine

Class Exercise: Where does the domain of operating systems end and the domain of applications begin?

What *is* an Operating System?

A Resource Manager

The operating system manages physical resources:

- Processor
- Memory
- Storage devices
- Network devices
- *etc….*

What *is* an Operating System?

A Resource Manager (contd.)

The operating system manages virtual resources:

- Processes
- Files
- Users
- Network connections
- Windows

What *is* an Operating System?

A Product

Many operating systems are sold by commercial companies.

- Market vs. Technical considerations
- The operating system is what comes in the box marked "operating system".

What *kinds* of Operating Systems are there?

Operating systems vary, just like computer systems vary.

Class Exercise: Develop a taxonomy to describe computer systems…

What *kinds* of Computer Systems are there?

A Quick Taxonomy

Special-purpose — General-purpose
Single-process — Multi-process
Single-user — Multi-user
Non–Resource-sharing — Resource-sharing
Single-processor — Multi-processor
Stand-alone — Networked
Centralized — Distributed
Batch — Interactive
Deadline-free — Real-time
Insecure — Secure
Symmetric — Asymmetric
Simple — Complex
Small — Large
Inexpensive — Expensive
etc.

Early Computers

1950s — large complex machines

- Operated directly from a console
- Used interactively by a single-user
- Ran one program at a time (uniprogramming)
- Read data from paper tape, punched cards, or toggle switches

A library containing code to work the I/O devices is useful.

Simple Batch Systems

Provide better use of resources:

- Users access computer indirectly
- Programs and input (*jobs*) taken from a *batch queue*
- Computer has a human operator to feed it jobs

Needs an operating system to manage the jobs:

- Need to protect the next program from the behaviour of the previous program

Thus, the operating system needs to:

- Mediate all device access
- Protect memory and processor

SPOOLing Batch Systems

Provide better use of resources — buffer input and output

- Read-ahead input from disk/tape
- Write-behind output to disk/tape

Class Exercise: Why *does* buffering improve performance?

Does buffering *always* improve performance? What assumptions are we making about I/O?

Mutliprogrammed Batch Systems

Provide better use of resources — multiplex the processor:

- Run multiple independent programs at once
- Switch to another program when running program waits for I/O

More work for the operating system:

- I/O, Memory, and Processor management become more necessary and more complex

Time-Sharing Systems

Provide better environment for users — multiplex the processor between users:

- Run multiple independent programs at once
- Switch between users rapidly, so each has the illusion of having the machine's full attention

More work for the operating system:

- I/O, Memory and Processor management become more necessary and more complex

Segment Review

You should be able to:

- Explain what an operating system is in basic terms
- Discuss the different roles an operating system fulfills
- Classify computer systems