Welcome to OS @ UNSW

COMP3231/9201/3891/9283

(Extended) Operating Systems

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Q & A

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Back to Operating Systems

Chapter 1 – 1.3

Chapter 1.5 – 1.9

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Learning Outcomes

- High-level understand what is an operating system and the role it plays
- A high-level understanding of the structure of operating systems, applications, and the relationship between them.

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What is an Operating System?

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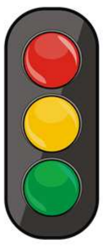
What is a traffic light?

- A signalling device that controls the flow of traffic
  - Defined in terms of the **role** it plays
- A signalling device consisting of three lights mounted at an intersection
  - Defined in terms of what it **is**



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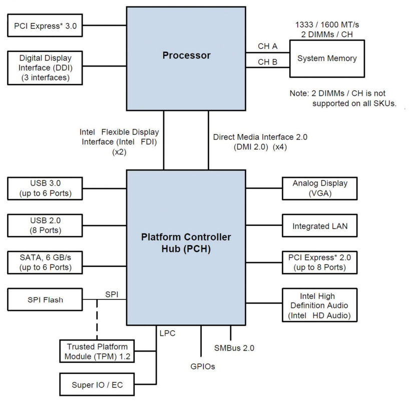
PCI Express* 3.0
Digital Display Interface (DDI) (3 interfaces)
Processor
1333 / 1600 MT/s 2 DIMMs / CH
CH A
CH B
System Memory
Note: 2 DIMMs / CH is not supported on all SKUs.
Intel Flexible Display Interface (Intel FDI) (x2)
Direct Media Interface 2.0 (DMI 2.0) (x4)
USB 3.0 (up to 6 Ports)
USB 2.0 (8 Ports)
SATA, 6 GB/s (up to 6 Ports)
SPI Flash
SPI
Platform Controller Hub (PCH)
Analog Display (VGA)
Integrated LAN
PCI Express* 2.0 (up to 8 Ports)
Intel High Definition Audio (Intel HD Audio)
Trusted Platform Module (TPM) 1.2
LPC
SMBus 2.0
GPIOs
Super IO / EC

Block Diagram of Haswell Platform Architecture http://www.pcquest.com

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Role 1: The Operating System is an Abstract Machine

- Extends the basic hardware with added functionality
- Provides high-level abstractions
  - More programmer friendly
  - Common core for all applications
    - E.g. Filesystem instead of just registers on a disk controller
- It hides the details of the hardware
  - Makes application code portable

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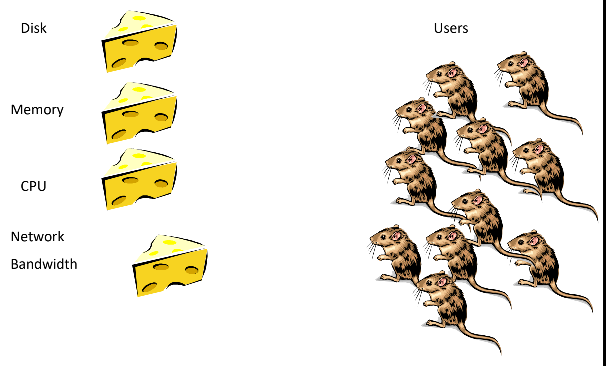

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Role 2: The Operating System is a Resource Manager

- Responsible for allocating resources to users and processes
- Must ensure
  - No Starvation
  - Progress
  - Allocation is according to some desired policy
    - First-come, first-served; Fair share; Weighted fair share; limits (quotas), etc…
  - Overall, that the system is efficiently used

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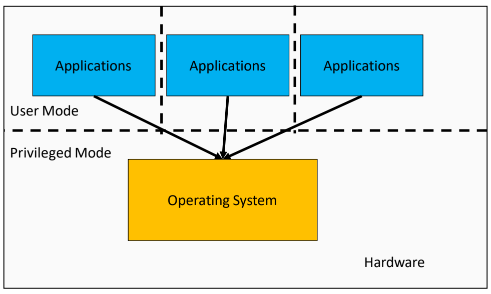
Structural (Implementation) View: the Operating System *is* the software *Privileged* mode.



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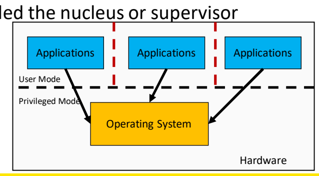
Operating System Kernel

- Portion of the operating system that is running in *privileged mode*
- Usually resident (stays) in main memory
- Contains fundamental functionality
  - Whatever is required to implement other services
  - Whatever is required to provide security
- Contains most-frequently used functions
- Also called the nucleus or supervisor



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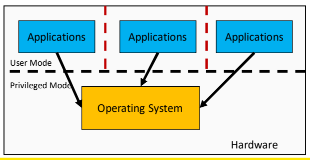
The Operating System is Privileged

- Applications should not be able to interfere or bypass the operating system
  - OS can enforce the "extended machine"
  - OS can enforce its resource allocation policies
  - Prevent applications from interfering with each other



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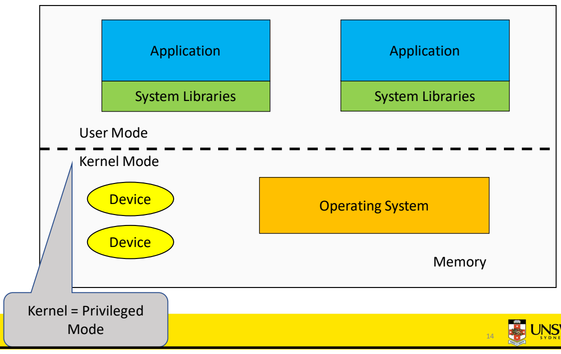
Delving Deeper: The Structure of a Computer System



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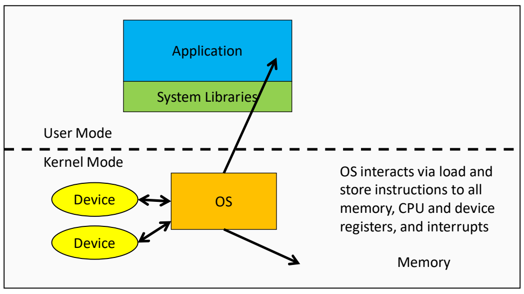
The Structure of a Computer System



OS interacts via load and store instructions to all memory, CPU and device registers, and interrupts

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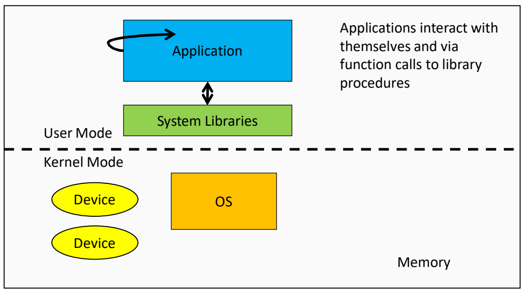
The Structure of a Computer System



Applications interact with themselves and via function calls to library procedures

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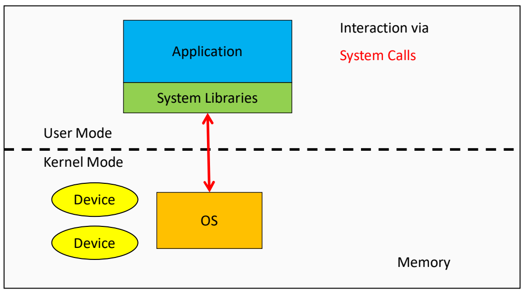
The Structure of a Computer System



Interaction via
System Calls

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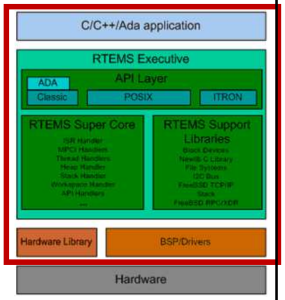
Privilege-less OS

- Some Embedded OSs have no privileged component
  - e.g. PalmOS, Mac OS 9, RTEMS
  - Can implement OS functionality, but cannot enforce it.
    - All software runs together
    - No isolation
    - One fault potentially brings down entire system



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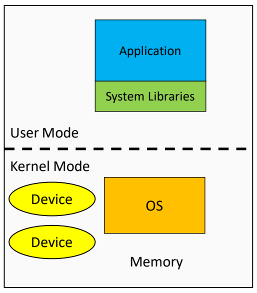
A Note on System Libraries

System libraries are just that, libraries of support functions (procedures, subroutines)

- Only a subset of library functions are actually system calls
  - strcmp(), memcpy(), are pure library functions
    - manipulate memory within the application, or perform computation
  - open(), close(), read(), write() are system calls
    - they cross the user-kernel boundary, e.g. to read from disk device
    - Implementation mainly focused on passing request to OS and returning result to application
- System call functions are in the library for convenience
  - try `man syscalls` on Linux

Operating System Software

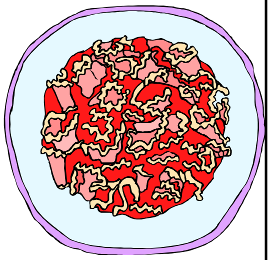
- Fundamentally, OS functions the same way as ordinary computer software
  - It is machine code that is executed (same machine instructions as application)
  - It has more privileges (extra instructions and access)
- Operating system relinquishes control of the processor to execute other programs
  - Reestablishes control after
    - System calls
    - Interrupts (especially timer interrupts)



Operating System Internal Structure?

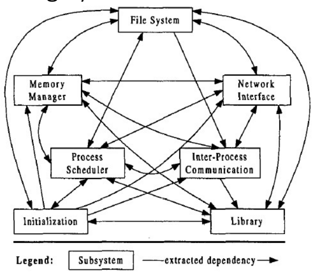
The Monolithic Operating System Structure

- Also called the “spaghetti nest” approach
  - Everything is tangled up with everything else.
- Linux, Windows, ….

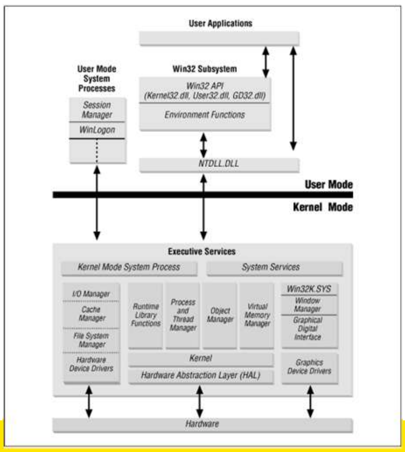


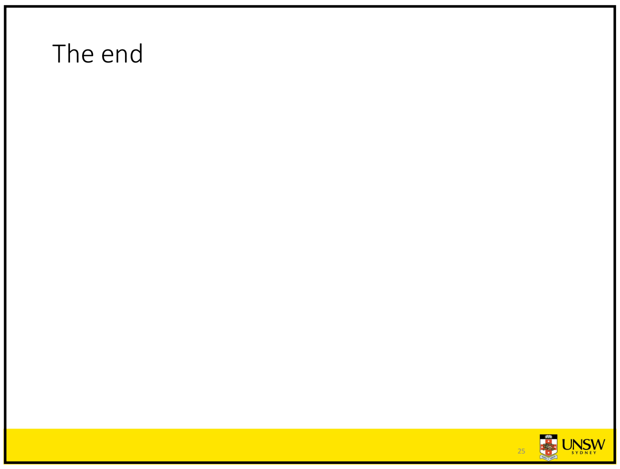
The Monolithic Operating System Structure

- However, some reasonable structure usually prevails



Bowman, I. T., Holt, R. C., and Brewster, N. V. 1999. Linux as a case study: its extracted software architecture. In *Proceedings of the 21st international Conference on Software Engineering* (Los Angeles, California, United States, May 16 - 22, 1999). ICSE '99. ACM, New York, NY, 555-563. DOI= http://doi.acm.org/10.1145/302405.302691





The end

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