Operating Systems

COSC-361

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Definitions

- operating system - software that marshals between hardware and software
- kernel - the "executable" containing all of the OS code
- input - data from hardware into operating system
- output - data from operating system to hardware

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Abstraction

- Operating systems provide an interface for applications to use.
  - Takes away the need to code towards a particular CPU/machine.
  - OS deals with the minutia, small details. User space is free just to have a standard interface to use.

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Virtualization

- The OS can create an illusion for programs.
  - Uniprocessor systems can be given the illusion of a multiprocessor system.
  - OS can schedule which processor gets which task.
  - OS can make all filesystems look the same
    - Half the time, you don't even know which file system you're using!

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Services

- OS may offer "services", such as priorities on tasks, network stack, etc.
- OS can act as a resource manager, especially in multiple-user environments.
  - User A writes to hard disk
  - User B writes to hard disk
  - Should OS write A's before B's or B's before A's
    - Which is the most efficient?

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Idle

- Non-mobile OSes try to keep all resources busy at all times to accelerate programs.
- Idle loop uses CPU instructions to put the CPU to sleep.
  - The sleep is interrupted by hardware timer

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Types

- Several design choices can be made.
- Monolithic kernel
  - The entire OS is in "kernel space" and runs in supervisor mode (privileged CPU mode).
- Micro kernel
  - User services (typically made by system calls) are in user space, even if controlled by the kernel.
- Hybrid kernel
  - Some combination of a monolithic and micro kernel.

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CPU Modes

- How does the kernel prevent user space from executing privileged instructions?
- CPU modes
  - User mode - the least privileged mode. Can execute the smallest subset of instructions. Cannot change memory maps.
  - Supervisor mode - a privileged mode, typically used by the kernel. Can allocate/deallocate memory maps. Called "kernel mode"
  - Machine mode - the highest privileged mode, typically reserved for reconfiguring CPU systems.

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Switching Modes

- Supervisor mode can switch itself into user mode
- User mode must use a system call or the hardware must interrupt the CPU to elevate its mode.

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Hypervisor mode

- Some CPUs support hypervisor mode.
- Typically used for supporting multiple virtual machines.
- CPU is responsible for allocating resources and virtualizing hardware.

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Mobile Operating Systems

- Mobile operating systems have a radically different challenge.
  - How to balance power and speed.
  - When to power off certain devices.
    - Which devices require a longer "spin-up" time?
    - Which use the most power?

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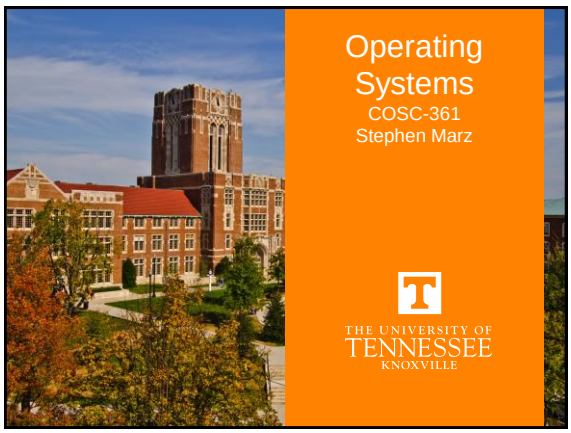

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