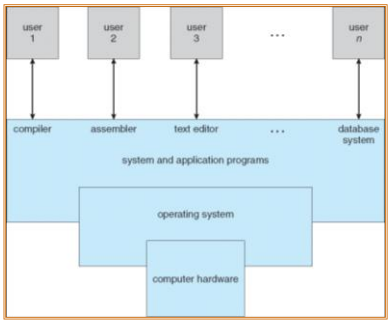
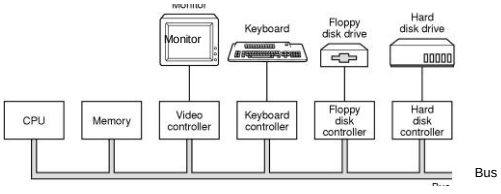
Hardware

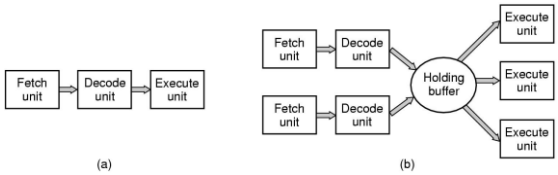
Four Components of a Computer System



Computer Hardware Review: A simple PC

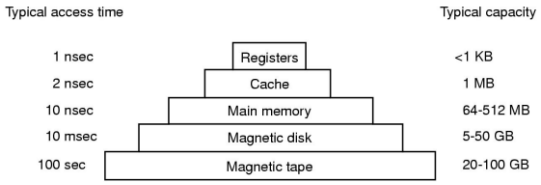


Computer Hardware Review:Instruction execution



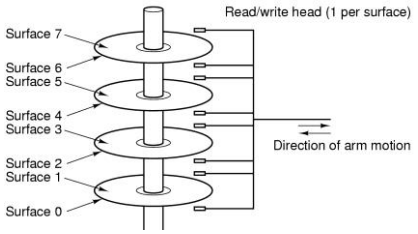
(a) A three-stage pipeline
(b) A superscalar CPU

Computer Hardware Review:Typical memory hierarchy

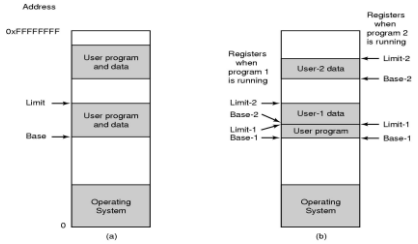


– numbers shown are rough approximations

Computer Hardware Review: Disk Drive

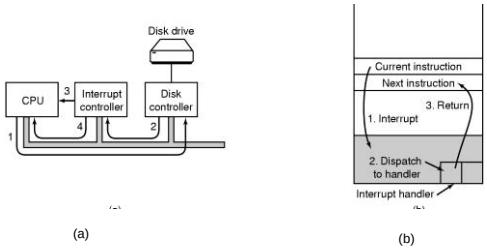


Computer Hardware Review:partitioned memory



(a) different programs with own base and limit registers;
(b) two programs running the same text but different data

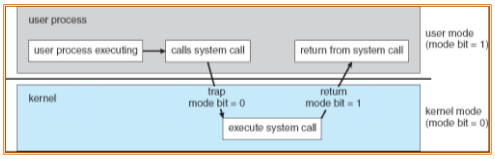
Computer Hardware Review:Hardware Interrupt



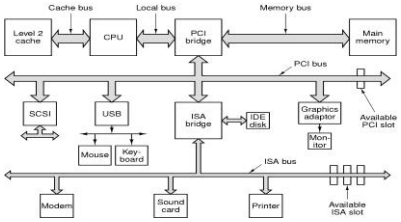
(a) Steps in starting an I/O device and getting interrupt
(b) How the CPU is interrupted

Transition from User to Kernel Mode

- Timer to prevent infinite loop / process hogging resources
  - Set interrupt after specific period

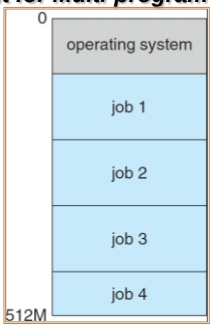


Computer Hardware Review:iPentium



Structure of a large Pentium system: PCI-Peripheral Component Interconnect; SCSI- Small Computer System Interface; ISA-Industry Standard Architecture; IDE-Integrated Disk Electronics or EIDE-Enhanced IDE

Memory Layout for Multi-program System



Process Management Activities

- Creating processes
- Suspending and resuming processes
- Process synchronization
- Process communication
- Deadlock handling

Memory Management

- Memory management activities
  - Keeping track of which parts of memory are currently being used and by whom
  - Deciding which processes (or parts thereof) and data to move into and out of memory
  - Allocating and deallocating memory space as needed

Storage Management

- OS provides uniform, logical view of information storage
  - Abstracts physical properties to logical storage unit - **file**
- File-System management
  - Creating and deleting files and directories
  - Primitives to manipulate files and dirs
  - Mapping files onto secondary storage
  - Backup files onto stable (non-volatile) storage media

Mass-Storage Management

- OS activities
  - Free-space management
  - Storage allocation
  - Disk scheduling
- Some storage need not be fast
  - Optical storage, magnetic tape

I/O Subsystem

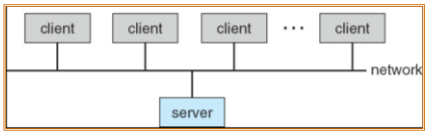
- I/O subsystem responsible for
  - Memory management of I/O including buffering (storing data temporarily while it is being transferred), caching (storing parts of data in faster storage for performance), spooling (the overlapping of output of one job with input of other jobs)
  - General device-driver interface

Protection and Security

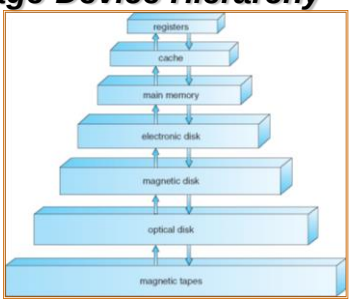
- **Protection** – any mechanism for controlling access of processes or users to resources defined by the OS
- **Security** – defense of the system against internal and external attacks
- Systems generally first distinguish among users, to determine who can do what.

Computing Environments (Cont.)

- *Client-Server Computing*
  - *Dumb terminals supplanted by smart PCs*
  - *Many systems (servers), responding to requests generated by clients*
    - *Compute-server provides an interface to client to request services (i.e. database)*
    - *File-server provides interface for clients to store and retrieve files*



Storage-Device Hierarchy



Caching

- Information in use copied from slower to faster storage temporarily
- Faster storage (cache) checked first to determine if information is there
  - If it is, information used directly from the cache (fast)
  - If not, data copied to cache and used there
- Cache is smaller than storage being cached. Its management is important design problem

Performance of Various Levels of Storage

- Movement between levels of storage hierarchy can be explicit or implicit

Level	1	2	3	4
Name	registers	cache	main memory	disk storage
Typical size	< 1 KB	> 16 MB	> 16 GB	> 100 GB
Implementation technology	custom memory with multiple ports, CMOS	on-chip or off-chip CMOS SRAM	CMOS DRAM	magnetic disk
Access time (ns)	0.25 – 0.5	0.5 – 25	80 – 250	5,000,000
Bandwidth (MB/sec)	20,000 – 100,000	5000 – 10,000	1000 – 5000	20 – 150
Managed by	compiler	hardware	operating system	operating system
Backed by	cache	main memory	disk	CD or tape