CS323 Operating Systems

Deadlock III & Memory Management

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Lecture 13

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Content of this lecture

- Administrative announcements
- Deadlock recovery
- Summary

Administrative

- None

Review

- Resource: preemptible or non-preemptible
- Deadlock avoidance
  - Unsafe vs. safe state
  - Banker algorithm
- Deadlock detection
  - Wait graph

Recovery From Deadlock

OPTIONS:

- Kill deadlocked processes and release resources
- Kill one deadlocked process at a time and release its resources
- Rollback all or one of the processes to a checkpoint that occurred before they requested any resources

Note: with rollback, difficult to prevent indefinite postponement

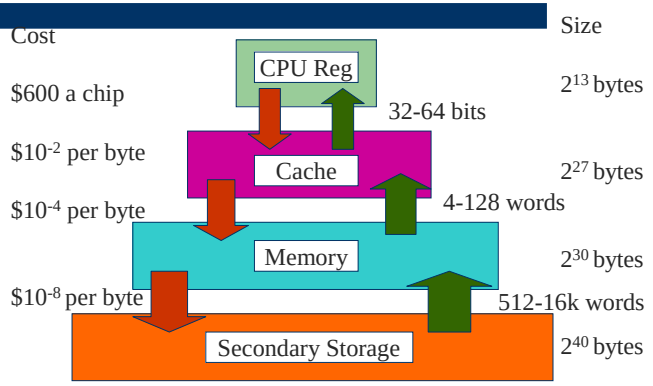
Deadlock Summary

- In general, deadlock detection or avoidance is expensive
- Must evaluate cost of deadlock against detection or avoidance costs
- Deadlock avoidance and recovery may cause indefinite postponement

Memory Management

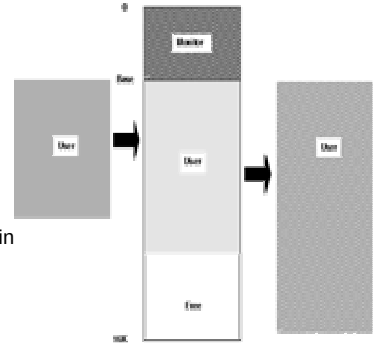
- Storage Hierarchy
- Resident Monitor
- Fixed Partitions for Spooling and Multiprogramming
- Variable Sized Partitions
- Storage Placement Strategies
- Compaction

Storage Hierarchy



Memory Manager

- Manage memory hierarchy
  - Monitor used and free memory
  - Allocate memory to processes
  - Reclaim (De-allocate) memory
  - Swapping between main memory and disk

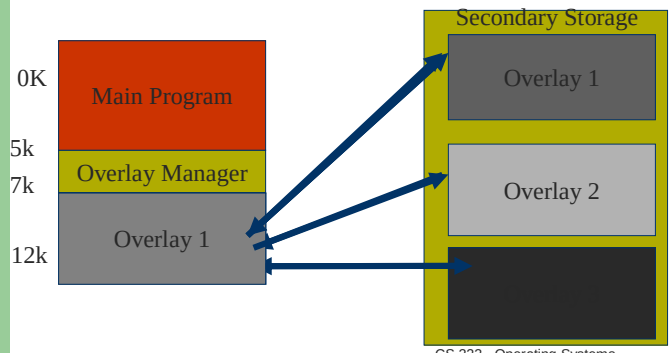


Mono-programming without Swapping

- Run one process at a time
  - simplest possible memory management scheme
- Memory is shared only between OS and the process.
- Three different ways to organize memory:
  - OS at the bottom of memory in RAM (Random Access Memory); was used in mainframes and minicomputers; not used anymore
  - OS is in ROM (Read-Only Memory) at the top of memory; is used in some palm-tops and embedded systems
  - Device drivers are in ROM at the top of memory and the rest is in RAM; was used by early PCs (e.g., running MS-DOS), where the portion in the ROM is called BIOS (Basic Input Output System).

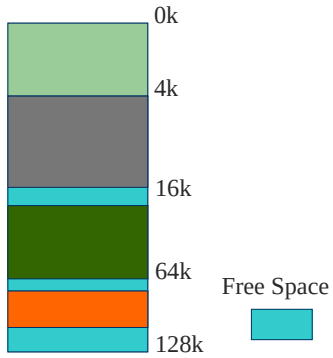
Overlaying

Used when process memory requirement exceeds the physical memory space



Multiprogramming with Fixed Partitions

- Divide memory into n (possible unequal) partitions.
- Problem:
  - Fragmentation



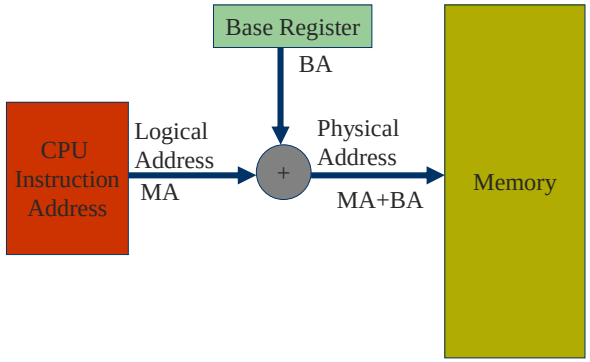
Fixed Partition Allocation

- Separate input queue for each partition
  - Requires sorting the incoming jobs and putting them into separate queues
  - Inefficient utilization of memory
    - when the queue for a large partition is empty but the queue for a small partition is full. Small jobs have to wait to get into memory even though plenty of memory is free.
- One single input queue for all partitions.
  - Allocate a partition where the job fits in.
    - Best Fit
    - Available Fit

Relocation

- Correct starting address when a program should start in the memory
- Different jobs will run at different addresses
  - When a program is linked, the linker must know at what address the program will begin in memory.
- Logical addresses, Virtual addresses
  - Logical address space , range (0 to max)
- Physical addresses, Physical address space
  - range (R+0 to R+max) for base value R.
- User program never sees the real physical addresses
- Memory-management unit (MMU)
  - map virtual to physical addresses.
- relocation register
  - Mapping requires hardware (MMU) with the base register

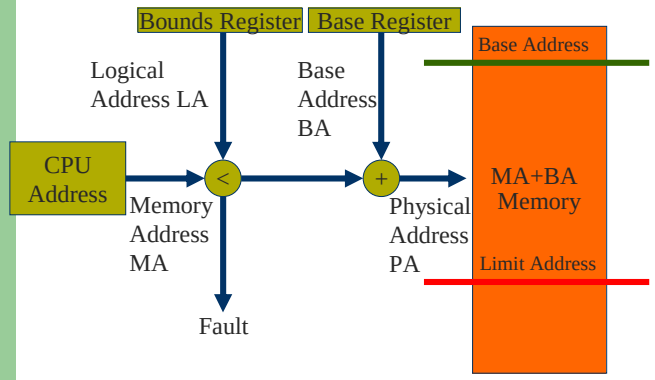
Relocation Register



Protection

- Problem:
  - How to prevent a malicious process to write or jump into other user's or OS partitions
- Solution:
  - Base bounds registers

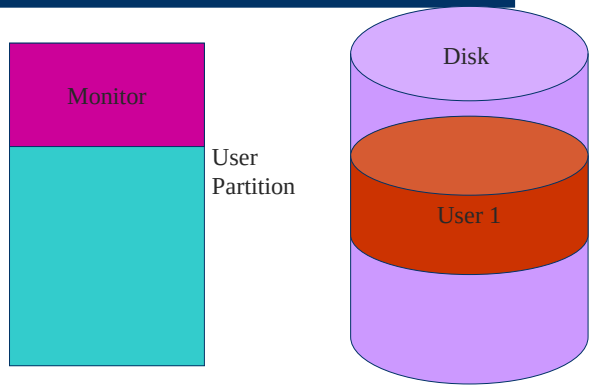
Base Bounds Registers



Swapping

- Move a part of or the whole process to disk
- Allows several processes to share a fixed partition
- Processes that grow can be swapped out and swapped back in a bigger partition

Swapping



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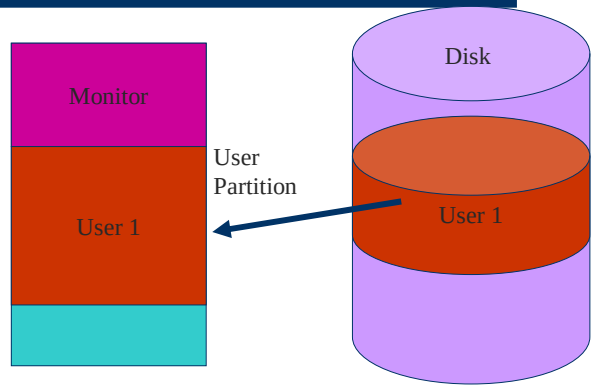

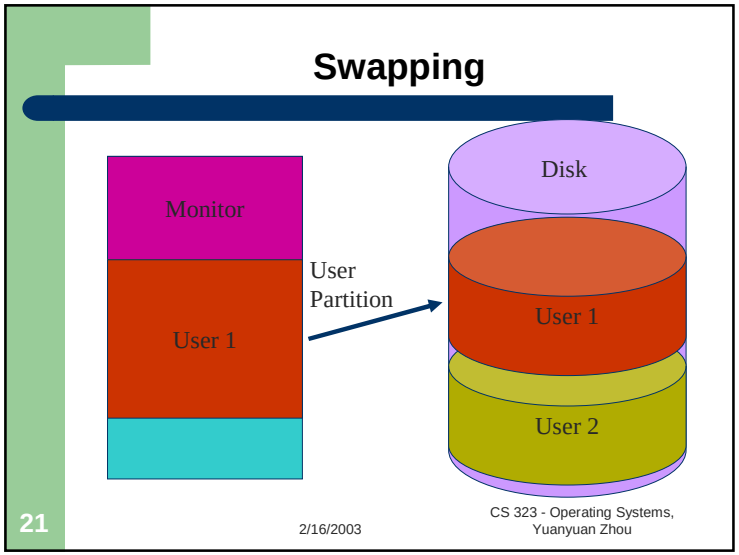
Swapping
Monitor
User 1
User Partition
Disk
User 1
User 2
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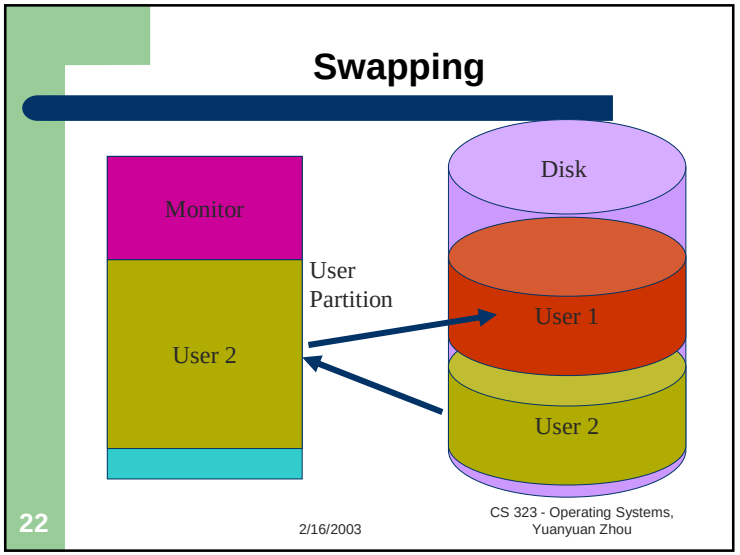
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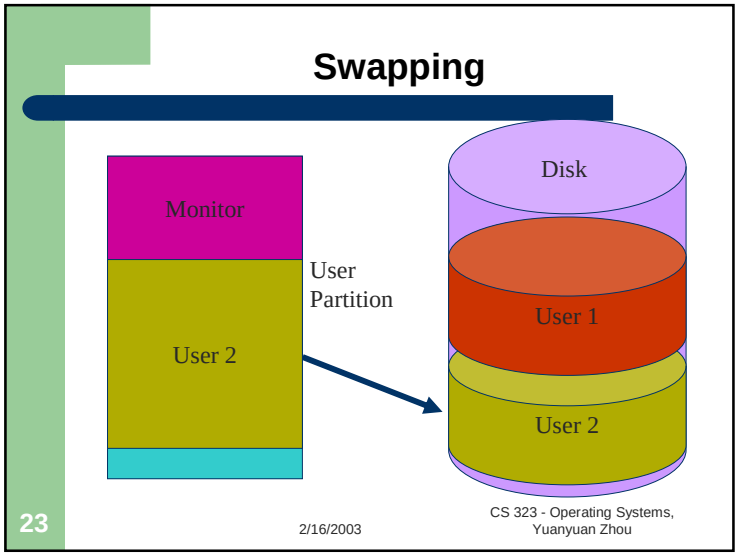
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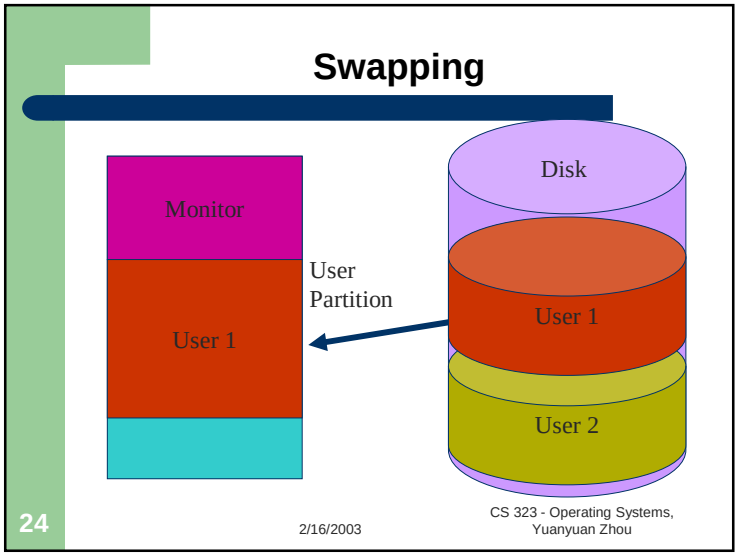
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User Partition
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User 2
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Variable Partitions and Fragmentation

Reminder

- Next lecture: Memory Management
- MP2