# Final Review

**Shengzhong Liu**

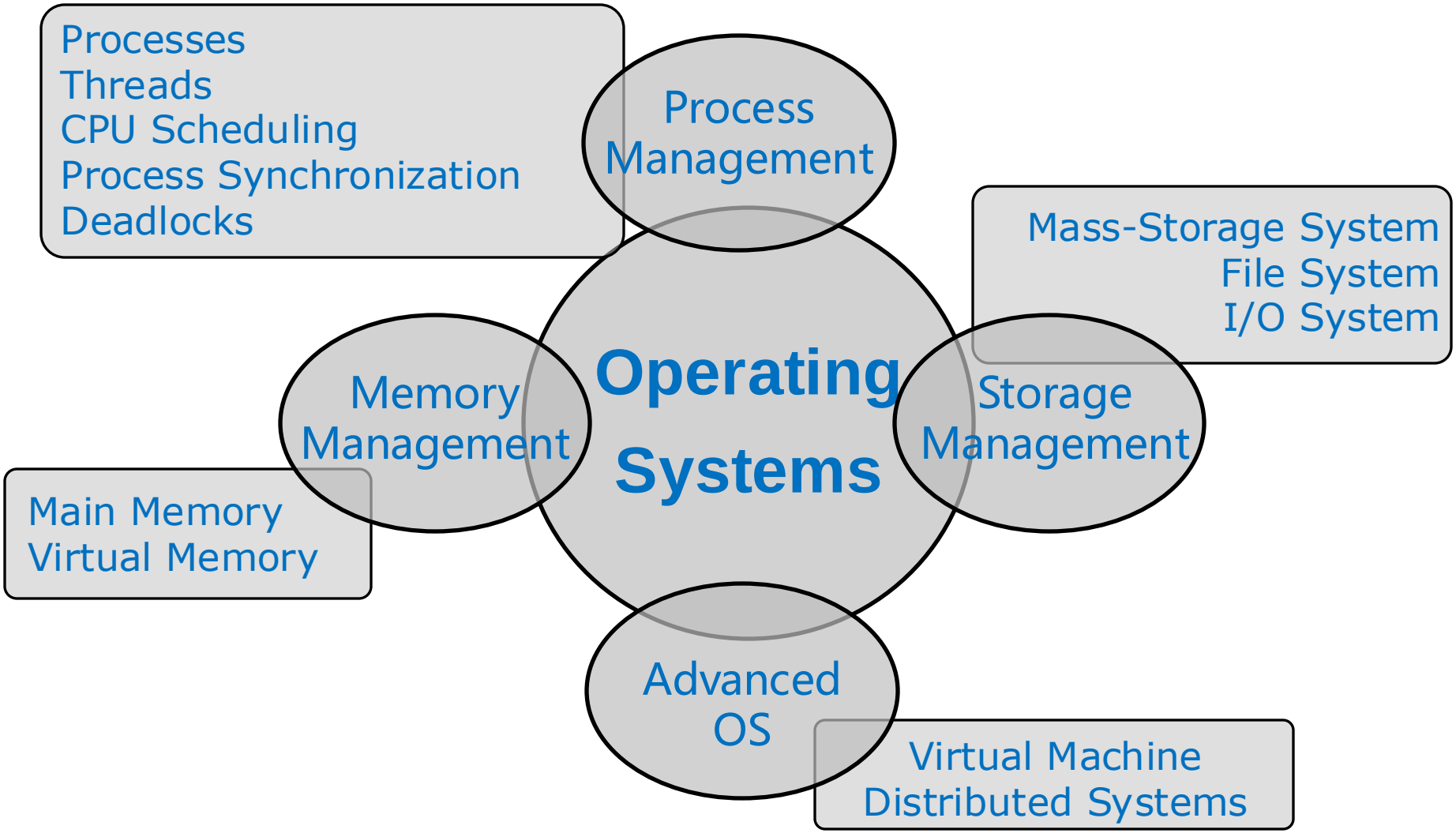
Department of Computer Science and Engineering

Shanghai Jiao Tong University

# Question Type

- Short answer questions (简答题)
- Quantity: 5-6
- Each question may have several sub-questions
- Closed-book exam

# Operating System Topics



# Process Management

# Process and Threads

- Process:
  - Process fork and variable value changes
  - Inter-process communication (IPC) through
    - Shared memory
    - Message passing

- Threads:
  - Parallelism vs. Concurrency
  - Use Amdahl's law to compute speedup with multi-threading
  - Pthread thread creation and shared variables

# CPU Scheduling

- Preemptive scheduling vs. non-preemptive scheduling
- Scheduling algorithms:
  - First-Come, First-Served Scheduling (FCFS)
  - Shortest Job First Scheduling (SJF)
  - Priority Scheduling
  - Round-Robin Scheduling (RR)
  - Multilevel Queue Scheduling (MQS)
  - Multilevel Feedback Queue Scheduling (MFQS)
- Deterministic evaluation of scheduling algorithms with Gantt chart
  - Turnaround time
  - Wait time

# Synchronization

- Critical section problem
- Process synchronization mechanisms:
  - Mutex and semaphores
  - Monitors and condition variables
- Synchronization problem formulations:
  - Bounded-buffer problem
  - Readers and writers problem
  - Dining-philosophers problem
- You are supposed to use synchronization mechanisms to solve other IPC problems

# Deadlock

- Deadlock avoidance algorithms:
  - Single-instance resource → Resource-Allocation Graph Algorithm
  - Multi-instance resource → Banker's Algorithm

- Deadlock detection algorithms:
  - Single-instance resource deadlock detection
  - Multi-instance resource deadlock detection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# Memory Management

# Main Memory

- Contiguous and Non-contiguous memory allocation
- Internal fragmentation vs. External fragmentation
- Paging
  - Virtual address and physical address translation
  - Valid/Invalid bits
  - Translation Lookaside Buffer (TLB)
- Page table structure
  - Hierarchical page table
  - Hashed page table
  - Inverted page table


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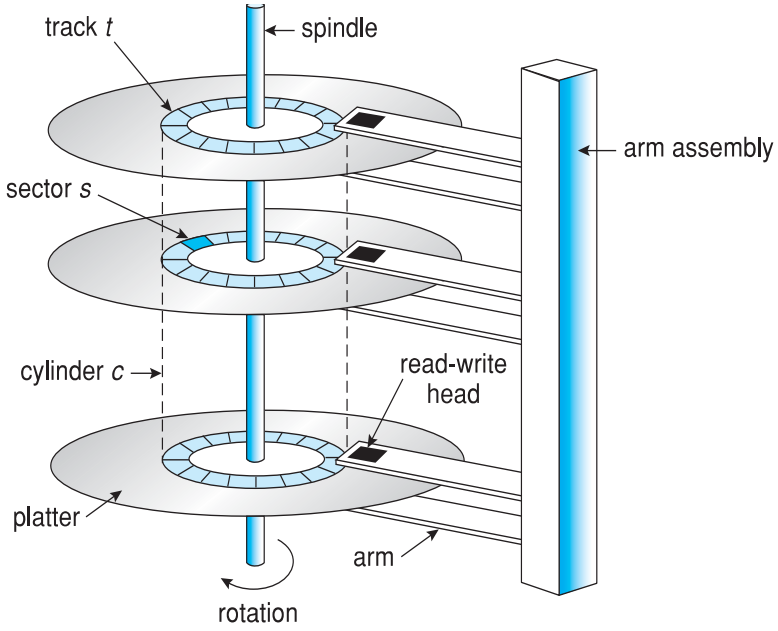
# Virtual Memories

- Demand paging
- Copy-on-Write
- Page replacement algorithms:
  - First-in, First-out algorithm
  - Least recently used (LRU) algorithm
  - LRU approximation
    - Reference bit
    - Second-chance algorithm
  - Counting algorithm:
    - Least frequently used (LFU) algorithm

# Storage Management

# Storage System

- Hard disk drive (HDD) structure and average I/O time
  - Track, sector, cylinder, platter
  - Logical block → physical track and sector mapping
  - Average seek time and I/O time
- Comparison of different storage device types
- Disk scheduling algorithms and analysis:
  - First-Come, First-Served Scheduling
  - Shortest Seek Time First Scheduling
  - SCAN Scheduling
  - C-SCAN Scheduling
  - LOOK/C-LOOK Scheduling
- RAID structures



# File Systems and I/O Systems

- File systems:
  - File access control
  - File system layers and roles
  - File allocation method:
    - Multilevel index (I-node)
    - File allocation + Disk scheduling
- I/O systems:
  - Host-controller communication:
    - Polling
    - Interrupt
    - Direct memory access (DMA)

# Advanced Topics

# Advanced Topics

- Virtual Machines:
  - VM building blocks:
    - Trap-and-emulate
    - Binary translation
  - VM Types:
    - Type 0, Type 1, Type2 hypervisors

- Distributed systems:
  - Network OS vs. Distributed OS
  - Distributed File System