Please consider the associated Links and References (Canvas, On-Line) provided in the class schedule.

Main topics:
- **Ch 1: Introduction to OS**
    - What is an Operating System? What are the OS goals?
    - Computer System Components (Users, Application Programs, OS, Hardware)
    - OS Usages
    - The Evolution of Operating Systems
        - Serial Processing: No Operating Systems
        - Simple Batch Systems: Monitor
        - Multiprogrammed Batch Systems
        - Time-Sharing Systems
    - Computer-System Architecture and the Advantageous
        - Asymmetric Multiprocessing
        - Symmetric Multiprocessing
    - Advanced OS
        - Distributed OS
        - Real-time OS (Hard and Soft Deadlines)
    - Computer-System Operation
        - Dual-mode operation
    - Interrupts (what is it? what types?, Handling)
    - Storage Hierarchy
        - Speed, Cost, Volatility
        - Caching
    - Operating System Components
        - Process Management
        - Memory Management
        - Storage Management
        - File-System Management
            - Mass-Storage Management
            - Caching
            - I/O Systems
        - Protection and Security
    - Virtual Machines (what? idea and benefit)

- **Ch 2: Chapter 2: Operating System Services and Structures**
    - Operating System Services
        - User interface
        - Program execution
        - I/O operations
        - File-system manipulation
        - Communications
        - Error detection

- - - Resource allocation
    - Accounting
    - Protection and security
  - System Calls (API, Types)
  - Operating System Structure
    - Simple structure (monolithic) – MS-DOS
    - Layered – an abstraction
    - Microkernel – Mach
    - Modules – Solaris
    - Hybrid

- **Ch 3: Chapter 3: Processes**
  - What is a process
  - Process Parts
    - Program code (Text Section)
    - Current Activity (Registers)
    - Data (Stack, Data Section, and Heap)
  - Process vs. Program
  - Process Management Tasks
  - Process States
  - Process Control Block
  - Context Switch
  - Process Scheduling
    - Main goals
    - Process Scheduling Queues
  - Types of Scheduler (long-term, medium-term, and short-term)
  - Process Creation and Termination (fork() and exit())
  - Interprocess Communication (IPC)
    - Shared memory
    - Message passing
  - Types of Communication
    - Indirect
    - Direct
  - Message passing Types
    - Blocking (Synchronous)
    - Non-blocking (Asynchronous)

- **Ch 4: Threads**
  - Process Characteristics
    - Resource Ownership, Scheduling/Execution
  - What is a thread?
  - Single and Multithreaded Processes
  - Key Benefits of Threads in comparison with Process

- o Benefits of Threads
  - Responsiveness
  - Resource Sharing
  - Economy
  - Scalability
- o Single-threaded vs. Multi-threaded Approaches
- o Concurrency vs. Parallelism
  - Types of parallelism
- o Thread Types(models) and their advantages and disadvantages
  - User Level Thread (ULT)
  - Kernel Level Thread (KLT) - Kernel-supported thread or Lightweight Process
  - Combined
- o Or (Silberschatz)
  - Many-to-One
  - One-to-One
  - Many-to-Many
- **Ch 5: CPU Scheduling**
  - o What is scheduling? What are the (resource) scheduling objectives?
  - o Types of Scheduling?
    - Long-term, medium-term, and short-term (CPU) scheduling
  - o Scheduling and Process State Transitions
  - o Queuing Diagram for Scheduling
  - o CPU burst and IO burst
  - o Preemptive vs. Non-preemptive Scheduling
  - o Scheduling Criteria
    - User-oriented
      - Turnaround time, Response time, Waiting time
    - System-oriented
      - CPU utilization, Throughput
  - o CPU Scheduling Algorithms
    - First Come First Served (FCFS)
    - Shortest Job First (SJF)
    - Shortest Remaining Time First (SRTF)
    - Highest Response Ratio Next (HRRN)
    - Round Robin (RR)
    - Virtual Round Robin (VRR)
    - Multilevel Feedback Queue (MLFQ)
    - Priority Scheduling (PR)
    - Multilevel Queue
  - o Scheduling Algorithm Evaluation Approaches
    - Deterministic Modeling
    - Queueing Models
    - Simulations

- Implementation