

## Review for Midterm #1

- Instruction Cycle: Fetch, Decode, Execute
- Von Neumann Bottleneck
- History of Operating System
  - The First Generation – Vacuum Tubes
  - The Second Generation – Transistors
    - Batch System
  - The Third Generation – IC (Integrated Circuits)
    - Time sharing
    - Multiprogramming
    - Spooling
  - The Fourth Generation – VLSI
  - The Fifth Generation – Mobile Devices

## Review for Midterm #1

- System Call
- Operating System Structure
  - Monolithic
  - Layered System
  - Virtual Machine
- Process Management
  - Process Models
  - Process Creation
  - Process Termination
  - Process State
  - Process Implementation

## Review for Midterm #1

- Concept of Threads
- Thread Implementation
  - User level thread
  - Kernel level thread
- Multithreading Model
  - Many-to-one
  - One-to-One
  - Many-to-Many
- **The Threading Issues**
  - Issues with fork(), exec()
  - Signal handling
  - Thread termination
  - Thread local storage

## Review for Midterm #1

- Inter-Process Communication
  - Race Condition
  - Mutual Exclusion Solutions with Busy Waiting
    - Disabling Interrupt
    - Lock Variable
    - Strict Alternation
    - Peterson's Solution

## Review for Midterm #1

- Mutual Exclusion with busy waiting
  - Test and Set Lock
  - Priority Inversion problem with busy waiting
- Mutual Exclusion with Sleep and Wakeup
  - The Producer-Consumer Problem
  - Race Condition in Producer-Consumer Problem
  - Semaphore
  - The producer-consumer problem with semaphore
  - Mutexes
  - **Monitor**
  - **Message Passing**

## Review for Midterm #1

- Process Scheduling
  - Schedulers
    - Long term, Short Term, Memory
  - Scheduling Algorithms
    - Shortest Job First
    - Shortest Remaining Time :preemptive, non-preemptive
    - Round Robin
    - Priority Queue: preemptive, non-preemptive

## Review for Midterm #1

---

### □ Memory Management

- With Mono-Process
- With Multi-Processes
  - Multi-process with Fixed partition
  - Multi-process with variable partition
- Modeling Multiprogramming: probabilistic model
- Swapping
- Memory Management with Bitmap
- Memory Management with Free-List
  - Memory allocation with Free-List
    - First fit, Next fit, Best fit Worst fit

## Review for Midterm #1

---

### □ Virtual Memory with Paging

- Page tables
- Page Table with Hardware Support
  - Translation Look-Aside Buffer
- Page Table Structure
  - Multilevel Page Table
  - Hashed Page Table
  - Inverted Page table