Detailed Notes on Operating System Concepts

1. Transition from User to Kernel Mode

- Timer is used to prevent infinite loops and resource hogging
- Timer interrupts the computer after a set time period
- Process:
  1. A counter is kept and decremented by the physical clock
  2. Operating system sets the counter (this is a privileged instruction)
  3. When the counter reaches zero, an interrupt is generated
  4. Timer is set up before scheduling a process
  5. Purpose: To regain control or terminate programs that exceed allotted time

2. Process Management

Definition and Characteristics

- A process is a program in execution
- It is a unit of work within the system
- Comparison:
  - Program: passive entity
  - Process: active entity

Resource Requirements

- Processes need resources to accomplish tasks:
  1. CPU
  2. Memory
  3. I/O

4. Files
5. Initialization data

Process Termination

- Requires reclaiming any reusable resources

Types of Processes

1. Single-threaded process:
   - Has one program counter
   - Specifies location of next instruction to execute
   - Executes instructions sequentially, one at a time, until completion

2. Multithreaded process:
   - Has multiple program counters
   - Each counter points to the next instruction to execute for a given thread

3. Process Management Activities

The operating system is responsible for:

1. Creating and deleting both user and system processes
2. Suspending and resuming processes
3. Providing mechanisms for process synchronization
4. Providing mechanisms for process communication
5. Providing mechanisms for deadlock handling

4. Memory Management

Characteristics of Main Memory

- Large array of bytes
- Size ranges from hundreds of thousands to billions of bytes
- Each byte has its own address
- Functions as a repository of quickly accessible data
- Shared by the CPU and I/O devices

CPU Interaction with Main Memory

- CPU reads instructions from main memory during the instruction-fetch cycle
- CPU reads and writes data from/to main memory during the data-fetch cycle

Program Execution Requirements

- All (or part) of the instructions must be in memory
- All (or part) of the data needed by the program must be in memory

Memory Management Activities

1. Keeping track of which parts of memory are currently being used and by whom
2. Deciding which processes (or parts thereof) and data to move into and out of memory
3. Allocating and deallocating memory space as needed

5. Storage Management

OS provides a uniform, logical view of information storage, abstracting physical properties to logical storage units (files).

File Characteristics

- A file is a container holding data/information in a structured format

- Files can store text, images, videos, executable code, and more.

Storage Devices

- Each medium is controlled by a device (disk drive, tape drive) with varying properties:
  - Access speed
  - Capacity
  - Data-transfer rate
  - Access method (sequential or random)

File System Management

- Files are organized into directories

- Access control determines who can access what

OS Activities in File System Management

1. Creating and deleting files and directories

2. Providing primitives to manipulate files and directories

3. Mapping files onto secondary storage

4. Backing up files onto stable (non-volatile) storage media