Name: JAY ARRE TALOSIG
Subject & Section: CCOPSYSL – COM232
Professor: Mr. Gaudencio Jeffrey G. Romano

Assignment #1: LEC-AS1: Multicore Tech

1. Discuss the multi-core technologies and give 2 examples each.

a) Symmetric Multiprocessing (SMP)

- Multiple cores share the same memory and I/O resources
- All cores have equal access to system resources
- Examples:

1. **Intel Core i7 processors** - Feature 4-8 cores with shared L3 cache and memory controllers
2. **AMD Ryzen processors** - Utilize multiple cores with simultaneous multithreading (SMT) technology

b) Non-Uniform Memory Access (NUMA)

- Memory access time depends on memory location relative to the processor
- Optimizes memory bandwidth in multi-core systems
- Examples:

1. **Intel Xeon servers** - Implement NUMA architecture for enterprise-level multi-core processing
2. **AMD EPYC processors** - Use chiplet design with NUMA topology for data center applications

2. Explain the process scheduler?

The process scheduler is a crucial component of the operating system kernel responsible for determining which process should be executed by the CPU at any given time. It manages the allocation of CPU time among competing processes to ensure efficient system utilization and fair resource distribution.

Process Scheduler Functions:

- **Process Selection**: Chooses the next process to execute from the ready queue

- **Context Switching**: Saves the current process state and loads the selected process state
- **Time Management**: Allocates CPU time slices to processes based on scheduling policies
- **Priority Management**: Handles process priorities and ensures critical processes receive adequate resources

Scheduler Components:

1. **Long-term Scheduler (Job Scheduler)**: Controls the degree of multiprogramming by selecting processes from the job pool
2. **Short-term Scheduler (CPU Scheduler)**: Selects processes from the ready queue for immediate execution
3. **Medium-term Scheduler**: Manages swapping of processes between main memory and secondary storage

3. Discuss the policies and algorithms and give examples.

Operating systems employ various scheduling policies and algorithms to optimize system performance, ensure fairness, and meet specific requirements.

Scheduling Policies:

a. Preemptive Scheduling

- The scheduler can interrupt a running process and allocate CPU to another process
- Example: **Round Robin** - Each process receives a fixed time quantum; if not completed, it's moved to the end of the ready queue

b. Non-preemptive Scheduling

- Once a process starts executing, it runs until completion or voluntary yielding
- Example: **First Come First Served (FCFS)** - Processes are executed in the order they arrive in the ready queue

Scheduling Algorithms:

a. Priority Scheduling

- Processes are assigned priorities; higher priority processes execute first
- Example: **Windows Task Manager** priority levels (Real-time, High, Normal, Low)

b. Shortest Job First (SJF)

- Selects the process with the shortest estimated execution time
- Example: **Batch processing systems** where job execution times are known in advance

c. Multilevel Queue Scheduling

- Multiple queues with different priorities and scheduling algorithms
- Example: **Unix/Linux systems** with separate queues for system processes, interactive processes, and batch processes

d. Completely Fair Scheduler (CFS)

- Aims to provide fair CPU time distribution among all processes
- Example: **Linux kernel's default scheduler** that uses red-black trees for efficient process selection

4. What are the different types of interrupts and give examples each?

Interrupts are signals that temporarily halt the normal execution of programs to handle urgent events or requests. They enable the operating system to respond to hardware events and manage system resources effectively.

Hardware Interrupts:

a. Maskable Interrupts

- Can be temporarily disabled by the processor
- Examples:
    1. **Timer interrupts** - Generated by system timers to implement time-sharing and process scheduling
    2. **I/O device interrupts** - Generated by keyboards, mice, network cards, and disk drives when data is ready

b. Non-maskable Interrupts (NMI)

- Cannot be disabled and have the highest priority
- Examples:
    1. **Power failure interrupts** - Signal critical power loss requiring immediate system shutdown
    2. **Memory parity error interrupts** - Indicate serious hardware memory errors requiring immediate attention

Software Interrupts:

a. System Call Interrupts

- Generated by programs requesting operating system services
- Examples:
    1. **File system operations** - Programs requesting file read/write operations through system calls
    2. **Process management calls** - Applications requesting process creation, termination, or synchronization

b. Exception Interrupts

- Generated by abnormal program execution conditions
- Examples:
    1. **Division by zero exceptions** - Arithmetic errors that require immediate handling
    2. **Page fault exceptions** - Memory access violations in virtual memory systems

External Interrupts:

a. I/O Interrupts

- Generated by external devices to signal completion of operations
- Examples:
    1. **Disk completion interrupts** - Hard drives signaling completion of read/write operations
    2. **Network packet interrupts** - Network interface cards indicating received data packets

b. Clock Interrupts

- Generated by system clock for time-based operations
- Examples:
    1. **Periodic timer interrupts** - Enable time-slicing in preemptive multitasking systems
    2. **Real-time clock interrupts** - Maintain system time and trigger scheduled tasks

References

1. Silberschatz, A., Galvin, P. B., & Gagne, G. (2018). *Operating System Concepts* (10th ed.). John Wiley & Sons.
2. Tanenbaum, A. S., & Bos, H. (2014). *Modern Operating Systems* (4th ed.). Pearson.
3. Stallings, W. (2017). *Operating Systems: Internals and Design Principles* (8th ed.). Pearson.
4. Nutt, G. (2003). *Operating Systems: A Modern Perspective* (3rd ed.). Addison-Wesley.
5. Love, R. (2010). *Linux Kernel Development* (3rd ed.). Addison-Wesley Professional.