



JOMO KENYATTA UNIVERSITY OF AGRICULTURE AND TECHNOLOGY

University Examinations 2013

FIRST YEAR SECOND SEMESTER EXAMINATIONS FOR THE DEGREE OF BACHELOR OF SCIENCE IN INFORMATION TECHNOLOGY

ICS 2202

Operating Systems I

DATE: APRIL 2013

TIME: 2HRS

INSTRUCTIONS

Answer Question 1 and Any Other Two Questions

Question One

- a. Define the term **operating system** and explain the two principal functions of an operating system. [6mks]

An OS is a suite of programs. Resource manager and providing a more friendly interface or abstraction.

- b. Explain the main activities performed by the operating systems when implementing memory management. [6mks]

The OS protects programs and data from each other and allocates all executing programs and data the required memory.

- c. Define the term **File** and highlight the contents and describe briefly the file management functions performed by the operating system. [6mks]

A **file** is a collection of related information defined by the creator. A file typically contains programs and/ or data. Files are managed by the operating system. This includes how they are **structured, named, accessed, used and protected.**

- d. Briefly describe the following techniques of memory management. **Paging, Segmentation and Virtual memory** [6mks]

Paging. Main memory is partitioned into relatively small, equal sized blocks named frames. Frame size is power of 2. Each process is also divided into blocks of the same size called pages. Logical address space of a process can be noncontiguous. A process is allocated physical memory wherever it is available. The system keeps track of all free frames. A page table translates logical to physical addresses. No external fragmentation. Small internal fragmentation.

Segmentation. Segments are constructed according to user semantics. This easily enables segment sharing and protection according to user semantics. External fragmentation exists. Less

severe compared with dynamic allocation because average size of each segment is smaller (several in one process).

Virtual memory is a technique that allows the execution of processes that may not be completely in memory. The key concept is to keep only the needed portion of the program in memory, load others into memory from disk when needed.

(2) Importance of abstraction in OS-User Interface, Standard code.

Question Two

a. Using suitable illustration, describe the six transitions in a process state. [10mks]

Process - a program in execution. Processes compete for resources in order to execute. Processes periodically change their State during time of execution. A process can be in any of the following states:

New: is being created

Running: instructions are being executed

Waiting: waiting for some event to occur (such as I/O completion)

Ready: waiting to be assigned to a processor

Terminated: has finished execution

b. Define the term scheduling in the context of operating systems and describe the factors taken into consideration in allocating CPU to a process. [10mks]

Scheduling is the activity of allocating resources and processor to the processes. The OS uses the following Scheduling Criteria in allocating the CPU to processes.

- **CPU utilization** - how often the CPU is busy - (maximize)
- **Throughput** - how many jobs are processed - (maximize)
- **Wait Time** - total time spent in the ready queue - (minimize)
- **Response Time** - amount of time to start responding - (minimize)
- **Time** - total time it takes from the time- (minimize) Turnaround of submission to completion

Question Three

a. Explain the main reasons why threads are more popular in designing operating systems. [6mks]

b. Describe the following security mechanisms as implemented by the operating system. [6mks]

(i) Authentication and authentication

(ii) Fire wall

(iii) Cryptography

Authentication is concerned with determination of who has permission to access what resources while **Authorization** determines what access is allowed to what entities

Fire wall is the use of software that protects the organizations intranet from external attacks. It screens programs and data which is sent to and received by the organization.

Cryptography is the use of data transformation to make data incomprehensible to all except its intended users.

c. Define the term Mutual Exclusion and describe **Four** conditions to hold to have a good solution for the critical section problem (mutual exclusion). [8mks]

A way of making sure that if one process is using a shared modifiable data, the other processes will be excluded from doing the same thing.

Good Solution

- No two processes may at the same moment inside their critical sections.
- No assumptions are made about relative speeds of processes or number of CPUs.
- No process should outside its critical section should block other processes.
- No process should wait arbitrary long to enter its critical section

Question Four

- a. Describe the differences and similarities between process and threads. **[6mks]**

Process - a program in execution. Processes compete for resources in order to execute. Processes periodically change their State during time of execution.

Threads - Also called a lightweight process, is a basic unit of CPU utilization and consists of: PC, register set, stack space, code section, data section and OS resources - all shared with peer threads.

- b. Describe the following Scheduling algorithms as used by the OS and suggest when they are suitable for use. **[6mks]**

- (i) FCFS – First Come First Serve
- (ii) Priority Scheduling
- (iii) Round Robin

FCFS (First Come First Served)

- non-preemptive
- very simple
- can be implemented with a FIFO queue.
- Not a good choice when there are variable burst times (CPU bound and I/O bound)
- drawback: causes short processes to wait for longer ones

Priority Scheduling

- preemptive or non-preemptive
- internal priorities can be used (ie, time limits, memory requirements, etc)
- external priorities can be used (ie, user defined priority, funds, dept., etc)
- Major problem is starvation or indefinite blocking (a solution to this is aging)

Round-Robin (RR) Scheduling

- designed especially for time-sharing systems
- depends heavily on the size of the time quantum
- preemptive (since processes switch in and out)
- if t.q. is too large, this just becomes FCFS
- Since context-switching costs time, the rule of thumb is 80% of CPU bursts should be shorter than the time quantum.

- a. Describe the conditions necessary and sufficient to create a deadlock and highlight avoidance mechanism associated with each. **[8mks]**

- **Mutual Exclusion** - avoided if resources are shareable

- **Hold and Wait**- avoided if all resources are allocated before execution of a process begins. avoided if process can only hold and use some resources at a time
- **No Preemption** - avoided if preempting of resources is allowed
- **Circular Wait** - . avoided if a total ordering of resource types is made