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Paper Code : CS-603

OPERATING SYSTEM

Time Allotted: 3 Hours

Full Marks: 70

*The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words
as far as practicable.*

Group – A

(Multiple Choice Type Questions)

1. Choose the correct alternative for any ten of the following:

1×10=10

(i) Which module gives control of the CPU to the process selected by the short-term scheduler?

☒ (a) Dispatcher

(b) Interrupt

(c) Scheduler

(d) None of the mentioned

(ii) The processes that are residing in main memory and are ready and waiting to execute are kept on a list called

(a) job queue

☒ (b) ready queue

(c) execution queue

(d) process queue

(iii) Page fault frequency in an operating system is reduced when

☒ (a) processes tend to be of an equal ratio of the I/O-bound and CPU-bound.

(b) size of pages is increased.

☒ (c) locality of reference is applicable to the process.

(d) processes tend to be CPU-bound.

Turn Over

(iv) _____ is a high speed cache used to hold recently referenced page table entries a part of paged virtual memory.

- (a) Translation lookaside buffer
- (b) Inverse page table
- (c) Segmented page table
- (d) Indexed page table

(v) Which directory implementation is used in most of the Operating System?

- (a) Single level directory structure
- (b) Two level directory structure
- (c) Tree directory structure
- (d) Acyclic directory structure

(vi) The total time to prepare a disk drive mechanism for a block of data to be read from is its

- (a) Access time
- (b) Seek time
- (c) Latency plus seek time
- (d) Access time plus seek time plus transmission time

(vii) The average wait time for five processes P1-P5 with burst of 5, 19, 2, 16 and 7 milliseconds respectively, using SJF is

- (a) 5 ms
- (b) 9.8 ms
- (c) 28 ms
- (d) 10.6 ms

(viii) A situation where several processes access and manipulate the same data concurrently and the outcome of the execution depends on the particular order in which access takes place is called

- (a) race condition
- (b) data inconsistency
- (c) starvation
- (d) fatal error

(ix) The address of the next instruction to be executed by the current process is provided by the

- (a) CPU registers
- (b) program counter
- (c) process stack
- (d) pipe

(x) Banker's algorithm for resource allocation deals with

- (a) Deadlock avoidance
- (b) Deadlock prevention
- (c) Deadlock recovery
- (d) Deadlock detection

(xi) _____ are very effective because a mode switch is not required to switch from one thread to another.

- (a) Kernel-level threads
- (b) Alterable threads
- (c) User-level threads
- (d) Application level threads

(xii) For 3 page frames, the following is the reference string:

7 0 1 2 0 3 0 4 2 3 0 3 2 1 2 0 1 7 0 1

- (a) 10
- (b) 15
- (c) 11
- (d) 12

Group - B

(Short Answer Type Questions)

Answer any three of the following:

5×3=15

2. (a) Explain the utility of Process Control Block (PCB) for a process?
- (b) Under what conditions the following state transition occurs with respect to a process?
 - (i) Run to ready,
 - (ii) Blocked (or wait) to ready

2+3=5

3. Assume you have the following jobs to execute with one processor, with the jobs arriving in the order listed here:

i	T _i	(P _i) Arrival Time
0	80	0
1	20	10
2	10	10
3	20	80
4	50	85

- (a) Suppose a system uses RR scheduling with a quantum of 15. Create a Gantt chart illustrating the execution of these processes? <http://www.makaut.com>
- (b) What is the turnaround time for process P³?
- (c) What is the average wait time for the processes? 1+2+2=5

4. (a) What are the operations on semaphores?

- (b) How to implement a solution to the Readers-Writers Problem with the use of semaphores? 1+4=5

5. What is the optimistic assumption made in the deadlock detection algorithm? How can this assumption be violated?

6. Under what circumstances do page faults occur? Describe the actions taken by the operating system when a page fault occurs. 2+3=5

Group - C

(Long Answer Type Questions)

Answer any three of the following:

15×3=45

7. Explain Circular-wait for the occurrence of deadlock and how it could be prevented. Consider a system consisting of m resources of the same type being shared by n processes only one at a time. Show that the system is deadlock free if the following condition holds:

- (a) The maximum need of each process is between 1 and m resources.
- (b) The sum of all maximum needs is less than $m + n$.

Consider the following snapshot of a system:

Process	Allocation	Max	Available
P0	A B C D	A B C D	A B C D
P1	0 0 1 2	0 0 1 2	1 5 2 0
P2	1 0 0 0	1 7 5 0	
P3	1 3 5 4	2 3 5 6	
P4	0 6 3 2	0 6 5 2	
P5	0 0 1 4	0 6 5 6	

Answer the following question using the Banker's algorithm:

- 1. What is the content of matrix "Need"?
- 2. Is the System in a safe state?
- 3. If a request from process P1 arrives for (0, 4, 2, 0) can the request be granted immediately?

4+3+8=15

8. What is thread? Explain types of thread with example. What advantages do threads have over multiple processes? When a process is called a cooperating process? Explain Critical-Section problem. Explain Counting Semaphore and binary semaphore with algorithm.

1+2+2+3+7=15

9. Give memory partition of 100K, 500K, 200K, 300K and 600K (in order). How would each of the first fit, best fit and worst fit algorithm place process of 212K, 417K, 112K and 426K (in order)? Which algorithm makes the most efficient use of memory? Compare the following main memory organization schemes: contiguous memory allocation, pure segmentation and pure paging with respect to the following issues:

- (a) External fragmentation
- (b) Internal fragmentation
- (c) Ability to share code across processes

5+1+9=15

10. What is meant by Process Control Block? Draw and explain different fields of PCB. Explain Context Switch by giving an example. Consider the following set of processes, with the length of the CPU-burst time given in milliseconds:

Process	Burst Time	Priority
P1	10	3
P2	1	1
P3	2	3
P4	1	4
P5	5	2

The processes are assumed to have arrived in the order P1, P2, P3, P4, P5 all at time 0.

- (a) Draw four Gantt charts illustrating the execution of these processes using FCFS, SJF, a non-preemptive priority (a smaller priority number implies a higher priority), and RR (quantum = 1) scheduling.
- (b) What is the turnaround time of each process for each of the scheduling algorithms in part a?
- (c) What is the waiting time of each process for each of the scheduling algorithms in part a?
- (d) Which of the schedules in part a results in the minimal average waiting time (over all processes)?

1+4+3+7=15

11. What is thrashing? How it can be prevented? What do you mean by page reference string? Suppose a process accesses the following addresses at a particular time interval:

0100, 0432, 0101, 0612, 0102, 0103, 0104, 0101, 0611, 0102, 0103, 0104, 0101, 0601, 0101, 0102, 0609, 0102, 0105.

Assume a page size = 100 bytes.

- (a) What will be the reference string?
- (b) Considering the above page reference string, calculate the page fault rate for the following algorithms:
 - (i) LRU replacement.
 - (ii) Optimal replacement. Assume that number of frames = 3.

Explain working sets. What is its physical significance?

$$1+2+1+2+6+2+1=15$$

$$5 \times 3 = 15$$

12. Write short notes on the following (any three):

- (a) Semaphore
- (b) Scan disk scheduling algorithm
- (c) Linked file allocation technique
- (d) Belady's anomaly
- (e) Preemptive SJF scheduling
- (f) Security and Protection

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