No of Pages : 4 Course Code : 15XD44 / 15XT44 / 15XW44

Roll No:

(To be filled in by the candidate)

# PSG COLLEGE OF TECHNOLOGY, COIMBATORE - 641 004 SEMESTER EXAMINATIONS, APRIL 2019

MSc – DATA SCIENCE / TCS / SOFTWARE SYSTEMS Semester: 4

15XD44 / 15XT44 / 15XW44 OPERATING SYSTEMS

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Time: 3 Hours				1	•	Ma	ximum	Mark	xs:100
<b>INSTRUCTIONS:</b>	1EO		-60			E	•		C.
1. Answer <b>ALL</b> questions. Each question carries 20 Marks.									
2. Subdivision (a) carries 3 marks each, subdivision (b) carries 7 (3+4) marks each and									
subdivision (c) carries 10 marks each.									
3.Course Outcome :	Qn.1 CO1	Qn.2	CO2	Qn.3	CO3	Qn.4	CO4	Qn.5	CO5

- 1. a) How does kernel code have more privileges than user code? What is the relationship between function calls, system calls and library calls?
  - b) i) How many processes will be created when the following program is executed?
    Assume that all fork system calls are successful. What will be printed? (3)

- ii) What is Context Switch? The following are the steps that OS takes when performing a context-switch. Put them in the correct order. What is the cost of context switch? (4)
  - Update the process control block of the selected (next) process.
  - Select a new process for execution.
  - Save the context of the process that is currently running on the CPU.
  - Move the process control block of the current process into the relevant queue such as the ready queue, I/O queue etc.
  - Update the memory management data structures as required.
  - Restore the context of the process that was previously running when it is loaded again on the processor.
  - Update the process control block and other important fields.
  - Update the process state of the selected process to running.
- c) Define the essential properties of the following types of operating systems
  - Batch
- Multiprogramming
- Timesharing

- Real time
- Distributed
- a) What are the optimal scheduling algorithms for minimizing average response time, for the case of non-preemptive scheduling and the case of preemptive scheduling, respectively? Justify.
  - b) i) Assume you have a system with three processes (X, Y, and Z) and a single CPU. Process X has the highest priority, process Z has the lowest, and Y is in the middle. Assume a priority-based scheduler (i.e., the scheduler runs the highest priority job, performing preemption as necessary). Processes can be in one of

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five states: RUNNING, READY, BLOCKED, NEW, or TERMINATED. Given the following cumulative timeline of process behavior, indicate the state the specified process is in AFTER that step, and all preceding steps, have taken place. Assume the scheduler has reacted to the specified workload change.

Step 1: Process X is loaded into memory and begins; it is the only user-level process in the system.

Step 2: Process X calls fork() and creates Process Y.

Step 3: The running process issues an I/O request to the disk.

Step 4: The running process calls fork() and creates process Z.

Step 5: The previously issued I/O request completes.

Step 6: The running process completes.

(3)

- ii) What is a thread? Write pseudo code that executes in parallel three threads called A, B and C.
  - A thread has three statements (a1, a2 and a3)
  - B thread has four statements (b1, b2, b3 and b4)
  - C thread has three statements (c1, c2 and c3).

Use as many semaphores as necessary to enforce the following execution order

- c1 will be executed after a1completion.
- a2 will be executed after b1 completion
- c2 will be executed after b2 completion
- b3 will be executed after a2 completion
- a3 will be executed after c2 completion
- b4 has to be the last statement executed.

(4)

 c) Consider the execution of two processes P1 and P2 with the following CPU and I/O burst times.

	A	A 3				
	P1	P2				
	CPU – 3.	CPU – 4				
	Net – 4	Disk – 3				
	CPU – 2	CPU - 3				
CX	Disk - 3	Net - 3				

Each row shows the required resource for the process and the time that the process needs that resource. For example "Net 3" in fourth row says that P2 needs network card for 3 time units.

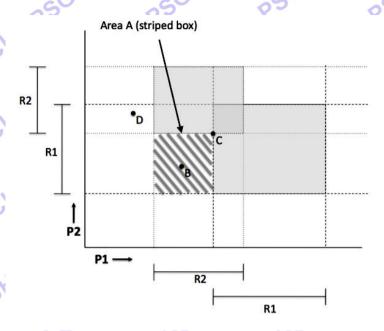
- If P2 arrives 2 time units after P1 and the scheduling policy is non-preemptive SJF then calculate the finish time for each process and the CPU idle time in that duration.
- If P2 arrives 2 time units before P1 and the scheduling policy is preemptive SJF then calculate the finish time for each process and the CPU idle time in that duration.
- 3. a) Do pointers in userspace (program address space) C programs contain virtual or physical addresses on Linux? Justify.
  - b) i) Which of the following pairs of TLB/page-table misses (Page Fault) are legitimate? Why? (3)
    - No TLB miss, no PT miss
    - TLB miss but no PT miss
    - PT miss but no TLB miss
    - TLB miss and PT miss
    - ii) For a processor with 64-bit virtual addresses, a flat paging scheme and flat page table, a 34-bit physical address space, and 32 Kbyte pages, show a diagram depicting how the virtual address is translated into a physical address. Be sure to label each field and path with a name and the number of bits, and be sure to

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include the TLB and page table in your diagram. No text is necessary if your diagram is complete. Hint:  $32K = 2^{15}$ . (4)

c) Consider the following resource trajectory graph for a system with two processes (P1 and P2) and two resources (R1 and R2)



- What does the area identified as Area A indicate?
- Draw three resource allocation diagrams (the ones with circles, squares and arrows), one for each of the points indicated above as B, C, and D.
- If you drew the same or different resource allocation graphs for points B and C, explain why. What does that tell you about the usefulness of using resource allocation graphs to avoid deadlock?
- In what way is the banker's algorithm "pessimistic"?
- 4. a) What is a deadlock? How does linearly ordering a resource help to prevent a deadlock?
  - b) i) Consider a system with the following specification:
    - Total available physical memory frame: 1200KB
    - Frame Size is 4 KB
    - Total processes : 6
    - The frame needed by each process has the following format (Process ID, Total frame). (0, 40), (1, 60), (2, 100), (3, 20), (4, 80), (5, 100)

As the total available frames are limited, The system cannot supply all the requested frames to every process. Determine total frames given to each process if the system uses 1) equal allocation mechanism. 2) proportional allocation algorithm.

- ii) A small computer has 8 page frames, each containing a page. The page frames contain virtual pages A, C, G, H, B, L, N, and F in that order. Their respective load times were 18, 23, 5, 7, 32, 19,3, and 8. Their reference bits are 1, 0, 1, 1, 0, 1, 1, and 0 and their modified bits are 1, 1, 1, 0, 0, 0, 1, and 1, respectively. What is the order that second chance considers pages and which one is selected? (4)
- c) In pure on-demand paging, a page replacement policy is used to manage system resources. Suppose that a newly-created process has 3 page frames allocated to it, and then generates the page references indicated below.

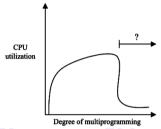
#### ABCBADABCDABACBD

How many page faults would occur with FIFO, LRU, and OPT page replacement policies?

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- 5. a) User A creates a file "a" with permissions such that A can read and write the file and all other users can only read it but not write it. User B creates a hard link to file "a" by the name of "b". User C creates a soft link to "b" by the name of "c". User D creates a soft link to "c" by the name of "d". Write what the user will see in the following two scenarios. Each scenario starts from the original situation described above.
  - User C deletes "c", and then D reads file "d".
  - User A deletes "a", and then D writes file "d".
  - b) i) How efficiently does the Contiguous, Linked and Indexed file allocation strategies handles sequential access of large files, and why?
    (3)
    - ii) Consider the graph given below that shows a plot of "degree of multiprogramming" on X-axis versus "CPU utilization" on Y-axis. What is the phenomenon observed by a sudden dip in the graph (as shown with the question mark) called? How can it be prevented?



Now assume working set window is 7, and the following reference string is given for process P:

What is the working set of this process at time t?

(4)

- c) Suppose we have files F1, F2, F3 and F4. File F1 is 11 logical records of 112 bytes each, file F2 is 890 logical records of 13 bytes each, file F3 is 510 bytes of binary data stream and file F4 is 4 logical blocks of 95 bytes each. The capacity of the disk is 30 blocks each of 1024 bytes (may be modeled as 6 X 5 matrix).
  - How many physical blocks would be needed to store these four files? Assume that in case of linked allocation strategy, 5 bytes are needed to store the next block in the link.
  - ii) Using a diagram, show how allocation for these files is done in contiguous, linked and indexed allocation.
  - iii) What is the type of fragmentation associated with each of file allocation policies. For each file, find the internal fragmentation measured as percentage of the file size.
  - iv) Write the bit vector for the disk and calculate the size of the bit-vector.
  - v) Now, the size of the file F3 is increased to 600 bytes. How many more physical blocks are required? How many disk IO is to be performed to add the new block(s) at the end in each allocation policy? Assume that the new block(s) are in memory and other structures are in disk.

/END

FD/JU