19CS2106S - OPERATING SYSTEMS DESIGN - S

Set No: 1

Time: **Max.Marks: 100**

S.NO	Answer All Questions	Choice	Options	Marks	CO	CO BTL	CO BT
1.	Explain how names are mapped to inodes recursively with an algorithm. How many disk operations are needed to fetch the i-node for a file with the path name /usr/ast/mbox? Assume that the i-node for the root directory is in memory, but nothing else along the path is in memory. Also, assume that all directories fit in one disk block. Illustrate the lookup process with a diagram	choice Q-2		10Marks	CO1	3	3
2.	Illustrate the algorithm for the Conversion of Byte Offset to Block Number in File System. A UNIX file system has 4-KB blocks and 4-byte disk addresses. What is the maximum file size if i-nodes contain 10 direct entries, and one single, double, and triple indirect entry each?			10Marks	CO1	3	3
3.	Answer the following	choice Q-4		15Marks	CO1	3	3
3.A.	Write a Program in which the reader and writer processes carry out two-way communication using two pipes. This program should open two pipes, pipe1 and pipe2, and creates a child process. The child process sends a message to the parent process using pipe1 and reads the parent's response from pipe2. The parent does it the other way round. Whatever data the parent and child processes read from their respective pipes, they throw to standard output. show the setup in a pictorial form.			8Marks	CO1	3	3
3.B.	Why are users never allowed to directly write to a directory? Why are file attributes not stored in the directory entry itself? why must directories be empty before they are allowed to be removed? In xv6, Explain dirent structure and the working of dirloopup, dirlink functions.			7Marks	CO1	3	3
4.	Answer the following			15Marks	CO1	3	3
4.A.	Unix uses three tables to hold data about open files. Give and explain the algorithm for creating and closing the file with the respective tables.			8Marks	CO1	3	3
4.B.	For xv6, Illustrate log design. why logging metadata updates ensure the recovery of a file system after a file system crash. What are the fields of the superblock and give its use?			7Marks	CO1	3	3
5.	Given a set of jobs that have to run in a non-preemptive single-programming fashion, which one of the two job schedulers, FCFS and SJF, always gives a better (or at least as good as the other) average turnaround time? Can you prove that this policy is optimal? The following table gives the arrival times and CPU times of five processes. If the process scheduler is round-robin, compute the average turnaround time of the processes.	choice Q-6		10Marks	CO2	3	3
6.	In xv6, why each process has 2 stacks? Describe how a process might move through the various process states. Create specific reasons why this process moves from one state to another. Explain Process & kernel data structures: struct proc, allproc function.			10Marks	CO2	3	3
7.	Answer the following	choice Q-8		15Marks	CO2	3	3
7.A.	What elements of the process context must the kernel explicitly save when handling (i) context switch, (ii) an interrupt, or (iii) a system call? What are the similarities and differences Explain?			8Marks	CO2	3	3
7.B.	Write a system program to execute a command and redirect the output to a file: $ wc sample.txt > newfile.			7Marks	CO2	3	3
8.	Answer the following			15Marks	CO2	3	3
8.A.	Write the C-style illumination of the part of the shell program involving the use of the fork, waitpid, and execve system calls.			8Marks	CO1	3	3
8.B.	After a process has exited, it may enter the state of being a ZOMBIE before disappearing from the system entirely. What is the purpose of the ZOMBIE state? What event causes a process to exit from ZOMBIE? Write an algorithm for a system call that makes the Parent waits and collect the termination status of a child process.			7Marks	CO2	3	3
9.	Design an algorithm for allocating and freeing memory pages and page tables. For a page-based memory management system that can run programs as large as one Giga bytes, if the size of pages is 2K: Illustrate the format of the logical addresses. Illustrate the format of the physical address. Illustrate the format of the page table entries. What is the maximum possible length of a page table?	choice Q-10		10Marks	CO3	3	3
10.	The page replacement algorithm in page-based memory management is a per-process second chance. Main memory consists of four frames and there are two processes in the system. Initially, all memory frames are free. The set of frames, which each process seizes from the initial free frames of main memory, belongs to the process for its lifetime. Each process is allowed to replace the content of its own frames with new pages if there is a page fault for that process. What is the page fault ratio for the following page trace? The pages of process one are: 2 1 5 2 0 1 3 0 4 2 3 1 2 The pages of process two are: 7 0 1 0 7 3 0 2 1 6 5 3			10Marks	CO3	3	3
11.	Answer the following	choice Q-12		15Marks	CO3	3	3
11.A.	What are the benefits and drawbacks of copying text pages to the swap area? What are the benefits and drawbacks of copy-on-write? What are the advantages of demand paging compared with segmentation?			8Marks	CO3	3	3
11.B.	Illustrate the Implementation of malloc() and free() using the Heap containing allocated blocks and a free list			7Marks	CO3	3	3
12.	Answer the following			15Marks	CO3	3	3
12.A.	In xv6, explain the first address space using Paging. Illustrate creating and running the first process.			8Marks	CO3	3	3
12.B.	For a given virtual address in a binary number, write and explain hardware-managed translation lookaside buffer control			7Marks	CO2	3	3

Process	1	2	3	4	5
Arrival time	0	0	2	3	3
CPU time	8	10	6	9	12

flow algorithm.

13.	In the semaphore-based solution of the producer-consumer problem, what are the consequences of interchanging the two statements wait(&available) and wait(&mutex) in the consumer procedure? Give pseudocode and tracing of execution by assuming the number of items=5, BUFFSIZE=10, and one producer-consumer thread.	choice Q-14		10Marks	CO4	4	3
14.	Maintenance of the stack frame and the entities included inside it (local variables, return address, etc.) is achieved with the help of base pointer/frame pointer (EBP), stack pointer (ESP), instruction pointer (EIP). With Run-Time Stack usage in 32-Bit GCC, illustrate how a given function call is made and the various steps involved during the process. main() { int x = 10; int y = 20; int z; z = add(10, 20); z++; }			10Marks	CO4	4	3
15.	Answer the following	choice Q-16		15Marks	CO4	4	3
15.A.	Many systems classify library functions as thread-safe or thread-unsafe. What causes a function to be unsafe for use by a multithreaded application? Illustrate the implementation of a concurrent linked list where multiple threads can simultaneously obtain the lock by calling the read-lock function, while only one thread can obtain the lock by calling the write-lock function.			8Marks	CO3	3	3
15.B.	Compare the IPC functionality provided by pipes and message queues. What are the advantages and drawbacks of each? When is one more suitable than the other? Illustrate message queue data structures by giving an algorithm for msgsnd() and msgrcv().			7Marks	CO4	4	3
16.	Answer the following			15Marks	CO3	3	3

16.A.	The following two processes are running concurrently. These two processes use two global variables x and y. Assume that the execution of each assignment statement is atomic (that is when started, it continues until completion without being interrupted). a. If the values of x and y are 1 and 3 respectively before the processes start, list all the possible values of x and y after the two processes finish. b. List all possible values of x and y, if the assumption of the atomicity of the assignment statements is removed. Hint: it is better to first translate the body of each process to assembly language.
	`Void proc1(void)` `{ x = x + 5; y = y + 23; }`
	`void proc2(void)` `{ x = x + 7; y = y + 31; }`
				8Marks	CO4	4	3

16.B.	Considering a system with five processes P1 through P5 and three resources of type A, B, C. Resource type A has 10 instances, B has 5 instances and type C has 7 instances. Suppose at time t0 following snapshot of the system has been taken: 1.what will be the content of the need matrix? 2. is the system in a safe state? if yes then what is the safe sequence? 3. what will happen if process p3 requests one additional instance of resource type C and two instances of resource type A?			7Marks	CO4	4	3

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

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