CS31202/CS39002 Operating Systems, Spring 2023–2024

Class Test 2

10 April, 2024, Time: 6:30pm–07:30pm Maximum marks: 20

Roll no:_____Name_____

[Write your answers in the question paper itself. Be brief and precise. Answer all questions.]

1. Consider the following snapshot of a system with 5 processes (P0 to P4) and 4 resources (A, B, C, D):

Allocation matrix

	A	B	C	D
P0	0	0	1	2
P1	1	0	0	0
P2	1	3	5	4
P3	0	6	3	2
P4	0	0	1	4

Max Requirement

	A	B	C	D
P0	0	0	1	2
P1	1	7	5	0
P2	2	3	5	6
P3	0	6	5	2
P4	0	6	5	6

Available vector

A	B	C	D
1	5	2	0

(i) Is the system in a safe state?

(ii) If a request from process P1 arrives for (0, 4, 2, 0), can the request be granted immediately?

[3+3]

Standard procedure

2

2. Consider a memory management unit implementing multilevel paging. Assuming a page size of 4 Kbytes and that a page table entry takes 4 bytes, how many levels of page table would be required to map a 64 bit address space, if the top level (outermost) page table fits within a single page? Show a brief schematic diagram to show the virtual address translation to physical address.

4

Six levels

2	10	10	10	10	10	12

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3. (a) A machine has a 32 bit logical address space and 8KB page size. The copy of the page table has been stored in hardware, with one 32 bit word per entry. Once a process starts, the page table is copied to the hardware from memory, where copying one word takes 100 nsec. If each process runs for 100 msec (including the time to load the page table), what fraction of the CPU time is devoted in loading the page tables?

The number of entries in the page table: Logical address space size / Page size Number of entries = 2^(32-13) = 2^19
Fraction of CPU time for loading page tables = (2^19 * 100 * 10^-9 sec) / (100 * 10^-3 sec)

(b) Explain with a schematic diagram, how shared page can be implemented using inverted page table.

[3+2]

4. Consider a memory management scheme implementing segmentation with paging. The maximum size of each segment is of 4GB and the maximum number of segments per process is 16. The frame size is of 4KB.

(a) If each page table entry takes 2 bytes, compute the maximum memory space to store the page table(s) of a single process. (b) At most how many page tables are required per process?

[5]

Number of pages in each segment = Segment size / page size = 2^(32-12) = 2^20

Size of page table for one segment = 2^20 frames * 2 bytes = 2^21 bytes
Max total size of page tables of a process for all 16 segments = 2^25 bytes