IIIT Vadodara
CS206 Operating System

Winter Semester 2022-23
End Semester Examination
Dr. Ashish Phophalia

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1. **[6 Marks]** In a reader-writer system, a read operation consumes 3 time units and a write operation consumes 5 time units in Critical Section. No reader or writer exist in the system at time $T = i - 1$. One reader arrive at time $T = i$, and 5 readers and 1 writer arrive at time $T = i + 1$. If no more readers or writers arrive, when will the writer finish writing? Justify.

2. **[6 Marks]** The Dining Philosophers have worked up a solution to avoid deadlock, with a little help from a consultant with a recent doctorate in algorithms. Before eating, each philosopher will flip a coin to decide whether to pick up the left fork or the right fork first. If the second fork is taken, the philosopher will put the first fork down, then flip the coin again. Is this solution deadlock-free? Does it guarantee that philosophers will not starve?

3. **[6 Marks]** Explain the difference between Logical address and physical address.

4. **[6 Marks]** Consider a disk having 8 surfaces, each surface is having an outer diameter of 16cm and an inner diameter of 6 cm and the inner track space is 0.2 mm. There are 32 sectors in each track. If the disk addresses for reading a byte of a sector on any surface track of the disk is 27 bits.

   (a) What is the sector size in bytes?

   (b) If the disk rotates at 3600 rpm, what is the effective data transfer rate in bytes/sec?

5. **[6 Marks]** Consider a page size of 2^6 bytes and the following page table. Which of the following virtual addresses would generate a page fault? For those that do not generate a page fault, to what physical address would they translate?

   (a) 0000111101001

Out	00101
In	11011
In	00001
In	11010
Out	10101
Out	10001
Out	11000
In	00101

Figure 1: Page Table

(b) 0000001110101

(c) 0000100010101

6. **[6 Marks]** Assume we have demand paging virtual memory system consisting of a TLB with access time of 10ns, a main memory having access time of 200ns, a disk backing store with an overall page transfer time of 8ms for a page read operation, and 20ms for a page swap when a page is modified. Assume that the main memory hit ratio is 99.9999%. The hit ratio for the TLB is 90%. 30% of page faults must replace a modified page thus requiring a page write back in addition to reading in a new page (page swap). The specification for this design is that effective access time must not exceed the main memory access time by more that 25%. Answer the following with Justification:

   (a) What is the average or effective access time of a reference?

   (b) Does this design meet the specification?

7. **[6 Marks]** The Open File Table is used to maintain information about files that are currently open. Should the OS maintain a separate table for each used or maintain just one table that contains references to files that are currently being accessed by all users? If the same file is being accessed by two different programs or users, should there be separate entries in the Open File Table? Explain.

8. **[8 Marks]** Given a system with 4 page frames, the Table 1 indicates page, load time, last reference time, dirty bit and reference bit. Justify for each page replacement algorithm.

   (a) Which page will FIFO Replace?

   (b) Which page will LRU Replace?

   (c) Which page will Optimal Replace?

Page	Load Time	Last Reference	Dirty Bit	Reference bit
0	167	374	1	1
1	321	321	0	0
2	254	306	1	0
3	154	331	0	1

Table 1: Page Replacement data

(d) Which page will Second Chance Replace?

9. **[10 Marks]** A Teaching Assistant (TA) is who helps undergraduate students with their programming assignments during regular office hours. The TA's office is rather small and has room for only one desk with a chair and computer. There are three chairs in the hallway outside the office where students can sit and wait if the TA is currently helping another student. When there are no students who need help during office hours, the TA sits at the desk and takes a nap. If a student arrives during office hours and finds the TA sleeping, the student must awaken the TA to ask for help. If a student arrives and finds the TA currently helping another student, the student sits on one of the chairs in the hallway and waits. If no chairs are available, the student will come back at a later time. Using POSIX threads, mutex locks, and semaphores, implement a solution that coordinates the activities of the TA and the students. When the TA finishes helping a student, the TA must check to see if there are students waiting for help in the hallway. If so, the TA must help each of these students in turn. If no students are present, the TA may return to napping.

10. **[10 Marks]** Consider an exponential buddy system of 4KB with the following allowable block sizes: 8, 16, 32, 64, 128, 512, 1024, 2048, and 4096. Draw a diagram showing the allocation/deallocation of the memory after each of the following events.

(a) Process A, request 50K
(b) Process B, request 150K
(c) Process C, request 60K
(d) Process D, request 60K
(e) Process E, request 60K
(f) Process D, exit
(g) Process C, exit
(h) Process E, exit
(i) Process A, exit
(j) Process F, request 125K

(k) Process G, request 150

(l) Process F, exit

(m) Process G, exit

(n) Process B, exit

11. [5×4 **=20 Marks**] Write short note on any **four** of the following:

(a) Process Control Block

(b) Programming Challenges for Multicore systems

(c) File Control Block

(d) Recovery Mechanism from Deadlock

(e) Demand Paging

(f) RAID Structure