[Total No. of Questions - 9] [Total No. of Printed Pages - 4]
(2063)

840

B.Tech 4th Semester Examination

Operating System Concepts

IT-4002

Time : 3 Hours **Max. Marks : 100**

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/ continuation sheet will be issued.

Note : Attempt any one question from section A, B, C and D. Section E is compulsory. Each question carries equal marks.

SECTION - A

1. (a) What is an Operating system? Explain the set of services provided by operating system that are helpful for user. What are the main differences between operating systems for mainframe computers and personal computers? **(10)**

   (b) What is process? What data structure is used by operating system for it? What are process states? Give reasons for occurring of each state. **(10)**

2. (a) Explain the architecture of operating system. Explain the evolution of the operating system from simple operating system to today's popular operating systems. **(10)**

   (b) What are the benefits and detriments of each of the following? Consider both the systems and the programmers' levels.

   a. Symmetric and asymmetric communication

   b. Automatic and explicit buffering

   c. Send by copy and send by reference

   d. Fixed-sized and variable-sized messages. **(10)**

SECTION - B

3. (a) Consider the deadlock situation that could occur in the dining-philosophers Problem when the philosophers obtain the chopsticks one at a time. Discuss how the four necessary conditions for deadlock indeed hold in this setting. Discuss how deadlocks could be avoided by eliminating any one of the four conditions. **(10)**

   (b) Consider a system consisting of *m* resources of the same type, being shared by *n* processes. Resources can be requested and released by processes only one at a time. Show that the system is deadlock free if the following two conditions hold:

   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* **(10)**

4. (a) A single-lane bridge connects the two Vermont villages of North Tunbridge and South Tunbridge. Farmers in the two villages use this bridge to deliver their produce to the neighbouring town. The bridge can become deadlocked if both a northbound and a southbound farmer get on the bridge at the same time (Vermont farmers are stubborn and are unable to back up.) Using semaphores, design an algorithm that prevents deadlock. Initially, do not be concerned about starvation (the situation in which northbound farmers prevent southbound farmers from using the bridge, or vice versa). Modify your solution to so that it is starvation-free. **(10)**

   (b) Discuss the strengths and weaknesses of implementing an access matrix: **(10)**

   - Using access lists that are associated with objects.
   - Using capabilities that are associated with domains

SECTION - C

5. (a) Compare the main memory organization schemes of 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 **(10)**

(b) A page-replacement algorithm should minimize the number of page faults. We can do this minimization by distributing heavily used pages evenly over all of memory, rather than having them comptete for a small number of page frames. We can associate with each page frame a counter of the number of pages that are associated with that frame. Then, to replace a page, we search for the page frame with the smallest counter.

a. Define a page-replacement algorithm using this basic idea. Specifically address the problems of (1) what the initial value of the counters is, (2) when counters are increased, (3) when counters are decreased, and (4) how the page to be replaced is selected.

b. How many page faults occur for your algorithm for the following reference string, for four page frames?

1, 2, 3, 4, 5, 3, 4, 1, 6, 7, 8, 7, 8, 9, 7, 8, 9, 5, 4, 5, 4, 2.

c. What is the minimum number of page faults for an optimal page replacement strategy for the reference string in part b with four page frames? **(10)**

6. (a) Consider a system that allocates pages of different sizes to its processes. What are the advantages and disadvantages of such a paging scheme? What modifications to the virtual memory system are providing this functionality? **(10)**

(b) Consider a file system on a disk that has both logical and physical block sizes of 512 bytes. Assume that the information about each file is already in memory. For each of the three allocation strategies (contiguous, linked, and indexed), answer these questions: **(10)**

a. How is the logical-to-physical address mapping accomplished in this system? (For the indexed allocation, assume that a file is always less than 512 blocks long.)

b. If we are currently at logical block 10 (the last block accessed was block 10) and want to access logical block 4, how many physical blocks must be read from the disk?

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SECTION - D

7. (a) Consider a file system that uses a modified contiguous-allocation scheme with support for extents. A file is a collection of extents, with each extent corresponding to a contiguous set of blocks. A key issue in such systems is the degree of variability in the size of the extents. What are the advantages and disadvantages of the following schemes:

   a. All extents are of the same size, and the size is predetermined.

   b. Extents can be of any size and are allocated dynamically.

   c. Extents can be of a few fixed sizes, and these sizes are predetermined. **(10)**

   (b) The open-file table is used to maintain information about files that are currently open. Should the operating system maintain a separate table for each user or just maintain one table that contains references to files that are being accessed by all users at the current time? If the same file is being accessed by two different programs or users, should there be separate entries in the open file table? **(10)**

8. (a) What are the advantages and disadvantages of a system providing mandatory locks instead of providing advisory locks whose usage is left to the users' discretion? **(10)**

   (b) Discuss how performance optimizations for file systems might result in difficulties in maintaining the consistency of the systems in the event of computer crashes. **(10)**

SECTION - E

9. (a) In what situations would using memory as a RAM disk be more useful than using it as a disk cache?

   (b) Discuss how the clone() operation supported by Linux is used to support both processes and threads.

   (c) How can starvation of a particular process be detected by a system?

   (d) What is the necessity of different directories for different users?

   (e) Explain the critical section problem. **(5×4=20)**