考試科目	作業系統	所別	8141 資訊科學	考試時間	3月6日(六) 第二節

1. **[Process and Thread Concepts]**

   (a) (4%)Describe the actions taken by a kernel to context-switch between processes.

   (b) (6%)Which of the following components of program state are shared across threads in a multithreaded process?

      i. Register values
      ii. Heap memory
      iii. Global variables
      iv. Stack memory

2. **[Process Synchronization]**

   (a) (6%)A semaphore S is an integer variable that, apart from initialization, is accessed only through two standard atomic operations: `wait()` and `signal()`. Please define these two standard semaphore atomic operations.

   (b) (6%)To overcome the need for busy waiting, we can modify the definition of (a)'s `wait()` and `signal()` standard semaphore atomic operations. To implement semaphores under this definition, we define a semaphore as a "C" struct:

```
typedef struct{
    int  value;
    struct process *list;
}semaphore;
```

   Each semaphore has an integer value and a list of processes `list`. When a process must wait on a semaphore via `wait()` operation, it is added to the list of processes. A `signal()` operation removes from the list of waiting processes and awakens that process. In terms of this idea, please define the `wait()` and `signal()` semaphore operations.

   (c) (6%) A file is to be shared among different processes, each of which has a unique number. The file can be accessed simultaneously by several processes, subject to the following constraint: The sum of all unique numbers associated with all the processes currently accessing the file must be less than n. Write a monitor pseudo code to coordinate access to the file.

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3. [Memory-Management Strategies]

   (a) (6%)What is the purpose of paging the page tables?

   (b) (6%)Consider the following segment table:

Segment	Base	Length
0	219	600
1	2300	14
2	90	100
3	1327	580
4	1952	96

   What are the physical addresses for the following logical addresses?

   i. 0, 430

   ii. 1, 10

   iii. 4, 112

   (c) (6%)Explain why sharing a reentrant module is easier when segmentation is used than when pure paging is used.

4. [Virtual-Memory Management]

   (a) (6%)Under what circumstances do page faults occur? Describe the actions taken by the operating system when a page fault occurs.

   (b) (4%)Consider a system that uses pure demand paging.

   i. When a process first starts execution, how would you characterize the page fault rate?

   ii. Once the working set for a process is loaded into memory, how would you characterize the page fault rate?

   (c) (8%)Assume that a program has just referenced an address in virtual memory. Describe a scenario in which each of the following can occur. (If no such scenario can occur, explain why.)

   - TLB miss with no page fault
   - TLB miss and page fault
   - TLB hit and no page fault
   - TLB hit and page fault

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5. **[Implementation File Systems]**

   (a) (6%) Please define the following terms: File Control Block (FCB), system-wide open-file table, per-process open-file table.

   (b) (6%)Consider a system that supports the strategies of contiguous, linked, and indexed allocation. What criteria should be used in deciding which strategy is best utilized for a particular file?

   (c) (6%)Consider a file system that uses inodes to represent files. Disk blocks are 16 KB in size, and a pointer to a disk block requires 4 bytes. This file system has 12 direct disk blocks, as well as single, double, and triple indirect disk blocks. What is the maximum size of a file that can be stored in this file system?

6. **[Secondary-Storage Structure]** The term *fast wide SCSI-II* denotes a SCSI bus that operates at a data rate 20 megabytes per second when it moves a packet of bytes between the host and a device. Suppose that a fast wide SCSI-II disk drive spins at 7200 RPM, has a sector size of 1024 bytes, and holds 160 sectors per track.

   (a) (3%)Estimate the sustained transfer rate of this drive in megabytes per second.

   (b) (5%)Suppose that the average seek time for the drive is 10 milliseconds. Estimate the I/O operations per second and the effective transfer rate for a random-access workload and reads individual sectors that are scattered across the disk.

   (c) (5%)Calculate the random-access I/O operations per second and transfer rate for I/O sizes of 8 kilobytes.

   (d) (5%)If multiple requests are in the queue, a scheduling algorithm such as SCAN should be able to reduce the average seek distance. Suppose that a random-access workload is reading 8-kilobyte pages, the average queue length is 10, and the scheduling algorithm reduces the average seek time to 3 milliseconds. Now calculate the I/O operations per second and the effective transfer rate of the drive.

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