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Master of Science (Computer Science)
MCSC202: Advanced Operating Systems
Unique Paper Code: 223411202
Semester III
May, 2023
Year of admission: 2021

Time: Three Hours **Max. Marks: 70**

Instructions:

- All questions are compulsory.
- Attempt all the parts of a question together.

1. a. Write the algorithm for the `wait` system call including input and output parameters. Also, write a code snippet in `C/C++` to demonstrate the use of `wait` system call. **[4+2]**

b. Consider the execution of four processes, namely, *A*, *B*, *C*, and *D*; and the following assumptions: **[8]**

(i) The processes are created simultaneously with an initial priority of 60.
(ii) The highest user level priority is 60.
(iii) The clock interrupts the system 120 times a second.
(iv) The processes make no system calls, and no other process is in a ready-to-run state.
(v) Process *A* is in one group and processes *B*, *C* and *D* are in another group.
(vi) The first process scheduled by the kernel is *C*. If two or more processes have equal priority, then the kernel picks processes in *reverse alphabetical order*. (C RONIX)
(vii) The process `priority` is computed as:

$Priority = decay(CPU)/2 + groupCount/2 + base\ level\ user\ priority,$
where $decay(CPU) = 0.5 * CPU$ and $groupCount = 0.5 * Group$ respectively.

(viii) `Fair-share` scheduling is used to schedule the processes.

Show the priority calculation and scheduling of these processes for four seconds and the steps involved in the scheduling.

2. a. In a client-server architecture in the network communication system, show the sequence of system calls at the *server-side* assuming reliable **[6]**

communication using the *Transmission Control Protocol*. Also, write the syntax of each system call.

b. Define signals. Write the Algorithm for *Handling Signals* in Unix System V. [1+4]

c. Differentiate multiprocessor systems and distributed systems. [3]

3. a. Enumerate all information with their significance retained in the page table for each page entry. [7]

b. Assume a system with swapping memory management policy and there is no space in the memory. Write the various steps performed by the swapper during the following scenarios: [4]

(i) The fork system call is invoked by a process
(ii) Swapper swaps processes in the memory from the swap device

c. Assuming a system where demand paging is used for memory management and there are three processes A, B and C with their page table as shown in Figure 1. These processes are sharing physical page 828. What will happen if process A attempts to update page 828? Write the issue and actions performed to fix it. Clearly mention the assumption(s), if any. [3]

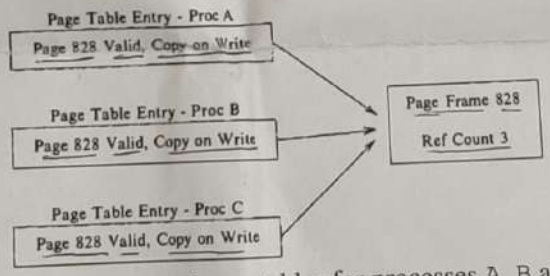

Figure 1. the state of page tables for processes A, B and C

4. a. What is the significance of a free header list in the buffer cache? Also, write its management policy. [4]

b. Consider the C code snippet shown in Figure 2. Show and explain the status of the kernel data structures after each system call. [5]

```
char string[] = "hello";
main()
{
        char buf[1024];
        char *cp1, *cp2;
        int fds[2];

        cp1 = string;
        cp2 = buf;
        while (*cp1)
                *cp2++ = *cp1++;
        pipe(fds);
        for (;;)
        {
                write(fds[1], buf, 6);
                read(fds[0], buf, 6);
        }
}
```

Figure 2. C code snippet

c. Consider the two configurations (Figure 2) of the Super block for disk block management. Show and explain the changes in the configuration of the Super block for the following: [5]

(i) When the kernel assigns a block from configuration Figure 2(a).
(ii) When the kernel assigns a block from configuration Figure 2(b).
(iii) When the kernel free a block says 100 after updating the configuration according to part (ii).

Clearly mention your assumption(s), if any.

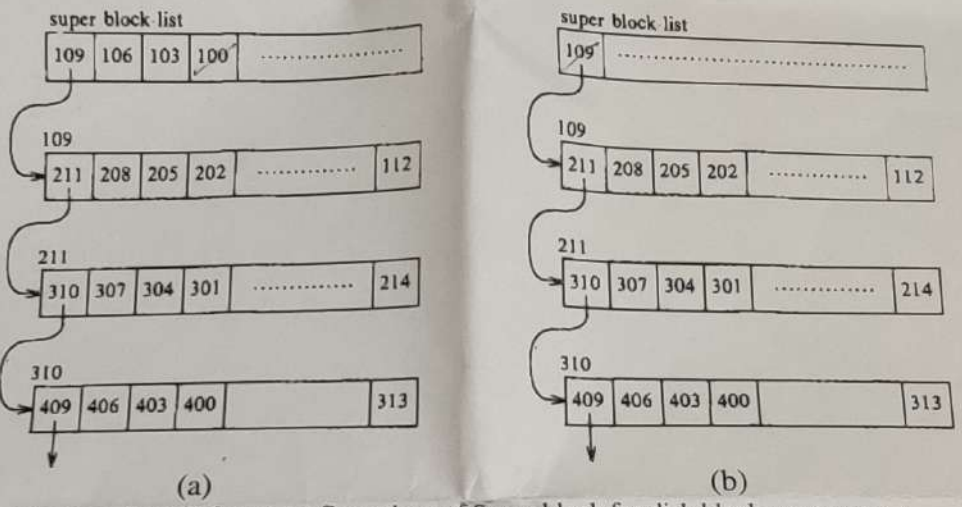

Figure 2. Two different configurations of Super block for disk block management

5. a. Consider a distributive system with seven nodes (A, B, C, D, E, F and G) that uses using *token ring algorithm* to resolve mutual exclusion. Now, node B and G attempt to enter into the critical section simultaneously while the token is with node E. Assuming the logical ring is formed in alphabetical order. [4+2 +1]

(i) Write down the various steps involved in handling mutual exclusion in this distributed system.
(ii) What are the disadvantages (atleast two) of this method?
(iii) Write down the maximum delay before entering (in message time) in the critical section for this distributed system.

Write down all assumption(s), if any.

b. What is the purpose of clock synchronization in distributed systems? Differentiate `Lampart's clock` synchronization algorithm and `Berkeley's clock` synchronization algorithm in the distributed systems. [2+3]

c. What are the advantages of buffered primitives over unbuffered primitives in the client-server model in distributed systems? [2]