

**College of Engineering, Pune**  
**Dept of Computer Engineering & Information Technology**  
**Final B. Tech END SEMESTER EXAMINATION - Dec 2012**  
**(CT 405)-Advanced Unix Programming**

Date: 01/12/2012

2-5pm

Durations: 3 hrs

Max. Marks- 100

**Instructions:**

1. Answer any 5 complete questions.
2. Write the programs using C/C++ language syntax

- |   | Marks |
|---|-------|
| Q. 1 a. Write a program that prints the owner, file type, access permissions, and access times of files supplied as parameters. If a file is a directory, the program should read the directory and print the above information for all files in the directory. | 8     |
| b. A file can be moved in two different ways:   | 6     |
| (i) Simply "rename" the file by updating the directory information  |       |
| (ii) Copying the file to the new location and deleting the original file  |       |
| Compare the two approaches (in terms of complexity and feasibility with respect to the file system operations).   |       |
| c. Can there be "stale" soft or hard links that point to non-existent files? Explain with proper examples to justify your answer.   | 6     |
| Q.2 a. A file 'infile' contains numbers from 1 to 10. What will be the expected output of the following program execution? Explain by showing the status of different kernel data structures and the stored data with them.                                     | 8     |

```

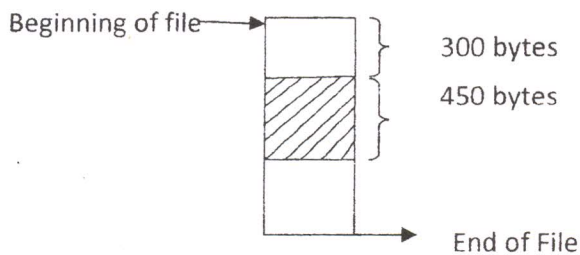
int main(void)
{
    int fd_in, fd_out;
    char buf[1024];
    memset(buf, 0, 1024); /* clear buffer*/
    fd_in = open("/tmp/infile", O_RDONLY);
    fd_out = open("/tmp/outfile", O_WRONLY|O_CREAT, 777);
    fork();
    while (read(fd_in, buf, 2) > 0)
    {
        printf("%d: %s", getpid(), buf);
        sprintf(buf, "%d Hello, world!\n\r", getpid());
        write(fd_out, buf, strlen(buf));
        sleep(1);
        memset(buf, 0, 1024); /* clear buffer*/
    }
}

```

b. A process can either call a function to perform a job and exit, or call one of exec functions and exit. What is the difference between calling a function and performing exec? Justify by showing the memory layout of the process. 6

c. Superuser is the only process who has permission to write a password file “/etc/passwd”, preventing malicious users from corrupting the contents. The passwd command allows users to change their password entry, but it must make sure that a user does not change other users’ entries. How is this achieved? Explain 6

Q.3 a. In a certain application, it is required to lock the hatched portion of the file, “test.txt” as shown in the figure. Before locking the program must query the OS to see if some other process has locked the file already. If yes, give the details of the locked portion and the PID of the process. Otherwise, obtain the lock, perform a write operation and later unlock the file. Write a program to implement this application. Assume suitable lock type and other requirements. 8



b. The setjmp based implementation of sleep2 function shown below avoids the race condition between alarm and pause. But the generated SIGALRM may interrupt some other signal handler. Write a program which includes a signal handler for SIGALRM and also call to sleep2. Explain with proper demonstrations how the SIGALRM from sleep interrupts the signal handler in your program. 8

```
static jmp_buf env_alarm;

static void
sig_alarm(int signo)
{
    longjmp(env_alarm, 1);
}

unsigned int
sleep2(unsigned int nsecs)
{
    if (signal(SIGALRM, sig_alarm) == SIG_ERR)
        return(nsecs);
    if (setjmp(env_alarm) == 0) {
        alarm(nsecs);
        pause();
    }
    return(alarm(0));
}
```

- c. Give an example of a program failure that might occur when an asynchronous function calls a non-re-entrant function. 4
- Q 4a. "Blocked signals do not get lost." Is this statement true or false? Assume a situation where SIGINT was blocked, then the process slept for 1 second and followed by terminated. Justify your answer assuming that SIGINT is generated for the process during the sleep period. 5
- b. The sigaction function specifies a signal mask to be applied when a signal handler is called. How does the handler-specific signal mask interact with the process signal mask? What will be the final mask for the process inside the signal handler? 5
- c. Write a program which does the following: 10
- a) Initially flag = 0
  - b) A disposition for SIGINT which sets a flag to 1 and print a suitable message
  - c) Assume that there are 2 steps in your program. During step 1, occurrence of SIGINT has to be blocked. During step 2, SIGINT should not be blocked. Suspend the process during step 2 until SIGINT is delivered to the process using suspend function.
- With proper output explain what will happen with your program execution if
- i. SIGINT is delivered only during execution of step1.
  - ii. SIGINT is delivered only during execution of step2.
  - iii. SIGINT is delivered after the execution of step1, but before program termination
- Q 5 a. Write a program which makes utilize memory mapped – I/O functions to emulate "cat filename" Unix command. Why is this program better than one based on file management functions? 8
- b. The traditional UNIX scheduler enforces an inverse relationship between priority numbers and priority: the higher the number the lower the priority. The scheduler recalculates process priorities once per second using the following function: 6
- $$\text{Priority} = (\text{recent CPU usage} / 2) + \text{base}$$
- where base = 60 and recent CPU usage refers to a value indicating how often a process has used the CPU since priorities were last recalculated. Assume that recent CPU usage for process P1 is 40, for process P2 is 18, and for process P3 is 10. The scheduler is based on round robin. What will be the new priorities of these three processes when priorities are recalculated at the end of one cycle of execution of these processes?
- c. Write a program using pipe function to emulate the Unix command, "ls | wc -l" 6

Q 6 a. Assume that a very secure system "A" is in execution. There is an admin process, "X" 12  
who verifies that there is any attack on A and for this, X has created a message queue.  
Whenever any signal (SIGINT, SIGQUIT, SIGTERM, SIGABRT) is delivered to A, a  
message (which contains the signo) is placed for A on the message queue. Every 5  
seconds, X displays all the messages in the message queue generated for A. Write  
appropriate code for A and X.

b. Shown below the code which uses semaphores to ensure that the parent does not read from 8  
location x until the child writes to location x. Fill in the blanks appropriately.

```
...
struct sembuf semwait, semsignal;
if((semid = _____(IPC_PRIVATE, 1,S_IRUSR|S_IWUSR) == -1) exit(1);
semwait.sem_num = 0;
semwait.sem_op = _____;
semwait.sem_flg = 0;
s semsignal.sem_num = 0;
semsignal.sem_op = _____;
semsignal.sem_flg = 0;
if ((childpid= _____()) == 0) {
    ...
    //Write to location x;
    _____(semid, _____,1);
    ...
}
else {
    ...
    semop(semid, semwait, 1);
    //Read from location x;
    ...
    _____(NULL);
    _____(semid,0,IPC_RMID);
    ...
}
```