

All 10 questions count equally. The final grade = max(midterm, part 1) + part 2

Part 1

1. UNIX has system calls FORK and EXEC. Give a concise explanation of what each one does.
2. A MINIX file with UID = 16 and GID = 20 has mode RWXR-XR--. Another user tries to execute the file. What will happen if that user has
 - (a) UID = 40 and GID = 20
 - (b) UID = 20 and GID = 40
3. For the purpose of scheduling, a process can be in one of three states. Draw a diagram showing these three states and label each one. Draw in the allowed transitions between the states and label each one.
4. A solution to the readers-writers problem is given below.

```
typedef int semaphore;
semaphore mutex = 1;
semaphore db = 1;
int rc = 0;

void reader(void)
{
    while (TRUE) {
        down(&mutex);
        rc = rc + 1;
        if (rc == 1) down(&db);
        up(&mutex);
        read_data_base( );
        down(&mutex);
        rc = rc - 1;
        if (rc == 0) up(&db);
        up(&mutex);
        use_data_read( );
    }
}

void writer(void)
{
    while (TRUE) {
        think_up_data( );
        down(&db);
        write_data_base( );
        up(&db);
    }
}
```

Under what conditions does the semaphore db have the value 0? Be precise.

5. Explain the concept of two level scheduling.

(Please continue on page 2)

Part 2

6. A computer has 10 copies of some resource. Suppose that the current allocation of resources is as follows:

User	Has	Max
Alice	1	6
Bob	1	5
Carla	2	4
David	4	7

For example, Alice has 1 resource but might potentially need as many as 6. For each of the following requests, tell whether it is safe to grant it.

- (a) Alice wants 1 unit
 - (b) Bob wants 1 unit
 - (c) Carla wants 1 unit
 - (d) David wants 1 unit
7. Suppose that a 32-bit virtual address is broken up into four fields, a , b , c , and d . The first three are used for a three-level page table system. The fourth field, d is the offset. Is it possible from this information to give an algebraic formula for the number of pages in the virtual address space? If so, give it. If not, explain why it is not possible to give it.

8. A computer has a virtual memory with 64 pages of 4 KB. The page table starts as follows:

Virtual	Physical
0	4
1	3
2	1
3	-
4	7
5	-
6	0
7	-

For each of the following virtual addresses, give the corresponding physical address where it exists: 0, 4095, 4096, 8192, 13000.

9. Give a short description of the how the MINIX CHDIR system call is carried out. What information does it store and in which table?
10. A file consists of the following disk blocks: 4, 2, 3, and 8. Show how MS-DOS keeps track of this information using the FAT-16 file system. Draw the FAT table correctly filled in.

