Mid Term Exam CS3600

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Note: This exam is timed. You have 11 questions and 80 points in total. Points for each question are given along with. Once you start you will get 1 hours and 50 minutes (110 minutes total), manage your time accordingly. You are allowed to use a one-sided 3X5 notecard. Answer **neatly** in the space given.

1. Processes p1 and p2 execute on a system with a single CPU and a single I/O device. Each process executes a compute-bound phase followed by an I/O-bound phase. The system uses multiprogramming without time-sharing. The following table shows the lengths of each phase. p1 starts first at time 0. (**4 Points**)

	CPU	I/O
p1	20	70
p2	10	80

Without multiprogramming, the computation terminates at time 100

With multiprogramming, the computation terminates at time 30

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2. The mutex can only have the values 0 or 1. (True / False) (**2 points**)

True

3. s = 0 initially.
Process p1 executes the sequence: P(s); P(s); V(s);
Process p2 executes the sequence: V(s); V(s);

Which process will start first? Process P1 (**2 points**) P2

4. The PCB (Process Control Block) is created by the CPU when execution starts. (**2 points**)

a. CPU
b. Operating System
c. Main Memory
d. Process itself

5. Which below given tasks need help of operating system? (**2 points**)

a. Click your mouse button. ✓
b. Call a recursive function from a program ✓
c. Close an application.
d. Document Printing. ✓

6. Process p is in the queue at level N-3, followed by process q at the same level. Queues at levels N through N-2 are empty. **(10 points)**

   a. If p needs 2 units of CPU time and q needs 1 unit of CPU time, process q will terminate first. q then p since q < p ✓

   b. When p starts executing, a new process r with a CPU time requirement of 3 units arrives at level N. The 3 processes will terminate in the order q r p. ✓ r q p

P1 stops P2 stops

0 10 20 30 40 50

P1=10	P2=10	P1=20	P2=20	P2=30

7. Two processes, p1 and p2 arrive at time 0 and start executing using RR scheduling. (p1 starts before p2) The total CPU time of p1 is 20-time units, and p2 is 30. The quantum is Q = 10. The context switching time is S = 0. **(10 points)**

   TAT = CT − AT

   The turnaround time of p1 is 30 time units 30 − 0 = 30

   The turnaround time of p2 is 50 time units 50 − 0 = 50

   The average turnaround time, ATT, is 40 time units $\frac{30+50}{2} = \frac{80}{2} = 40$

8. Two processes, p1 and p2 are executing using RR scheduling. The context switching time is S = 3.

   a. Determine the maximum quantum size Q such that the gap between the end of a process pi's quantum and the start of pi's next quantum does not exceed M = 50-time units. Write the equation and steps **(5 points)**

P1	S=3	P2	S=3	P1 ...

a = end Quantum b = start

Gap = 50

From a to b, we have 2 S=3 times + 1 quantum of size Q. Thus...

Quantum + 2(S=3) = 50

Quantum + 6 = 50

Quantum = 44

b. Determine the percentage of CPU time wasted on context switching. **(5 points)**

$$\text{Wastage} = \left(\frac{\text{context switch}}{\text{Quantum}}\right) \cdot 100\%$$

$$= \left(\frac{3 \text{ time units}}{44 \text{ time units}}\right) \cdot 100\%$$

$$\approx 6.818\%$$

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9. Consider a parent process P that has forked a child process C in the program below:

```
int a=5;
int fd=open("test.txt") // statement to open a file
int ret=fork();
if(ret>0){
   close(fd); //close the test.txt file
     a=6;
}
else if(ret==0){
   printf("a=%d\n",a);
read(fd);// reading the test.txt file
}
```

parent ~~~~.

then → child ~~~~

Assume that the child process is scheduled for the first time only after the parent completes the changes.

(a) What is the value of the variable 'a' as printed in the child process, when it is scheduled next? Explain. **(4 points)**

Since the value of ret is initially equal to zero, the program initially prints 5 and then reads the file. Afterwards, the program ends and 6 is set to the variable of a.

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(b) Will the attempt to read from the file descriptor succeed in the child? Explain. **(4 points)**

Since the parent process closes the file, the child process will not be able to access the file and the attempt to read from the file descriptor will fail.

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10. Three periodic processes with the following characteristics are to be scheduled.

Process	Period	Total CPU Time
p1	5	1
p2	10	3
p3	4	2

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Determine if a feasible schedule exists. Determine how many more processes, each with T = 1 and D = 4, can run concurrently under RM. Justify your answer. **(10 points)**

P1 = 1 [+4 T.U.] T=5 | P2 = 3 [+7 T.U.] T=10 | P3 = 2 [+2 TU] T=4

- A feasible schedule does not yet exist. ✓
- 4 TU + 7 TU + 2 TU = 13 TU

13 / 4 = 3 whole, 1 remainder

3 additional processes may run concurrently under RM.

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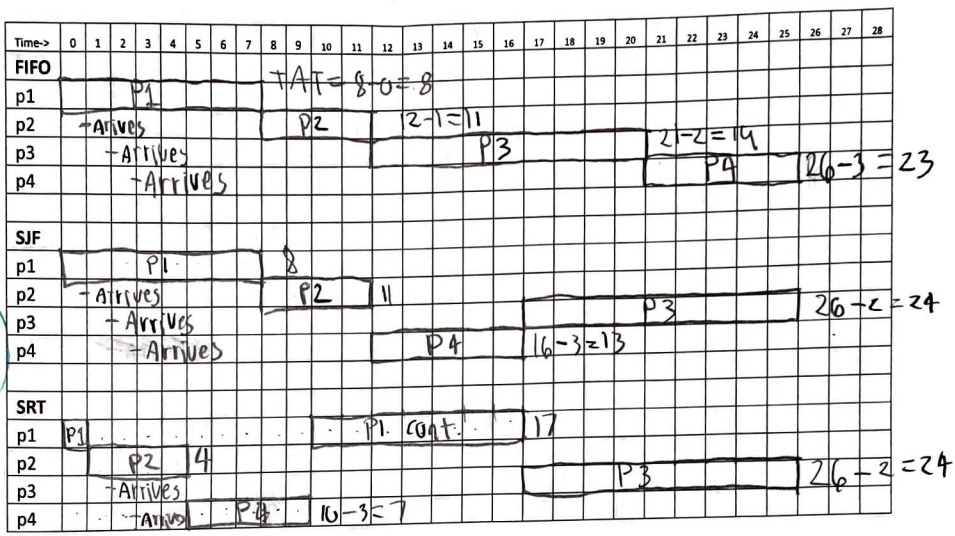
11. For the 4 processes described below, draw the Gantt chart showing when each process executes under FIFO, SJF, and SRT. **(20 points)**

Process	p1	p2	p3	p4
Arrival Time	0	1	2	3
Total CPU time	8	4	9	5

Determine the ATT for each scheduling algorithm for the 4 processes.



$$FIFO = \frac{8+11+19+23}{4} = 15.25$$

$$SJF = \frac{8+11+24+13}{4} = 14$$

$$SRT = \frac{17+4+24+7}{4} = 13$$