CSCI 3753: Operating Systems
Summer 2019

Midterm Exam Practice Solutions

06/27/2019

Multiple Choice Questions: [30 Points] Choose one option that answers the question best.

1. Advantages of threads over processes include

   A. lower context switch time
   B. no possibility of race conditions
   C. sharing of heap and stack
   D. smaller code size
   E. All of the above

2. Which of the following is FALSE about IPC via pipes?

   A. Basic primitives are `send()` and `receive()`.
   B. Communication can be blocking or non-blocking.
   C. Pipes can be anonymous or named.
   D. Pipes can be used for only one-way communication.
   E. IPC via pipes is slower than IPC using shared memory.

3. Which of the following is NOT required for a system to be in deadlock?

   A. mutual exclusion
   B. no preemption
   C. acquire and hold
   D. circular dependency

Short Answer Questions: [30 Points]

Consider the following program code for the next question (Question 1).

```
int ret = fork();
if (ret == 0){
     ret = fork();
     printf("Hello \n");
}
printf("World \n");
return 0;
```

1. How many times the following word will be printed?

   A. "Hello": __2___ times

   B. "World": __3___ times

Consider the following program code for the next question (Question 2).

```
int t;

void swap(int *x, int *y)
{
     int s;
     s = t;
     t = *x;
     *x = *y;
     *y = t;
     t = s;
}
```

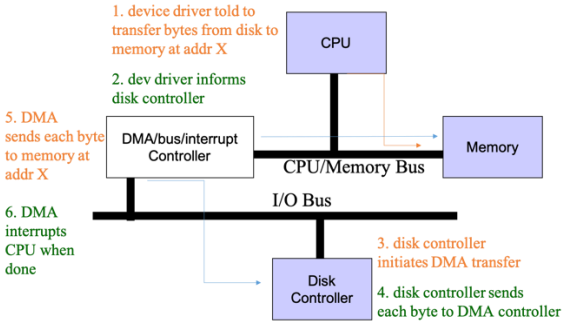
2. Is there a possibility of a race condition updating variable t in the code above? yes

3. Mark each term with the letter of the correct statement.

A. A piece of code functions correctly during simultaneous or concurrent execution by multiple threads.	C. A function defined in the Linux kernel to copy data from kernel-space.
B. A function defined in the Linux kernel to copy data to kernel-space.	D. The procedure for replacing the currently executing process with another.

Thread-safe	**copy_to_user()**
A	C

4. What is the I/O strategy of the device manager illustrated in the image below?



A. direct I/O with polling
B. direct I/O with interrupts
C. DMA with interrupts
D. hardware interrupts

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Problems: **[40 Points]**

1. Consider three processes, P, Q and R with the following code:
   - P: ps1; ps2; ps3; ps4;
   - Q: qs1; qs2; qs3; qs4;
   - R: rs1; rs2; rs3; rs4;

These processes have the following synchronization constraint:
   - rs1 must be the first statement to execute
   - process R should be the last process to exit
   - ps3 must execute after qs2
   - qs3 must execute after ps4 and rs3
   - rs4 must execute after either ps4 or qs4 (or both) have executed

Using semaphores, provide updated codes for P, Q and R that satisfy these constraints.

Solution:

The semaphores are all initialized to a value of zero: **s1 = 0, s2 = 0, s3 = 0, s4 = 0, s5 = 0.**

Process P	**Process Q**	**Process R**
wait(&s1)	wait(&s1)	
<ps1>	**<qs1>**	**<rs1>**
		signal(&s1) signal(&s1)
<ps2>	**<qs2>**	**<rs2>**
wait(&s2)	signal(&s2) wait(&s3) wait(&s3)	
<ps3>	**<qs3>**	**<rs3>**
		signal(&s3) wait(&s4)
<ps4>	**<qs4>**	**<rs4>**
signal(&s3) signal(&s4) signal(&s5)	signal(&s4) signal(&s5)	wait(&s5) wait(&s5)

2. Consider the set of processes with the length of the CPU-time given in milliseconds

Process	Original Priority	Arrival Time	Execution Time	Deadline
P1	2	0	80	100
P2	1	60	20	40
P3	5	50	30	60

Show the Gantt chart for the execution of these processes, if the preemptive Round Robin scheduling algorithm is used with 20 tick time slice. Calculate the average turnaround time.

P1	P1	P1	P2	P1	P3	P3	
0	20	40	60	80	100	120	130

→ Average TAT = (100 + 20 + 80)/3 = 66.67

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