Computing Science 300

Sample Quiz 1 (50 minutes)

Your first assignment gives you a good idea of the types of calculation problems that might appear on your quiz here are a few examples of the other types of questions that might appear.

1. Consider a computer system that includes a single 200 GB internal hard disk, 4 GB of RAM, 1 DMA and 1 output device that writes 1 word of data at a time. The DMA is used to transfer data and instructions between RAM and internal disk. It can transfer up to 200Mb at a rate of 12.5Mb/s. The DMA setup takes 4ms. The DMA sends an interrupt when it has completed the transfer. The output hardware setup takes 2ms and transfer of 1 word of data takes 1ms. The output device busy waits during the transfer of data. When an ISR, hardware setup or other process completes the OS scheduler is run to determine which process will run next. Assume that after the DMA transfer completes the OS scheduler will choose the process that started the DMA transfer as the next process to run. Time taken by context switches and ISRs can be ignored. State any further assumptions you make in your solution
   a) **[12 points]** Explain briefly what happens during the DMA setup.
   b) **[18 points]** How long would it take to transfer a 500Mb block of data?

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2. The C code snippet shown below is a small chunk of the code extracted from a large application. This code snippet shows a parent process creating a child process.

```
1. if ( (pid = fork()) == 0 ) {
2.       processitInner(); /* function called completes task 1 */
3.       exit (0);
4. }
5. processitOuter(); /* function called completes task 2 */
```

Answer each of the questions below. Explain your answers

- **[6 points]** Is task2 done by the child process?
- **[6 points]** What does the fork() function do?
- **[6 points]** What is the expected return value of the fork() function?
- **[6 points]** Are all illustrated lines of code executed by the parent process?
- **[6 points]** What were the differences between the child's process control block and the parents process control block that were discussed in class?

3. Consider a system that uses a 64-bit word. This system uses a 512 byte cache memory on the CPU that has a 64 byte cache slot size. The system has 1 Mbyte of RAM memory. Remember 1 byte = 8 bits and 1Mbyte=1024*1024 bytes and 1Kbyte = 1024 bytes. When a cache line is placed in the cache, the following rules are used.

    i. There are M cache lines in this system. The first cache line is cache line 0; the next is cache line 1, and so on. The last cache line is cache line M-1. All cache lines are the same size.)
    ii. There are N cache slots in this system. The first cache slot is cache slot 0; the next is cache slot 1, and so on. The last cache slot is cache slot N-1. All cache slots are the same size.
    iii. Cache line K can be placed in cache slot K%(N/2) and cache slot K%(N/2)+N/2
    iv. If both cache slot K%(N/2) A and cache slot K%(N/2)+N/2 are empty the cache line will be placed in cache slot K%(N/2).
    v. If cache slot K%(N/2) is empty and cache slot K%(N/2)+N/2 is full, or cache slot K%(N/2) is full and cache slot K%(N/2)+N/2 is empty the cache line will be placed in the empty slot.
    vi. If both cache slot K%(N/2) and cache slot K%(N/2)+N/2 are full the cache line will be placed in the cache slot with the earliest last accessed time.

a) **[8 points]** What is a cache slot? How many cache slots would there be in this computer system? Where would the cache slots be located?
b) **[8 points]** What is a cache line? How many cache lines would there be in this computer system? Where would the cache lines be located?
c) **[8 points]** What is the purpose of a mapping function? For the system described above what would the mapping function be?
d) **[10 points]** What is the purpose of a replacement policy? For the system described above what would the replacement policy be?
e) [6 points] Which cache slots could hold cache line 1234?