Operating Systems Exercises Week beginning 10th February 2014

Which of the following operations should be allowed only in kernel mode?

(a) write the program counter – allowed in either user or kernel mode. For any process, the program counter is incremented at the end of the fetch cycle.

(b) clear memory - (can omit this one, as its ambiguous) or kernel mode only because user program shouldn't be able to clear arbitrary memory

(c) turn off interrupts - only in kernel mode because:

If CPU allows user processes to disable all interrupts, chaos will occur.

(d) access I/O device – only in kernel mode as otherwise a user process could e.g. overwrite a file on hard drive

(e) write the instruction register - allowed in either user or kernel mode. For any process, the instruction register is written to during the fetch cycle.

2. A workstation has a clock rate of 25MHz which means that the machine is capable of performing 25 million basic operations per second. e.g. a register test instruction might just take one clock cycle but an arithmetic instruction might require 10 clock cycles while an I/O instruction might require hundreds.

What is the time duration of one basic operation (or one clock cycle)?

Assuming the average instruction takes 2.5 clock cycles, how many average instructions can be executed in 100 microseconds. A microsecond (µs) is a unit of time equal to one millionth (10-6) of a second

25 MHz means 25,000,000 clock cycles per second

1 clock cycle = 1/25,000,000 sec = 1/25 (microseconds) =0.04 µs

average instruction = 2.5 cycles = 2.5\*0.04 µs = 0.1 µs

How many in 100 µs?

average instruction = 0.1 µs

=> 10 average in 1 µs

1,000 average instructions in 100 µs

3. Some hardware devices follow:

* processor
* bus
* main memory
* hard disk
* register
* cache

Indicate which of these devices is best defined by the following: (Some items may have more than one answer)

executes program instructions - processor

volatile storage medium – main memory, register, cache

fastest memory in a computer system - register

transmits data between hardwire devices - bus

fast memory that improves application performance - cache

4. Use the hypothetical machine given to you in fetch-execute-cyle slides. The following is an extra opcode:

0110 – subtract memory from AC, storing result in AC.

The following are the contents of memory:

Memory Address Memory contents

1. 1510
2. 6511
3. 2512

…

1. 0005
2. 0001
3. 0000

The PC (program counter) contains 200, the address of the first instruction.

Show the fetch and execute cycle for this partial program

1510 => Load AC from memory location 510. So 0005 is copied into AC

6511 => subtract memory location 511 from AC, storing result in AC. So 0001 is subtracted from 0005 and thus 0004 is stored in AC

2512 => Store AC to memory location 512. Thus 0004 is stored in memory location 512