CIS 415 Operating Systems * Spring 2010 (Answers)

Worksheet 1: Terms and Interrupts

1. **OS Terminology**
   For each term below indicate the number of (human) users, CPUs, and operating systems that is/are active at the same time. You answers should be one of the following: 0 (none), 1 (exactly one), >=1 (one or more), or >1 (more than one). Be ready to justify or explain each answer. OS’s should be interpreted as complete copy of an OS (rather than type of OS). Assumptions: no virtualization, no dual-booted systems. (Extra credit – remove these assumptions.)

   Note: these answers assume typical usage situation. The answers make certain assumptions. Alternative answers are possible.

<table>
<thead>
<tr>
<th>Number of Users</th>
<th>Number of CPUs</th>
<th>Number of OS Types</th>
<th>Number of OS Copies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiprogrammed uniprocessor</td>
<td>&gt;=1 (assuming remote logins, multiple terminals) =1 is OK</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Time-shared uniprocessor</td>
<td>&gt;1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Multi-programmed multiprocessor</td>
<td>&gt;=1</td>
<td>&gt;1</td>
<td>1 if homogeneous &gt;1 if heterogeneous</td>
</tr>
<tr>
<td>Multi-core Processor</td>
<td>&gt;=1</td>
<td>&gt;1</td>
<td>1</td>
</tr>
<tr>
<td>Compute cluster or Grid</td>
<td>&gt;=1</td>
<td>&gt;1</td>
<td>&gt;=1</td>
</tr>
<tr>
<td>An iMac in Room 100 Deschutes</td>
<td>&gt;=1</td>
<td>&gt;1</td>
<td>1</td>
</tr>
</tbody>
</table>

2. **Multiprogramming** Is there a limit to the number of processes that can be executing concurrently in a uniprocessor multiprogrammed system? Consider both performance and resource usage issues. Performance degrades if too many processes executing concurrently. (Can be to the point that the system is constantly “context-switching” (switching among processes) but not doing any useful work.) Another constraint is the size of data structures allocated by the OS to keep track of processes. Process ID (pid) may be limited to a fixed number of bits. Process table may be limited to a fixed number of total entries.
3. **Interrupt Basics**
   If process A is currently running, which of the following interrupts can occur? why did they occur? which ones are most likely to occur?

   ___X__ a clock interrupt – **one of the most common, initiated by scheduler who sets time quantum**

   ___X__ an I/O interrupt – **one of the most common, previously initiated by a process requesting I/O services.**

   ___X__ an arithmetic fault interrupt – **caused by program error**

   ___X__ an illegal instruction interrupt – **caused by program error**

   ___X__ a memory protection interrupt - **caused by program error**

4. **Interrupts**
   When an interrupt occurs, the PC gets loaded with a new value. For each of the answers below, write "+" if it describes a value that would very likely be loaded into the PC just after the interrupt occurs. Write "0" if it describes a value that would not likely be loaded into the PC just after the interrupt occurs (e.g never or far fetched scenario). Assume interrupts are enabled (not masked).

   _____ address of the next instruction in memory

   ___+__ address of the first instruction in the interrupt handler

   _____ address in the user's program

   ___+__ address in the operating system kernel

   ___+__ an address that it has loaded in the past (because interrupt handlers are repeatedly invoked)

   _____ address of your CIS 415 professor