CS 377 – Operating Systems

Discussion Session 8 Questions

Name: _____

Write your answers individually, without consulting notes, slides, books, or the internet. Be succinct (complete sentences not necessary). **Remember to turn your paper over.**

1. **Memory management**. In memory management, what do we mean by a *segment*, a *physical address*, and a *virtual address*? What is the relationship between physical and virtual addresses?

   Solution. *A segment is a chunk of memory that is assigned to a specific process. A physical address refers to a hardware memory address (that is, corresponding to a specific physical location in RAM). A virtual address refers to a memory address relative to a process' own address space – this does not necessarily correspond to any particular physical address. The OS maps virtual addresses to physical addresses to actually place data in memory, and this mapping may change over time.*

2. **Relocation**. *Relocation* refers to placing a process' position in physical memory (allowing the program to execute independently of whatever its current physical address is). Explain how **dynamic relocation** works.

   Solution. *In dynamic relocation, there are two special-purpose CPU registers – a base register and a limit register. The base register stores the base (i.e., offset zero) physical address for the current process, while the limit register stores the maximum offset of the process in physical memory. Logical addresses from the CPU are translated by adding the base register value to get the physical address. If the logical address is larger than the limit register value, then an addressing trap results.*

3. **Fragmentation**. What is fragmentation and what (at a high level) can we do to address it?

   Solution. *Fragmentation refers to the unused space in memory that results from loading and unloading processes into physical memory. Since this unused space may be in small chunks, it is not useful for new processes, and hence is wasted until memory is* **compacted**. *Compaction moves around active memory to reduce fragmentation by joining such fragments into larger (usable) memory chunks.*

4. **Paging**. Suppose we have a system with 8k of physical memory in which the OS uses 2k and a single running process A uses 4k. Assuming the system is using paging with a 1k page size, sketch a diagram showing what the logical memory of A and the physical memory of the machine might look like.

   Solution.