Homework Chapter 9

1. Suppose you are working on a large project with several smaller teams working semi-independently. What are some pros- and cons- of using shared, dynamic libraries for sharing code versus sharing source code .

   Using shared, dynamic libraries means that each individual portion of the project is able to use the same library that is loaded in at runtime. This saves disk space by reducing executable size, and it also saves main memory usage by not having each program run its own copies of the libraries. The downside of this is that it has to involve the operating system to determine if the libraries are loaded into another program's address space, and the processes must be allowed to access the same address.

2. Despite memories and programs growing in size, memory page sizes have mostly remained fixed at 4KB. Some architectures do support larger pages, but the 4KB is still the standard. Why can't we just modify the kernel to support something other than 4KB?

   Because page size is architecture dependent, the kernel cannot simply be changed and expect the architecture of the hardware to change with it. Manufacturers would have to change the MMUs on their CPUs in order to support larger page sizes.

3. What is the address-space identifier, and why is it crucial to storing this in the TLB?

   The address-space identifier identifies each process and is used to provide address-space protection for that process. This is critical to identifying TLB misses when a process attempts to access a virtual page number with an ASID that doesn't match the process's ASID.

4. Is it possible to have more *page in* than *page out*s? Is this the sign of a healthy, well-performing system?

   Yes, and more page ins are desirable. Page outs mean that the data was not in main memory and had to be accessed from the disk. More page outs than page ins usually indicates the need for more ram.

5. A program is running on a 32-bit intel computer, and the virtual address for variable ***a*** is 0x4010_001F. The operating system has assigned virtual page $262{,}400_{10}$ to physical page $524{,}102_{10}$. Show the 32-bit hexadecimal physical address for variable ***a***. Also, write the *page directory* address and the *page table's* address using Intel's 32-bit scheme.

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