**CPHE 222: Organization, Architecture, and Assembly Language**

**Homework -- Chapter 5C**

**Exercise 1**:

A certain computer system has a virtual memory system with 2 KB pages, 24-bit virtual

addresses, 32-bit physical addresses, a 1 KB fully associative TLB, 32 KB two-way set associative data cache, 16 GB main memory, and a 256 B block size. Each page table entry has a length of 4 bytes. Answer the following questions regarding this system.

1. How many total pages are there in the main memory for this system?
2. How many bits of the virtual address are used for the page offset?
3. If the entire page table is stored in main memory, how much space is consumed with the page table?

1. How many bits of the physical address are used as the cache index for the data cache?
2. How many bits of the physical address are used for the block offset when referencing the data cache?
3. How many bits of the virtual address are used as the cache index for the TLB?
4. How many bits of the virtual address are stored in the TLB tag field?
5. How many virtual pages are there in this system (for each process)?

**Exercise 2**:

A certain computer system has a virtual memory system with 1 KB pages, 28-bit virtual

addresses, 34-bit physical addresses, a 2 KB 8-way associative TLB (each entry consumes 4 bytes), 64 KB four-way set associative data cache, 8 GB main memory, and a 128 B block size. Each page table entry has a length of 4 bytes. Answer the following questions regarding this system.

1. How many total pages are there in the main memory for this system?
2. How many bits of the virtual address are used for the page offset?
3. If the entire page table is stored in main memory, how much space is consumed with the page table?
4. How many bits of the physical address are used as the cache index for the data cache?
5. How many bits of the physical address are used for the block offset when referencing the data cache?
6. How many bits of the virtual address are used as the cache index for the TLB?
7. How many bits of the virtual address are stored in the TLB tag field?
8. How many virtual pages are there in this system (for each process)?