CPSC 313, Winter 2006 - Term 2
Problem Set #9

Assigned: April 2
Due Wednesday, April 11, 13:00 pm (no grace period)

1. Textbook 10.11
2. Textbook 10.12
3. Textbook 10.13
4. Consider a virtual-memory system with the following parameters

   - PTBR = physical address of page table base
   - PTE[i] = page table entry at physical address i (i.e., the byte address of PTE)
   - PTE[i] is a struct with these fields: PFN, S (system), W (writeable), P (present)
   - one-level page table
   - 32-bit virtual addresses
   - 4-KB page size
   - VA = virtual address
   - VA is a struct with these fields: VPN and PO

   List the physical address of every memory access required to complete a read from a user-mode program to virtual address 0x8063472 (i.e., 0000 1000 0000 0110 0011 0100 0111 0010) (in terms of VA, PTE[i] and PTBR), assuming that there are no cache hits in any cache. Be sure to list every memory access (i.e., to the page table AND the target data itself). Briefly explain each answer and list the checks that determine whether the read access is valid and permitted.

   You may use the notation FOO[i..j] to be the number formed by selecting bits i through j from FOO as bits i-j through 0 of the result, where bit 0 is the lowest order bit. For example,

   $$101101[4..2] = 011 = 310.$$

5. Repeat question 4, with the following changes to the VM system

   - two-level page table with 1024 entries in the level-one page table
   - PDE[i] = page directory entry at physical address i with same fields as PTE[i]

6. Compare the replacement mechanisms of set-associative caches and virtual memory by describing the algorithm each uses and justifying why this algorithm is a good choice for that problem, but not for the other.