

CDA3101 - Spring 2015  
Assignment 7  
Virtual Address Translation

**Objectives.** Learn how virtual addresses are translated to physical addresses and are efficiently accessed.

This homework is due at the beginning of class on April 21. Late submissions will **not** be accepted for this assignment since we will review the solution during the following lecture, which is the last class for the semester.

Assume the following information for questions 1-7.

The page size for a virtual memory system is 8KB.

The instruction TLB is direct-mapped with 2 sets and each block contains one translation.

The number of bits in a virtual address is 20.

The number of bits in a physical address is 15.

- (1) What is the number of virtual pages?
- (2) What is the number of physical pages?
- (3) How many bits are used in the virtual address for the page offset?
- (4) How many bits are used in the virtual address for the TLB index?
- (5) How many bits are used in the virtual address for the TLB tag?
- (6) Assume each entry in the TLB and page table are initially invalid. Fill in the missing fields of the table below, where each of the virtual addresses are referencing instructions. Write the page numbers, page offset, tag, and index in decimal. For the TLB Result, you should write `hit` or `miss`. For the Page Table Result, you should write `hit`, `miss`, or `none` if the page table was not accessed. Assume that the replacement policy for the page table is LRU and the physical pages are initially allocated in order from page 0 to page  $n-1$ , where  $n$  is the number of physical pages.

Virtual Address	Virtual Page #	Page Offset	TLB Tag	TLB Index	TLB Result	Page Table Result	Physical Page #
0x4a14							
0x2008							
0x40c4							
0x8c00							
0x6404							
0x4000							
0xa0b8							

- (7) Update the following figures to indicate the final state of the TLB and the page table. You only need to represent the physical page numbers for the entries in the page table that are resident.

TLB		
	V	tag      physical page #
0		
1		

Page Table	
	physical page #      resident?
0	
1	
2	
3	
4	
5	
6	
...	