

CSCI-3150: Introduction to Operating Systems

Assignment Four: Virtual Memory

Deadline: December 3, 2022 23:59

Suppose the page size is 8 bytes, the first-level page table has 4 entries and the second-level page table has 8 entries. You need to answer the following questions:

1 Calculation

1. What is the size of the virtual address space?
2. How many bits does a virtual address have?
3. How many bits should be reserved for the first-level page table index, the second-level page table index and the offset respectively?

2 Address Translation

For the virtual address space defined by the two-level page tables as shown in Figure 1, given the following virtual addresses: **51, 72, 172, 200**.

1. Which virtual addresses are mapped?
2. If a virtual address is mapped, what is its corresponding physical address?

Page Directory		PT@PFN=10		PT@PFN=11	
0	10	0		0	
			2		
	11				
3			6		
					8
			5		4
		7	3	7	

Figure 1: The two-level page mapping table. The numbers in entries are physical page frame numbers. Entries in gray color are not mapped.

3 Page Mapping Setup

A program has three segments that should be loaded and mapped:

1. **Code segment** is loaded at physical memory range [0, 24) and should be mapped to virtual memory range [16, 40)
2. **Data segment**: PA [32, 64) and should be mapped to VA [64, 96)
3. **Stack segment**: PA [64, 80) and should be mapped to VA [240, 256)

You should fill the **physical page frame numbers** in the following page tables in Figure 2 to set up the page mapping. If some entries in the page tables are not used, you can just leave them empty.

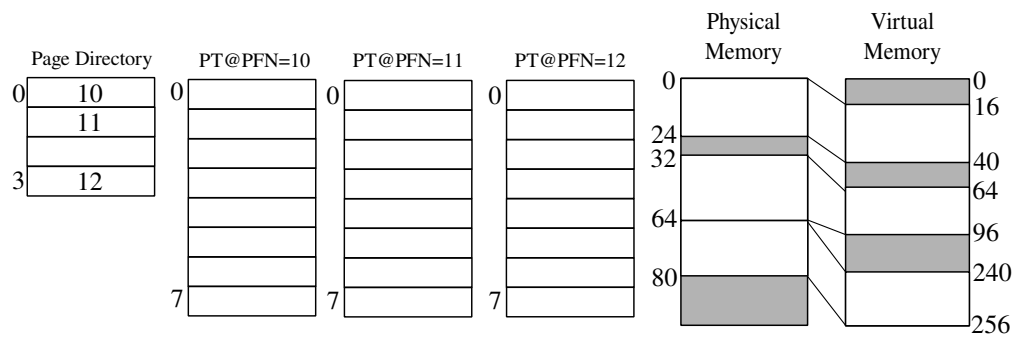


Figure 2: Page tables and address mapping.

Note: the page directory has been set up. You only need to attach the three filled page tables **PT@PFN=10**, **PT@PFN=11** and **PT@PFN=12** in your answer.

Submission

You only need to submit a PDF that contains your answer to Blackboard. If you have any questions about this assignment, please send a email to jinxue@cse.cuhk.edu.hk.