COSE321 Computer Systems Design

Assignment #9

No late turn-in accepted

You want to see the effect of virtual memory by writing a simple program with page tables. **Your program adds all the integers in 12KB space from the virtual locations 0x20_0000 to 0x20_2FFF**. Create 2 page tables, run your program, and observe the addition outcomes according to the two different page tables.

1. First, initialize **main memory** with the flat mapping, as shown in Figure 1 below.
   - Note that, if you don't do anything, the flat mapping is provided in the bootup code (that Xilinx provides), meaning that virtual address is equal to the physical address
2. Create a page table in Figure 2, run the program, and check out the addition outcome.
3. Create a page table in Figure 3, run the program, and check out the addition outcome.

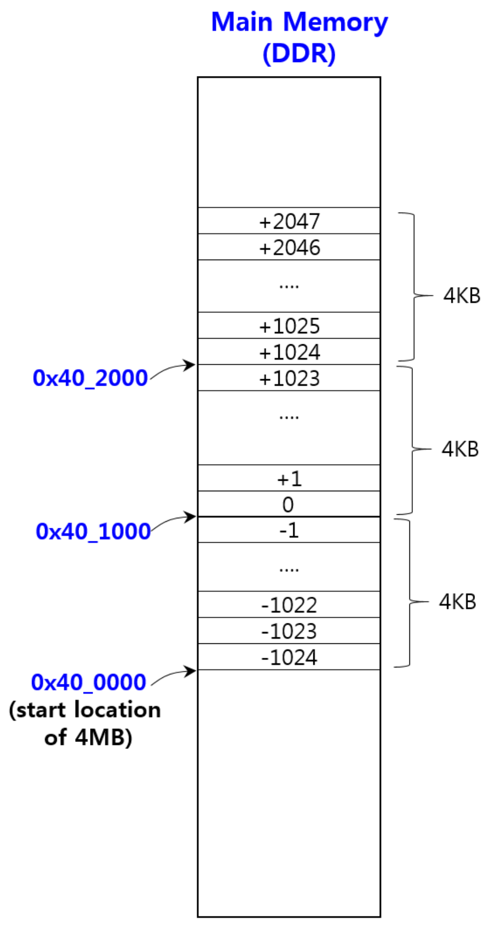
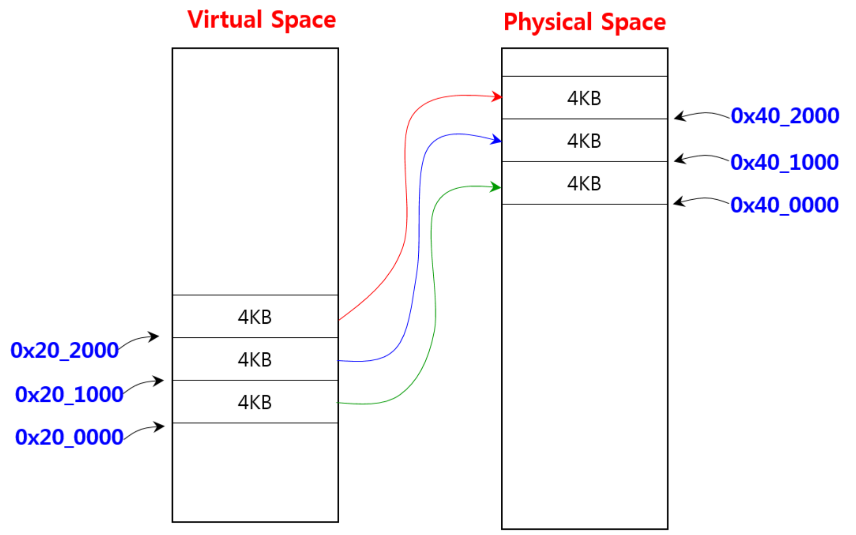
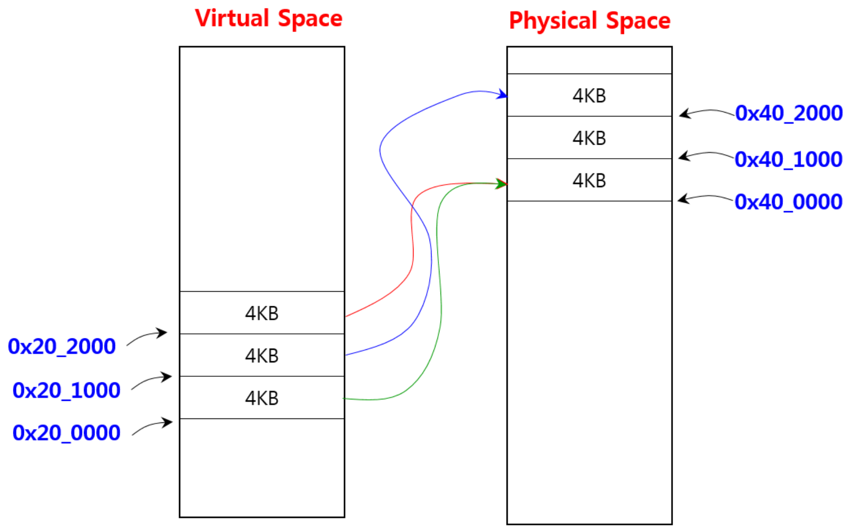


Figure 1. Initialized memory



① Virtual-to-physical page mapping

Figure 2. Page Table #1



② Virtual-to-physical page mapping

Figure 3. Page Table #2

One possible organization of the page table for Figure 2 is as follows:

- **1st 1MB** (0x0 ~ 0xF_FFFF) in VA → 0x0 ~ 0xFFFFF in PA
- **2rd 1MB** (0x10_0000 ~ 0x1F_FFFF) in VA → 0x10_0000 ~ 0x1F_FFFF in PA
- First three 4KB pages in **3rd 1MB** (0x20_0000 ~ 0x2F_FFFF) of VA
  - 1st 4KB (0x20_0000 ~ 0x20_0FFF) in VA → 0x40_0000 ~ 0x40_0FFF in PA
  - 2nd 4KB (0x20_1000 ~ 0x20_1FFF) in VA → 0x41_0000 ~ 0x41_0FFF in PA
  - 3rd 4KB (0x20_2000 ~ 0x20_2FFF) in VA → 0x42_0000 ~ 0x42_0FFF in PA

What and How to submit:

1. Upload your source code to Blackboard.
2. Upload video clip (3-min?) to Blackboard. Your video clip should have **at least** the following contents:
   - Your smiling face
   - Drawing of virtual-to-physical mapping
   - Understandable explanation of your page table, your code, the addition outcomes according to the different page tables
   - Demo on Zedboard

Note: This is an individual assignment. You are welcome to discuss, but DO NOT COPY solutions. If you are found to copy solutions from others or slightly modify the solutions from others, both of you will be given 0 credits.