MP4 Design Tsao Yuan Chang 927000791

In MP4, we need to do some modification on page_table.C, page_table.H to make use of virtual memory. We also need to implement VM pool in vm_pool.C and vm_pool.H. I didn't do any modification on cont_frame_pool.C and cont_frame_pool.H since they're working great. This design document won't cover cont_frame_pool.C and cont_frame_pool.H, but I'll cover my works on other parts.

page_table.C

1. constructor

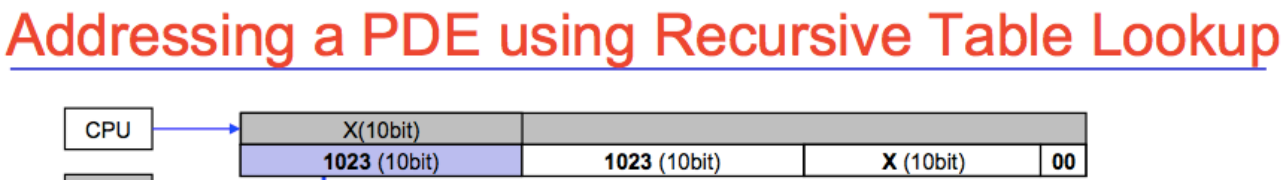
Unlike MP3, I save page directory and page table outside the first 4MB, so I need to get the frame from process_mem_pool. For PTEs, I make them writable and valid while PDEs are writable but not valid(not present). And for the last PDE, it points to the start of the page directory, so I can do the recursive page table lookup task. The registered VM pools are stored in the array registered_vmpools whose maximum size is 100. registered_vmpools is initialized to NULL in the constructor.

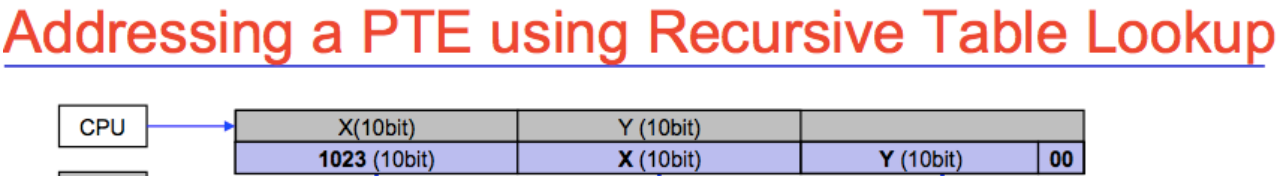
2. load() and enable_paging()

There's no modification in these 2 functions comparing to MP3.

3. handle_fault()

First, I read the address causing page fault from CR2. And then I compute the PD and PT virtual address of this address in the format (1023 1023 X) and (1023 X Y) respectively.





If the page fault is due to accessing invalid page, which is what we're trying to deal with, I'll handle this page fault. First I'll find which vm pool this page fault address is in. If I successfully find the vm pool, I'll check where did the page fault happen: PD or PT. If it happened in PT, I'll get a frame from process_mem_pool use this frame as a PTE. Otherwise, I need to get frames for both PDE and PTE.

4. register_pool()

If the number of registered pool hasn't reached 100, I'll register the input _pool and update the registered_num.

5. free_page()

In this function, we need to compute which frame contains _page_no, and then use release_frame() to free this page.

page_table.H

I added some private variables such as registered_vmpools and registered_num. And I also added some functions for this MP like handle_fault, register_pool and free_page. Other parts are the same as MP3.

vm_pool.C

1. constructor

In the constructor, first I save the inputs into private variables. And then I use the struct regions to save the region descriptor, including the information such as the region's base address and its size. Finally, I use the function register_pool in page_table.C to register this vm pool.

2. allocate()

In this function, I get the new region's base address by the previous one's descriptor. And then add the current one into the regions array.

3. release()

First I need to know which region does the start_address belong to. After that, I free the pages one by one in that region using the free_page() function. Finally I update the regions array and flush the TLB by reloading the page table.

4.is_legitimate()

I check whether the input _address is legitimate by going through the regions array. If for some region, the input _address is greater or equal than the region's base_address and smaller or equal to base_address + size, then the address is inside this region and we can return 1. Else if we cannot find any region containing this address, we return 0.

vm_pool.H

In this file, I declared a struct region_descriptor to record each region's base address and size. I also added some private variables such as region_num and regions(of region_descriptor type) for convenience.

Final testing result :