CS 2200 Homework 8

Spring 2019

Instructions:

- Please print a copy of the assignment and hand write your answers. No electronic submissions are allowed. **Please print as one double-sided page. Do NOT staple multiple sheets together. There will be a 70 point penalty if you do not.**
- This is an individual assignment. You may discuss concepts but not the answers.
- Due Date: **03/27/19 – 6:00 PM** in recitation. Bring your BuzzCard. Show up on time.

Name:_____ **GT Username:**_____ **Section:**_____

1. Address Layouts

Our OS uses 64-bit virtual addresses, 32-bit physical addresses, and page sizes of 16KB. Draw the layout of **both** the virtual and physical addresses along with the size in bits. (Note: 1KB = 2^10 bytes)

2. Address Translation

Say we have virtual addresses of 32 bits, physical addresses of 28 bits, and a page size of 64 KB. Given the process's entire page table below, translate the virtual addresses into their respective physical addresses. Identify any page faults you may find by writing "page fault".

VPN	PFN	VALID
DEAD	8DE	1
4316	111	1
FAAD	57C	0
FACE	D85	1
BB8D	235	0
DE2F	123	1
DEAF	B72	0
BEAD	6A1	1

Virtual Address	Physical Address
0x4316B19D	
0xBB8D789E	
0xBEAD2CD3	
0xEF1201DD	

3. Page Replacement - Least Recently Used (LRU)
Consider a system with **4 physical frames**. Each frame has 4-bit reference counter, which is a shift register that is **right shifted in each time slice**.

Only one page is accessed in each time slice. **When a page is accessed**, the corresponding frame's counter should have its **MSB set to 1.** Note that at t = 1, only VPN 5 has been accessed, and the corresponding frame has a reference counter of 1000.

When there are no free frames left, **evict the frame with the lowest valued reference counter.**

Time	**1**	**2**	**3**	**4**	**5**
VPN Ref #	**5**	**2**	**4**	**5**	**4**
Victim	None				
Currently mapped pages and reference counters	5 - 1000				

Time	**6**	**7**	**8**	**9**	**10**
VPN Ref #	**1**	**2**	**4**	**6**	**3**
Victim					
Currently mapped pages and reference counters					

What is the working set of the process in this time interval? What is the size of the working set?

4. Memory Fragmentation
Define **internal** and **external fragmentation** and state one memory system in which each occur.