

Name: **Sample Solutions**

Email:

## Operating Systems CS 1217 Spring 2023

### Quiz 3 - 22nd March 2023

#### Instructions

1. This quiz is for **15 minutes and 20 points**
2. This quiz accounts for **3%** of your final grade.
3. Be precise in your answers; unnecessarily verbose answers will fetch negative marks

#### Q1

Briefly describe the tradeoffs around decisions for memory page size. What happens when pages become very small? What happens when pages become very large? **(5 points)**

When pages become very small, internal fragmentation decreases (good), the size of kernel memory management data structures increases (bad), and the amount of memory that can be translated by a fixed-size TLB decreases (bad).

When pages become very big, internal fragmentation increases (bad), the size of kernel memory management data structures shrinks (good), and the amount of memory that can be translated by a fixed-size TLB increases (good).

#### Q2

Starting Virtual Address	Bound	Base Physical Address	Permissions
98	100	450	R,W,E
2	40	100	R
1040	1000	10,000	R,W
2200	500	1000	R,W,E

Given the segment table above, indicate the result of the following five load, stores, and fetches (load and execute). Note: to make things easier on everyone the question uses base-10 arithmetic. **(10 points)**

1. load 1200
2. store 10
3. load 2080
4. fetch 143
5. store 1050

1. load 1200 -- load 10160.
2. store 10 -- exception, segment starting at 2 marked as read only. Had the segment been marked writable, would have gone to 108.

3. load 2080 -- exception, no segment loaded for this virtual address. Kernel must either load a segment description into the MMU or kill this process if the address is not valid.
4. fetch 143 -- fetch from 495
5. store 1050 -- store to 10010

Q3 What are the pros and cons of Segmentation over a Base and Bounds approach to address translation as discussed in class? In Segmentation, as compared to Base and Bounds, there is an extra piece of information that is needed by the MMU for completing the translation for a given address. What is the extra piece of information, and why is it needed? **(5 points)**

Segmentation pros:

- + fairly simple mechanism for address translation
- + Can provide protection per segment
- + Address Translation is simple – one addition. (Once the segment is located)
- + can organize and protect regions of memory appropriately.
- + less internal fragmentation.

Segmentation cons

- Still requires entire segments to be contiguous in memory; potential for external fragmentation due to this requirement

Need base and bound information / segment, along with the start virtual address for that segment.

Unlike the vanilla B&B, where the entire virtual address space fits into one large space in memory, segmentation allows for the address space to be broken down into smaller segments, where each segment starts at a specific address. The start virtual address is the extra information required.