CSCI 8530: Computer Science
Advanced Operating Systems
Spring 2020
Homework 4

Due on April 14, 2020

Please keep answers short. Every sub-answer should be limited <u>within 3 lines.</u>
You may either type your answers or write them by hand and upload it to the Canvas. Note that a "good effort" on the homework includes that all answers are in your own words (short sentences). DO NOT SHARE YOUR ANSWERS WITH OTHER STUDENTS OR ATTEMPT TO OBTAIN ANSWERS FROM OTHERS.

Questions

1. *Mkbufpool* forms a linked list of all buffers in a pool. Explain how to modify the code so it allocates memory but does not link buffers together until a call to *getbuf* requires a new buffer to be allocated.
2. Is *freebuf* more efficient than *freemem*? Justify your answer.
3. Suppose a processor has support for paging. Describe paging hardware that can be used to protect a process's stack from access by other processes, even if demand paging is not implemented (i.e., all pages remain resident and no replacement is performed).
4. Consider a modification of the buffer pool mechanism in which *mkbufpool* stores the pool ID in the first four bytes of a buffer and then uses the next four bytes in the buffer to store a pointer when linking the buffer onto a free list. What are the advantages of such an approach?
5. What is the major reason why high-level memory management even exists?
6. Briefly, describe the steps involved in translation of a virtual address on an x86 processor to a physical address. Be certain to mention the organization of the page directory and page tables, the TLB, and the major attributes associated with each page (e.g. dirty, referenced, present).
7. How are the unused memory regions associated with the Xinu low-level memory management facilities ordered? How does this affect the time complexity of the algorithm used to perform low-level memory allocation?
8. ARM processors require that data objects be aligned with boundaries that are a multiple of the object size. For example, a 32-bit integer must be aligned on a 4-byte boundary. How does this affect the low-level memory management software?
9. Deallocation of low-level memory in any system returns the deallocated memory to the collection of memory that can be reallocated. What else must be done when unused memory is returned to the available state?
10. Xinu has two different memory management "levels" – high-level and low-level. Why are there two levels? Briefly indicate the major differences between the mechanisms used to allocate and deallocate memory at each level.