IC411 Homework, ch.7 (80 points total) Spring 2016 Name \_\_\_\_Pullig\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Learning Objectives

(MEM) Memory. Explain the operation of a typical memory hierarchy, and the associated design tradeoffs.

Memory Management

(MEM, 15) 7.1 List and describe the five requirements of OS memory management

*Relocation – programs may be moved in and out of main memory due to swapping*

*Protection – processes should be protected from each other; OS must be protected from user processes*

*Sharing – multiple processes may have access to the same portions of memory*

*Logical Organization – memory is architecturally linear; programs are modular (segmentation)*

*Physical Organization – memory is layered; OS is responsible for moving programs and data between layers*

(MEM, 12) 7.2 Define each of the following:

Internal Fragmentation - *Unused space within a unit of allocation*

External Fragmentation – *Unused space outside a unit of allocation*

Logical Address – *page number, offset (paging)*

Physical Address – *frame number, offset*

(MEM, 5) 7.3 Describe the difference between *fixed* and *dynamic* partitioning, and the key limitation of each system.

*Fixed partitioning – fixed boundary between OS and other programs, data*

*Strengths – Simple to implement, little OS overhead*

*Weaknesses – Inefficient due to internal fragmentation*

*Dynamic Partitioning – partitions vary dynamically in number and size; new process allocated a partition of exactly the right size*

*Suffers from external fragmentation (needs a placement algorithm)*

(MEM, 5) 7.4 Explain how the Buddy System of memory allocation reduces some of the inefficiencies of standard partitioning schemes.

*Overcomes some of the inefficiencies of fixed and dynamic partitioning. Memory allocation blocks form a binary tree. Has been used in UNIX kernel memory allocation. Allows the next biggest chunk of memory to be easily found while able to be split into equal halves if need be.*

(MEM, 5) 7.5 What is the difference between a page and a frame?

*Frame – partitioned main memory chunk in a physical address*

*Page – partitioned processes into chunks of same size of virtual memory space*

(MEM, 5) 7.6 In a paged memory system, what is the relationship between the size of a page, and the size of a frame?

*Pages are placed into physical addressed frames. They are the same size.*

(MEM, 5) 7.7 Consider a fixed partitioning system with equal-size partitions of 216 bytes and a total main memory size of 224 bytes. A process table is maintained that includes a pointer to a partition for each resident process. How many bits are required for the pointer?

*2^24 / 2^16 = 2^8; 8 bits*

(MEM, 3) 7.8 What type of fragmentation occurs in a paged memory system?

*Internal*

(MEM, 3) 7.9 What type of fragmentation occurs in a segmented memory system?

*External*

(MEM, 12) 7.10 Consider a simple paging system with the following parameters:

* 230 bytes of physical memory
* Frame size of 210 bytes

How many bytes are in a *page*? *2^10*

How many bits specify the *offset*? *2^10*

How many *frames* are there? *2^20*

How many bits in the physical address specify the *frame number*? *2^20 / 2^10 = 2^2; 20 bits*

Consider a simple segmentation system that has the following segment table:

|  |  |  |
| --- | --- | --- |
| Segment | Start Address | Length |
| 0 | 500 | 250 |
| 1 | 800 | 400 |
| 2 | 1150 | 150 |
| 3 | 2000 | 3000 |

(MEM, 10) 7.1 For each of the following *logical* addresses, determine the *physical* address or indicate if a segment fault occurs:

Segment 0, offset 198 *698*

Segment 2, offset 156 *SEGFAULT*

Segment 1, offset 530 *SEGFAULT*

Segment 3, offset 444 *2444*

Segment 0, offset 272 *SEGFAULT*