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CS 143A

Homework 9

1) **File System Implementation**

A. True or False? Disk blocks are made up of one or more sectors.
   True
B. What is the name of the standard Linux file system?
   Extended File System
C. What is the UNIX term for a file control block?
   Superblock
D. True or False? UNIX treats a directory exactly the same as a file.
   True
E. What does the acronym VFS refer to?
   Virtual File System
F. What are the two general approaches for implementing a directory?
   - **Linear List**
   - **Hash Table**
G. Provide at least two different approaches for allocating disk blocks to files.
   - **Contiguous Allocation**
   - **Linked Allocation**
H. True or False? The UNIX inode is an example of linked allocation.
   False
I. What two forms of I/O are stored in a unified buffer cache?
   - **Memory-mapped I/O**
   - **I/O using read() and write()**
J. What is the name of the consistency checker program for UNIX systems?
   File System Check (FSCK)
K. True or False? If a system crashes, all transactions in the log file were not completed to the file system.
   True
L. What are the two protocols associated with NFS?
   - **NFS Protocol**
   - **Mount Protocol**
M. What does the acronym WAFL stand for?
   Write-Anywhere File Layout

2) Memory Management

A. What two registers can be used to provide a simple form of memory protection?
   - **Base**
   - **Limit**

B. What is it called when a physical address is assigned to a virtual address?
   Address binding time

C. What is the hardware device that maps virtual to physical addresses?
   Memory Management Unit (MMU)

D. The space on secondary storage (e.g., on disk) for a virtual address page or segment is called what?
   Backing Store

E. What are three algorithms for allocating memory in the OS kernel?
   - **Buddy**
   - **Slab**
   - **First**

F. What memory allocation algorithm successively divides large free blocks in half until the partial block is the next power of two large enough to satisfy the allocation request?
   Buddy

G. What memory allocation algorithm organizes storage into lists of blocks of the same size then chooses a block from head of the list of blocks just large enough to satisfy the allocation request?
   Slab

H. What are the two forms of fragmentation?
   - **Internal**
   - **External**

I. List three parts of an executable program that may be assigned separate segments.
   - **Code**
   - **Heap**
   - **Stack**

J. What are the two parts of an address generated by the CPU?
   - **Page**
   - **Offset**

K. What does each entry in the page table contain?
   - **Valid bit**
   - **Dirty bit**
   - **Location of page**

L. What type of fragmentation can still occur in paging systems?
Internal fragmentation
M. What type of fragmentation can still occur in systems using segmentation?
External fragmentation
N. What is the term that describes when a page number is not present in the TLB?
TLB miss
O. If a page offset is 13 bits, how large (in bytes) is the page?
8k
P. Does x86 address translation hardware support paging, segmentation, or both?
Both
Q. What is the effect of allowing two entries in a page table to point to the same page frame in memory?
Processes can share memory
R. What can be used to avoid copying a large amount of data from memory of one process to memory of another process but still allow the two processes to communicate the data?
Shared virtual memory

3) Virtual Memory

A. What allows a program to run with only a subset of its assigned address space in memory?
Virtual Memory
B. Can a computer's physical address space be smaller than its virtual address space?
Yes
C. What is it called when memory on a page is referenced but that page is not in memory?
A page fault
D. What technique loads pages into memory only when they needed (and maybe never if never accessed)?
Demand paging
E. What POSIX system call initiates copy on write?
fork()
F. What is the simplest page replacement algorithm?
First in first out (FIFO)
G. What is the name of the page replacement algorithm that operates by replacing the page that will not be used for the longest period of time?
Optimal page replacement algorithm

H. What page replacement algorithm could be implemented using either a stack or counters?
Least recently used

I. Which commonly used page replacement algorithm uses approximations for page age (because true age is too costly to record)?
Least recently used

J. Which page replacement scope is limited to one user or one process?
Local page replacement

K. Which page replacement scope is shared across all users and/or processes?
Global page replacement

L. What term is used to describe the situation where a process spends more time paging than executing user programs?
Thrashing

M. What term is used to describe the set of pages a process is currently referencing?
Working set

N. When a process first starts to run with demand paging will initial page faults be high or low?
High

O. Shared memory is typically implemented using what?
Memory mapping

P. Using the buddy system, if a request for 200 KB of kernel memory is made, how much is actually allocated?
256

Q. What kernel memory allocation technique allows allocating memory blocks without searching for a size match?
Slab allocation

R. What is the TLB reach of a system with 4KB page sizes and 32 entries in the TLB?
128KB

S. What is the most common page size for 32 bit machines?
4KB

T. Solaris uses the clock algorithm variation of LRU. How many hands does this algorithm employ?
Two