

Closed Book. You can have one sheet of notes. UH expels cheaters.

1. Answer in one or two sentences to the following questions (6×5 points).

a. What is the main disadvantage of the VMS page replacement policy?

The policy assumes that we can predict ahead of time the sizes of the resident set of pages for each process. In fact, this is not possible.

b. What is the main advantage of having TLB misses handled by the hardware?

A TLB miss will cost only one main memory access instead of requiring two context switches.

c. What is the purpose of the *dirty bit*? (5 points)

To tell whether the page has been modified since it was brought into main memory.

d. What is the main advantage of mapping files into the address space of the processes that access them?

The portions of the file that are brought into main memory can be accessed without any kernel intervention.

e. What is the major difference between the contents of a page table entry and those of a TLB entry?

The TLB entry must include the page number.

f. What is the major disadvantage of some inverted page tables?

Each page frame can only belong to one process.

2. What was the motivation for adding a second hand to the Clock page replacement policy? (5 points) In a system having a very large physical memory, why would you like to have the two hands separated by a *small* angle? (5 points)

When main memory sizes started to grow in the mid-eighties, it was found that the hand of the clock was taking too much time to scan the whole main memory. Hence, more recent UNIX implementations have added a second hand that expels the pages that have not been accessed by the process after their valid bit had been cleared by the first hand. The angle should be kept small so that pages are expelled fast enough.

3. Complete the following sentences: (4×5 points)

- a. To implement the Clock policy on the VAX, the designers of Berkeley UNIX had to simulate the page-referenced bit _____ in software.
- b. On demand fetch means that pages are loaded into main memory when they are accessed for the first time _____.
- c. Memory compaction is used to fight external fragmentation _____.
- d. The simplest way to reduce the size of page tables is to increase the page size of the system _____.

4. Given the page reference string

1 0 4 0 2 1 2 4 3 3 3 0 5 4 3 1 7 2 0

and a memory size of four page frames, list the pages that would be expelled from main memory:

- a. under a **LRU** policy (5 points): _____
- b. under a **FIFO** policy (5 points): _____

5. It is often said that the UNIX file system favors small files. Do you think it is true? (5 points) Why? (5 points)

UNIX favors small files because its i-node structure provides faster access to files that do not use indirect blocks. This was done because most UNIX files are small files.

6. Explain how the UNIX file system implements access control lists (5 points) What would be the main advantage of a fuller implementation of the concept?(5 points)

UNIX uses a fixed size access control list where one can specify three classes of users (owner, all members of one of the groups specified in /etc/groups, all users) and three access rights (read, write and execute).

A more complete implementation of the concept would allow the file owner to specify exactly who can access the file and exactly what each individual can do.