

COSC 6360 FIRST MIDTERM SEPTEMBER 26, 2006

THIS EXAM IS **CLOSED BOOK**. YOU CAN HAVE **ONE SHEET** (I.E., **TWO PAGES**) OF NOTES. PLEASE ANSWER EVERY PART OF EVERY QUESTION. THIS UNIVERSITY EXPELS CHEATERS.

1. Consider a Mach process consisting of a code segment, a data segment, a mapped file and a shared memory segment. What should be the inheritance attribute of
 - a) Its *code segment*? (5 points) _shared _____
 - b) Its *data segment*? (5 points) _copy (implemented by copy-on-write) _____
 - c) Its *mapped file*? (5 points) _shared _____
 - d) Its *shared memory segment*? (5 points) _shared _____
 - e) Assume now that we want to create another thread within the address space of that process. What do we need to change before forking that thread? (5 points)
Set the inheritance attribute of the data segment to shared. _____

2. Consider a 64-bit system with page size of 8 kilobytes. Sketch a page table organization that would interact in an effective fashion with a TLB using *partial subblocking* with a subblocking factor of 2. (10 points if your answer includes a correct diagram).

VPNO	
PPNO	b
NEXT	

Each page table entry will contain;

- a) The virtual page number of the first page of the cluster (VPNO)
- b) The physical page number of the page frame containing the first page of the cluster (PPNO)
- c) A bitmap indicating which of the two pages are currently residing in main memory (b)
- d) The address of the next subblock in the hash bucket (NEXT)

In addition, the hash function will ignore the least significant bit of the virtual page number to ensure that pages that belong to the same subblock will hash into the same bucket.

3. Explain why the ARC cache replacement policy is said to be: (2×5 points)
 - a) *Scan-resistant*: The ARC cache replacement policy is said to be scan-resistant because it expels quickly pages that are referenced only once as it is the case when one process scans the whole file system.
 - b) *Self-tuning*: The ARC cache replacement policy is said to be self-tuning because it has no parameter than can be adjusted by the user.

4. Explain the following terms: (6×5 points)

- a) *Superpage*: A superpage is a set of pages that are brought in and out of memory as a single entity. They are aligned both in virtual and in physical memory and their size is a power-of-two multiple of the page size.
- b) *Set user-ID bit*: The set user-ID bit is a file attribute that specifies that a given file should be executed with the rights of the owner of the file rather than with the rights of the user executing it.
- c) *Cylinder group*: In the "Fast" File System, a cylinder group is a set of consecutive cylinders that contains (a) a redundant copy of the superblock, (b) space for i-nodes and (c) a bit map of all available blocks in the cylinder group.
- d) *Unix special file*: A UNIX special file is a name within the file system hierarchy that corresponds to a device (such as /dev/tty) and allows user processes to access that device as if it was a regular file.
- e) *Access control list*: An access control list is a list of users specifying which access rights each of them has for a specific file.
- f) *Valid bit*: The valid bit is a bit indicating whether a given page is in main memory.

5. When does *false sharing* happen in a distributed shared memory system? (5 points)

When _ two distinct processors simultaneously access two or more distinct _____
 _ variables that are located in the same page, _____

What problem does it cause? (5 points)

_ The page goes back and forth between the two processors. _____

Which feature of Munin addresses that issue? (5 points)

_ The Munin write-shared consistency protocol. _____

6. What are the undesirable effects of letting the hand of the Clock page replacement policy move: (2×5 points)

- a) *Too fast*: Letting the hand of the clock move too fast will cause the premature expulsion of too many pages. In the BSD implementation of the policy, it will also result into an excessive number of context switches.
- b) *Too slow*: Letting the hand of the clock move too slow will result in an inefficient use of the main memory as pages will remain in memory for too long after the last time they have been accessed.