

Name:

CSCI 3753: Operating Systems
Spring 2014
Final Exam
05/05/2014 (4:30 – 6:30 PM)

Answer all questions in the space provided

Multiple Choice Questions: Choose one option that answers the question best.
[30 Points]

1. Which of the following is true for address binding?
 - A. In runtime binding, CPU only refers to the logical addresses of a processes
 - B. In compile time binding, absolute physical addresses are stored in the object code produced by a compiler
 - C. In load time binding, CPU refers to the physical addresses of a process
 - D. An advantage of load time binding over compile time binding is that a process may be loaded anywhere in memory when it runs
 - E. All of the above
2. Which of the following NOT correct about runtime binding with dynamic linking?
 - A. Processes have access to the most recently updated dynamically linked libraries
 - B. Object code contains references to the dynamically linked libraries
 - C. Multiple process may share a single copy of a dynamically linked library
 - D. Object code size is typically smaller than in case of static linking
 - E. Dynamically linked libraries are written as position independent and reentrant code
3. Which of the following in NOT correct about working set theory
 - A. Working set theory is designed to prevent thrashing
 - B. Working set theory attempts to maximize CPU utilization by dynamically adjusting the degree of multiprogramming
 - C. Working set theory uses on-demand paging
 - D. Working set of a process is determined by the principle of locality of reference
 - E. A process is allowed to run only if its working set is loaded in memory

4. In a memory mapped file

- A. some parts of the file on disk are mapped to the virtual address space of the process
- B. the entire file is stored in memory
- C. the first read/write operation from/to the file is very fast
- D. multiple processes cannot share the same file
- E. None of the above

5. Which of the following is NOT correct about memory allocation policies?

- A. First fit tends to create lots of fragments in the beginning of the memory
- B. Next fit typically requires less amount of time to find the available memory to allocate than worst fit
- C. Best fit and worst fit take the same amount of time on average to find the available memory to allocate
- D. Worst fit increases the chances of external fragmentation over best fit
- E. All four allocation policies can result in external fragmentation

6. In the enhanced second chance (clock) algorithm for page replacement

- A. principle of locality of reference is approximated
- B. a page with reference bit 0 and dirty bit 1 is replaced before a page with reference bit 1 and dirty bit 0
- C. dirty bit of a page is cleared periodically
- D. A, B and C
- E. A and B, but not C

7. Which of the following is NOT correct about RAID?

- A. There is no redundancy in RAID 0
- B. There is a possibility of limited speedup in read operation in RAID 1
- C. RAID 3 provides redundancy, but the space overhead is not as high as in RAID 2
- D. RAID 4 is comprised of block interleaved distributed parity
- E. RAID 5 avoids the overuse of parity disk

8. A virtual file system (VFS)

- A. is a file system that makes use of the virtual memory of processes
- B. is an abstraction layer on top of more concrete file systems
- C. enables user applications to access different types of concrete file systems in a uniform way
- D. works with different types of file systems mounted at different locations in the directory structure
- E. B, C and D, but not A

9. Which of the following is NOT correct about SSH?

- A. It provides support for secure authentication over a public network
- B. It is not vulnerable to replay attacks
- C. It uses a different symmetric key every time a user logs in from remote
- D. It uses a different asymmetric key every time a user logs in from remote
- E. It may be vulnerable to man-in-the-middle attack

10. An advantage of symmetric key cryptography is

- A. the strength of encryption and decryption algorithm lies in Mathematics
- B. the encryption and decryption algorithms are extremely difficult for anyone to understand
- C. key sharing is simplified
- D. encryption and decryption algorithms can be implemented very efficiently
- E. it can be used for secure conversation between two complete strangers

Short Answer Questions:

1. **[5 Points]** Draw a diagram to illustrate the memory hierarchy in computer systems. Indicate how memory size, access time and cost vary in this hierarchy.
2. **[6 Points]** What is a translation lookaside buffer? Explain its usage in implementing paging.
3. **[6 Points]** Consider the following factors: internal fragmentation, page table size, I/O overhead, and locality of reference. Which of these factors could be used to argue for a large page size, and which could be used to argue for a smaller page size? Explain your answer.

4. **[6 Points]** Describe how access control lists and capabilities are used as protection mechanisms.
5. **[5 Points]** Consider a new page replacement algorithm *Most Recently Used* (MRU). On a page fault, this algorithm replaces the page that was referenced most recently. Does MSU suffer from Belady's anomaly? Explain your answer.
6. **[6 Points]** A sector in a flash memory has 10 pages. Pages 0, 4 and 5 have data written in them while all other pages are clean pages, i.e. no data was ever written on these pages. Describe the steps involved in writing a few bytes in
- (i) page number 4
 - (ii) page number 7

7. **[5 Points]** Provide a step-by-step description of how a *read()* command is implemented in a file system.

Problems

1. [9 Points] A disk has 200 cylinders, 0 – 199. Disk access requests arrive in the following order of cylinder numbers: 27 129 110 186 147 41 27 10. Assume that the R/W head is on cylinder number 30 initially moving towards lower numbered cylinders. Calculate the total distance (Number of cylinders) travelled by the R/W head to service these requests if

(a) FCFS algorithm is used

(b) SSTF algorithm is used

(c) SCAN algorithm is used

2. [9 Points] Assume that you have a primary memory consisting of 3 page frames. Initially, this memory is empty. Consider a page reference string 4, 1, 3, 2, 4, 3, 1, 6, 3, 2. For each of the following page replacement algorithm (a) show the pages loaded in memory after each page reference, and (2) calculate the number of page faults.

(a) Optimal

(b) Least Recently Used

(c) FIFO

3. **[8 Points]** Compute physical addresses for the following virtual addresses (represented in binary). Write the corresponding physical addresses in binary format. Assume that memory size is 128K, page size is 8K, and the page mapping table is as shown below (page numbers not shown are not loaded in the memory):

Page Number	Page Frame Number
0	0
18	7
25	3
20	11
3	10
8	4
63	8
64	2
31	13

111110100111011110

101101010000110101

1001101100010

10000001010000111100

4. **[5 Points]** How many disk seek operations will performed to fetch the file /usr/shiv/final_exam.pdf? Assume that the FCB of the root directory is cached in memory, but nothing else is cached in memory. Also assume each FCB requires one disk block and that the directory content of each directory can fit in one block.