

國立中山大學 103 學年度碩士暨碩士專班招生考試試題

科目名稱：作業系統與資料結構【資工系碩士班甲組】

題號：434003

※本科目依簡章規定「不可以」使用計算機

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INSTRUCTIONS: If any question is unclear or you believe some assumptions need to be made, state your assumptions clearly at the beginning of your answer.

1. (10%) A computer has six tape drives, with n processes competing for them. Each process may need two drives. For which values of n is the system deadlock free?

2. (10%) Consider the two-dimensional array A:

`double A[200][200] = new double[200][200];`

where each double occupies 8 bytes and $A[0][0]$ is at location 200, in a paged system with pages of size 200 bytes. A small process is in page 0 (locations 0 to 199) for manipulating the matrix; thus, every instruction fetch will be from page 0. For three page frames, how many page faults are generated by the following array initialization loops, using LRU replacement and assuming (1) page frame 0 has the process in it, (2) the other two are initially empty, and (3) the array is stored in memory column-major?

(a) (5%) for (int $i = 0$; $i < 200$; $i++$)
for (int $j = 0$; $j < 200$; $j++$)
 $A[i][j] = 0$;

(b) (5%) for (int $j = 0$; $j < 200$; $j++$)
for (int $i = 0$; $i < 200$; $i++$)
 $A[i][j] = 0$;

3. (10%) Assume a page reference string for a process with m frames (initially all empty). The page reference string has length n with p distinct page numbers occurring in it. For any page-replacement algorithms,

- (a) (5%) What is a lower bound on the number of page faults?
(b) (5%) What is an upper bound on the number of page faults?

4. (10%) Given a UNIX i -node with ten direct blocks and three levels of indirect blocks (i.e., a single, a double, and a triple) and assuming that the sizes of a pointer and a block are, respectively, 8 bytes and 8 Kbytes, answer the following questions.

- (a) (5%) What would be the size of the smallest file allowed in bytes?
(b) (5%) What would be the size of the largest file allowed in bytes?

5. (10%) A disk has 10000 cylinders, each with 10 tracks of 512 blocks. A seek takes 1 ms per cylinder moved. If no attempt is made to put the blocks of a file close to each other, two blocks that are logically consecutive (i.e., follow one another in the file) will require an average seek, which takes 6 ms. If, however, the operating system makes an attempt to cluster related blocks, the mean interblock distance can be reduced to 2 cylinders and the seek time reduced to 200 μ s. Assuming that the rotational latency is 3 ms and the transfer time is 10 μ s per block, answer the following questions.

- (a) (5%) How long does it take to read a 200 block randomly placed file?
(b) (5%) How long does it take to read a 200 block clustered file?

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6. Red-Black Tree (10%):

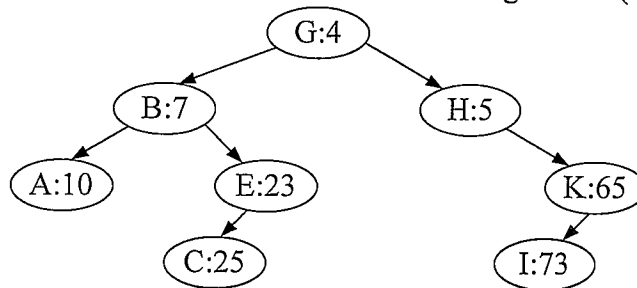
- (1) (4%) A red-black tree is a binary search tree where every node is either red or black. What are the four properties of a red-black tree?
- (2) (3%) Suppose that a red-black tree contains n internal nodes. What is its maximum height? What is the time to search one value? What is the time to find the maximum value?
- (3) (3%) Do you think whether a red-black tree is balanced or not? Please give your reason.

7. Tree Search & Expression Tree (10%):

- (1) (6%) Suppose that each internal node of a tree has at most three children. Given the BFS sequence "iceodlmfhjbgna" and the DFS sequence "icdbglemnofhaj" of the tree, please draw that tree.
- (2) (4%) Given a postfix expression "8 3 2 + - 4 9 3 / + * 3 * 7 +", please translate it into an infix expression and give the calculation result.

8. Treap (10%):

- (1) (5%) Given the following treap, please show the final result after inserting a node (D:9).
- (2) (5%) Following (1), please show the final result after inserting a node (F:2).



9. Hash Functions (10%):

- (1) (4%) What are the two major characteristics of hash functions to make them be widely adopted in authentication applications?
- (2) (4%) What is a hash collision? How can you solve this problem by chaining?
- (3) (2%) What is a perfect hashing?

10. Heaps (10%):

- (1) (2%) What is a binomial heap?
- (2) (4%) Please explain the two binomial-heap properties.
- (3) (2%) Suppose that two binomial heap H_1 and H_2 have n_1 and n_2 nodes, respectively. Then, what is the worst-case running time to unite H_1 and H_2 ?
- (4) (2%) What is a Fibonacci heap?