國立中山大學104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(問答申論題)　　

1. [Sorting: 10%]

Please prove that any comparison-based sorting algorithm requires O(n lgn) computation time in the worst case, where n is the number of objects to be sorted.

2. [Basic Data Structures: 10%]

(1) From the viewpoint of an operating system, please give practical applications of using a stack, queue, and linked list. (3%)

(2) Given a prefix expression "+ + (2) × (3) (4) × + × (5) (6) (7) (8)", please convert it to the infix expression and calculate the result. (2%)

(3) What is the assumption of simple uniform hashing? Under this assumption, given a hash table with m slots that stores n elements, what is the expected time taken by an unsuccessful search when the hash collisions are resolved by chaining? (3%)

(4) Please explain the property of a binary search tree. (2%)

3. [Graph: 15%]

You are given the adjacency matrix of an undirected graph:

	A	B	C	D	E	F	S
A	0	4	7	0	0	0	0
B	4	0	9	8	0	0	0
C	7	9	0	11	6	1	0
D	0	8	11	0	0	10	0
E	0	0	6	0	0	3	5
F	0	0	1	10	3	0	2
S	0	0	0	0	5	2	0

Starting from node S, please answer the following questions.

(1) Draw the corresponding graph. (3%)

(2) Write down the sequence of nodes that you visit by using breadth-first search. If there are multiple choices to select nodes, just follow the alphabetical order. (4%)

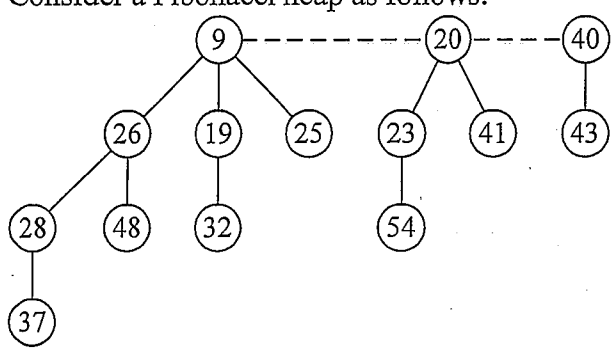
(3) Write down the sequence of nodes that you visit by using depth-first search. If there are multiple choices to select nodes, just follow the alphabetical order. (4%)

(4) Show the sequence of edges added to the minimum spanning tree based on the Prim's algorithm. Please use the edge weight to represent each edge in your answer. (4%)

4. [Advanced Data Structures: 15%]

(1) Please give the five properties of a binomial tree. (5%)

(2) Consider a Fibonacci heap as follows:



The number in each node indicates its key value. Suppose that we decrease key 48 to 17 and then decrease key 37 to 7. Please show the final result of the revised heap. (5%)

(3) Why does a B-tree can help reduce the cost of disk access? (5%)

5. **[Process: 10%]**
   (1) Please explain the five states of a process. (5%)
   (2) What is the risk of terminating a single thread by calling the exit() procedure in a multi-threading program? (2%)
   (3) Except for CPU utilization and throughput, please explain the three criteria to measure the performance of a process scheduling algorithm. (3%)

6. **[File System and Disk: 10%]**
   (1) Except for single-level and two-level directories, what are the three popular schemes to define the logical structure of directories? (3%)
   (2) Suppose that the range of a disk's cylinders is [1, 200] and the disk head currently stops at cylinder 55. Let the disk queue contain the requests of blocks on cylinders {99, 187, 39, 124, 14, 131, 65, 70}. Please show how the disk head moves in the SSTF, SCAN, C-SCAN, and C-LOOK disk scheduling schemes. (6%)
   (3) What is a component unit of the distributed file system? (1%)

7. **[Memory: 15%]**
   (1) Let the time to search the TLB and to access memory is 25 ns and 95 ns, respectively. Supposing that the TLB has 80% hit ratio, what is the effective memory-access time? Notice that you have to give the calculation. (3%)
   (2) Please explain both external and internal fragmentation in memory allocation. (4%)
   (3) From the viewpoint of a process, what is thrashing? (2%)
   (4) What is memory-mapped I/O? Why do we need it? (3%)
   (5) Why can virtual memory speed up process creation? (3%)

8. **[Synchronization: 15%]**
   (1) Please explain the three synchronization mechanisms for threads to access a shared data item in UNIX systems. (6%)
   (2) Suppose that three processes P1, P2, and P3 respectively have timestamps 17, 25, and 30, and P2 currently holds a resource requested by both P1 and P3. Please give the results of wait-die and wound-wait schemes used to handle deadlocks. (4%)
   (3) Please explain how the two-phase locking protocol works to check the correctness of a non-serial schedule for atomic transactions. (5%)