國立成功大學 107 學年度碩士班招生考試試題

系　　所：數據科學研究所

考試科目：計算機概論

考試日期：0205，節次：2

※ 考生請注意：本試題不可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. Multiple Choice Questions

(1) (4%) Which of the following item is normally not contained in Process Control Block (PCB)?

(A) CPU registers

(B) Memory-management information

(C) I/O device queues

(D) Process Number

(E) CPU scheduling information

(2) (4%) Which of the following statements are correct?

S1. Semaphores are designed to prevent deadlock.

S2. When a computer is powered on, the program counter is assigned to a particular address in the BIOS.

S3. The advantage of using threads instead of processes is that running multi-thread need not switch context.

S4. Messages cannot be relayed within the Internet forever.

(A) S1 and S4

(B) S2 and S3

(C) S1 and S3

(D) S2 and S4

(3) (4%) Which of the following statements are not correct?

(A) Videos in YouTube are contributed by users all over the world. Thus, viewing videos from YouTube follows a peer-to-peer model.

(B) Any interactive system needs multiprogramming capability to provide real time response.

(C) Encryption can prevent email spam.

(D) All of above are not correct.

(4) (4%) Which of the following statements is not correct?

(A) Queue is known as FIFO (First In First Out) list.

(B) Queue and Stack can be represented by linked lists.

(C) If T is a complete binary tree, then T is full binary tree.

(D) If G is an undirected graph, G has a spanning tree if and only if G is connected

(E) All of above are correct.

(5) (4%) If a 10 minute song is sampled at 44 kHz (44,000 sample/sec), and each sample is stored as one 8 bit numbers (stereo), what is the total space needed for storage?
(A) 211.2 Mbytes (B) 26.4 Mbytes (C) 2.64 Mbytes (D) 13.2 Mbytes

(6) (4%) What is the worst-case running time of Remove(x) operation for a linked list?
(A) $O(1)$ (B) $O(\log n)$ (C) $O(n)$ (D) $O(n^3)$

(7) (4%) Which data structure is the best in representing the sparse matrices?
(A) Tree (B) Linked list (C) Array (D) Queue or Stack

(8) (4%) Let T be a binary tree. Given that the inorder sequence of T=BDCFEAGIHJ and the preorder sequence of T=ABCDEFGHIJ. What is the postorder sequence of T?
(A) DCFEBIHJGA
(B) DFECBIJHGA
(C) GIJHDFECBA
(D) DFECBGIJHA

(9) (4%) Let $G = (V, E)$ be an undirected graph with n vertices, where $n \geq 1$, and A be the adjacent matrix of G. Which of the following statement is not correct?
(A) A is symmetric.
(B) A is a 2-dimension $n \times n$ array.
(C) The degree of any vertex, i, is equal to i-th row sum.
(D) The number of the edges of G is equal to $\sum_{i=1}^{n} \sum_{j=1}^{n} A(i,j)/2$.
(E) All of above are correct.

(10) (4%) Which of the following statements about sorting is correct?
S1. The worst-case time complexity of insertion sort is $O(n \log n)$.
S2. The average-case time complexity of quick sort is $O(n \log n)$.
S3. The worst-case time complexity of any comparison-based sorting algorithm cannot be lower than $O(n \log n)$.
S4. Merge sort has both benefits of "sort in-place" and "$O(n \log n)$ run time".
(A) S1 and S2
(B) S2 and S3
(C) S1 and S3
(D) S3 and S4

2. (3%) Suppose an image is represented on a display screen by a square array containing 512 columns and 512 rows of pixels. If for each pixel, 3 bytes are required to encode the color and 8 bits to encode the intensity, how many byte-size memory cells are required to hold the entire picture?

3. (8%) What is starvation? How does it differ from deadlock? What are the conditions that lead to a deadlock? What are the similar parts between starvation and deadlock?

4. (5%) A process is said to be I/O-bound if it requires a lot of I/O operations, whereas a process that consists of mostly computations within the CPU/memory system is said to be computation-bound. If both a computation -bound process and an I/O-bound process are waiting for a time slice, which should be given priority? Why?

5. (6%) Translate the SQL statement

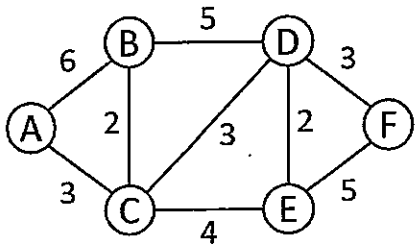
```
SELECT Assignment.StartDate
FROM Assignment, Employee
WHERE Assignment.EmplId = Employee.EmplId
AND Employee.Name = 'Alan Turing';
```

into a sequence of SELECT, PROJECT, and JOIN operations.

6. (6%) Name and explain two data structures that can be used to implement a tree.

7. (8%) For each of the following data structures, describe one application of the structure in the operation of a computer/information system.
   (1) Stack
   (2) Queue
   (3) Tree
   (4) Graph

8. Given the graph below, answer the following questions.



(1) (4%) List all the shortest paths from vertex B and all destinations.
(2) (4%) Write an algorithm that can find out the shortest paths for a given graph of n vertices from an assigned starting vertex.
(3) (4%) Find the minimum spanning tree and explain the algorithm you use.

9. A hashed table is constructed using the division hashing function with 5 buckets (a bucket at most 4 records). If the following key field values are to be placed in buckets: 3, 5, 24, 22, 109, 10, 8, 6, 23, 28, 100, 103, 9, 39, 27, 0, answer the following questions.

(1) (3%) Briefly explain what overflow and collision are in hashing.
(2) (3%) Briefly compare three collision handling mechanisms: linear probing, quadratic probing, and chaining.
(3) (3%) In the inserted keys, identify the number of records in each bucket.
(4) (3%) Which bucket overflows?