

國立臺灣科技大學  
113學年度碩士班招生  
試題

系所組別：1500資訊工程系碩士班

科    目：資訊工程概論

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I. (35%) Multiple choice questions.

1. (5%) Order the following functions by growth rate in increasing order.  
 $N, \sqrt{N}, N^{1.5}, M\log N, N^2, M\log(\log N), M\log^2 N, M\log(N^2), 2^N, 2048$   
 Which is the 5th function in the ordered sequence?  
 (a)  $N$ , (b)  $\sqrt{N}$ , (c)  $N^{1.5}$ , (d)  $M\log N$ , (e)  $N^2$ , (f)  $M\log(\log N)$ , (g)  $M\log^2 N$ , (h)  $M\log(N^2)$ ,  
 (i)  $2^N$ , (j) 2048
  
2. (5%) Select all the incorrect statements for minimum spanning trees.
  - (a) Every spanning tree of an unweighted graph is a minimum spanning tree.
  - (b) If Kruskal's algorithm is performed on a graph that is not connected, then it finds a minimum spanning forest.
  - (c) If Prim's algorithm is performed on a graph that is not connected, then it finds a minimum spanning forest.
  - (d) To perform Kruskal's algorithm, the graph must be a connected graph.
  - (e) To perform Prim's algorithm, the graph must be a connected graph.
  - (f) Prim's algorithm is a greedy algorithm.
  - (g) Kruskal's algorithm is a greedy algorithm.
  
3. (5%) Select all the correct statements for finding the shortest paths from a given node in a graph.
  - (a) Dijkstra's algorithm can be applied if the graph is undirected without negative weights.
  - (b) Dijkstra's algorithm can be applied if the graph is directed with negative weights but without negative cycles.
  - (c) Dijkstra's algorithm can be applied if the graph is undirected with negative cycles.
  - (d) Bellman-ford algorithm can be applied if the graph is undirected without negative weights.
  - (e) Bellman-ford algorithm can indicate that no solution exists if the graph is directed with negative cycles.
  - (f) The answers must be the same for every graph that can successfully find shortest path solutions using both Dijkstra's and Bellman-ford algorithms.
  
4. (5%) Select all the correct statements about graphs with the depth-first search (DFS) algorithm and the breadth-first search (BFS) algorithm.
  - (a) No directed graph has the same BFS and DFS traversals.
  - (b) Given the BFS and the DFS traversals of a directed graph, we can derive the original directed graph.
  - (c) The DFS algorithm is usually implemented with a stack.
  - (d) The BFS algorithm uses a queue to maintain the nodes that need to be visited.



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5. (5%) The following is the height data for eight students in a class. If we use a sorting algorithm to sort the students from low to high according to their height, which algorithm will get a different student sequence than using tree sorting?

Name	Alpha	Bella	Cock	Duke	Elsa	Fiona	Gina	Hulk
Height (cm)	160	170	185	173	160	153	170	180

- (a) Bubble  
 (b) Insertion sort  
 (c) Merge sort  
 (d) Selection sort  
 (e) Heap sort
6. (5%) Consider the following segment table:

Segment	Base	Length
0	219	600
1	2300	14
2	90	100
3	1327	580
4	1952	96

Which following logical addresses are illegal?

- (a) 0, 430 (b) 1, 10 (c) 2, 450 (d) 3, 300 (e) 4, 100
7. (5%) Use operations push, pop, and no-op (i.e., forward the input to the output directly) to rearrange an input sequence. For six numbers 1, 2, 3, 4, 5, 6 entered in that order, which of the following rearrangements is/are not possible?  
 (a) 235146, (b) 325641, (c) 154623

**II. (65%) Fill in the following blanks.**

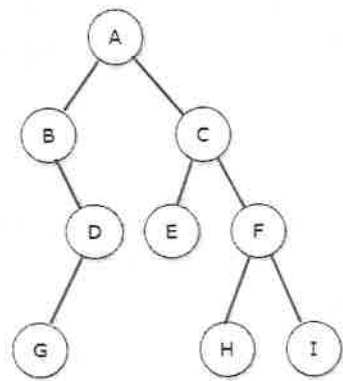
1. (10%) Consider a two-dimensional array X within a system where each element occupies two bytes. The starting memory address for element X(4, 2) is 1978, and the starting memory address for element X(2, 3) is 1986.  
 (a) The address of X(3, 8) is (A)  
 (b) The number of rows of X is (B)



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2. (5%) There are three types of iterative binary tree traversal (i.e., inorder, preorder, and postorder). Conduct a traversal of the following binary tree using preorder. What is the 5th element of this preorder traversal? (C)



3. (5%) If a complete undirected graph has 3,403 distinct edges, there are (D) nodes in this graph.
4. (10%) Check the following codes in C.

```

#include <unistd.h>
int value = 5;

int main(){
    pid_t pid;
    pid = fork();

    if(pid == 0){
        value += 10;
        printf("child: value = %d\n", value); // Line A
        return 0;
    }

    else if(pid > 0){
        wait(NULL);
        value -= 3;
        printf("parent: value = %d\n", value); // Line B
        return 0;
    }
}
  
```

What is the output in Line A? child: value = (E)

What is the output in Line B? parent: value = (F)



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5. (5%) The table given below lists the arrival and burst times of four processes P1, P2, P3 and P4. Assume that SJF non-preemptive scheduling is used. Calculate the average waiting time.

Process	Arrival Time (ms)	Burst Time (ms)
P1	0	7
P2	2	4
P3	4	1
P4	5	4

Average waiting time = (G) ms

6. (5%) Suppose that a disk drive has 1,000 cylinders, numbered 0 to 4999. The drive is currently serving a request at cylinder 100. The queue of pending requests is:

39, 150, 160, 18, 55, 90, 184, 58, 38

Starting from the current head position, what is the total distance (in cylinders) that the disk arm moves to satisfy all the pending requests for the disk-scheduling algorithm Shortest Seek Time First (SSTF)? (H)

7. (10%) MIPS is a word-addressing instruction set architecture with a 16-bit immediate field. The MIPS branch on equal (BEQ) instruction modifies the \$PC value if the condition is true with branch target address ranges from (next \$PC)+A to (next \$PC)+B. The decimal value of A + B is (I) bytes. On the other hand, RISC-V is a half-word addressing instruction set architecture for compressed ISA extension with a total 12-bit immediate field. The RISC-V branch on equal (BEQ) instruction modifies the \$PC value if the condition is true with branch target address ranges from (next \$PC)+A to (next \$PC)+B. The decimal value of A + B is (J) bytes.
8. (5%) "Mini-float" is a low-precision floating-point number representation similar to the IEEE 754 standard except that it is only 8-bit wide. The leftmost bit is still the sign bit, the exponent is 4-bit wide with bias 7 (excess-7 code), and the mantissa (fraction) is only 3-bit long. A hidden leading 1 is assumed. The decimal number (K) can be encoded to a hexadecimal "mini-float" value  $(55)_{16}$ .
9. (10%) You are designing a 256KB 4-way set associative instruction cache with a 32-bit address and 32 bytes per cache block. There are (L) bits used for the set (index) field and (M) bits used for the tag field.

