國立成功大學

110學年度碩士班招生考試試題

編　號：203

系　所：電機資訊學院-資訊聯招

科　目：程式設計

日　期：0202

節　次：第 2 節

備　註：不可使用計算機

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※ 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。

Part I. 資料結構 (50%)

1. (10 %) Please show the level of the binary search tree which constructed from given preorder traversal.
   The preorder traversal: 50, 15, 11, 3, 2, 22, 84, 80, 77, 90, 95.
   Note: In a tree, each step from top to bottom is called as level of a tree. The level count starts with 1 and increments by 1 at each level or step.

2. (10%) Let input is an array of unique characters along with their frequency of occurrences, shown as following table. Please show the total bits of the constructed Huffman code.

Character	A	L	G	O	R	I	T	H	M
Frequency	12	3	13	23	1	5	16	21	6

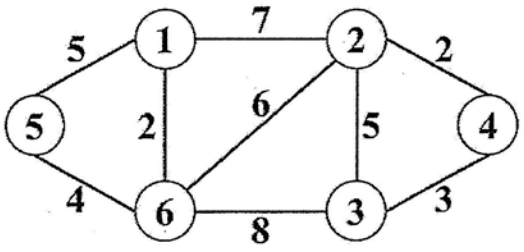
3. (10%) Assume that you have to store the four strings: "abcdef", "bcdefa", "cdefab", and "defabc", in the hash table by using the hashing technique.
   (1) (5%) Consider the hash function: the index for a specific string will be equal to the sum of the ASCII values of the characters modulo 11. Please determine how many collisions if we use this hash function.
   (2) (5%) Consider the hash function: the index for a specific string will be equal to sum of ASCII values of characters multiplied by their respective order in the string after which it is modulo with 11. Please determine how many collisions if we use this hash function.
   Note: The ASCII values of a, b, c, d, e, and f are 97, 98, 99, 100, 101, and 102 respectively.

4. (10%) Consider the following algorithm:

```
for (i = 1; i <= 2n; i++)
  sum = sum + i;
for (i = n; i >= 1; i--)
  sum = sum + i;
cout << sum;
```

   (1) (5%) What is the output when n = 4?
   (2) (5%) What is the time complexity T(n)?

5. (10%) Please show the cost of the minimum cost spanning tree for the following graph.



Part II. 演算法 (50%)

6. (15%) Use the master method to give tight asymptotic bounds for the following recurrences. If the master method does not apply, you should point out and explain.

(1) (3%) $T(n) = 2T(n/4) + \sqrt{n}$

(2) (3%) $T(n) = T(n-1) + n \lg n$

(3) (3%) $T(n) = 3T(n/4) + n \lg n$

(4) (3%) $T(n) = 4T(n/2) + n^2 \lg n$

(5) (3%) $T(n) = 7T(n/2) + \Theta(n^2)$

7. (15%) Answer **True** or **False** for the following statements and also justify your reasons.

(1) (3%) If an NP-complete problem can be reduced to a problem L in polynomial time, then L is NP-complete.

(2) (3%) If a problem A can be reduced to a problem B and $A \in$ P, then $B \in$ P.

(3) (3%) If a problem $A \in$ P, then $A \in$ NP.

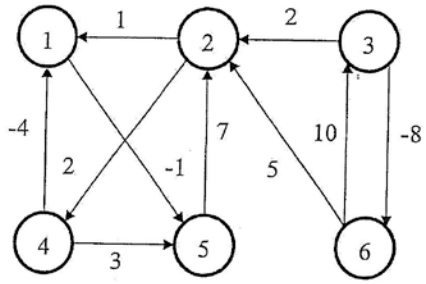
(4) (3%) If P≠NP, there exists a 2-approximation algorithm for the general traveling-salesman problem.

(5) (3%) The maximum numbers of elements in a heap of height h is $2^h - 1$.

8. (10%) Given three strings $x[0, \ldots, n-1]$, $y[0, \ldots, m-1]$ and $z[0, \ldots, r-1]$. We say that z is a shuffle of x and y if it contains all characters of x and y and the left-to-right ordering of the characters from x and the characters from y is preserved. For example, "NcCKsiUe" is a shuffle of "NCKU" and "csie". The dynamic programming algorithm uses a table S to check x, y and z, where $S[i][j]$ is true if and only if the first $i+j$ characters of z are a shuffle of the first i characters of x together with the first j characters of y. Complete the following pseudocode for checks whether z is a shuffle of x and y by filling (1), (2) and (3). (please use C-style expression)

```
isShuffle(x, y, z)
    Let S[0 ... n][0 ... m] be a new table
    S[0][0] = true
    if r ≠ n + m
        return false
    for i = 1 to n
        S[i][0] = _____ (1) (3%) _____
    for j = 1 to m
        S[0][j] = _____ (2) (3%) _____
    for i = 1 to n
        for j = 1 to m
            S[i][j] = _____ (3) (4%) _____
    return S[n][m]
```

9. (10%) Consider the given directed graph.



The Floyd-Warshall algorithm can solve the all-pairs shortest-paths problem on a directed graph $G = (V, E)$. Answer the following questions.

(1) (2%) What is the time complexity of Floyd-Warshall algorithm?

(2) (3%) Let $d_{ij}^{(k)}$ be the weight of a shortest path from vertex i to vertex j for which all intermediate vertices are in the set $\{1,2,\ldots,k\}$ and $D^{(k)} = \left(d_{ij}^{(k)}\right)$ be a $n \times n$ matrix. Floyd-Warshall algorithm computes $D^{(k)}$ from $D^{(k-1)}$ as the following formula.

$d_{ij}^{(k)} =$_____

Please complete the above formula.

(3) (5%) Let $dist(i,j)$ be the length of the shortest path from node i to node j. What is $dist(1,5) + dist(2,5) + dist(3,5) + dist(4,5) + dist(6,5)$?