考試科目	資料結構及演算法	所別	8141 資訊科學系	考試時間	2 月 25 日(六) 第 一 節

1. (20%) **True or False.** Please answer "T" or "F" for the following question. Each 2%

(1) Both insert and delete operations of a stack take O(1) time.
(2) f(n) = O(g(n)) if and only if g(n) = Ω(f(n)).
(3) Adjacency-list representation is suitable for dense graph.
(4) The complexity of parent operation of each element in a binary heap is O(1).
(5) $\Theta(n!) + O(2^n) = O(2^n)$.
(6) A complete binary tree having n nodes have log$n$ levels
(7) A greedy algorithm always leads to global optimal solution.
(8) Merge sort is a "in place" sort algorithm.
(9) Any problem in P is also in NP.
(10) The class NP consists of those problems that are solvable in non-polynomial time.

2. (20%) **Single selection.** Each 2%

(1) Which of the following sorting algorithm takes the least number of comparisons for sorting of the following sequence of data (2, 17, 66, 80, 98, 123, 170, 200)?
(a) quick sort (b) insertion sort (c) merge sort (d) heap sort (e) selection sort

(2) Solve the following prefix expression: / - * 2 5 * 1 2 - 13 11
(a) 0 (b) 1 (c) 4 (d) 12

(3) Which of the following formula is the time complexity in term of comparison operations for merge sort of n records?
(a) T(n) = T(n/2) + cn
(b) T(n) = 2T(n/2) +c n^2
(c) T(n) = T(n-1) + cn
(d) T(n) = 2T(n/2) + cn

(4) The worst case time complexity of finding the maximum in a N-key AVL tree
(a) O(1) (b) O($\log N$) (c) O(N) (d) O($N \log N$) (e) O(N^2) (f) O($N^2 \log N$)

(5) The minimum edges need for a n-node connected undirected graph.
(a) n (b) n^2 (c) $n-1$ (d) $\log n$

備註	試題隨卷繳交

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(6) A cycle in a graph that visits every vertex us called as

(a)Euler circuit (b)Hamiltonian circuit (c)Connected cycle (d)Hamiltonian cycle (e)Euler cycle

(7) Which of the following are max-heaps?

	1	2	3	4	5	6	7	8	9
(a)	1	3	2	7	9	8	14		
(b)	16	14	10	8	7	9	3	2	4
(c)	17	10	14	7	8	3	9	11	
(d)	18	8	9	14	5	6	3	1	

(8) The worst case time complexity of finding the minimum or maximum in a Binary Search Tree with N elements is

(a) O(1) (b) $O(\log N)$ (c) $O(N)$ (d) $O(N \log N)$ (e) $O(N^2)$

(9) What is the time complexity of $T(n) = 5T(n/2) + \Theta(n^3)$

(a) $\Theta(n^2)$ (b) $\Theta(n^{\lg 5})$ (c) $\Theta(n^3 \log n)$ (d) $\Theta(n^3)$

(10) The maximum height of the recursion tree for the recurrence $T(n)=T(n/3)+T(2n/3)+cn$ will be

(a) $\log n$ (b) $\log_{3/2} n$ (c) $3 \log n$ (d) 2^n

說明: 3 ~ 8 題，請書寫必要的解題過程。僅書寫答案而缺乏必要的過程，亦無法獲得該題滿分。可使用中文或英文作答。

3. (10%) Procedure Q3 takes a n-element integer array p[1..n] and an integer n as input. Let $T(n)$ denote the total number of calls made to Q3(p, n). Please analyze the complexity of $T(n)$ in following pseudo code, and propose a better pseudo code

```
Q3(p, n)
1 if n == 0
2       return 0
3 q = -∞
4 for i = 1 to n
5       q = max( q, p[1]+Q3(p, n-1) )
6 return q
```

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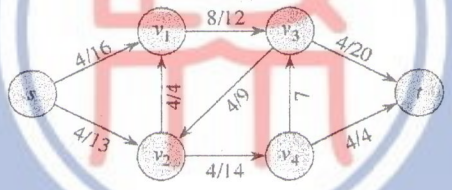
4. (10%) What is an optimal Huffman code tree for the following set of frequencies, a:33 b:4 c:5 d:12 e:6 f:8 g:13 . The result of each pass must be listed.

5. (10%) A=(a_{ij}) and B=(b_{ij}) are square n x n matrices, write a recursive pseudo code to compute their multiplication C=(c_{ij}), and analyze the complexity of the pseudo code.

6. (10%) Describe an algorithm that, given n integers in the range 0 to k, preprocess the input and then answers any query about how many integers fall into a range [a···b] in O(1) time, where $a, b \in \{0,1,...,k\}$. The preprocess algorithm should be linear time complexity.

7. (10%) Give the definition of residual network and augmenting path in a flow network, and draw the residual network and augmenting path of the following flow network G and flow. (note: flow/capacity)



8. (10%) The Fibonacci numbers are defined by recurrence: $F_0=0$, $F_1=1$, $F_i=F_{i-1}+F_{i-2}$ for $i \geqq 2$. Write an O(n)-time dynamic-programming algorithm to compute the n th Fibonacci number.

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