

國立中山大學100學年度碩士班招生考試試題

科目：資料結構【資管系碩士班乙組】

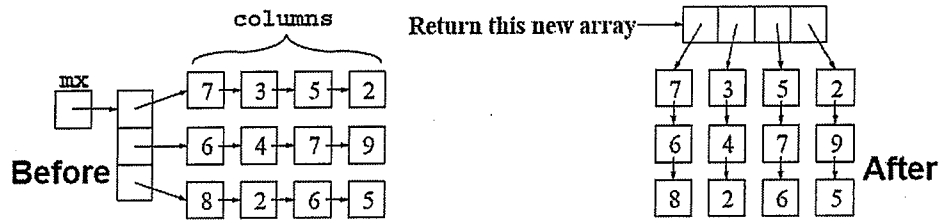
1. (10%) Order the following functions by growth rate (in non-decreasing order):
 $n, n^{1.3}, n^2, n \log n, n \log(\log n), n(\log n)^2, n \log(n^2), 2/n, 2^n, 2^{n/2}, 100, n^3, 1.2^n$
2. (15%) 請說明底下的程式在做什麼？另外，請分析它的running time complexity。


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1 for j ← 2 to length[A]
2   do key ← A[j]
3   i ← j - 1
4   while i > 0 and A[i] > key
5     do A[i+1] ← A[i]
6     i ← i - 1
7   A[i+1] ← key
      
```
3. (15%) Let $X[1..n]$ and $Y[1..n]$ be two arrays, each containing n numbers already in sorted order. Give an $O(\lg n)$ -time algorithm to find the median of all $2n$ elements in arrays X and Y .
4. (15%) A d -ary heap is like a binary heap, but (with one possible exception) each non-leaf node has d children instead of 2 children.
 - (a) How would you represent a d -ary heap in an array?
 - (b) What is the height of a d -ary heap of n elements in terms of n and d ?
 - (c) Assume the heap operations are only BUILD-HEAP, EXTRACT-MAX, HEAP-INSERT. Now Dr. D claimed that 3-ary heaps are better (faster) than binary heaps because they need less comparison. Check whether the claim is right or wrong and explain your answer.
5. (15%) Write a method called transpose that performs a matrix transpose in the SListNode class below. The input parameter mx is an array of singly-linked lists, each representing a row of a matrix. (i.e. mx is a two dimensional array, except it's an array of lists instead of an array of arrays). The input parameter columns is the length of every linked list (no error checking required). Your job is to return an array of singly-linked lists, each representing a **column** of the same matrix. Here's a picture of what you should do:

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6. (15%) Write a search-based procedure to count the number of internal nodes in a binary tree.
7. For a directed graph $G = (V, A)$, $V = \{1, 2, 3, 4, 5, 6\}$, $A = \{(1, 2), (2, 3), (3, 4), (4, 5), (1, 5), (2, 4), (2, 6), (1, 6), (4, 1), (5, 6)\}$, and each pair (i, j) in A describes an arc from node i to node j .
 - (a) Use adjacency matrix and adjacency list to represent the graph. (5%)
 - (b) Write a procedure to count the in-degree and out-degree for each node in G . (10%)