

大同大學 九十三年 學年度研究所碩士班入學考試試題

考試科目：資料結構與演算法

所別：資訊經營研究所

第 1/1 頁

註：本次考試 不可以參考自己的書籍及筆記； 不可以使用字典； 不可以使用計算器。

1. (12 %) (a) Given a three dimensional array $A(3,5,4)$, and its data is stored sequentially starting from memory address 66ED:0000H. Find the address of $A(2,3,4)$ for the row-major order, and for the column-major order. Assume a byte-addressable machine and each element of A occupies 2 bytes. (b) The following two code segments should have same result. Do they have the same efficiency in using computer? Why or why not? (Hint: C generally uses row-major order.)

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1) for (i = 0; i < 10; i++)
   for (j = 0; j < 1000; j++)
     a[i][j] = b[i][j] + c[i][j];
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```
2) for (j = 0; j < 1000; j++)
   for (i = 0; i < 10; i++)
     a[i][j] = b[i][j] + c[i][j];
```

2. (6 %) A spelling checker reads an input file and prints out all words not in some online dictionary. Suppose the dictionary contains 30,000 words and the file is large, so that the algorithm can make only one pass through the input file. A simple strategy is to read the dictionary into a hash table and look for each input word as it is read. Assuming that an average word is seven characters and that it is possible to store words of length L in $L+1$ bytes, and assuming an open addressing table, how much space does this require?
3. (12 %) Any sorting algorithm that uses only comparisons between elements requires at least $\lceil \log(N!) \rceil$ comparisons in the worst case; this also means it requires $\Omega(N \log N)$ comparisons. Prove them!
4. (12 %) Explain why quicksort is $O(n^2)$ in its worst case, and $O(n \log n)$ in average.
5. (18 %) (a) True or false: the minimum number of nodes, $N(h)$, in an AVL tree of height h expressed in terms of the Fibonacci numbers would be $N(h) = F_{h+2} - 1$ with $F_0=1, F_1=1$. Justify your answer. (b) What is the minimum number of nodes in an AVL tree of height 7? (c) Show the result of inserting 2, 1, 4, 5, 9, 3, 6, 7 into an initially empty AVL tree.
6. (18 %) The following table characterizes six operators: +, -, =, *, / and !. Note that larger n has higher precedence.

symbol	operator	precedence n	associativity
!	unary	4	right to left
* /	binary	3	left to right
- +	binary	2	right to left
=	binary	1	right to left

For the expression $A = B = C + D * E / F - !! G * H$

- (a) Draw a binary tree representation which represents the evaluation sequence of this infix expression.
 (b) Give the equivalent prefix and postfix expressions.
 (c) If you want to convert this infix expression to a postfix expression, briefly describe how can you implement such function with the help of stack.
7. (12 %) We can perform buildheap in linear time for leftist heaps by considering each element as a one-node leftist heap, placing all these heaps on a queue, and performing the following step: until only one heap is on the queue, dequeue two heaps, merge them, and enqueue the result. Prove that this algorithm is $O(N)$ in the worst case.
8. (10 %) Determine which of the following functions asymptotically dominate others. Express the dominance relationship using a digraph in which f_j is adjacent to f_i if f_j has lower order than f_i or f_i and f_j have the same complexity. Which function(s) is/are said to be of polynomial order? Which is/are exponential order?

$$\begin{aligned}
 f_1(n) &= n^2 \log n + \log n \\
 f_2(n) &= n/100 + 100/n^2 \\
 f_3(n) &= n^3 + 2n^2 + 1 \\
 f_4(n) &= (\log n)^2 \\
 f_5(n) &= 2 \log n \\
 f_6(n) &= \log n^2 \\
 f_7(n) &= 2^n + n
 \end{aligned}$$