國立嘉義大學九十七學年度

資訊工程學系碩士班招生考試試題

科目：數學

1. Given a 2-dimensional array A[i,j] with the size of 256x256, show how to calculate the relative address of the element A[i,j] while representing the array in column-major order. (10%)
2. Draw the equation (A+B)*D+E/(F+A*D)+C as a binary tree, then write down its postfix and prefix representations. (10%)
3. Show a recursive algorithm of merge sort and show the processes of analyzing its time complexity. (10%)
4. Briefly explain the following questions:
   (a) the definition of asymptotic notation θ. (5%)
   (b) the purpose to introduce threaded tree. (5%)
   (c) the advantages and disadvantages of interpolation search (over simple binary search). (5%)
5. Suppose the symbols to be coded by Huffman coding are the characters in the word "HELLO". A simple list data structure is used.
   (a) show the coding tree. (3%)
   (b) compute the total of bits needed to encode the string. (2%)
6. Observe that

   $1 = 1$

   $1 - 4 = -(1 + 2)$

   $1 - 4 + 9 = 1 + 2 + 3$

   $1 - 4 + 9 - 16 = -(1 + 2 + 3 + 4)$

   $1 - 4 + 9 - 16 + 25 = 1 + 2 + 3 + 4 + 5$

   Guess a general formula and prove it by mathematical induction. (10%)
7. Explain the following questions:
   (a) How many integers from 1 to 1000 do not have any repeated digits (e.g., both 999 and 858 have repeated digits.)? (5%)
   (b) What is the probability that an integer chosen at random from 1 through 1000 has at least one repeated digit? (5%)
8. Design a finite-state automaton to accept the set of all strings of 0's and 1's that end 011.(10%)
9. Let A = {1, 2, 3, 4, 5, 6, 7, 8}.
   (a) If five integers are selected from A, must at least one pair of the integers have a sum of 9? Justify your answer. (5%)
   (b) If four integers are selected from A, must at least one pair of the integers have a sum of 9? Justify your answer. (5%)
10. For each positive integer n, let a_n be the number of iterations of the while loop in the following code segment:

```
while (n > 0)
    n = floor(n / 2)
end while
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   (a) Find a recurrence relation for a_n. (5%)
   (b) Solve the recurrence relation. (5%)