國立高雄大學九十六學年度轉學招生考試試題

科目：資料結構　　系所：資訊工程學系　　是否使用計算機：否

考試時間：90 分鐘　　本科原始成績：100 分

1. A *lower triangular matrix A* is an *n*-by-*n* array in which $a_{ij} = 0$, if $i < j$.
   (1) What is the maximum number of nonzero elements in such an array? (5%)
   (2) Assume the nonzero elements of the matrix *A* is represented sequentially in an one-dimensional array *b* by row major, e.g.,

$$\begin{pmatrix} a_{11} & 0 & 0 & 0 \\ a_{21} & a_{22} & 0 & 0 \\ a_{31} & a_{32} & a_{33} & 0 \\ a_{41} & a_{42} & a_{43} & a_{44} \end{pmatrix}$$

matrix *A*	a_{11}	a_{21}	a_{22}	a_{31}	a_{32}	a_{33}	...
array *b*	b[0]	b[1]	b[2]	b[3]	b[4]	b[5]	...

   What is the position in array *b* that stores element a_{ij}? (10%)

2. Consider the following recursive function.

$$A(m,n) = \begin{cases} m+1, & \text{if } n = 0 \\ A(m, n-1), & \text{otherwise} \end{cases}$$

   (1) What is the result of *A*(3, 2)? (5%)
   (2) Write a recursive algorithm to complete this function. (10%)

3. Consider an array *NODE* that consists of the linked list pointed to by *List* and another available list of unused nodes pointed to by *Avail*.

List = 0
Avail = 4

	info	next
0	BOB	7
1		2
2		6
3	LIN	5
4		1
5	ROSE	-1
6		8
7	JOE	3
8		-1

   (1) List the elements of the linked list, starting from *List*. (6%)
   (2) Show the resulting array *NODE* after inserting MARY into the linked list starting from *List* so that the resulting list is still in alphabetical order? (7%)
   (3) After inserting MARY, if LIN is removed, what is the resulting array *NODE*? (7%)

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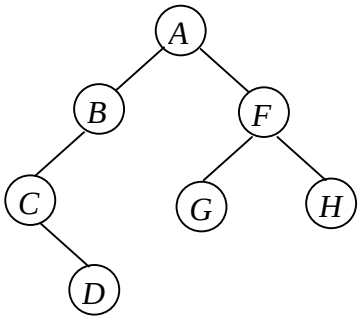
4. Consider the following binary search tree.

   (1) What are the resulting sequences obtained by traversing the tree in inorder and postorder? (10%)
   (2) Please show how to represent the binary tree with a sequential array. (10%)
   (3) Devise an algorithm that can compute the number of leaf nodes for a given binary tree. (10%)



5. A “ternary” search algorithm is a divide-and-conquer searching approach which first tests the element at position $n/3$ for equality with some value x and then possibly checks the element at $2n/3$ either discovering x or reducing the set size to one third of the original.

   (1) Show the searching steps for searching $x = 21$ over the following sorted sequences. (10%)

   1 3 5 7 9 11 13 15 17 19 21 23 25 27 29

   (2) What is the time complexity of this algorithm? You have to show the derivation. (10%)

背面尚有試題

國立高雄大學九十六學年度轉學招生考試試題

科目：離散數學　　系所：資訊工程學系　　是否使用計算機：否
考試時間：90 分鐘　　本科原始成績：100 分

1. Consider the three persons, John, George, and Peter, and 8 different balls, b_1, b_2, b_3, b_4, b_5, b_6, b_7, and b_8.
   (a) (4%) In how many ways can these 8 balls be arranged in a line so that b_1 is not at position 1 and b_2 is not at position 2?
   (b) (4%) In how many ways can these 8 balls be arranged in a line so that b_i is not at position i, i =1, 2, 3,…, 8?
   (c) (4%) In how many ways can these 8 balls be distributed to the three persons?
   (d) (4%) In how many ways can these 8 balls be distributed to the three persons such that each person gets at least one ball?
   (e) (4%) In how many ways can these 8 balls be distributed to the three persons such that John does not get b_1, George does not get b_2, and Peter does not get b_3?
   (f) (4%) In how many ways can these 8 balls be packed into 3 same boxes so that each box contains at least one ball?
   (g) (4%) In how many ways can these 8 balls be packed into 3 same boxes (boxes can be empty)?

2. In a shop, there are four kinds of flags, red, green, blue, and yellow.
   (a) (4%) In how many ways can John pick 8 flags?
   (b) (4%) In how many ways can John pick 8 flags so that each kind of flag is selected at least one?
   (c) (4%) In how many ways can John pick 8 flags so that each kind of flag is selected at most three?
   (d) (4%) In how many ways can John pick 8 flags so that he selects an even number of red flags, an odd number of green flags, and any number of blue and yellow flags?
   (e) (4%) In how many ways can John pick 8 flags so that the number of red flags is less than or equal to the number of green flags, and any number of blue and yellow flags?

3. Let $A = \begin{bmatrix} 1 & -1 \\ -1 & 0 \end{bmatrix}$.
   (a) (5%) Compute A^2, A^3, A^4, and A^5.
   (b) (5%) Conjecture a general formula for A^n, $n \in Z^+$, and establish your conjecture by the Principle of Mathematical Induction.

4. (8%) $42x + 90y = c$, x, $y \in Z$, $0 < c < 10$, $c \in Z^+$. Find all solutions of x, y, and c.

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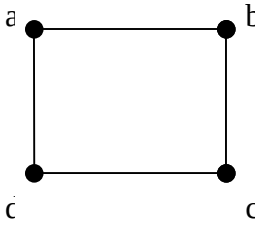
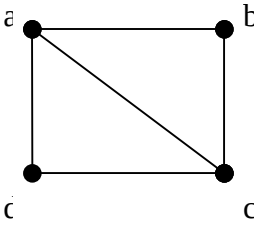
5. What is the number of ways to properly color the vertices of the following figures using 6 colors so that if $\{a, b\}$ is an edge, then a and b are colored with different colors?

(a) (5%)



(b) (5%)



6. (8%) Prove that for all integers x, y, and z, if $x + y + z \geq 0$, then $x \geq 0$ or $y \geq 0$ or $z \geq 0$.

7. (8%) For $n \in Z^+$, prove that $3 \mid (n^3 + 2n)$.

8. (8%) Let $\{x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8\} \subseteq Z^+$. Show that for some $i \neq j$, $x_i - x_j$ is divisible by 7.

背面尚有試題