Data Structure (CS2351) Midterm Exam May 1, 2006

Class: **Student ID:**   **Student Name:**

1. What is abstract data type? What are their advantages? (6%)

2. Using both variable count and tabular methods to compute the program steps of the following program. (10%)

```
void transpose(term a[], term b[])
/* b is set to the transpose of a */
{
    int n, i, j, currentb;
    n = a[0].value;          /* total number of elements */
    b[0].row = a[0].col;  /* rows in b = columns in a */
    b[0].col = a[0].row;  /* columns in b = rows in a */
    b[0].value = n;
    if (n > 0 )   { /* non zero matrix */
        currentb = 1;
        for (i = 0; i < a[0].col; i++)
        /* transpose by the columns in a */
            for (j = 1; j <= n; j++)
            /* find elements from the current column */
                if (a[j].col == i) {
                /* element is in current column, add it to b */
                    b[currentb].row = a[j].col;
                    b[currentb].col = a[j].row;
                    b[currentb].value = a[j].value;
                    currentb++;
                }
    }
}
```

Program 2.7: Transpose of a sparse matrix

3. What are the meaning of asymptotic notation (O, Ω, Θ)? (9%)

4. Given an infix expression $(a + b) / d * (e - (f + a * b)) - c$.
   (a) What is its corresponding prefix expression? (4%)
   (b) What is its corresponding postfix expression? (4%) $a b + d / e f a b * + - * c -$
   (c) What is its corresponding binary tree in which we can apply preorder and postorder traversal to get the prefix and postfix expressions shown in (a) and (b), respectively? (4%)

5. Given set $S = \{a, b, c, d, e, f, g, h, i, j, k, l\}$ and the following equivalence pairs

$$a \equiv e, g \equiv k, d \equiv b, j \equiv i, h \equiv e, g \equiv i, d \equiv f, c \equiv l, l \equiv a, g \equiv h$$

Find the corresponding equivalence classes. (6%)

6. Given a tree $(A(B(E(K\ (L,O,P)),F,Q),C(G,N),D(H(M,I),J)))$ that is represented as a list, where the root node comes first followed by a list of the subtrees of that node.

   (a) Draw the corresponding tree structure. (4 %)

   (b) Transfer the tree shown in (a) to its corresponding left-child right-sibling tree. (4 %)

   (c) What is the preorder sequence of the tree shown in (b). (4 %)

   (d) What is the inorder sequence of the tree shown in (b). (4 %)

   (e) What is the postorder sequence of the tree shown in (b). (4 %)

   (f) What is the level-order sequence of the tree shown in (b). (4 %)

   (g) Translate the binary tree shown in (b) to its corresponding threaded binary tree that maintains inorder traversal property. (4%)

7. Given a threaded binary tree T that maintains inorder traversal property. How to insert node r as a left child of a node s in T such that the inorder traversal property of the threaded binary tree is preserved? Please use an example to show the correctness of your approach. (6 %)

8. Given an input sequence as Aug, Mar, Feb, Nov, Dec, Jan, Oct, Jun, May, Sep, July, Apr.

   (a) Construct the corresponding min heap step by step. (10 %)

   (b) What is the output sequence when deleting node from the min heap one node at a time until the heap is empty? (5%)

9. The preorder and inorder sequences of a binary tree are 1,2,3,4,5,6,7,8,9 and 2,3,1,5,4,7,8,9,6, respectively. Does this binary tree exit? If yes, draw the binary tree structure. If no, give your reasons. (8 %)