Data Structures Midterm Exam, Fall 2008

01. (30%) Explain the following terms and terms comparisons:

(a) Tree traversal (b) Binary search trees (c) LIFO lists vs. FIFO lists (d) Max heaps vs. Max trees (e) The degree of a tree

(f) Row major order (g) Complete binary trees (h) Full binary trees (i) Underflow (j) Algorithm vs. programs

02. (5%) Answer “True” or “False” for the following statements.

(a) An empty binary tree is invalid while a tree may have zero nodes. (b) The order of children is irrelevant in a binary tree. (c) The order of operators in infix representation is the same as that in postfix

representation. (d) Compared a binary search tree with a heap, the former is more suited for

deleting arbitrary elements. (e) The time complexity of a declaration operation from a n-element max heap is

O ( )n .

03. (8%) Prove or disprove the following statements:

**(a)**

*∑ n*

=Θ (c) n ! =O ( n )n i

**(d) (b)**

3 4

0

*i ( n*

) =

n 1.001 + n log n =Θ ( n 1.001 ) 100 n 2 + 200 =O ( n ) 04. (3%) Derive the worst case time complexity of the binary search function

binsearch as follows. (Assume that there are n elements in the array list.)

int binsearch(int list[], int searchnum, int left, int right) {

int middle; while (left <= right) {

middle = (left + right) / 2; if (list[middle] < searchnum)

left = middle + 1; else if (list[middle] == searchnum)

**return middle; else**

right = middle – 1; } return -1; }

05. (a) (5%) How to represent polynomials as singly linked lists? Your answer should

include the node structure and a pseudo code for polynomial addition. (b) (3%) Assume that the two arguments of the polynomial addition have m and n

terms respectively. Determine the time complexity of your pseudo code.

06. (9%) Assume that it takes two units of memory location to store an integer and row

major order is adopted. Consider the following array declaration:

int A[5][8][8]; (a) If A[0][0][0] is stored at address 2000, calculate the memory address of

A[2][0][7]. (b) If A[0][0][0] is stored at address 2000, indicate which array element is at the

location 2080. (c) If A[3][0][0] is stored at address 2000, calculate the memory address of

A[1][5][5].

07. (a) (3%) During the process of transforming a parenthesized infix expression to a

postfix one, why do we need two types of precedence, an in-stack precedence and an incoming precedence? (b) (4%) Write the postfix form of the following expressions:

*(i) \* / \* A B D E F A D C - + + + (ii) ( )\* /( \* ) A B D E F A D C - + + +*

08. (a) (8%) Describe how to delete an element from a binary search tree. Calculate the

time complexity of the deletion operation. (b) (8%) Describe how to insert an element into a min heap. Calculate the time

complexity of the insertion operation. (c) (3%) Solving the equivalence classes problem is an application of binary search

trees. Explain how to process an equivalence pair, i j ≡ .

09. (8%) How can we apply a linked list representation to sparse matrices? It is not

necessary to follow the design introduced in the textbook.

10. (3%) Given an in-order sequence BAECDJHFGI and a post-order sequence

ABCDEFGHIJ, can you derive a unique binary tree? If yes, draw the binary tree; or you have to give two distinct binary trees which can generate above sequences.