Data Structures

Midterm Exam, Fall 2007

01. **(10%)** Give $O(\bullet)$ for the following expressions.

    (a) (3%) $6 \cdot 2^n + 2 \cdot n! + 3$

    (b) (3%) $n^2 \log n + 9n(\log n)^2$

    (c) (4%) $\sum_{i=0}^{n} i^2$

02. **(20%)** Answer the following questions:

    (a) Define the data type for each node of a doubly linked list. (Not just draw a diagram. You need to define the data type.) Each node stores the information of a process, including process name (PN) and process type (PT). PN has at most 15 characters. PT is compared of other two components, priority (PO) and memory size (MS). Both PO and MS are of an integer type. Use these abbreviations (i.e., PN, PT, etc.) in your type definition.

    (b) Write a subroutine (program) that deletes a node whose PN is "explore.exe" from a doubly linked list.

03. **(20%)** Answer the following questions:

    (a) **(4%)** What kind of data structure (queue, stack, array, or linked list) is the most suitable for translating an infix order to a postfix order?

    (b) **(6%)** Give the postfix and the prefix of the following expression.
$$(A+B)*D+E/(F+A*D)+C$$

    (c) **(10%)** Describe the steps of the above translation into postfix using the data structure answered in (a). (Note that what the question asks is the steps for "translating" the expression into a postfix expression, not the steps for "executing" the expression. The translation should be done using the designated data structure.)

04. **(10%)** For a sequence of input data 8, 5, 1, 3, 7, 9, 4, give the detailed steps of building a min heap based on the order given above. (Note that you have to give the "detailed" steps for how the heap is updated when each value is inserted. Otherwise, you will get no points from this question.)

05. **(20%)** Answer the following questions.

    (a) Let the preorder of a binary tree be EDAKHCBFG and the in-order be DKAHEBCGF. Draw the diagram of this binary tree.

    (b) Can a binary tree uniquely determined if the pre-order and the post-order of this

tree are given? How about given the pair post-order and in-order? Explain why?

06. (20%) Answer the following questions.

    (a) Given a formal definition of a full binary tree.

    (b) For a nonempty binary tree, let n_0 be the number of leaf nodes and n_2 be the number of nodes of degree 2. Prove that $n_0 = n_2 + 1$.