

Prelim Exam

Data Structures

January 2009

1. A *lower triangular* array is an $n \times n$ array A in which $A[i, j] = 0$ if $i < j$.
 - (a) What is the maximum number of nonzero elements in such an array?
 - (b) How can these elements be stored sequentially in memory?
 - (c) Develop an algorithm for accessing $A[i, j]$ when it is stored sequentially in memory.
2. Define the necessary data structures and write algorithms for the following expressions transformation.
 - (a) An *infix* notation to a *postfix* notation.
 - (b) An *infix* notation to a *prefix* notation.
 - (c) A *postfix* notation to a *prefix* notation.
 - (d) Show how they [(a), (b), and (c)] work (step-by-step) when the infix expression is $A * B + C / D$.
3. One can generalize the definition of *binary tree* to d -array tree in which every node has at most d children. Describe a data structure for such a tree. In other words, if such a tree is stored in an array, for an entry located at position i of the array, find the indices for its parent and children nodes.
4. How long does it take to determine if an undirected graph contains a vertex that is connected to no other vertices;
 - (a) if you use an adjacency matrix,
 - (b) if you use adjacency lists.