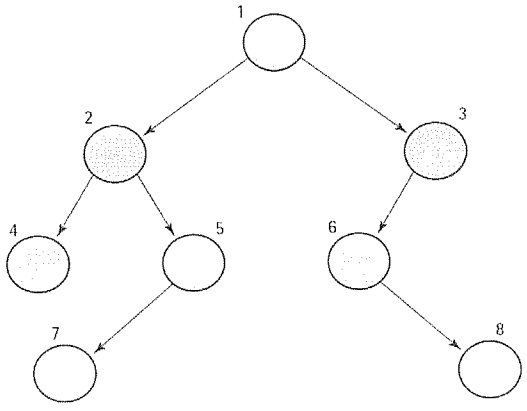
# 國立清華大學資訊系統與應用研究所 2012 春博士班資格考－資料結構

1. Assume you are going to implement an alternative Social Network application, called FaceNet™. In FaceNet™, there are several types of data: (20%)
   - User profile information: such as work, education, contact information, and favorite activities.
   - Photos: including albums, photos (which can be changed their corresponding albums at any time), and photo descriptions.
   - Friends: friends and their associated groups (one friend can be associated with several groups).
   - Status: short text, updated time, and associated groups
   - Messages: correspondent person, text, and updated time

   You also need to implement a search engine, which returns the most similar status/message/photo/friend to a given query. So far, you have the following types of data structures can be your candidates:
   1) Arrays
   2) Stacks
   3) Queues
   4) Linked Lists

2. Please analyze each data structure for FaceNet™ and justify which can be the winner for each data type in FaceNet™ (in other words, you will use it in your implementation). Note: you cannot get full credits without analyzing the corresponding complexity. (14%)

3. The following is a *binary search tree* and the numbers on the nodes are *labels*. They are not key values within the nodes. (12%)




   (a) If an item is to be inserted whose key value is less than the key value in node 1 but greater than the key value in node 5, where would it be inserted?
   (b) If node 1 is to be deleted, the value in which node could be used to replace it?
   (c) 4 2 7 5 1 6 8 3 is a traversal of the tree in which order?
   (d) 1 2 4 5 7 3 6 8 is a traversal of the tree in which order?

4. A *binary tree* is stored in an array called treeNodes, which is indexed from 0 to 99. The tree contains 85 elements. Read the following statements and based on your understanding mark each statement as True or False. (9%)

(a) treeNodes[41] has only one child.

(b) The right child of treeNodes[12] is treeNodes[25].

(c) The tree has seven levels that are full, and one additional level that contains some elements.

5. Please show that a graph of V vertices can have $V^{V-2}$ minimum spanning trees. (12%)

6. Is it possible that you can give an O(n)-time algorithm to sort n integers in the range $(-n^3, n^3)$? Please justify your answer. (15%)

7. Given 2n+1 integers in the range (-m, m), Please design an O(n + m) algorithm to find the median of these numbers. (18%)