國立交通大學 100 學年度碩士班考試入學試題

科目：計算機概論(5131)　　　　　　　　　　考試日期：100 年 2 月 17 日　第 2 節
系所班別：資訊管理研究所　　　　組別：資管所乙組　　　　第 1 頁,共 2 頁
【不可使用計算機】＊作答前請先核對試題、答案卷(試卷)與准考證之所組別與考科是否相符！！

1. (15%) Explain the following terms
(a) Sniffer (b) Community cloud (c) Scale free networks (d) PageRank algorithm (e) Structure holes

2. (7 %) Define the "critical mass" in network service and give an approach to find the "critical mass" point of a network.

3. (12 %)
(a) Compare the three measures for network structure analysis: degree centrality, closeness centrality, and betweenness centrality.
(b) Give the applications of these measures for the online social networks you know (such as facebook and twitter).

4. An undirected friend network G is used to model the friend relationships among users as follows. (i) Each user is represented as a vertex in G; (ii) if user i and user j are friends, then an edge (i, j) connects vertex i and j; (iii) Each edge is associated with a marketing cost for user i (user j) to recommend products to user j (user i). The friend network G is a connected graph.

　A company M would like to advertise M's products to all users in G by viral marketing (e.g. recommending products to friends or friends' friends) according to users' friendships. The marketing cost of advertising M's products to a user directly is greater than any marketing cost by friend recommendation. Meanwhile, a user can get reward by recommending products to his/her friends. A user p's possible reward is the summation of his/her marketing costs for recommending products to his/her friends.
(a) (8 %) Write an algorithm to find the user with maximal possible reward in G.
(b) (10 %) Write an algorithm to generate a marketing plan of least (minimum) marketing cost for company M.

5. A social blog network can be formed based on the interconnections among blog communities. Bloggers can add their favorite blogs as reference links on their blogs' main pages. Assume that the blogs in the blogosphere have been simplified to be organized in a generalized tree structure, which models the reference links among blogs.
(i) The root node represents the root blog. Each internal node represents a blog with at most N reference links to other blogs. Each reference link is associated with a reference cost. All blogs, except the root blog, are referenced by only one blog. A leaf node represents a blog that does not have any reference links to other blogs. A tree structure may be skewed.
(ii) A reference path is an ordered list of blogs in referencing blogs, which traverses from the root blog to one of the leaf blogs according to the reference links. The cost of a reference path is the summation of the reference costs of those reference links contained in the reference path. A maximal-cost reference path is a reference path with maximal cost.

(a) (5%) Suppose that k is the maximum level of any blog in the blogosphere. What's the maximum number of blogs in the blogosphere? You need to show the derivation of your answer.　Note that the level of a blog (node) is defined by initially letting the root be at level one. For all subsequent blogs, the level is the level of the blog's parent plus one.
(b) (10%) Write a recursive algorithm to find the maximal-cost reference path in the blogosphere. Analyze the time complexity of your algorithm, assuming that there are n blogs in the blogosphere.

6. Tower of Hanoi: Move n discs (disc 1 is the smallest on top and disc n is the largest at bottom) from peg A to peg C using auxiliary peg B. (a) (5%) Write a recursive program for producing the moves. (b) (3%) Give a recurrence relation of the number of moves for the n discs. (c) (5%) Solve the recurrence relation.

7. (a) (5%) Ten integers are input in the order 10, 5, 7, 1, 6, 9, 4, 3, 8, 2 for constructing a min-heap. Assume that we use an array $A[0:9]$ to manipulate the construction. Give the contents of the array of the resulting min-heap. (b) (4%) What are the worst-case running time, and the average-case running time, of heap sort for n integers? (c) (4%) What is the lower bound on the running time required for sorting n integers? (d) (4%) Explain whether the following statement is correct or not. *Heap sort is an optimal sorting algorithm.*

8. (3%) When a query is applied to one or more tables of a database system, the outcome can be regarded a table as well. Which of the following properties describes the above statement? Completeness, Soundness, Closure, or Associativity.