

國立交通大學 107 學年度碩士班考試入學招生試題

科目：計算機概論 (5081)

考試日期：107 年 2 月 1 日 第 2 節

系所班別：資訊管理研究所碩士班

組別：資管碩乙組

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【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. Artificial Intelligence is changing the way we think of information technology. Machine learning, data mining, data science, big data analytics, and deep learning techniques have also attracted the interests of scientists from multiple disciplines. In this research field, please briefly explain the following abbreviations:
 - (a) (3%) SVM
 - (b) (3%) CNN
 - (c) (3%) LSTM
 - (d) (3%) GAN
 - (e) (3%) HMM

2. Paging is an important virtual memory management scheme in operating systems. In this scheme, the OS retrieves data from secondary storage in same-size blocks called pages. Page replacement algorithms decide which memory pages to page out, when a requested page is not in memory (page faults) and needs to be allocated. Given a system with four page frames, which are initially empty, receives a sequence of pages that are requested: 12343125412345, please answer the following questions:
 - (a) (5%) Calculate the number of page faults using FIFO page replacement algorithm.
 - (b) (5%) Briefly explain Belady's anomaly in FIFO page replacement algorithm.
 - (c) (5%) Calculate the number of page faults using LRU page replacement algorithm.
 - (d) (5%) Calculate the number of page faults using optimal page replacement algorithm.

3. (15 %) Quicksort is an efficient sorting algorithm. This divide-and-conquer algorithm repeatedly divide a large array into two smaller sub-arrays, and then sort each sub-array in a recursive way. Please implement the recursive function void QSort(int data[], int L, int R) to sort the array elements between and including index L and R with the following major steps:
 - Pick the first element data[L] from the array as a pivot.
 - Partitioning: reorder the array so that all elements with values less than the pivot come before the pivot, while all elements with values greater than the pivot come after it. The partitioning should be executed in $O(n)$ time.
 - Recursively apply the above steps to the sub-array with more than one element.

4. (14%) Below is a subset of relations from COMPANY schema. The keys have been underlined.

EMPLOYEE(EMPNAME, EmpID, ADDRESS, SALARY, SupervisorEmpID, DNUMBER)

DEPARTMENT(DNAME, DNUMBER, ManagerID)

WORKS_ON(EmpID, PrjID, HOURS)

PROJECT(PROJNAME, PrjID, DNUMBER)

In a company, each employee works for a department and may work on several projects. The WORKS_ON table keeps track of the project Ids that employees work on. The DEPARTMENT table also keeps track of the employee id (ManagerID) of the manager of each department.

Express the following Query in SQL statement. You also need to clearly draw the tables and the join relationships between the tables used in your SQL statement.

Query: For each employee who works on projects more than the number of projects that his/her department manager works on, list the name of the employee and the name of his/her department manager.

5. Consider the relation $R = \{A, B, C, D, E, F, G, H, I, J, K, L\}$ and the functional dependencies

$F = \{ \{A, B, C\} \rightarrow \{D, E\}, \{A, B\} \rightarrow \{F, G\}, \{F\} \rightarrow \{H, I\}, \{D\} \rightarrow \{L\}, \{I\} \rightarrow \{J, K\} \}$.

(a) (2%) What is the key for R?

(b) (12 %) Decompose R into 2NF (second Normal Form), then 3NF relations.

6. The Web pages in a Web site have been simplified and organized in a k -ary tree structure, i.e., a tree with no more than k children for each node

(i) The root node represents the home page. Each internal node represents a Web page with at most k reference links to other Web pages. All Web pages, except the home page, are referenced by only one Web page. The leaf node represents a Web page that does not have any reference links to other Web pages. A tree structure may be skewed.

(ii) A reference path is defined as a list of Web pages traversed from the Home page (root node) to a leaf node according to the reference links. The length of a reference path is the number of Web pages contained in the reference path. A maximum reference path is a reference path that contains the maximum number of Web pages.

(a) (6%) Assume that the length of a maximum reference path in a Web site (organized as a k -ary tree structure) is H . What is the maximum number of reference paths that the Web site may have? What is the maximum number of Web pages that the Web site may have?

(b) (16%) Write a recursive algorithm to find the length of the maximum reference path in the Web site (organized as a k -ary tree structure). Assume that the number of nodes of the k -ary tree structure is N . Analyze the time complexity of your algorithm based on N .