

## 計算機概論試題

適用學系：資訊工程學系碩士班

1. Convert the following numbers as indicated, using as few digits in the results as necessary. (10%)
  - (a)  $(18.375)_{10}$  to base 4
  - (b)  $(7D)_{15}$  to base 7
  - (c)  $(-53.625)_{10}$  to signed binary (2's complement)
  - (d)  $(2B)_{16}$  to excess 64 in binary
  - (e)  $(11001)_2$  (2's complement) to base 5
  
2. Answer the following questions. (10%)
  - (a) What is the pipeline technique?
  - (b) What is the forwarding technique?
  - (c) In a pipelined system, how to discard an instruction just been fetched?
  - (d) In a pipelined system, how to discard an instruction just been decoded?
  
3. For a two-way set-associative cache design with 128 KB of data and 4-word block, assuming a 12-bit tag.
  - (a) What is the address size? (3%)
  - (b) Assume that the valid and dirty bits take a total of 2 bits. What is the total size of the cache in Kbits? (3%)
  - (c) If we reorganize this cache to direct mapped with 16-word block. What is the total size of the cache in Kbits? (4%)
  
4. Choose the appropriate word to complete the following sentences. (10%)
  - ① memory                      ② compiler                      ③ system software
  - ④ input/output (I/O) units   ⑤ algorithm                      ⑥ protocol
  - ⑦ computer network        ⑧ operating system
  - (a) \_\_\_\_\_ is a collection of computer programs that manage the resources of a computer and facilitate access to those resources.
  - (b) A \_\_\_\_\_ is a collection of operations, and there must be a clear and

unambiguous ordering to these operations.

- (c) High-level languages must be translated into machine language prior to execution by a special piece of system software called a \_\_\_\_\_.
- (d) A \_\_\_\_\_ is an enormously large and complex piece of software that has many responsibilities within a computer system.
- (e) In networking, a \_\_\_\_\_ is a mutually agreed upon set of rules, conventions, and agreements of the efficient and orderly exchange of information.

5. In a company named Delta, the CIO hired a programmer to write a program that records the resources that an employee can use in the company. Below is a portion of the program. However, there is a security flaw in the program, that is, an employee can find a way to obtain resources that he/she is not authorized to use. You are here to assist the CIO to find out why it is possible to do so and how to fix the problem. The class Employee and ResourceList are written in other files and listed here for convenience, which means that you **cannot** alter the definition of the two classes. You can only demonstrate the flaw by modifying the code in main() function. However this restriction does not apply to the correction you are trying to make to the program. (10%)

```
#include <iostream>

using namespace std;

class Employee {
public:
    ResourceList getResourceList() { return list; }
    // other public members
private:
    ResourceList list;
    // other private members
};

class ResourceList {
public:
    void input();    //used for input various kinds of resources that can be used
    void output();  //output the list of resources
private:
    // private members of class ResourceList
};

int main() {
    Employee john;
    ResourceList list = john.getResourceList();
    r.output();
}
```

6. Below is a fragment code of a class Money:

```
#include <iostream>

using namespace std;

class Money {
public:
    const Money operator +(const Money& value) const;
    // other public members
private:
    // other private members
};
```

Please explain the meaning of the three “const” in the declaration of function operator + in the public section of class Money. (10%)

7. Please explain the concept of polymorphism in object-oriented programming. In C++, the achievement of polymorphism is by adding a keyword to the language. What is the keyword called? In Java, does this keyword exist? Why or Why not? (10%)
8. Select the wrong description(s) and write down your reasons. (a) Job queue maintains related information of the set of all processes residing in main memory (b) CPU scheduler selects which processes should be brought into the ready queue (c) CPU scheduler controls the degree of multiprogramming of the system. (5%)
9. Select the wrong description(s) and write down your reasons. (a) Response time is the amount of time to execute a particular process (b) Waiting time is the amount of time a process has been waiting in the ready queue (c) One of the problems of SJF scheduling is the convoy effect (d) One of the problems of SJF scheduling is the difficulty of knowing the length of the next CPU request (e) One of the problems of priority scheduling is the possibility of starvation. (5%)
10. Select the layer(s) which is/are not included in the typical Internet protocol stack and write down its/their main functionalities. (a) Application layer (b) Presentation layer (c) Session layer (d) Transport layer (e) Network layer (f) Link layer (g) Physical layer. (5%)
11. Write down the relationship between IPv6 and NAT. (5%)

12. Select the characteristics of TCP and write down your reasons. (a) Connectionless (b) Supporting flow control (c) Supporting congestion control (d) Supporting reliable transport (e) Guaranteeing minimum throughput. (10%)

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資料結構試題

適用學系：資訊工程學系碩士班

1. Please explain the following terms: (10%)
  - (a) Stack
  - (b) Min Heap
  - (c) Singly linked list
  - (d) Chain
  - (e) Circular list
  
2. Fill in Table 1 (using answer sheet) of asymptotic complexities (Big-O Analysis) for each of the given data structures and operations. (10%)

Table 1

	Sorted Array List	Sorted doubly-linked List
finding the smallest element		
finding the largest element		
searching for a given element		
deleting a given element		
finding the median		

3. Consider the AVL Tree in Fig. 1.

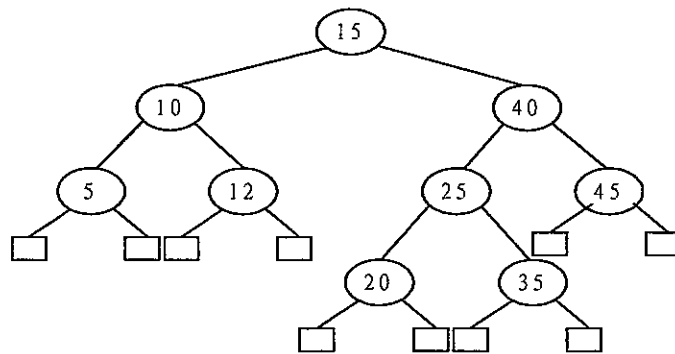


Fig. 1

- (a) Insert the key 25 into the tree (Fig. 1) and re-balance if needed. Draw the final tree and all intermediate trees in your answer. (5%)
- (b) Remove the value 40 from the original tree (Fig. 1) and re-balance if needed. Draw the final tree and all intermediate trees in your answer. (5%)

4. Give the Big-O characterization for each of the following three algorithms; give its time complexity (in Big-Oh notation).

(a) **Algorithm AlgoONE(A) (3%)**

Input: An array  $A$  storing  $n \geq 1$  integers

Output: The sum of the elements in  $A$

```

s ← A[0]
for i ← 1 to n-1 do
    s ← s + A[i]
return s

```

(b) **Algorithm AlgoTWO(A) (3%)**

Input: An array  $A$  storing  $n \geq 1$  integers

Output: The sum of the prefix sums in  $A$

```

s ← 0
for i ← 1 to n-1 do
    s ← s + A[0]
    for j ← 1 to i do
        s ← s + A[j]
return s

```

(c) **Algorithm AlgoTHREE(A) (4%)**

Input: Arrays  $A$  and  $B$ , each of them storing  $n \geq 1$  integers

Output: The number of elements in  $B$  equal to the sum of the prefix sums in  $A$

```

c ← 0
for i ← 1 to n-1 do
    s ← 0
    for j ← 1 to n-1 do
        s ← s + A[0]
        for k ← 1 to j do
            s ← s + A[k]
        if B[i] = s then
            c ← c + 1
return c

```

5. The nodes in a doubly-linked list are represented by the following data structure.

```

struct node {
    struct node *llink;
    char item;
    struct node *rlink; };

```

Please write a piece of code to **swaps** X and Y in a doubly linked list in the Fig. 2. Please draw the state of the linked list after each step execution of your code statement. (10%)

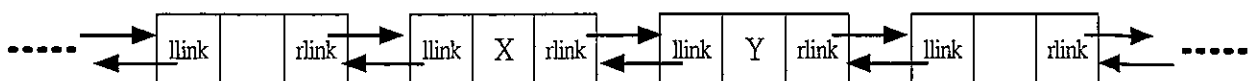


Fig. 2

6. (a) What is called a bipartite graph?  
 (b) Is a binary tree a bipartite graph? Why or why not?  
 (c) Give an example of a bipartite graph with 4 edges.  
 (d) Give an example that is not a bipartite graph with 4 edges. (10%)
  
7. Give a proper representation of a directed graph  $G_1$  as shown in Fig. 3 using (a) adjacency matrix (b) adjacency list. (10%)

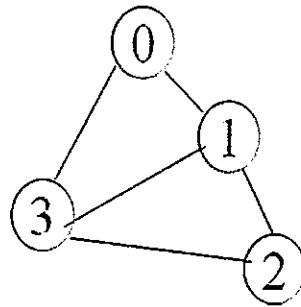


Fig. 3

8. Use Prim's algorithm to generate a minimum spanning tree (MST) of the following graph  $G_2$  as shown in Fig. 4. List the order that edges are added to the MST. (10%)

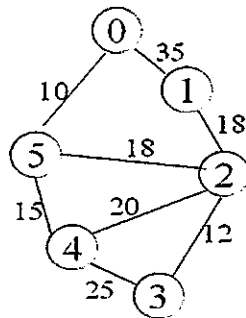


Fig. 4

9. Suppose we are to sort a list of 10 records with keys (23, 3, 40, 1, 86, 11, 55, 16, 44, 20) using *quick sort*. Show the detailed status of the list STEP by STEP for each call of quick sort. (10%)
  
10. Suppose we are to sort a list of 10 records with keys (23, 3, 40, 1, 86, 11, 55, 16, 44, 20) using *heap sort*. Show the detailed status of the heap STEP by STEP for each call of *heap sort*. (10%)

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