

國立臺中教育大學 103 學年度碩士班招生考試

計算機概論試題

適用學系：資訊工程學系碩士班

※共 10 題，每題 10%

1. (a) What is the even parity bit of the data 1001001? (5%)
(b) Can the parity-bit mechanism detect a two-bit error? Why? (5%)
2. (a) What is the 1's complement of 1110110? (3%)
(b) What is the 2's complement of 1101001? (3%)
(c) What's the advantage of 2' complement over 1's complement? (4%)
3. (a) What is the binary equivalent of the decimal number 23.625? (5%)
(b) What is the decimal equivalent of the binary number 1101101? (5%)
4. About network protocols, please determine the following descriptions are TRUE or FALSE. If your answer is FALSE, please also describe your reasons.
 - (a) *Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA)* is a media access control method. When a node detects other signals while transmitting a frame, it will terminate transmission and wait for a random time interval before trying to resend the frame. (2.5%)
 - (b) *User Datagram Protocol (UDP)* provides reliable, ordered, error-checked delivery of a stream of octets between programs running on computers connected to a network. (2.5%)
 - (c) There are seven logical layers in the *Open Systems Interconnection (OSI)* model. *Network layer* (3rd layer) controls the reliability of a given link through flow control, segmentation/desegmentation, and error control. (2.5%)
 - (d) *Address Resolution Protocol (ARP)* is used by network devices to send error messages or relay query messages. ARP messages are typically used for diagnostic or control purposes. (2.5%)

5. For a pipelined datapath, please answer the following questions.
- (a) Why using the pipelining technique can enhance the performance? (2.5%)
 - (b) There are three kinds of pipeline hazards that will affect the performance of the pipelined datapath. Please describe the reasons that will cause those pipeline hazards. (2.5%)
 - (c) Which hazard can be resolved using the forwarding technique? (2.5%)
 - (d) How to discard an instruction just been fetched? (2.5%)
6. For a two-way set associative cache design with 32-bit address, 8-word blocks, and 16 blocks.
- (a) How many bits are used for the index? How many bits are used for the tag? (4%)
 - (b) How many total bits are required for this cache? (3%)
 - (c) Starting from power on, the following word-addressed cache references are recorded. How many blocks are replaced using LRU replacement scheme? (3%)
15 199 270 300 653 70 321 172
7. Choose the appropriate word to complete the following sentences.
- ① computer network ② network protocol ③ database ④ cloud computing
 ⑤ algorithm ⑥ input/output ⑦ compiler ⑧ memory
 ⑨ operating system ⑩ embedded system
- (a) An _____ is any device that includes a programmable computer. It usually designed to execute dedicated function with real-time computing constraints. (1%)
 - (b) _____ is a technology consisting of computer components and recording media used to store and retrieve the instructions and data being executed. (1%)
 - (c) A _____ is a computer program that transforms high-level languages into machine language to create an executable program. (1%)
 - (d) A _____ is a system of mutually agreed upon set of rules, conventions, and agreements for data exchange within or between computers. (1%)
 - (e) An _____ is a collection of software that manages computer hardware resources and provides common services for computer programs. (1%)
 - (f) An _____ is a set of rules that precisely defines a sequence of operations. It would include all computer programs, including programs that do not perform numeric calculations. (1%)

- (g) _____ is the communication between an information processing system (such as a computer) and the outside world, possibly a human or another information processing system. (1%)
- (h) A _____ is a set of independent computer systems connected by telecommunication links for the purpose of sharing information and resources. (1%)
- (i) A _____ is an organized collection of data. The data are typically organized to model relevant aspects of reality in a way that supports processes requiring this information. (1%)
- (j) _____ over a network means the ability to run a program or application on many connected computers at the same time. (1%)

8. (a) Could you briefly explain the differences between call by reference and call by value? (5%)
- (b) John has developed a swap function in Java language (see below on the left hand side) to swap the content store in the Box class (see below on the right hand side). However, somebody accidentally deleted some portion of his swap code. Could you help John to recover his swap code? (5%)

```

swap(Box<?> i, Box j) {
    tmp;
    tmp = i;
    i = j;
}

```

```

class Box<T extends Comparable> {
    public T item;
    public Box(T typeltem) {
        item = typeltem;
    }

    T getItem() { return item; }

    boolean smaller(Box<?> compare) {
        return (item.compareTo(compare.getItem())<0);
    }
}

```

9. Please briefly explain the following terms.
- (a) Polymorphism (2%)
- (b) Virtual functions in C++ (2%)
- (c) Encapsulation (2%)
- (d) Inheritance (2%)
- (e) Function Overloading (2%)

10. Please write down the result labeled (1) to (5) after executing the following program. (10%)

```
#include<string>
#include<iostream>

using namespace std;
class Act {
protected:
    string nameString;
public:
    Act(string name):nameString(name) {}
    virtual string getName() { return nameString; }
    string act() { return " is acting"; }
};
class Knock: public Act{
public:
    Knock(string name):Act(name) {}
    string act() { return " is knocking"; }
};
class Kick: public Act {
public:
    Kick(string name):Act(name) {}
    string getName() { return "[" + nameString + "]"; }
    string act() { return " is kicking"; }
};

ostream& operator <<(ostream& os, Act& nameObj) {
    os << "<" + nameObj.getName() + ">" << nameObj.act();
    return os;
}

int main() {
    Knock knockObject("Bill");
    Kick kickObject("Steve");
    Act* actPtr = &kickObject;
    Kick* kickPtr = new Kick("Andrew");
    cout << knockObject.getName() << knockObject.act() << endl;      (1)
    cout << actPtr->getName() << actPtr->act() << endl;                (2)
    cout << kickPtr->getName() << kickPtr->act() << endl;                (3)
    cout << knockObject << endl;                                        (4)
    cout << *kickPtr << endl;                                          (5)
}
```

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資料結構試題

適用學系：資訊工程學系碩士班

一、選擇題 (10%，每題 2%)

Please select the correct answer for each question.

1. What is the time complexity (in big-O notation) of insertion into a binary heap with N elements?
(a) $O(N \log N)$ (b) $O(\log N)$ (c) $O(1)$ (d) $O(\log^2 N)$ (e) $O(N)$
2. What is the time complexity (in big-O notation) of insertion into a unsorted Linked List with N elements?
(a) $O(N \log N)$ (b) $O(\log N)$ (c) $O(1)$ (d) $O(\log^2 N)$ (e) $O(N)$
3. What is the time complexity (in big-O notation) of insertion into a sorted Linked List with N elements?
(a) $O(N \log N)$ (b) $O(\log N)$ (c) $O(1)$ (d) $O(\log^2 N)$ (e) $O(N)$
4. What is the worst-case time complexity (in big-O notation) of insertion into a Binary Search Tree with N elements?
(a) $O(N \log N)$ (b) $O(\log N)$ (c) $O(1)$ (d) $O(\log^2 N)$ (e) $O(N)$
5. What is the time complexity (in big-O notation) of finding the largest element in a Binomial Heap with N elements?
(a) $O(N \log N)$ (b) $O(\log N)$ (c) $O(1)$ (d) $O(\log^2 N)$ (e) $O(N)$

二、問答題 (90%，每題 10%)

1. Please explain the following terms:

- (1) Complete Binary Trees
- (2) Skewed Binary Trees
- (3) Doubly Linked Lists
- (4) Queue
- (5) Max Heap

(2% for each question)

2. Consider the Tree in Fig. 1. Find

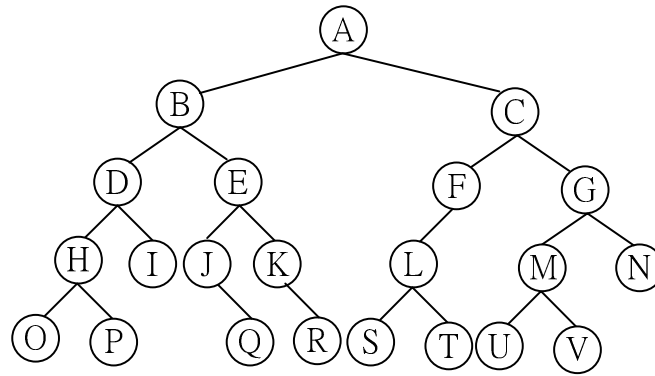


Fig. 1

- (1) The degree of the tree
 - (2) The preorder of the tree
 - (3) The inorder of the tree
 - (4) The postorder of the tree
 - (5) The levelorder of the tree
- (2% for each question)

3. Please answer following questions:

(1) Translate the following infix expression into postfix.

$$\frac{(A - \frac{B}{C} + D)^{\frac{1}{2}}}{A + B}$$

(2) Given $A=4$, $B=14$ and $C=2$, evaluate the following prefix expression.

$$* / - + A B C * A C B$$

(3) Evaluate the following prefix expression, when $A=10$, $B=2$, $C=12$ and $D=2$.

$$+ / \hat{\wedge} - A B 2 \hat{\wedge} / - C D / A B 3 / + A C B$$

(4) Please convert equation from Infix to Postfix.

$$(a + b) / c \% d - e * a - c$$

(5) Please convert equation from Infix to Prefix.

$$a - b * (d + e) / (f + a * d)$$

(2% for each question)

4. Write a C function `returnNthValue(struct node* head, int index)` that takes head pointer of the linked list and an integer index and returns the data value stored in the node at that index position. The function use the following declarations:

```
/* Link list node */
struct node {
    int value;
    struct node* next;
};
```

5. Consider the multiplication of the following four matrices:

A x B x C x D
20 x 3 3 x 28 28 x 12 12 x 8

Please determine the minimum number of elementary multiplications needed to multiply these four matrices.

6. Suppose that there is a list of numbers: 11, 23, 8, 12, 20, 6, 9, 16.
- (1) Show the content of the array that stores the above list of numbers to form a max-heap tree. (2%)
- (2) Show the intermediate steps (whenever any data moves) after inserting 3 and 10 in order in the max-heap tree obtained in the step (1). (4%)
- (3) Show the intermediate steps (whenever any data moves) after removing the max value in the max-heap tree obtained in the step (2). (4%)
7. Please write out a recursive program to calculate the length of the longest path from the root node to leaf nodes in a binary tree.
8. Assume that there is an integer number series: 2, 4, 6, 8, 10, 13, 14, 15, 17, 21, 23, 26, 28, 30, 33, 34, 36, 38, and 40. Please search 13 and 36 in this number series by Interpolation Search algorithm, and describe the searching procedure step by step.
9. Use Huffman's algorithm to construct the optimal binary prefix code for the following letters step by step, where the probability occurrence of each letter is given in parentheses: A(0.1), B(0.25), C(0.05), D(0.12), E(0.01), F(0.17), G(0.16), H(0.14).