

# 國立臺北科技大學 100 學年度碩士班招生考試

系所組別：2300 資訊工程系碩士班

## 第三節 軟體設計 試題

第一頁 共五頁

### 注意事項：

1. 本試題共五題，配分共 100 分。
2. 請標明大題、子題編號作答，不必抄題。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

#### Problem 1 [21%, each 3%]

Given the program below in C. Please trace the program and fill the 1-1~1-7 blanks with the printf output of each statement.

```
#include <stdio.h>
void test01(int a, int b, int c) {
    int average;
    average = (a + b + c)/3.0;
    printf("%d\n", average);          /* Problem 1-1 */
}
void test02(int a, int b){
    printf("%d\n", (a|b)/(a&b));      /* Problem 1-2 */
}
void test03(int a[], int size){
    int x;
    if (a[0]==0 && a[1]!=0 || a[2]<=0)    x=a[0];
    else if (a[0]==0 || a[1]!=0 && a[2]>=0) x=a[1];
    else          x=a[2];
    printf("%d\n", x);                /* Problem 1-3 */
}
void test04(int a[]) {
    enum WEEK {MON=1, TUE, WED, THR, FRI, SAT, SUN};
    enum WEEK week;
    int sum=0;
    for(week=MON; week <=WED; week++)
        sum+=a[week];
    printf("%d\n", sum);              /* Problem 1-4 */
}
void test05(int a[], int size) {
    int i, j, temp;
    for(i=0; i<size-1; i++)
        for(j=i+1; j<size; j++)
            if (a[i] < a[j]){
```

```
                temp = a[i]; a[i] = a[j]; a[j] = temp;
            }
    printf("%d\n", a[size-1]);        /* Problem 1-5 */
}
void test06(char s[]) {
    int i=0, aCount=0, bCount=0, xCount=0;
    do{
        switch (s[i++]) {
            case 'a': ++aCount;
                       break;
            case 'b': ++bCount;
                       break;
            default: ++xCount;
                     break;
        }
    }while(s[i]!='\0');
    printf("%d\n", xCount);          /* Problem 1-6 */
}
void test07(int a, int *b) {
    a+=1;
    *b+=1;
}
int main() {
    int a=1, b=2, c=5, array[]={1, 2, 3, 2, 4};
    char s[]="happy birthday";
    test01(a, b, c);
    test02(12, 8);
    test03(array, 3);
    test04(array);
    test05(array, 5);
    test06(s);
    test07(a, &b);
    printf("%d\n", a+b);            /* Problem 1-7 */
    return 0;
}
```

Problem	Answer
1-1	
1-2	
1-3	
1-4	
1-5	
1-6	
1-7	

Please copy the above answer table to your answer sheet.

注意：背面尚有試題

**Problem 2 [18%, each 3%]**

Consider the following C program that reads student's grade from a file. The file consists of a number of student records and each record has two data fields: *name* and *score*. An example of the file is given as follows.

```
Alex      86
Eric      78
...       ...
Bob       92
```

The program will calculate the average score of the students. In addition, the program can search the records and find the student who has the highest score. Please trace this C program and fill the blanks with correct statements.

```
#include <stdio.h>
#include <string.h>
#define LENGTH 20
#define NUM_STUDENT 10

typedef struct student {
    char name[LENGTH];
    int score;
} studentRecord;

double calculateAVG(studentRecord gradeReport[], int numStudent);
int findMax(studentRecord gradeReport[], int numStudent);

int main() {
    FILE *ifp;
    studentRecord gradeReport[NUM_STUDENT];
    int numStudent=0;
    int i, index_max;
    double avg;

    /* open the score.txt file and check if the file exists */
    ifp=fopen("score.txt", "r");
    if(_____) {
        printf("Score file open error!\n");
        exit(1);
    }

    /* fscanf the student records and count the number of records */
    while( fscanf(ifp, "%s %d", _____, &gradeReport[numStudent].score) != EOF )
        _____;

    /* calculate average score and find the student with the highest score */
    avg=calculateAVG(gradeReport, numStudent);
    index_max = findMax(gradeReport, numStudent);
}
```

```
/* print out the results */
printf("name      score\n");
printf("-----\n");
for(i=0; i<numStudent; i++) {
    printf("%-10s", gradeReport[i].name);
    printf("%3d\n", gradeReport[i].score);
}

printf("Highest score: %3d\n", gradeReport[index_max].score);
printf("Class average = %3.2f\n", avg);
fclose(ifp);
system("PAUSE");
return 0;
}

/* calculate the average score of all students */
double calculateAVG(studentRecord gradeReport[], int numStudent){
    int i, sum=0;
    for(i=0; i<numStudent; i++)
        sum += gradeReport[i].score;
    return _____;
}

/* find the record index of the student with the highest score */
int findMax(studentRecord gradeReport[], int numStudent){
    int i, max_score;
    int index_max=0;
    _____ = gradeReport[0].score;

    /* runs a test to see where the highest score is located at */
    for (i=1; i < numStudent; i++){
        if (_____) {
            max_score = gradeReport[i].score;
            index_max = i;
        }
    }
    return index_max;
}
```

Problem	Answer
2-1	
2-2	
2-3	
2-4	
2-5	
2-6	

Please copy the above answer table to your answer sheet.

**Problem 3 [18%, each 3%]**

Please trace the following C++ program and provide the results of the cout statements.

```
#include <iostream>
#include <vector>
using namespace std;
class Component {
public:
    virtual int area()=0;
};
class Shape : public Component {
public:
    virtual int area() = 0;
};
class Picture : public Component {
private:
    vector <Component*> coms;
public:
    void add(Component* c);
    int area();
};
void Picture::add(Component* c) {
    coms.push_back(c);
}
int Picture::area() {
    int total=0;
    for (int i=0; i<coms.size(); i++) {
        total += coms[i]->area();
    }
    return total;
}
class Rectangle : public Shape {
private:
    int length;
    int width;
public:
    Rectangle(int l, int w) {
        length = l;
        width = w;
    }
    int area() { return length*width; }
};
class Triangle : public Shape {
private:
    int base;
    int height;
public:
    Triangle(int b, int h){
        base = b;
        height = h;
    }
    int area() { return (base*height/2); }
};
int main() {
    int shapeCode[]={2, 1, 2};
    int data[][2] = {{2, 3}, {2, 4}, {2, 5}};
```

```
Shape *shape[3];
Picture *p[3];
for (int i=0; i<3; i++) p[i]= new Picture();
for (int i=0; i<3; i++) {
    if (shapeCode[i]==1)
        shape[i] = new Rectangle(data[i][0], data[i][1]);
    else
        shape[i] = new Triangle(data[i][0], data[i][1]);
    p[i]->add(shape[i]);
}
cout << shape[0]->area() <<endl;    /* problem 3-1 */
cout << shape[1]->area() <<endl;    /* problem 3-2 */
cout << shape[2]->area() <<endl;    /* problem 3-3 */
p[0]->add(p[1]);
p[1]->add(p[2]);
cout << p[0]->area() <<endl;        /* problem 3-4 */
cout << p[1]->area() <<endl;        /* problem 3-5 */
cout << p[2]->area() <<endl;        /* problem 3-6 */
return 0;
```

Problem	Answer
3-1	
3-2	
3-3	
3-4	
3-5	
3-6	

Please copy the above answer table to your answer sheet.

**Problem 4 [21%, each 3%]**

A positive rational number is any number that can be expressed as  $\frac{e}{d}$ , where  $e$  is a nonnegative integer (0,1,2,3, ...) and  $d$  is a positive integer (1, 2, 3, ...). If  $e \geq d$ , it can be expressed as  $a\frac{c}{b}$ . For example,  $\frac{8}{3} = 2\frac{2}{3}$ .

In the above examples,  $a$  is called whole number,  $c$  and  $e$  are called numerator, and  $b$  and  $d$  are called denominator. In addition,  $b \geq c$  and  $a \times b + c = e$ .

We would like to implement a Rational class which encapsulates rational numbers with the following functions:

- (1) void Reduction(); //Simplify an "improper fraction" into a "mixed number". e.g.  $\frac{8}{3} \Rightarrow 2\frac{2}{3}$
- (2) int Gcd(int num1, int num2); // Calculate the "Greatest Common Divisor" of num1 and num2. e.g. Gcd(4, 6) = 2.

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(3) Rational operator +(Rational& f); // Add two rational numbers, e.g.  $2\frac{1}{3} + 1\frac{1}{2} = 3\frac{5}{6}$

(4) Rational operator +(const int number); // Add a rational number with an integer, e.g.

$$\frac{1}{2} + 2 = 2\frac{1}{2}$$

Please trace the following C++ program, and fill the blanks with the correct statements.

```
#include <iostream>
#include <iostream>
using namespace std;
class Rational {
private:
    int wholeNumber;
    int numerator;
    int denominator;
public:
    Rational() { SetValue(0, 0, 1); }
    Rational(int iWholeNumber, int iNumerator, int iDenominator) {
        SetValue(iWholeNumber, iNumerator, iDenominator);
    }
    void SetValue(int iWholeNumber, int iNumerator, int iDenominator) {
        if (iDenominator <= 0) return;
        wholeNumber = _____; /* problem 4-1 */
        numerator = iNumerator;
        denominator = iDenominator;
        Reduction();
    }
    void Reduction() {
        int gcdValue, wn;
        if (denominator == 0) return;
        wn = numerator / denominator;
        wholeNumber += wn;
        numerator %= denominator;
        gcdValue = Gcd(numerator, denominator);
        if (_____) { /* problem 4-2 */
            numerator /= gcdValue;
            denominator /= gcdValue;
        }
    }
    int Gcd(int num1, int num2) {
        int a, b, c;
        a = num1;
        b = num2;
        c = a % b;
        while (_____) { /* problem 4-3 */
            a = b;
            b = c;
            c = a % b;
        }
        return _____; /* problem 4-4 */
    }
    int Lcm(int num1, int num2) {
        int gcdValue = Gcd(num1, num2);
        return (num1 * num2 / gcdValue);
    }
};
```

```
void PrintOut() {
    if (denominator == 0) {
        cout << "NaN" << endl;
    }
    else if ((wholeNumber == 0) && (numerator == 0))
        cout << "0" << endl;
    else {
        if (wholeNumber != 0) cout << wholeNumber << "+";
        if (numerator != 0)
            cout << numerator << "/" << denominator << endl;
    }
}

Rational& operator =(int number) {
    wholeNumber = number;
    numerator = 0;
    denominator = 1;
    return _____; /* problem 4-5 */
}

Rational operator +(Rational& f) {
    int wn, num, den;
    wn = wholeNumber + f.wholeNumber;
    den = Lcm(denominator, _____); /* problem 4-6 */
    num = numerator * (den / denominator) + f.numerator * (den / f.denominator);
    return Rational(wn, num, den);
}

Rational operator +(const int number) {
    int wn = _____; /* problem 4-7 */
    return Rational(wn, numerator, denominator);
}

};

int main() {
    Rational r1, r2, r3, ratout;
    r1.SetValue(2, 3, 4);
    r2.SetValue(1, 2, 3);
    r1.PrintOut();
    r3 = 3;
    ratout = r1 + r3 + 1;
    ratout = ratout + r2;
    ratout.PrintOut();
    return 0;
}
```

The output is:

2+3/4

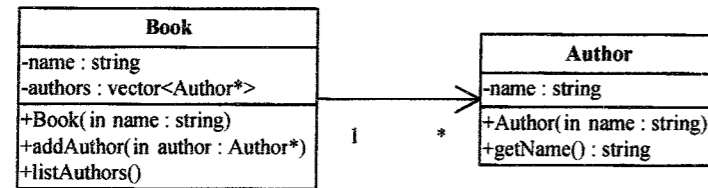
8+5/12

Problem	Answer
4-1	
4-2	
4-3	
4-4	
4-5	
4-6	
4-7	

Please copy the above answer table to your answer sheet.

**Problem 5 [22%]**

A bookstore application with two classes Book and Author is designed based on the following class diagram.



(a) Please finish the declaration (.h only) of the following Book class in C++. [7%]

```

class Book {
public:
    ...
};
    
```

(b) The listAuthors() function prints all authors of the book to the console. Please give a C++ implementation of the listAuthors() function (.cpp only). The output format should be as follows. [7%]

```

Authors of BookName are:
    AuthorName1
    AuthorName2
    AuthorName3
    ...
    
```

(c) By using Book and Author classes, we would like to create a book “C++ PRIMER” that is authored by “Stanley B. Lippman,” “Josee Lajoei,” and “Barbara E. Moo.” Please give the C++ client code that can create the instances of such a book, such authors, and the associations between the book and the authors. [8%]