School of Computer Science at Wuhan University
Spring 2020 (2019 Grade)
《Advanced Language Programming》 Paper (A)

(Open Book)

Name: _____ **Student ID:** _____ **Class:** _____

Question	I	II	III	IV	V	Total
Max points	16	10	24	30	20	100

I. Short-Answer Questions (4×4 = 16 points)

1. (4 points) Suppose that the following class definition is provided:

```
class Data{
  public: int num;
          static int data;
};
```

Please briefly explain what is the difference between the members `num` and `data` for the class `Data`? Please write a statement that defines and initializes member `data` to 0, and give the right place of this statement.

2. (4 points) Suppose that the following definitions are provided:

```
unsigned int x1=0X67FE, x2=0x4E79, x3=1;
```

Please give the result of the expression (`x1 & x2 + x3`) , expressed in hexadecimal.

3. (4 points) Suppose that the following definitions are provided:

```
char s[50]="The C++ Programming Language!";
short *p1=(short*)(s+4),*p2=(short *)(s+20);
```

Please give the result of `p2-p1`, and explain why.

4. (4 points) What is class encapsulation? How to achieve class encapsulation in C ++?

II. Mistake Correction (10 points)

5. (6 points) The task of the following program is to multiply from 1 to 50. Although it passed the grammar check, the test engineer believes that there are 2 errors and 1 potential stability problem in the program. Please find them and correct them:

```
1.  long int s = 0;
2.  for (int i = 1; i!=51; i++)
3.     s *= i;
```

6. (4 points) The following program fragment checks whether the formal parameter num is a prime number (0 is not a prime number). Please point out where the function can be optimized, and write the optimized statements.

```
1.  int prime(int num)
2.  {  int val = 0;
3.     for  (int n=2;  n <=(num/2);  n++)
4.        if  (!(num % n))  val++;
5.        return (val);
6.  }
```

III. Program Analysis (2×12= 24 points)

7. (12 points) Please read the following program carefully to complete the following tasks:

1) Explain the function of the program, and give the order of the function calls.

2) The initial state of the array `arr` in memory is:

3	7	1	6	9	4	8	5

Following this form, please draw the memory change process of `arr` when the `dataprocess()` function is executed, and write the final output of the program.

3) Please rewrite function `dataprocess()` in a non-recursive way.

```
1.  void sort(int a[], int n)
2.  {
3.     int tmp;
4.     for (int i = 0; i < n; i++)
5.     {
6.        if (a[i] < a[n - 1])
7.        {
8.           tmp = a[i];
```

```
            a[i] = a[n - 1];
            a[n - 1] = tmp;
        }

    }
    if (n > 2)
    {
        sort(a, n - 1);
        n--;
    }
}

int main()
{
    int arr[8] = {3,7,1,6,9,4,8,5};
    int n = 8;
    sort(arr, n);
    for (int i =0; i < n; i++)
    {
        cout << arr[i] << " ";
    }
    return 0;
}
```

8. (12 points) Please read the following program carefully to complete the following tasks:

   1) Please briefly describe the relationship between the classes defined in this program, and explain the execution process of the program.

   2) Please give the output of the program.

```
class A {
public:
    A(int i):va(i) {
        cout << "Constructing A " << i << endl;
        count++;
        cout << "Object A count = " << count << endl;
    }
private:
    int va;
    static int count;

};
int A::count = 0;

class B:public A {
```

```
16.   public:
17.      B(int i,int j):A(i),vb(j){
18.         cout << "Constructing B " << i<<" " << j<< endl;
19.      }
20.   private:
21.      int vb;
22.
23.   };
24.
25.   class C {
26.   public:
27.      C(int i):vc(i) {
28.         cout << "Constructing C " << i<< endl;
29.      }
30.   private:
31.      int vc;
32.   };
33.
34.   class D: public C, public B {
35.   public:
36.   D(int a,int b,int c,int d,int e,int f): B(a,b), objb(d,e), objc(f), C(c){ }
37.   private:
38.      C objc;
39.      B objb;
40.   };
41.
42.   int main() {
43.      D obj(1, 2, 3, 4, 5, 6);
44.      return 0;
45.   }
```

IV. Code Implementation (2×15= 30 points)

9. (15 points) Please write the code of function `priceStatistics()`, which is to calculate the highest, lowest and average prices for a given set of commodity prices.

   For example, for the following definition:

   `float price[10]={7.7,10,6.7,5.4,9.2,3.4,6.5,9.9,8.7,9};` //commodity price array

   `float max, min, avg;` //statistical variable, max corresponds to the highest price, min is the lowest price, avg is the average price

the variables `max, min`, and `avg` take the values 10, 3.4, and 7.65, respectively, after the execution of `priceStatistics (price,10,max,min,avg)`.

Note:

(1) Please complete the required main function or auxiliary function by yourself;

(2) Call `priceStatistics (price,10,max,min,avg)` in the main function;

(3) The data type of highest, lowest and average price is float.

10. (15 points) Please completely define and implement a `Clock` class using 24-hour clock. The Clock class is required to support the following operations:

```
Clock c1; //C1's hour is 0, minute is 0, second is 0
Clock c2(13,40,40); // c2's hour is 13, minute is 40, second is 40
c1+c2; //Calculate the sum of two Clock objects c1 and c2 and return a Clock object
c1<c2; //Determine the size of two Clock objects c1 and c2 and return the bool value
       // For example, the return value of 8:20:21 <13:40:40 is true
++c2; //c2 plus 1 second
```

```
class Clock{
private:
 int hour, minute, second;
public:
//Please complete the definition of Clock
};
```

V. Problem Analysis and Program Design (20 points)

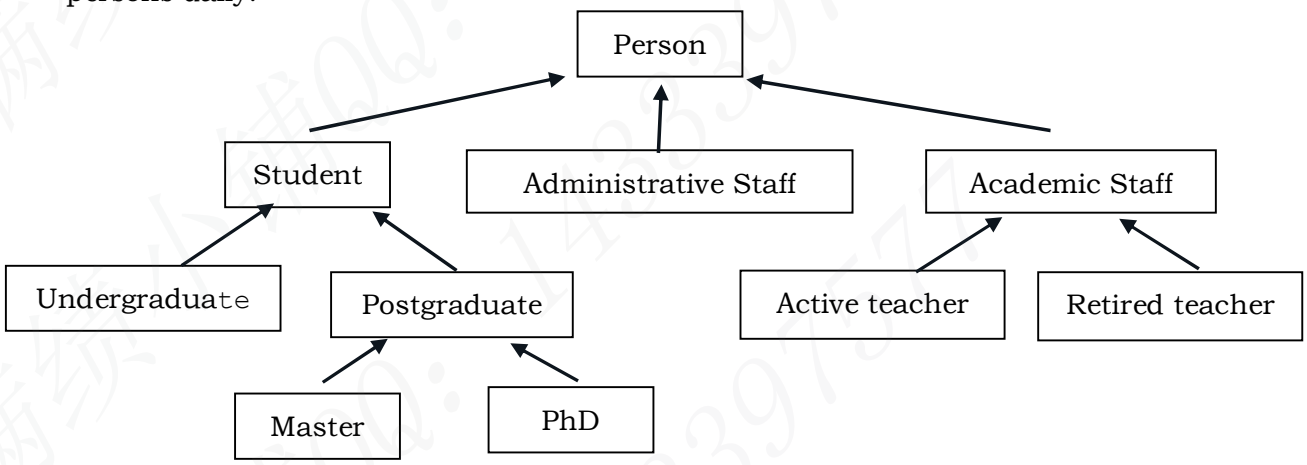
Note:

A. This question mainly focusses on the analysis and design, and you don’t need to write the complete functions that include all the details. The completeness of the function will not be used as the basis for scoring.

B. For the definition of the function, the following comments are required: explanation of the main task of this function, the meaning and type of formal parameters, the type of return value type, etc.

C. Please comment the definition of important data types in the design.

11. (20 points) 10. Analyze and design the health information management module. The following figure is a classification of persons in a university. It is now necessary to record the information of various types of person, collect and analyze the health status of these persons daily.



This module should have the following functions:

1) Record the basic information of various types of person, including: number, name, gender, mobile phone number, types of IDs (work ID, student ID, retirement ID), ID number, etc.;

2) Record the residence information, including: current country/region, current province, current city, current community, detailed address, etc.;

3) Record daily health information, such as: recording time, body temperature, health status (health, fever, suspicion, diagnosis, cure, other), etc.;

4) Get the statistical information, including: daily and weekly statistics on the number of people in various health states; daily and weekly statistics on the number of people in various health states for each type of person; and weekly statistics on the number of people whose residence changes.

Please complete the following three tasks:

1) Design the classes required by this management module. UML class diagrams can be used to explain the relationship between the designed classes, and please briefly explain

the reasons, advantages and disadvantages of the classes you designed.

2) Please use the standard C++ class definition syntax to write the definition statements of the above designed class. Write the declarations of the data members, function members, constructors and destructors of the class, and the access rights of the members according to the required situation. All function implementation (function body) statements do not need to be provided.

3) Design the functions required to complete the above-mentioned information recording, statistical analysis and other functions. Will you define these functions as member functions of a class or non-member functions? Please briefly explain the reasons for your design. For these functions, please write the declaration of the function, and you do not need to give the implementation (function body). However, please provide the comments on the task of the function, the meaning and type of formal parameters, and the type of return value.