Programming Design, Spring 2014
Midterm Exam

Instructor: Ling-Chieh Kung
Department of Information Management
National Taiwan University

Name: _____   Student ID: _____

Note. You do not need to return these problem sheets. Write down all your answers on the answer sheets provided to you.

0. (0 point) Write down the name of your tutor and the number of points (from 0 to 5) that you want to give to her/him.

1. (20 points; 2 points each) For the following statements, Write down "T" if one is true or "F" if it is false. DO NOT provide any explanation.

   (a) In C++, codes are always case-sensitive.

   (b) The executable file produced by compiling a C++ source file cannot be executed if it and the source file are not placed in the same folder.

   (c) In a `for` loop in C++, if we declare an object, it cannot be accessed outside the `for` loop.

   (d) A global variable cannot be a static variable.

   (e) A global variable cannot be an instance variable.

   (f) When we overload an operator for a class in C++, if we overload it as a member function of that class, this can always be replaced by overloading it as a global function.

   (g) When we overload an operator for a class in C++, if we overload it as a global function, this can always be replaced by overloading it as a member function of that class.

   (h) Pointers pointing to different types may be allocated different number of bytes in memory.

   (i) The value stored in a pointer pointing to another pointer can be modified without causing memory leak.

   (j) If a class has a destructor implemented by a programmer, it cannot have any static variable.

2. (20 points; 5 points each) Briefly answer the following questions. Your answers need to be precise but need not to be long.

   (a) For a `while` or `for` loop, there is no semicolon at the end. However, there is a semicolon required at the end of a `do-while` loop. Why?

   (b) When a pointer `p` points to an object *o* of the structure

   ```
   structure
   {
     int a;
     int b;
     int c;
   };
   ```

   What are the relationships among `p`, `&p`, `*p`, `o`, `o.a`, `o.b`, `o.c`, `&o`, `&o.a`, `&o.b`, and `&o.c`?

   (c) Write down one typical situation in which static variables are used.

   (d) If there is no pointer as a member variable of a class, should we implement the default constructor, copy constructor, assignment operator, and destructor? Explain.

Outputs:

(a) `3`

(b) `3`

(c) `20`

(d) `22`

(e) `10000`

(f) `0`

(g) `unpredictable` (short int s = 32500 + 500 = 33000 overflows a 16-bit short)

(h) `unpredictable` (continued overflow)

(i) `abcxyz`

(j) `efg-y`

4. (10 points) Rewrite the following program with proper indentations and added curly brackets. Your program will be graded according to the readability.

```
#include <iostream>
using namespace std;
int main(){ int i = 0; double j = 1.5;
if(i > 0) cout << j;
else if(i < 0){ for(int a = 0; a < 100; a++)
{
cout << a;
cout << "\n";
}}
else j = j + i;
while(true) if(j > 10) break;
else j++;
return 0;}
```

5. (30 points; 10 points each) Answer the following questions:

   (a) Given two square symmetric $n \times n$ matrices A and B, write down a pseudocode that finds AB. Your pseudocode will be graded according to correctness and efficiency.

   (b) What will be the output of executing the following program? Briefly explaining why. [1]

```
#include <iostream>
using namespace std;

int func(int v[], int n)
{
  static int s = 0;
  if(n == 1)
    return n;
  int m = func(v, n - 1);
  s++;
  cout << s << " " << m << "\n";
  if(v[n - 1] > m)
    return v[n - 1];
  else
    return m;
}

int main()
{
  int v[5] = {1, 4, 3, 6, 2};
  cout << "! " << func(v, 5) << "\n";
  return 0;
}
```

   (c) Define a C++ class for the game "tic-tac-toe" over a 3×3 game board for two players. You should define member variables that record the status of a game and member functions that allow other programmers to update the game status and check whether the game ends. DO NOT implement those member functions; just write down function headers and comments that describe the input/output of those functions. Your answer will be graded according to correctness, clearness, and completeness.

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[1] If a function is invoked inside the function itself, we say this is a recursive call. Even though this will be formally introduce only after the midterm exam, simply trace the codes line by line carefully. Then you will be able to answer this question.