C/C++ workshop

Practice

You should do the high priority (70% score) first and then do another (30% score)

Contents

Each ½ day, you will do each of below part:

Part1: Question 1, 2, 3, 4, 8 (high priority: 4, 8)

Part2: Question 5, 6, 7 (high priority: 5, 6, 7)

Part3: Question 9, 10, 11, 12 (high priority: 9, 10, 11, 12)

Then, commit all to SVN

Notes

- Each question has 100 points (100%). Score of each question is depend on how many percent this question has been completed.
- Score of sub-questions in a question are the same, and counted by 100/number-of-sub-questions.
- Score of practice is average score of all questions
- Candidate zip all answers (doc file and zipped-project file in <your_name>.zip

Question 1: Hello world

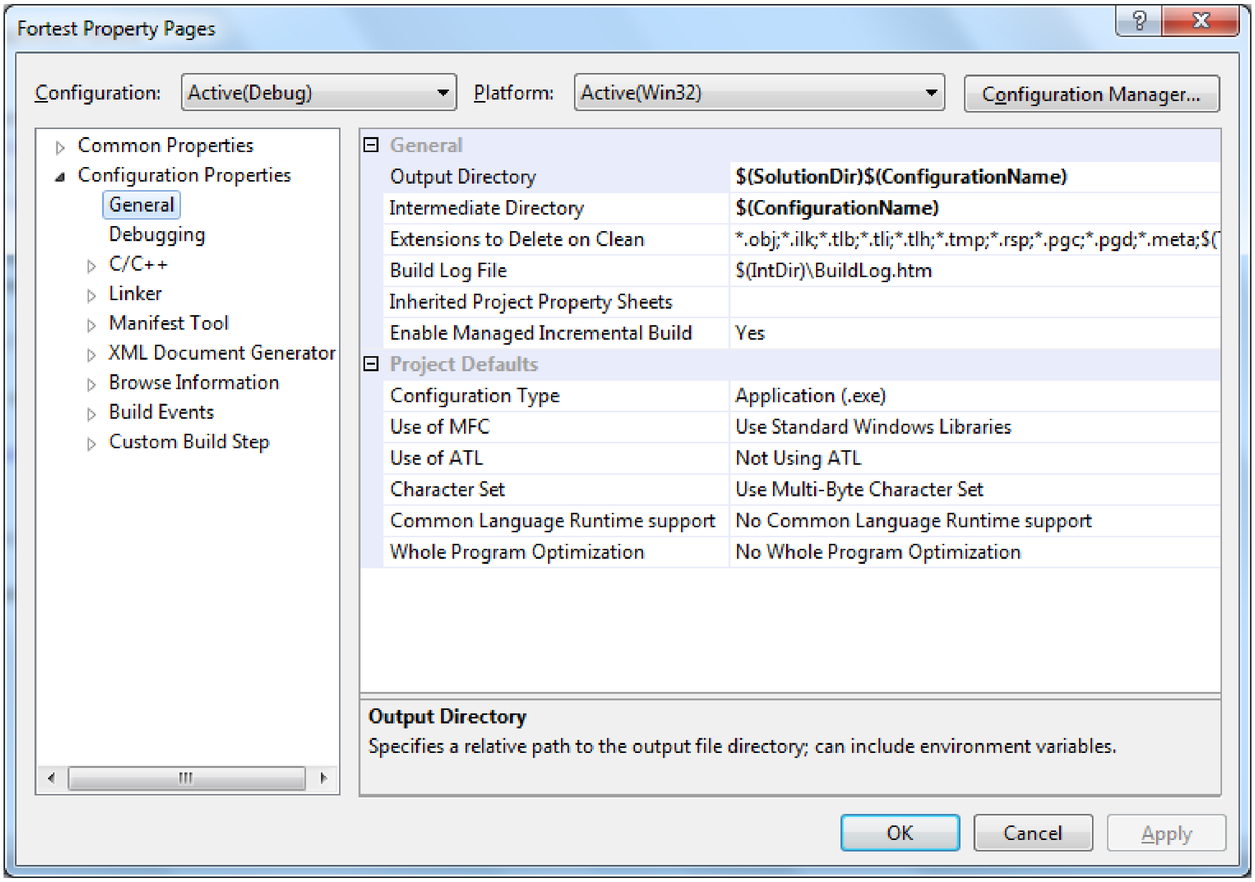
Write your answer in word document (includes code) in Q1_<yourname>.doc

Q 1.1

Use Visual Studio, code a simple program, display “hello C/C++” in console screen

Q 1.2

Open project property. Try to explain some elements in tab General: Output Directory, Intermediate Directory, Extensions to Delete on Clean, Build Log File, and Configuration Type. (use google)



Configuration: Active(Debug)

Platform: Active(Win32)

⊟ General	
Output Directory	**$(SolutionDir)$(ConfigurationName)**
Intermediate Directory	**$(ConfigurationName)**
Extensions to Delete on Clean	*.obj;*.ilk;*.tlb;*.tli;*.tlh;*.tmp;*.rsp;*.pgc;*.pgd;*.meta;$(
Build Log File	$(IntDir)\BuildLog.htm
Inherited Project Property Sheets	
Enable Managed Incremental Build	Yes
⊟ Project Defaults	
Configuration Type	Application (.exe)
Use of MFC	Use Standard Windows Libraries
Use of ATL	Not Using ATL
Character Set	Use Multi-Byte Character Set
Common Language Runtime support	No Common Language Runtime support
Whole Program Optimization	No Whole Program Optimization

Output Directory

Specifies a relative path to the output file directory; can include environment variables.

Q 1.3

Modified entry point like:

```
#include <stdio.h>
#include <iostream>

int main(int n, char** args)
{
      printf("Number of Param %d\n", n);
```

```
        for (int i = 0; i < n; i++)
        {
                printf("param[%d] = %s\n", i, args[i]);
        }
        system("pause");
}
```

Try to run, and watch the result in console screen and explain.

Q 1.4

Code a program: make an infinity loop, limit frame-rate to 5. Each frame, print to console screen current time.

HINT:

- use `clock()`, `time()` of `time.h`;
- use `sleep()` of `windows.h`

Question 2: Variable

Write your answer in word document (includes code) in Q2_<yourname>.doc

Q 2.1

Implement the following

```
void calculate(int val)
{
        static int count=10;
        static int value;
        printf("%d %d\n",value, count++);
        value = val;
}

int main(int n, char** args)
{
        int i, j;
        calculate(i);
        calculate(j);
}
```

Look at the result and explain why?

Q 2.2

For counting number of times a function has been called, we use three ways:

- Global variable
- Static variable inside function
- Static variable outside function

Implements those ways, and compare

Q 2.3

A programmer codes his program with 2 files: main.cpp and another.cpp. In another.cpp, he declares a **global variable** named myVar with initial value is 10. In main .cpp, he needs to print value of myVar into screen. And he tries the following ways:

- Declare myVar in another.cpp, and in print it in main() in main.cpp
- Declare myVar in another.cpp. Declare again myVar in main.cpp and print it
- Declare myVar in another.cpp. In main.cpp, declare myVar with extern keyword, and print it.

He's got problem with the first and second way. The third is run well.
Please explain what happen with the first and second; explain the reason why the third is OK and try to implement it.

Q 2.4

Detect & solve problem of the following code:

```
#include <stdio.h>

const int xyz;
int main(int n, char** args)
{
        xyz = 0;
        printf("%d", xyz);
}
```

Question 3: Primary data type

Write your answer in word document (includes code) in Q3_<yourname>.doc

Q 3.1 (*)

- Run the following code, and explain the result.
- If replacing "char c" with "unsigned char c", what will happen, and why?
- Set "i" value to 260. Explain the result.
- Supposing that "i" is always from 0 to 255. Try to give a solution to get j's value equal to i's value. (does not used unsigned char)

```
#include <stdio.h>
#include <iostream>
int main(int n, char** args)
{
      int i = 140;
      char c = i;
      int j = c;
      printf("%d", j);
      system("pause");
}
```

Q 3.2

Run the following code, and explain the result.

```
#include <stdio.h>
#include <iostream>
int main(int n, char** args)
{
        int i = 5;
        while (i = 5)
        {
                printf("Inside loop\n");
                i--;
        }
}
```

Question 4: Array

Write your answer in word document (includes code) in Q4_<yourname>.doc

Q 4.1

Write program to ask the user to type 10 integers of an array. The program must compute and write the number of integers greater or equal to 10.

Q 4.2

Write a program which takes 2 arrays of 10 integers each, a and b. c is an array with 20 integers. The program should put into c the appending of b to a, the first 10 integers of c from array a, the latter 10 from b. Then the program should display c.

- Use memcpy
- Without memcpy

Q 4.3 (*)

Explain the result:

```
#include <stdio.h>
#include <iostream>

int main(int n, char** args)
{
        int a[10];
        for (int i = 0; i < 10; i++)
        {
                a[i] = i*10;
        }
        printf("0x%x 0x%x 0x%x\n", a, *a, &a);
        printf("0x%x 0x%x 0x%x 0x%x\n", (a + 1), *(a + 1), *a + 1, &a + 1);
}
```

Q 4.4

Implement bubble sort algorithm (sort acceding) to sort an array from “offset” with “count” elements. For example: a[5] = {100, 4, 2, 6, 3} → sort(a, 1, 4) → {100, 2, 3, 4, 6}

```
void BubbleSort(int arr[], int offset, int count)
```

Q 4.5 (*)

Implement functions to invert member of an array

- `void Invert(int input[], int num_element)`: invert input array.
- `void Invert(int input[], int num_element, int output[])`: generate output array from inverted input. Note: after executing this function, input array is not changed

Question 5: Pointer

Write your answer in word document (includes code) in Q5_<yourname>.doc

Q 5.1 (*)

Explain the result

```
#include <stdio.h>
#include <iostream>
using namespace std;

typedef int *IntPtrType;

int main()
{
	IntPtrType ptr_a, ptr_b, *ptr_c;

	ptr_a = new int;
	*ptr_a = 3;
	ptr_b = ptr_a;
	cout << *ptr_a << " " << *ptr_b << "\n";

	ptr_b = new int;
	*ptr_b = 9;
	cout << *ptr_a << " " << *ptr_b << "\n";

	*ptr_b = *ptr_a;
	cout << *ptr_a << " " << *ptr_b << "\n";

	delete ptr_a;
	ptr_a = ptr_b;
	cout << *ptr_a << " " << *&*&*&*&*ptr_b << "\n";

	ptr_c = &ptr_a;
	cout << *ptr_c << " " << **ptr_c << "\n";

	delete ptr_a;
	ptr_a = NULL;

	return 0;
}
```

Q 5.2

Introduce int variables x and y and int* pointer variables p and q. Set x to 2, y to 8, p to the address of x, and q to the address of y. Then print the following information:

1. The address of x and the value of x.
2. The value of p and the value of *p.
3. The address of y and the value of y.
4. The value of q and the value of *q.
5. The address of p (not its contents!).
6. The address of q (not its contents!).

Use the Hex function to print all pointer/address values and format the output so it is easy to make comparisons.

Q 5.3

Introduce int variables x, y, z and int* pointer variables p, q, r. Set x, y, z to three distinct values. Set p, q, r to the addresses of x, y, z respectively.

1. Print with labels the values of x, y, z, p, q, r, *p, *q, *r.
2. Print the message: Swapping values.
3. Execute the swap code: z = x; x = y; y = z;
4. Print with labels the values of x, y, z, p, q, r, *p, *q, *r.

Draw diagrams to explain the results

Q 5.4

Introduce int variables x, y, z and int* pointer variables p, q, r. Set x, y, z to three distinct values. Set p, q, r to the addresses of x, y, z respectively.

1. Print with labels the values of x, y, z, p, q, r, *p, *q, *r.
2. Print the message: Swapping pointers.
3. Execute the swap code: r = p; p = q; q = r;
4. Print with labels the values of x, y, z, p, q, r, *p, *q, *r.

Draw diagrams to explain the results

Q 5.5 (*)

Draw diagrams to explain the results:

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


void main()
{
	int a[4] = {1, 2, 3, 4};
	int *p = a;
	printf("0x%x 0x%x 0x%x\n", a, *a, &a);
	printf("0x%x 0x%x 0x%x\n", p, *p, &p);

	printf("0x%x 0x%x 0x%x 0x%x\n", (a + 1), *(a + 1), *a + 1, &a + 1);
	printf("0x%x 0x%x 0x%x 0x%x\n", (p + 1), *(p + 1), *p + 1, &p + 1);
}
```

Q 5.6 (*)

Detect and solve problems of following program:

```
void main()
{
        int a[4] = {1, 2, 3, 4};
        int *p = a;

        int *p2 = new int;

        delete p;
        delete a;
        delete p2;
}
```

Q 5.7 (*)

- Why should we use delete?
- When we use delete?
- Difference between delete and delete[]. Write a demo

Q 5.8 (*)

Detect and solve problems of following program:

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

#define COUNT 10
#define MAX(a, b) ((a) < (b) ? (a):(b))
void main()
{
        int *p = new int[COUNT];
        int a[COUNT];

        for (int i = 0; i < sizeof(a); i++)
        {
                a[i] = i;
        }

        for (int i = 0; i < sizeof(a); i++)
        {
                p[i] = i;
        }


        for (int i = 0; i < MAX(sizeof(a), sizeof(p)); i++)
        {
                printf("%d %d\n", a[i], p[i]);
        }
}
```

Question 6: String

Write your answer in word document (includes code) in Q6_<yourname>.doc

Q 6.1

Print a string “Hello world” to screen, by using:

- char *st = “Hello world”
- char st[] = {‘H’, ‘e’, ….}
- char *st = new char[…] ….

Q 6.2

Implement a function to clone a string:

- `void clone(char *input, char *output)`

Q 6.3 (**)

Implement a function to copy a string:

void copyString(char *input, int offset, int length, bool invert, char *output, int output_offset)

- input: input string
- offset: starting position for copy
- length: length of substring to be copied
- invert: invert the result
- output: output string
- output_offset: the beginning of copied position of output

for example:
st = “Hello world”
st2 = “My name is C++”
copyString(st, 6, 5, true, st2, 11) → st2 = “My name is dlr”;

Implement this function in 3 ways:

- using memcpy
- using strcpy
- without memcpy and strcpy

Question 7: Struct

Use visual studio, named your project as Q7_<yourname>. Zip and send your project

Q 7.1

Date information includes:

- Day of week : 0 for Sunday and 6 for Saturday (unsigned char)
- Day: 0..31 (unsigned char)
- Month: 0..12 (unsigned char)
- Year: xxxx (unsigned int)

Implement:

- Define struct of date
- Get date of system and save to a struct instance
- Print struct information as format:
    - dow, dd-mm-yyyy
    - dd/mm/yyyy
    - mm-dd-yyyy
    - dow dd.mm.yy

Q 7.2 (*)

Use struct of 7.1. Implement:

- Print size of struct
- Declare year in second (dow, year, day, month), and print size of struct. Draw diagrams to explain the result
- Build project with 1 byte alignment, print size of struct in two above cases and explain the result.

Q 7.3 (**)

Use struct of 7.1. Implement:

- Constructor with dow, day, month, year.
- Implement function check valid date (valid of dow, day, month year)

Q 7.4 (*)

Student information include

- name (char *)
- id (int)
- score (float) (0 to 10)

Implement:

- Struct of student
- A class room is included ten students. (List of student is stored in an array).
- Implement a function to input the student information (check if duplicated student ID, and value of score must be in range)
- Sort list of student by score.

Q 7.5 (**)

Use visual studio, create new project. Named your project as Q7_5_<yourname>. Zip and send your project.

Same as 7.4, however, students are stored in a linked-list structure:

```
typedef struct _Student
{
      char *Name;
      int ID;
      float Score;
      struct _Student *next;
} Student;
```

- Input student information until ID is equal to zero (check if duplicated student ID, and value of score must be in range)
- Sort list by score
- Remove all students get score less than 5

Question 8: Function

Write your answer in word document (includes code). in Q8_<yourname>.doc

Q 8.1

Implement a function function SayHello, to print screen “Hello world”

- No parameter
- A string, print to screen “hello world” and that string
- A string, and a bool: If bool value is true, convert to string to capital; print to screen “hello world” and modified string. (bool parameter has default value is false).

Q 8.2 (*)

Implement a sort function (bubble sort) with unknown order preference (ascending or descending). The order preference is decided by a pointer function parameter.

```
void sort(int *arr, int count, int (*order) (int, int));
int CheckBigger(int a, int b) {return a>b;}
int CheckSmaller(int a, int b) {return a<b;}
```

Q 8.3 (**)

Use visual studio, create new project. Named your project as Q8_3_<yourname>. Zip and send your project.

Same requirement as Q8.3, however, sort function is implemented in another file:

- “**sort_cpp.cpp**” (use extern)
- “**sort_c.c**” (use extern “C”)

Q 8.4 (*)

Introduce classA and several functions. Draw diagrams to explain the results:

```
class ClassA
{
public:
      ClassA(int val = 0) {m_pVal = val;}
      int m_pVal;
};
```

```
void Todo1(ClassA *A, ClassA *B)
{
      ClassA *tmp = A;
      A = B;
      B = tmp;
}
```

```
void Todo2(ClassA &A, ClassA &B)
{
      ClassA tmp = A;
      A = B;
      B = tmp;
}
```

```
void Todo3(ClassA A, ClassA B)
{
      ClassA tmp = A;
      A = B;
      B = tmp;
}
```

```
void Todo4(ClassA *&A, ClassA *&B)
{
      ClassA *tmp = A;
      A = B;
      B = tmp;
}
```

```
void main()
{
      ClassA *A = new ClassA(10);
      ClassA B(0);
      ClassA *C = &B;

      printf("%d %d %d\n", A->m_pVal, B.m_pVal, C->m_pVal);
      Todo1(A, &B);
      printf("%d %d %d\n", A->m_pVal, B.m_pVal, C->m_pVal);
      Todo2(*A, B);
      printf("%d %d %d\n", A->m_pVal, B.m_pVal, C->m_pVal);
      Todo3(*A, B);
      printf("%d %d %d\n", A->m_pVal, B.m_pVal, C->m_pVal);
      Todo4(A, C);
      printf("%d %d %d\n", A->m_pVal, B.m_pVal, C->m_pVal);
}
```

Question 9: Class

Use visual studio, create new project. Named your project as Q9_<yourname>. Zip and send your project.

Q 9.1

Introduce class for people:

- Properties
  - [protected] Name: char*
  - [protected] Birthday: struct Date
  - [protected] ID code: int
- Methods:
  - [public - virtual] PrintInfo: display information
  - [public] Get/set name, birthday, ID code

Introduce class for staff: (inherit from people)

- Properties
  - [protected] Department ID: int
  - [protected] Joined Date: structDate
  - [protected] Level: int
- Methods:
  - [public - virtual] PrintInfo: display information (+ people information)
  - [public] Get/set department ID, joined date, level

Introduce class for student: (inherit from people)

- Properties
  - [private] Grade: int
  - [private] Number of project: int
  - [private] Score of each project: float*
- Methods:
  - [public] PrintInfo: display student information (+ people information)
  - [public] Get/set grade, number of project, score
  - [private] Calculate average score
  - [public] Get average score

Introduce class for teacher: (inherit from people and staff)

- Properties
  - [private] Class: int
  - [private] Subject: enum {MATHS, PHYS, ENGLISH}
  - [private] Second subject: enum {MATHS, PHYS, ENGLISH}
- Methods:
  - [public] PrintInfo: display teacher information (+ people and staff information)
  - [public] Get/set class, subject, second subject

All people are stored in a linked-list:

```
class Node
{
public:
        People* data;
        Node* next;
};
```

Implement above introduction.

Q 9.2

Implements:

- Implements counting number of peoples, staffs, teachers, students are created (use static member)
- In node, implement static function to add element
- Add to list 5 staff, 5 teacher, and 5 student
- Sort list group by type: staff first, teacher next, and student last
- Print information of all students have had average score more than 5.0

Q 9.3 (*)

Implements:

- Implement copy constructor
- Clone current list, using copy constructor for each element

Q 9.4 (*)

Implements:

- Implement static methods remove element for node. Make sure class memory was clean up. (When delete student, memory of people MUST BE clean too – use virtual destructor and println to check when an instance is destroyed).

Q 9.5 (**)

Implements:

- Save a list to of student to file
- Load list of student from file

Question 10: C/C++ advance features

Q 10.1

Write your answer in word document (includes code) in Q10_1_<yourname>.doc

Define a template function to calculate average values of an array:

```
template <class R, class T> R Average(int count, T* list)
```

Q 10.2

Use visual studio, create new project. Named your project as Q10_2_<yourname>. Zip and send your project.

Use 9.1, define a template class node

```
template <class T>
class Node
{
public:
		T* data;
		Node* next;
};
```

Implement methods:

- Add a node
- Remove a node
- Remove all nodes

Q 10.3

Use visual studio, create new project. Named your project as Q10_3_<yourname>. Zip and send your project. Use 9.1.

- Supposing that we have an instance of teacher, try to cast to
  - Staff
  - People
- Supposing that we have an instance of student, try to cast to
  - People
  - Teach

By using explicit casting, dynamic/static casting.
(Test by call all member methods after casting)

Q 10.4

Use visual studio, create new project. Named your project as Q10_4_<yourname>. Zip and send your project. Implement

- Divide function, support division by zero exception
- Calculate average of a list, support out of bound exception, division by zero exception:
  - float Average(int count, int offset, float *arr)

Question 11: STL

Use visual studio, create new project. Named your project as Q11_<yourname>. Zip and send your project.

Q 11.1

Implement 10.2, but use STL list instead of Node structure.
Support:

- Add element (people, staff, student, teacher)
- Modified people, staff, student, teacher information
- Remove element, check memory clean up
- Use VLD to detect leak

Q 11.2

Compile 11.1 by using GNU GCC through Cygwin. Attach your makefile into Q11_<yourname> package

Question 12: Convert from Java to C

Use visual studio, create new project. Named your project as Q12_<yourname>. Zip and send your project.

Q 12.1

Convert the following code from Java to C++
Note: Object in Java is same as void* in C++

```
/* class Stack
*/

public class Stack
{
      private Object[] stack ;
      private int total;    // to track number of items

      public Stack(int size)
      {
            stack = new Object[size];  // create array
            total = 0;     // set number of items to zero
      }
      /**
      * add an item to the array
      */
      public boolean push(Object obj)
      {
            if ( isFull() == false)  // checks if space in stack
            {
                  stack[total] = obj;   // add item
                  total++;              // increment item counter
                  return true;          // to indicate success
            }
            else
            {
                  return false;       // to indicate failure
            }
      }

      /**
      * remove an item by obeying LIFO rule
      */
      public Object pop()
      {
            if (isEmpty() == false)   // check stack is not empty
            {
                  // reduce counter by one
                  Object obj = stack[total-1];  // get last item
                  stack[total-1]= null;  // remove item from array
                  total--;   // update total
                  return obj;   // return item
            }
            else
            {
                  return null;       // to indicate failure
            }
      }
      /*
      * checks if array is empty
```

```
        */
        public boolean isEmpty()
        {
                if (total ==0) {
                        return true;
                }
                else
                {
                        return false;
                }
        }

        /**
        * checks if array is full
        */
        public boolean isFull()
        {
                if (total ==stack.length)
                {
                        return true;
                }
                else
                {
                        return false;
                }
        }

        /**
        * returns the item at index i
        */
        public Object getItem(int i)
        {
                return stack[i-1];      // ith item at position i-1
        }
        /**
        * return the number of items in the array
        */
        public int getTotal()
        {
                return total;
        }
}
```

Q 12.2

Use 12.1, write an C/C++ demo with stack of integer