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THE UNIVERSITY OF HONG KONG

FACULTY OF ENGINEERING
DEPARTMENT OF COMPUTER SCIENCE

COMP1117 A/B Computer Programming
CSIS1117 A/B Computer Programming I

Date: December 18, 2013 Time: 9:30am – 12:30pm

Only approved calculators as announced by the Examinations Secretary can be used in this examination. It is the candidates' responsibility to ensure that their calculator operates satisfactorily, and candidates must record the name and type of the calculator used on the front page of the examination script.

Brand and type of calculator:_____

Instructions:

- Write your university number at the top of each page.
- Answer ALL questions in the space provided.
- Total mark in the paper is 100.

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Section A: True or False. (10 marks) Each correct answer will be given 1 mark. 1 mark will be deducted for each wrong answer. The minimum score for the entire section is 0 mark.

1. The compiler will catch all your programming mistakes. **Ans:** [ ]
2. The body of a for loop may never execute. **Ans:** [ ]
3. The break statement causes all loops to exit. **Ans:** [ ]
4. Functions may have multiple return statements. **Ans:** [ ]
5. A void function can be used in an assignment. **Ans:** [ ]
6. You may not have more than one input and one output stream open at any one time. **Ans:** [ ]
7. The following array declaration is legal:

```
double scores[]={0.1,0.2,0.3};
```

Ans: [ ]

8. You can assign an array to a pointer variable. **Ans:** [ ]
9. The assignment operator may not be used with objects of a class. **Ans:** [ ]
10. Friend functions are members of the class. **Ans:** [ ]

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Section B. Multiple Choices. (20 marks) There may be more than one correct choice in the questions. The answer will only be considered correct when all correct choices are written down. Each question carries 2 marks. 1 mark will be deducted for a wrong answer. The minimum score for this section is 0 mark.

1. Given the following code fragment, which of the following expressions is always true?

```
int x;
cin >> x;
```

(a) `if (x < 3)`

(b) `if (x == 1)`

(c) `if ((x / 3) > 1)`

(d) `if (x = 1)`

Ans: [ ]

2. Which of the following are equivalent to

```
(!(x < 15 && y >= 3))?
```

(a) `(x > 15 && y <= 3)`

(b) `(x >= 15 && y < 3)`

(c) `(x >= 15 || y < 3)`

(d) `(x > 15 || y < 3)`

Ans: [ ]

3. Which of the following is/are allowed in the last section of the for loop statement?

(a) `i++`

(b) `i--`

(c) `i += 2`

(d) `cout << "Hello" << endl`

Ans: [ ]

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4. If you need a function to get both the number of items and the cost per item from a user, which would be a good function declaration to use?

   (a) `int,float getData();`

   (b) `int getData(float cost);`

   (c) `void getData(int count, float cost);`

   (d) `void getData(int& count, float& cost);`

   Ans: [ ]

5. Which of the following loop condition statements will read all the data in the file assuming that each record in the file is two integer values, and you will read the first one into a variable named `intOne`, and the other into `intTwo`?

   (a) `while (inFile >> intOne >> intTwo)`

   (b) `while (inFile(intOne, intTwo))`

   (c) `while (inFile)`

   (d) `while (inFile << intOne << intTwo)`

   Ans: [ ]

6. Which of the following declare an array of 5 characters, and initializes them to some known values?

   (a) `char array[5]={'a','b','c','d','e'};`

   (b) `char array[4]={'a','b','c','d','e'};`

   (c) `char array[5]={''};`

   (d) `char array[]={'a','b','d','e'};`

   Ans: [ ]

7. Which of the following correctly declare 3 integer pointers?

   (a) `int* p1, p2, p3;`

   (b) `int *p1, p2, p3;`

   (c) `int *p1, *p2, *p3;`

   (d) all of the above.

   Ans: [ ]

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8. Which of the following correctly declares a user-defined data type that defines a pointer to a float?

   (a) `float* floatPtr ;`

   (b) `typedef float* floatPtr;`

   (c) `typedef floatPtr *float;`

   (d) `typedef floatPtr* float`

   Ans: [ ]

9. Given the following class definition and variable declaration,

```
class Rational
{
public:
    Rational();
    int getNumerator();
    int getDenominator();
    friend void display(ostream& out, const Rational& value);
    friend bool operator<(const Rational& left, const Rational& right);
private:
    int numerator;
    int denominator;
};
```

```
Rational number;
```

   which one(s) of the following statements will cause compiler error?

   (a) `cout << number.getNumerator();`

   (b) `cout << number.numerator;`

   (c) `cout << number;`

   (d) `display(cout, number);`

   Ans: [ ]

10. Why should you generally pass an object of the class to a friend function as a reference parameter?

    (a) If the friend function changes the values of the data member(s).

    (b) If the friend function will not change the values of the data member(s).

    (c) If data member(s) are put in the private section of the class.

    (d) none of the above

    Ans: [ ]

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Section C: Written Questions (70 marks) The mark of each question is put in a pair of square bracket [ ].

1. [2] Given the following operator precedence

   `!` (unary not operator) *greater than* `==, !=` (left associative) *greater than* `&&` *greater than* `||`

   Write down meaning of the following expression by putting parenthesis to it. Put down "`Syntax Error`" if the statement is not valid.

   ```
   x!=z && !x==7 || !z!=x && !z!=!!y
   ```

   Answer:

---

2. [2] What is the difference between `x++` and `++x`? Is the following two for-loops the same?

   ```
   for (int i=0; i<10; i++) {...}

   for (int i=0; i<10; ++i) {...}
   ```

   Answer:

---

3. [2] What will be printed on the screen by the following code fragment? Give a one-sentence explanation.

   ```
   int i=5;
   int sum=0;
   for(int i=0; i<14 ;i++) sum+=i;
   cout << i << endl;
   ```

   Answer:

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4. [2] Explain why sometimes the following code fragment will produce an error, and sometimes not.

```
int x[10];
i=1000;
x[i]=x[i]+100;
```

Answer:

---

5. [2] What is the value of i aftger the execution of the following code fragment? Given a brief explanation.

```
int i=4;
switch(i) {
  case 0: i=15;break;
  case 2: i=35;break;
  case 4: i=40;
  default: i=0;
}
```

Answer:

---

6. [3] What is the value returned by fn(20), fn(21), fn(35), fn(36) respectively?

```
int fn (int val)
{
    if (val>30)
      if ((val%2)==0) return val++;
    else return ++val;
    return 0;
}
```

Answer:

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7. [3] What is the output of the following program?

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

void calculate(int a, int & b)
{
    int c;
    c = a + 2;
    a = a * 2;
    b = c + a;
}

int main(void)
{
    int r = 1;
    int s = 2;
    int t = 3;

    calculate(t, s);
    cout << r << ", " << s << ", " << t << endl;
    return 0;
}
```

Answer:

---

8. [2] Explain when do we need a class destructor for a class definition, and why.

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9. [3] The following Class definition of `Rational` implements a rational number given by *numerator/denominator*.

```
class Rational
{
public:
    Rational();
    friend bool operator < (Rational left, Rational right);

private:
    int numerator;
    int denominator;
};
```

Write the function for the boolean operator <.

```
bool operator < (Rational left, Rational right)
{
```

Answer:

---

10. [2] Write a function which will convert a smaller letter character into capital letter, and remain unchange for all other characters.

```
char Cap(char c)
{
```

Answer:

11. [4] Write a function which will capitalize the first letter of every word, separated by one or more white spaces (blanks, tabs and new lines), after a full-stop. You may use the function in Question 10.

```
void capword(string& line)
{
```

Answer:

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12. [3] Write a function that will return a string which replace the first occurence of string `s1` by string `s2` within the string `line`.

```
string replace (string line, string s1, string s2)
{
// return a string which replaces the first occurrence of s1 by s2 in line
```

Answer:

---

13. [3] What is the output of the following code fragment? Also, explain why a runtime error occurs if we `delete p2;` at the end of the code fragment?

```
int *p1, **p2;
p1 = new int [5];
for (int i=0; i<5; i++) p1[i]=0;
p2 = &p1;
*p1=11;
p1[4]=12;
**p2=0;
for (int i=0; i<5; i++) cout << p1[i] << " ";
cout << **p2 << endl;
delete p1;
```

Answer:

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14. [2] Given a linked list `list` with member function `insert_front(int)` to insert an integer into the beginning of the list, `insert_back(int)` to insert an integer at the end of the list, and `remove()` to remove an integer from the beginning of the list. Consider the following operation:

```
list.insert_front(3), list.insert_front(5), list.insert_back(9),
list.remove(), list.remove(), list.insert_back(7) list.insert_front(11)
```

Write down the result if we traverse the list and print the values from the beginning of the list to the end of the list.

Answer:

---

15. We are going to write an encryption program using a simple scheme. First we place all possible letters (say 70 of them, including capital and small letters and punctuations, new line character included) in an array`char source[70]`. Each character in a text will be replaced by another character, and the mapping is stored in `char target[70]`. The 70 characters were printed first into the output file, and followed by the transformed text.

The array `source` and `target` are declared globally.

(a) [2] Write a function `void init()` which will read from a file named `charsource.dat` 70 characters and put it in the array `source[]`.

```
void init()
{
```

Answer:

(b) [2] Write a function to find the index of character `c` in the `source` array, assuming that the character `c` exists in the array:

```
int cidx(char c)
{
```

Answer:

(c) [4] Given the random number generator `rand()`, you can generate a random number between 0-69 by `rand()%70`. Generate the target character array by randomly pick a character. If the character has been picked before, then repeat until one not used is found.

```
void gentarget()
{
```

Answer:

(d) [6] Complete the program by writing the main function, which init the source array, and generate the target array. It then prompt the user for an input filename, and write the output to another file, with filename appended by "`-encrypted`" to the original file. For example, input filename is `myinput.txt`, then output filename is `myinput.txt-encrypted`. In the output file, we first printed 70 characters of the `target[]` array, so that we can decrypt the file. Then each character of the input file is transformed by the mapping provided by `target[]`.

```
int main()
{
    init();
    gentarget();
    cout << "Enter filename to Encrypt: ";
    ...
```

Answer:

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16. A class `longint` is used to represent a 40-digit long non-negative integer, and is defined as follows.

```
class longint
{
  public:
    longint(string input);
             //initialize to the 40 digits given by the string input
    bool isinteger();     // return whether it can be represented
                          // by a C++ integer, i.e. smaller than
                          // INT_MAX, a predefined constant for the
                          // largest integer in the system
    int integer();        // return the integer values, assuming it is
                          // smaller than INT_MAX
    void print();         // print the long integer on the screen
    friend longint operator + (longint a, longint b);
                          // add two longint together

  private:
    int digits[40];       // the 40 digits of the long integer,
                          // digit[0] is the rightmost digit
                          // digit[39] is the leftmost digit
};
```

(a) [2] Explain why the array `digits[]` is placed in the private section instead of public section.

Answer:

(b) [3] Write the member function `integer()`.

```
int longint::integer()
{
```

Answer:

(c) [2] Write the member function `print()`

```
void longint::print()
{
```

Answer:

(d) [5] You can add two `longint` together by adding digits by digits, starting from the rightmost one. If the sum is greater than 10, then carry is generated and will be added to the next digit. The sum is reduced by 10.

Write the operator `+()` which will add two `longint`'s and return a `longint`.

```
longint operator +(longint a, longint b)
{
```

Answer:

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17. It is known that for a function $f(x)$, and two values a and b, $a < b$, such that $f(a)$ and $f(b)$ are of opposite sign, i.e. $f(a)f(b) < 0$, then there exist a root of $f(x)$ within the interval $[a, b]$. Given that $f(a)f(b) < 0$, we can use the following alogrithm to find the root:

    1. Let $c = \frac{a+b}{2}$, if $f(c) = 0$ c is the root
    2. if $f(a)f(c) < 0$, the root lies within $[a, c]$
    3. if $f(c)f(b) < 0$, the root lies within $[c, b]$
    4. stop when the interval is smaller a threshold `delta`.

    (a) [4] Assuming that the function `double f(double x)` is given, Write a function `double root(double a, double b)` to find the root by using looping (e.g. `while`-loop).

    ```
    double root(double a, double b)
    {
    ```

    Answer:

    (b)

[5] Repeat the problem by using recursion.

```
double root(double a, double b)
{
```

Answer:

END OF PAPER