University of Toronto
Faculty of Applied Science and Engineering

ECE 244F

PROGRAMMING FUNDAMENTALS

Fall 2013

Midterm Test

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Duration: 110 minutes

This test is OPEN Textbook and CLOSED notes. The use of computing and/or communicating devices is NOT permitted.

Do not remove any sheets from this test book. Answer all questions in the space provided. No additional sheets are permitted.

Work independently. The value of each question is indicated. The total value of all questions is 100.

Write your name and student number in the space below. Do the same on the top of each sheet of this exam book.

Name: ______________________________
(Underline last name)

Student Number: ______________________________

Q1. __________

Q2. __________

Q3. __________

Q4. __________

Q5. __________

Q6. __________

Q7. _________

Q8. _________

Q9. _________

Q10. _________

Q11. _________

Q12. _________

Total

□

Question 1. (6 marks). *Stringstreams*

A token in a stream is defined as a group of adjacent non-white-space characters surrounded by white space, except for the first token that may not have white space before the first character, and except for the last token that may not have white space after the last character.

You are to write a function, `getNextInt()` that reads from `stringstream ss`. If the next token is an integer, the function should return TRUE **and** the integer; otherwise it should return FALSE. Fill in the required code below to define the function `getNextInt()` and fill in the code required to properly make the call to the function.

```
int main() {
    int x ;
    stringstream ss ;

    ss << getcontent() ;

    if( getNextInt(____________________________________) )
        cout << "The first token is " << x << endl ;
    else
        cout << "Error: first token is not an int" << endl ;
}


bool getNextInt(                                         ) {









}
```

Question 2. (12 marks). *Operator Overloading.*

The following class is used to create objects that represent distance, consisting of “feet” and “inches”.

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

class Distance {
   private:
      int feet;
      int inches;

   public:
      Distance(int f, int i);
      int getFeet();
      int getInches();
      void setFeet(int f);
      void setInches(int i);
      void print();
};


Distance::Distance(int f, int i) {
      feet = f;
      inches = i;
}


int Distance::getFeet() {
      return (feet);
}


int Distance::getInches() {
      return (inches);
}


void Distance::setFeet(int f) {
      feet = f;
}


void Distance::setInches(int i) {
      inches = i;
}


void Distance::print() {
      cout << “Distance is: “ << feet
           << “ feet and” << inches << “inches”
           << endl;
}
```

We wish to overload the "+" and "==" operators for the `Distance` class to be able to write code like this in a non-member function (say `main`):

```
Distance X(10,2);
Distance Y(1,3);
Distance Z(0,0);
    :
Z = X + Y;
if (X == Y) …;
```

For the example declarations above, `X + Y` results in an object that represents 11 feet and 5 inches and (`X == Y`) results in false.

Write the implementation of the two overloaded operator functions as members of the class `Distance`. Clearly show the function header and its body.

Write the overloaded + operator function below

Write the overloaded == operator function below

Question 3. (6 marks). *Operator Overloading.*

The Toronto Census Bureau keeps the records for each of Toronto's residents in a `Resident` class. A portion of the declaration for the Resident class is shown below.

```
class Resident {
  public:
    Resident();
    ...
  private:
    string first_name; // e.g. "John"
    string last_name;  // e.g. "Baggenstos"
    ...
};
```

The string class allows you to use the < operator to lexically compare two strings. So for example:

Judy < Suzy
Jack < Joe

are both true.

For consistency, the symbol < should also be overloaded for the `Resident` class to sort the residents alphabetically based on their name. As in a standard directory, the names are sorted first by last name and if the last names are the same they are then sorted by first name. For example,

Judy Baggenstos < Alice Zachoski
Aaron Baggenstos < Frodo Baggenstos

Write the definition of the `operator<` member function for the `Resident` class.

Write the overloaded < operator function below

Question 4. (13 marks). *Constructors and Destructors.*

Consider the following definition and implementation of a class that represents a day of the year. You may assume that this code is **error-free**.

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

class DayOfYear {
   private:
      int day;
      int month;
      DayOfYear(const DayOfYear & other);

   public:
     ~DayOfYear();
      DayOfYear(int d, int m);
      int getDay();
      int getMonth();
      void setDay(int d);
      void setMonth(int m);
      DayOfYear operator=(DayOfYear src);
      void print();
};


DayOfYear::~DayOfYear () {/* Nothing to do */}

DayOfYear::DayOfYear (int d, int m) {
      day = d;
      month = m;
}

DayOfYear::DayOfYear(const DayOfYear & other) {
      day = other.day;
      month = other.month;
}

int DayOfYear::getDay() {return (day);}

int DayOfYear::getMonth() {return (month);}

void DayOfYear::setDay(int d) {day = d;}

void DayOfYear::setMonth(int m) {month = m;}

DayOfYear DayOfYear::operator=(DayOfYear src) {
       day = src.day;
       month = src.month;
       return(*this);
}

void DayOfYear::print() {cout << day << “/” << month << endl;}
```

Now consider the following code in the functions `main` and `mystery`. The code is shown in a table to facilitate the writing of your answers. Indicate which lines generate a compile time error by writing `X` next the line in the second column of the table.

Code	Compile-time Error?
using namespace std;	
#include <iostream>	
#include “DayOfYear.h”	
void mystery (DayOfYear);	
int main() {	
DayOfYear FirstOfJuly(1,7);	
DayOfYear Christmas(25,12);	
DayOfYear temp;	
DayOfYear May11(11,5);	
DayOfYear MothersDay = May11;	
DayOfYear today(1,1);	
DayOfYear Oct22(22,10);	
today = Oct22;	
mystery(today);	
return(0);	
}	
void mystery(DayOfYear source) {	
DayOfYear* temp = new DayOfYear(0,0);	
temp->setMonth(source.getDay());	
temp->setDay(source.getMonth());	
delete temp;	
}	

Question 5. (11 marks). *Scopes.*

The following class definition describes a simple C++ class called `AnExampleClass`.

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

class AnExampleClass {
private:
        int value;
public:
        AnExampleClass ();
        AnExampleClass (int v);
        ~AnExampleClass ();
};

AnExampleClass::AnExampleClass () {
        value = 0;
        cout << "Constructing object with value 0"<< endl;
}

AnExampleClass::AnExampleClass (int v) {
        value = v;
        cout << "Constructing object with value " << value << endl;
}

AnExampleClass::~AnExampleClass () {
        cout << "Destructing object with value " << value << endl;
}
```

Now consider the following code, which uses `AnExampleClass`:

```
AnExampleClass a;

void mystery() {
         cout << "Entering mystery" << endl;
         AnExampleClass x(100);
         AnExampleClass* p;
         p = new AnExampleClass(5);
         cout << "Leaving mystery" << endl;
         return;
}

int main() {
         cout << "Staring main" << endl;
         AnExampleClass a;
         if (true) {
                 AnExampleClass* p;
                 p = new AnExampleClass[2];
                 delete [] p;
         }

         mystery();

         cout << "Leaving main" << endl;
         return 0;
}
```

In the table below, write the output that an execution of the above program produces in the order in which it is produced. Use one entry in the table for each line of output produced.

Question 6. (6 marks). *Pointers.*

What is the output produced by the following segments of code?

(a)

```
int* p1;
int* p2;
p1 = new int;
p2 = new int;
*p1 = 10;
*p2 = 20;
cout << *p1 << “ “ << *p2 << endl;
p1 = p2;
cout << *p1 << “ “ << *p2 << endl;
*p1 = 30;
cout << *p1 << “ “ << *p2 << endl;
```

Write the output here.

(b)

```
int* p1;
int* p2;
p1 = new int;
p2 = new int;
*p1 = 10;
*p2 = 20;
cout << *p1 << “ “ << *p2 << endl;
*p1 = *p2;
cout << *p1 << “ “ << *p2 << endl;
*p1 = 30;
cout << *p1 << “ “ << *p2 << endl;
```

Write the output here.

Question 7. (12 marks). *Classes.*

Consider the following definition for a class `Mystery`.

```
#include <string>
class Mystery {
   private:
       int value;

   public:
       Mystery (const Mystery & s);
       Mystery (const string & s);
       ~Mystery ();
       int getValue() const;
       void setValue(int i);
       bool operator<(const Mystery & rhs);
};
```

Indicate by placing an **X** in the appropriate column whether each of the following statements is *valid*, or *not valid* given the definition of `Mystery` above. A statement is valid if it compiles and executes correctly. A statement is not valid if it either generates a compile-time error, or if it compiles correctly, but produces a run-time error. Assume that each of the statements is independent of the others and that they all appear in the `main` function.

Statement	Comments	Valid	Not Valid
`Mystery s;`			
`Mystery a(sv);`	`sv` is a string object		
`Mystery W(X);`	`X` is an object of type `Mystery`		
`Mystery c = sv;`	`sv` is a string object		
`cout << f.getValue();`	`f` is an object of type `Mystery`		
`(d < e);`	`d` and `e` are objects of type `Mystery`		
`Mystery h = j;`	`h` and `j` are objects of type `Mystery`		
`Y = W;`	`Y` and `W` are objects of type `Mystery`		
`e = sv;`	`e` is an object of type `Mystery` `sv` is a string object		
`e < v;`	`e` is an object of type `Mystery` `v` is an integer		
`cout << f.value;`	`f` is an object of type `Mystery`		
`f = d + e`	`f`, `d` and `e` are objects of type `Mystery`		

Question 8. (8 marks). *Arrays and Objects.*

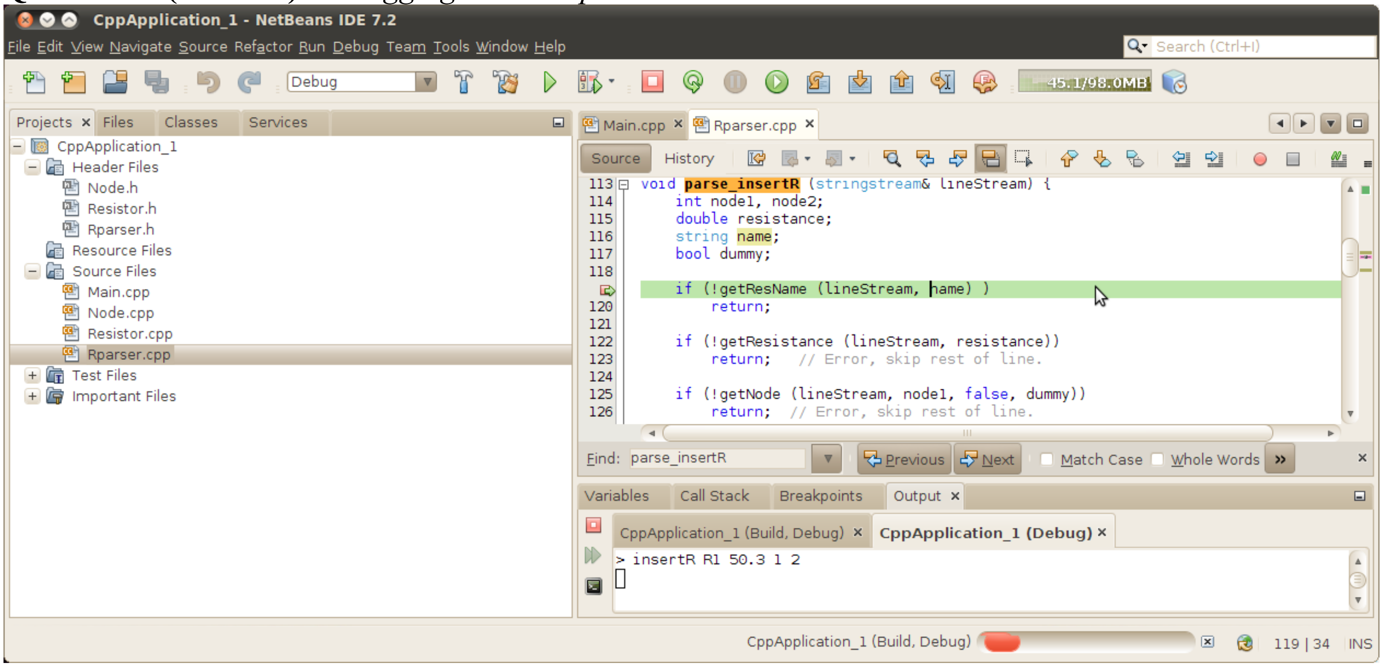
Consider the following definition of the class Complex:

```
class Complex {
   private:
      float real;
      float imag;

   public:
      Complex();                          // Default constructor
      Complex(float r, float imag);  // Second constructor
      int getReal();
      int getImag();
      void setReal(float r);
      void setImag(float i);
      void print();
};
```

The following function has been written by a programmer to allocate an array with n Complex objects, where n is an integer value read from the input. Complete the code of the function to delete all dynamically allocated data so that there is no memory leak at the end of the function.

```
void create () {
   Complex** p;
   int n;

   cin >> n;

   p = new Complex* [n];

   for (int i=0; i < n; ++i) {
       p[i] = new Complex((float)i,(float)2*i);
   }

   Complex* q = new Complex();
   *q = *p[n-1];
   q->setReal(5.0);
   q->setImag(3.0);

   // ADD CODE HERE







}
```

Question 9. (5 marks). *Debugging and Compilation.*



CppApplication_1 - NetBeans IDE 7.2
File Edit View Navigate Source Refactor Run Debug Team Tools Window Help
Search (Ctrl+I)
Debug
45.1/98.0MB
Projects × Files Classes Services
CppApplication_1
Header Files
Node.h
Resistor.h
Rparser.h
Resource Files
Source Files
Main.cpp
Node.cpp
Resistor.cpp
Rparser.cpp
Test Files
Important Files
Main.cpp × Rparser.cpp ×
Source History
Previous Next □ Match Case □ Whole Words
Variables Call Stack Breakpoints Output ×
CppApplication_1 (Build, Debug) × CppApplication_1 (Debug) ×
CppApplication_1 (Build, Debug)
119 | 34 INS

```
void parse_insertR (stringstream& lineStream) {
    int node1, node2;
    double resistance;
    string name;
    bool dummy;

    if (!getResName (lineStream, name) )
        return;

    if (!getResistance (lineStream, resistance))
        return;   // Error, skip rest of line.

    if (!getNode (lineStream, node1, false, dummy))
        return;  // Error, skip rest of line.
```

Find: parse_insertR

```
> insertR R1 50.3 1 2
```

(a) You are debugging a program in NetBeans, and execution has paused due to hitting a breakpoint at the line highlighted in the figure above. You wish to see what happens when you execute one line of the `getResName` function (i.e. you want to execute just the start of that function, and then examine some variables). Either *circle the button* you should click on in the screen shot above, **or** *describe the menu command* you should use to make this happen.

(b) What is the difference between a compiler error and a compiler warning?

(c) Assuming a file `main.cpp` exists and contains valid C++ code, what is the file that will be generated by the command:

```
g++ -g -Wall main.cpp -o foo
```

(d) Assuming a file `main.cpp` exists and contains valid C++ code, what is the file that will be generated by the command:

```
g++ -g -c main.cpp
```

Question 10. (4 marks). *Program Organization.*

Consider the program below, which is organized into two header files and three .cpp files.

A.h

```
#ifndef A_H
#define A_H


class A {
private:
   double d1;
public:
   A();
};

#endif
```

B.h

```
#ifndef A_H
#define A_H
#include “A.h”


class B {
private:
   A a1;
public:
   B();
};

#endif
```

A.cpp

```
#include “A.h”


A::A () {
}
```

B.cpp

```
B::B () {
}
```

main.cpp

```
#include “A.h”
#include “B.h”


int main () {
   A myA;
   B myB;
   return (0);
}
```

When compiled with the command:

```
g++ A.cpp B.cpp main.cpp -o prog
```

two compiler errors are reported. Modify some of the files shown above so that the program compiles properly – you can add, delete or modify lines in any of the 5 files. You should make only the minimal modifications necessary in order to make the program compile properly.

Question 11. (7 marks). *Functions and Parameters.*

(a) (3 marks). Consider the functions below.

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

int compute (int i1) {
   i1 = i1 + 3;
   return (i1);
}


int compute (int i1, int& i2) {
   i1 = i1 + 4;
   i2 = i1 + i2;
   return (i1 + i2);
}


int compute2 (const int& i1) {
   return (i1 + i1);
}


int main () {
   int ival1 = 2;
   int ival2 = 3;
   int resVal = compute (ival1, ival2);
   resVal = resVal + compute (ival2);
   resVal = resVal + compute2 (ival2);
   cout << "resVal is " << resVal << endl;
}
```

Write the program output below.

(b) (4 marks). Consider the following class definition and implementation, contained in a file called “`number.cc`”. The line numbers shown are for reference and are not part of the code.

```
 1     #include <iostream>
 2     using namespace std;
 3
 4     class Number {
 5      private:
 6            int _number;
 7      public:
 8            Number ();
 9            Number (int v);
10            void increment () const;
11            void copy_and_destroy (const Number & other);
12            void print() const;
13     };
14
15     Number::Number () {
16             _number = 0;
17     }
18
19     Number::Number (int num) {
20             _number = num;
21     }
22
23     void Number::increment () const {
24             _number = _number + 1;
25     }
26
27     void Number:: copy_and_destroy (const Number & other) {
28             _number = other._number;
29             other._number = 0;
30     }
31
32     void Number::print() const {
33             cout << _number << endl;
34     }
```

The above code with the command “`g++ -c number.cc`” generates some compiler errors. In the table below indicate what these errors are by writing the number of each line of code that generates the error and a brief explanation of the error. There may or may not be as many errors as there are rows in the table.

Line # causing error	Explanation

Question 12. (10 marks). *Programming and File I/O.*

Write a full program, that inputs the name of a text file from `cin`, opens that file, and then count the number of words and lines in the file. The program should output two numbers: the number of words in the file and the number of lines in the file.

You may assume a file with the input name exists and that the file only contains words with no numbers or isolated punctuation marks. Your program should include the required `#include` statements. (You can open a file with `ifstream filename("filename")`.

You will get full marks if the program is written with 25 or fewer statements, where statements counted are if-, while-, for-, and the "#include" statements, as well as any statement ending with ";". You will get a 10% reduction in your mark for every 2 statements over 25.