Université d'Ottawa Faculté de genie

École de science d'informatique et de génie électrique



University of Ottawa Faculty of Engineering

School of Electrical Engineering and **Computer Science** 

# **CSI2372A** Advanced Programming Concepts with C++

#### **FINAL EXAMINATION**

Length of Examination: 3 hours	December 9, 2011, 9:30
Length of Examination, 5 hours	December 3, 2011, 3.

**Professor: Jochen Lang Page 1 of 16** 

Family Name:		
Other Names:		
Student Number:		down.
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You are allowed **ONE TEXTBOOK** of your choice as a reference.

No calculators or other electronic devices are allowed.

Please answer the questions in this booklet.

If you do not understand a question, clearly state an assumption and proceed.

At the end of the exam, when time is up:

1) Stop working and turn your exam upside

- ent.
- 3) Do not move or speak until <u>all</u> exams have been picked up, and a TA or the Professor gives the go-ahead to leave.

	Marks	Out of
A		11
B.1		3
B.2		2
B.3		3
B.4		3
B.5		2
С		16
Total		40

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### PART A: Short Questions (11 POINTS)

For all questions in this part containing code excerpts assume that the necessary standard headers and using statements have been included.

1. Use a reverse iterator to loop and print (to cout) all the elements of type string stored in a std::vector

2. Given the function isZero use a typedef to name a pointer to such a function zeroComp and make the following program work correctly.

```
bool isZero( int );
// Give typedef

int main() {
  zeroComp ptrIsZero = isZero;
  ptrIsZero(1);
  return 0;
}
```

3. Use the function std::replace\_if to replace all numbers equals 0 in the vector std::vector<int> ivec; with the number 1.

Replace\_if replaces every element in the range [first, last) for which pred returns true with new\_value.

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4. The following code does not work as intended. Explain the error.

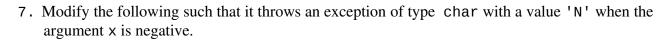
```
class A; class B;
A *objA = new A();
try {
   B* objB= dynamic_cast<B *>(objA);
} catch ( std::bad_cast& except ) {
   cout << "Cast failed!" << endl;
}</pre>
```

5. Use the function std::copy, to copy the content of the array int tab[5]= {1,4,2,7,8};
into std::vector<int> v;

6. What does the following program print?

```
std::auto_ptr<int> pi(new int(4));
std::auto_ptr<int> pj = pi;
cout << pi.get() << endl;</pre>
```

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```
int fct(int x) {
    x+= 2;
    return 3*x;
}
```

8. Given a class Point with class variables  $d_x$  and  $d_y$ . O, define the necessary operation to convert a Point to an integer (the result should be  $d_x*d_x+d_y*d_y$ ).

9. Allocate dynamic memory for a two-dimensional array with 5 columns and 3 rows and assign it to the pointer int \*\*tab;

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ret= m.insert(std::make\_pair<int,float>(3,4.5));

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## PART B: Questions on Selected Topics (13 Marks)

1. Implement the assignment operator for class A such that it implements a deep copy strategy [3].

```
class A {
   int* d_a;
   int d_sz;
public:
   A(int sz=0) : d_sz(sz) {
     d_a = new int[d_sz];
   }
   // other stuff
};

int main() {
   A a1(3), a2;
   a2=a1;
   a1=a1;
   return 0;
}
```

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2. Give an implementation for the postfix increment operator for class Integer [2].

```
class Integer {
   int i;
public:
   // other stuff
};
int main() {
   Integer myInt;
   myInt++;
   return 0;
}
```

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3. Make class A a template with the array type and array size as template parameters and change the main function to behave as before [3].

```
class A {
   static const int sz=3;
   double array[sz];
};
int main A {
   A a;
};
```

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4. Add the functionality to the class Couple for the code below to give the desired output [3].

```
#include <iostream>

class Couple {
    int a,b;
public:
    Couple(int a, int b) : a(a), b(b) {}
    // ...
};

int main() {
    Couple c(3,2);
    // Desired output: c=(3,2)
    std::cout << "c=" << c;
    return 0;
}</pre>
```

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5. Define a function that creates a file and stores the numbers 1 2 3 in a single line. The file name should be passed as argument to the function. [2]

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# **PART C: Programming Questions (16 Marks)**

The class BookShelf is used to organize a bookcase of N shelves. The books on each shelf are entered in a std::list. For greater flexibility, the class BookShelf is defined using a template.

```
#include <iostream>

template <typename T, int N=3>
class BookShelf {

   std::list<T> shelves[N];

public:

   T operator()(int shelfNumber, int elementNumber) const;
   BookShelf<T,N> operator+=(const T& element);
   BookShelf<T,N> operator--();
   int getNumberOfShelves() const {return N;}
   bool find(const T &element) const;
};
```

1. Suppose a class Livre has been defined, declare a bookcase (an object of type BookShelf) which contains 5 shelves [2].

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2. Define the operator += such that it inserts an element in the shelf with the fewest elements (in case two shelves have an equal number of elements, use the shelf with the lower index) [3].

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3. Define the operator () such that the call bookcase(i,j) returns the  $j^{th}$  element in the shelf i by value [3].

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4. Define the operator -- such that --bookcase; removes the last element of the shelf that contains the most elements. [3].

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5. Define the method find returning true if the element is in the BookShelf. Your function must use std::find for each shelf in the class BookShelf [3].

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6. The class BookShelf does not contain a default constructor, copy constructor, assignment operator = or a destructor. Explain why those are not necessary for this class [2].

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