

NAME: Ameet Kumar Upadhyay (71791181) AB

CSCI 589-2

Midterm Exam
Closed Book & Notes
(180 points)

Spring 2016

2. Write a C++ program that calculates a car's gas mileage. The program should ask the user to enter the number of gallons of gas the car can hold and the number of miles it can be driven on a full tank. It should then display the number of miles that may be driven per gallon of gas.

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

int main()
{
    double gallons_of_gas = 0.0d;
    double miles_driven = 0.0d;
    double miles_per_gallon = 0.0d;
    cout << "Enter number of gallons of gas & miles-driven" << endl;
    cin >> gallons_of_gas >> miles_driven;
    miles_per_gallon = miles_driven / gallons_of_gas;
    cout << "Number of miles driven per gallon:" << miles_per_gallon
        << endl;
}
```

return 0;

Assignment no 3

- year first for - value, $-5 + 2 = 2$
 $-5 - 4 - 3 - 1 = 2$
- month first ~ 50 $\sim 4 \neq 4$ $\sim 3 \neq 2$
- days first $\sim 2 = 2$

2. Assume the variables $x = 5$, $y = 6$, and $z = 8$. Indicate by circling the T or F whether each of the following conditions is true or false:

- (a) $x == 5 \quad || \quad y > 3$ T F
- (b) $7 <= x \quad \&\& \quad z > 4$ T F
- (c) $2 != y \quad \&\& \quad z != 4$ T F
- (d) $x >= 0 \quad || \quad x <= y$ T F

$$x = 5$$

$$y = 6$$

$$z = 8$$

8. Write a C++ program to add integers between a and b (inclusive), where $a \leq b$.

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

int main()
{
    int a, b;
    int sum = 0;

    cout << "Enter a & b" << endl;
    cin >> a >> b;

    if (a > b)
        cout << "Enter correct number" << endl;

    else
    {
        for (int i=a ; i<=b ; i++)
        {
            sum = sum + i;
        }

        cout << "Sum is :" << sum << endl;
    }

    return 0;
}
```

4) Convert the following while loop to a for loop:

```
int count = 0;  
while ( count < 10 ) {  
    cout << "count is " << count << endl;  
    count++;  
}
```

while count < 10

```
int count = 0;  
for ( int i = 0 ; i < 10 ; i++ )  
{  
    cout << "count is " << i << endl;  
}
```

5. What is the output of the following C++ program?

```
void test ( int = 2, int = 4, int = 6 );
int main ( )
{
    test ( ); test ( 6 ); test ( 3, 9 ); test ( 1, 5, 7 );
    return 0;
}

void test ( int first, int second, int third )
{
    first += 3; second += 6; third += 9;
    cout << first << " " << second << " " << third << endl;
}
```

Output :

5 10 15 /
9 10 15 /
6 15 15 /
4 11 16 /

1. 2+3	4+6	9+6
2. 6+3	6+4	6+9
3. 3+3	9+6	6+9
4. 1+3	6+5	2+9

⇒ The below written program is actually returning the remainder dividing by 10.

- Q. What is the purpose of the following C++ function?

```
unsigned F( unsigned n )  
{  
    unsigned s = 0;  
    while (n > 0) {  
        s += n % 10;  
        n /= 10;  
    }  
    return s;  
}
```

Eg:- if

$$n = 123$$

$$s = (n \% 10) + s = 3$$

$s = 0$ $n = 500$
Let $n = 123$ $s = 0$
 s $n = 575$
 $s = 5$
 $\rightarrow s = 3$
 $s = 0$; return $s = 3$

- The above function in every value "unsigned" is returning $s = 0$.

- For example,

Let $n = 123$,
 $s = s + (n \% 10) = 3$
 $s = s / 10 = 3 / 10 = 0$
return $s = 0$

Let $n = 100$
 $s = s + (n \% 10) = 0$
 $s = s / 10 = 0 / 10 = 0$
return $s = 0$

Let $n = 575$
 $s = s + (n \% 10) = 5$
 $s = s / 10 = 5 / 10 = 0$
return $s = 0$

- Hence, every time, the

$s = 0$ $n = 100$ $123 \% 10$
 $s = 0$ $s = 3$
 $s = 0$ $n = 12$
Let $n = 525$
 $s = 5$
 $s = s / 10 = 0$
return $s = 0$

- The purpose of C++ function is returning the remainder after dividing by 10.

• For eg: for $n = 123 \rightarrow s = n \% 10 = s = 3$

return $s = 3$

for $n = 500 \rightarrow s = n \% 10 = s = 0$

return 0

for $n = 575 \rightarrow s = n \% 10 = s = 5$

return 5 ;

- Hence, the function is useful in returning the remainder,

above function will return '0'.

7

7. Write a C++ program segment for the followings:

- Create an empty C++ string.
- Assign the name "Michael J. Fox" to the string.
- Erase the middle initial of the name in the string.
- Replace the first name "Michael" with "Mike" in the string.
- Create a new string from the existing one as the name in the new string will be "Fox, Mike".

```
#include <iostream>
#include <string>
```

```
int main()
{
```

```
    string str = " ";
```

```
    str = " Michael J. Fox" ;
```

```
    str = str.erase(8, 1);
```

```
    str = str.replace(0, 7, "Mike");
```

```
    string str1 = str.substr(0, 4);
```

```
    string str2 = str.substr(5);
```

```
    string str3 = str2 + string(" ") + str1;
```

3

1 2 3 4 5 6
Michael - J. - Fox
1 2 2 4 5 6 7 8 9 0 1 1 2 3 4

Michael - J. - Fox
0 1 2 3 4 5 6 7 8 9 0 1 1 2 3

Mike Fox
0 1 2 3 4 5 6 7

8. An empty list container is declared as `list < int > List`. Write C++ statements for the followings:

- (a) Add integers 13, 75, 28, and 35 in List.
- (b) Double the value of each element in List.
- (c) Print out the contents of List on stdout on a single line separated by spaces.

```
list <int> List;
```

```
list.insert(13);  
list.insert(75);  
list.insert(28);  
list.insert(35);
```

```
list <int> :: iterator i;
```

```
for (i = List.begin(); i != List.end(); i++)  
{
```

~~i~~ *i = (*i) * 2;
~~*i = (*i) * 2;~~

```
}
```

```
for (i = List.begin(); i != List.end(); i++)
```

```
{
```

`cout << *i << " "`

```
}
```

Q. What is the output of the following C++ program?

```
int main ()  
{  
    map < string, unsigned > m;  
  
    m [ "freshman" ]; m [ "sophomore" ]; m [ "junior" ]; m [ "senior" ];  
    m [ "graduate" ]; m [ "freshman" ]++; m [ "sophomore" ] += 3; m [ "junior" ] += 8;  
    m [ "senior" ] += 5;  
  
    map < string, unsigned > :: const_reverse_iterator p = m.rbegin ( );  
    while ( p != m.rend ( ) ) {  
        cout << p->first << ":" << p->second << endl; p++;  
    }  
  
    return 0;  
}
```

Output :

Sophomore : 3

Senior : 5

~~Junior : 8~~

Graduate : 0

Freshman : 1

Freshman = 0 1

Sophomore = 0 3

Junior = 0 8

Senior = 0 5

Graduate = 0

Fresh = 1

Grad = 0

Junior = 8

Senior = 5

Sophomore = 3

10. What will the following C++ program display on the screen?

```
class Tank {  
    unsigned gallons;  
public:  
    Tank ( const unsigned& gal = 50 ) : gallons ( gal ) { }  
    unsigned getGallons ( ) const { return gallons; }  
};  
  
int main ( )  
{  
    Tank storage [ 3 ] { 10, 20 };  
  
    for ( int i = 0; i < 3; i++ ) cout << storage [ i ].getGallons ( ) << endl;  
  
    return 0;  
}
```

Output -

10
20
50

11. What is the output of the following C++ program?

```
string intToString ( const int& );  
  
class Date {  
    friend ostream& operator<< ( ostream&, const Date& );  
public:  
    Date ( const string& s ) { stringToDate ( s ); }  
    void setDate ( const string& s ) { stringToDate ( s ); }  
private:  
    int day, month, year;  
};  
  
void Date :: stringToDate ( const string& s )  
{  
    char a, b;  
    istringstream is ( s );  
    is >> day >> a >> month >> b >> year;  
}  
  
ostream& operator<< ( ostream& os, const Date& d )  
{  
    os << intToString ( d.month ) << " " << d.day << ", " << d.year;  
    return os;  
}  
  
int main ( )  
{  
    Date peace ( "11-11-1918" );  
    cout << "World War I ended on " << peace << ".\n";  
  
    peace.setDate ( "14/8/1945" );  
    cout << "World War II ended on " << peace << ".\n";  
    return 0;  
}  
  
string intToString ( const int& n )  
{  
    switch ( n ) {  
        case 1: return "January"; case 2: return "February";  
        case 3: return "March"; case 4: return "April";  
        case 5: return "May"; case 6: return "June";  
        case 7: return "July"; case 8: return "August";  
        case 9: return "September"; case 10: return "October";  
        case 11: return "November"; case 12: return "December";  
        default: return "";  
    }  
}
```

Output:

World War I ended on November 11, 1918.
World War II ended on August 14, 1945.

- ~~+ 2/5~~
12. Write a function template Max () that returns the maximum value of its three arguments. For example, Max (3, -2, 5) should return 5 and Max ("abc", "XYZ", "ABC") should return abc.

< Template T >

+
Max (T &a, T &b, T &c)
{

T x , Ty , Tz ;

x =a , y =b , z =c ;

if (x > y && x > z)

return x ;

else if (y > x && y > z)

return y ;

else

return z ;

}

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9.3/27.9

CSCI 689-2

Quiz 1
Closed Book & Notes

Spring 2016

10 points
~~3~~

1. Assuming x is 5, y is 6, and z is 8, indicate by circling the T or F whether each of the following relational expressions is true or false:

- a) $x = 5$ T F
b) $7 \leq (x + 2)$ T F
c) $z < 4$ T F
d) $(2 + x) != y$ T F
e) $z != 4$ T F
f) $x \geq 9$ T F
g) $x \leq (y * 2)$ T F X

2. Write a C++ program that calculates a user's pay. The program reads the number of hours that the user worked and the amount paid per hour from stdin, and then computes the total pay for the user and displays it on stdout.

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

int main()
{
    double hours = 0.00d;
    double amount = 0.00d;           // Amount per hours
    double total_amount = 0.00d;
    cout << "Please enter hours & amount" << endl;
    cin >> hours >> amount;
    total_amount = hours * amount;
    cout << "Total Pay for user is " << total_amount << endl;

    return 0;
}
```

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CSCI 689-2

Quiz 2
Closed Book & Notes
(30 points)

Spring 2016

1. Circle the best answer for each following C++ segments:

a) if (60 <= 12 + 5)
cout << "Hello";
cout << " There ";

outputs the following:

- (i) Hello There (ii) Hello
(iii) Hello There (iv) There

b) if ('a' > 'b' || 'B' > 'A')
cout << "#*#" << endl;

outputs the following:

- (i) #*# (ii) #
* (iii) * (iv) none of these
#

c) if (7 <= 7)
cout << 6 - 9 * 2 / 6 << endl;

outputs the following:

- (i) -1 (ii) 3 (iii) 3.0 (iv) none of these

d) if (7 < 8) {
cout << "2 4 6 8" << endl;
cout << "1 3 5 7" << endl;
}

outputs the following:

- (i) 2 4 6 8 (ii) 1 3 5 7 (iii) none of these
1 3 5 7

e) if (5 < 3)
cout << "*";
else if (7 == 8)
cout << "&";
else
cout << "\$";

outputs the following:

- (i) * (ii) & (iii) \$ (iv) none of these

2. Suppose the input is 5. What is the value of alpha after the following C++ code executes?

```
cin >> alpha;
switch ( alpha ) {
case 1:
case 2:
    alpha += 2;
    break;
case 4:
    alpha++;
case 5:
    alpha *= 2;    10 +  
case 6:
    alpha += 5;    + 5 = 15
default:
    alpha--;
}
```

$$9. \quad \underline{14.}$$

Answer:

~~20~~

5 x 10.

5

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CSCI 689-2

Quiz 3
Closed Book & Notes
(30 points)

Spring 2016

~~3~~

- Suppose that you have declared and initialized the variables s and t like this:

string s = "ABCDE", t = "";

Given these declarations, what is the effect of each of the following calls?

- a. s.length () 5
- b. t.length () 0
- c. s[2] C
- d. s+t A B C D E
- e. t += 'a' X
- f. s.replace (0, 2, "Z") Z Z Q D E
- g. s.substr (0, 3) A B
- h. s.substr (4) E
- i. s.substr (3, 9) D E
- j. s.substr (3, 3) D E

Q1.
Z C D E

A B C D E
↑

Z Z C D E

Indice APPA
0 1 2 3 4 5 6 7 8

$$\begin{array}{r} a = 97 \\ 2 - 122 \end{array} \quad \begin{array}{r} A = 65 \\ 2 - 90 \end{array}$$

X-10

2. Write a C++ function capitalize (str) that returns a string in which the initial character is capitalized (if it is a letter) and all other letters are converted to lowercase. Characters other than letters are not affected. For example, both capitalize ("BOOLEAN") and capitalize ("boolean") should return the string "Boolean".

```
#include <iostream>
#include <string>
using namespace std;
string capitalize (string n);
int main()
{
    string s;
    cout << "Please enter string" >>
    cin >> s;
    string c=capitalize (s);
    cout << c << endl;
}

string capitalize (string n)
{
    for (int i=0 ; i<=0 ; i++)
    {
        if (s[i]>65 && s[i]<102)
            s[i]= if (s[i]<90 || s[i]<122)
                    if s[i]<90 || s[i]<122
                    {
                        s[i]=(to_upper)(s[i])
                    }
    }
    for (int i=1 ; i<=str.length(n) ; i++)
    {
        if (s[i]>65 && s[i]<102)
            if (s[i]<90 || s[i]<122)
                s[i]=(to_lower)(s[i])
    }
    return n;
}
```

*I can give you {
more pts if you can
show me that
this works!*

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CSCI 689-2

Quiz 4
Closed Book & Notes
(30 points)

Spring 2016

1. What is the output of the following C++ program?

```
const unsigned N = 5;

int main ()
{
    vector< int > v;
    cout << v.size() << endl;

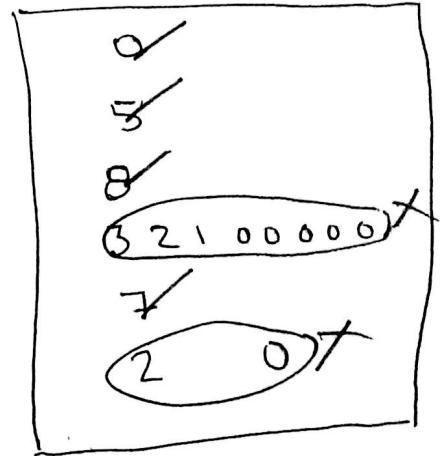
    v.resize(N); cout << v.size() << endl;
    v.push_back(1); v.push_back(2); v.push_back(3);
    cout << v.size() << endl;

    for (unsigned i = 0; i < v.size(); i++) cout << v[i] << ',';
    cout << endl;

    v.pop_back(); cout << v.size() << endl;
    cout << v.front() << '\t' << v.back() << endl;

    return 0;
}
```

Ans :-



0
5

5

1, 2, 3

5

i = 0 : < 5 i++

0 0 0 0
1 2 3 0

0
5
5
3 2 1 0 0
2 1 0 0
2 1 0 0
1

X-12.5

2. In statistics, a collection of data values is often referred to as a *distribution*. The most common statistical measure is the *mean*, which is simply the traditional average. Write a C++ function: double mean (const vector < double >& data); that returns the mean of the data in the vector.

```
const &  
double mean  
{  
    vector < double > d(10);  
    double sum = 0.0d;  
    for (unsigned int i=0; i < d.size(); i++)  
    {  
        cin >> d[i];  
        if (d.size() == i)  
            d.resize(d.size() + 1);  
    }  
    for (unsigned int i=0; i < d.size(); i++)  
    {  
        sum += d[i];  
    }  
    sum double mean = sum / (d.size());  
    cout << mean << endl;  
}
```

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CSCI 689-2

Quiz 5
Closed Book & Notes
(30 points)

Spring 2016

1. What is the output of the following C++ program?

```

int main ()
{
    vector < int > v { 4, 8, 12, 16, 20 };
    for ( const int& x : v ) cout << x << ' '; cout << endl;

    list < int > l ( v.begin ( ) + 1, v.end ( ) - 1 );
    for ( const int& x : l ) cout << x << ' '; cout << endl;

    l.push_front ( -4 ); l.push_back ( 24 );
    for ( const int& x : l ) cout << x << ' '; cout << endl;

    list < int > :: iterator p = l.insert ( ++l.begin ( ), 0 );
    cout << *p << endl;

    l.erase ( ++l.begin ( ), --l.end ( ) );
    cout << l.size ( ) << endl;

    return 0;
}

```

}

vector <id> := the i;
for (i := begin(); i <= next());
* i

17

4 2 3 4 5 6 ↘
0 1 2 3 4 5 7

1 6

1, 6

10

2. Write a C++ program (a) to read an English text from the stdin, one word at a time, and store those words in the set < string > container called words, and (b) to display the contents of two-letter words in the words on stdout in alphabetical order.

```
#include <string>
#include <iostream>

#include <set>
using namespace std;
int main()

{
    Set <string> word;

    Set <string> :: iterator i;
    cout << "Enter string" << endl;
    for(;; string first, second)
        while ((cin >> word >> second))
    {
        first = first + second;
        word word.insert(first);
    }
    for (i = word.begin(); i != word.end(); i++)
    {
        cout << *i << endl;
    }
    return 0;
}
```

This points
to current
cell

}

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CSCI 689-2

Quiz 6
Closed Book & Notes
(30 points)

Spring 2016

1. What is the output of the following C++ program? Note: the default value of int type is 0.

```
typedef map < string, int > :: const_iterator l;

int main ()
{
    map < string, int > m;
    m [ "peach" ]; m [ "apple" ]; m [ "kiwifruit" ]; m [ "pear" ];
    m [ "starfruit" ]; m [ "grape" ]; m [ "orange" ];
    m [ "pear" ]++; m [ "apple" ]++; m [ "pear" ]++;

    for ( l p = m.begin ( ); p != m.end ( ); p++)
        cout << p->first << ':' << p->second << endl;

    return 0;
}
```

Apple : 1

Grape : 0

Kiwifruit : 0

Orange : 0

Peach : 0

Pear : 2

Starfruit : 0

P first = 0

A apple : 0 2
K kiwifruit : 0
P pear : 0 2 2
S starfruit : 0
G grape : 0
O orange : 0

2. Consider the definition of the following class:

```
class Test {  
public:  
    int sum ( );           // returns the sum of private data members  
    void print ( );        // prints out values of private data members  
    Test ( );              // default constructor – initializes private data  
                          // members to 0  
    Test ( int a, int b ); // constructor – initializes private data members to  
                          // values a and b, respectively  
  
private:  
    int x, y;  
};
```

- (a) Write the implementations of the member functions as described in the definition of the class Test.
 - (b) Write a prototype of a new constructor of the class Test that combines the prototypes of its existing two constructors into a single one by using the default values.

97

Test (int a, int b)
{
 a = a ;

Test()
{
 ~~x = 0;~~
 y = 0;
}

```
int sum ()  
{  
    int c = x + y;  
    return c;  
}
```

```
void print()  
{
```

(out) << "x" = "<< (at end);
(out) << "y" = "<< ~~at~~ (end)

b) Public:

~~Test(int a, int b) \Rightarrow Test(int a=0, int b=0)~~
 {
 a = 0;
 b = 0;
 x = a;
 y = b;
 }
 { x = a; y = b; }

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CSCI 689-2

Quiz 7
Closed Book & Notes
(30 points)

Spring 2013

1. Here is a class interface for the rational numbers in the form of n/d, where n refers to the numerator and d refers to the denominator of a rational number:

class R

friend bool operator== (const R& r1, const R& r2); // relational operator
public:

R (const int& n = 0, const int& d = 1); // constructor
R (const R& r); // copy constructor
R& operator= (const R& r); // assignment operator

private:

int num, den; // numerator and denominator
};

Show the implementation of the overloaded relational (==) operator. Do not assume that the input arguments (rational numbers) are given in a reduced form and do not reduce those numbers.

R bool :: operator== (const R& r1, const R& r2)

{

if (r1.num == r2.num && r1.den == r2.den)
return true;

else

return false;
if $r1 = \frac{1}{2}$ and $r2 = \frac{2}{4}$,
→ not true false!



$$\frac{a}{b} = \frac{k \cdot a}{k \cdot b}$$

$$\therefore k(a+b) = k(a+b)$$

$$\text{return } (r1.num * r2.den - r2.num * r1.den) \neq 0;$$

1

- 2
2. Write a C++ *function template*, named Swap(), that can be used to swap the values of its two arguments. See the following example program for a usage of this function:

```
int main()
{
    int x = 5, y = 7; Swap(x, y);
    string s = "ABC", t = "XYZ"; Swap(s, t);
    return 0;
}
```

Void Swap (const T& a, const T& b)

{

T c :

c = a ;

a = b ;

b = c ;

Template < class T >

(class X {

T a, b;

Public : x (const T& aa = T(), const T& bb = T());
 a(aa), b(bb) {} }

↓

template < class T >
 void Swap (T &x, T &y)
 { x = y, y = x; }

T::Swap (const

{ return Swap(a, b);

}

} :

template < class T > X .

class X {

T a, b : cols v

Public :

x (const T& aa = T(), const T& bb = T());
 a(aa), b(bb) {} }

} :

T::Swap (const { return Swap(a, b);

2

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CSCI 689-2

Quiz 8
Closed Book & Notes
(30 points)

Spring 2016

1. Consider the following statements:

```
class A {  
public:  
    A ( const unsigned& = 1 ); // constructor, where the argument is  
                           // default size for an object  
    A ( const A& ); // copy constructor  
    A& operator= ( const A& ); // assignment operator  
    ~A (); // destructor  
private:  
    unsigned sz; // size of array  
    int* p; // points to integer array  
};
```

- a) Show the implementation of the *constructor*. Assign consecutive integers to the elements of the integer array, starting from 1.
- b) Show the implementation of the *copy constructor*.
- c) Show the implementation of the *assignment operator*.
- d) Show the implementation of the *destructor*.

a) $A::A(\text{const unsigned\&} s): \text{sz}(s)$

```
P = new int[sz];  
unsigned m = 1,  
for (unsigned i = 0; i < sz; i++)  
{  
    P[i] = m,  
    m++;  
}
```

$\cancel{A::operator=(\text{const A\&} a)}$
 $\{$
 $\quad \text{if } (\text{this} \neq \&a)\{$
 $\quad \quad \text{delete}[\cancel{P}]$
 $\quad \quad P = 0,$
 $\quad \quad \text{sz} = a.\text{sz};$
 $\quad \quad P = \text{new int}[\text{sz}];$
 $\quad \}$
 $\quad \text{return } * \text{this};$

b) $A::A(\text{const A\&} a): \text{sz}(a.\text{sz})$

```
P = new int[sz],  
for (unsigned i = 0; i < sz; i++)  
    P[i] = a.P[i],
```

$\cancel{A::operator=(\text{const A\&} a)}$
 $\{$
 $\quad \text{delete}[\cancel{P}],$
 $\quad P = 0;$

2. Write a C++ program with the function `createIndexArray(n)` that allocates a dynamic array of n integers, in which each integer is initialized to its own index, and it returns the address of this array. The `main()` routine gets the value n from `stdin`, calls the function `createIndexArray()`, and prints out the values in the returned array on `stdout`.

```

class DynamicArray {
public:
    DynamicArray( const int& = 0 );
    int createIndexArray( const int& n );
    void print( ) const;
private:
    int n;
    int * p;
};

DynamicArray::DynamicArray( const int& s ) : n(s) {}

DynamicArray::int createIndexArray( const int& n )
{
    int * p = new int [n];
    for (unsigned i=0; i<n; i++)
    {
        p[i] = i;
    }
    return *this;
}

DynamicArray::print( ) const
{
    cout << "For unsigned i=0; i<n; i++"
    cout << " value is " << p[i] << endl;
}

int main()
{
    cout << "Enter n";
    cin >> n;
    DynamicArray d = new int (n);
    d.createIndexArray( n );
    d.print( );
    return 0;
}

```

NAME: Ameet Kumar Upadhyay (1791181)

CSCI 689-2

Quiz 9
Closed Book & Notes
(30 points)

94
Spring 2016

1. What is the output of the following C++ program?

```
class B {  
public:  
    B ( string s = " ", int a = 0 );  
    void print () const;  
protected:  
    int x;  
private:  
    string str;  
};
```

```
class D : public B {  
public:  
    D ( string s = "", int a = 0, int b = 0 );  
    void print () const;  
private:  
    int y;  
};
```

```
B :: B ( string s, int a ) : x ( a ), str ( s ) { }  
void B :: print () const { cout << x << " " << str << endl; }
```

```
D :: D ( string s, int a, int b ) : B ( "Hello Base", a + b ), y ( b ) { }  
void D :: print () const { cout << "Derived class: " << y << endl; B :: print ( ); }
```

```
int main ( )  
{  
    B b ( "This is the base class", 2 );  
    D d ( "DDDDDD", 3, 7 );  
  
    b.print (); d.print ();  
    return 0;  
}
```

Output :-

2 This is the base class
Derived class: 4
10 Hello Base

2 This is base class

cout << a << endl
10 Hello Base

2. The following class can be used to represent long integers in a computer system:

```
class longInt {  
public:  
    ~longInt ( long = 0, unsigned long = 0 );  
    longInt ( const longInt& );  
    longInt& operator= ( const longInt& );  
    ~longInt ( );  
    void print ( ) const;  
private:  
    long msp; // most significant part  
    unsigned long lsp; // least significant part  
};
```

The following is a test program for this class:

```
int main ()  
{  
    longInt x, y ( 1 ), z ( 1, 2 ), u ( z );  
  
    cout << "x = "; x.print ( ); cout << endl;  
    cout << "y = "; y.print ( ); cout << endl;  
    cout << "z = "; z.print ( ); cout << endl;  
  
    cout << "u = "; u.print ( ); cout << endl;  
    u = y; cout << "u = "; u.print ( ); cout << endl;  
  
    longInt v = longInt ( 0xff, 0xffffffff0 );  
    cout << "v = "; v.print ( ); cout << endl;  
    return 0;  
}
```

And the output is:

```
x = ( 0x0, 0x0 )  
y = ( 0x1, 0x0 )  
z = ( 0x1, 0x2 )  
u = ( 0x1, 0x2 )  
u = ( 0x1, 0x0 )  
v = ( 0xff, 0xffffffff0 )
```

Show the implementation of all member functions of the class longInt. Your print () function should print all objects of longInt in hexadecimal form.

5) longInt :: ~longInt ()

```
{  
    msp = 0 ;  
    lsp = 0 ;  
}
```

2

NAME: Ameeet Kumar Upadhyay (Z1791181)**CSCI 689-2**

Quiz 10
Closed Book & Notes
(30 points)

Spring 2016

1. Suppose that you have the following classes, A and B:

```
class A {
public:
    A ( int = 0 );
    void f ( );
    virtual void print ( ) const;
private:
    int x;
};
```

```
A :: A ( int a ) : x ( a ) { }
void A :: f ( ) { x *= 2; }
void A :: print ( ) const {
    cout << "A :: x = " << x << endl;
}
```

$x=2$
 $x=4$

```
class B : public A {
public:
    B ( int = 0, int = 0 );
    void f ( );
    void print ( ) const;
private:
    int y;
};
```

```
B :: B ( int a, int b ) : A ( a ), y ( b ) { }
void B :: f ( ) { A :: f ( ); y *= 2; }
void B :: print ( ) const {
    A :: print ( ); cout << "B :: y = " << y << endl;
}
```

$A :: x = 4$

$A :: x = 6$

$B :: y = 5$

- (a) What is the output of the following program?

```
int main ( )
{
    A* p; A a ( 2 ); B b ( 3, 5 );

    p = &a; p->f ( ); p->print ( );
    p = &b; p->f ( ); p->print ( );

    return 0;
}
```

Output:

$A :: x = 4$
 $A :: x = 6$
 $B :: y = 5$

- (b) What is the output of the previous program if the definition of the class A is replaced by the following definition?

```
class A {
public:
    A ( int = 0 );
    virtual void f ( );
    virtual void print ( ) const;
private:
    int x;
};
```

Output:

$A :: x = 4$
 $A :: x = 6$
 $B :: y = 10$

X-2.5

2. The following is a partial definition of the Vector class template:

```
template < class T > class Vector {  
public:  
    Vector ( const unsigned& =1 ); // default constructor  
    Vector ( const Vector < T >& ); // copy constructor  
    ~Vector ( ); // destructor  
    Vector < T >& operator= ( const Vector < T >& ); // assignment operator  
    T& operator [ ] ( const int& ) const; // subscription operator  
    unsigned size ( ) const; // returns size of an object  
    void print ( ) const; // prints elements of an object  
private:  
    bool replace ( const T& x, const T& y ); // size of an object  
    unsigned sz; // points to data segment  
    T* data;  
};
```

Modify this class template so that you add the member function, bool replace (const T& x, const T& y), which can be used to search for value x in a Vector object. If x is found, it replaces the first occurrence of x by y and returns true; otherwise, it returns false. Show your implementation of this function template.

```
template < class T >  
bool vector :: replace ( const T& x, const T& y )  
{  
    data = new T [sz];  
    for ( unsigned i=0 ; i<sz ; i++ )  
    {  
        if ( data [i] == x )  
        {  
            data [i] = y ;  
            return true;  
        }  
    }  
    return false;  
}
```

```
template < class T >  
bool vector :: replace ( const T& x, const T& y )  
{  
    data = new T [sz];  
    for ( unsigned i=0 ; i<sz ; i++ )  
    {  
        if ( data [i] == x )  
        {  
            data [i] = y ;  
            return true;  
        }  
    }  
}
```

NAME: Ameet Kumar Upadhyay (21791181) 21

CSCI 689-2

Quiz 11
Closed Book & Notes
(30 points)

Spring 2016

- ✓ 1. What is the output of the following C++ program?

```
void func ( int );  
  
int main ( )  
{  
    int x = 10;  
  
    cout << func ( x ) << endl;  
    return 0;  
}  
  
int func ( int num )  
{ return num <= 0 ? 0 : func ( num - 1 ) + num; }
```

Output : 55

Answer: 55

If num = 0.
→ 0.

∴ 10 + (10 - 1) 55

10 + 9 + 8 + 7 + 6 + 5 + 4 + 3 + 2 + 1 + 0 = 55

2. Spherical objects, such as cannonballs, can be stacked to form a pyramid with one cannonball at the top, sitting on top of a square composed of four cannonballs, sitting on top of a square composed of nine cannonballs, and so forth. Write a recursive C++ function cannonball() that takes as its argument the height of the pyramid and returns the number of cannonballs it contains. Your function must operate recursively and must not use any iterative constructs, such as while or for.

```

int cannonball (int height)
{
    if (height == 0)
        return 0;
    else
    {
        return ((height * height) + cannonball(height - 1));
    }
}

```

0 0 0
0 0 0 0 0
0 0 0 0 0 0
0 0 0 0 0 0 0
0 0 0 0 0 0 0 0

0 0 0
0 0 0
0 0

int cannonball (height)

height = 0

0

height = height - 1

height = height - 1
height = height - 1

0 → 0
1 → 4 → 2²
4 → 4 → 2³ × 2
16 → 16 → 2
→ 2

0 0 0
0 0 0
0 0

0 0 0 0 0

0 0 0
0 0 0
0 0

height = 0 → 2
height = 1 → 4
height = 2

NAME: Anup Kumar Upadhyay (Z1791181)
CSCI 689-2

Quiz 12
Closed Book & Notes
(30 points)

Spring 2016

- X 1.5
1. The following is the implementation of an *iterative* binary search function: int iterative_search (const vector<int>& v, int x), where v is a vector of integers and x is the search value. The function returns the index in vector v for the value x if the *recursive* version of this function with the prototype: int recursive_search (const vector<int>& v, int x, int low, int high), where low and high are the index values in vector v to search the value x in the range [low, high].

```
int iterative_search ( const vector<int>& v, int x )  
{  
    int low = 0, high = v.size() - 1.  
  
    while ( low <= high ) {  
        int mid = ( low + high ) / 2;  
        if ( x == v[ mid ] ) return mid;  
        else if ( x < v[ mid ] ) high = mid - 1;  
        else low = mid + 1;  
    }  
  
    return -1;  
}
```

```
int recursive_search ( const vector<int>& v, int x, int low, int high )  
{  
    if ( low == high && low != x )  
        return -1;  
    else if ( low == high && low == x )  
        return low;  
    else {  
        int mid = low + high;  
        if ( x == v[mid] ) return mid;  
        else if ( x < v[mid] ) {  
            high = mid - 1;  
            return recursive_search ( v, x, low, high );  
        }  
        else {  
            low = mid + 1;  
            return recursive_search ( v, x, low, high );  
        }  
    }  
}
```

3
int mid = low + high
if x == v[mid] return mid
else if x < v[mid] high = mid - 1
return recursive_search (v, x, low, high);

{ (low == high) if low == x
return -1;

$$(1,1) \rightarrow A(0, A(1,0))$$

↓
0,1 (0,3)

2. The Ackermann's Function is a *recursive* mathematical algorithm that can be used to test how well a computer performs recursion.

$A(0, A(1,1))$

a) Write a function $A(m, n)$ that solves the Ackermann's Function. Use the following logic in your function:

$A(0, A(1,0)) \rightarrow A(0,1) \leftarrow 0$.

If $m = 0$ then return $n + 1$

o. If $n = 0$ then return $A(m - 1, 1)$

Otherwise, return $A(m - 1, A(m, n - 1))$

b) What is the output of each of the following function calls?

$A(0,0), A(0,1), A(1,1), A(1,2), A(1,3), A(2,2)$, and $A(3,2)$.

$\Delta(1,2) \Rightarrow 4$

a)

$\{ \quad A(\text{int } m, \text{int } n)$

if ($m == 0$)

return $n + 1$;

else if ($n == 0$)

return $A(m - 1, 1)$;

else

return $A(m - 1, A(m, n - 1))$;

}

$A(3,2)$

\downarrow
 $A(2, A(3,1))$

\downarrow
 $A(2, A(3,0))$

\downarrow
 $(4,4)$

\downarrow
 $A(2,1)$

\downarrow
 $A(1, A(2,0))$

\downarrow
 $4(1,2)$

\downarrow
 $A(1,1)$

\downarrow
 $A(0, A(1,0))$

\downarrow
 $A(0,1)$

\downarrow
 2

b) $A(0,0) \Rightarrow 1$

$(0,1)$

$A(0,1) \Rightarrow 2$

$A(1,1) \Rightarrow 3$

$A(1,2) \Rightarrow 4$

$A(1,3) \Rightarrow 5$

$A(2,2) \Rightarrow 7$

$A(3,2) \Rightarrow 97 < 2^9$

2

NAME: Khaja Moinuddin Mohammad

CSCI 689-2

Quiz 6
Closed Book & Notes
(30 points)

Spring 2016

- +15
1. What is the output of the following C++ program? Note: the default value of int type is 0.

```
typedef map < string, int > :: const_iterator ;  
  

int main ( )  

{  

    map < string, int > m;  
  

    m [ "peach" ]; m [ "apple" ]; m [ "kiwifruit" ]; m [ "pear" ];  

    m [ "starfruit" ]; m [ "grape" ]; m [ "orange" ];  

    m [ "pear" ]++; m [ "apple" ]++; m [ "pear" ]++;  
  

    for ( | p = m.begin ( ); p != m.end ( ); p++)  

        cout << p->first << ':' << p->second << endl;  
  

    return 0;  

}
```

Any peach : apple : kiwifruit : pear : starfruit
grape : 0

apple X pear

X → 15
2. Consider the definition of the following class:

```
class Test {  
public:  
    int sum ( );           // returns the sum of private data members  
    void print ( );        // prints out values of private data members  
    Test ( );              // default constructor – initializes private data  
                          // members to 0  
    Test ( int a, int b ); // constructor – initializes private data members to  
                          // values a and b, respectively  
private:  
    int x, y;  
};
```

- (a) Write the implementations of the member functions as described in the definition of the class Test.
- (b) Write a prototype of a new constructor of the class Test that combines the prototypes of its existing two constructors into a single one by using the default values.

(a) X

(b) Test (int a, ~~int~~ b, 0);

NAME: Khaja Moinuddin Mohammad

Spring 2016

CSCI 689-2

Quiz 8
Closed Book & Notes
(30 points)

1. Consider the following statements:

```
class A {  
public:  
    A ( const unsigned& = 1 ); // constructor, where the argument is  
                           // default size for an object  
    A ( const A& ); // copy constructor  
    A& operator= ( const A& ); // assignment operator  
    ~A (); // destructor  
private:  
    unsigned sz; // size of array  
    int* p; // points to integer array  
};
```

- a) Show the implementation of the *constructor*. Assign consecutive integers to the elements of the integer array, starting from 1.
- b) Show the implementation of the *copy constructor*.
- c) Show the implementation of the *assignment operator*.
- d) Show the implementation of the *destructor*.

a) ~~A :: A [Const unsigned& n]~~ : Sz(n) {
 P = new int [Sz];
 unsigned j = 1;
 for (unsigned i=0; i < Sz; i++)
 { P[i] = j, j++ }

~~d). A :: A.~~
{
 delete [] P;
 P = 0
}

b) ~~A [Const A & a]~~ {
 P = new int (Sz);
 for (unsigned i=0; i < Sz; i++)
 { P[i] = a * P[i]; }

c) ~~A & A:: operator=(Const A & a)~~
if (~~this != a~~) {
 delete [] P;
 P = 0;
 Sz = a.Sz; → P = new int[Sz], return ~~*this~~ };

2. Write a C++ program with the function createIndexArray (n) that allocates a dynamic array of n integers, in which each integer is initialized to its own index, and it returns the address of this array. The main () routine gets the value n from stdin, calls the function createIndexArray (), and prints out the values in the returned array on stdout.

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

CreateIndexArray(unsigned int n);
int main () {
    unsigned n = 0;
    cout << "Enter the Value of n" << endl;
    cin >> n;
    CreateIndexArray(n);

    return 0;
}

CreateIndexArray(unsigned int n) {
    int *p = new int [n];
    for (unsigned i=0; i<n; i++)
        p[i] = i;
    return p;
}

dynamic Array :: int[n];
{
    for (unsigned i=0; i<n; i++)
        cout << "Find Values is" << p[i] << endl;
}
```

NAME: SHREYAS BELUR NATARAJ

~~X-15~~ CSCI 689-2

Quiz 7
Closed Book & Notes
(30 points)

Spring 2013

1. Here is a class interface for the rational numbers in the form of n/d, where n refers to the numerator and d refers to the denominator of a rational number:

```
class R
    friend bool operator== ( const R& r1, const R& r2); // relational operator
public:
    R ( const int& n = 0, const int& d = 1 );           // constructor
    R ( const R& r );                                // copy constructor
    R& operator= ( const R& r );                      // assignment operator
private:
    int num, den;                                     // numerator and denominator
};
```

Show the implementation of the overloaded relational (==) operator. Do not assume that the input arguments (rational numbers) are given in a reduced form and do not reduce those numbers.

int main ()

~~R r1(2, 5); // 2/5~~
~~R r2(); // 0/1.~~
~~R r3(r1); // 2/5~~
~~R r4 = r1; // 2/5~~

3

X¹⁵

2. Write a C++ *function template*, named Swap (), that can be used to swap the values of its two arguments. See the following example program for a usage of this function:

```
int main ()
{
    int x = 5, y = 7; Swap ( x, y );
    string s = "ABC", t = "XYZ"; Swap ( s, t );
    return 0;
}
```

class S ()

```

<

Swap (int a, int b)
Swap (String c, String d)
    int a, b;
    String s, t;
    {
        x = y; exit
        y = x; int a = x;
        s = t; int b = y;
        String c = s;
        String d = t;
        a = b;
        c = d;
    }
}
```

a = b