

National University of Computer and Emerging Sciences

School of Computing

Spring 2018

Islamabad Campus

CS103 Computer Programming

Wednesday, May 16, 2018

Course Instructor(s)

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Serial No:

Final Exam

Total Time: 3 Hours

Total Marks: 161

Signature of Invigilator

Student Name

Roll No

Section

Signature

DO NOT OPEN THE QUESTION BOOK OR START UNTIL INSTRUCTED.

Instructions:

1. Attempt on question paper. Attempt all of them. Read the question carefully, understand the question, and then attempt it.
2. No additional sheet will be provided for rough work. Use the back of the last page for rough work.
3. If you need more space use the extra sheets provided inside the booklet but please clearly mark question and part number, etc.
4. After asked to commence the exam, please verify that you have (32) different printed pages including this title page. There are total of (5) questions.
5. Use of calculator is strictly prohibited.
6. Use permanent ink pens only. Any part done using soft pencil will not be marked and cannot be claimed for rechecking.
7. Use **proper indentation** while writing code and make sure that your code is legible. Failing to do so can cost you marks.
8. Please read the question thoroughly and use your time **properly**, an uneven distribution of time can lead to incomplete answers. **1 Mark = 1 Minute**

	I	II	III	IV	V	Total
Total Marks	81	15	15	15	35	161
Marks Obtained						

Vetted By: _____ Vetter Signature: _____

Question I (81 Marks)

Please write proper explanation of the bug where required, without proper explanation no marks will be awarded, note there are **no syntax errors** in the given set of codes.

(a) **(2 Marks)** What is the output of the following program segment? Identify errors (if any).

```

1  int num1 = 392;
2  int& num2 = num1;
3  num2 = 444;
4  num1 = num1 + num2;
5  int *pointer1 = &num1;
6  cout<< *pointer1<<endl;

```

Solution:

888

(b) **(1 Mark)** True/False: You must declare all private members of a class before the public members.

Solution: False

(c) **(1 Mark)** Assume that *InventoryItem* is the name of a class, and the class has a *void* member function named *setPrice* which accepts a *double* argument. If *book* is an instance of the *InventoryItem* class, which of the following statements properly uses the *book* object to call the *setPrice* member function?

- ☐ *InventoryItem::setPrice(1.49)*
- ☒ ***book.setPrice(1.49)***
- ☐ *book::setPrice(1.49)*
- ☐ *book:setPrice(1.49)*

(d) **(1 Mark)** Declare an array of three *InventoryItem* objects.

Solution:

`InventoryItem arr[3];`

(e) **(10 Marks)** What will the following program display on screen. Explain the logical error or bug if there is any. **Please note that there are no syntax errors in the program..** Show the complete stack trace as well.

```

1  #include<iostream>
2  #include<algorithm>
3  #include<iterator>
4  #include<vector>
5  using namespace std;
6  template<class T>
7  ostream & operator<<(ostream & o, vector<T> & t) {
8      for (typename vector<T>::iterator it = t.begin(); it != t.end(); ++it)
9          cout << *it << " ";
10     return o;

```

```
11 }
12 void Magic(vector<vector<int> > &v, int s) {
13     if (s > v.size() / 2)
14         return;
15     for (int i = s; i < v[0].size() - s; ++i)
16         cout << v[s][i] << " ";
17     cout << endl;
18     for (int i = s + 1; i < v.size() - s - 1; ++i)
19         cout << v[i][v[0].size() - s - 1] << " ";
20     cout << endl;
21     if (s != v.size() / 2)
22         for (int i = v[0].size() - s - 1; i >= s; --i)
23             cout << v[v.size() - s - 1][i] << " ";
24     cout << endl;
25     for (int i = v.size() - s - 2; i >= s + 1; --i)
26         cout << v[i][s] << " ";
27     cout << endl;
28     Magic(v, s + 1);
29 }
30 int main() {
31     vector<vector<int> > v(3, vector<int>(3, 0));
32     int count = 0;
33     for (vector<vector<int> >::iterator it = v.begin(); it != v.end(); ++it)
34         for (vector<int>::iterator it2 = it->begin();
35             it2 != it->end(); ++it2)
36             *it2 = ++count;
37     cout << "Result" << endl;
38     Magic(v, 0);
39 }
```

Solution:

```
1 1 2 3
2 6
```

```
3  9 8 7
4  4
5  5
```

(f) **(3 Marks)** What will the following program display on screen. Explain the logical error or bug if there is any. **Please note that there are no syntax errors in the program..**

```
1  string Q = "ABCDEFGH";
2  cout << Q + Q.substr(2,4) << "\n";
3  Q.erase(3,2);
4  cout << Q << "\n";
5  Q.insert(2, "123");
6  cout << Q;
```

Solution:

```
1  ABCDEFGCDEF
2  ABCFG
3  AB123CFG
```

- (g) (3 Marks) What will the following program display on screen. Explain the logical error or bug if there is any. **Please note that there are no syntax errors in the program..**

```
1  #include <iostream>
2  using namespace std;
3  template<class T>
4  class Parcel{
5  private:
6      T value;
7  public:
8      Parcel(){
9          value = 7;
10         cout << value << endl;
11     }
12     Parcel(const T & v){
13         value = v;
14         cout << value << endl;
15     }
16     ~Parcel(){cout << value << endl;}
17 };
18 int main(){
19     Parcel<int> o1(4);
20     Parcel<float> o2;
21     Parcel<double> o3(2.5);
22     return 0;
23 }
```

Solution:

```
1  4
2  7
3  2.5
4  2.5
5  7
6  4
```

- (h) (6 Marks) What will the following program display on screen. Explain the logical error or bug if there is any. **Please note that there are no syntax errors in the program..**

```
1  #include<iostream>
2  using namespace std;
3  template<class T>
```

```

4  void Qdoba( T x ){
5      cout << "Hi" << endl;
6  }
7  template<class T>
8  void Qdoba( T* x ){
9      cout << "Fi" << endl;
10 }
11 template<>
12 void Qdoba( char* x ){
13     cout << "Bi" << endl;
14 }
15 void Qdoba(int x){
16     cout << "Pi" << endl;
17 }
18 int main(){
19     int v = 10;
20     int *p = new int(100);
21     char s[10] = "abc";
22     double d = 2.5;
23     Qdoba(v);
24     Qdoba(p);
25     Qdoba(s);
26     Qdoba(d);
27     return 0;
28 }

```

Solution:

```

1      Pi
2      Fi
3      Bi
4      Hi

```

- (i) (6 Marks) What will the following program display on screen. Explain the logical error or bug if there is any. Please note that there are no syntax errors in the program..

```

1  #include <iostream>
2  #include <fstream>
3  using namespace std;
4  class Dummy {
5      int data[5];
6      int size;
7      int inc;
8  public:
9      void display() {
10         for (int i = 0; i < size; i++)

```

```

11             cout << data[i] + inc << endl;
12         }
13     };
14     int main() {
15         Dummy D;
16         int temp[] = { 0, 1, 2, 3, 4, 5, 6 };
17         ofstream ofile("dummy.dat", ios::binary);
18         ofile.write((char*) temp, sizeof(temp));
19         ofile.close();
20         ifstream ifile("dummy.dat", ios::binary );
21         ifile.read((char*) &D, sizeof(D));
22         D.display();
23         ifile.close();
24         return 0;
25     }

```

Solution:

```

1  6
2  7
3  8
4  9
5  10

```

- (j) (10 Marks) What will the following program display on screen. Explain the logical error or bug if there is any. Please note that there are no syntax errors in the program..

```

1  #include <iostream>
2  #include <vector>
3  using namespace std;
4  template<class T, class U>
5  class Data {
6  public:
7      T key;
8      U value;
9      Data(T x = 0, U y = 0) :
10          key(x), value(y) {
11      }
12  };
13  template<class T, class U>
14  void operator<<(ostream &out, Data<T, U> dat) {

```

```
15         out << dat.key << endl;
16         dat.value->start();
17     }
18     class Vehicle {
19     public:
20         virtual void start() {
21             cout << "The vehicle is started" << endl;
22         }
23         virtual void start(Vehicle &v) {
24             start();
25             v.start();
26         }
27     };
28     class Car: public Vehicle {
29     public:
30         void start() {
31             cout << "The car is started" << endl;
32         }
33     };
34     class SuperCar: public Car {
35     public:
36         void start() {
37             cout << "The SuperCar is started" << endl;
38         }
39     };
40     int main() {
41         vector<Data<string, Car*> > directory;
42         directory.push_back(Data<string, Car*>("Mehran", new Car()));
43         SuperCar *S = new SuperCar();
44         directory.push_back(Data<string, Car*>("Diablo", S));
45         S = new SuperCar();
46         Data<string, Car*> D("Gallardo", S);
47         directory.push_back(D);
48         vector<Data<string, Car*> >::iterator it = directory.begin();
49         for (; it != directory.end(); it++) {
50             cout << *it;
51         }
52         Vehicle V;
53         V.start(*S);
54         return 0;
55     }
```


Solution:

```
1 Mehran
2 The car is started
3 Diablo
4 The SuperCar is started
5 Gallardo
6 The SuperCar is started
7 The vehicle is started
8 The SuperCar is started
```

- (k) **(15 Marks)** What will the following program display on screen. Explain the logical error or bug if there is any. **Please note that there are no syntax errors in the program..** *Hint: you can draw an hierarchy to make your task easy.*

```
1  #include<iostream>
2  using namespace std;
3  class Hobbits {
4  public:
5      virtual void Function1() {
6          cout << " Cp's Hobbitsess " << endl;
7      }
8      void Function2() {
9          cout << " Enjoy Programming " << endl;
10     }
11 };
12 class Gollum: public Hobbits {
13 public:
14     virtual void Function3() {
15         cout << " Gollum 3" << endl;
16     }
17 };
18 class Bilbo: public Hobbits {
19 public:
20     virtual void Function1() {
21         cout << " Bilbo 1" << endl;
22     }
23     virtual void Function2() {
24         cout << " Bilbo 2" << endl;
25     }
26 };
27 class Frodo: public Bilbo {
28 public:
29     void Function1() {
30         cout << " Frodo 1" << endl;
31         Hobbits::Function1();
32     }
33     void Function2() {
34         cout << " Frodo 2" << endl;
35     }
36     void Function3() {
37         cout << " Frodo 3" << endl;
38     }
39 };
40
41 int main() {
42     Hobbits *var1 = new Frodo;
43     Hobbits *var2 = new Bilbo;
44     Bilbo *var3 = new Frodo;
45     Hobbits &var4 = *var3;
46     Gollum g;
47     Hobbits &var5 = g;
48     Frodo *f = new Frodo;
49     var1->Function1();
```

```

50     var1->Function2();
51     var2->Function1();
52     var2->Function2();
53     var3->Function1();
54     var3->Function2();
55     var4.Function1();
56     var4.Function2();
57     var5.Function1();
58     var5.Function2();
59     g.Function1();
60     g.Function2();
61     g.Function3();
62     f->Function1();
63     f->Function2();
64     f->Function3();
65 }

```

This image shows a single sheet of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There are approximately 20 lines visible. The paper has a slight shadow on the right side, suggesting it's resting on a surface.

Solution:

```
1 Frodo 1
2 Cp's Hobbitsess
3 Enjoy Programming
4 Bilbo 1
5 Enjoy Programming
6 Frodo 1
7 Cp's Hobbitsess
8 Frodo 2
9 Frodo 1
10 Cp's Hobbitsess
11 Enjoy Programming
12 Cp's Hobbitsess
13 Enjoy Programming
14 Cp's Hobbitsess
15 Enjoy Programming
16 Gollum 3
17 Frodo 1
18 Cp's Hobbitsess
19 Frodo 2
20 Frodo 3
```

- (I) **(15 Marks)** What will the following program display on screen. Explain the logical error or bug if there is any. **Please note that there are no syntax errors in the program..**

```

1  #include<iostream>
2  using namespace std;
3  class H {
4  public:
5      H() {cout << " H-C ";}
6      ~H() {cout << " H-D ";}
7  };
8  class E {
9  public:
10     E() {cout << " E-C ";}
11     virtual ~E() {cout << " E-D ";}
12 };
13 class F: public E {
14 public:
15     F() {cout << " F-C ";}
16     ~F() {cout << " F-D ";}
17 };
18 class A {
19 private:
20     H h;
21     E * ep;
22 public:
23     A(E *t) : ep(t) {cout << " A-C ";}
24     virtual ~A() {
25         cout << " A-D ";
26         delete ep;
27     }
28 };
29 class B:public A {
30 private:
31     H h2;
32 public:
33     B(E *t) : A(t) {cout << " B-C ";}
34     virtual ~B() {cout << " B-D ";}
35 };
36 int main() {
37     A a(new E);
38     cout<<endl<<" 1 2 3 "<<endl;
39     B b(new F);
40     cout<<endl<<" 1 2 3 "<<endl;
41     B b2(new F);
42     cout<<endl<<" 1 2 3 "<<endl;
43 }

```

Solution:

1	E-C	H-C	A-C			
2	1 2 3					
3	E-C	F-C	H-C	A-C	H-C	B-C
4	1 2 3					
5	E-C	F-C	H-C	A-C	H-C	B-C
6	1 2 3					

7

B-D H-D A-D F-D E-D H-D B-D H-D A-D F-D E-D H-D A-D E-D
↔ H-D

- (m) **(8 Marks)** What will the following program display on screen. Explain the logical error or bug if there is any. **Please note that there are no syntax errors in the program..**

```

1  #include<algorithm>
2  #include<iostream>
3  using namespace std;
4  template<typename T>
5  class Matrice {
6  public:
7      Matrice(int r, int c) :
8          rows(r), columns(c), ptr(new T[r * c]) {}
9      ~Matrice() {
10         cout << *this;
11         delete[] ptr;
12     }
13     template<typename S>
14     void operator=(S *lmat) {
15         for(int i=0; i<rows*columns;++i)
16             ptr[i]=lmat[i];
17     }
18     T &operator()(int i, int j) {
19         return ptr[j + i * columns];
20     }
21     T &operator[](int i) {
22         return ptr[i];
23     }
24     int GetRows() {
25         return rows;
26     }
27     int GetCols() {
28         return columns;
29     }
30 private:
31     int rows, columns;
32     int *ptr;
33 };
34 template<typename T>
35 ostream& operator <<(ostream& cout, Matrice<T>& m) {
36     cout << " Matrix = " << endl;
37     for (int i = 0; i < m.GetRows() * m.GetCols(); ++i) {
38         cout << m[i] << " ";
39         if ((i + 1) % m.GetCols() == 0)
40             cout << endl;
41     }
42     return cout;
43 }
44 int main() {
45     int a[] = { 10, 20, 30, 40, 50, 60, 70, 80 };
46     Matrice<int> v(4, 2);
47     v = a;
48     int z = ++v(2, 1);
49     cout << " Z= " << z << endl;
50 }

```

Solution:

```
1  Z= 61
2  Matrix =
3  10  20
4  30  40
5  50  61
6  70  80
```

Solution: Segmentation Fault; 1 2 3 4 5 6 6 6 6 6

Question II (15 Marks)

- (a) **(15 Marks)** Write a recursive method called `parenthesize` that takes a `String` and an integer `n` as parameters and that prints the string inside `n` sets of parentheses. For example, this code:

```
1      parenthesize("CP", 2);
2      parenthesize("FAST University", 6);
3      parenthesize("final-exam", 1);
```

should produce these 3 lines of output:

```
((CP))
((((FAST University))))
(final-exam)
```

Solution:

```
1 #include<iostream>
2 #include<algorithm>
3 #include<iterator>
4 #include<vector>
5 using namespace std;
6 void writeSquares(int n) {
7     if (n <= 1) {
```

```
8         cout << n << ", ";
9         return;
10    }
11
12    if (n % 2 == 0) {
13
14        writeSquares(n - 1);
15        cout << n * n << ", ";
16    } else {
17        cout << n * n << ", ";
18        writeSquares(n - 1);
19    }
20
21 }
22 int main() {
23     writeSquares(5);
24     cout << endl;
25     writeSquares(1);
26     cout << endl;
27     writeSquares(8);
28     cout << endl;
29 }
```

Extra Sheet

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Question III (15 Marks)

- (a) **(15 Marks)** Suppose there is a Vehicle Plate Recognition System installed at Golra Mor that captures images of cars and recognizes their numbers. It stores all the numbers in a new text file everyday. Suppose the authorities have another text file containing all the possible initials of every city (such as Islamabad is represented by IDD and IDH, Lahore by LHY and LHE, *etc.* in this file).

Now Your task is to write code for counting the number of vehicles of each city that passed Golra Mor on a particular day.

You are provided 2 text files: one carrying all the used initials of every city and the other carrying identified numbers of the day. Sample input files and output are shown below:

File **cities.txt** content is as follows:

```
City Initial
Islamabad IDD
Lahore LHY
Islamabad IDH
Lahore LHE
```

File **May16.txt** content is as follows, where each line contains number of vehicle:

LHY	2140
LHY	2202
IDD	516
LHE	888

Your program should read both the files and write a new file named *output.txt* containing the name of each city and number of vehicles with that city number plate passed on that day. For example, for above given output following should be content of your file **output.txt**:

Islamabad 1
Lahore 3

You can make this task fairly easy by using STL

[illegible]

Extra Sheet

[illegible]

Question IV.....(15 Marks)

- (a) **(15 Marks)** Your goal is to write a class `Set` that will be used to build set of integers (you can make it generic if you want). Remember that a set only contains unique items. Now given following code segments, first identify all the basic functions and operators you need, and then write these functions.

```
1  int a[] = { 1, 3, 3, 2, 5 };
2  Set s1(a, 5); // set initialized using an array with 5 elements
3  s1 + 4; // add a new item to the set
4  s1 - 3; // remove 3 from the set.
5
6  Set s2(a, 5); // set initialized using an array with 5 elements
7  if (s2 == s1)
8      cout << " Both Sets are equal";
9
10 Set s3;
11 s3 = s1 & s2; // intersection of s1 and s2
12
13 Set s4;
14 s4 = s1 | s2; // union of s1 and s2
15
16 cout << s1 << " " << s2 << " " << s3 << " " << s4 << endl;
```

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[illegible]

Question V (35 Marks)

Please read and understand the question carefully before proceeding with design and code writing.

You are going to build a minimal Bill Management System (BMS) for a Chemist store like Shaheen Chemists. The developed system will be used for managing the bills of sold items. Each bill will be issued to a customer, a customer can be either a registered user of the store or can be a non-registered user. The system will be used to sell following types of Items: Medicines and Cosmetics. Each sold medicine will have a unique number, name, price, quantity, and description of disease for which it has been prescribed. Similarly, each sold cosmetic item will have unique number, name and price.

Chemist store will be selling two types of cosmetics, local and imported. Local cosmetics will be liable to 17% GST, that is their price will be calculated by including 17% GST on the listed price. Imported cosmetics will have 17% GST and 4% VAT (value added tax). Furthermore, each imported cosmetic item will have its country of origin listed in the bill.

A registered user will have a unique-id, his email and phone number along with total number of bonus points it has accumulated. The chemist store gives special discount to its registered members on each bill. Thus while buying if the customer provides his valid membership-id then store will give him 1% discount on the total price. Furthermore, a registered user accumulates 100 bonus points if he buys items of price more than 500. On accumulating 1000 bonus points, a registered user is given further 5% discount on his bill, and his bonus account is reset to zero. If the customer is not registered and wants to have an account with then the system asks him to register himself by providing his name, city, joining date (string).

Your designed system will be used to manage the bills for sold items and generate total bill after calculating all the sold items in a single bill by incorporating all the taxes and discounts.

Furthermore, your designed system shall maintain all bills in a list. At any time, system can calculate the total sales amount by adding the total amount of each bill. You can use STL-containers to simplify your task.

- (a) **(10 Marks)** Build a hierarchical diagram of your system by identifying the main classes and the relationships among them.

- (b) **(15 Marks)** Write the complete code for all the classes (except main) of your BMS system, including set-
ters/getters (where required), constructor(s) and destructor(s) in addition to the other functions (such as
print_bill, calculate_item_price) as discussed above.

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[illegible]

Extra Sheet

[illegible]

- (c) **(10 Marks)** Given the classes of your system, now create a **function name** `GenerateBill` in your main class that calculates the total price from all the items in the bill. It is a must that you use polymorphism (You can also use STL containers, of course if you wish) to calculate total bill amount .

```
1 Bill b;
2 // some other code here
3
4 // finally;
5 b.Generate_Bill(); // should compute the total price of all the items
```

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Extra Sheet

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Extra Sheet

[illegible]