



# Indian Institute of Technology Kharagpur

## Class Test II 2022-23

Date of Examination: Feb, 2023

Duration: 45 Minutes

Subject No.: CS20006/CS20202

Subject: Software Engineering

Department/Center/School: Computer Science

Credits: 3

Full marks: 20

Name: \_\_\_\_\_

Roll Number: \_\_\_\_\_

### Instructions

- Please write your name and roll number above before attempting any solution.
- Write your answers in this question paper itself. It has been given a booklet form for this purpose.
- Use of electronic calculators only is permitted. No extra resources viz. graph papers, log-tables, trigonometric tables would be required.
- All questions are compulsory.** Be brief and precise. Mysterious or unsupported answers will not receive full marks.
- A few extra blank sheets are provided at the end.** Please use them, if for any question, you need extra space.

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Question:	1	2	3	Total
Points:	6	4	10	20
Score:				

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1. Consider the following function definitions:

```
1 #include <iostream>
2 using namespace std;
3
4 int f(int,int);
5 double f(int);
6 int f(double,double);
7
8 int f(int a, int b) {
9     cout << "calling f1"<<endl;
10    return f(f(a - b),f(b - a));
11    }
12
13 double f(int c) {
14    cout << "calling f2"<<endl;
15    if(c>10) return c/2; else return c;
16    }
17
18 int f(double a, double b) {
19    cout << "calling f3"<<endl;
20    if(b>a) return f(a - b); else return f(b - a);
21    }
```

- (a) (3 points) What will be the output for the following code:

```
1 int main()
2 {
3     cout << f(66,25)<<endl;
4 }
```

**Solution:** Output:

```
calling f1
calling f2
calling f2
calling f3
calling f2
-61
```

(b) (3 points) What will be the output for the following code:

```
1 int main()
2 {
3     cout << f(66.0,25.0)<<endl;
4 }
```

**Solution:** Output:

```
calling f3
calling f2
-41
```

2. Consider the following program:

```
1 #include <iostream>
2 #include <cstdlib>
3 using namespace std;
4
5 class A {
6     public: int i,j;
7     A(int a =4, int b =5) {i=a;j=b;}
8     void print() { cout <<"i: "<<i<<" j: "<<j<<endl; }
9 };
10
11 void * operator new(size_t n, char c) {
12     cout << c<<endl;
13     return operator new(n);
14 }
15
16 int main() {
17     _____STATEMENT_____
18     a->print();
19 }
```

What will be the output if you compiled and executed the above program with the following statements (value for STATEMENT):

(a) (1 point) A \*a = **new** A(2,3);

**Solution:** Answer: i: 2 j: 3

(b) (1 point) `A *a = new A( 4 );`

**Solution:** Answer: i: 52 j: 5

(c) (1 point) `A *a = new('4') A(2,3);`

**Solution:** Answer: 4 i: 2 j: 3

(d) (1 point) `A *a = new A('4',2,3);`

**Solution:** Answer: Compilation error

3. (10 points) Consider the following code for implementing a set of integers. Class `Listnode` implements the nodes of a singly linked list, with the next pointer being `NULL` for last nodes. The destructor deallocates the entire list starting with a given node.

Class `IntSet` implements the set of integers, where there are `numSlots` many slots in a hashtable each holding a list of integers mapped to that slot. The implementations for the hash function, the insert function, and the checkmember functions are given for reference into the functioning of the set.

The output of the main function given below should be:

```
creating nodes with 100 slots
creating node: 2
creating node: 3
1 1 0
creating node: 5
0 1
deleting node: 2
deleting node: 3
deleting node: 5
destroying set
```

```

1 #include <iostream>
2 using namespace std;
3
4 class Listnode {
5     public:
6     int value;
7     Listnode *next;
8     _____Listnode Constructor_____
9     _____Listnode Destructor_____
10 };
11
12 class IntSet {
13     //set of integers
14     //There are numSlots many slots each holding a list of integers
15     Listnode **hashslots;
16     int numSlots;
17     public:
18     _____IntSet Constructor_____
19     _____IntSet Destructor_____
20
21     unsigned int hash(int a) {return ((unsigned int) a) % numSlots;}
22     void insert(int a) {
23         Listnode * ptr = hashslots[this->hash(a)];
24         if(ptr == NULL) { hashslots[hash(a)]=new Listnode(a); return; }
25         while(ptr->value != a) {
26             if(ptr->next == NULL) { ptr->next = new Listnode(a); return; }
27             ptr=ptr->next;
28         }
29     }
30     bool checkmember(int a) {
31         Listnode * ptr = hashslots[hash(a)];
32         while(ptr != NULL) {
33             if(ptr->value == a) return true;
34             ptr=ptr->next;
35         }
36         return false;
37     }
38 };
39
40 int main() {
41     IntSet s;
42     s.insert(2);
43     s.insert(3);
44     cout<<s.checkmember(3)<<" "<<s.checkmember(2)<<" "<<s.checkmember(4)<<
45     endl;
46     s.insert(5);
47     cout<<s.checkmember(4)<<" "<<s.checkmember(5)<<endl;
48 }

```

Write the functions below to complete the above program.

(a) Listnode Constructor:

**Solution:**

```
1 //constructor which initializes next to null and optionally
  takes value as argument
2 Listnode(int v=0): value(v), next(NULL) { cout<<"creating node:
  "<<value<<endl; }
```

(b) Listnode Destructor:

**Solution:**

```
1 //destructor which deletes the whole list recursively
2 ~Listnode() { cout<<"deleting node: "<<value<<endl; if(this->
  next != NULL) delete this->next; }
```

(c) IntSet Constructor:

**Solution:**

```
1 //constructor allocates numSlots many hashslots and sets them to
  null
2 IntSet(int numslots = 100) : numSlots(numslots), hashslots(new
  Listnode*[numslots] ) {
3     cout<<"creating nodes with "<<numSlots<<" slots"<<endl;
4     for(int i=0; i<numslots; i++) hashslots[i]=NULL;
5 }
```

(d) IntSet Destructor:

**Solution:**

```
1 //destructor freeing all the lists and then freeing the list
2 ~IntSet() {
3     for(int i=0; i<numSlots; i++) if(hashslots[i] != NULL) delete
  hashslots[i];
4     cout<<"destroying set"<<endl;
5     delete [] hashslots;
6 }
```



