CS272 Midterm 1

Close book; Time: 11:45am-1:00pm, Oct. 2, 2014 Points: 100pts

Banner ID: _____ Name: _____ Score: _____

Q1. (8 pts) Please express each of the following formula in big-O notation.

(A) $1+ 2+ \ldots +n$ _____

(B) $2n^3 + 2^n$ _____

(C) $2n+3\log_2 n$ _____

(D) $5\log n+ 10000$ _____

Q2. (5 pts) What is the worst-case big-O complexity of the following code fragment?

```
for(int i=0; i<n ; i++){
    for(int j=i; j<n; j++){
            System.out.println(i+“,”+j);
    }
}
```

Please first analyze the program and derive a formula for the number of operations it needs to have. Then derive the big-O notation for it.

Q3. For a given Computer class, please answer the following questions.

```
public class  Computer {
        public String maker;     //the maker of a computer object
        public String cpu;       //the cpu type of a computer object

        //(1) Define and implement no-argument constructor here (2pts)




        //(2) Define and implement copy constructor here (4pts)




        //(3) Define and implement the equals method (6pts)
        //This method should return true when this computer's maker and cpu equals
        //to the parameter object's maker and cpu; Otherwise, it should return false.




}
```

Q4. Given the class ComputerSet, which uses the Computer class defined in Q3, please answer the following questions.

```
public class ComputerSet {
        //The invariant for this class is:
        // 1. The number of elements in the set is in the instance variable
        //    num, which is no more than data.length.
        //2. For an empty set, we do not care what is stored in the data array;
        //   For a non-empty set, the elements in the set are stored in data[0] … …
        //   through data[num-1], and we don't care what is in the rest of data array.
        //3. NO elements in the set are the same.
        private int num;
        private Computer [] data;
        public ComputerSet ()           { num =0; data = new Computer [6];}

        public boolean F1(Computer c) {
                if(c==null) return false;
                int i=0, oldnum = num;
                while(i<num){
                        if(data[i].equals(c)) {data[i]=data[num-1]; num--;}
                        else i++;
                }
                if(oldnum==num) return false;
                else return true;
        }
        //(1) (8pts) Please implement the following method.
        //This method checks whether this collection contains the input parameter
        //      If a computer with the same maker and cpu exists in the set,
        //        return its index in the data array
        //      Otherwise, return -1. Please add proper pre-condition checking.
        public int contains(Computer c){









        }
}
```

(2) (8pts) Let a ComputerSet object S1 has the following values for its instance variables

num = 4, data=

5	7	9	10		

First, we run S1.F1(7), what will the instance variables be after running S1.F1(7)?

_____

Then, we run S1.F1(17), what will the instance variables be after running S1.F1(17)?

_____

Q5. For the IntNode class, which is used to define a singly linked list, please answer the following questions.

```
public class IntNode{
        private int data = 0;                   // contain the real content
        private IntNode link = null;            // point to the current node's next node

        //(1) (4pts) Please define and implement a no-argument constructor for this class.









        //(2) (6pts) Please define and implement the get and set methods
        //          for the two instance variables.









        // (3) (6pts) Please implement a method to add a node
        //          with the given parameter value immediately after this node.
        public void addNodeAfter(int item)
        {









        }

        //Other methods are here.

}
```

(4) (3pts) Given the following method X in IntNode class. What is its complexity (in Big-O)?

First, define n=_____
Then, the complexity in Big-O is _____

```
public void X(int item) {
        IntNode newnode = new IntNode();
        newnode.setData(item);

        IntNode preCursor = null;
        IntNode cursor = this;
        while(cursor!=null){
                preCursor = cursor;
                cursor = cursor.getLink();
        }
        preCursor.setLink(newnode);
}
```

(5) (10 pts) Given the X method as shown above, if we run the following several lines of code:

```
IntNode node = new IntNode();
node. X(1);
node. X(3);
node. X(4);
```

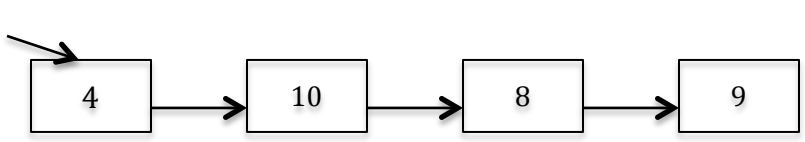
Please draw the linked list that starts from *node*.

_____

(6) (10 pts) Please implement a method to calculate the summation of the elements in the last "*num*" nodes in a given linked list starting from "*head*".

public static int sumLast(IntNode head, int num)

The pre-condition is that "*num*" is non-negative. When "*num*" is bigger than the number of nodes in the list, it should return the summation of elements in all the nodes.
For example, given the following linked list:



sumLast(head, 1) should return 9;
sumLast(head, 2) should return 17 (8+9);
sumLast(head, 5) should return 31 (4+10+8+9);

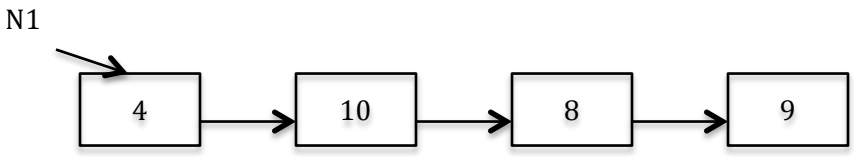
(7) (10 pts) Please design and implement a method for IntNode to remove all the nodes whose data is an odd number.

(8) (10 pts) Given the following function for class IntNode

```
public static IntNode Y(IntNode head) {
        IntNode cursor = null;
        IntNode prev = null;

        for(cursor = head; cursor!=null; ){
                IntNode next = cursor.getLink();
                cursor.setLink(prev);
                prev = cursor;
                cursor = next;
        }
        head = prev;
        return head;
}
```

Given a head N1 pointing to the following linked list



If we run the following code, please draw the result:

```
IntNode N2 = IntNode.Y(N1)
```

(**Bonus question: 10pts**). Given two linked lists L1 and L2 with N1 and N2 nodes respectively. The values in the nodes of L1 and L2 are distinct. Write an algorithm to find the median value of these N1+N2 nodes in these two linked lists. You are not allowed to use extra array space. Please denote the complexity of your algorithm.

public static int findMedian(IntNode L1head, int N1, IntNode L2head, int N2)

========== END ==========