

Trạng thái	Đã xong
Bắt đầu vào lúc	Thứ Ba, 30 tháng 1 2024, 4:11 PM
Kết thúc lúc	Thứ Ba, 30 tháng 1 2024, 4:25 PM
Thời gian thực hiện	14 phút 2 giây
Điểm	8,80/9,00
Điểm	9,78 trên 10,00 (97,78%)



Câu hỏi 1

Đúng

Đạt điểm 1,00
trên 1,00

Class `LLNode` is used to store a node in a singly linked list, described on the following:

```
class LLNode {
    public:
        int val;
        LLNode* next;
        LLNode();
        LLNode(int val, LLNode* next);
}
```

Where `val` is the value of node, `next` is the pointer to the next node.

Request: Implement function:

```
LLNode* addLinkedList(LLNode* l0, LLNode* l1);
```

Where `l0`, `l1` are two linked lists represented positive integers, each node is a digit, the head is the least significant digit (the value of each node is between 0 and 9, the length of each linked list is between 0 and 100000). This function returns the linked list representing the sum of the two integers.

Example:

Given `l0 = [2, 3]` (representing 32) and `l1 = [1, 8]` (representing 81). The result would be `l0 = [3, 1, 1]` (representing 32 + 81 = 113).

Note:

In this exercise, the libraries `iostream`, `string`, `cstring`, `climits`, `utility`, `vector`, `list`, `stack`, `queue`, `map`, `unordered_map`, `set`, `unordered_set`, `functional`, `algorithm` has been included and `namespace std` are used. You can write helper functions and classes. Importing other libraries is allowed, but not encouraged, and may result in unexpected errors.

For example:

Test	Result
<pre>int arr1[] = {2, 9}; int arr2[] = {0, 5}; LLNode* head1 = LLNode::createWithIterators(arr1, arr1 + sizeof(arr1) / sizeof(int)); LLNode* head2 = LLNode::createWithIterators(arr2, arr2 + sizeof(arr2) / sizeof(int)); LLNode* newhead = addLinkedList(head1, head2); LLNode::printList(newhead); head1->clear(); head2->clear(); newhead->clear();</pre>	[2, 4, 1]


Answer: (penalty regime: 0, 0, 0, 5, 10, ... %)

Reset answer

```
1 LLNode* addLinkedList(LLNode* l0, LLNode* l1) {
2     LLNode *tmp0 = l0;
3     LLNode *tmp1 = l1;
```

```
4 LLNode *head = NULL;
5 LLNode *tail = NULL;
6 int sum = 0;
7 int carry = 0;
8
9 while (tmp0 != NULL || tmp1 != NULL || carry != 0) {
10     sum = carry;
11
12     if (tmp0 != NULL) {
13         sum += tmp0->val;
14         tmp0 = tmp0->next;
15     }
16
17     if (tmp1 != NULL) {
18         sum += tmp1->val;
19         tmp1 = tmp1->next;
20     }
21
22     carry = sum / 10;
23     sum = sum % 10;
24
25     LLNode* newNode = new LLNode(sum);
26
27     if (head == NULL) {
28         head = newNode;
29         tail = newNode;
30     } else {
31         tail->next = newNode;
32         tail = newNode;
33     }
34 }
35
36 return head;
37 }
38
```

	Test	Expected	Got	
✓	int arr1[] = {2, 9}; int arr2[] = {0, 5}; LLNode* head1 = LLNode::createWithIterators(arr1, arr1 + sizeof(arr1) / sizeof(int)); LLNode* head2 = LLNode::createWithIterators(arr2, arr2 + sizeof(arr2) / sizeof(int)); LLNode* newhead = addLinkedList(head1, head2); LLNode::printList(newhead); head1->clear(); head2->clear(); newhead->clear();	[2, 4, 1]	[2, 4, 1]	✓

Passed all tests! 

Đúng

Marks for this submission: 1,00/1,00.



Câu hỏi 2

Đúng

Đạt điểm 1,00
trên 1,00

Polynomials is an important application of arrays and linked lists. A polynomial is composed of different terms where each of them holds a coefficient and an exponent. A polynomial $p(x)$ is the expression in variable x which is in the form $(a_nx^n + a_{n-1}x^{n-1} + + a_1x + a_0)$, where $a_n, a_{n-1},, a_0$ fall in the category of real numbers and 'n' is the non-negative integer, which is called the degree of polynomial.

Example: $10x^2 + 26x$, here 10 and 26 are coefficients and 2, 1 is its exponential value.

- Points to keep in Mind while working with Polynomials:
- The sign of each coefficient and exponent is stored within the coefficient and the exponent itself.
 - The storage allocation for each term in the polynomial must be done in descending order of their exponent.

In this question, complete SLinkedList class is included. You should use this class to complete your Polynomial class with initialized frame as following. This task is implement insertTerm to insert a term into a polynomial.



```
class Polynomial;
class Term {
private:
    double coeff;
    int exp;
    friend class Polynomial;
public:
    Term(double coeff = 0.0, int exp = 0) {
        this->coeff = coeff;
        this->exp = exp;
    }
    bool operator==(const Term& rhs) const {
        return this->coeff == rhs.coeff && this->exp == rhs.exp;
    }
    friend ostream & operator<<(ostream &os, const Term& term) {
        cout << endl;
        cout << "Term: " << "(" << term.coeff << " " << term.exp << ")";
        return os;
    }
};

class Polynomial {
private:
    SLinkedList<Term>* terms;
public:
    Polynomial() {
        this->terms = new SLinkedList<Term>();
    }
    ~Polynomial() {
        this->terms->clear();
    }
    void insertTerm(const Term& term);
    void insertTerm(double coeff, int exp);
    void print() {
        SLinkedList<Term>::Iterator it;
        cout << "[";
        for (it = this->terms->begin(); it != this->terms->end(); it++) {
            cout << (*it);
        }
        cout << endl << "]";
    }
};
```

//SLinkedList has been done with the following attributes and methods:



```
class SLinkedList : IList<T>
{
public:
    class Iterator; //forward declaration
    class Node;     //forward declaration

protected:
    Node* head;
    Node* tail;
    int count;

public:
    SLinkedList() : head(NULL), tail(NULL), count(0) {};
    virtual ~SLinkedList();
    virtual void add(const T& e);
    virtual void add(int index, const T& e);
    virtual T removeAt(int index);
    virtual bool removeItem(const T& removeItem);
    virtual bool empty();
    virtual int size();
    virtual void clear();
    virtual T get(int index);
    virtual void set(int index, const T& e);
    virtual int indexOf(const T& item);
    virtual bool contains(const T& item);
}
```

For example:

Test	Result
Polynomial *poly = new Polynomial(); poly->insertTerm(6.0, 2); poly->insertTerm(4.0, 5); poly->insertTerm(4.0, 3); poly->insertTerm(6.0, 5); poly->insertTerm(-1.0, 0); poly->insertTerm(-6.0, 6); poly->insertTerm(6.0, 6); poly->print();	[Term: (10 5) Term: (4 3) Term: (6 2) Term: (-1 0)]



Test	Result
<pre>int n = 5; int coeff[] = { 1, 2, 3, 4, 5 }; int exp[] = { 1, 2, 3, 4, 5 }; Polynomial p1; for (int i = 0; i < n; ++i) p1.insertTerm(coeff[i], exp[i]); p1.print();</pre>	<pre>[Term: (5 5) Term: (4 4) Term: (3 3) Term: (2 2) Term: (1 1)]</pre>

Answer: (penalty regime: 0, 0, 0, 5, 10 %)


Reset answer

```
1 void Polynomial::insertTerm(const Term& term) {
2     // STUDENT ANSWER
3     if(term.coeff != 0){
4         if (terms->size() == 0 || terms->get(terms->size()-1).exp > term.exp)
5             terms->add(term);
6     }
7     else {
8         int i = 0;
9         SLinkedList<Term>::Iterator it;
10        for (it = this->terms->begin(); it != this->terms->end(); it++){
11            if (term.exp == (*it).exp){
12                if (term.coeff + (*it).coeff == 0) it.remove();
13                else it.set(Term(term.coeff + (*it).coeff, term.exp));
14                break;
15            }
16            if (term.exp > (*it).exp){
17                terms->add(i, term);
18                break;
19            }
20            i++;
21        }
22    }
23    SLinkedList<Term>::Iterator it;
24    for (it = this->terms->begin(); it != this->terms->end(); it++)
25        if ((*it).coeff == 0)
26            it.remove();
27 }
28
29 void Polynomial::insertTerm(double coeff, int exp) {
30     // STUDENT ANSWER
31     const Term* newT = new Term(coeff, exp);
32     insertTerm(*newT);
33 }
```




	Test	Expected	Got	
✓	<pre>Polynomial *poly = new Polynomial(); poly->insertTerm(6.0, 2); poly->insertTerm(4.0, 5); poly->insertTerm(4.0, 3); poly->insertTerm(6.0, 5); poly->insertTerm(-1.0, 0); poly->insertTerm(-6.0, 6); poly->insertTerm(6.0, 6); poly->print();</pre>	<pre>[Term: (10 5) Term: (4 3) Term: (6 2) Term: (-1 0)]</pre>	<pre>[Term: (10 5) Term: (4 3) Term: (6 2) Term: (-1 0)]</pre>	✓
✓	<pre>int n = 5; int coeff[] = { 1, 2, 3, 4, 5 }; int exp[] = { 1, 2, 3, 4, 5 }; Polynomial p1; for (int i = 0; i < n; ++i) p1.insertTerm(coeff[i], exp[i]); p1.print();</pre>	<pre>[Term: (5 5) Term: (4 4) Term: (3 3) Term: (2 2) Term: (1 1)]</pre>	<pre>[Term: (5 5) Term: (4 4) Term: (3 3) Term: (2 2) Term: (1 1)]</pre>	✓



Passed all tests! 

Đúng

Marks for this submission: 1,00/1,00.



Câu hỏi 3

Đúng một phần

Đạt điểm 0,80 trên 1,00

Implement Iterator class in class SLinkedList.

Note: Iterator is a concept of repetitive elements on sequence structures. Iterator is implemented in class vector, list in STL container in C++ (<https://www.geeksforgeeks.org/iterators-c-stl/>). Your task is to implement the simple same class with iterator in C++ STL container.

Please read example and testcase carefully.



```
template <class T>
class SLinkedList
{
public:
    class Iterator; //forward declaration
    class Node;     //forward declaration
protected:
    Node *head;
    Node *tail;
    int count;
public:
    SLinkedList() : head(NULL), tail(NULL), count(0){};
    ~SLinkedList();
    void add(const T &e);
    void add(int index, const T &e);
    T removeAt(int index);
    bool removeItem(const T &removeItem);
    bool empty();
    int size();
    void clear();
    T get(int index);
    void set(int index, const T &e);
    int indexOf(const T &item);
    bool contains(const T &item);
    string toString();
    SLinkedList(const SLinkedList &list)
    {
        this->count = 0;
        this->head = NULL;
        this->tail = NULL;
    }
    Iterator begin()
    {
        return Iterator(this, true);
    }
    Iterator end()
    {
        return Iterator(this, false);
    }
public:
    class Node
    {
    private:
        T data;
        Node *next;
        friend class SLinkedList<T>;
    public:
        Node()
        {
```



```
        next = 0;
    }
    Node(Node *next)
    {
        this->next = next;
    }
    Node(T data, Node *next = NULL)
    {
        this->data = data;
        this->next = next;
    }
};

class Iterator
{
private:
    SLinkedList<T> *pList;
    Node *current;
    int index; // corresponding with current node
public:
    Iterator(SLinkedList<T> *pList, bool begin);
    Iterator &operator=(const Iterator &iterator);
    void set(const T &e);
    T &operator*();
    bool operator!=(const Iterator &iterator);

    // Prefix ++ overload
    Iterator &operator++();

    // Postfix ++ overload
    Iterator operator++(int);

};

};
```

For example:



Test	Result
<pre>SLinkedList<int> list; int size = 10; for(int idx=0; idx < size; idx++){ list.add(idx); } SLinkedList<int>::Iterator it; int expvalue = 0; for(it = list.begin(); it != list.end(); it++){ assert(*it == expvalue); expvalue += 1; }</pre>	
<pre>SLinkedList<int> list; int size = 10; for(int idx=0; idx < size; idx++){ list.add(idx); } SLinkedList<int>::Iterator it; int expvalue = 0; for(it = list.begin(); it != list.end(); ++it){ assert(*it == expvalue); expvalue += 1; }</pre>	

Answer: (penalty regime: 0, 0, 0, 5, 10 %)

Reset answer

```
1 template <class T>
2 SLinkedList<T>::Iterator::Iterator(SLinkedList<T>* pList, bool begin)
3 {
4     /*
5      * Constructor of iterator
6      * Set pList to pList
7      * begin = true:
8      * * Set current (index = 0) to pList's head if pList is not NULL
9      * * Otherwise set to NULL (index = -1)
10     * begin = false:
11     * * Always set current to NULL
12     * * Set index to pList's size if pList is not NULL, otherwise 0
13     */
14     this->pList = pList;
15     if (begin==true){
16         if(pList!=nullptr) {this->current = pList->head; this->index = 0;}
```

```

17     this->current = nullptr;
18     this->index = -1;
19 }
20 if (begin == false){
21     this->current = nullptr;
22     if (pList != nullptr) this->index = this->pList->size();
23     this->index=0;
24 }
25 }
26
27 template <class T>
28 typename SLinkedList<T>::Iterator& SLinkedList<T>::Iterator::operator=(const Iterator& ite
29 {
30     /*
31      * Assignment operator
32      * Set this current, index, pList to iterator corresponding elements.
33      */
34     this->pList = iterator.pList;
35     this->current = iterator.current;
36     this->index = iterator.index;
37     return *this;
38 }
39
40 template <class T>
41 void SLinkedList<T>::Iterator::remove()
42 {
43     /*
44      * Remove a node which is pointed by current
45      * After remove current points to the previous node of this position (or node with
46      * If remove at front, current points to previous "node" of head (current = NULL, i
47      * Exception: throw std::out_of_range("Segmentation fault!") if remove when current
48      */
49     if (this->current == nullptr || this->pList->head == nullptr || this->index<0 || this-
50     throw std::out_of_range("Segmentation fault!");
51     Node* pDelete;
52
53     if (this->index == 0){
54         pDelete = this->pList->head;
55         this->current = nullptr;
56         this->index = -1;
57     }
58
59     else{
60         Node* prev = this->pList->head;
61         for (int i=1; i<this->index; i++){
62

```

	Test	Got	
✓	<pre>SLinkedList<int> list; int size = 10; for(int idx=0; idx < size; idx++){ list.add(idx); } SLinkedList<int>::Iterator it; int expvalue = 0; for(it = list.begin(); it != list.end(); it++){ assert(*it == expvalue); expvalue += 1; }</pre>		✓
✓	<pre>SLinkedList<int> list; int size = 10; for(int idx=0; idx < size; idx++){ list.add(idx); } SLinkedList<int>::Iterator it; int expvalue = 0; for(it = list.begin(); it != list.end(); ++it){ assert(*it == expvalue); expvalue += 1; }</pre>		✓

Your code failed one or more hidden tests.

Đúng một phần

Marks for this submission: 0,80/1,00.



Câu hỏi 4

Đúng

Đạt điểm 1,00
trên 1,00

Class **LinkedList** is used to represent single linked list, described as the following:

```
class LinkedList {
    public:
        class Node;
    private:
        Node* head;
        Node* tail;
        int size;
    public:
        class Node {
            private:
                int value;
                Node* next;
                friend class LinkedList;
            public:
                Node() {
                    this->next = NULL;
                }
                Node(Node* node) {
                    this->value = node->value;
                    this->next = node->next;
                }
                Node(int value, Node* next = NULL) {
                    this->value = value;
                    this->next = next;
                }
        };
        LinkedList(): head(NULL), tail(NULL), size(0) {};
        void partition(int k);
};
```

In this class; **head**, **tail** and **size** are the pointers of the first element, the last element and size of linked list.

Request: Implement function

```
void LinkedList::partition(int k);
```



To rearrange elements in this linked list by this way: split all elements of this linked list to 3 groups include: group I (the value of each element is smaller than k), group II (the value of each element is equal to k) and group III (the value of each element is larger than k); after that, move group I to the head of linked list, group II is after group I and group III is after group II. Note that the orders of the elements of each group are unchanged.

Example:

- The given linked list: 10->55->45->42->50
- k=45

In this case, group I includes elements with value 10 and 42, group II includes elements with 45 and group III includes elements with value 55 and 50. Rearrange by above way, this linked list will become 10->42->45->55->50 (the orders of th elements in each group is unchanged: 10 before 42 and 55 before 50).

Note: In this exercise, libraries `iostream`, `sstream` and `using namespace std`; have been used. You can add other functions for your answer, but you are not allowed to add other libraries.

For example:

Test	Result
<pre>LinkedList* l1 = new LinkedList(); l1->add(20); l1->add(30); l1->add(10); l1->add(60); l1->add(40); l1->add(45); l1->add(55); l1->partition(45); cout << l1->toString() << "\n";</pre>	[20, 30, 10, 40, 45, 60, 55]

Answer: (penalty regime: 0 %)

Reset answer

```
1 void LinkedList::partition(int k){
2     Node *tmp = this->head;
3     int len = this->size;
4     int arr[len];
5     int count = 0;
6     for (int i = 0; i < len; i++)
7     {
8         if (tmp->value < k)
9         {
10             arr[count] = tmp->value;
11             count++;
12         }
13         tmp = tmp->next;
14     }
15     tmp = this->head;
16     for (int i = 0; i < len; i++)
17     {
18         if (tmp->value == k)
```

```
19  {
20      arr[count] = tmp->value;
21      count++;
22  }
23  tmp = tmp->next;
24  }
25  tmp = this->head;
26  for (int i = 0; i < len; i++)
27  {
28      if (tmp->value > k)
29      {
30          arr[count] = tmp->value;
31          count++;
32      }
33      tmp = tmp->next;
34  }
35  tmp = this->head;
36  for (int i = 0; i < count; i++)
37  {
38      tmp->value = arr[i];
39      tmp = tmp->next;
40  }
41 }
```



	Test	Expected	Got	
✓	<pre>LinkedList* l1 = new LinkedList(); l1->add(20); l1->add(30); l1->add(10); l1->add(60); l1->add(40); l1->add(45); l1->add(55); l1->partition(45); cout << l1->toString() << "\n";</pre>	[20,30,10,40,45,60,55]	[20,30,10,40,45,60,55]	✓

Passed all tests! ✓

Đúng

Marks for this submission: 1,00/1,00.



Câu hỏi 5

Đúng

Đạt điểm 1,00
trên 1,00

Implement methods **add**, **size** in template class **SLinkedList** (which implements **List ADT**) representing the singly linked list with type **T** with the initialized frame. The description of each method is given in the code.

```
template <class T>
class SLinkedList {
public:
    class Node; // Forward declaration
protected:
    Node* head;
    Node* tail;
    int count;
public:
    SLinkedList();
    ~SLinkedList();
    void    add(T e);
    void    add(int index, T e);
    int     size();
public:
    class Node {
    private:
        T data;
        Node* next;
        friend class SLinkedList<T>;
    public:
        Node() {
            next = 0;
        }
        Node(Node* next) {
            this->next = next;
        }
        Node(T data, Node* next) {
            this->data = data;
            this->next = next;
        }
    };
};
```

For example:



Test	Result
<pre>SLinkedList<int> list; int size = 10; for(int index = 0; index < size; index++){ list.add(index); } cout << list.toString();</pre>	[0,1,2,3,4,5,6,7,8,9]
<pre>SLinkedList<int> list; int size = 10; for(int index = 0; index < size; index++){ list.add(0, index); } cout << list.toString();</pre>	[9,8,7,6,5,4,3,2,1,0]

Answer: (penalty regime: 0, 0, 0, 5, 10, 15, ... %)

Reset answer

```
1  template <class T>
2  void SLinkedList<T>::add(const T& e) {
3      /* Insert an element into the end of the list. */
4      Node* pNew = new Node(e, nullptr);
5      if(this->head==nullptr){
6          this->head = pNew;
7      }
8      else {
9          this->tail->next = pNew;
10     }
11     this->tail = pNew;
12     this->count++;
13 }
14
15 template<class T>
16 void SLinkedList<T>::add(int index, const T& e) {
17     /* Insert an element into the list at given index. */
18     Node* pNew = new Node(e, nullptr);
19     if (index==0)
20     {
21         if (this->head == nullptr){
22             this->head = pNew;
23             this->tail = pNew;
24         } else {
25             pNew->next = this->head;
26             this->head = pNew;
27         }
```

```
28     this->count++;
29 } else if (index == this->size()) add(e);
30 else {
31     Node* pPrev = this->head;
32     for (int i=1; i<index; i++){
33         if (pPrev->next == nullptr) break;
34         pPrev = pPrev->next;
35     }
36     pNew->next = pPrev->next;
37     pPrev->next = pNew;
38     this->count++;
39 }
40 }
41
42 template<class T>
43 int SLinkedList<T>::size() {
44     /* Return the length (size) of list */
45     Node* pCurr = this->head;
46     int length = 0;
47     while(pCurr != nullptr){
48         length++;
49         pCurr = pCurr->next;
50     }
51     return length;
52 }
53
```

	Test	Expected	Got	
✓	<pre>SLinkedList<int> list; int size = 10; for(int index = 0; index < size; index++){ list.add(index); } cout << list.toString();</pre>	[0,1,2,3,4,5,6,7,8,9]	[0,1,2,3,4,5,6,7,8,9]	✓

Passed all tests! ✓

Đúng

Marks for this submission: 1,00/1,00.



Câu hỏi 6

Đúng

Đạt điểm 1,00
trên 1,00

Implement methods **get**, **set**, **empty**, **indexOf**, **contains** in template class **SLinkedList** (which implements **List ADT**) representing the singly linked list with type T with the initialized frame. The description of each method is given in the code.

```
template <class T>
class SLinkedList {
public:
    class Node; // Forward declaration
protected:
    Node* head;
    Node* tail;
    int count;
public:
    SLinkedList(): head(NULL), tail(NULL), count(0);
    ~SLinkedList() { };
    void    add(T e);
    void    add(int index, T e);
    int     size();
    bool    empty();
    T       get(int index);
    void    set(int index, T e);
    int     indexOf(T item);
    bool    contains(T item);
public:
    class Node {
    private:
        T data;
        Node* next;
        friend class SLinkedList<T>;
    public:
        Node() {
            next = 0;
        }
        Node(Node* next) {
            this->next = next;
        }
        Node(T data, Node* next = NULL) {
            this->data = data;
            this->next = next;
        }
    };
};
```



For example:

Test	Result
<pre>SLinkedList<int> list; int values[] = {10, 15, 2, 6, 4, 7, 40, 8}; int index[] = {0, 0, 1, 3, 2, 3, 5, 0}; int expvalues[] = {8, 15, 2, 4, 7, 10, 40, 6}; for (int idx = 0; idx < 8; idx++){ list.add(index[idx], values[idx]); } assert(list.size() == 8); for (int idx = 0; idx < 8; idx++){ assert(list.get(idx) == expvalues[idx]); } cout << list.toString();</pre>	[8,15,2,4,7,10,40,6]
<pre>SLinkedList<int> list; assert(list.empty() == true); cout << list.toString();</pre>	[]

Answer: (penalty regime: 0, 0, 0, 5, 10, 15, ... %)

Reset answer

```
1  template<class T>
2  T SLinkedList<T>::get(int index) {
3      /* Give the data of the element at the given index in the list. */
4      Node* tmp = head;
5      int pos = 0;
6      if(index < 0 || index > size())
7      {
8          return 0;
9      }
10 while(tmp != nullptr){
11     if(pos ==index){
12         return tmp->data;
13     }
14     tmp = tmp->next;
15     pos++;
16 }
17 return tmp->data;
18 }
19
20 template<class T>
21 void SLinkedList<T>::set(int index, const T& e) {
22     /* Assign a new value for the element at the given index in the list */
23     int pos = 0;
```

```
24 //Node* p = new Node(e);
25 Node* tmp = head;
26 ▾ if(index < 0 || index > size()){
27     return;
28 }
29 tmp = head;
30 ▾ while(tmp != nullptr && pos < index){
31     tmp = tmp->next;
32     pos++;
33 }
34 ▾ if(tmp != nullptr){
35     tmp->data = e;
36 }
37 }
38
39 template<class T>
40 ▾ bool SLinkedList<T>::empty() {
41     /* Check if the list is empty or not. */
42     return head == nullptr;
43 }
44
45 template<class T>
46 ▾ int SLinkedList<T>::indexOf(const T& item) {
47     /* Return the first index whether the item appears in the list, otherwise return -1 */
48     int pos = -1;
49     Node* tmp = head;
50     Node* p = new Node(item);
51 ▾ while (tmp != nullptr) {
52     pos++;
53 ▾ if (tmp->data == p->data){
54     return pos;
55 }
56 tmp = tmp->next;
57 }
58 return -1;
59 }
60
61 template<class T>
62 ▾
```



	Test	Expected	Got	
✓	<pre>SLinkedList<int> list; int values[] = {10, 15, 2, 6, 4, 7, 40, 8}; int index[] = {0, 0, 1, 3, 2, 3, 5, 0}; int expvalues[] = {8, 15, 2, 4, 7, 10, 40, 6}; for (int idx = 0; idx < 8; idx++){ list.add(index[idx], values[idx]); } assert(list.size() == 8); for (int idx = 0; idx < 8; idx++){ assert(list.get(idx) == expvalues[idx]); } cout << list.toString();</pre>	[8,15,2,4,7,10,40,6]	[8,15,2,4,7,10,40,6]	✓
✓	<pre>SLinkedList<int> list; assert(list.empty() == true); cout << list.toString();</pre>	[]	[]	✓

Passed all tests! ✓

Đúng

Marks for this submission: 1,00/1,00.



Câu hỏi 7

Đúng

Đạt điểm 1,00
trên 1,00

Implement methods **removeAt**, **removeItem**, **clear** in template class **SLinkedList** (which implements **List ADT**) representing the singly linked list with type T with the initialized frame. The description of each method is given in the code.

```
template <class T>
class SLinkedList {
public:
    class Node; // Forward declaration
protected:
    Node* head;
    Node* tail;
    int count;
public:
    SLinkedList();
    ~SLinkedList();
    void    add(T e);
    void    add(int index, T e);
    int     size();
    bool    empty();
    int     size();
    void    clear();
    T       get(int index);
    void    set(int index, T e);
    int     indexOf(T item);
    bool    contains(T item);
    T       removeAt(int index);
    bool    removeItem(T item);
public:
    class Node {
    private:
        T data;
        Node* next;
        friend class SLinkedList<T>;
    public:
        Node() {
            next = 0;
        }
        Node(Node* next) {
            this->next = next;
        }
        Node(T data, Node* next = NULL) {
            this->data = data;
            this->next = next;
        }
    };
};
```

For example:

Test	Result
<pre>SLinkedList<int> list; for (int i = 0; i < 10; ++i) { list.add(i); } assert(list.get(0) == list.removeAt(0)); cout << list.toString();</pre>	[1,2,3,4,5,6,7,8,9]
<pre>SLinkedList<int> list; for (int i = 0; i < 10; ++i) { list.add(i); } assert(list.get(9) == list.removeAt(9)); cout << list.toString();</pre>	[0,1,2,3,4,5,6,7,8]
<pre>SLinkedList<int> list; for (int i = 0; i < 10; ++i) { list.add(i); } assert(list.removeItem(9)); cout << list.toString();</pre>	[0,1,2,3,4,5,6,7,8]

Answer: (penalty regime: 0, 0, 0, 5, 10, 15, ... %)

Reset answer

```
1  template <class T>
2  T SLinkedList<T>::removeAt(int index)
3  {
4      /* Remove element at index and return removed value */
5      Node* pDelete;
6      if (index<0 || index >=this->size())
7          throw std::out_of_range("Segmentation fault!");
8      if (index == 0)
9      {
10         pDelete = this->head;
11         if (this->size() == 1)
12         {
13             this->head = nullptr;
14             this->tail = nullptr;
15         } else
16             this->head = this->head->next;
17     } else
18     {
```

```
18     Node* pPrev = this->head;
19     for (int i=1; i<index; i++){
20         if (pPrev->next == nullptr) break;
21         pPrev = pPrev->next;
22     }
23     pDelete = pPrev->next;
24     if (pDelete) pPrev->next = pDelete->next;
25     if (index == this->size() - 1) this->tail = pPrev;
26 }
27 T dataOut = pDelete->data;
28 delete pDelete;
29 this->count--;
30 return dataOut;
31 }
32
33 template <class T>
34 bool SLinkedList<T>::removeItem(const T& item)
35 {
36     /* Remove the first apperance of item in list and return true, otherwise return false */
37     Node* pCurr = this->head;
38     int index = 0;
39     while (pCurr != nullptr){
40         if (pCurr->data == item){
41             removeAt(index);
42             return true;
43         }
44         index++;
45         pCurr = pCurr->next;
46     }
47     return false;
48 }
49
50 template<class T>
51 void SLinkedList<T>::clear(){
52     /* Remove all elements in list */
53     Node* pCurr = this->head;
54     while (pCurr != nullptr){
55         pCurr = pCurr->next;
56         delete this->head;
57         this->head = pCurr;
58     }
59     this->count = 0;
60     this->head = nullptr;
61     this->tail = nullptr;
62 }
```

	Test	Expected	Got	
✓	<pre>SLinkedList<int> list; for (int i = 0; i < 10; ++i) { list.add(i); } assert(list.get(0) == list.removeAt(0)); cout << list.toString();</pre>	[1,2,3,4,5,6,7,8,9]	[1,2,3,4,5,6,7,8,9]	✓
✓	<pre>SLinkedList<int> list; for (int i = 0; i < 10; ++i) { list.add(i); } assert(list.get(9) == list.removeAt(9)); cout << list.toString();</pre>	[0,1,2,3,4,5,6,7,8]	[0,1,2,3,4,5,6,7,8]	✓

Passed all tests! ✓

Đúng

Marks for this submission: 1,00/1,00.



Câu hỏi 8

Đúng

Đạt điểm 1,00
trên 1,00

Class `LLNode` representing a node of singly linked lists is declared as below:

```
class LLNode {
public:
    int val;
    LLNode* next;
    LLNode(); // Constructor: val = 0, next = nullptr
    LLNode(int val, LLNode* next); // Constructor with customized data
}
```

Given a singly linked list head node.
Your task is to implement a function with following prototype:

```
LLNode* reverseLinkedList(LLNode* head);
```

The function returns head node of the reversed singly linked list.

Note:

- The `iostream` library has been included and `namespace std` is being used. No other libraries are allowed.
- The constructors and methods of class `LLNode` have been defined fully so you do not need to redefine them.
- You can write helper functions.

For example:

Test	Result
<pre>int arr[] = {13, 88, 60, 7, 192}; LLNode* head = LLNode::createWithIterators(arr, arr + sizeof(arr) / sizeof(int)); LLNode::printList(head); cout << "\n"; LLNode* newhead = reverseLinkedList(head); LLNode::printList(newhead); newhead->clear();</pre>	<pre>[13, 88, 60, 7, 192] [192, 7, 60, 88, 13]</pre>

Answer: (penalty regime: 0 %)

Reset answer

```
1 LLNode* reverseLinkedList(LLNode* head) {
2     // STUDENT ANSWER
3     if (head == nullptr || head->next == nullptr){
4         return head;
5     }
6     LLNode*tmp = head;
7     LLNode*revLL = nullptr;
8     LLNode* next = nullptr;
9     while (tmp!= nullptr)
10    {
11        next = tmp->next;
12        tmp->next = revLL;
```

```
13         revLL = tmp;
14         tmp = next;
15     }
16     return revLL;
17 }
```

	Test	Expected	Got	
✓	<pre>int arr[] = {13, 88, 60, 7, 192}; LLNode* head = LLNode::createWithIterators(arr, arr + sizeof(arr) / sizeof(int)); LLNode::printList(head); cout << "\n"; LLNode* newhead = reverseLinkedList(head); LLNode::printList(newhead); newhead->clear();</pre>	<pre>[13, 88, 60, 7, 192] [192, 7, 60, 88, 13]</pre>	<pre>[13, 88, 60, 7, 192] [192, 7, 60, 88, 13]</pre>	✓ //
✓	<pre>int arr[] = {}; LLNode* head = LLNode::createWithIterators(arr, arr + sizeof(arr) / sizeof(int)); LLNode::printList(head); cout << "\n"; LLNode* newhead = reverseLinkedList(head); LLNode::printList(newhead); newhead->clear();</pre>	<pre>[] []</pre>	<pre>[] []</pre>	✓
✓	<pre>int arr[] = {31, 22, 46, 152, 14, 87, 196, 97, 5, 93}; LLNode* head = LLNode::createWithIterators(arr, arr + sizeof(arr) / sizeof(int)); LLNode::printList(head); cout << "\n"; LLNode* newhead = reverseLinkedList(head); LLNode::printList(newhead); newhead->clear();</pre>	<pre>[31, 22, 46, 152, 14, 87, 196, 97, 5, 93] [93, 5, 97, 196, 87, 14, 152, 46, 22, 31]</pre>	<pre>[31, 22, 46, 152, 14, 87, 196, 97, 5, 93] [93, 5, 97, 196, 87, 14, 152, 46, 22, 31]</pre>	✓



	Test	Expected	Got	
✓	<pre>int arr[] = {115, 59, 178, 39, 109, 18, 154, 106, 94, 174, 51, 33, 132, 195, 161, 37, 61, 107, 120, 190}; LLNode* head = LLNode::createWithIterators(arr, arr + sizeof(arr) / sizeof(int)); LLNode::printList(head); cout << "\n"; LLNode* newhead = reverseLinkedList(head); LLNode::printList(newhead); newhead->clear();</pre>	[115, 59, 178, 39, 109, 18, 154, 106, 94, 174, 51, 33, 132, 195, 161, 37, 61, 107, 120, 190] [190, 120, 107, 61, 37, 161, 195, 132, 33, 51, 174, 94, 106, 154, 18, 109, 39, 178, 59, 115]	[115, 59, 178, 39, 109, 18, 154, 106, 94, 174, 51, 33, 132, 195, 161, 37, 61, 107, 120, 190] [190, 120, 107, 61, 37, 161, 195, 132, 33, 51, 174, 94, 106, 154, 18, 109, 39, 178, 59, 115]	✓
✓	<pre>int arr[] = {104, 50, 154, 40, 15, 171, 56, 114, 67, 90, 46, 179, 152, 177, 139, 45, 18, 55, 38, 158, 8, 157, 143, 37, 16, 83, 173, 82, 156, 51, 124, 25, 68, 51, 194, 105, 44, 17, 97, 0, 150, 66, 71, 81, 11, 180, 148, 160, 127, 93, 108, 13, 122, 172, 39, 88, 62, 38, 61, 156, 45, 131, 69, 191, 123, 42, 103, 56, 69, 138, 185, 162, 192, 147, 71, 80, 12, 36, 191, 121, 194, 86, 92, 183, 164, 97, 185, 130, 29, 174, 112, 194, 185, 132, 27, 197, 158, 151, 51, 174}; LLNode* head = LLNode::createWithIterators(arr, arr + sizeof(arr) / sizeof(int)); LLNode::printList(head); cout << "\n"; LLNode* newhead = reverseLinkedList(head); LLNode::printList(newhead); newhead->clear();</pre>	[104, 50, 154, 40, 15, 171, 56, 114, 67, 90, 46, 179, 152, 177, 139, 45, 18, 55, 38, 158, 8, 157, 143, 37, 16, 83, 173, 82, 156, 51, 124, 25, 68, 51, 194, 105, 44, 17, 97, 0, 150, 66, 71, 81, 11, 180, 148, 160, 127, 93, 108, 13, 122, 172, 39, 88, 62, 38, 61, 156, 45, 131, 69, 191, 123, 42, 103, 56, 69, 138, 185, 162, 192, 147, 71, 80, 12, 36, 191, 121, 194, 86, 92, 183, 164, 97, 185, 130, 29, 174, 112, 194, 185, 132, 27, 197, 158, 151, 51, 174] [174, 51, 151, 158, 197, 27, 132, 185, 194, 112, 174, 29, 130, 185, 97, 164, 183, 92, 86, 194, 121, 191, 36, 12, 80, 71, 147, 192, 162, 185, 138, 69, 56, 103, 42, 123, 191, 69, 131, 45, 156, 61, 38, 62, 88, 39, 172, 122, 13, 108, 93, 127, 160, 148, 180, 11, 81, 71, 66, 150, 0, 97, 17, 44, 105, 194, 51, 68, 25, 124, 51, 156, 82, 173, 83, 16, 37, 143, 157, 8, 158, 38, 55, 18, 45, 139, 177, 152, 179, 46, 90, 67, 114, 56, 171, 15, 40, 154, 50, 104]	[104, 50, 154, 40, 15, 171, 56, 114, 67, 90, 46, 179, 152, 177, 139, 45, 18, 55, 38, 158, 8, 157, 143, 37, 16, 83, 173, 82, 156, 51, 124, 25, 68, 51, 194, 105, 44, 17, 97, 0, 150, 66, 71, 81, 11, 180, 148, 160, 127, 93, 108, 13, 122, 172, 39, 88, 62, 38, 61, 156, 45, 131, 69, 191, 123, 42, 103, 56, 69, 138, 185, 162, 192, 147, 71, 80, 12, 36, 191, 121, 194, 86, 92, 183, 164, 97, 185, 130, 29, 174, 112, 194, 185, 132, 27, 197, 158, 151, 51, 174] [174, 51, 151, 158, 197, 27, 132, 185, 194, 112, 174, 29, 130, 185, 97, 164, 183, 92, 86, 194, 121, 191, 36, 12, 80, 71, 147, 192, 162, 185, 138, 69, 56, 103, 42, 123, 191, 69, 131, 45, 156, 61, 38, 62, 88, 39, 172, 122, 13, 108, 93, 127, 160, 148, 180, 11, 81, 71, 66, 150, 0, 97, 17, 44, 105, 194, 51, 68, 25, 124, 51, 156, 82, 173, 83, 16, 37, 143, 157, 8, 158, 38, 55, 18, 45, 139, 177, 152, 179, 46, 90, 67, 114, 56, 171, 15, 40, 154, 50, 104]	✓



	Test	Expected	Got	
✓	<pre>int arr[] = {106, 14, 71, 71, 166, 172, 128, 128, 52, 113, 58, 184, 70, 73, 37, 83, 71, 46, 133, 100, 37, 186, 199, 69, 79, 71, 70, 13, 155, 90, 60, 82, 180, 125, 108, 160, 74, 93, 72, 152, 106, 11, 174, 164, 168, 6, 9, 41, 58, 65, 141, 22, 103, 49, 114, 197, 175, 131, 109, 135, 124, 19, 76, 109, 130, 15, 120, 12, 11, 77, 88, 56, 127, 162, 67, 133, 162, 22, 94, 122, 53, 132, 167, 111, 138, 61, 169, 64, 98, 159, 58, 147, 137, 50, 193, 190, 173, 28, 35, 108, 138, 110, 184, 82, 114, 199, 137, 156, 155, 167, 165, 134, 193, 22, 173, 176, 46, 61, 196, 137, 151, 69, 67, 87, 161, 72, 60, 70, 67, 109, 149, 16, 38, 127, 15, 12, 107, 48, 184, 185, 43, 178, 14, 188, 61, 79, 189, 144, 27, 41, 114, 182, 118, 76, 89, 126, 124, 195, 180, 133, 118, 96, 61, 95, 127, 40, 62, 102, 130, 174, 47, 131, 187, 103, 88, 109, 153, 110, 184, 72, 178, 41, 93, 112, 24, 156, 180, 150, 114, 172, 43, 170, 46, 166, 109, 193, 13, 17, 190, 153, 80, 106, 199, 163, 106, 39, 85, 56, 174, 189, 61, 72, 154, 149, 59, 110, 139, 189, 99, 40, 84, 180, 23, 13, 9, 192, 163, 88, 1, 3, 149, 132, 36, 34, 120, 40, 48, 32, 91, 166, 42, 155, 30, 111, 140, 6, 189, 169, 50, 15, 144, 67, 145, 169, 49, 135, 49, 76, 0, 105, 90, 60, 75, 88, 150, 88, 122, 11, 158, 12, 43, 182, 152, 112, 65, 149, 14, 194, 146, 120, 114, 178, 177, 159, 105, 45, 169, 152, 150, 60, 99, 39, 73, 101, 162, 173, 127, 122, 157, 116, 139, 57, 101, 121, 45, 133, 151, 171, 186, 186, 116, 4, 173, 118, 103, 70, 133, 158, 119, 47, 142, 111, 110, 96, 68, 118, 153, 178, 174, 130, 176, 186, 23, 193, 40, 175, 107, 184, 168, 185, 56, 167, 169, 68, 42, 75, 26, 174, 92, 46, 18, 85, 131, 164, 15, 116, 197, 88, 143, 8, 115, 199, 173, 142, 139, 162, 62, 7, 33, 2, 4, 54, 22, 135, 194, 34, 17, 90, 154, 71, 6, 156, 76, 66, 172, 157, 39, 92, 68, 169, 117, 166, 86, 153, 106, 63, 142, 190, 149, 58, 31, 19, 114, 35, 110, 108, 103, 27, 139, 97, 166, 186, 164, 55, 19, 133, 194, 153, 38, 8, 87, 35, 179, 5, 32, 143, 104, 86, 184, 116, 70, 39, 22, 172, 28, 40, 72, 116, 192, 17, 159, 169, 143, 167, 77, 25, 128, 102, 140, 120, 140, 71, 56, 76, 16, 13, 144, 91, 166, 2, 74, 164, 153, 71, 37, 187, 104, 172, 122, 9, 109, 116, 173, 75, 70, 117, 57, 129, 171, 198, 194, 154, 177, 82, 103, 30, 174, 85, 191, 116, 30, 164, 155, 38, 38, 49, 84, 34, 111, 159};</pre>	[106, 14, 71, 71, 166, 172, 128, 128, 52, 113, 58, 184, 70, 73, 37, 83, 71, 46, 133, 100, 37, 186, 199, 69, 79, 71, 70, 13, 155, 90, 60, 82, 180, 125, 108, 160, 74, 93, 72, 152, 106, 11, 174, 164, 168, 6, 9, 41, 58, 65, 141, 22, 103, 49, 114, 197, 175, 131, 109, 135, 124, 19, 76, 109, 130, 15, 120, 12, 11, 77, 88, 56, 127, 162, 67, 133, 162, 22, 94, 122, 53, 132, 167, 111, 138, 61, 169, 64, 98, 159, 58, 147, 137, 50, 193, 190, 173, 28, 35, 108, 138, 110, 184, 82, 114, 199, 137, 156, 155, 167, 165, 134, 193, 22, 173, 176, 46, 61, 196, 137, 151, 69, 67, 87, 161, 72, 60, 70, 67, 109, 149, 16, 38, 127, 15, 12, 107, 48, 184, 185, 43, 178, 14, 188, 61, 79, 189, 144, 27, 41, 114, 182, 118, 76, 89, 126, 124, 195, 180, 133, 118, 96, 61, 95, 127, 40, 62, 102, 130, 174, 47, 131, 187, 103, 88, 109, 153, 110, 184, 72, 178, 41, 93, 112, 24, 156, 180, 150, 114, 172, 43, 170, 46, 166, 109, 193, 13, 17, 190, 153, 80, 106, 199, 163, 106, 39, 85, 56, 174, 189, 61, 72, 154, 149, 59, 110, 139, 189, 99, 40, 84, 180, 23, 13, 9, 192, 163, 88, 1, 3, 149, 132, 36, 34, 120, 40, 48, 32, 91, 166, 42, 155, 30, 111, 140, 6, 189, 169, 50, 15, 144, 67, 145, 169, 49, 135, 49, 76, 0, 105, 90, 60, 75, 88, 150, 88, 122, 11, 158, 12, 43, 182, 152, 112, 65, 149, 14, 194, 146, 120, 114, 178, 177, 159, 105, 45, 169, 152, 150, 60, 99, 39,	[106, 14, 71, 71, 166, 172, 128, 128, 52, 113, 58, 184, 70, 73, 37, 83, 71, 46, 133, 100, 37, 186, 199, 69, 79, 71, 70, 13, 155, 90, 60, 82, 180, 125, 108, 160, 74, 93, 72, 152, 106, 11, 174, 164, 168, 6, 9, 41, 58, 65, 141, 22, 103, 49, 114, 197, 175, 131, 109, 135, 124, 19, 76, 109, 130, 15, 120, 12, 11, 77, 88, 56, 127, 162, 67, 133, 162, 22, 94, 122, 53, 132, 167, 111, 138, 61, 169, 64, 98, 159, 58, 147, 137, 50, 193, 190, 173, 28, 35, 108, 138, 110, 184, 82, 114, 199, 137, 156, 155, 167, 165, 134, 193, 22, 173, 176, 46, 61, 196, 137, 151, 69, 67, 87, 161, 72, 60, 70, 67, 109, 149, 16, 38, 127, 15, 12, 107, 48, 184, 185, 43, 178, 14, 188, 61, 79, 189, 144, 27, 41, 114, 182, 118, 76, 89, 126, 124, 195, 180, 133, 118, 96, 61, 95, 127, 40, 62, 102, 130, 174, 47, 131, 187, 103, 88, 109, 153, 110, 184, 72, 178, 41, 93, 112, 24, 156, 180, 150, 114, 172, 43, 170, 46, 166, 109, 193, 13, 17, 190, 153, 80, 106, 199, 163, 106, 39, 85, 56, 174, 189, 61, 72, 154, 149, 59, 110, 139, 189, 99, 40, 84, 180, 23, 13, 9, 192, 163, 88, 1, 3, 149, 132, 36, 34, 120, 40, 48, 32, 91, 166, 42, 155, 30, 111, 140, 6, 189, 169, 50, 15, 144, 67, 145, 169, 49, 135, 49, 76, 0, 105, 90, 60, 75, 88, 150, 88, 122, 11, 158, 12, 43, 182, 152, 112, 65, 149, 14, 194, 146, 120, 114, 178, 177, 159, 105, 45, 169, 152, 150, 60, 99, 39,	✓

	Test	Expected	Got	
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	<pre>43, 148, 154, 111, 197, 119, 131, 73, 123, 1, 54, 185, 93, 156, 83, 129, 62, 161, 133, 84, 58, 144, 128, 196, 58, 95, 89, 158, 76, 88, 5, 188, 5, 80, 173, 156, 48, 85, 184, 166, 100, 176, 33, 140, 96, 27, 66, 69, 194, 37, 146, 107, 161, 11, 11, 150, 135, 145, 183, 135, 3, 106, 124, 34, 158, 149, 37, 134, 61, 112, 100, 54, 70, 81, 181, 141, 134, 130, 44, 30, 26, 29, 145, 2, 45, 9, 138, 158, 97, 43, 10, 195, 106, 32, 121, 111, 55, 98, 141, 93, 74, 33, 111, 105, 18, 124, 128, 86, 79, 41, 14, 75, 198, 33, 162, 171, 101, 111, 100, 132, 42, 98, 25, 98, 23, 169, 140, 109, 96, 111, 18, 81, 0, 104, 74, 37, 81, 90, 21, 166, 106, 191, 170, 44, 6, 90, 174, 44, 195, 88, 154, 64, 112, 33, 61, 141, 98, 14, 91, 59, 137, 150, 118, 114, 55, 36, 108, 83, 144}}; LLNode* head = LLNode::createWithIterators(arr, arr + sizeof(arr) / sizeof(int)); LLNode::printList(head); cout << "\n"; LLNode* newhead = reverseLinkedList(head); LLNode::printList(newhead); newhead->clear();</pre>	<pre>166, 91, 56, 34, 9, 26, 177, 198, 52, 48, 13, 7, 172, 125, 13, 187, 90, 108, 174, 157, 37, 30, 107, 52, 136, 147, 141, 177, 181, 107, 134, 164, 34, 176, 46, 168, 75, 167, 181, 44, 136, 111, 106, 12, 89, 90, 131, 104, 38, 11, 6, 148, 107, 135, 119, 81, 20, 71, 67, 67, 173, 54, 108, 99, 134, 183, 158, 175, 61, 97, 49, 167, 11, 87, 159, 49, 99, 18, 0, 128, 40, 160, 132, 97, 14, 65, 185, 120, 195, 160, 38, 170, 79, 88, 174, 114, 42, 169, 32, 136, 5, 186, 94, 31, 156, 95, 45, 199, 122, 93, 172, 12, 157, 180, 0, 93, 131, 165, 136, 16, 149, 86, 52, 20, 66, 122, 82, 160, 143, 29, 60, 179, 149, 87, 100, 68, 132, 32, 58, 52, 111, 92, 103, 138, 199, 39, 82, 134, 92, 171, 75, 16, 112, 32, 29, 171, 198, 60, 90, 53, 68, 36, 121, 112, 93, 51, 155, 7, 41, 97, 142, 122, 41, 14, 185, 91, 149, 144, 97, 5, 96, 74, 107, 98, 62, 150, 179, 53, 100, 61, 92, 8, 193, 165, 17, 96, 196, 180, 114, 110, 101, 67, 35, 64, 184, 148, 145, 119, 7, 176, 191, 75, 167, 59, 40, 109, 86, 105, 125, 20, 91, 46, 185, 11, 103, 137, 130, 169, 146, 170, 139, 2, 104, 157, 119, 85, 109, 142, 185, 71, 150, 158, 122, 190, 26, 133, 186, 89, 17, 33, 114, 135, 19, 23, 0, 173, 28, 176, 133, 125, 63, 174, 124, 12, 57, 24, 3, 11, 174, 99, 167, 193, 129, 51, 42, 184, 152, 193, 192, 182, 166, 77, 147, 45, 61, 159, 75, 6, 83, 81, 186, 98, 92, 136, 38, 130, 40, 132, 111, 145, 174, 84, 100,</pre>	<pre>166, 91, 56, 34, 9, 26, 177, 198, 52, 48, 13, 7, 172, 125, 13, 187, 90, 108, 174, 157, 37, 30, 107, 52, 136, 147, 141, 177, 181, 107, 134, 164, 34, 176, 46, 168, 75, 167, 181, 44, 136, 111, 106, 12, 89, 90, 131, 104, 38, 11, 6, 148, 107, 135, 119, 81, 20, 71, 67, 67, 173, 54, 108, 99, 134, 183, 158, 175, 61, 97, 49, 167, 11, 87, 159, 49, 99, 18, 0, 128, 40, 160, 132, 97, 14, 65, 185, 120, 195, 160, 38, 170, 79, 88, 174, 114, 42, 169, 32, 136, 5, 186, 94, 31, 156, 95, 45, 199, 122, 93, 172, 12, 157, 180, 0, 93, 131, 165, 136, 16, 149, 86, 52, 20, 66, 122, 82, 160, 143, 29, 60, 179, 149, 87, 100, 68, 132, 32, 58, 52, 111, 92, 103, 138, 199, 39, 82, 134, 92, 171, 75, 16, 112, 32, 29, 171, 198, 60, 90, 53, 68, 36, 121, 112, 93, 51, 155, 7, 41, 97, 142, 122, 41, 14, 185, 91, 149, 144, 97, 5, 96, 74, 107, 98, 62, 150, 179, 53, 100, 61, 92, 8, 193, 165, 17, 96, 196, 180, 114, 110, 101, 67, 35, 64, 184, 148, 145, 119, 7, 176, 191, 75, 167, 59, 40, 109, 86, 105, 125, 20, 91, 46, 185, 11, 103, 137, 130, 169, 146, 170, 139, 2, 104, 157, 119, 85, 109, 142, 185, 71, 150, 158, 122, 190, 26, 133, 186, 89, 17, 33, 114, 135, 19, 23, 0, 173, 28, 176, 133, 125, 63, 174, 124, 12, 57, 24, 3, 11, 174, 99, 167, 193, 129, 51, 42, 184, 152, 193, 192, 182, 166, 77, 147, 45, 61, 159, 75, 6, 83, 81, 186, 98, 92, 136, 38, 130, 40, 132, 111, 145, 174, 84, 100,</pre>	




	Test	Expected	Got	
		199, 176, 126, 185, 199, 57, 94, 12, 164, 189, 22, 8, 48, 120, 110, 48, 158, 17, 61, 64, 146, 72, 55, 81, 182, 149, 184, 91, 175, 122, 144, 23, 63, 4, 160, 174, 69, 78, 117, 28, 139, 118, 59, 169, 87, 60, 157, 64, 37, 32, 27, 169, 4, 139, 188, 92, 23, 192, 60, 39, 5, 68, 160, 82, 99, 132, 105, 80, 169, 46, 198, 169, 115, 2, 53, 157, 26, 9, 172, 99, 156, 71, 36, 83, 191, 21, 86, 17, 108, 18, 145, 42, 19, 51, 132, 155, 50, 192, 152, 0, 59, 89, 128, 27, 196, 160, 44, 149, 105, 24, 18, 137, 121, 22, 151, 111, 109, 111, 86, 30, 159, 59, 135, 6, 185, 40, 147, 27, 188, 33, 165, 14, 82, 95, 28, 97, 87, 65, 79, 146, 52, 152, 80, 130, 173, 54, 5, 77, 109, 128, 51, 148, 63, 185, 93, 153, 55, 33, 189, 50, 88, 174, 153, 58, 64, 49, 105, 117, 122, 91, 110, 130, 108, 74, 69, 197, 120, 110, 78, 124, 23, 153, 70, 91, 4, 150, 28, 163, 125, 89, 163, 16, 24, 15, 28, 115, 44, 94, 24, 85, 71, 0, 35, 5, 95, 125, 18, 99, 35, 47, 185, 118, 99, 161, 119, 10, 134, 17, 156, 134, 11, 61, 101, 117, 99, 4, 46, 163, 46, 71, 176, 10, 68, 160, 19, 165, 54, 177, 87, 28, 188, 167, 118, 73, 33, 88, 133, 99, 37, 163, 132, 17, 178, 63, 18, 48, 153, 198, 133, 160, 174, 115, 106, 68, 179, 17, 41, 184, 137, 22, 123, 152, 149, 48, 142, 62, 73, 102, 137, 52, 161, 171, 52, 147, 136, 6, 163, 10, 154, 196, 28, 19, 149, 186, 53, 170, 2, 165, 82, 64, 17, 53, 198, 135, 189, 49,	199, 176, 126, 185, 199, 57, 94, 12, 164, 189, 22, 8, 48, 120, 110, 48, 158, 17, 61, 64, 146, 72, 55, 81, 182, 149, 184, 91, 175, 122, 144, 23, 63, 4, 160, 174, 69, 78, 117, 28, 139, 118, 59, 169, 87, 60, 157, 64, 37, 32, 27, 169, 4, 139, 188, 92, 23, 192, 60, 39, 5, 68, 160, 82, 99, 132, 105, 80, 169, 46, 198, 169, 115, 2, 53, 157, 26, 9, 172, 99, 156, 71, 36, 83, 191, 21, 86, 17, 108, 18, 145, 42, 19, 51, 132, 155, 50, 192, 152, 0, 59, 89, 128, 27, 196, 160, 44, 149, 105, 24, 18, 137, 121, 22, 151, 111, 109, 111, 86, 30, 159, 59, 135, 6, 185, 40, 147, 27, 188, 33, 165, 14, 82, 95, 28, 97, 87, 65, 79, 146, 52, 152, 80, 130, 173, 54, 5, 77, 109, 128, 51, 148, 63, 185, 93, 153, 55, 33, 189, 50, 88, 174, 153, 58, 64, 49, 105, 117, 122, 91, 110, 130, 108, 74, 69, 197, 120, 110, 78, 124, 23, 153, 70, 91, 4, 150, 28, 163, 125, 89, 163, 16, 24, 15, 28, 115, 44, 94, 24, 85, 71, 0, 35, 5, 95, 125, 18, 99, 35, 47, 185, 118, 99, 161, 119, 10, 134, 17, 156, 134, 11, 61, 101, 117, 99, 4, 46, 163, 46, 71, 176, 10, 68, 160, 19, 165, 54, 177, 87, 28, 188, 167, 118, 73, 33, 88, 133, 99, 37, 163, 132, 17, 178, 63, 18, 48, 153, 198, 133, 160, 174, 115, 106, 68, 179, 17, 41, 184, 137, 22, 123, 152, 149, 48, 142, 62, 73, 102, 137, 52, 161, 171, 52, 147, 136, 6, 163, 10, 154, 196, 28, 19, 149, 186, 53, 170, 2, 165, 82, 64, 17, 53, 198, 135, 189, 49,	



	Test	Expected	Got	
		97, 5, 147, 60, 82, 198, 122, 41, 85, 117, 15, 26, 168, 172, 71, 15, 169, 172, 73, 44, 178, 134, 35, 108, 1, 51, 12, 21, 10, 48, 139, 139, 94, 14, 0, 153, 73, 73, 0, 149, 111, 103, 125, 92, 24, 3, 38, 110, 77, 75, 131, 106, 33, 110, 109, 92, 28, 49, 124, 38, 12, 132, 137, 197, 190, 17, 22, 62, 141, 13, 107, 48, 113, 169, 92, 163, 115, 50, 56, 185, 7, 63, 59, 187, 193, 155, 183, 111, 67, 84, 104, 81, 151, 131, 14, 15, 177, 197, 190, 65, 143, 25, 156, 137, 116, 98, 90, 127, 114, 88, 189, 88, 23, 65, 106, 95, 27, 93, 155, 4, 199, 99, 151, 53, 192, 125, 2, 98, 158, 155, 129, 100, 55, 119, 89, 128, 88, 60, 145, 169, 85, 132, 70, 76, 167, 25, 70, 199, 190, 52, 184, 188, 144, 53, 147, 50, 162, 130, 197, 125, 173, 147, 45, 71, 180, 173, 83, 174, 68, 77, 96, 199, 115, 167, 193, 156, 148, 175, 33, 98, 99, 96, 62, 54, 125, 131, 155, 64, 179, 66, 63, 192, 7, 149, 60, 136, 78, 172, 115, 10, 168, 158, 63, 28, 117, 81, 24, 40, 89, 67, 57, 184, 89, 160, 13, 10, 15, 37, 23, 152, 147, 188, 96, 99, 116, 88, 13, 121, 167, 67, 24, 180, 45, 199, 86, 85, 58, 98, 121, 25, 148, 172, 24, 146, 193, 149, 61, 72, 117, 59, 79, 162, 100, 89, 88, 167, 99, 14, 55, 178, 20, 116, 49, 173, 27, 183, 117, 4, 99, 145, 46, 46, 61, 116, 125, 31, 195, 103, 30, 137, 184, 36, 67, 68]	97, 5, 147, 60, 82, 198, 122, 41, 85, 117, 15, 26, 168, 172, 71, 15, 169, 172, 73, 44, 178, 134, 35, 108, 1, 51, 12, 21, 10, 48, 139, 139, 94, 14, 0, 153, 73, 73, 0, 149, 111, 103, 125, 92, 24, 3, 38, 110, 77, 75, 131, 106, 33, 110, 109, 92, 28, 49, 124, 38, 12, 132, 137, 197, 190, 17, 22, 62, 141, 13, 107, 48, 113, 169, 92, 163, 115, 50, 56, 185, 7, 63, 59, 187, 193, 155, 183, 111, 67, 84, 104, 81, 151, 131, 14, 15, 177, 197, 190, 65, 143, 25, 156, 137, 116, 98, 90, 127, 114, 88, 189, 88, 23, 65, 106, 95, 27, 93, 155, 4, 199, 99, 151, 53, 192, 125, 2, 98, 158, 155, 129, 100, 55, 119, 89, 128, 88, 60, 145, 169, 85, 132, 70, 76, 167, 25, 70, 199, 190, 52, 184, 188, 144, 53, 147, 50, 162, 130, 197, 125, 173, 147, 45, 71, 180, 173, 83, 174, 68, 77, 96, 199, 115, 167, 193, 156, 148, 175, 33, 98, 99, 96, 62, 54, 125, 131, 155, 64, 179, 66, 63, 192, 7, 149, 60, 136, 78, 172, 115, 10, 168, 158, 63, 28, 117, 81, 24, 40, 89, 67, 57, 184, 89, 160, 13, 10, 15, 37, 23, 152, 147, 188, 96, 99, 116, 88, 13, 121, 167, 67, 24, 180, 45, 199, 86, 85, 58, 98, 121, 25, 148, 172, 24, 146, 193, 149, 61, 72, 117, 59, 79, 162, 100, 89, 88, 167, 99, 14, 55, 178, 20, 116, 49, 173, 27, 183, 117, 4, 99, 145, 46, 46, 61, 116, 125, 31, 195, 103, 30, 137, 184, 36, 67, 68]	



Passed all tests! 

Đúng

Marks for this submission: 1,00/1,00.



Câu hỏi 9

Đúng

Đạt điểm 1,00
trên 1,00

Class `LLNode` representing a node of singly linked lists is declared as below:

```
class LLNode {
public:
    int val;
    LLNode* next;
    LLNode(); // Constructor: val = 0, next = nullptr
    LLNode(int val, LLNode* next); // Constructor with customized data
}
```

Given a singly linked list head node and a integer `k`.
Your task is to implement a function with following prototype:

```
LLNode* rotateLinkedList(LLNode* head, int k);
```

The function returns head node of the rotated singly linked list obtained after rotate the linked list to the right by `k` places.

Note:

- The `iostream` library has been used and `namespace std` is being used. No other libraries are allowed.
- The constructors and methods of class `LLNode` have been defined fully so you do not need to redefine them.
- You can write helper functions.

For example:

Test	Result
<pre>int arr[] = {2, 4, 6, 6, 3}; int k = 3; LLNode* head = LLNode::createWithIterators(arr, arr + sizeof(arr) / sizeof(int)); LLNode::printList(head); cout << "\n"; LLNode* newhead = rotateLinkedList(head, k); LLNode::printList(newhead);</pre>	<pre>[2, 4, 6, 6, 3] [6, 6, 3, 2, 4]</pre>

Answer: (penalty regime: 0 %)

Reset answer

```
1 LLNode* rotateLinkedList(LLNode* head, int k) {
2     if (head == nullptr || head->next == nullptr || k == 0) {
3         return head;
4     }
5     LLNode* tail = head;
6     LLNode* new_list_head = head;
7     int len = 1;
8     while (tail->next != nullptr) {
9         tail = tail->next;
10        len++;
11    }
12    k = k % len;
```

```
13  if (k == 0) {
14      return head;
15  }
16  for (int i = 0; i < len - k - 1; i++) {
17      new_list_head = new_list_head->next;
18  }
19  tail->next = head;
20  head = new_list_head->next;
21  new_list_head->next = nullptr;
22  return head;
23 }
24
```

	Test	Expected	Got	
✓	<pre>int arr[] = {2, 4, 6, 6, 3}; int k = 3; LLNode* head = LLNode::createWithIterators(arr, arr + sizeof(arr) / sizeof(int)); LLNode::printList(head); cout << "\n"; LLNode* newhead = rotateLinkedList(head, k); LLNode::printList(newhead);</pre>	<pre>[2, 4, 6, 6, 3] [6, 6, 3, 2, 4]</pre>	<pre>[2, 4, 6, 6, 3] [6, 6, 3, 2, 4]</pre>	✓
✓	<pre>int arr[] = {}; int k = 2; LLNode* head = LLNode::createWithIterators(arr, arr + sizeof(arr) / sizeof(int)); LLNode::printList(head); cout << "\n"; LLNode* newhead = rotateLinkedList(head, k); LLNode::printList(newhead);</pre>	<pre>[] []</pre>	<pre>[] []</pre>	✓
✓	<pre>int arr[] = {0, 4, 2, 5, 1, 0, 6, 4, 8, 6}; int k = 11; LLNode* head = LLNode::createWithIterators(arr, arr + sizeof(arr) / sizeof(int)); LLNode::printList(head); cout << "\n"; LLNode* newhead = rotateLinkedList(head, k); LLNode::printList(newhead);</pre>	<pre>[0, 4, 2, 5, 1, 0, 6, 4, 8, 6] [6, 0, 4, 2, 5, 1, 0, 6, 4, 8]</pre>	<pre>[0, 4, 2, 5, 1, 0, 6, 4, 8, 6] [6, 0, 4, 2, 5, 1, 0, 6, 4, 8]</pre>	✓

	Test	Expected	Got	
✓	<pre>int arr[] = {6, 1, 3, 2, 6, 0, 0, 0, 3, 3, 9, 8, 5, 6, 0, 7, 7, 8, 5, 7, 7, 9, 6, 3, 3, 0, 0, 8, 0, 0, 4, 9, 7, 1, 7, 2, 7, 5, 4, 4, 7, 5, 9, 2, 4, 5, 7, 9, 7, 9, 7, 2, 0, 6, 7, 6, 5, 1, 9, 7, 1, 2, 7, 8, 7, 5, 4, 7, 6, 9, 0, 2, 7, 0, 5, 5, 6, 8, 3, 1, 9, 3, 0, 1, 4, 6, 6, 9, 2, 2, 0, 6, 7, 4, 4, 6, 0, 7, 3, 5, 2, 9, 1, 0, 9}; int k = 35; LLNode* head = LLNode::createWithIterators(arr, arr + sizeof(arr) / sizeof(int)); LLNode::printList(head); cout << "\n"; LLNode* newhead = rotateLinkedList(head, k); LLNode::printList(newhead);</pre>	<pre>[6, 1, 3, 2, 6, 0, 0, 0, 3, 3, 9, 8, 5, 6, 0, 7, 7, 8, 5, 7, 7, 9, 6, 3, 3, 0, 0, 8, 0, 0, 4, 9, 7, 1, 7, 2, 7, 5, 4, 4, 7, 5, 9, 2, 4, 5, 7, 9, 7, 9, 7, 2, 0, 6, 7, 6, 5, 1, 9, 7, 1, 2, 7, 8, 7, 5, 4, 7, 6, 9, 0, 2, 7, 0, 5, 5, 6, 8, 3, 1, 9, 3, 0, 1, 4, 6, 6, 9, 2, 2, 0, 6, 7, 4, 4, 6, 0, 7, 3, 5, 2, 9, 1, 0, 9] [0, 2, 7, 0, 5, 5, 6, 8, 3, 1, 9, 3, 0, 1, 4, 6, 6, 9, 2, 2, 0, 6, 7, 4, 4, 6, 0, 7, 3, 5, 2, 9, 1, 0, 9, 6, 1, 3, 2, 6, 0, 0, 0, 3, 3, 9, 8, 5, 6, 0, 7, 7, 8, 5, 7, 7, 9, 6, 3, 3, 0, 0, 8, 0, 0, 4, 9, 7, 1, 7, 2, 7, 5, 4, 4, 7, 5, 9, 2, 4, 5, 7, 9, 7, 9, 7, 2, 0, 6, 7, 6, 5, 1, 9, 7, 1, 2, 7, 8, 7, 5, 4, 7, 6, 9]</pre>	<pre>[6, 1, 3, 2, 6, 0, 0, 0, 3, 3, 9, 8, 5, 6, 0, 7, 7, 8, 5, 3, 9, 8, 5, 6, 0, 7, 7, 8, 5, 7, 7, 9, 6, 3, 3, 0, 0, 8, 0, 0, 4, 9, 7, 1, 7, 2, 7, 5, 4, 4, 7, 5, 9, 2, 4, 5, 7, 9, 7, 9, 7, 2, 0, 6, 7, 6, 5, 1, 9, 7, 1, 2, 7, 8, 7, 5, 4, 7, 6, 9, 0, 2, 7, 0, 5, 5, 6, 8, 3, 1, 9, 3, 0, 1, 4, 6, 6, 9, 2, 2, 0, 6, 7, 4, 4, 6, 0, 7, 3, 5, 2, 9, 1, 0, 9] [0, 2, 7, 0, 5, 5, 6, 8, 3, 1, 9, 3, 0, 1, 4, 6, 6, 9, 2, 2, 0, 6, 7, 4, 4, 6, 0, 7, 3, 5, 2, 9, 1, 0, 9, 6, 1, 3, 2, 6, 0, 0, 0, 3, 3, 9, 8, 5, 6, 0, 7, 7, 8, 5, 7, 7, 9, 6, 3, 3, 0, 0, 8, 0, 0, 4, 9, 7, 1, 7, 2, 7, 5, 4, 4, 7, 5, 9, 2, 4, 5, 7, 9, 7, 9, 7, 2, 0, 6, 7, 6, 5, 1, 9, 7, 1, 2, 7, 8, 7, 5, 4, 7, 6, 9]</pre>	✓



	Test	Expected	Got	
✓	<pre>int arr[] = {9, 1, 7, 5, 8, 6, 2, 2, 2, 6, 0, 8, 1, 9, 6, 8, 4, 8, 4, 3, 7, 0, 7, 8, 9, 5, 3, 4, 7, 4, 3, 5, 2, 2, 7, 8, 9, 7, 1, 9, 9, 8, 3, 5, 7, 1, 6, 9, 1, 2, 0, 6, 8, 0, 4, 1, 6, 5, 8, 7, 6, 8, 0, 5, 7, 8, 8, 6, 7, 5, 8, 0, 7, 6, 4, 9, 5, 9, 6, 4, 1, 5, 6, 2, 2, 6, 7, 0, 3, 4, 2, 3, 9, 0, 9, 6, 3, 6, 7, 5, 5, 5, 9, 0, 6, 1, 1, 5, 0, 9, 1, 1, 1, 0, 4, 6, 3, 3, 3, 5, 8, 7, 4, 7, 1, 7, 1, 8, 4, 2, 0, 1, 9, 0, 7, 9, 2, 8, 9, 2, 5, 3, 5, 9, 3, 2, 7, 3, 5, 9, 5, 5, 3, 2, 3, 9, 4, 1, 6, 1, 8, 3, 1, 4, 5, 2, 5, 7, 7, 0, 9, 6, 6, 4, 8, 1, 1, 6, 0, 2, 6, 0, 7, 5, 5, 0, 5, 2, 6, 9, 9, 9, 9, 2, 3, 0, 6, 8, 8, 4, 5, 6, 2, 8, 5, 9, 8, 3, 6, 8, 8, 6, 2, 1, 2, 1, 4, 6, 2, 0, 9, 3, 9, 6, 4, 2, 3, 6, 2, 0, 9, 8, 7, 0, 6, 0, 7, 0, 5, 9, 4, 3, 7, 9, 7, 3, 5, 7, 0, 3, 1, 8, 9, 9, 4, 0, 8, 6, 4, 6, 7, 3, 8, 1, 2, 1, 5, 4, 9, 5, 9, 5, 8, 6, 6, 8, 9, 4, 4, 0, 6, 4, 5, 3, 0, 3, 9, 7, 1, 7, 2, 5, 0, 1, 9, 1, 2, 5, 6, 8, 7, 1, 6, 9, 6, 2, 8, 1, 2, 0, 4, 3, 4, 6, 7, 1, 0, 7, 0, 7, 9, 4, 0, 1, 2, 3, 5, 6, 3, 5, 6, 7, 5, 4, 2, 4, 8, 2, 5, 8, 8, 6, 6, 2, 6, 6, 8, 1, 2, 2, 8, 0, 8, 9, 0, 7, 9, 0, 1, 6, 6, 3, 6, 5, 1, 5, 9, 0, 3, 7, 3, 7, 2, 0, 0, 2, 7, 5, 2, 9, 5, 5, 8, 1, 7, 7, 9, 7, 1, 1, 6, 4, 3, 8, 0, 7, 9, 1, 0, 9, 5, 2, 7, 2, 1, 5, 3, 9, 7, 6, 9, 1, 3, 5, 5, 0, 6, 9, 4, 7, 2, 0, 4, 5, 8, 1, 6, 1, 0, 7, 2, 2, 6, 7, 4, 4, 9, 5, 4, 5, 2, 0, 8, 0, 5, 5, 1, 8, 9, 4, 5, 6, 1, 2, 0, 7, 0, 2, 1, 6, 8, 8, 7, 8, 7, 0, 1, 8, 5, 6, 5, 9, 2, 2, 9, 3, 6, 0, 1, 7, 9, 8, 1, 1, 5, 4, 5, 7, 5, 0, 2, 0, 4, 4, 8, 0, 7, 3}; int k = 196; LLNode* head = LLNode::createWithIterators(arr, arr + sizeof(arr) / sizeof(int)); LLNode::printList(head); cout << "\n"; LLNode* newhead = rotateLinkedList(head, k); LLNode::printList(newhead);</pre>	<pre>[9, 1, 7, 5, 8, 6, 2, 2, 2, 6, 0, 8, 1, 9, 6, 8, 4, 8, 4, 3, 7, 0, 7, 8, 9, 5, 3, 4, 7, 4, 3, 5, 2, 2, 7, 8, 9, 7, 1, 9, 9, 8, 3, 5, 7, 1, 6, 9, 1, 2, 0, 6, 8, 0, 4, 1, 6, 5, 8, 7, 6, 8, 0, 5, 7, 8, 8, 6, 7, 5, 8, 0, 7, 6, 4, 9, 5, 9, 6, 4, 1, 5, 6, 2, 2, 6, 7, 0, 3, 4, 2, 3, 9, 0, 9, 6, 3, 6, 7, 5, 5, 5, 9, 0, 6, 1, 1, 5, 0, 9, 1, 1, 1, 0, 4, 6, 3, 3, 3, 5, 8, 7, 4, 7, 1, 7, 1, 8, 4, 2, 0, 1, 9, 0, 7, 9, 2, 8, 9, 2, 5, 3, 5, 9, 3, 2, 7, 3, 5, 9, 5, 5, 3, 2, 3, 9, 4, 1, 6, 1, 8, 3, 1, 4, 5, 2, 5, 7, 7, 0, 9, 6, 6, 4, 8, 1, 1, 6, 0, 2, 6, 0, 7, 5, 5, 0, 5, 2, 6, 9, 9, 9, 9, 2, 3, 0, 6, 8, 8, 4, 5, 6, 2, 8, 5, 9, 8, 3, 6, 8, 8, 6, 2, 1, 2, 1, 4, 6, 2, 0, 9, 3, 9, 6, 4, 2, 3, 6, 2, 0, 9, 8, 7, 0, 6, 0, 7, 0, 5, 9, 4, 3, 7, 9, 7, 3, 5, 7, 0, 3, 1, 8, 9, 9, 4, 0, 8, 6, 4, 6, 7, 3, 8, 1, 2, 1, 5, 4, 9, 5, 9, 5, 8, 6, 6, 8, 9, 4, 4, 0, 6, 4, 5, 3, 0, 3, 9, 7, 1, 7, 2, 5, 0, 1, 9, 1, 2, 5, 6, 8, 7, 1, 6, 9, 6, 2, 8, 1, 2, 0, 4, 3, 4, 6, 7, 1, 0, 7, 0, 7, 9, 4, 0, 1, 2, 3, 5, 6, 3, 5, 6, 7, 5, 4, 2, 4, 8, 2, 5, 8, 8, 6, 6, 2, 6, 6, 8, 1, 2, 2, 8, 0, 8, 9, 0, 7, 9, 0, 1, 6, 6, 3, 6, 5, 1, 5, 9, 0, 3, 7, 3, 7, 2, 0, 0, 2, 7, 5, 2, 9, 5, 5, 8, 1, 7, 7, 9, 7, 1, 1, 6, 4, 3, 8, 0, 7, 9, 1, 0, 9, 5, 2, 7, 2, 1, 5, 3, 9, 7, 6, 9, 1, 3, 5, 5, 0, 6, 9, 4, 7, 1, 7, 2, 0, 4, 5, 8, 1, 6, 1, 0, 7, 2, 2, 6, 7, 4, 4, 9, 5, 4, 5, 2, 0, 8, 0, 5, 5, 1, 8, 9, 4, 5, 6, 1, 2, 0, 7, 0, 2, 1, 6, 8, 8, 7, 8, 7, 0, 1,</pre>	<pre>[9, 1, 7, 5, 8, 6, 2, 2, 2, 6, 0, 8, 1, 9, 6, 8, 4, 8, 4, 3, 7, 0, 7, 8, 9, 5, 3, 4, 7, 4, 3, 5, 2, 2, 7, 8, 9, 7, 1, 9, 9, 8, 3, 5, 7, 1, 6, 9, 1, 2, 0, 6, 8, 0, 4, 1, 6, 5, 8, 7, 6, 8, 0, 5, 7, 8, 8, 6, 7, 5, 8, 0, 7, 6, 4, 9, 5, 9, 6, 4, 1, 5, 6, 2, 2, 6, 7, 0, 3, 4, 2, 3, 9, 0, 9, 6, 3, 6, 7, 5, 5, 5, 9, 0, 6, 1, 1, 5, 0, 9, 1, 1, 1, 0, 4, 6, 3, 3, 3, 5, 8, 7, 4, 7, 1, 7, 1, 8, 4, 2, 0, 1, 9, 0, 7, 9, 2, 8, 9, 2, 5, 3, 5, 9, 3, 2, 7, 3, 5, 9, 5, 5, 3, 2, 3, 9, 4, 1, 6, 1, 8, 3, 1, 4, 5, 2, 5, 7, 7, 0, 9, 6, 6, 4, 8, 1, 1, 6, 0, 2, 6, 0, 7, 5, 5, 0, 5, 2, 6, 9, 9, 9, 9, 2, 3, 0, 6, 8, 8, 4, 5, 6, 2, 8, 5, 9, 8, 3, 6, 8, 8, 6, 2, 1, 2, 1, 4, 6, 2, 0, 9, 3, 9, 6, 4, 2, 3, 6, 2, 0, 9, 8, 7, 0, 6, 0, 7, 0, 5, 9, 4, 3, 7, 9, 7, 3, 5, 7, 0, 3, 1, 8, 9, 9, 4, 0, 8, 6, 4, 6, 7, 3, 8, 1, 2, 1, 5, 4, 9, 5, 9, 5, 8, 6, 6, 8, 9, 4, 4, 0, 6, 4, 5, 3, 0, 3, 9, 7, 1, 7, 2, 5, 0, 1, 9, 1, 2, 5, 6, 8, 7, 1, 6, 9, 6, 2, 8, 1, 2, 0, 4, 3, 4, 6, 7, 1, 0, 7, 0, 7, 9, 4, 0, 1, 2, 3, 5, 6, 3, 5, 6, 7, 5, 4, 2, 4, 8, 2, 5, 8, 8, 6, 6, 2, 6, 6, 8, 1, 2, 2, 8, 0, 8, 9, 0, 7, 9, 0, 1, 6, 6, 3, 6, 5, 1, 5, 9, 0, 3, 7, 3, 7, 2, 0, 0, 2, 7, 5, 2, 9, 5, 5, 8, 1, 7, 7, 9, 7, 1, 1, 6, 4, 3, 8, 0, 7, 9, 1, 0, 9, 5, 2, 7, 2, 1, 5, 3, 9, 7, 6, 9, 1, 3, 5, 5, 0, 6, 9, 4, 7, 1, 7, 2, 0, 4, 5, 8, 1, 6, 1, 0, 7, 2, 2, 6, 7, 4, 4, 9, 5, 4, 5, 2, 0, 8, 0, 5, 5, 1, 8, 9, 4, 5, 6, 1, 2, 0, 7, 0, 2, 1, 6, 8, 8, 7, 8, 7, 0, 1,</pre>	✓

	Test	Expected	Got	
		8, 5, 6, 5, 9, 2, 2, 9, 3, 6, 0, 1, 7, 9, 8, 1, 1, 5, 4, 5, 7, 5, 0, 2, 0, 4, 4, 8, 0, 7, 3] [6, 2, 8, 1, 2, 0, 4, 3, 4, 6, 7, 1, 0, 7, 0, 7, 9, 4, 0, 1, 2, 3, 5, 6, 3, 5, 6, 7, 5, 4, 2, 4, 8, 2, 5, 8, 8, 6, 6, 2, 6, 6, 8, 1, 2, 2, 8, 0, 8, 9, 0, 7, 9, 0, 1, 6, 6, 3, 6, 5, 1, 5, 9, 0, 3, 7, 3, 7, 2, 0, 0, 2, 7, 5, 2, 9, 5, 5, 8, 1, 7, 7, 9, 7, 1, 1, 6, 4, 3, 8, 0, 7, 9, 1, 0, 9, 5, 2, 7, 2, 1, 5, 3, 9, 7, 6, 9, 1, 3, 5, 5, 0, 6, 9, 4, 7, 1, 7, 2, 0, 4, 5, 8, 1, 6, 1, 0, 7, 2, 2, 6, 7, 4, 4, 9, 5, 4, 5, 2, 0, 8, 0, 5, 5, 1, 8, 9, 4, 5, 6, 1, 2, 0, 7, 0, 2, 1, 6, 8, 8, 7, 8, 7, 0, 1, 8, 5, 6, 5, 9, 2, 2, 9, 3, 6, 0, 1, 7, 9, 8, 1, 1, 5, 4, 5, 7, 5, 0, 2, 0, 4, 4, 8, 0, 7, 3, 9, 1, 7, 5, 8, 6, 2, 2, 2, 6, 0, 8, 1, 9, 6, 8, 4, 8, 4, 3, 7, 0, 7, 8, 9, 5, 3, 4, 7, 4, 3, 5, 2, 2, 7, 8, 9, 7, 1, 9, 9, 8, 3, 5, 7, 1, 6, 9, 1, 2, 0, 6, 8, 0, 4, 1, 6, 5, 8, 7, 6, 8, 0, 5, 7, 8, 8, 6, 7, 5, 8, 0, 7, 6, 4, 9, 5, 9, 6, 4, 1, 5, 6, 2, 2, 6, 7, 0, 3, 4, 2, 3, 9, 0, 9, 6, 3, 6, 7, 5, 5, 5, 9, 0, 6, 1, 1, 5, 0, 9, 1, 1, 1, 0, 4, 6, 3, 3, 3, 5, 8, 7, 4, 7, 1, 7, 1, 8, 4, 2, 0, 1, 9, 0, 7, 9, 2, 8, 9, 2, 5, 3, 5, 9, 3, 2, 7, 3, 5, 9, 5, 5, 3, 2, 3, 9, 4, 1, 6, 1, 8, 3, 1, 4, 5, 2, 5, 7, 7, 0, 9, 6, 6, 4, 8, 1, 1, 6, 0, 2, 6, 0, 7, 5, 5, 0, 5, 2, 6, 9, 9, 9, 9, 2, 3, 0, 6, 8, 8, 4, 5, 6, 2, 8, 5, 9, 8, 3, 6, 8, 8, 6, 2, 1, 2, 1, 4, 6, 2, 0, 9, 3, 9, 6, 4, 2, 3, 6, 2, 0, 9, 8, 7, 0, 6, 0, 7, 0, 5, 9, 4, 3, 7,	8, 5, 6, 5, 9, 2, 2, 9, 3, 6, 0, 1, 7, 9, 8, 1, 1, 5, 4, 5, 7, 5, 0, 2, 0, 4, 4, 8, 0, 7, 3] [6, 2, 8, 1, 2, 0, 4, 3, 4, 6, 7, 1, 0, 7, 0, 7, 9, 4, 0, 1, 2, 3, 5, 6, 3, 5, 6, 7, 5, 4, 2, 4, 8, 2, 5, 8, 8, 6, 6, 2, 6, 6, 8, 1, 2, 2, 8, 0, 8, 9, 0, 7, 9, 0, 1, 6, 6, 3, 6, 5, 1, 5, 9, 0, 3, 7, 3, 7, 2, 0, 0, 2, 7, 5, 2, 9, 5, 5, 8, 1, 7, 7, 9, 7, 1, 1, 6, 4, 3, 8, 0, 7, 9, 1, 0, 9, 5, 2, 7, 2, 1, 5, 3, 9, 7, 6, 9, 1, 3, 5, 5, 0, 6, 9, 4, 7, 1, 7, 2, 0, 4, 5, 8, 1, 6, 1, 0, 7, 2, 2, 6, 7, 4, 4, 9, 5, 4, 5, 2, 0, 8, 0, 5, 5, 1, 8, 9, 4, 5, 6, 1, 2, 0, 7, 0, 2, 1, 6, 8, 8, 7, 8, 7, 0, 1, 8, 5, 6, 5, 9, 2, 2, 9, 3, 6, 0, 1, 7, 9, 8, 1, 1, 5, 4, 5, 7, 5, 0, 2, 0, 4, 4, 8, 0, 7, 3, 9, 1, 7, 5, 8, 6, 2, 2, 2, 6, 0, 8, 1, 9, 6, 8, 4, 8, 4, 3, 7, 0, 7, 8, 9, 5, 3, 4, 7, 4, 3, 5, 2, 2, 7, 8, 9, 7, 1, 9, 9, 8, 3, 5, 7, 1, 6, 9, 1, 2, 0, 6, 8, 0, 4, 1, 6, 5, 8, 7, 6, 8, 0, 5, 7, 8, 8, 6, 7, 5, 8, 0, 7, 6, 4, 9, 5, 9, 6, 4, 1, 5, 6, 2, 2, 6, 7, 0, 3, 4, 2, 3, 9, 0, 9, 6, 3, 6, 7, 5, 5, 5, 9, 0, 6, 1, 1, 5, 0, 9, 1, 1, 1, 0, 4, 6, 3, 3, 3, 5, 8, 7, 4, 7, 1, 7, 1, 8, 4, 2, 0, 1, 9, 0, 7, 9, 2, 8, 9, 2, 5, 3, 5, 9, 3, 2, 7, 3, 5, 9, 5, 5, 3, 2, 3, 9, 4, 1, 6, 1, 8, 3, 1, 4, 5, 2, 5, 7, 7, 0, 9, 6, 6, 4, 8, 1, 1, 6, 0, 2, 6, 0, 7, 5, 5, 0, 5, 2, 6, 9, 9, 9, 9, 2, 3, 0, 6, 8, 8, 4, 5, 6, 2, 8, 5, 9, 8, 3, 6, 8, 8, 6, 2, 1, 2, 1, 4, 6, 2, 0, 9, 3, 9, 6, 4, 2, 3, 6, 2, 0, 9, 8, 7, 0, 6, 0, 7, 0, 5, 9, 4, 3, 7,	



	Test	Expected	Got	
		9, 7, 3, 5, 7, 0, 3, 1, 8, 9, 9, 4, 0, 8, 6, 4, 6, 7, 3, 8, 1, 2, 1, 5, 4, 9, 5, 9, 5, 8, 6, 6, 8, 9, 4, 4, 0, 6, 4, 5, 3, 0, 3, 9, 7, 1, 7, 2, 5, 0, 1, 9, 1, 2, 5, 6, 8, 7, 1, 6, 9]	9, 7, 3, 5, 7, 0, 3, 1, 8, 9, 9, 4, 0, 8, 6, 4, 6, 7, 3, 8, 1, 2, 1, 5, 4, 9, 5, 9, 5, 8, 6, 6, 8, 9, 4, 4, 0, 6, 4, 5, 3, 0, 3, 9, 7, 1, 7, 2, 5, 0, 1, 9, 1, 2, 5, 6, 8, 7, 1, 6, 9]	



	Test	Expected	Got	
✓	<pre>int arr[] = {8, 0, 8, 8, 9, 3, 3, 5, 4, 9, 7, 9, 5, 3, 8, 6, 1, 0, 6, 4, 5, 1, 1, 5, 3, 8, 6, 1, 1, 1, 0, 1, 4, 9, 0, 1, 8, 0, 2, 7, 1, 5, 7, 6, 7, 7, 9, 5, 0, 9, 6, 3, 7, 6, 6, 4, 6, 2, 9, 1, 5, 0, 8, 6, 0, 8, 6, 3, 0, 3, 6, 8, 5, 0, 1, 9, 9, 6, 3, 3, 2, 9, 2, 0, 0, 5, 0, 4, 6, 7, 2, 6, 5, 2, 8, 8, 7, 1, 0, 9, 7, 7, 1, 5, 8, 7, 5, 7, 8, 7, 8, 7, 1, 7, 9, 7, 1, 3, 0, 5, 5, 1, 0, 2, 1, 0, 1, 5, 3, 7, 7, 9, 6, 1, 6, 4, 8, 9, 8, 6, 0, 0, 3, 6, 2, 3, 4, 9, 7, 4, 2, 2, 9, 7, 7, 4, 9, 9, 7, 5, 6, 2, 4, 0, 1, 9, 9, 8, 4, 6, 1, 2, 9, 6, 7, 9, 4, 7, 5, 2, 9, 4, 2, 5, 9, 4, 1, 6, 0, 0, 5, 0, 0, 6, 1, 7, 8, 6, 9, 5, 4, 7, 0, 5, 3, 2, 4, 9, 9, 2, 3, 4, 4, 1, 8, 2, 4, 4, 6, 2, 0, 5, 9, 4, 5, 8, 1, 8, 4, 7, 5, 4, 9, 7, 3, 1, 7, 7, 5, 4, 5, 6, 2, 1, 7, 5, 9, 7, 4, 8, 4, 6, 9, 3, 4, 4, 3, 7, 1, 3, 9, 3, 3, 7, 9, 7, 9, 4, 6, 0, 5, 5, 5, 6, 2, 5, 5, 9, 0, 2, 9, 0, 3, 8, 7, 6, 1, 0, 4, 0, 7, 4, 2, 5, 0, 0, 6, 4, 3, 6, 0, 9, 2, 4, 1, 0, 3, 8, 0, 1, 7, 3, 8, 9, 0, 5, 3, 2, 8, 4, 0, 4, 6, 9, 8, 6, 5, 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		5, 3, 9, 8, 0, 0, 8, 1, 0, 8, 8, 7, 3, 6, 2, 3, 0, 8, 2, 5, 2, 2, 3, 3, 2, 2, 9, 4, 4, 4, 1, 0, 8, 3, 4, 8, 9, 1, 1, 0, 8, 2, 6, 0, 9, 3, 5, 6, 3, 8, 5, 4, 5, 8, 9, 0, 3, 9, 8, 9, 8, 3, 5, 4, 5, 4, 3, 8, 0, 3, 4, 5, 1, 3, 4, 6, 7, 9, 6, 5, 4, 1, 1, 6, 5, 2, 0, 7, 5, 3, 7, 5, 1, 4, 4, 9, 6, 0, 7, 1, 7, 6, 6, 9, 5, 3, 9, 2, 7, 6, 8, 5, 5, 3, 7, 2, 4, 7, 5, 4, 0, 9, 4, 9, 3, 8, 6, 5, 5, 5, 8, 2, 8, 8, 9, 5, 7, 4, 8, 4, 9, 3, 2, 2, 6, 0, 6, 4, 4, 5, 9, 4, 5, 9, 4, 3, 6, 5, 1, 1, 6, 2, 9, 1, 1, 0, 6, 0, 5, 5, 8, 5, 7, 4, 9, 6, 3, 5, 7, 8, 1, 8, 7, 4, 2, 1, 7, 0, 5, 3, 5, 4, 7, 3, 7, 3, 9, 2, 3, 0, 5, 1, 9, 9, 1, 3, 0, 0, 8, 8, 5, 3, 0, 0, 7, 8, 1, 0, 7, 5, 2, 4, 9, 8, 6, 0, 3, 2, 6, 4, 0, 5, 1, 4, 2, 5, 6, 9, 2, 1, 9, 3, 1, 0, 7, 0, 8, 5, 8, 0, 8, 5, 6, 5, 4, 4, 2, 1, 6, 5, 5, 4, 7, 0, 3, 6, 2, 0, 8, 8, 6, 3, 1, 7, 0, 5, 4, 7, 7, 0, 9, 1, 5, 4, 4, 1, 9, 3, 7, 9, 9, 3, 2, 8, 5, 4, 9, 2, 2, 0, 5, 1, 8, 3, 6, 7, 2, 7, 7, 0, 3, 5, 2, 6, 8, 4, 6, 2, 7, 0, 1, 5, 3, 2, 0, 3, 2, 6, 9, 2, 5, 8, 3, 6, 3, 0, 4, 9, 8, 1, 2, 4, 9, 6, 3, 3, 2, 7, 2, 8, 2, 1, 0, 5, 1, 7, 1, 2, 7, 1, 5, 4, 2, 5, 4, 3, 0, 2, 9, 3, 9, 5, 9, 4, 4, 1, 5, 1, 7, 5, 6, 3, 2, 2, 8, 1, 8, 7, 0, 6, 7, 3, 4, 7, 4, 1, 2, 9, 8, 8, 1, 7, 2, 2, 8, 3, 9, 9, 8, 8, 4, 8, 4, 6, 4, 1, 7, 3, 8, 4, 3, 1, 6, 4, 6, 1, 0, 1, 3, 8, 4, 3, 0, 7, 8, 1, 2, 6, 8, 4, 7, 4, 8, 8, 9, 3, 6, 6, 9, 4, 2, 4, 7, 3, 2, 3, 1, 6, 7, 0, 2, 4, 7, 9, 0, 0, 0, 4, 0, 2, 4, 0, 7, 8, 0, 5, 9, 2, 9, 5,	5, 3, 9, 8, 0, 0, 8, 1, 0, 8, 8, 7, 3, 6, 2, 3, 0, 8, 2, 5, 2, 2, 3, 3, 2, 2, 9, 4, 4, 4, 1, 0, 8, 3, 4, 8, 9, 1, 1, 0, 8, 2, 6, 0, 9, 3, 5, 6, 3, 8, 5, 4, 5, 8, 9, 0, 3, 9, 8, 9, 8, 3, 5, 4, 5, 4, 3, 8, 0, 3, 4, 5, 1, 3, 4, 6, 7, 9, 6, 5, 4, 1, 1, 6, 5, 2, 0, 7, 5, 3, 7, 5, 1, 4, 4, 9, 6, 0, 7, 1, 7, 6, 6, 9, 5, 3, 9, 2, 7, 6, 8, 5, 5, 3, 7, 2, 4, 7, 5, 4, 0, 9, 4, 9, 3, 8, 6, 5, 5, 5, 8, 2, 8, 8, 9, 5, 7, 4, 8, 4, 9, 3, 2, 2, 6, 0, 6, 4, 4, 5, 9, 4, 5, 9, 4, 3, 6, 5, 1, 1, 6, 2, 9, 1, 1, 0, 6, 0, 5, 5, 8, 5, 7, 4, 9, 6, 3, 5, 7, 8, 1, 8, 7, 4, 2, 1, 7, 0, 5, 3, 5, 4, 7, 3, 7, 3, 9, 2, 3, 0, 5, 1, 9, 9, 1, 3, 0, 0, 8, 8, 5, 3, 0, 0, 7, 8, 1, 0, 7, 5, 2, 4, 9, 8, 6, 0, 3, 2, 6, 4, 0, 5, 1, 4, 2, 5, 6, 9, 2, 1, 9, 3, 1, 0, 7, 0, 8, 5, 8, 0, 8, 5, 6, 5, 4, 4, 2, 1, 6, 5, 5, 4, 7, 0, 3, 6, 2, 0, 8, 8, 6, 3, 1, 7, 0, 5, 4, 7, 7, 0, 9, 1, 5, 4, 4, 1, 9, 3, 7, 9, 9, 3, 2, 8, 5, 4, 9, 2, 2, 0, 5, 1, 8, 3, 6, 7, 2, 7, 7, 0, 3, 5, 2, 6, 8, 4, 6, 2, 7, 0, 1, 5, 3, 2, 0, 3, 2, 6, 9, 2, 5, 8, 3, 6, 3, 0, 4, 9, 8, 1, 2, 4, 9, 6, 3, 3, 2, 7, 2, 8, 2, 1, 0, 5, 1, 7, 1, 2, 7, 1, 5, 4, 2, 5, 4, 3, 0, 2, 9, 3, 9, 5, 9, 4, 4, 1, 5, 1, 7, 5, 6, 3, 2, 2, 8, 1, 8, 7, 0, 6, 7, 3, 4, 7, 4, 1, 2, 9, 8, 8, 1, 7, 2, 2, 8, 3, 9, 9, 8, 8, 4, 8, 4, 6, 4, 1, 7, 3, 8, 4, 3, 1, 6, 4, 6, 1, 0, 1, 3, 8, 4, 3, 0, 7, 8, 1, 2, 6, 8, 4, 7, 4, 8, 8, 9, 3, 6, 6, 9, 4, 2, 4, 7, 3, 2, 3, 1, 6, 7, 0, 2, 4, 7, 9, 0, 0, 0, 4, 0, 2, 4, 0, 7, 8, 0, 5, 9, 2, 9, 5,	



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		3, 3, 3, 5, 0, 9, 8, 7, 5, 9, 5, 0, 1, 2, 4, 7, 4, 9, 9, 4, 2, 9, 7, 8, 4, 4, 9, 7, 4, 0, 8, 3, 2, 8, 0, 8, 7, 1, 9, 4, 2, 5, 1, 2, 3, 9, 1, 2, 6, 0, 5, 0, 9, 1, 6, 7, 6, 6, 6, 1, 3, 8, 4, 1, 6, 7, 6, 3, 4, 3, 5, 1, 8, 0, 8, 2, 7, 2, 9, 4, 4, 5, 7, 0, 7, 6, 5, 3, 4, 1, 0, 4, 8, 2, 2, 0, 6, 4, 4, 0, 9, 8, 6, 5, 1, 8, 3, 9, 9, 4, 9, 5, 6, 2, 4, 8, 6, 7, 9, 2, 7, 7, 5, 4, 6, 2, 0, 6, 2, 3, 7, 8, 8, 0, 7, 8, 2, 9, 7, 2, 1, 4, 4, 8, 2, 0, 1, 9, 6, 5, 7, 5, 9, 6, 4, 4, 0, 7, 9, 7, 0, 9, 1, 6, 5, 2, 6, 2, 1, 7, 7, 5, 0, 9, 5, 0, 6, 2, 9, 0, 1, 4, 5, 4, 5, 7, 8, 9, 6, 7, 7, 4, 2, 7, 1, 0, 9, 2, 0, 8, 2, 9, 2, 9, 1, 4, 7, 2, 6, 6, 7, 4, 4, 4, 8, 5, 3, 7, 2, 7, 5, 2, 3, 0, 7, 5, 9, 8, 1, 2, 8, 1, 4, 0, 4, 7, 0, 0, 3, 7, 0, 6, 6, 3, 3, 7, 0, 4, 7, 4, 3, 9, 3, 2, 1, 2, 1, 9, 4, 1, 3, 9, 7, 6, 1, 4, 2, 5, 0, 1, 8, 7, 4, 2, 6, 7, 1, 8]	3, 3, 3, 5, 0, 9, 8, 7, 5, 9, 5, 0, 1, 2, 4, 7, 4, 9, 9, 4, 2, 9, 7, 8, 4, 4, 9, 7, 4, 0, 8, 3, 2, 8, 0, 8, 7, 1, 9, 4, 2, 5, 1, 2, 3, 9, 1, 2, 6, 0, 5, 0, 9, 1, 6, 7, 6, 6, 6, 1, 3, 8, 4, 1, 6, 7, 6, 3, 4, 3, 5, 1, 8, 0, 8, 2, 7, 2, 9, 4, 4, 5, 7, 0, 7, 6, 5, 3, 4, 1, 0, 4, 8, 2, 2, 0, 6, 4, 4, 0, 9, 8, 6, 5, 1, 8, 3, 9, 9, 4, 9, 5, 6, 2, 4, 8, 6, 7, 9, 2, 7, 7, 5, 4, 6, 2, 0, 6, 2, 3, 7, 8, 8, 0, 7, 8, 2, 9, 7, 2, 1, 4, 4, 8, 2, 0, 1, 9, 6, 5, 7, 5, 9, 6, 4, 4, 0, 7, 9, 7, 0, 9, 1, 6, 5, 2, 6, 2, 1, 7, 7, 5, 0, 9, 5, 0, 6, 2, 9, 0, 1, 4, 5, 4, 5, 7, 8, 9, 6, 7, 7, 4, 2, 7, 1, 0, 9, 2, 0, 8, 2, 9, 2, 9, 1, 4, 7, 2, 6, 6, 7, 4, 4, 4, 8, 5, 3, 7, 2, 7, 5, 2, 3, 0, 7, 5, 9, 8, 1, 2, 8, 1, 4, 0, 4, 7, 0, 0, 3, 7, 0, 6, 6, 3, 3, 7, 0, 4, 7, 4, 3, 9, 3, 2, 1, 2, 1, 9, 4, 1, 3, 9, 7, 6, 1, 4, 2, 5, 0, 1, 8, 7, 4, 2, 6, 7, 1, 8]	



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	<pre>4, 4, 9, 3, 4, 9, 1, 4, 2, 2, 9, 5, 7, 8, 9, 7, 0, 9, 5, 4, 7, 2, 1, 3, 3, 2, 7, 6, 0, 0, 1, 2, 7, 3, 2, 8, 7, 1, 0, 6, 8, 8, 8, 2, 8, 9, 5, 6, 5, 0, 5, 9, 7, 2, 2, 3, 9, 3, 1, 8, 6, 9, 1, 1, 4, 9, 0, 9, 1, 3, 1, 9, 1, 0, 5, 3, 6, 9, 0, 3, 6, 5, 6, 1, 0, 7, 4, 2, 3, 3, 1, 4, 7, 3, 8, 2, 5, 6, 8, 4, 8, 6, 7, 4, 8, 3, 7, 4, 7, 1, 4, 0, 3, 8, 1, 0, 2, 3, 4, 9, 1, 5, 0, 6, 3, 4, 9, 4, 3, 3, 6, 3, 6, 8, 1, 9, 7, 4, 5, 7, 4, 9, 5, 0, 9, 7, 4, 1, 8, 0, 7, 5, 0, 2, 7, 8, 0, 9, 4, 5, 2, 0, 9, 6, 4, 7, 0}; int k = 990; LLNode* head = LLNode::createWithIterators(arr, arr + sizeof(arr) / sizeof(int)); LLNode::printList(head); cout << "\n"; LLNode* newhead = rotateLinkedList(head, k); LLNode::printList(newhead);</pre>	<pre>3, 4, 3, 6, 7, 4, 4, 7, 4, 7, 8, 6, 5, 5, 1, 5, 9, 8, 4, 6, 9, 6, 8, 5, 0, 8, 2, 9, 1, 3, 7, 9, 5, 2, 1, 8, 0, 5, 9, 4, 9, 5, 6, 3, 2, 8, 2, 8, 5, 8, 8, 7, 1, 4, 4, 6, 2, 6, 1, 7, 0, 4, 9, 9, 6, 3, 1, 3, 3, 3, 5, 8, 7, 2, 5, 1, 3, 8, 2, 8, 1, 5, 2, 0, 6, 6, 5, 5, 4, 5, 7, 9, 3, 5, 3, 1, 6, 9, 0, 9, 5, 8, 8, 4, 6, 0, 9, 4, 0, 8, 1, 2, 3, 9, 9, 6, 9, 2, 8, 6, 5, 4, 9, 2, 4, 2, 3, 1, 8, 6, 8, 3, 3, 5, 4, 7, 1, 1, 2, 7, 5, 8, 7, 7, 2, 3, 5, 3, 4, 7, 2, 8, 5, 6, 9, 7, 1, 4, 0, 0, 3, 6, 3, 0, 4, 4, 0, 4, 3, 7, 1, 8, 5, 1, 3, 0, 9, 0, 2, 2, 5, 3, 3, 8, 7, 9, 3, 9, 5, 9, 0, 7, 7, 0, 2, 9, 8, 4, 0, 6, 0, 4, 2, 3, 3, 4, 9, 7, 2, 8, 3, 1, 9, 2, 7, 9, 8, 7, 5, 7, 1, 9, 3, 9, 4, 2, 9, 1, 1, 0, 4, 6, 3, 8, 6, 9, 3, 9, 5, 1, 8, 0, 6, 7, 6, 4, 7, 7, 6, 7, 4, 3, 8, 4, 4, 3, 3, 6, 8, 3, 7, 4, 5, 4, 7, 7, 5, 1, 6, 8, 2, 8, 0, 8, 0, 8, 8, 7, 3, 6, 5, 2, 4, 3, 9, 8, 7, 6, 3, 0, 4, 4, 6, 2, 3, 5, 6, 0, 9, 2, 1, 9, 4, 8, 9, 8, 9, 1, 1, 5, 7, 8, 0, 0, 1, 1, 2, 7, 8, 9, 7, 2, 3, 2, 8, 9, 5, 1, 8, 9, 9, 5, 2, 2, 0, 6, 5, 6, 9, 5, 2, 6, 2, 3, 7, 4, 2, 6, 1, 9, 8, 0, 0, 4, 7, 2, 1, 6, 1, 8, 6, 7, 1, 2, 6, 1, 4, 1, 6, 2, 1, 9, 5, 0, 0, 4, 6, 2, 5, 3, 3, 0, 5, 0, 2, 2, 7, 6, 1, 1, 3, 9, 5, 6, 0, 3, 4, 2, 8, 3, 7, 2, 9, 6, 1, 8, 3, 1, 3, 8, 5, 1, 9, 0, 0, 4, 3, 4, 6, 4, 6, 7, 8, 5, 2, 5, 6, 1, 6, 8, 5, 2, 1, 1, 0, 4, 7, 0, 4, 9, 1, 4, 2, 1, 4, 4, 5, 7, 2, 1, 2, 5, 3, 8, 0, 6, 6, 0, 5, 2, 7, 5, 7, 5, 7, 9, 0, 8, 3, 3, 4, 0, 3, 8, 4, 1, 4, 0, 8, 4,</pre>	<pre>3, 4, 3, 6, 7, 4, 4, 7, 4, 7, 8, 6, 5, 5, 1, 5, 9, 8, 4, 6, 9, 6, 8, 5, 0, 8, 2, 9, 1, 3, 7, 9, 5, 2, 1, 8, 0, 5, 9, 4, 9, 5, 6, 3, 2, 8, 2, 8, 5, 8, 8, 7, 1, 4, 4, 6, 2, 6, 1, 7, 0, 4, 9, 9, 6, 3, 1, 3, 3, 3, 5, 8, 7, 2, 5, 1, 3, 8, 2, 8, 1, 5, 2, 0, 6, 6, 5, 5, 4, 5, 7, 9, 3, 5, 3, 1, 6, 9, 0, 9, 5, 8, 8, 4, 6, 0, 9, 4, 0, 8, 1, 2, 3, 9, 9, 6, 9, 2, 8, 6, 5, 4, 9, 2, 4, 2, 3, 1, 8, 6, 8, 3, 3, 5, 4, 7, 1, 1, 2, 7, 5, 8, 7, 7, 2, 3, 5, 3, 4, 7, 2, 8, 5, 6, 9, 7, 1, 4, 0, 0, 3, 6, 3, 0, 4, 4, 0, 4, 3, 7, 1, 8, 5, 1, 3, 0, 9, 0, 2, 2, 5, 3, 3, 8, 7, 9, 3, 9, 5, 9, 0, 7, 7, 0, 2, 9, 8, 4, 0, 6, 0, 4, 2, 3, 3, 4, 9, 7, 2, 8, 3, 1, 9, 2, 7, 9, 8, 7, 5, 7, 1, 9, 3, 9, 4, 2, 9, 1, 1, 0, 4, 6, 3, 8, 6, 9, 3, 9, 5, 1, 8, 0, 6, 7, 6, 4, 7, 7, 6, 7, 4, 3, 8, 4, 4, 3, 3, 6, 8, 3, 7, 4, 5, 4, 7, 7, 5, 1, 6, 8, 2, 8, 0, 8, 0, 8, 8, 7, 3, 6, 5, 2, 4, 3, 9, 8, 7, 6, 3, 0, 4, 4, 6, 2, 3, 5, 6, 0, 9, 2, 1, 9, 4, 8, 9, 8, 9, 1, 1, 5, 7, 8, 0, 0, 1, 1, 2, 7, 8, 9, 7, 2, 3, 2, 8, 9, 5, 1, 8, 9, 9, 5, 2, 2, 0, 6, 5, 6, 9, 5, 2, 6, 2, 3, 7, 4, 2, 6, 1, 9, 8, 0, 0, 4, 7, 2, 1, 6, 1, 8, 6, 7, 1, 2, 6, 1, 4, 1, 6, 2, 1, 9, 5, 0, 0, 4, 6, 2, 5, 3, 3, 0, 5, 0, 2, 2, 7, 6, 1, 1, 3, 9, 5, 6, 0, 3, 4, 2, 8, 3, 7, 2, 9, 6, 1, 8, 3, 1, 3, 8, 5, 1, 9, 0, 0, 4, 3, 4, 6, 4, 6, 7, 8, 5, 2, 5, 6, 1, 6, 8, 5, 2, 1, 1, 0, 4, 7, 0, 4, 9, 1, 4, 2, 1, 4, 4, 5, 7, 2, 1, 2, 5, 3, 8, 0, 6, 6, 0, 5, 2, 7, 5, 7, 5, 7, 9, 0, 8, 3, 3, 4, 0, 3, 8, 4, 1, 4, 0, 8, 4,</pre>	



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		3, 4, 5, 4, 3, 0, 3, 7, 2, 0, 9, 3, 4, 2, 4, 3, 5, 7, 8, 4, 7, 4, 9, 5, 6, 4, 5, 0, 5, 2, 9, 6, 9, 3, 5, 6, 9, 9, 0, 5, 2, 1, 0, 4, 6, 1, 1, 7, 8, 8, 5, 3, 5, 8, 1, 1, 2, 6, 8, 1, 8, 2, 3, 9, 3, 0, 5, 8, 0, 0, 6, 2, 4, 0, 2, 6, 2, 2, 8, 7, 1, 8, 6, 8, 2, 7, 9, 3, 6, 3, 5, 7, 1, 7, 0, 8, 6, 6, 6, 5, 2, 6, 3, 2, 6, 3, 5, 6, 5, 2, 3, 1, 7, 0, 2, 3, 2, 3, 3, 0, 6, 1, 5, 1, 1, 0, 2, 1, 7, 8, 8, 6, 7, 2, 9, 6, 1, 0, 1, 2, 5, 0, 0, 6, 5, 7, 7, 4, 6, 4, 7, 4, 1, 5, 6, 3, 1, 7, 5, 6, 4, 4, 2, 8, 5, 7, 6, 2, 8, 1, 2, 2, 0, 8, 9, 3, 5, 6, 4, 3, 4, 0, 9, 7, 7, 0, 0, 9, 8, 8, 9, 6, 4, 6, 6, 4, 8, 0, 8, 2, 8, 0, 0, 4, 1, 3, 0, 2, 9, 7, 3, 3, 0, 5, 9, 0, 1, 4, 7, 1, 6, 4, 4, 1, 4, 8, 9, 7, 5, 9, 1, 9, 6, 5, 3, 4, 5, 3, 6, 1, 0, 4, 3, 0, 9, 3, 8, 8, 9, 7, 3, 0, 4, 2, 4, 9, 7, 4, 3, 2, 2, 8, 9, 2, 5, 0, 9, 3, 2, 1, 9, 3, 2, 3, 2, 8, 0, 2, 5, 1, 6, 8, 3, 1, 7, 8, 2, 6, 2, 0, 2, 7, 2, 6, 7, 3, 6, 1, 5, 6, 3, 0, 4, 6, 4, 4, 2, 4, 1, 6, 0, 5, 5, 9, 3, 8, 4, 3, 4, 9, 6, 2, 0, 4, 6, 0, 5, 0, 9, 0, 9, 7, 6, 8, 7, 0, 7, 3, 6, 1, 8, 4, 2, 8, 7, 0, 2, 5, 4, 0, 5, 7, 4, 8, 5, 1, 2, 2, 1, 6, 5, 0, 9, 4, 6, 2, 7, 7, 4, 2, 9, 7, 6, 7, 5, 0, 5, 5, 2, 8, 8, 8, 8, 2, 0, 6, 2, 1, 8, 9, 5, 1, 2, 8, 1, 5, 5, 7, 2, 8, 6, 1, 9, 6, 9, 4, 1, 0, 0, 9, 4, 1, 1, 3, 9, 8, 1, 0, 4, 3, 2, 6, 5, 9, 8, 3, 7, 9, 4, 0, 6, 8, 8, 4, 1, 5, 0, 5, 6, 3, 3, 1, 0, 9, 3, 7, 6, 8, 7, 8, 1, 1, 0, 3, 1, 8, 9, 7, 9, 1, 8, 5, 8, 3, 3, 0, 7, 2, 3, 8, 9, 5, 0, 9, 4, 7, 7, 5, 6, 2,	3, 4, 5, 4, 3, 0, 3, 7, 2, 0, 9, 3, 4, 2, 4, 3, 5, 7, 8, 4, 7, 4, 9, 5, 6, 4, 5, 0, 5, 2, 9, 6, 9, 3, 5, 6, 9, 9, 0, 5, 2, 1, 0, 4, 6, 1, 1, 7, 8, 8, 5, 3, 5, 8, 1, 1, 2, 6, 8, 1, 8, 2, 3, 9, 3, 0, 5, 8, 0, 0, 6, 2, 4, 0, 2, 6, 2, 2, 8, 7, 1, 8, 6, 8, 2, 7, 9, 3, 6, 3, 5, 7, 1, 7, 0, 8, 6, 6, 6, 5, 2, 6, 3, 2, 6, 3, 5, 6, 5, 2, 3, 1, 7, 0, 2, 3, 2, 3, 3, 0, 6, 1, 5, 1, 1, 0, 2, 1, 7, 8, 8, 6, 7, 2, 9, 6, 1, 0, 1, 2, 5, 0, 0, 6, 5, 7, 7, 4, 6, 4, 7, 4, 1, 5, 6, 3, 1, 7, 5, 6, 4, 4, 2, 8, 5, 7, 6, 2, 8, 1, 2, 2, 0, 8, 9, 3, 5, 6, 4, 3, 4, 0, 9, 7, 7, 0, 0, 9, 8, 8, 9, 6, 4, 6, 6, 4, 8, 0, 8, 2, 8, 0, 0, 4, 1, 3, 0, 2, 9, 7, 3, 3, 0, 5, 9, 0, 1, 4, 7, 1, 6, 4, 4, 1, 4, 8, 9, 7, 5, 9, 1, 9, 6, 5, 3, 4, 5, 3, 6, 1, 0, 4, 3, 0, 9, 3, 8, 8, 9, 7, 3, 0, 4, 2, 4, 9, 7, 4, 3, 2, 2, 8, 9, 2, 5, 0, 9, 3, 2, 1, 9, 3, 2, 3, 2, 8, 0, 2, 5, 1, 6, 8, 3, 1, 7, 8, 2, 6, 2, 0, 2, 7, 2, 6, 7, 3, 6, 1, 5, 6, 3, 0, 4, 6, 4, 4, 2, 4, 1, 6, 0, 5, 5, 9, 3, 8, 4, 3, 4, 9, 6, 2, 0, 4, 6, 0, 5, 0, 9, 0, 9, 7, 6, 8, 7, 0, 7, 3, 6, 1, 8, 4, 2, 8, 7, 0, 2, 5, 4, 0, 5, 7, 4, 8, 5, 1, 2, 2, 1, 6, 5, 0, 9, 4, 6, 2, 7, 7, 4, 2, 9, 7, 6, 7, 5, 0, 5, 5, 2, 8, 8, 8, 8, 2, 0, 6, 2, 1, 8, 9, 5, 1, 2, 8, 1, 5, 5, 7, 2, 8, 6, 1, 9, 6, 9, 4, 1, 0, 0, 9, 4, 1, 1, 3, 9, 8, 1, 0, 4, 3, 2, 6, 5, 9, 8, 3, 7, 9, 4, 0, 6, 8, 8, 4, 1, 5, 0, 5, 6, 3, 3, 1, 0, 9, 3, 7, 6, 8, 7, 8, 1, 1, 0, 3, 1, 8, 9, 7, 9, 1, 8, 5, 8, 3, 3, 0, 7, 2, 3, 8, 9, 5, 0, 9, 4, 7, 7, 5, 6, 2,	



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		2, 2, 6, 5, 3, 1, 9, 5, 1, 4, 7, 7, 4, 6, 6, 1, 6, 0, 6, 3, 8, 0, 4, 2, 2, 0, 5, 3, 9, 8, 7, 6, 3, 5, 1, 9, 4, 5, 0, 7, 9, 1, 9, 1, 3, 6, 3, 2, 3, 9, 2, 5, 6, 0, 2, 7, 2, 7, 9, 1, 5, 1, 4, 3, 9, 8, 6, 2, 1, 9, 0, 2, 8, 1, 9, 3, 5, 2, 7, 7, 9, 9, 9, 6, 6, 6, 7, 6, 1, 2, 7, 6, 4, 0, 9, 5, 6, 7, 5, 1, 3, 7, 7, 8, 1, 6, 8, 4, 5, 4, 7, 2, 4, 0, 1, 4, 8, 1, 2, 3, 0, 8, 8, 0, 5, 0, 5, 8, 4, 7, 8, 7, 0, 0, 0, 5, 0, 1, 0, 0, 1, 5, 5, 1, 4, 5, 7, 6, 8, 4, 9, 9, 6, 5, 6, 5, 2, 9, 2, 7, 6, 3, 5, 5, 0, 5, 9, 0, 4, 7, 1, 7, 9, 8, 1, 5, 5, 1, 5, 4, 5, 9, 6, 6, 8, 8, 7, 0, 7, 2, 4, 4, 4, 3, 1, 4, 5, 9, 8, 0, 8, 4, 9, 2, 4, 1, 9, 9, 1, 9, 5, 3, 3, 1, 9, 2, 6, 0, 3, 3, 3, 0, 3, 9, 1, 2, 4, 5, 3, 5, 7, 9, 7, 7, 4, 6, 9, 7, 5, 9, 9, 5, 2, 5, 9, 7, 0, 4, 3, 1, 4, 3, 6, 1, 8, 5, 8, 8, 3, 7, 1, 5, 3, 5, 0, 3, 4, 3, 7, 9, 6, 9, 6, 9, 6, 6, 4, 7]	2, 2, 6, 5, 3, 1, 9, 5, 1, 4, 7, 7, 4, 6, 6, 1, 6, 0, 6, 3, 8, 0, 4, 2, 2, 0, 5, 3, 9, 8, 7, 6, 3, 5, 1, 9, 4, 5, 0, 7, 9, 1, 9, 1, 3, 6, 3, 2, 3, 9, 2, 5, 6, 0, 2, 7, 2, 7, 9, 1, 5, 1, 4, 3, 9, 8, 6, 2, 1, 9, 0, 2, 8, 1, 9, 3, 5, 2, 7, 7, 9, 9, 9, 6, 6, 6, 7, 6, 1, 2, 7, 6, 4, 0, 9, 5, 6, 7, 5, 1, 3, 7, 7, 8, 1, 6, 8, 4, 5, 4, 7, 2, 4, 0, 1, 4, 8, 1, 2, 3, 0, 8, 8, 0, 5, 0, 5, 8, 4, 7, 8, 7, 0, 0, 0, 5, 0, 1, 0, 0, 1, 5, 5, 1, 4, 5, 7, 6, 8, 4, 9, 9, 6, 5, 6, 5, 2, 9, 2, 7, 6, 3, 5, 5, 0, 5, 9, 0, 4, 7, 1, 7, 9, 8, 1, 5, 5, 1, 5, 4, 5, 9, 6, 6, 8, 8, 7, 0, 7, 2, 4, 4, 4, 3, 1, 4, 5, 9, 8, 0, 8, 4, 9, 2, 4, 1, 9, 9, 1, 9, 5, 3, 3, 1, 9, 2, 6, 0, 3, 3, 3, 0, 3, 9, 1, 2, 4, 5, 3, 5, 7, 9, 7, 7, 4, 6, 9, 7, 5, 9, 9, 5, 2, 5, 9, 7, 0, 4, 3, 1, 4, 3, 6, 1, 8, 5, 8, 8, 3, 7, 1, 5, 3, 5, 0, 3, 4, 3, 7, 9, 6, 9, 6, 9, 6, 6, 4, 7]	



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	<pre>0, 2, 5, 9, 5, 0, 5, 4, 3, 6, 2, 5, 0, 4, 5, 9, 7, 4, 4, 5, 0, 3, 7, 5, 4, 5, 0, 0, 5, 2, 0, 8, 0, 3, 5, 2, 9, 8, 5, 6, 3, 0, 3, 5, 6, 2, 2, 8, 1, 4, 9, 8, 8, 7, 7, 1, 4, 8, 2, 1, 3, 9, 8, 8, 0, 5, 0, 5, 2, 4, 0, 4, 6, 0, 8, 5, 7, 2, 9, 6, 4, 2, 0, 0, 7, 7, 1, 2, 4, 4, 3, 6, 2, 0, 2, 9, 8, 0, 8, 0, 2, 2, 5, 3, 2, 2, 8, 5, 7, 5, 5, 7, 4, 2, 4, 2, 9, 4, 1, 4, 1, 8, 8, 4, 1, 0, 3, 4, 0, 5, 8, 8, 4, 4, 2, 7, 0, 3, 1, 3, 3, 1, 4, 4, 1, 7, 4, 9, 3, 2, 3, 7, 0, 8, 1, 9, 7, 2, 1, 9, 3, 7, 6, 0, 5, 1, 4}; int k = 5555; LLNode* head = LLNode::createWithIterators(arr, arr + sizeof(arr) / sizeof(int)); LLNode::printList(head); cout << "\n"; LLNode* newhead = rotateLinkedList(head, k); LLNode::printList(newhead);</pre>	<pre>9, 4, 8, 0, 5, 1, 0, 4, 0, 5, 6, 3, 6, 6, 1, 3, 5, 0, 0, 7, 9, 1, 7, 9, 1, 7, 3, 3, 4, 0, 2, 5, 0, 8, 7, 3, 9, 4, 9, 7, 7, 9, 0, 2, 1, 6, 8, 2, 0, 7, 9, 9, 4, 2, 2, 8, 8, 1, 7, 9, 7, 8, 7, 7, 6, 7, 2, 9, 4, 6, 2, 5, 1, 7, 3, 3, 1, 7, 5, 4, 9, 9, 4, 0, 4, 7, 4, 3, 5, 2, 9, 7, 5, 6, 9, 2, 0, 1, 9, 7, 2, 5, 0, 6, 2, 6, 4, 1, 5, 1, 7, 9, 0, 5, 2, 4, 1, 3, 9, 7, 2, 4, 0, 9, 2, 6, 6, 2, 9, 1, 1, 3, 4, 4, 9, 0, 5, 1, 7, 7, 4, 5, 0, 5, 4, 7, 1, 9, 1, 0, 5, 6, 3, 4, 2, 0, 1, 6, 6, 5, 4, 0, 0, 7, 8, 3, 4, 3, 7, 1, 3, 1, 9, 0, 4, 3, 5, 0, 9, 7, 9, 3, 0, 2, 9, 3, 0, 8, 0, 0, 5, 2, 8, 5, 8, 0, 6, 3, 8, 7, 3, 6, 2, 3, 7, 8, 5, 5, 4, 9, 5, 5, 3, 7, 7, 0, 0, 0, 0, 5, 4, 6, 1, 2, 3, 2, 2, 9, 1, 1, 5, 9, 8, 8, 9, 9, 4, 4, 1, 8, 2, 9, 9, 0, 8, 0, 2, 2, 3, 9, 3, 3, 0, 1, 4, 7, 6, 6, 0, 6, 4, 1, 2, 8, 7, 9, 2, 7, 0, 7, 9, 8, 0, 8, 7, 4, 4, 2, 3, 5, 0, 2, 7, 9, 5, 8, 5, 9, 9, 1, 1, 7, 7, 6, 3, 6, 3, 1, 3, 9, 8, 5, 6, 1, 3, 6, 1, 1, 7, 0, 4, 5, 7, 6, 2, 8, 8, 2, 7, 7, 1, 4, 4, 3, 7, 9, 0, 1, 6, 0, 3, 1, 2, 6, 8, 2, 2, 1, 1, 0, 6, 9, 1, 4, 7, 4, 3, 4, 6, 1, 6, 5, 8, 4, 1, 2, 8, 5, 7, 6, 7, 8, 5, 5, 7, 5, 4, 1, 4, 1, 8, 5, 8, 0, 2, 1, 1, 7, 2, 3, 4, 6, 3, 3, 5, 5, 5, 4, 1, 2, 3, 1, 6, 5, 5, 9, 6, 9, 0, 1, 5, 6, 8, 8, 5, 5, 9, 0, 1, 8, 4, 5, 8, 6, 4, 5, 1, 4, 0, 1, 0, 2, 2, 6, 7, 9, 0, 7, 0, 5, 0, 4, 0, 1, 4, 0, 1, 0, 9, 9, 9, 1, 9, 7, 1, 5, 9, 2, 9, 9, 7, 0, 6, 0, 5, 5, 9, 7, 6, 4, 0, 4, 4, 4, 1, 5, 6, 9, 3, 1, 8, 3, 0, 0, 4, 5, 6, 3, 6, 9,</pre>	<pre>9, 4, 8, 0, 5, 1, 0, 4, 0, 5, 6, 3, 6, 6, 1, 3, 5, 0, 0, 7, 9, 1, 7, 9, 1, 7, 3, 3, 4, 0, 2, 5, 0, 8, 7, 3, 9, 4, 9, 7, 7, 9, 0, 2, 1, 6, 8, 2, 0, 7, 9, 9, 4, 2, 2, 8, 8, 1, 7, 9, 7, 8, 7, 7, 6, 7, 2, 9, 4, 6, 2, 5, 1, 7, 3, 3, 1, 7, 5, 4, 9, 9, 4, 0, 4, 7, 4, 3, 5, 2, 9, 7, 5, 6, 9, 2, 0, 1, 9, 7, 2, 5, 0, 6, 2, 6, 4, 1, 5, 1, 7, 9, 0, 5, 2, 4, 1, 3, 9, 7, 2, 4, 0, 9, 2, 6, 6, 2, 9, 1, 1, 3, 4, 4, 9, 0, 5, 1, 7, 7, 4, 5, 0, 5, 4, 7, 1, 9, 1, 0, 5, 6, 3, 4, 2, 0, 1, 6, 6, 5, 4, 0, 0, 7, 8, 3, 4, 3, 7, 1, 3, 1, 9, 0, 4, 3, 5, 0, 9, 7, 9, 3, 0, 2, 9, 3, 0, 8, 0, 0, 5, 2, 8, 5, 8, 0, 6, 3, 8, 7, 3, 6, 2, 3, 7, 8, 5, 5, 4, 9, 5, 5, 3, 7, 7, 0, 0, 0, 0, 5, 4, 6, 1, 2, 3, 2, 2, 9, 1, 1, 5, 9, 8, 8, 9, 9, 4, 4, 1, 8, 2, 9, 9, 0, 8, 0, 2, 2, 3, 9, 3, 3, 0, 1, 4, 7, 6, 6, 0, 6, 4, 1, 2, 8, 7, 9, 2, 7, 0, 7, 9, 8, 0, 8, 7, 4, 4, 2, 3, 5, 0, 2, 7, 9, 5, 8, 5, 9, 9, 1, 1, 7, 7, 6, 3, 6, 3, 1, 3, 9, 8, 5, 6, 1, 3, 6, 1, 1, 7, 0, 4, 5, 7, 6, 2, 8, 8, 2, 7, 7, 1, 4, 4, 3, 7, 9, 0, 1, 6, 0, 3, 1, 2, 6, 8, 2, 2, 1, 1, 0, 6, 9, 1, 4, 7, 4, 3, 4, 6, 1, 6, 5, 8, 4, 1, 2, 8, 5, 7, 6, 7, 8, 5, 5, 7, 5, 4, 1, 4, 1, 8, 5, 8, 0, 2, 1, 1, 7, 2, 3, 4, 6, 3, 3, 5, 5, 5, 4, 1, 2, 3, 1, 6, 5, 5, 9, 6, 9, 0, 1, 5, 6, 8, 8, 5, 5, 9, 0, 1, 8, 4, 5, 8, 6, 4, 5, 1, 4, 0, 1, 0, 2, 2, 6, 7, 9, 0, 7, 0, 5, 0, 4, 0, 1, 4, 0, 1, 0, 9, 9, 9, 1, 9, 7, 1, 5, 9, 2, 9, 9, 7, 0, 6, 0, 5, 5, 9, 7, 6, 4, 0, 4, 4, 4, 1, 5, 6, 9, 3, 1, 8, 3, 0, 0, 4, 5, 6, 3, 6, 9,</pre>	

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