```
//  Yousef Zoumot
//  main.cpp
//  Coen70HW2.1 *Chapter 3 Problem 4
//
//  Created by Yousef Zoumot on 1/18/16.
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//

#include <iostream>
#include <assert.h>
#include <cstdlib>//Provides size_t

using namespace std;


class sequence{
public:
    //TYPEDEFS and MEMBER CONSTANTS
    typedef double value_type;
    typedef std::size_t size_type;
    static const size_type CAPACITY=30;
    //CONSTRUCTOR
    sequence();
    //MODIFICATION MEMBER FUNCTIONS
    void start();
    void advance();
    void insert(const value_type& entry);
    void attach(const value_type& entry);
    void remove_current();

    void addToFront(const value_type& entry);
    void removeFront();
    void addToEnd(const value_type& entry);
    void lastToCurrent();

    sequence operator +(const sequence& s2);
    void operator +=(const sequence& s2);

    value_type operator[](size_type index);

    void printValues();

    //CONSTANT MEMBER FUNCTIONS
    size_type size() const;
    bool is_item() const;
    value_type current() const;
private:
    value_type data[CAPACITY];
    size_type used;
    size_type current_index;
```

```
};

int main(int argc, const char * argv[]) {
    // insert code here...
    sequence s1, s2;
    s1.addToEnd(1);
    s1.addToEnd(2);
    s1.addToEnd(3);
    s1.addToEnd(4);
    s1.addToEnd(5);
    s2.addToEnd(6);
    s2.addToEnd(7);
    s2.addToEnd(8);
    s2.addToEnd(9);
    s1.printValues();
    s2.printValues();
    sequence s3;
    s3= s1+s2;
    s3.printValues();
    sequence s4;
    s4+=s1;
    s4+=s2;
    s4.printValues();
    cout<<s4[0];

    return 0;
}

// MODIFICATION MEMBER FUNCTIONS
sequence::sequence ()
{
    current_index = 0;
    used = 0;
}

void sequence::start( )
{
    current_index = 0;
}

void sequence::advance( )
{
    current_index++;
}

void sequence::insert(const value_type& entry)
{
    if(current_index==used){
        data[current_index]=entry;
        used++;
```

```
        return;
    }
    size_type i;
    for (i = used; i > current_index; i--)
        data[i]= data[i-1];

    data[current_index] = entry;
    used++;
}

void sequence::attach(const value_type& entry)
{
    if(!is_item()){
        data[current_index]=entry;
        used++;
        return;
    }
    size_type i;
    for (i = used; i > current_index+1; i--)
        data[i] = data[i+1];

    data[current_index+1] = entry;
    current_index++;
    used++;
}

void sequence::remove_current( )
{
    size_type i;
    for (i= current_index; i < used-1; i++)
        data[i] = data[i+1];
    used--;
}

void sequence:: addToFront(const value_type& entry){

    if(current_index==used){
        data[current_index]=entry;
        used++;
        return;
    }
    size_type i;
    for (i = used; i > 0; i--)
        data[i]= data[i-1];

    data[0] = entry;
    start();
    used++;
}
```

```
void sequence:: removeFront(){
    start();
    remove_current();
}

void sequence:: addToEnd(const value_type& entry){
    current_index=used;
    data[current_index]=entry;
    used++;
}

void sequence:: lastToCurrent(){
    data[current_index]=data[used-1];
    used--;
}

double sequence:: operator[](size_type index){
    value_type invalid=100000;
    if(index<size())
        return data[index];
    else{
        cout<<"This is not a valid index";
        return invalid;
    };
}

sequence sequence:: operator +(const sequence& s2){
    sequence temp;
    size_type i=0;
    size_type f=0;
    while(temp.size() < size()){
        temp.data[i]=data[i];
        i++;
        temp.used++;
    }
    while (temp.size() < (size()+s2.size())) {
        temp.data[i]=s2.data[f];
        f++;
        i++;
        temp.used++;
    }
    return temp;
}

void sequence:: operator +=(const sequence& s2){
    *this=*this+s2;

}
```

```
void sequence:: printValues(){
    cout<<"The values in the sequence are as follows: "<<"\n";
    size_type i;
    for(i=0; i<size(); i++)
        cout<<data[i]<<" \n";
}

// CONSTANT MEMBER FUNCTIONS
sequence::size_type sequence::size( ) const
{
    return used;
}

bool sequence::is_item( ) const
{
    return current_index != used;
}

sequence::value_type sequence::current( ) const
{
    return data[current_index];
}
```

```
The values in the sequence are as follows:
1
2
3
4
5
The values in the sequence are as follows:
6
7
8
9
The values in the sequence are as follows:
1
2
3
4
5
6
7
8
9
The values in the sequence are as follows:
1
2
3
4
5
6
7
8
9
1Program ended with exit code: 0
```

```
//  Yousef Zoumot
//  main.cpp
//  Coen70HW2.2 *Chapter 3 Problem 5
//
//  Created by Yousef Zoumot on 1/12/16.
//  Copyright (c) 2016 Yousef Zoumot. All rights reserved.
//

#include <iostream>
#include <cassert>
#include <cstdlib> //provide size_t

using namespace std;

class set
{
public:
    //TYPEDEFS and MEMBER CONSTANTS
    typedef int value_type;
    typedef std::size_t size_type;
    static const size_type CAPACITY=30;
    //CONSTRUCTOR
    set() {used = 0;}
    //MODIFICATION
    size_type erase (const value_type& target);
    bool erase_one(const value_type& target);
    void insert(const value_type&entry);
    void operator +=(const set& addend);
    set operator -(const set& b);
    void operator -=(const set& remove);
    //CONSTANT MEMBER FUNCTIONS
    size_type size() const { return used;}
    size_type count(const value_type& target) const;
    void printValues();
    bool contains(const value_type& target);
    set operator +(const set& b2);
private:
    value_type data[CAPACITY]; //the array to store items
    size_type used;            // much of the array is used
};
//NONMEMBER FUNCTIONS for the set class
set operator +(const set& b1, const set& b2);

const set:: size_type set::CAPACITY;
```

```
bool set:: contains(const value_type& target){
    for(size_type i=0; i<size(); i++){
        if(data[i]== target)
            return true;
    }
    return false;
}

set::size_type set::erase(const value_type& target){
    size_type index = 0;
    size_type many_removed = 0;

    while(index < used){
        if (data[index] == target){
            --used;
            data[index] = data [used];
            ++many_removed;
        }
        else
            ++index;
    }

    return many_removed;

}

bool set::erase_one(const value_type& target){
    size_type index;
    index = 0;
    while((index < used) && (data[index] != target))
        ++index;
    if(index == used)
        return false;
    --used;
    data[index] = data[used];
    return true;
}

void set::insert(const value_type& entry){
    assert(size() < CAPACITY);
    if(contains(entry)){
        return;
    }
    data[used] = entry;
    ++used;
    return;
}
```

```
set set:: operator -(const set& b){
    set temp = *this;
    for(set::value_type i=0; i< b.size(); i++)
        temp.erase_one(b.data[i]);
    return temp;

}

void set:: operator -=(const set& remove){
    for(set::value_type i=0; i< remove.size(); i++)
        erase_one(remove.data[i]);


}

set::size_type set::count(const value_type& target) const {
    size_type answer;
    size_type i;
    answer = 0;
    for(i = 0; i < used; ++i)
        if (target == data[i])
            ++answer;
    return answer;
}

void set::operator +=(const set& addend){
    assert(size() + addend.size() <= CAPACITY);
    for(int i=0; i<addend.size(); i++){
        if(!contains(addend.data[i])){
            data[used]=addend.data[i];
            used++;
        }
    }

}

set set:: operator +(const set& b2){
    set answer;

    assert(size() + b2.size() <= CAPACITY);
    answer=*this;
    answer+=b2;
    return answer;
}
```

```
void set :: printValues(){//a function that prints all the values
in order to clean up the main function
    size_type index=0;
    cout<<"\n";
    while(size() > index){
        cout<<data[index]<<"\n";
        index++;
    }
}



int main(int argc, const char * argv[]) {
    // insert code here...

    set b, b2;
    b.insert(1);
    b.insert(2);
    b.insert(3);
    b.insert(4);
    b.insert(3);

    b2.insert(4);
    b2.insert(5);
    b2.insert(6);
    b2.insert(2);
    b.printValues();
    b2.printValues();

    set c;
    c=b+b2;
    c.printValues();

    b+=b2;
    b.printValues();
    return 0;
}
```

```
1
2
3
4

4
5
6
2

1
2
3
4
5
6

1
2
3
4
5
6
Program ended with exit code: 0
```

Choose stack frame

```
//  Yousef Zoumot
//  main.cpp
//  Coen70HW2.3 *Chapter 3 Problem 8
//
//  Created by Yousef Zoumot on 1/12/16.
//  Copyright (c) 2016 Yousef Zoumot. All rights reserved.
//

#include <iostream>
#include <cassert>
#include <cstdlib> //provide size_t

using namespace std;


class bag
{
public:
    //TYPEDEFS and MEMBER CONSTANTS
    typedef int value_type;
    typedef std::size_t size_type;
    static const size_type CAPACITY=30;
    //CONSTRUCTOR
    bag() {used = 0;}
    //MODIFICATION
    size_type erase (const value_type& target);
    bool erase_one(const value_type& target);
    void insert(const value_type& entry, int key);
    void operator +=(const bag& addend);
    bag operator -(const bag& b);
    void operator -=(const bag& remove);
    //CONSTANT MEMBER FUNCTIONS
    size_type size() const { return used;}
    size_type count(const value_type& target) const;
    void printValues();
private:
    value_type data[CAPACITY];//the array to store items
    int keys[CAPACITY];
    size_type used;            //How much of the array is used
};
//NONMEMBER FUNCTIONS for the bag class
bag operator +(const bag& b1, const bag& b2);


const bag:: size_type bag::CAPACITY;
```

```
bag::size_type bag::erase(const value_type& target){
    size_type index = 0;
    size_type many_removed = 0;

    while(index < used){
        if (data[index] == target){
            --used;
            data[index] = data [used];
            ++many_removed;
        }
        else
            ++index;
    }

    return many_removed;

}

bool bag::erase_one(const value_type& key1){
    size_type index;
    index = 0;
    while((index < used) && (keys[index] != key1))
        ++index;
    if(index == used)
        return false;
    --used;
    data[index] = data[used];
    keys[index]=keys[used];
    return true;
}

void bag::insert(const value_type& entry, int key){
    assert(size() < CAPACITY);
    for(int i=0; i<size(); i++){
        if(keys[i]==key)
            return;
    }
    data[used] = entry;
    keys[used]=key;
    ++used;
    return;
}
```

```
void bag::operator +=(const bag& addend){
    assert(size() + addend.size() <= CAPACITY);
    bool tmp=false;
    for(int i=0; i<addend.size(); i++){
        for(int j=0; j<size(); j++){
            if(addend.keys[i]==keys[j])
                tmp=true;
        }
        if(tmp==false){
            data[used]=addend.data[i];
            keys[used]=addend.keys[i];
            used++;
        }
        tmp=false;
    }
    //copy(addend.data, addend.data + addend.used, data + used);
    //copy(addend.keys, addend.keys + addend.used, keys + used);
    //used += addend.used;
}

bag bag:: operator -(const bag& b){
    bag temp = *this;
    for(bag::value_type i=0; i< b.size(); i++)
        temp.erase_one(b.keys[i]);
    return temp;

}


void bag:: operator -=(const bag& remove){
    for(bag::value_type i=0; i< remove.size(); i++)
        erase_one(remove.data[i]);


}


bag::size_type bag::count(const value_type& target) const {
    size_type answer;
    size_type i;
    answer = 0;
    for(i = 0; i < used; ++i)
        if (target == data[i])
            ++answer;
    return answer;
}
```

```
bag operator +(const bag& b1, const bag& b2){
    bag answer;

    assert(b1.size() + b2.size() <= bag::CAPACITY);

    answer += b1;
    answer += b2;
    return answer;
}
void bag :: printValues(){//a function that prints all the values
in order to clean up the main function
    size_type index=0;
    cout<<"\n";
    while(size() > index){
        cout<<data[index]<<" with index: "<<keys[index]<<"\n";
        index++;
    }
}



int main(int argc, const char * argv[]) {
    // insert code here...

    bag b, b2;
    b.insert(1,1);
    b.insert(2,2);
    b.insert(3,3);
    b.insert(4,4);
    b.insert(3,5);

    b2.insert(3,6);
    b2.insert(7,7);
    b2.insert(2,2);
    b2.insert(3,3);
    b.printValues();
    b2.printValues();

    bag c;
    c=b-b2;
    c.printValues();

    b-=b2;
    b.printValues();
    b+=b2;
    b.printValues();
    return 0;
}
```

```
1 with index: 1
4 with index: 4
3 with index: 5

1 with index: 1
4 with index: 4
3 with index: 5
3 with index: 6
7 with index: 7
2 with index: 2
3 with index: 3
Program ended with exit code: 0
```

```
//  Yousef Zoumot
//  main.cpp
//  Coen70HW2.4 *Chapter 4 Problem 1 parts A, D, F, G b/c
professor said we only need to choose 4 to do
//
//  Created by Yousef Zoumot on 1/18/16.
//  Copyright (c) 2016 Yousef Zoumot. All rights reserved.
//

#include <iostream>
#include <assert.h>
#include <cstdlib>//Provides size_t

using namespace std;


class String{
    char myString[200];
    size_t length;
public:
    //CONSTRUCTOR FOR THE STRING CLASS
    String(const char str[] = "");
    String(const char c);//part A

    //CONSTANT MEMBER FUNCTIONS FOR THE STRING CLASS
    int searchF(const char c);//Part F returns index of first
occurrence or returns -1
    int searchA(const char c);//Part G returns number of
occurrences or returns 0

    //MODIFICATION MEMBER FUNCTIONS FOR THE STRING CLASS
    void replaceChar(const char c, int index);//part D

    //Tester Function
    void printValues();
};

String:: String(const char str[]){
    int i=0;
    if(str[i]=='\0'){
        myString[i]='\0';
        length++;
        return;
    }
    while(str[i]!= '\0'){
        myString[i]=str[i];
        i++;
        length++;
    }
    return;
```

```
}

String::String(const char c){
    if(c=='\0'){
        myString[0]=c;
        length++;
        return;
    }
    myString[0]=c;
    length++;
    myString[1]='\0';
    length++;
    return;

}


void String:: replaceChar(const char c, int index){
    myString[index]=c;
    return;
}

int String:: searchF(const char c){
    int i=0;
    while(myString[i]!='\0'){
        if(myString[i]==c)
            return i;
        i++;
    }
    cout<<"Not Found ";
    return -1;
}

int String:: searchA(const char c){
    int i=0;
    int answer=0;
    while(myString[i]!='\0'){
        if(myString[i]==c){
            answer++;
        }
        i++;
    }
    return answer;
}

void String:: printValues(){
    int i=0;
    while(myString[i]!='\0'){
        cout<<myString[i];
        i++;
```

```
    }
    cout<<"\n";

}

int main(int argc, const char * argv[]) {
    String s1("Hello my name is Johnny");
    s1.printValues();
    char c='A';
    String s2(c);
    s2.printValues();
    s2.replaceChar('B', 0);
    s2.printValues();
    c='n';
    cout<<s1.searchF(c)<<"\n";
    cout<<s1.searchA(c)<<"\n";

}
```

```
Hello my name is Johnny
A
B
9
3
Program ended with exit code: 0
```

```
//  Yousef Zoumot
//  main.cpp
//  Coen70HW2.5 *Chapter 4 Problem 2A
//
//  Created by Yousef Zoumot on 1/18/16.
//  Copyright (c) 2016 Yousef Zoumot. All rights reserved.
//

#include <iostream>
#include <assert.h>
#include<vector>
#include <cstdlib>//Provides size_t

using namespace std;


class sequence{
public:
    //TYPEDEFS and MEMBER CONSTANTS
    typedef double value_type;
    typedef std::size_t size_type;
    //CONSTRUCTOR
    sequence(const size_t cap);
    //MODIFICATION MEMBER FUNCTIONS
    void start();
    void advance();
    void insert(const value_type& entry);
    void attach(const value_type& entry);
    void remove_current();

    void addToFront(const value_type& entry);
    void removeFront();
    void addToEnd(const value_type& entry);
    void lastToCurrent();
    sequence operator +(const sequence& s2);
    void operator +=(const sequence& s2);
    value_type operator[](size_type index);
    void printValues();

    //CONSTANT MEMBER FUNCTIONS
    size_type size() const;
    bool is_item() const;
    value_type current() const;
private:
    value_type* data;
    size_t capacity;
    size_type used;
    size_type current_index;
    void increaseS();
};
```

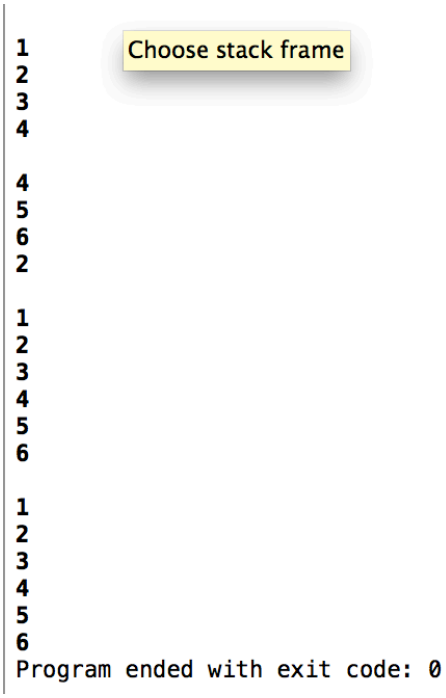
```
int main(int argc, const char * argv[]) {
    // insert code here...
    sequence s1(100), s2(100);
    s1.addToEnd(1);
    s1.addToEnd(2);
    s1.addToEnd(3);
    s1.addToEnd(4);
    s1.addToEnd(5);
    s2.addToEnd(6);
    s2.addToEnd(7);
    s2.addToEnd(8);
    s2.addToEnd(9);
    s1.printValues();
    s2.printValues();
    sequence s3(100);
    s3= s1+s2;
    s3.printValues();
    sequence s4(100);
    s4+=s1;
    s4+=s2;
    s4.printValues();
    cout<<s4[0];

    return 0;
}

// MODIFICATION MEMBER FUNCTIONS
sequence::sequence (const size_t cap)
{
    current_index = 0;
    used = 0;
    capacity=cap;
    data= new value_type[capacity];
}

void sequence::start( )
{
    current_index = 0;
}

void sequence::advance( )
{
    current_index++;
}
```

```
void sequence::insert(const value_type& entry)
{
    if(current_index==used){
        data[current_index]=entry;
        used++;
        return;
    }
    size_type i;
    for (i = used; i > current_index; i--)
        data[i]= data[i-1];

    data[current_index] = entry;
    used++;
}

void sequence::attach(const value_type& entry)
{
    if(!is_item()){
        data[current_index]=entry;
        used++;
        return;
    }
    size_type i;
    for (i = used; i > current_index+1; i--)
        data[i] = data[i+1];

    data[current_index+1] = entry;
    current_index++;
    used++;
}

void sequence::remove_current( )
{
    size_type i;
    for (i= current_index; i < used-1; i++)
        data[i] = data[i+1];
    used--;
}
```

```
void sequence:: addToFront(const value_type& entry){

    if(current_index==used){
        data[current_index]=entry;
        used++;
        return;
    }
    size_type i;
    for (i = used; i > 0; i--)
        data[i]= data[i-1];

    data[0] = entry;
    start();
    used++;
}

void sequence:: removeFront(){
    start();
    remove_current();
}

void sequence:: addToEnd(const value_type& entry){
    current_index=used;
    data[current_index]=entry;
    used++;
}

void sequence:: lastToCurrent(){
    data[current_index]=data[used-1];
    used--;
}

double sequence:: operator[](size_type index){
    value_type invalid=100000;
    if(index<size())
        return data[index];
    else{
        cout<<"This is not a valid index";
        return invalid;
    };
}
```

```
sequence sequence:: operator +(const sequence& s2){
    sequence temp(100);
    size_type i=0;
    size_type f=0;
    while(temp.size() < size()){
        temp.data[i]=data[i];
        i++;
        temp.used++;
    }
    while (temp.size() < (size()+s2.size())) {
        temp.data[i]=s2.data[f];
        f++;
        i++;
        temp.used++;
    }
    return temp;
}

void sequence:: operator +=(const sequence& s2){
    *this=*this+s2;

}

void sequence:: printValues(){
    cout<<"The values in the sequence are as follows: "<<"\n";
    size_type i;
    for(i=0; i<size(); i++)
        cout<<data[i]<<" \n";
}

void sequence:: increaseS(){
    value_type* tmp= new value_type[2*capacity];
    for(int i=0; i<size(); i++){
        tmp[i]=data[i];
    }
    delete[] data;
    data=tmp;
    capacity*=2;

}

// CONSTANT MEMBER FUNCTIONS
sequence::size_type sequence::size( ) const
{
    return used;
}
```

```
bool sequence::is_item( ) const
{
    return current_index != used;
}

sequence::value_type sequence::current( ) const
{
    return data[current_index];
}
```



```
//  Yousef Zoumot
//  main.cpp
//  Coen70HW2.6 *Chapter 4 Problem 2b
//
//  Created by Yousef Zoumot on 1/23/16.
//  Copyright (c) 2016 Yousef Zoumot. All rights reserved.
//


#include <algorithm>
#include <iostream>
#include <cassert>
using namespace std;

class set{
    int* data;
    int capacity;
    void incSize();
    int used;
public:
    set(int x = 20);
    set(const set& source);
    ~set();
    int erase(const int& target);
    bool erase_one(const int& target);
    void insert(const int& target);
    set operator -(const set& b2);
    set& operator =(const set& source);
    void operator -=(const set& removeIt);
    void operator +=(const set& addend);
    set operator +(const set& b2);
    bool contains(const int& target) const;
    int size() const { return used; }
    int count( const int& target) const;
    void printValues();
};

int main(){
    set a;
    set b;
    set c;
    set d;
    a.insert(1);
    a.insert(2);
    a.insert(2);
    a.insert(3);
    a.printValues();
    b.insert(3);
    b.insert(2);
    b.insert(5);
```

```
    b.printValues();
    c = a - b;
    c.printValues();
    c = a + b;
    c.printValues();
    d.insert(3);
    c += d;
    c.printValues();
    c -= d;
    c.printValues();
    c.erase_one(1);
    c.printValues();
}
```

```
    int set::erase(const int& target){
        int index = 0;
        int many_removed = 0;

        while(index < used){
            if (data[index] == target){
                --used;
                data[index] = data [used];
                ++many_removed;
            }
            else
                ++index;
        }

        return many_removed;

    }
    set:: set (int x){
        assert(x>0);
        used = 0;
        capacity = x;
        data = new int[x];
    }
    set:: ~set(){
        if (data)
            delete[] data;
    }
    set:: set(const set& source){
        data = NULL;
        *this = source;
    }
```

```
void set:: incSize(){
    int* temp = new int[2*capacity];
    for(int i = 0; i < capacity; i++){
        temp[i] = data[i];
    }
    delete[] data;
    data = temp;
    capacity *= 2;
}
void set::printValues(){
    int i;
    for(i = 0; i < used; i++){
        cout << data[i] << " ";
    }
    cout << endl;
}

bool set::erase_one(const int& target){
    int index;
    index = 0;
    while((index < used) && (data[index] != target))
        ++index;
    if(index == used)
        return false;
    --used;
    data[index] = data[used];
    return true;
}

void set::operator +=(const set& addend){
    int i;
    if(size() + addend.size() >= capacity)
        incSize();
    for(i = 0; i < addend.used; i++){
        if(!contains(addend.data[i])){
            data[used] = addend.data[i];
            used++;
        }
    }
}




set set:: operator -(const set& b2){
    set answer = *this;
    for(int i = 0; i < b2.used; i++)
        answer.erase_one(b2.data[i]);
    return answer;
}
```

```
int set::count(const int& target) const {
    int answer;
    int i;
    answer = 0;
    for(i = 0; i < used; ++i)
        if (target == data[i])
            ++answer;
    return answer;
}

void set:: operator -=(const set& removeIt){
    int i;
    for(i = 0; i < removeIt.used; i++)
        erase_one(removeIt.data[i]);
}
void set::insert(const int& entry){
    if(contains(entry))
        return;
    if(size() >= capacity)
        incSize();
    data[used] = entry;
    ++used;
    return;
}
set& set:: operator =(const set& source){
    if(this == &source)
        return *this;
    if (data)
        delete[] data;
    if(source.used == 0){
        used = 0;
        capacity = 20;
        data = new int[capacity];
        return *this;
    }
    data = new int[source.capacity];
    for(int i = 0; i < source.capacity; i++){
        data[i] = source.data[i];
    }
    used = source.used;
    capacity = source.capacity;
    return  *this;
}

bool set:: contains(const int& target) const{
    int i;
    for(i = 0; i < used; ++i)
        if (target == data[i])
            return true;
```

```
    return false;

}

set set::operator +(const set& b2){

    set answer = *this;
    if(answer.size() + b2.size() >= capacity)
        incSize();
    for(int i = 0; i < b2.used; i++){
        if(!answer.contains(b2.data[i])){
            answer.data[used] = b2.data[i];
            answer.used++;
        }
    }
    return answer;


}
```

```
1 2 3
3 2 5
1
1 2 3 5
1 2 3 5
1 2 5
5 2
Program ended with exit code: 0
```

```
//  Yousef Zoumot
//  main.cpp
//  Coen70HW2.7 *Chapter 4 Problem 2e
//
//  Created by Yousef Zoumot on 1/12/16.
//  Copyright (c) 2016 Yousef Zoumot. All rights reserved.
//


#include <algorithm>
#include <iostream>
#include <cassert>

using namespace std;

class bag{
public:
    bag(int x = 20);
    bag(const bag& source);
    ~bag();
    int erase(const int& target);
    bool erase_one(const int& target);
    bool contains(const int& target);
    void insert(const int& entry, int key);
    int size() const { return used; }
    int count( const int& target) const;
    void printValues();
    bag operator +(const bag& b2);
    bag& operator =(const bag& source);
    bag operator -(const bag& b2);
    void operator -=(const bag& removeIt);
    void operator +=(const bag& addend);
private:
    int** data;
    int capacity;
    int used;
    void incSize();
};



int main(){
    bag a;
    bag b;
    bag c;
    bag d;
    a.insert(1, 1);
    a.insert(2, 2);
    a.insert(3, 3);
    a.insert(4, 4);
```

```
    b.insert(5, 5);
    b.insert(6, 6);
    b.insert(7, 7);
    a.printValues();
    b.printValues();
    c = a + b;
    c.printValues();
    c = a - b;
    c.printValues();
    d.insert(1,6);
    d.insert(2, 2);
    d.insert(3, 5);
    d.printValues();
    c -= d;
    c.printValues();
    d.erase_one(6);
    d.erase_one(5);
    d.printValues();
}
```

```
int bag::erase(const int& target){
    int index = 0;
    int many_removed = 0;

    while(index < used){
        if (data[index][0] == target){
            --used;
            data[index][0] = data[used][0];
            data[index][1] = data[used][1];
            ++many_removed;
        }
        else
            ++index;
    }

    return many_removed;

}

bag:: bag (int x){
    assert(x>0);
    used = 0;
    capacity = x;
    data = new int*[x];
    for(int i = 0; i < x; i++){
        data[i] = new int[2];
```

```
    }
}
bag:: bag(const bag& source){

    data = NULL;
    *this = source;
}
bag:: ~bag(){

    for(int i = 0; i < capacity; i++){
        delete[] data[i];
    }
    delete[] data;
}
void bag::printValues(){
    int i;
    for(i = 0; i < used; i++){
        cout <<data[i][0]<<" " ;
    }
    cout << endl;
    for(i = 0; i < used; i++){
        cout << data[i][1] << " ";
    }
    cout << endl << endl << endl;
}

bool bag::erase_one(const int& target){
    int index;
    index = 0;
    while((index < used) && (data[index][1] != target))
        ++index;
    if(index == used)
        return false;
    --used;
    data[index][1] = data[used][1];
    data[index][0] = data[used][0];
    return true;
}

void bag:: incSize(){
    int** temp = new int* [2*capacity];
    for(int i = 0; i < 2*capacity; i++){
        temp[i][0] = data[i][0];
        temp[i][1] = data[i][1];
    }
    for(int i = 0; i < capacity; i++){
        temp[i][0] = data[i][0];
        temp[i][1] = data[i][1];
    }
    for(int i = 0; i < capacity; i++){
```

```
        delete[] data[i];
    }
    delete[] data;
    data = temp;
    capacity *= 2;
}


void bag::insert(const int& entry, int key1){
    if(size() == capacity)
        incSize();
    data[used][0] = entry;
    for(int i = 0; i < used; i++){
        if(data[i][1] == key1){
            cout << "That key is already used. Enter another";
            cin >> key1;
            i = 0;
        }
    }
    data[used][1] = key1;
    ++used;
    return;
}

void bag::operator +=(const bag& addend){
    *this = *this + addend;
}

bag bag:: operator -(const bag& source){
    /*bag answer;
     answer.data = NULL;
     answer = *this;*/
    bag answer;
    if(answer.data){
        for(int i = 0; i < answer.capacity; i++){
            delete[] answer.data[i];
        }
        delete[] answer.data;
    }
    answer.data = new int*[capacity];
    for(int i = 0; i < capacity; i++)
        answer.data[i] = new int[2];
    for(int i = 0; i < source.capacity; i++){
        answer.data[i][0] = data[i][0];
        answer.data[i][1] = data[i][1];
    }
    answer.capacity = capacity;
    answer.used = used;
    for(int i = 0; i < source.used; i++){
        answer.erase_one(source.data[i][1]);
```

```
    }
    return answer;
}

void bag:: operator -=(const bag& removeIt){
    *this = *this - removeIt;
}

int bag::count(const int& target) const {
    int answer;
    int i;
    answer = 0;
    for(i = 0; i < used; ++i)
        if (target == data[i][0])
            ++answer;
    return answer;
}

bag& bag:: operator =(const bag& source){
    if(this == &source)
        return *this;
    if(data){
        for(int i = 0; i < capacity; i++){
            delete[] data[i];
        }
        delete[] data;
    }

    if(source.used == 0){
        used = 0;
        capacity = 20;
        data = new int*[20];
        for(int i = 0; i < 20; i++){
            data[i] = new int[2];
        }
        return *this;
    }
    data = new int*[source.capacity];
    for(int i = 0; i < source.capacity; i++)
        data[i] = new int[2];
    for(int i = 0; i < source.used; i++){
        data[i][0] = source.data[i][0];
        data[i][1] = source.data[i][1];
    }
    capacity = source.capacity;
    used =source.used;
    return *this;
}
bag bag::operator +(const bag& source){
```

```
    bag answer;
    answer = *this;
    if(source.used + used >= capacity)
        answer.incSize();
    for(int i = 0; i < source.used; i++){
        if(!answer.contains(source.data[i][1])){
            answer.insert(source.data[i][0],source.data[i][1]);
        }
    }
    return answer;
}

bool bag:: contains(const int &target){
    for(int i = 0; i < used; i++){
        if(data[i][1] == target)
            return true;
    }
    return false;

}
```

```
1 2 3 4
1 2 3 4


5 6 7
5 6 7


1 2 3 4 5 6 7
1 2 3 4 5 6 7


1 2 3 4
1 2 3 4


1 2 3
6 2 5


1 4 3
1 4 3


2
2


Program ended with exit code: 0
```