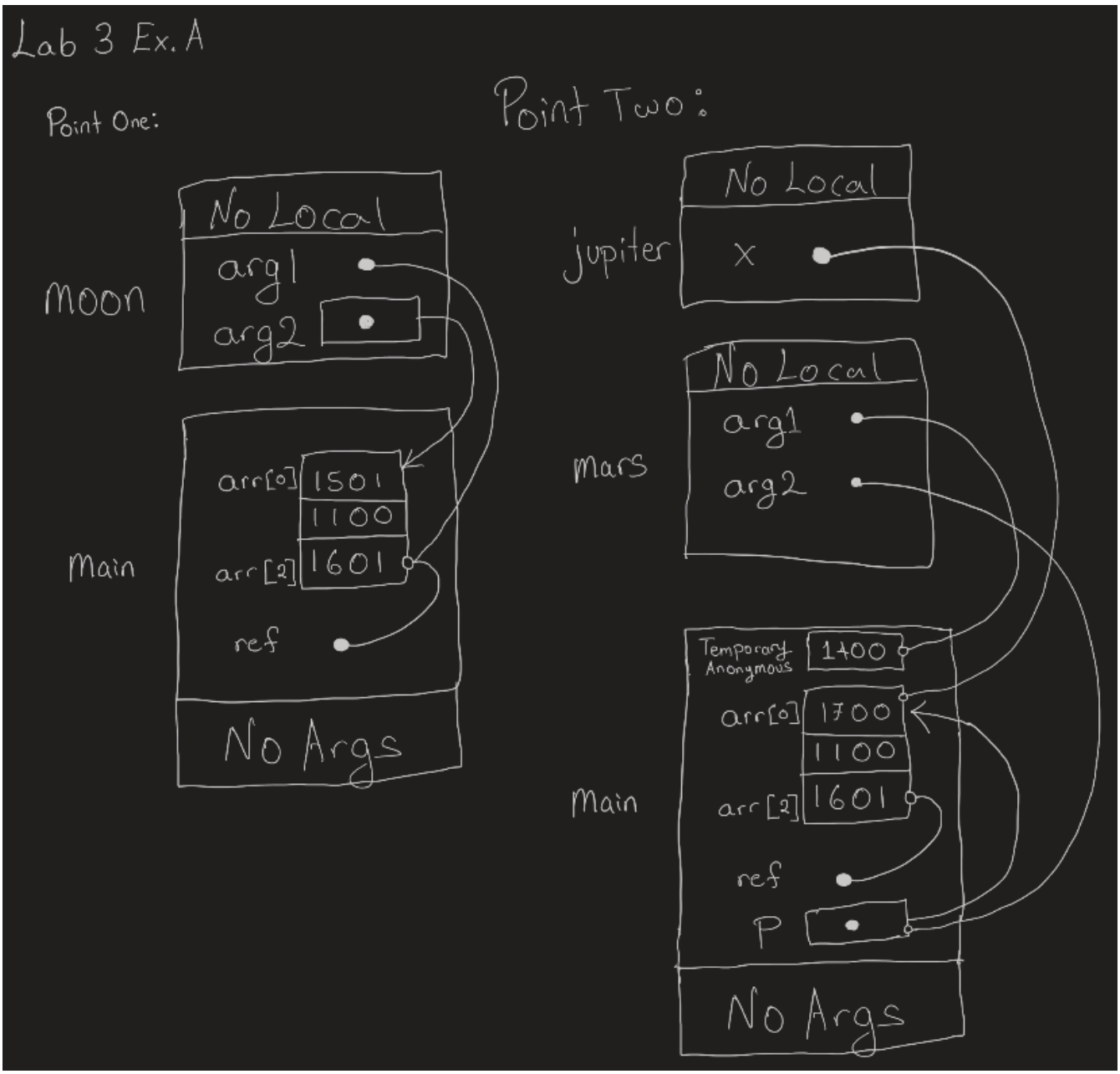
Course: ENSF 614 – Fall 2023
Lab #: Lab 3
Instructor: Mahmood Moussavi
Student Name: Satchytan Karalasingham, Romil Dhagat
Submission Date: October 13, 2023

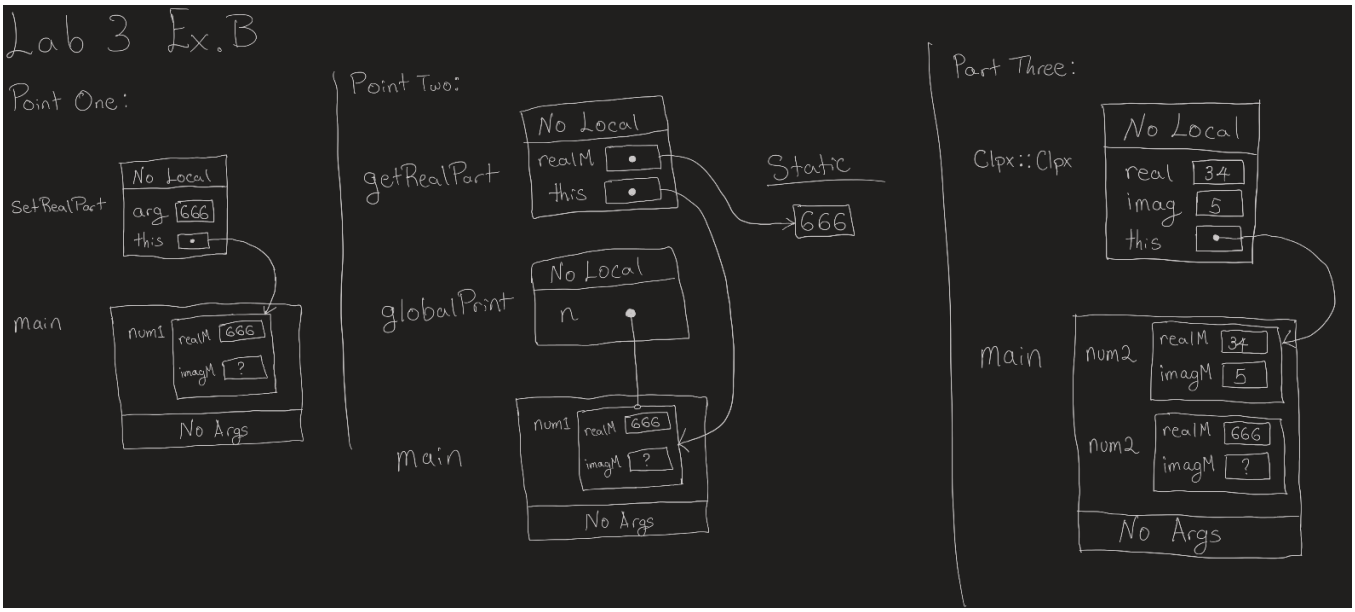
Lab 3 Exercise A:

AR DIAGRAMS:



Lab 3 Exercise B:

AR DIAGRAM:



Lab 3 Exercise C:

CODE:

```
// lab3Clock.h
// ENSF 614 Lab 3 Exercise C
// Instructor: M. Moussavi
// Submitted by: Satchytan Karalasingham, Romil Dhagat
// Development Date: October 13th, 2023// lab3CLock.h
// By: Romil Dhagat and Satchy Keralasingham

#ifndef lab3Clock_H
#define lab3Clock_H

class Clock{
    private:
        int hour;
        int minute;
        int second;

        int hms_to_sec() const;
        void sec_to_hms(int sec);

    public:
        Clock();
        Clock(int seconds);
        Clock(int h, int m, int s);

        int get_hour() const;
        int get_minute() const;
        int get_second() const;

        void set_hour(int h);
        void set_minute(int m);
        void set_second(int s);

        void increment();
        void decrement();
        void add_seconds(int seconds);
};

#endif
```

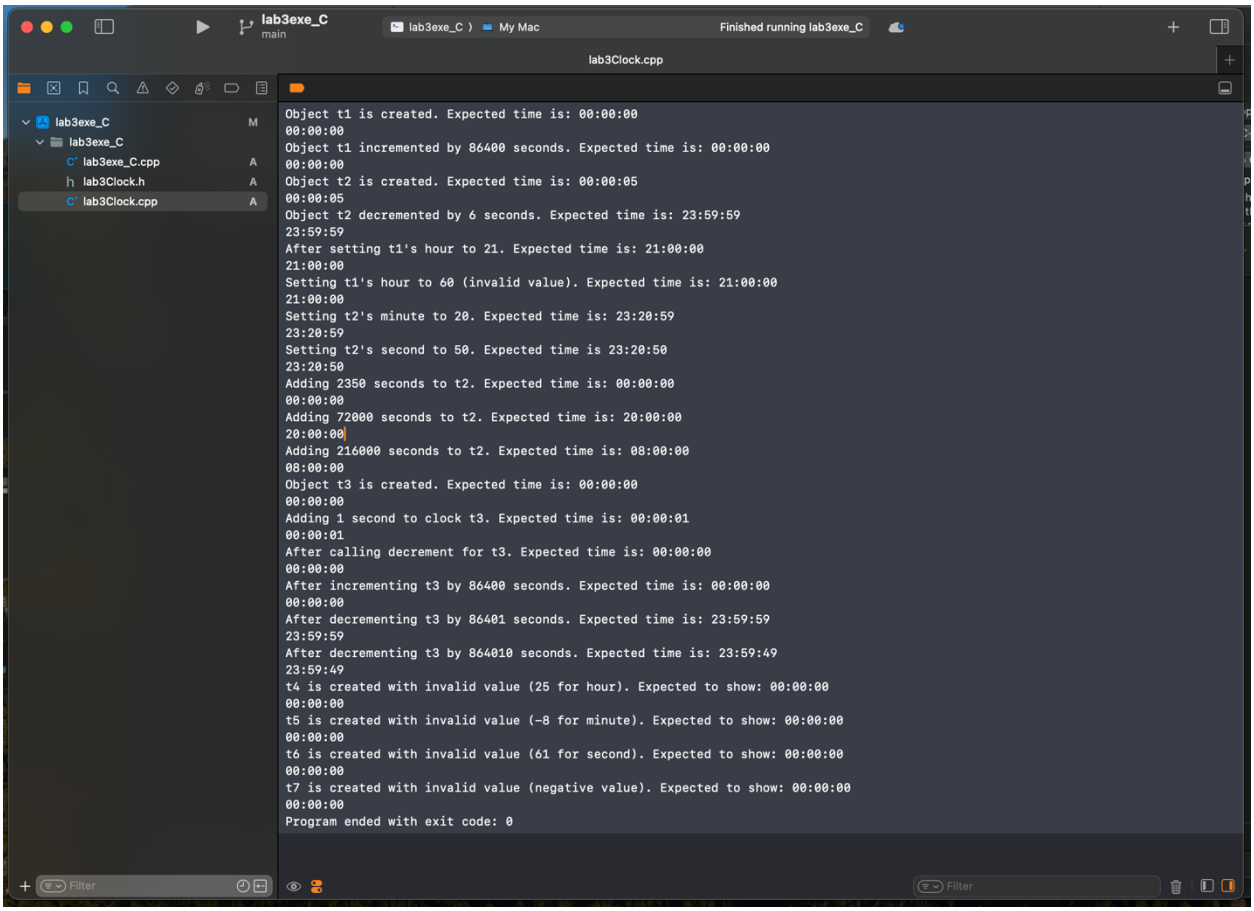
```cpp
// lab3Clock.cpp
// ENSF 614 Lab 3 Exercise C
// Instructor: M. Moussavi
// Submitted by: Satchytan Karalasingham, Romil Dhagat
// Development Date: October 13th, 2023// lab3CLock.cpp
// By: Romil Dhagat and Satchy Keralasingham

#include <iostream>
using namespace std;
#include "lab3Clock.h"

Clock::Clock(): hour(0), minute(0), second(0){

}

Clock::Clock(int sec){
    sec_to_hms(sec);
}

Clock::Clock(int h, int m, int s){
    if (h >= 0 && h <= 23 && m >= 0 && m <= 59 && s >= 0 && s <= 59) {
        hour = h;
        minute = m;
        second = s;
    } else {
        hour = 0;
        minute = 0;
        second = 0;
    }
}

int Clock::get_hour() const {
    return hour;
}

int Clock::get_minute() const {
    return minute;
}

int Clock::get_second() const {
    return second;
}

void Clock::set_hour(int h) {
    if (h >= 0 && h <= 23) {
        hour = h;
    }
}

void Clock::set_minute(int m) {
```

```
    if (m >= 0 && m <= 59) {
        minute = m;
    }
}

void Clock::set_second(int s) {
    if (s >= 0 && s <= 59) {
        second = s;
    }
}

void Clock::increment() {
    int sec = hms_to_sec();
    sec = (sec + 1) % 86400;
    sec_to_hms(sec);
}

void Clock::decrement() {
    int sec = hms_to_sec();
    sec = (sec - 1 + 86400) % 86400;
    sec_to_hms(sec);
}

void Clock::add_seconds(int seconds) {
    int sec = hms_to_sec() + seconds;
    sec = (sec + 86400) % 86400;
    sec_to_hms(sec);
}

int Clock::hms_to_sec() const {
    return (hour * 3600 + minute * 60 + second);
}

void Clock::sec_to_hms(int sec) {
    hour = sec / 3600;
    sec %= 3600;
    minute = sec / 60;
    second = sec % 60;
    if (second < 0 || second > 59) {
        second = 0;
    }
    if (hour < 0 || hour > 23) {
        hour = 0;
    }
    if (minute < 0 || minute > 59) {
        minute = 0;
    }
}
```

OUTPUT:

```
Object t1 is created. Expected time is: 00:00:00
00:00:00
Object t1 incremented by 86400 seconds. Expected time is: 00:00:00
00:00:00
Object t2 is created. Expected time is: 00:00:05
00:00:05
Object t2 decremented by 6 seconds. Expected time is: 23:59:59
23:59:59
After setting t1's hour to 21. Expected time is: 21:00:00
21:00:00
Setting t1's hour to 60 (invalid value). Expected time is: 21:00:00
21:00:00
Setting t2's minute to 20. Expected time is: 23:20:59
23:20:59
Setting t2's second to 50. Expected time is 23:20:50
23:20:50
Adding 2350 seconds to t2. Expected time is: 00:00:00
00:00:00
Adding 72000 seconds to t2. Expected time is: 20:00:00
20:00:00
Adding 216000 seconds to t2. Expected time is: 08:00:00
08:00:00
Object t3 is created. Expected time is: 00:00:00
00:00:00
Adding 1 second to clock t3. Expected time is: 00:00:01
00:00:01
After calling decrement for t3. Expected time is: 00:00:00
00:00:00
After incrementing t3 by 86400 seconds. Expected time is: 00:00:00
00:00:00
After decrementing t3 by 86401 seconds. Expected time is: 23:59:59
23:59:59
After decrementing t3 by 864010 seconds. Expected time is: 23:59:49
23:59:49
t4 is created with invalid value (25 for hour). Expected to show:
00:00:00
00:00:00
t5 is created with invalid value (-8 for minute). Expected to show:
00:00:00
00:00:00
t6 is created with invalid value (61 for second). Expected to show:
00:00:00
00:00:00
t7 is created with invalid value (negative value). Expected to show:
00:00:00
00:00:00
Program ended with exit code: 0
```

SCREENSHOT:


lab3exe_C
main
lab3exe_C 〉 My Mac
Finished running lab3exe_C
lab3Clock.cpp
lab3exe_C
lab3exe_C
lab3exe_C.cpp
lab3Clock.h
lab3Clock.cpp
Object t1 is created. Expected time is: 00:00:00
00:00:00
Object t1 incremented by 86400 seconds. Expected time is: 00:00:00
00:00:00
Object t2 is created. Expected time is: 00:00:05
00:00:05
Object t2 decremented by 6 seconds. Expected time is: 23:59:59
23:59:59
After setting t1's hour to 21. Expected time is: 21:00:00
21:00:00
Setting t1's hour to 60 (invalid value). Expected time is: 21:00:00
21:00:00
Setting t2's minute to 20. Expected time is: 23:20:59
23:20:59
Setting t2's second to 50. Expected time is 23:20:50
23:20:50
Adding 2350 seconds to t2. Expected time is: 00:00:00
00:00:00
Adding 72000 seconds to t2. Expected time is: 20:00:00
20:00:00
Adding 216000 seconds to t2. Expected time is: 08:00:00
08:00:00
Object t3 is created. Expected time is: 00:00:00
00:00:00
Adding 1 second to clock t3. Expected time is: 00:00:01
00:00:01
After calling decrement for t3. Expected time is: 00:00:00
00:00:00
After incrementing t3 by 86400 seconds. Expected time is: 00:00:00
00:00:00
After decrementing t3 by 86401 seconds. Expected time is: 23:59:59
23:59:59
After decrementing t3 by 864010 seconds. Expected time is: 23:59:49
23:59:49
t4 is created with invalid value (25 for hour). Expected to show: 00:00:00
00:00:00
t5 is created with invalid value (-8 for minute). Expected to show: 00:00:00
00:00:00
t6 is created with invalid value (61 for second). Expected to show: 00:00:00
00:00:00
t7 is created with invalid value (negative value). Expected to show: 00:00:00
00:00:00
Program ended with exit code: 0

Lab 3 Exercise D:

CODE:

```
// myArray.cpp
// ENSF 614 Lab 3 Exercise D
// Instructor: M. Moussavi
// Submitted by: Satchytan Karalasingham, Romil Dhagat
// Development Date: October 13th, 2023
// This program demonstrates the use of all the features
// of the MyArray class.


#include "MyArray.h"

MyArray::MyArray() : sizeM(0), storageM(nullptr)
{
    // Constructor for an empty array
}

MyArray::MyArray(const EType *builtin, int sizeA) : sizeM(sizeA)
{
    // Constructor to create an object by copying a built-in array
    storageM = new EType[sizeA];
    for (int i = 0; i < sizeA; i++)
    {
        storageM[i] = builtin[i];
    }
}

MyArray::MyArray(const MyArray &source) : sizeM(source.sizeM)
{
    // Copy constructor
    storageM = new EType[sizeM];
    for (int i = 0; i < sizeM; i++)
    {
        storageM[i] = source.storageM[i];
    }
}

MyArray &MyArray::operator=(const MyArray &rhs)
{
    // Assignment operator
    if (this != &rhs)
    {
        // Check for self-assignment
        if (storageM)
        {
            delete[] storageM;
        }
```

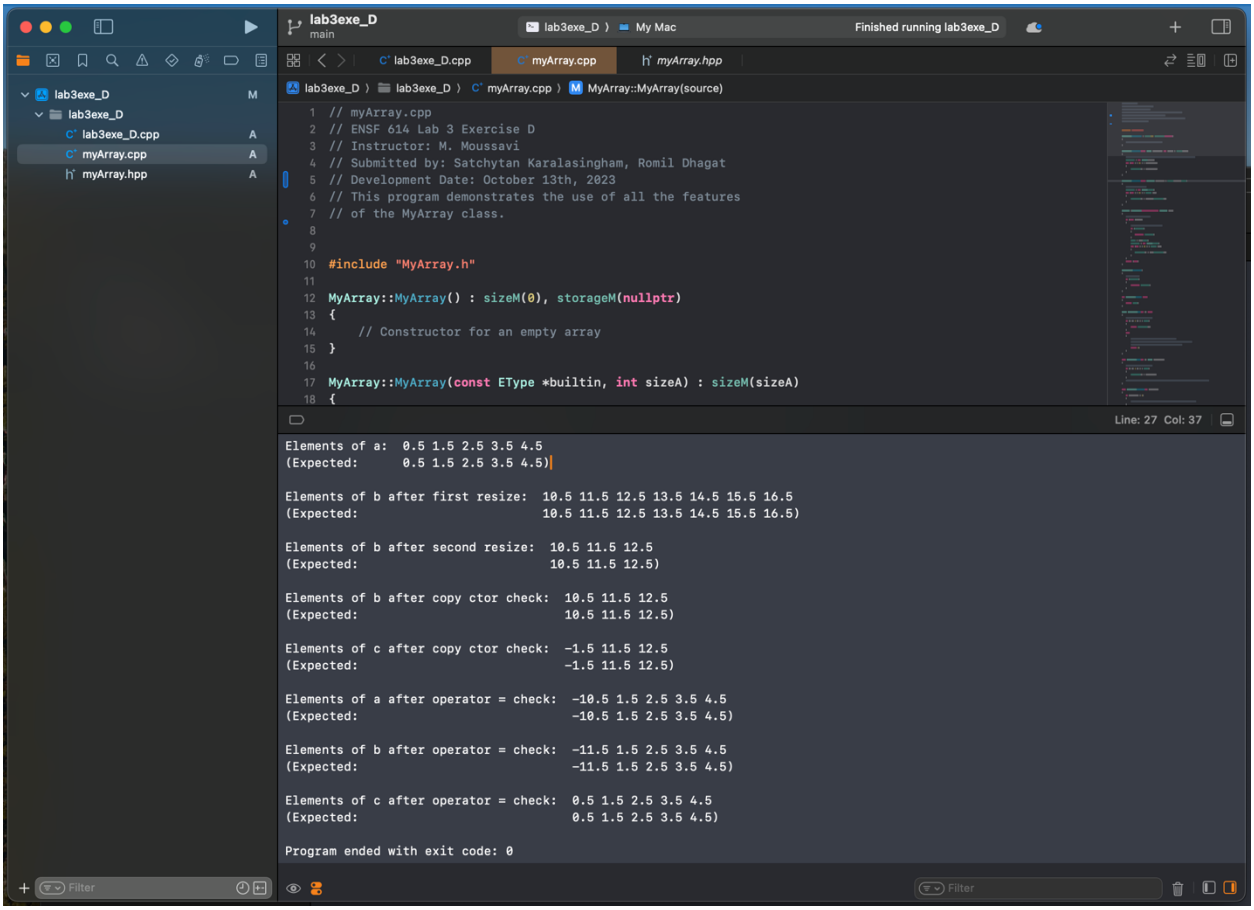
```
        sizeM = rhs.sizeM;
        storageM = new EType[sizeM];
        for (int i = 0; i < sizeM; i++)
        {
            storageM[i] = rhs.storageM[i];
        }
    }
    return *this;
}

MyArray::~MyArray()
{
    // Destructor
    if (storageM)
    {
        delete[] storageM;
    }
}

int MyArray::size() const
{
    return sizeM;
}

EType MyArray::at(int i) const
{
    // Check for valid index
    if (i >= 0 && i < sizeM)
    {
        return storageM[i];
    }
    else
    {
        return 0;
    }
}

void MyArray::set(int i, EType new_value)
{
    // Check for valid index
    if (i >= 0 && i < sizeM)
    {
        storageM[i] = new_value;
    }
}

void MyArray::resize(int new_size)
{
    if (new_size < 0)
    {
```

```
    }
    else if (new_size == 0)
    {
        // If the new size is zero, deallocate the storage
        if (storageM)
        {
            delete[] storageM;
            storageM = nullptr;
        }
        sizeM = 0;
    }
    else
    {
        // Allocate a new array and copy elements
        EType *newStorage = new EType[new_size];
        int elementsToCopy = (new_size < sizeM) ? new_size : sizeM;
        for (int i = 0; i < elementsToCopy; i++)
        {
            newStorage[i] = storageM[i];
        }

        // Deallocate the old storage and update the size and storage
pointer
        if (storageM)
        {
            delete[] storageM;
        }
        sizeM = new_size;
        storageM = newStorage;
    }
}
```

OUTPUT:

```
Elements of a:  0.5 1.5 2.5 3.5 4.5
(Expected:      0.5 1.5 2.5 3.5 4.5)

Elements of b after first resize:  10.5 11.5 12.5 13.5 14.5
15.5 16.5
(Expected:                         10.5 11.5 12.5 13.5 14.5
15.5 16.5)

Elements of b after second resize:  10.5 11.5 12.5
(Expected:                          10.5 11.5 12.5)

Elements of b after copy ctor check:  10.5 11.5 12.5
(Expected:                            10.5 11.5 12.5)

Elements of c after copy ctor check:  -1.5 11.5 12.5
(Expected:                            -1.5 11.5 12.5)

Elements of a after operator = check:  -10.5 1.5 2.5 3.5 4.5
(Expected:                             -10.5 1.5 2.5 3.5 4.5)

Elements of b after operator = check:  -11.5 1.5 2.5 3.5 4.5
(Expected:                             -11.5 1.5 2.5 3.5 4.5)

Elements of c after operator = check:  0.5 1.5 2.5 3.5 4.5
(Expected:                             0.5 1.5 2.5 3.5 4.5)

Program ended with exit code: 0
```

SCREENSHOT:


lab3exe_D
main
lab3exe_D) My Mac
Finished running lab3exe_D
lab3exe_D.cpp
myArray.cpp
myArray.hpp
lab3exe_D) lab3exe_D) myArray.cpp) MyArray::MyArray(source)
// myArray.cpp
// ENSF 614 Lab 3 Exercise D
// Instructor: M. Moussavi
// Submitted by: Satchytan Karalasingham, Romil Dhagat
// Development Date: October 13th, 2023
// This program demonstrates the use of all the features
// of the MyArray class.
#include "MyArray.h"
MyArray::MyArray() : sizeM(0), storageM(nullptr)
{
// Constructor for an empty array
}
MyArray::MyArray(const EType *builtin, int sizeA) : sizeM(sizeA)
{
Line: 27 Col: 37
Elements of a: 0.5 1.5 2.5 3.5 4.5
(Expected: 0.5 1.5 2.5 3.5 4.5)
Elements of b after first resize: 10.5 11.5 12.5 13.5 14.5 15.5 16.5
(Expected: 10.5 11.5 12.5 13.5 14.5 15.5 16.5)
Elements of b after second resize: 10.5 11.5 12.5
(Expected: 10.5 11.5 12.5)
Elements of b after copy ctor check: 10.5 11.5 12.5
(Expected: 10.5 11.5 12.5)
Elements of c after copy ctor check: -1.5 11.5 12.5
(Expected: -1.5 11.5 12.5)
Elements of a after operator = check: -10.5 1.5 2.5 3.5 4.5
(Expected: -10.5 1.5 2.5 3.5 4.5)
Elements of b after operator = check: -11.5 1.5 2.5 3.5 4.5
(Expected: -11.5 1.5 2.5 3.5 4.5)
Elements of c after operator = check: 0.5 1.5 2.5 3.5 4.5
(Expected: 0.5 1.5 2.5 3.5 4.5)
Program ended with exit code: 0