CSCI 140 Final Submission

Due Date: 12/09/2021 Late (date and time):__________________

Name(s): Nero Li

Question 1

Source code below:

```
/*  Program: Lab_Final_1
    Author: Nero Li
    Class: CSCI 220
    Date: 12/09/2021
    Description:
        Set up MyIntQueue class that supports standard queue operations
with int values. The
        class must use two stacks of integers to store data and support
stack operations (no
        additional variables in the class). What is the running time for
each queue operation?
        You can use your stack class from a PA or one from C++/ Java
language. You might
        want to make sure that your implementation would work with the
following test case:
        // s is an object of type MyIntQueue
        s.enqueue(5);
        s. enqueue(7);
        x = s.front(); // x is 5
        s. enqueue(1);
        x = s.dequeue(); // x is 5, dequeue() will return a value
        s.enqueue(2);
        x = s.dequeue(); // x is 7
        x = s.dequeue(); // x is 1

    I certify that the code below is my own work.

    Exception(s): N/A

*/

#include <iostream>
#include <stack>
```

```cpp
using namespace std;

class MyIntQueue
{
private:
    stack<int> stk1;
    stack<int> stk2;
public:
    // Running Time: O(1)
    void enqueue(int n)
    {
        stk1.push(n);
    }

    // Running Time: O(n^2)
    int dequeue()
    {
        int n;
        while (!stk1.empty())
        {
            stk2.push(stk1.top());
            stk1.pop();
        }
        n = stk2.top();
        stk2.pop();
        while (!stk2.empty())
        {
            stk1.push(stk2.top());
            stk2.pop();
        }
        return n;
    }

    // Running Time: O(n^2)
    int front()
    {
        int n;
        while (!stk1.empty())
        {
            stk2.push(stk1.top());
            stk1.pop();
        }
        n = stk2.top();
        while (!stk2.empty())
        {
            stk1.push(stk2.top());
            stk2.pop();
        }
        return n;
    }
};

void requirement1()
{
    int x;
    MyIntQueue s;       // s is an object of type MyIntQueue

    s.enqueue(5);
    s.enqueue(7);
    x = s.front();      // x is 5
    cout << x << ' ';
    s.enqueue(1);
    x = s.dequeue();    // x is 5, dequeue() will return a value
    cout << x << ' ';
    s.enqueue(2);
    x = s.dequeue();    // x is 7
    cout << x << ' ';
    x = s.dequeue();    // x is 1
    cout << x << ' ';

    cout << endl;
}

void requirement2()
{
    int a[] = {5, 7, 1, 2, 4};
    int count{5};
    MyIntQueue q1;
    MyIntQueue q2;
    int switcher{1};

    for (int i = 0; i < count; ++i)
    {
        q2.enqueue(a[i]);
    }

    for (int i = 0; i < count; ++i)
    {
        switch (switcher)
        {
```

```cpp
        case 1:
            for (int j = 0; j < count - 1 - i; ++j)
            {
                q1.enqueue(q2.dequeue());
            }
            switcher = 2;
            a[i] = q2.dequeue();
            break;

        case 2:
            for (int j = 0; j < count - 1 - i; ++j)
            {
                q2.enqueue(q1.dequeue());
            }
            switcher = 1;
            a[i] = q1.dequeue();
            break;

        default:
            break;
        }
    }

    for (int i = 0; i < count; ++i)
    {
        cout << a[i] << ' ';
    }
    cout << endl;
}

int main()
{
    requirement1();
    requirement2();

    cout << "Author: Nero Li\n";
    return 0;
}
```

Input/output below:

```
5 5 7 1
4 2 1 7 5
Author: Nero Li
```

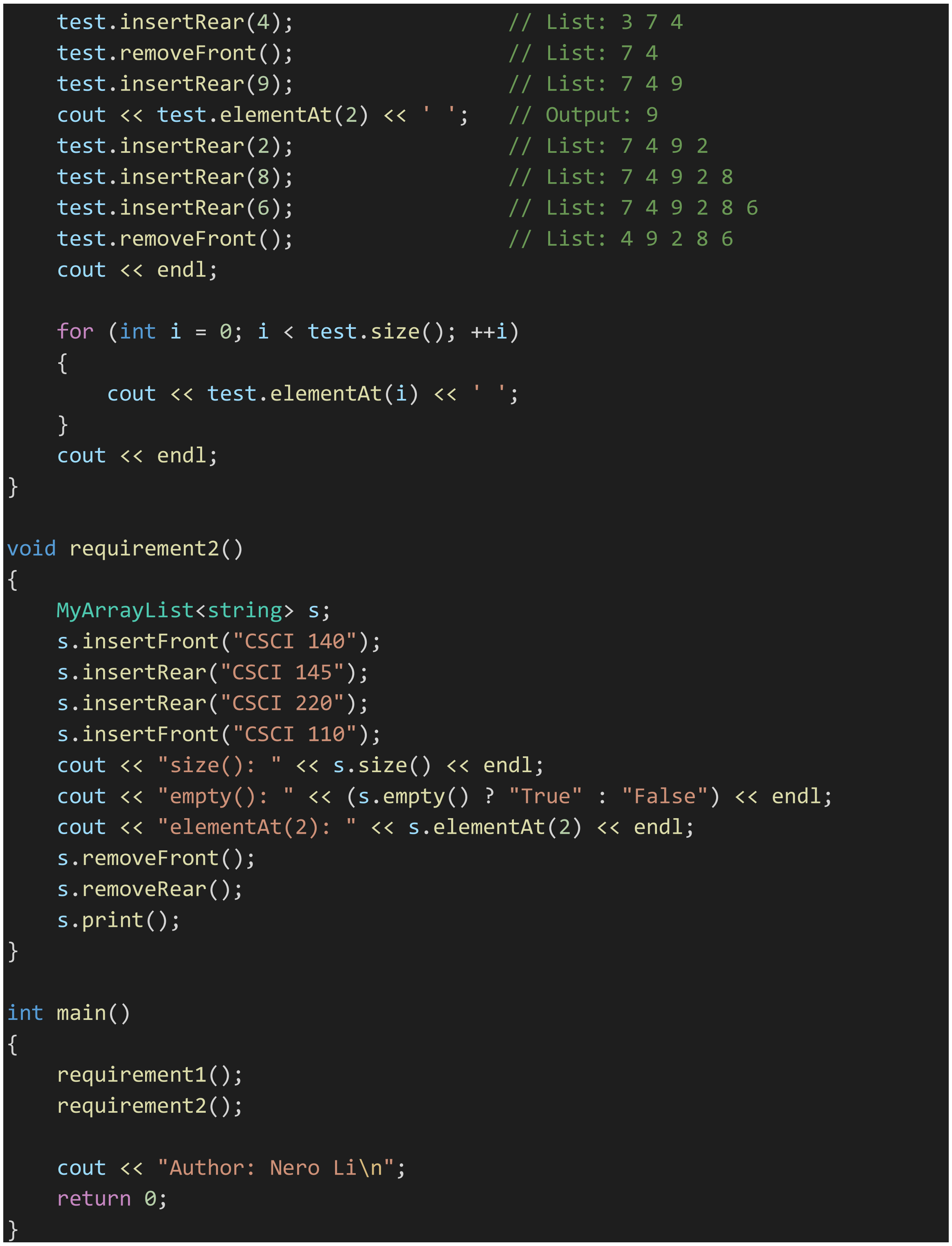
Question 2 - skipped

Question 3

Source code below:

```
/*  Program: Lab_Final_3
    Author: Nero Li
    Class: CSCI 220
    Date: 12/09/2021
    Description:
        Implement a C++ class template or Java class generic MyArrayList
that uses an array to
        include the following operations: insertRear(e), removeFront(),
elementAt(i), empty(),
        and cap(). You must set up a dynamic array with room for up to 10
elements and you
        can assume that there is at least one element when removeFront()
is called. There is a
        penalty of 5 points if it is not a C++ class template or Java
class generic. What is the
        running time for each operation?

    I certify that the code below is my own work.

    Exception(s): N/A

*/

#include <iostream>

using namespace std;

template <typename T>
class MyArrayList
{
private:
    T *a;
    int cap;
    int amount;

protected:
    // Running Time: O(n) when array need to expand
    void expandArray()
    {
        if (amount >= cap)
```

```cpp
        {
            cap *= 2;
            T *b = a;
            a = new T[cap];
            for (int i = 0; i < amount; ++i)
            {
                a[i] = b[i];
            }
            delete [] b;
        }
    }
public:
    MyArrayList()
    {
        cap = 2;
        amount = 0;
        a = new T[cap];
    };

    // Running Time: O(1)
    void insertRear(T e)
    {
        a[amount++] = e;
        expandArray();
    }

    // Running Time: O(n)
    void removeFront()
    {
        for (int i = 0; i < amount; ++i)
        {
            a[i] = a[i + 1];
        }
        --amount;
    }

    // Running Time: O(1)
    T elementAt(int i)
    {
        return a[i];
    }

    // Running Time: O(1)
    bool empty()
    {
        return amount == 0;
    }

    // Running Time: O(1)
    int size()
    {
        return amount;
    }

    // Running Time: O(n)
    void print()
    {
        for (int i = 0; i < amount; i++)
        {
            cout << a[i] << endl;
        }
    }

    // Running Time: O(n)
    void insertFront(T e)
    {
        for (int i = amount - 1; i > 0; --i)
        {
            a[i] = a[i - 1];
        }
        ++amount;
        expandArray();
        a[0] = e;
    }

    // Running Time: O(1)
    void removeRear()
    {
        --amount;
    }
};

void requirement1()
{
    MyArrayList<int> test;

    cout << test.empty() << ' ';         // Output: 1
    test.insertRear(3);                  // List: 3
    test.insertRear(7);                  // List: 3 7
    cout << test.elementAt(0) << ' ';    // Output: 3
```



```cpp
    test.insertRear(4);                 // List: 3 7 4
    test.removeFront();                 // List: 7 4
    test.insertRear(9);                 // List: 7 4 9
    cout << test.elementAt(2) << ' ';   // Output: 9
    test.insertRear(2);                 // List: 7 4 9 2
    test.insertRear(8);                 // List: 7 4 9 2 8
    test.insertRear(6);                 // List: 7 4 9 2 8 6
    test.removeFront();                 // List: 4 9 2 8 6
    cout << endl;

    for (int i = 0; i < test.size(); ++i)
    {
        cout << test.elementAt(i) << ' ';
    }
    cout << endl;
}

void requirement2()
{
    MyArrayList<string> s;
    s.insertFront("CSCI 140");
    s.insertRear("CSCI 145");
    s.insertRear("CSCI 220");
    s.insertFront("CSCI 110");
    cout << "size(): " << s.size() << endl;
    cout << "empty(): " << (s.empty() ? "True" : "False") << endl;
    cout << "elementAt(2): " << s.elementAt(2) << endl;
    s.removeFront();
    s.removeRear();
    s.print();
}

int main()
{
    requirement1();
    requirement2();

    cout << "Author: Nero Li\n";
    return 0;
}
```

Input/output below:

```
1 3 9
4 9 2 8 6
size(): 4
empty(): False
elementAt(2): CSCI 145
CSCI 140
CSCI 145
Author: Nero Li
```