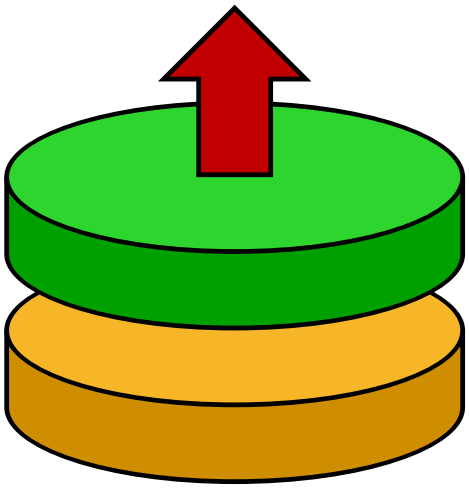
California State University, Sacramento
College of Engineering and Computer Science

Computer Science 130: Data Structures and Algorithm Analysis

Spring 2025 – Project #2 – Proper Stack & Queue

Overview

For this assignment, you are going to use your well-written Linked List to create a nice, and efficient, Stack and Queue. Make sure to do a good job on these classes, you will use them in a future assignment.



Part 1: Generic Key-Value Class

Before we continue, we need to make a simple modification to your Linked List. This will include a new function to remove the item from the head.

But wait, the Node Class (which is hidden deep inside the LinkedList class) is set to **private**. Are we going to make it public now? No. You never want to expose the secret internal working of a data structure. So, we will use a helper class.

This class won't have any functionality except to hold a couple pieces of data. The class definition is below:

```
class KeyValue
   public String key
   public String value
end class
```

Note that this is very similar to the Node Class you wrote before. Except, this one lacks the link to the next node. In fact, this is a generic class that we will use in many different ways. When you write this class, it should be in it's own .java file (or .cpp if you use C++).

Part 2: Modifying Your Linked List Class

Before you create your Stack and Queue, you need to make a simple modification to your LinkedList class. In particular, we need to be able to remove from the head. Also, let's use your new KeyValue class.

Add the following functions to your class. Don't remove anything.

LinkedList Class – NEW Functions		
void	**AddHead(KeyValue item)**	You can call the two parameter version using the values.
void	**AddTail(KeyValue item)**	You can call the two parameter version using the values.
KeyValue	**RemoveHead()**	Removes a node from the head of the list and returns the two values in a generic KeyValue instance. I have the pseudocode listed below.

When you create your Stack and Queue, you want to keep the LinkedList class private (and hidden) from the client (the user of your class). So, an instance of the LinkedList could be created inside both your Stack and Queue. Naturally, this should be private.

Part 3: Your Stack & Queue

The Stack Class

The following is the interface (public functions) for the Stack Class. This will be fairly easy to write – since it wraps around your LinkedList class. In other words, these functions merely call the appropriate function on the instance of the LinkedList. **Don't inherit**.

class Stack		
void	**Push(KeyValue item)**	Pushes a KeyValue onto the stack.
KeyValue	**Pop()**	Pops (removes) a KeyValue from the top of the stack.
boolean	**IsEmpty()**	Returns true of the stack is empty.
String	**ToNumberedList()**	Returns the contents of the Stack from first to last, with each item on a different line. This is good for testing.

The Queue Class

Like before, these functions should call the appropriate function on the private LinkedList instance. **Don't inherit**.

`class Queue`		
`void`	`Enqueue(KeyValue item)`	Enqueues a string onto the queue.
`KeyValue`	`Dequeue()`	Dequeues (removes) a string from the front of the queue.
`boolean`	`IsEmpty()`	Returns true of the stack is empty.
`String`	`ToNumberedList()`	Returns the contents of the Stack from first to last, with each item on a different line. This is good for testing.

Part 4: Testing

File Format

The file format hasn't changed from Project 1. So, you won't have to change the code much for your testing.

```
Key 1
Value 1
#
Key 2
Value 2
#
...
Key n
Value n
#
```

How to Test

1. Read the input file into an instance of your Stack and Queue
2. Print them to the screen to verify they were loaded correctly.
3. Write a loop and dequeue KeyValue objects from the Queue and print them to the screen
4. Write a loop and pop all the KeyValue objects from the Stack and print them to the screen.
5. Afterwards, try manually adding a few KeyValues to the Queue and Stack see if you get pop/dequeue them

Allowed Programming Languages

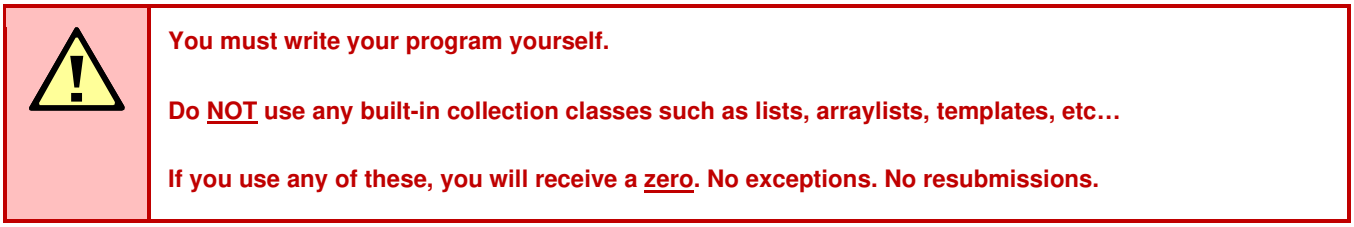
You may use any of the following programming languages.

- C#
- C++ (not recommended)
- Java
- Swift
- Visual Basic .NET

The following **cannot** be used:

- Groovy
- JavaScript
- Kotlin
- Lua
- Nim
- Python
- Ruby
- Scala
- TypeScript

Requirements



The following are the requirements for this assignment:

- This **must** be completely all your code. If you share your solution with another student or re-use code from another class, you will receive a zero.
- Do not use any built-in Stack or Queue classe (many programming languages provide them).
- You **must** encapsulate (i.e. make a private instance) of your LinkedList in both the Stack and Queue. **Do not inherit.**
- You must use your LinkedList from Project 1.
- You may use any of the programming languages listed below.
- Create some excellent testing for your class.
- Proper style (see below).

Some Helpful Pseudocode

RemoveHead Pseudocode

```
function RemoveHead() returns KeyValue
    if the list is empty                          ... is head null?
        result = null                             ... We could also throw an error
    else if (this.head == this.tail)              ... Just 1 node. Set head/tail to null
        result = new KeyValue using the head's values
        this.head = null                          ... Deference both
        this.tail = null
    else                                          ... 2 or more nodes.
        result = new KeyValue using the head's values
        this.head = this.head next;               ... Link new node to the current head
    end if

    return result
end function
```

Grading

1	New LinkedList functions	20%
2	The KeyValue class	15%
3	LinkedList class is encapsulated (private) in Stack and Queue	20%
4	Correct interface for Queue and Stack	10%
5	Proper output	10%
6	Proper Style	10%
7	Testing by Reading the File	15%

Due Date

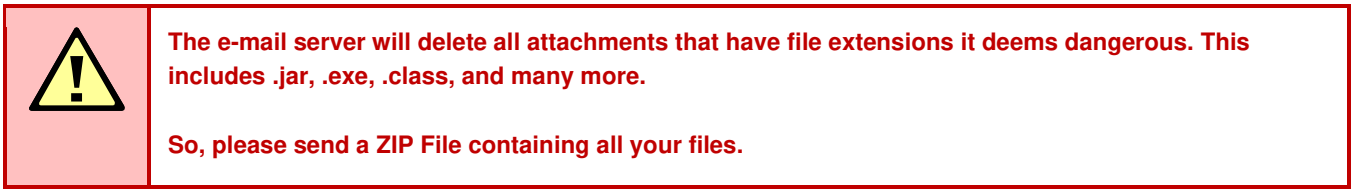
Due **March 1, 2025** by **11:59 pm.**

Given you already have developed excellent programming skills in CSc 20, this shouldn't be a difficult assignment.

- **Do not send it to canvas. I will not read nor grade Canvas e-mails.**
- **Do not send a cloud link. I cannot open cloud links.**

E-Mail the following to **dcook@csus.edu**:

- The source code for the classes. Just send the source code files (.java, .cs, .cpp,, etc….)
- The source code containing your tests.



The e-mail server will delete all attachments that have file extensions it deems dangerous. This includes .jar, .exe, .class, and many more.

So, please send a ZIP File containing all your files.