

1 More Practice with Linked Lists

Recall the definition of `SLList` from lecture:

```
public class SLList {
    private class IntNode {
        public int item;
        public IntNode next;
        public IntNode(int item, IntNode next) {
            this.item = item;
            this.next = next;
        }
    }

    private IntNode first;

    public void addFirst(int x) {
        first = new IntNode(x, first);
    }
}
```

1.1 Insert

Add a method to the `SLList` class that inserts a new element at the given position. If the position is past the end of the list, insert the new node at the end of the list. For example, if the `SLList` is `5 -> 6 -> 2`, insert `(10, 1)` should result in `5 -> 10 -> 6 -> 2`.

```
public void insert(int item, int position) {

    if (first == null || position == 0) {
        addFirst(item);
        return;
    }
    IntNode currentNode = first;
    while (position > 1 && currentNode.next != null) {
        position--;
        currentNode = currentNode.next;
    }
    IntNode newNode = new IntNode(item, currentNode.next);
    currentNode.next = newNode;
}
```

1.2 Reverse

Add another method to the `SLList` class that reverses the elements. Do this using the existing `IntNodes` (you should not use `new`).

```
public void reverse() {  
  
    // One way to think about this method is that we're going to  
    // traverse through the IntNodes, and for each IntNode, we're going  
    // to insert it at the front of the new list. To do this, we'll  
    // maintain two pointers: one to the current front node of our  
    // newly reversed list (frontOfReversed), and one to the next  
    // node in the un-reversed part of the old list (nextNodeToAdd).  
    IntNode frontOfReversed = null;  
    IntNode nextNodeToAdd = first;  
    while (nextNodeToAdd != null) {  
        IntNode remainderOfOriginal = nextNodeToAdd.next;  
        // Put nextNodeToAdd on the front of the reversed list.  
        nextNodeToAdd.next = frontOfReversed;  
        // Update the pointers.  
        frontOfReversed = nextNodeToAdd;  
        nextNodeToAdd = remainderOfOriginal;  
    }  
    first = frontOfReversed;  
}
```

Bonus: If you wrote `reverse()` iteratively, write a second version that uses recursion (you may need a helper method). If you wrote it recursively, write an iterative version.

```
private IntNode reverseRecursiveHelper(IntNode front) {  
    if (front == null || front.next == null) {  
        return front;  
    } else {  
        // Reverse everything except the front node.  
        IntNode reversed = reverseRecursiveHelper(front.next);  
        // Put the front onto the back of the new reversed list.  
        // Since everything after front got reversed, front.next is  
        // the LAST thing in reversed. Change this last thing's  
        // next pointer to point to front, so front is now at the back  
        // of reversed.  
        front.next.next = front;  
        // Since the front is now the last element, its next pointer  
        // should be null.  
        front.next = null;  
        return reversed;  
    }  
}  
  
public void reverse() {  
  
    first = reverseRecursiveHelper(first);  
  
}
```

2 Arrays

2.1 Insert

Write a method that non-destructively inserts `item` into array `x` at the given position. The method should return the resulting array. For example, if `x = [5, 9, 14, 15]`, `item = 6`, and `position = 2`, then the method should return `[5, 9, 6, 14, 15]`. If `position` is past the end of the array, insert `item` at the end of the array.

```
public static int[] insert(int[] x, int item, int position) {  
  
    int[] newX = new int[x.length + 1];  
    position = Math.min(x.length, position);  
    for (int i = 0; i < position; i++) {  
        newX[i] = x[i];  
    }  
    // Alternately, if you can remember the syntax for this method:  
    // System.arraycopy(x, 0, newX, 0, position);  
    newX[position] = item;  
    for (int indexInOld = position; indexInOld < x.length; indexInOld++) {  
        newX[indexInOld + 1] = x[indexInOld];  
    }  
    // Alternately:  
    // System.arraycopy(x, position, newX, position + 1, x.length -  
    // position)  
    return newX;  
}
```

Is it possible to write a version of this method that returns `void` and changes `x` in place (i.e., destructively)?

No, because arrays have a fixed size, so to add an element, you need to create a new array.

2.2 Bonus: reverse

Write a method that destructively reverses the items in `x`. For example calling `reverse` on an array `[1, 2, 3]` should change the array to be `[3, 2, 1]`.

```
public static void reverse(int[] x) {  
  
    for (int i = 0; i < x.length / 2; i++) {  
        int j = x.length - i - 1;  
        // Can separate following into "swap" method  
        int temp = x[i];  
        x[i] = x[j];  
        x[j] = temp;  
    }  
}
```

2.3 Bonus: xify

Write a non-destructive method `xify(int[] x)` that replaces the number at index i with $x[i]$ copies of itself. For example, `xify([3, 2, 1])` would return `[3, 3, 3, 2, 2, 1]`.

```
public static int[] xify(int[] x) {  
  
    int total = 0;  
    for (int item : x) {  
        total += item;  
    }  
    int[] newX = new int[total];  
    int newIndex = 0;  
    for (int item : x) {  
        for (int counter = 0; counter < item; counter++) {  
            newX[newIndex] = item;  
            newIndex++;  
        }  
    }  
    return newX;  
}
```