

# C S 272/463 Introduction to data structures

## Fall 2019

### Lab 5: Singly Linked List (advanced)

## 1 Learning objectives

Objective 1 (list), Objective 5, Objective 6, Objective 7

## 2 Requirements

- Add the following methods to **IntNode.java** that you implemented in the previous lab. Note that all the methods except the **hasCycle** method assume that the given linked list does not have cycles.

- 1 (10 pts) A method to calculate the number of even elements in the linked list starting from the given **head**. When **head** is **null**, return 0.

```
public static int listEvenNumber(IntNode head)
```

- 2 (10 pts) A method to add the given **newdata** to the end of the linked list that starts from the current node.

NOTE: the elements in the list starting from the current node do not need to be ordered.

```
public void addToEnd(int newdata)
```

- 3 (10 pts) The following method to calculate the summation of elements in the last **num** nodes in a given linked list.

```
public static int sumLast(IntNode head, int num)
```

When **num** is bigger than the number of nodes in the list, it should return the summation of elements in all the nodes. For example, given the following list and **let head point to its first node**,

12->28->12->28

**sumLast(head, 1)** should return 28;

**sumLast(head, 2)** should return 40 (=28+12);

**sumLast(head, 5)** should return 80 (=28+12+28+12);

**Please put proper precondition.**

- 4 (15 pts) Copy part of a given linked list.

```
public static IntNode copyOdd (IntNode head)
```

If **head** is **null**, this method returns **null**.

If **head** is not **null**, this method should copy all the odd elements in the linked list **starting from the given head**, create a new linked list with all these odd numbers, and return the linked list with the new head.

- 5 (15 pts) A method to remove **ALL** the nodes that have the data value **e** from the linked list starting from the given **head**. This method should return **the linked list with the new head**. If **head** is **null**, this method returns **null**.

```
public static IntNode removeAll(IntNode head, int e)
```

**NOTE: you are NOT allowed to create more than two IntNode objects. You can use IntNode references.**

The elements in the list starting from **head** do not need to be ordered.

- 6 (15 pts) A method to reverse a linked list.

```
public static IntNode reverse (IntNode head)
```

This method should return the linked list **with the new head**.

For example, given a list

12->28->0->34

- If the input parameter **head** points to the node with value 12, this function should return 34->0->28->12.
- If the input parameter **head** points to the node with value 28 (which implicitly passes the list 28->0->34), this function should return 34->0->28.  
Note that 12 should not be shown in the reversed list.
- If the input parameter **head** points to the node with value 0 (which implicitly passes the list 0->34), this function should return 34->0.  
Note that 12 and 28 should not be shown in the reversed list.

NOTE: the elements in the list starting from **head** do not need to be ordered.

- 7 (15 pts) A method to test whether a linked list starting from the given **head** is cyclic or acyclic. Your function should return true if it is cyclic. Otherwise, it should return false if the list is acyclic. **NOTE: You should NOT modify the list content in any way.**

```
public static boolean hasCycle(IntNode head)
```

- (10 pts) Implement **IntNodeAdvancedTest.java** with test cases to test all the above methods in **IntNode.java**.
  - Implement a **main()** method to thoroughly test all the methods in **IntNode.java**. Design test cases, put them in your main method, run your program through the test cases.

### 3 Note

- **Specifications** for all your classes and methods:  
Please properly explain (1) the functionality of the methods, (2) the parameters, (3) the return values, (4) the pre-conditions if there is any;  
Please use inline comments, meaningful variable names, indentation, formatting, and whitespace throughout your program to improve its readability.
- You can (but are not required to) design and implement other facilitating methods (E.g., other get and set methods, toString method) to finish the implementation of the required methods.

### 4 Submission

Submit through canvas a zipped file containing your java file(s) (not **.class** files).

### 5 Grading Criteria

- (1) The score allocation is beside the questions.
- (2) Please make sure that you test your code **thoroughly** by considering all possible test cases.  
Your code may be tested using more test cases.