

American University of Armenia, CSE  
CS 121 Data Structures A, B, C  
Fall 2019

Homework Assignment 4

Due Date: Thursday, October 24 by 23:55 electronically on moodle

**Any submissions containing cheating and/or plagiarism, by university policy, will be reported and will result in the grade F for the entire course.**

*Please solve the programming tasks either in Java or C++, following good coding practices (details posted in moodle).*

**You should submit full tested programs for all questions.**

1. **(20 points)** The **sieve of Eratosthenes** is an algorithm for finding the prime numbers below some  $N$ , as described on Wikipedia. Write a method/function that implements the sieve of Eratosthenes using an **ArrayList**  $A$  of integers. Your method/function should **not** use any **boolean** arrays. Rather, it should store in  $A$  the current list of candidates for being prime. Thus, the algorithm should proceed by iteratively removing elements from  $A$ . What is the complexity of your method? Do you think this is a good implementation of the sieve of Eratosthenes? **Briefly justify your answers.**
2. **(10 points)** Write a class **LinkedListPositionalList** that represents a positional list of integers using a doubly linked list as the underlying data structure. Note that your class should implement the **PositionalList<Integer>** interface.
3. **(25 points)** Extend your answer in question 2 with an **iterator** (using the **Iterator** and **Iterable** interfaces) that enumerates the contents of a **LinkedListPositionalList** in **ascending** (i.e. **non-decreasing**) order. What is the running time of your iterator class constructor? What is the space complexity of your iterator class implementation? **Briefly justify your answers.**
4. **(20 points)** Write a generic class **ArrayPositionalList** that represents a positional list using an array of fixed capacity as the underlying data structure. Note that your class should implement the **PositionalList<E>** interface.
5. **(15 points)** Extend your answer in question 4 with an **iterator** (using the **Iterator** and **Iterable** interfaces) that enumerates the contents of an **ArrayPositionalList** in **reversed** order.
6. (a) **(5 points)** Draw an arithmetic expression tree for  $((165 + 7)/((19 * 7) - 11)) + ((77 * 10) - 15)$ .  
(b) **(5 points)** Determine the arithmetic expression for the tree in Figure 1.

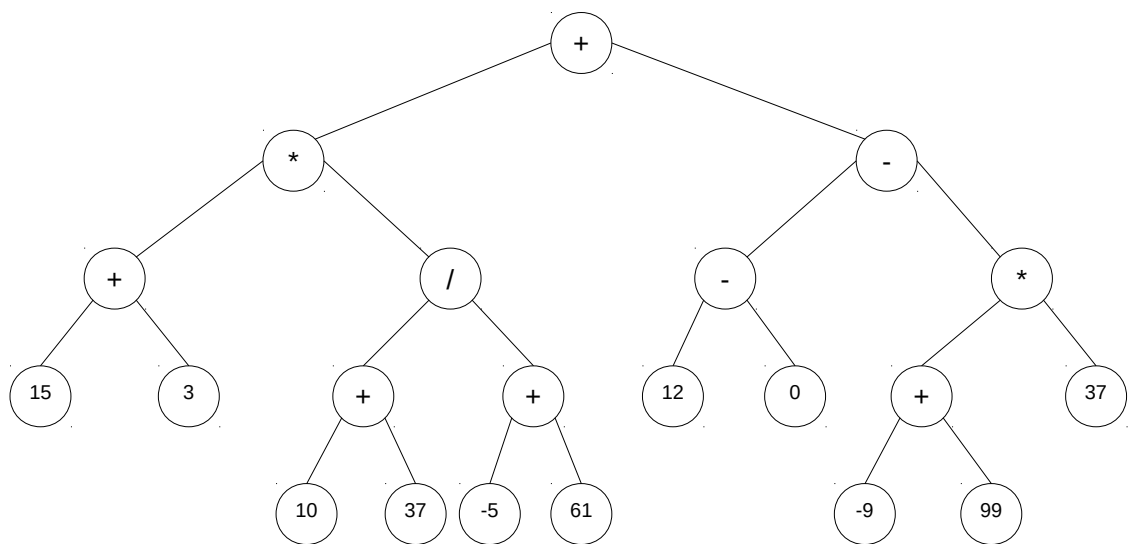


Figure 1: An arithmetic expression tree