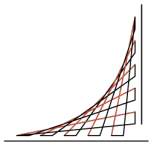


Laboratory 1

Introduction To Complex Systems, Java, Maven, and Git.

Author: Angi Paola Jimenez Pira
Teacher: Luis Daniel Benavides Navarro

Date: Friday 29th January, 2021
Bogota, Colombia

1 Introduction

This document explain a solution implemented for the problem described in the enunced of this Laboratory. First, it will be made known the way to calculate the arithmetic mean and standar deviation of a set of values, after, it will show the architecture developed and tools used to make a statistics calculator that allow calculate this measures. Worth noting, that data structure used for develop the calculator is a doubly linked list also developed in this laboratory, for this reason, this document will also contains information about this data structure.

2 Problem description

Use Maven and GITHUB.

Write a program to calculate the mean and standard deviation of a set of n real numbers.

Your program reads the n real numbers from a file.

Use a linked list to store the n numbers for the calculations. (Note: You have to write your own implementation of a linked list and it must be compliant with Java's collections API).

Thoroughly test the program. At least two tests should use the data in the columns of Table 1. Expected results are provided in Table 2.

Column 1 Estimate Proxy Size	Column 2 Development Hours
160	15.0
591	69.9
114	6.5
229	22.4
230	28.4
270	65.9
128	19.4
1657	198.7
624	38.8
1503	138.2

Table 1

Test	**Expected Value**		**Actual Value**	
	Mean	*Std. Dev*	*Mean*	*Std. Dev*
Table 1: Column 1	550.6	572.03		
Table 1: Column 2	60.32	62.26		

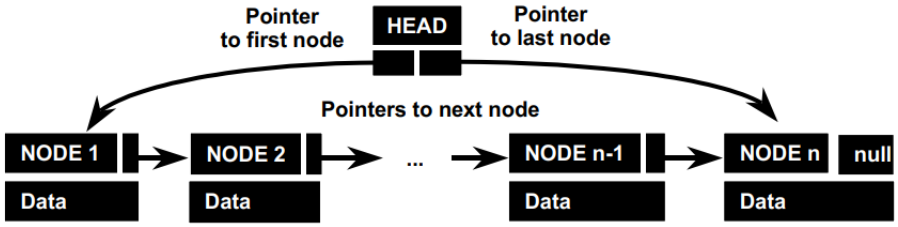
Table 2

3 Overview

3.1 About Linked Lists

Linked lists are a common abstract data type used to maintain collections of data.
Linked lists are implemented with pointers. A linked list typically has two components.

- list head
- list node(s)



Some of the options for linked list structure are:

- the list head can point to the first node, last node, or both
- a list node can point to the next node, prior node, or both

Null pointers are often used to indicate an empty list or the end of the list.Typical operations on a linked list include:

- add node
- remove node
- next node
- prior node

3.2 Arithmetic Mean and Standard Deviation

The mean is the average of a set of data. The average is the most common measure of location for a set of numbers. The average locates the center of the data.

Standard deviation is a measure of the spread or dispersion of a set of data. The more widely the values are spread out, the larger the standard deviation. For example, say we have two separate lists of exam results from a class of 30 students; one ranges from 31standard deviation would be larger for the results of the first exam.

The formula for calculating the mean is:

$$x_{avg} = \frac{\sum_{i=1}^{n} x_i}{n} \tag{3.1}$$

The formula for standard deviation, σ, is :

$$\sigma = \sqrt{\frac{\sum_{i=1}^{n}(x_i - x_{avg})^2}{n-1}} \tag{3.2}$$

Where:

- S is the symbol for summation
- i is an index to the n numbers
- x is the data in the set
- n is the number of items in the set

For the next set of values the arithmetic and standard deviation is:

x
186
699
132
272
291
331
199
1890
788
1601

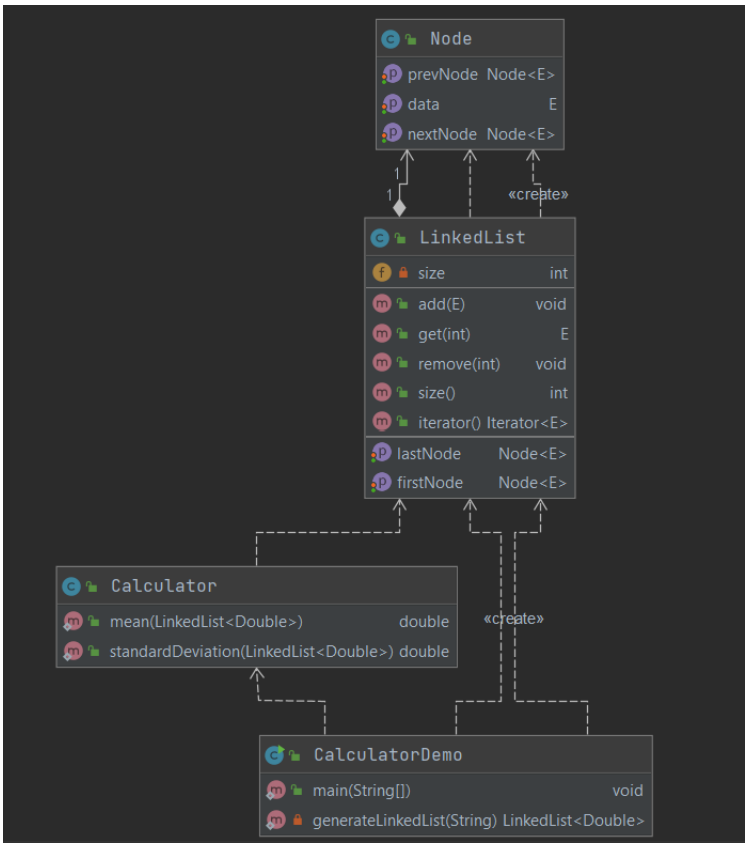
Table 3

$x_{avg} = 638.9$
$\sigma = 625.633981$

4 Architecture of program

4.1 Class Diagram

The next image shows the class Diagram of the solution implemented:



4.2 Technology Stack

- Development environment: Java Development Kit 8.0, IntelliJ IDEA
- Dependency Manager: Maven
- Version Control: Git
- Tests: JUnit4

4.3 Documentation

The documentation and instructions for use are in a git repository: https://github.com/angipaola10/AREP-LAB1.