OO Design

Assignment Kit

Requirements

Program 1 requirements

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	Column 2
Estimate Proxy Size	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

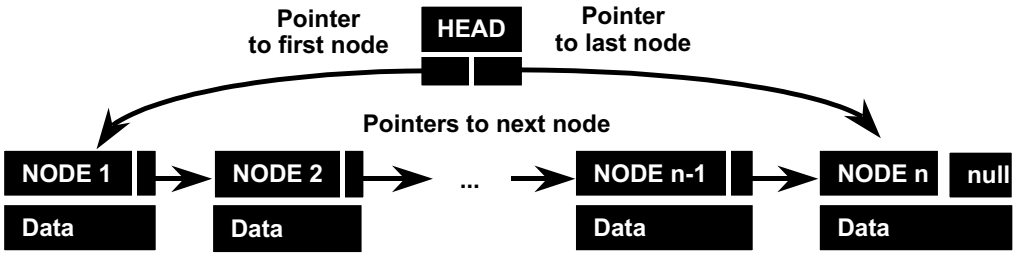
Linked lists

Overview

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

Mean and standard deviation

Overview

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 31% to 98%, the other from 82% to 93%. The standard deviation would be larger for the results of the first exam.

Calculating mean and standard deviation

The formula for calculating the mean is

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

The formula for standard deviation, σ, is

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

where

- Σ 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

A mean and standard deviation example

A mean and standard deviation example

In this example, we will calculate mean and standard deviation of the data in Table 3.

x
186
699
132
272
291
331
199
1890
788
1601

Table 3

1. In this example, there are 10 items in the data set. Therefore, we set $n = 10$.
2. We can now solve the summation items in the mean formula.

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

n	x
1	186
2	699
3	132
4	272
5	291
6	331
7	199
8	1890
9	788
10	1601
Total	$\sum_{i=1}^{10} x_i = 6389$

3. We can then substitute the intermediate value into the formula.

$$x_{avg} = \frac{6389}{10}$$

$$x_{avg} = 638.9$$

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A mean and standard deviation example, Continued

A mean and standard deviation example, cont.

4. We can now substitute x_{avg} to calculate the intermediate values for the standard deviation formula.

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

n	x	$\left(x_i - x_{avg}\right)^2$
1	186	205,118.41
2	699	3,612.01
3	132	256,947.61
4	272	134,615.61
5	291	121,034.41
6	331	94,802.41
7	199	193,512.01
8	1890	1,565,251.21
9	788	22,230.81
10	1601	925,636.41
Total	$\sum_{i=1}^{10} x_i = 6389$	$\sum_{i=1}^{10}\left(x_i - x_{azvg}\right)^2 = 3{,}522{,}761.90$

5. We can then substitute the intermediate value into the formula.

$$\sigma = \sqrt{\frac{3{,}522{,}761.00}{9}}$$

$$\sigma = \sqrt{391{,}417.878}$$

$$\sigma = 625.633981$$

Submitting your assignment

Submit the link to the project on Github.

The package should contain:

- The source code
- The Readme and license.
- A description of your design
- The Javadoc.
