

# PSP0 Homework

Before starting the homework, do the following to set up the Process Dashboard:

- Set up the Process Dashboard software on your computer.
- Enter your details in the Student profile (fill only fields highlighted with an \*).

Develop the program specified on pages 2-7 using the PSP0 process. To follow the PSP0 process, make use of the process scripts available on Process dashboard.

Record the following information on the Process Dashboard, as described in the process scripts:

- Your estimated total time on the Project Plan Summary form (in Planning phase).
- The time taken for each PSP0 phase.
- Details of all the defects found/fixed in each phase.

The program should work correctly in a linux environment.

Remember to mark the completion of each phase and the Project overall on the Dashboard before saving your data for submission.

Submit the following in a zip file on Blackboard by the due date and time:

- PSP data from Process Dashboard retrieved using the save data backup function.
- Your well documented C program as a text file with .c extension.
- Input data file used for testing the program.
- A document showing the program test results including inputs/outputs and run time messages as evidence that the program works correctly.

An important note:

Programming environments include a wide variety of mathematical and other embedded functions. While using embedded functions for some program actions is appropriate, they should not be used to write the principal functions of the exercise program. When students use such functions, they can write many of the PSP exercises in fewer than ten LOC. This takes too little time and is of no value in a PSP exercise which is focused on the process of program development. If students use these functions, they will not be fulfilling the purpose of the exercise and so will not receive credit for doing the homework.

# Program 1 Requirements Description

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# Program 1 requirements

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## Program 1 requirements

Using PSP0, write a program in C to calculate the mean and standard deviation of a set of  $n$  real numbers.

Your program should read  $n$  real numbers from a file.

Use a linked list to store the  $n$  numbers for the calculations. If necessary, a variable or static array(s), database, or other data structure(s) may be used to hold the data.

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	
	<i>Mean</i>	<i>Std. Dev</i>
Table 1: Column 1	550.6	572.03
Table 1: Column 2	60.32	62.26

Table 2

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# Linked lists

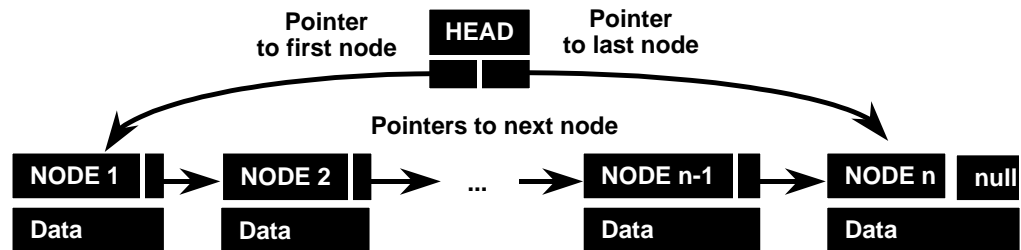
## Overview

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

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## 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.

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## Using mean and standard deviation in the PSP

Mean and standard deviation are used to divide your historical size data into categories and size ranges. This will be discussed in more detail in Lecture 5 - Estimating with PROBE II.

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## 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,  $\sigma$ , is

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

where

- $\Sigma$  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
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## A mean and standard deviation example

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### A mean and standard deviation example

$x$
186
699
132
272
291
331
199
1890
788
1601

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

**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

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A mean and standard deviation example, cont.

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

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

$n$	$x$	$(x_i - x_{avg})^2$
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	$\sum_{i=1}^{10} x_i = 6389$	$\sum_{i=1}^{10} (x_i - x_{avg})^2 = 3,522,761.90$

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

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

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

$$\sigma = 625.633981$$

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