ASSIGNMENT #2

INTRODUCTION TO ARRAYS IN C LANGUAGE

CS3540 SYSTEM PROGRAMMING WITH C AND LINUX

SPRING 2015

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Assignment Description:

CS3540 Assignment No. 2

Due Wed, Jan 20, 2015

1. Develop a program that computes the standard deviation of values in an array. The standard deviation measures the spread, or dispersion, of the values in the array with respect to the average value. Implement with C. The standard deviation of array X with N elements is defined as:

$$std = \sqrt{\frac{sqdif}{N-1}}$$

where

$$sqdif = \sum_{j=0}^{N-1} (X_j - Avg)^2$$

2. Develop a program that inputs and processes the rainfall data for the last five years. For every year, four quarters of rainfall are provided measured in inches. Hint: use a matrix to store these values. The attributes are: the precipitation (in inches), the year, and the quarter. The program must compute the average, minimum, and maximum rainfall per year and per quarter (for the last five years). Implement with C.

Solution Details:

All solutions are developed on Debian 7 running within VirtualBox 4.3.20 hosted by Windows 8.1 environment. Debian 7's default GNU Compiler is used to compile the source files.

Solution to Problem 1)

Solution assumes a function to be called in order to randomly fill up an array structure. Solution also uses std_dev function from basic_lib.h to calculate the standard deviation of the array values.

Source:

```
00000001 /*
00000002  * Program: assignment2_1.c
00000003  * Author: Baturay Daylak, January 14, 2015
00000004  * Class: CS3540 Spring '15 - System Programing with Linux and C
00000005  * Description: Calculates standard deviation for an N element array.
00000006  * Comments: randouble function has been gathered from a GNU source.
00000007  */
00000008 #include <stdio.h>
00000009 #include <stdlib.h>
00000010 #include <math.h>
00000011 #include "basic_lib.h"
00000012
00000013 double randouble(double min, double max)
00000014 {
00000015     double range = (max - min);
00000016     double div = RAND_MAX / range;
00000017     return min + (rand()/div);
00000018 }
```

```
00000019
00000020 int main()
00000021 {
00000022     //Assignment information
00000023     print_assignment_header(2,1);
00000024
00000025     srand(time(NULL)); //This will make rand function generate unique
                               output at each program run.
00000026     int i = 0;
00000027     int n = 50;
00000028     double values[n];
00000029
00000030     printf("\nInput values for std_dev calculation:\n");
00000031     for(i = 0; i<n; i++)
00000032     {
00000033           values[i] = randouble(0.0,100.0);      //random double
                                                         between 0 and 100
00000034           printf("%f\n",values[i]);
00000035     }
00000036     print_separator();
00000037     printf("\nStandard deviation of values: %f\n",std_dev(values,n));
00000038     print_separator();
00000039     print_newline();
00000040     return 0;
00000041 }
```

Output

```
Script started on Wed 14 Jan 2015 05:14:13 PM EST
baturay@debian:~/CS3540/Assignments/2/src$ ./a1

-----------------------------------------------------

Assignment 2 - Question 1 - CS3540 - Baturay Daylak
-----------------------------------------------------


Input values for std_dev calculation:

72.506369

35.309785

43.661690

43.663136

43.864286

23.105020

74.238713

30.783506

21.820930

53.730926

9.412201

14.647858

76.090986

59.624315

5.975324

48.064173

0.202343

37.402051

95.095053

24.685482

75.740842

76.958029

40.729994

47.626104

8.238333
```

```
17.535922
73.741477
77.939194
46.615356
13.073561
96.738601
19.121726
48.383346
40.400290
62.784862
92.247632
63.505311
37.023575
23.031138
85.326241
90.754501
32.443339
99.974099
66.845487
92.067654
5.949423
14.909660
92.269997
43.351474
10.004712
-----------------------------------------------------
Standard deviation of values: 29.178037
-----------------------------------------------------

baturay@debian:~/CS3540/Assignments/2/src$ exit
exit

Script done on Wed 14 Jan 2015 05:14:20 PM EST
```

Solution to Problem 2)

Solution assumes user would input the data required correctly. There are no input validations at the moment. (Not specified by the assignment.) Solution uses ***pow*** and ***sqrt*** functions from C's standard math library. Therefore, source code is compiled with math module.

Source:

```
00000001 /*
00000002  * Program: assignment2_2.c
00000003  * Author: Baturay Daylak, January 14, 2015
00000004  * Class: CS3540 Spring '15 - System Programing with Linux and C
00000005  * Description: Calculates standard deviation for an N element array.
00000006  * Comments: randouble function has been gathered from a GNU source.
00000007  */
00000008 #include <stdio.h>
00000009 #include <stdlib.h>
00000010 #include "basic_lib.c"
00000011
00000012 int main()
00000013 {
00000014     double values[5][4] = {
00000015
00000016           {213.2, 564.3, 485.0, 321.5},
00000017           {301.2, 523.2, 468.6, 352.4},
00000018           {200.2, 510.2, 435.3, 408.4},
00000019           {276.5, 543.1, 432.4, 453.3},
00000020           {298.5, 456.6, 478.2, 300.7}
00000021
00000022     };
00000023
00000024     int i;
00000025     int j;
00000026
00000027     //Assignment information
00000028     print_assignment_header(2,2);
00000029
00000030     printf("\nInput data for annual quarterly rain fall: \n");
00000031     for(i=0;i<5;i++)
00000032     {
00000033           printf("%d data: ",2010+i);
00000034           for(j=0;j<4;j++)
00000035                 printf("%f\t",values[i][j]);
```

```
00000036            printf("\n");
00000037     }
00000038
00000039     print_separator();
00000040     print_newline();
00000041
00000042     for(i=0;i<5;i++)
00000043     {
00000044
00000045            printf("Minimum rainfall for %d: %f\n",
2010+i,min(values[i],4));
00000046            printf("Maximum rainfall for %d: %f\n",
2010+i,max(values[i],4));
00000047            printf("Average rainfall for %d: %f\n\n",
2010+i,ave_magn(values[i],4));
00000048
00000049     }
00000050 }
```

Output:

```
Script started on Wed 14 Jan 2015 06:34:10 PM EST
baturay@debian:~/CS3540/Assignments/2/src$ ./a1

-----------------------------------------------------

Assignment 2 - Question 2 - CS3540 - Baturay Daylak
-----------------------------------------------------

Input data for annual quarterly rain fall:
2010 data: 213.200000   564.300000      485.000000      321.500000
2011 data: 301.200000   523.200000      468.600000      352.400000
2012 data: 200.200000   510.200000      435.300000      408.400000
2013 data: 276.500000   543.100000      432.400000      453.300000
2014 data: 298.500000   456.600000      478.200000      300.700000

Minimum rainfall for 2010: 213.200000
Maximum rainfall for 2010: 564.300000
Average rainfall for 2010: 396.000000

Minimum rainfall for 2011: 301.200000
Maximum rainfall for 2011: 523.200000
Average rainfall for 2011: 411.350000

Minimum rainfall for 2012: 200.200000
Maximum rainfall for 2012: 510.200000
Average rainfall for 2012: 388.525000

Minimum rainfall for 2013: 276.500000
Maximum rainfall for 2013: 543.100000
Average rainfall for 2013: 426.325000

Minimum rainfall for 2014: 298.500000
Maximum rainfall for 2014: 478.200000
Average rainfall for 2014: 383.500000


baturay@debian:~/CS3540/Assignments/2/src$ exit
exit

Script done  on Wed 14 Jan 2015 06:34:13 PM EST
```