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| **Instructor** |  | **Due Date** |  |

**PROJECT Determining Square Roots Using Newton’s Method 100 points**

**Objective** To write a program that calculates square roots using Newton’s Method.

***PROJECT DESCRIPTION***

Write, compile and execute a complete program that prompts the user for a nonnegative real number, calls a method named **Compute** that uses Newton’s Method to compute the square root of the number and then displays the square root to the user. The method prototype for method **Compute** and the driver program to test method   
 **Compute** is given in the program code in **Figure 1**, which follows. Complete this code by adding the method definition of **Compute**.

A sample program output is given below.

**Output**

**Program: find square roots by Newton's Method**

**Please enter a number: 3**

|  |  |  |  |
| --- | --- | --- | --- |
| **1.50000** | **1.75000** | **1** | **0.25000** |
|  |  |  |  |
| **1.75000** | **1.73214** | **2** | **0.01786** |
|  |  |  |  |
| **1.73214** | **1.73205** | **3** | **0.00009** |
|  |  |  |  |
| **1.73205** | **1.73205** | **4** | **0.00000** |

**The square root of 3.00000 is 1.73205**

***Information about This Project***

This particular program uses Newton’s Method, which is an example of an iterative process. An iterative process is one which performs some task until a result is satisfied.

Newton’s Method for determining square roots is outlined in the steps which follow:

**STEP 1** Prompt the user for *R* ,the number whose square root is to be determined.

**STEP 2** Set*x* 0 = *R*  ÷ 2

**STEP 3** Compute an approximation of the square root of *R* using the formula:

|  |  |  |  |
| --- | --- | --- | --- |
| *x n* + 1 = | *x n* | − | ( *x n* )2− *R* |
| 2 *x n* |

**STEP 4** Repeat **STEP 3** until | *x n* + 1 −*x n* | is less than the desired level of accuracy. When this level of accuracy has been reached, terminate the process and let *x n* + 1 be a final approximation of the square root of *R* .

For the above example, *x* 0 = 3 ÷ 2 = 1.5

*x* 1 = *x* 0 − ( *x* 02 − *R* ) / ( 2 *x* 0 )

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substitution yields

*x* 1 = 1.50 − ( 1.502 − 3) / ( 2 ×1.50 ) = 1.75

*x* 2 = *x* 1 − ( *x* 12 − *R* ) / ( 2 *x* 1 )

substitution yields

*x* 2 = 1.75 − ( 1.752 − 3) / ( 2 ×1.75 ) = 1.73214

*x* 3 = *x* 2 − ( *x* 22 − *R* ) / ( 2 *x* 2 )

substitution yields

*x* 3 = 1.73214 − ( 1.732142 − 3) / ( 2 ×1.73214 ) = 1.73205

*x* 4 = *x* 3 − ( *x* 32 − *R* ) / ( 2 *x* 3 )

substitution yields

*x* 4 = 1.73205 − ( 1.732052 − 3) / ( 2 ×1.73205 ) = 1.73205

Since *x* 4 and *x* 3 are approximately the same, the iterative process ceases and the square root of 3 is reported as 1.73205 .

***Steps To Complete This Project***

**STEP 1**  **Open Eclipse and Write the Program Code**

Open Eclipse, or JCreator or equivalent Java IDE on your computer. Write the program code that will allow the user to enter the necessary input item(s) and then use these items to compute the required output value(s).

**STEP 2**  **Compile and Run Your Program**

Build, compile and run your program. Test the operation of your program using appropriate numbers for your input variable(s).

**STEP 3**  **Submit Your Program Code and Your Run Time Output**

When completed, submit your program source code as well as the program output(s).

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**Figure 1** Method Definition and Driver Program for **Newton** Program

|  |
| --- |
| **import java.text.DecimalFormat;**  **import java.util.Scanner;**  **public class Newton {**  **public static float Compute(float num)**  **{**  **float sqrRoot = 0;**  **// method definition**    **return sqrRoot;**  **}**    **public static void main(String[] args)**  **{**  **// declare a Scanner class object**  **Scanner sc = new Scanner(System.in);**  **// declare a DecimalFormat class object**  **DecimalFormat fourDecimal = new DecimalFormat("0.0000");**    **float Number = 0;**    **System.out.println("Program: find square roots by   Newton's Method");**  **System.out.println("Please enter a number: ");**  **Number = sc.nextFloat();**  **System.out.println("The square root of " + Number +   " is " + fourDecimal.format(Compute(Number)));**  **}**  **}** |