Computer Science Department, El Camino College

CSCI 1 Assignment 3 (Use of Nested if/else Selection Structure)

Please see IOAA document submission requirement. Complete all checklist items shown at the end of this document

Sorry. No debugging support is available on the day of submission! Plan in advance so that your program is debugged the day before or earlier than the submission day.

Number of code lines allowed: Please understand, that code lines, more than necessary, would not mean that it would be a good software. In this lab, if your number of code lines exceed 150 (lines), then your code will be rejected and no credit is given. This will not happen if you study, diligently, the design example 4 and apply it's learning to your lab.

IOAA (Input/Output/Analysis/Algorithm) document requirements
This document must precede any coding. No help on coding is available until IOAA has been graded. DO NOT EVEN BEGIN TO CODE UNLESS IOAA HAS BEEN DONE!!!!!
Read the bigger picture/ prologue, then problem statement, then IOAA requirements. Then prepare IOAA before touching the computer to begin to code.

Bigger Picture/Prologue
Mathematical computations abound in STEM disciplines. In fact, software called Mathematica, might have been used by some of you in some of your math courses. For example, if you put the equation below in Mathematica for solution, then Mathematica will run a computer program similar to the one you will write in this assignment and give you two roots of below quadratic equations as below:

$5X^2 + 8X + 1 = 0$

Root1 = -1.4633

Root2 = -0.13688

We are starting your journey of writing programs to find numerical solution to mathematical equations by modeling a computer programming solution to quadratic equations, where solution can be real or may involve complex numbers. You can extend this small step, to someday write your own version of Mathematica.

Quadratic equations have wide application in day-to-day life. Any projectile thrown in air would follow a trajectory that can be modeled by the quadratic equation. For example, a baseball hit by the hitter, thrown by the player, gun and machine guns shooting bullets in air, all follow quadratic formulae. Web address below would help you learn some fun applications of quadratic formula.

https://www.mathsisfun.com/algebra/quadratic-equation-real-world.html

Description of Assignment
This lab assignment will help you understand the use of if and if/else selection structures, use cmath library functions sqrt and abs, and understand integer division in more detail.

The solution to the quadratic equation $Ax^2 + Bx + C = 0$ may be calculated using the quadratic formulae:

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49    $X = (-B +(B^2 – 4AC)^{1/2})/2A$ or $X = (-B - (B^2 – 4AC)^{1/2})/2A$
50
51   These formulae may be used, of course, only if the leading coefficient, A is not zero, in which
52   case the equation adapts a linear form. The number and type of solutions is determined by the
53   value of the expression under the square root (power ½), B^2 - 4AC, also known as
54   **discriminant**. Table below gives describes various possible solutions related to the discriminant
55   value.
56

Value of Discriminant	Number of Solutions	Nature of Solutions
Positive	2	Real
Zero	1	Real
Negative	2	Imaginary

57
58   Write a program, which will ask user to input the coefficients A, B, and C as Integers. Calculate
59   the solutions and report the solutions if the leading coefficient A is non-zero. Otherwise report
60   to user that only a linear solution x = -c/b is possible for a leading coefficient A = 0.
61
62   Since programming language does not provide the imaginary numbers and the facility to output
63   them, you will have to take appropriate steps to give imaginary results in the form shown in the
64   output example later. Just remember that a pair of real numbers determines every imaginary
65   number.
66
67   <u>**Source Code Control Specifications**</u>
68   Source code control forms set of rules that define some specifications to be observed
69   while writing the source code. Two important specifications in this lab are:
70   1. *Use only int type variables for A, B, C and discriminant. double type is <u>**NOT**</u>*
71   *allowed for A, B, and C! This is being done just for now to avoid the*
72   *complication of comparing floating point numbers for equality. In more*
73   *advanced program (possibly in CS2 and CS30), this limitation may be removed.*
74   2. *No use of function pow. You can however, use sqrt function.*
75   3. *Figure out the output formatting requirements from sample output*
76   *given in this document. Sample output in all assignments is part of*
77   *specification.*
78   These rules are in addition to other rules, such as choose descriptive or relevant names for
79   variables and minimize number of declared variables in the final code.
80
81   Several sample runs appear on this page and next, with user input shown in **bold type**.
82   The "*I" which appears in the output is simply outputted as a literal string as needed; and
83   the actual calculations only involve <u>real</u> results. Your program must produce output that
84   may match any of the output shown in boxes on this page and following pages. These test
85   runs further inform you of the specifications of software that you are developing in this
86   assignment. In all outputs ignore the fact that in scientific notation power shown after e is
87   showing three digits. That is system dependent. You have no control over it.
88   cout<<scientific; will decide upon a default behavior.
89

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****************************************************************
          EL CAMINO QUADRATIC EQUATION SOLVER
****************************************************************
This program will provide solutions for an equation of the form
                  Ax^2 + Bx  + C  = 0,
Where A, B and C are integers, and A is not equal to zero.
****************************************************************

Enter value of A (int only): 2
Enter value of B (int only): -5
Enter value of C (int only): -3
The two real solutions are            X = 3.0000e+00
                     And              X = -5.0000e-01
****************************************************************

Thanks for using El Camino Quadratic Equation Solver.
****************************************************************
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****************************************************************
          EL CAMINO QUADRATIC EQUATION SOLVER
****************************************************************
This program will provide solutions for an equation of the form
                  Ax^2 + Bx  + C  = 0,
Where A, B and C are integers, and A is not equal to zero.
****************************************************************

Enter value of A (int only): 1
Enter value of B (int only): -8
Enter value of C (int only): 16
The one real solution is            X = 4.0000e+00
****************************************************************

Thanks for using El Camino Quadratic Equation Solver.
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*****************************************************************
            EL CAMINO QUADRATIC EQUATION SOLVER
*****************************************************************
This program will provide solutions for an equation of the form
                    Ax^2 + Bx  + C  = 0,
Where A, B and C are integers, and A is not equal to zero.
*****************************************************************

Enter value of A (int only): 4
Enter value of B (int only): 0
Enter value of C (int only): 0
The one real solution is            X = 0.0000e+00
*****************************************************************

Thanks for using El Camino Quadratic Equation Solver.
*****************************************************************
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*****************************************************************
            EL CAMINO QUADRATIC EQUATION SOLVER
*****************************************************************
This program will provide solutions for an equation of the form
                    Ax^2 + Bx  + C  = 0,
Where A, B and C are integers, and A is not equal to zero.
*****************************************************************

Enter value of A (int only): 2
Enter value of B (int only): -5
Enter value of C (int only): 4
The two imaginary solutions are       X = 1.2500e+00 + (6.6144e-01)*I
                    And               X = 1.2500e+00 - (6.6144e-01)*I
*****************************************************************

Thanks for using El Camino Quadratic Equation Solver.
*****************************************************************
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*****************************************************************
            EL CAMINO QUADRATIC EQUATION SOLVER
*****************************************************************
This program will provide solutions for an equation of the form
                    Ax^2 + Bx  + C  = 0,
Where A, B and C are integers, and A is not equal to zero.
*****************************************************************

Enter value of A (int only): 4
Enter value of B (int only): 0
Enter value of C (int only): 25
The two imaginary solutions are        X =  (2.5000e+00)*I
                            And        X = - (2.5000e+00)*I
*****************************************************************

Thanks for using El Camino Quadratic Equation Solver.
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*****************************************************************
            EL CAMINO QUADRATIC EQUATION SOLVER
*****************************************************************
This program will provide solutions for an equation of the form
                    Ax^2 + Bx  + C  = 0,
Where A, B and C are integers, and A is not equal to zero.
*****************************************************************

Enter value of A (int only): 0
Caution! If leading coefficient is zero then you actually do not have a quadratic equation. You
have a linear equation. If you wish to solve the linear equation BX + C = 0, then please
proceed.
Enter value of B: 2
Enter value of C: -7
Solution is                    X = 3.5000e+00


*****************************************************************

Thanks for using El Camino Quadratic Equation Solver.
*****************************************************************
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****************************************************************
              EL CAMINO QUADRATIC EQUATION SOLVER
****************************************************************
This program will provide solutions for an equation of the form
                  Ax^2 + Bx  + C  = 0,
Where A, B and C are integers, and A is not equal to zero.
****************************************************************

Enter value of A (int only): 0
Caution! If leading coefficient is zero then you actually do not have a quadratic equation. You
may have a linear equation. If you wish to solve the linear equation BX + C = 0, then please
proceed.
Enter value of B: 0
With A and B both being zero you actually do not have an algebraic equation.


****************************************************************

Thanks for using El Camino Quadratic Equation Solver.
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****************************************************************
              EL CAMINO QUADRATIC EQUATION SOLVER
****************************************************************
This program will provide solutions for an equation of the form
                  Ax^2 + Bx  + C  = 0,
Where A, B and C are integers, and A is not equal to zero.
****************************************************************

Enter value of A (int only): 2
Enter value of B: 4
Enter value of C: 0
The two real solutions are              X = 0.0000e+00
                          And           X = -2.0000e+00


****************************************************************

Thanks for using El Camino Quadratic Equation Solver.
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117 **IOAA Requirements**

118 This document should have following sections.

119 Part 1. Data Input:

120 In a tabular form describe followings: variable names used in the program, their data types,

121 units (if any, otherwise skip), and the explanation of variables if variable name is short and is not

122 self-describing. Only include those variables that will be populated by user input. Do not include

123 anything else.

124

125 Part 2. Data Output, Intermediate Program Variables, And Any Comments on Output

126 Formatting:

127 Only include those data items that are outputted. Do not include non-data items, such as

128 prompts to the user etc. You can specify variable names and data types of computed and to be

129 outputted items here. If there is a required output format, then you can describe that here as

130 well.

131

132 Part 3. Analysis

133 Include any Math formulae your program uses and their C++ translation. Understand that we

134 need both! By now all input and output variables have been named in parts 1 and 2. Thus you

135 can express formulae in terms of the variable names. Also include a table of all Boolean

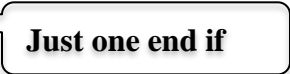136 conditions and their purposes.

137

138 Part 4. Algorithm/pseudo code/ Any C++ Program notes

139 Describe your algorithm/pseudo code in enough detail that someone else can take this

140 document and be able to translate your algorithm into a C++ program. This part does not have

141 to be perfect in the first draft. In fact first draft of algorithm will be a working draft. However, it

142 must map reasonably well with your C++ source code once you have finished coding, and testing

143 your C++ program. The pseudo code or algorithm for stand-alone if and nested if/else are shown

144 in table below. This format must be used. Points will be deducted if erratic format is used. The

145 rules shown in pseudo code/algorithm below are as follows:

146   1. Each if or else if must have the word then at the end.

147   2. Each of three type of control structure must have "end if" as last statement.

148   3. Else does not use the word "then" because else is an alternate to previous if and does

149   not test a condition.

150

Type of control structure coded	Example

Single if statement	If (age>=62) then
	        Print "Welcome, you are qualified to collect Social Security.", end of line
	End if

If/else	If (age>=62) then
	        Print "Welcome, you are qualified to collect Social Security.", end of line
	Else
	        Print "Please wait till you pass 62nd birthday to collect Social Security.", end of line
	End if

Nested if/else	Get and store semester score If (score>90) **then** Print, "A grade", end of line

(Note that else DOES NOT have then after it)	Else if (score>80) **then**
	    Print, "B grade", end of line
	Else if (score>70) **then**
	    Print, "C grade", end of line
	Else if (score>60) **then**
	    Print, "D grade", end of line
	Else
	Print, "F grade", end of line
	End if
	
	Just one end if

151

152

Are You Submission Ready?

154 Use the checklist below to see if you are submission ready?

155

Item	Completed? Yes? No?
Preparation Work Exercises	
IOAA	
Wrote Source code, compiled, ran	
Output matches the test runs shown in this document	

156

157 You are not submission ready until all items in table above have been completed with
158 required quality of work.

159