Computing Assignment 1

(A) Four-digit rounding arithmetic - to round the numbers to have 4-digit where the fifth digit determines the last digit of representation; it has to be performed each steps of operation.
MATLAB code to compute equation 1.1,1.2, and 1.3

1. Define a function that can take inputs, which are coefficients equation; ax^2+bx+c; (a,b,c)
2. Perform a calculation; four-digit rounding is performed on every operation conducted as well as the initial inputs; rounding is to be done up to four-significant digits
3. When you try to get solution for the equation, call the function by putting the coefficients along with the defined function such as [myfunction(a,b,c)]

(B) I calculated standard quadratic equation by using [roots()] function to get exact solution in matlab. Also, all operation is used four-digit rounding arithmetic.

1. $x^2-\sqrt{7}x+\sqrt{2}=0$

	x1	x2
standard quadratic formula	**1.903**	**0.7431**
Equation 1.1	**1.903**	**0.7430**
Absolute error	0	0.0001
Relative error	0	1.346×10^{-4}
Equation 1.2 (x1) & 1.3 (x2)	**1.903**	**0.7430**
Absolute error	0	0.0001
Relative error	0	1.346×10^{-4}

2. $\pi x^2+13x+1=0$

	x1	x2
standard quadratic formula	**-0.07840**	**-4.059**
Equation 1.1	**-0.07800**	**-4.060**
Absolute error	4.000×10^{-4}	1.000×10^{-4}
Relative error	5.102×10^{-3}	2.464×10^{-5}
Equation 1.2 (x1) & 1.3 (x2)	**-0.07840**	**-4.082**
Absolute error	4.000×10^{-4}	2.300×10^{-2}
Relative error	5.102×10^{-3}	5.666×10^{-3}

3. $x^2+x-e=0$

	x1	x2
standard quadratic formula	**1.223**	**-2.223**
Equation 1.1	**1.223**	**-2.223**
Absolute error	0	0
Relative error	0	0
Equation 1.2 (x1) & 1.3 (x2)	**1.223**	**-2.223**
Absolute error	0	0
Relative error	0	0

4. $x^2-\sqrt{35}x-2=0$

	x1	x2
standard quadratic formula	**6.237**	**-0.3207**
Equation 1.1	**6.235**	**-0.3205**
Absolute error	2.000×10^{-3}	2.000×10^{-4}
Relative error	3.207×10^{-4}	6.236×10^{-4}
Equation 1.2 (x1) & 1.3 (x2)	**6.241**	**-0.3208**
Absolute error	4.000×10^{-3}	1.000×10^{-4}
Relative error	6.413×10^{-4}	3.118×10^{-4}

(C) When is your algorithm better than the standard quadratic formula?
We are always pursuing to have small relative error as it implies good approximation. The computed algorithm for (1.2) and (1.3) is form of the quadratic formula by rationalizing the numerator. We have to use appropriate formula to avoid the cancellation error that happens when trying to subtract nearly equal numbers. For example last equation in part(b); $x^2-\sqrt{35}x-2=0$, $\sqrt{b^2-4ac}$ turns out to be 6.557 and $b = -\sqrt{35}$. When doing $-b+\sqrt{b^2-4ac}$, which is a numerator of x2 of (1.1), it is subtracting nearly equal number, 5.916-6.557; therefore, it is not an appropriate formula to use at this moment due to the cancellation error; instead, we can alternatively use (1.3) to get x2. It has been proven by the errors; compare the errors between x2 by (1.1) and (1.3); both errors from (1.3) are smaller.