Transcendental Project Instructions

This project aims to numerically solve for x in a transcendental math equation. A transcendental equation is an equation where the variable being solved for does not have an analytical solution. It is an introduction to numerical modelling and computational methods.

Number of Group Members: 1

Report Due: week 14

Worth: 10% of final grade

Project Equation

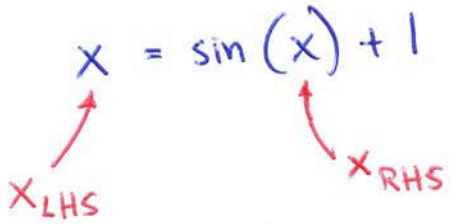
Given a transcendental equation, such as:

$$\sin(x) = x - 1$$

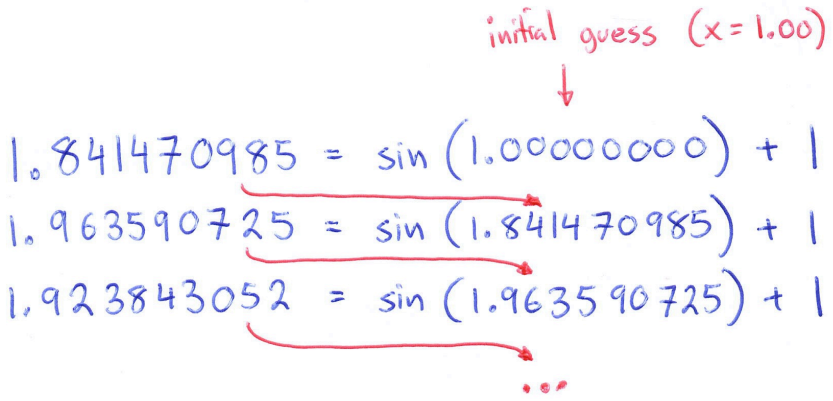
Solve for one of the x values, such as:

$$x = \sin(x) + 1 \qquad \text{or} \qquad x = \sin^{-1}(x - 1)$$

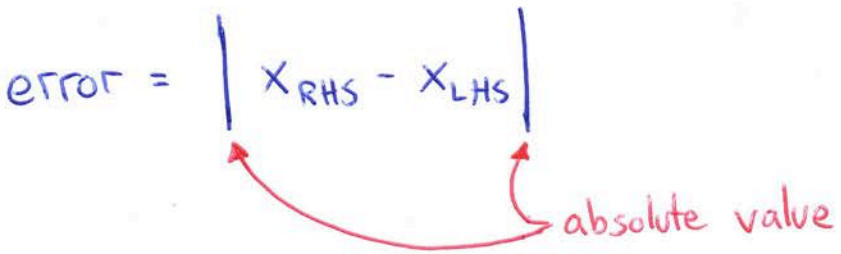
The x's on the right hand side will be referred to as x_RHS. The single x on the left hand side will be referred to as x_LHS.



The objective is to guess an initial x value (start with x_RHS = 1.00) and solve for the single x on the left hand side (x_LHS). Next, substitute the new x value (x_LHS) into x_RHS and start the process over again, such as:



Label each iteration and calculate the error using;



where the absolute value makes the value positive.

You should setup a excel file such as:

transcendental project

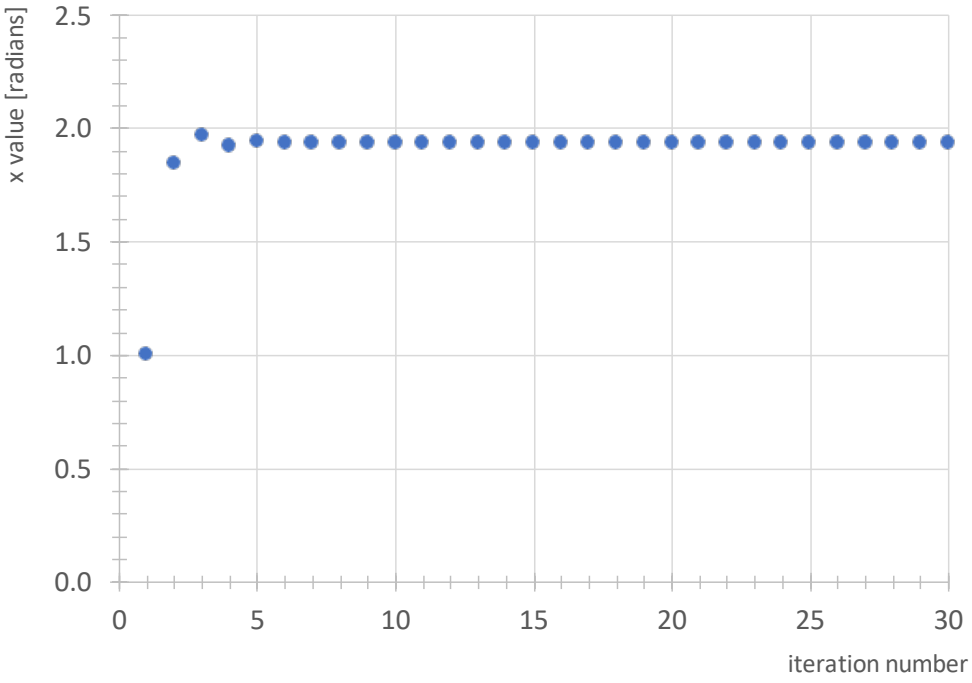
equation to solve: x=sin(x)+1

iteration number	x_RHS [radians]	x_LHS [radians]	error [radians]
1	1.0	1.84147	8E-01
2	1.84147	1.96359	1E-01
3	1.96359	1.92384	4E-02
4	1.92384	1.93832	1E-02
5	1.93832	1.93322	5E-03
6	1.93322	1.93504	2E-03
7	1.93504	1.93439	6E-04
8	1.93439	1.93462	2E-04
9	1.93462	1.93454	8E-05
10	1.93454	1.93457	3E-05
11	1.93457	1.93456	1E-05
12	1.93456	1.93456	4E-06
13	1.93456	1.93456	1E-06
14	1.93456	1.93456	5E-07
15	1.93456	1.93456	2E-07
16	1.93456	1.93456	6E-08
17	1.93456	1.93456	2E-08
18	1.93456	1.93456	7E-09
19	1.93456	1.93456	3E-09
20	1.93456	1.93456	9E-10
21	1.93456	1.93456	3E-10
22	1.93456	1.93456	1E-10
23	1.93456	1.93456	4E-11
24	1.93456	1.93456	2E-11
25	1.93456	1.93456	5E-12
26	1.93456	1.93456	2E-12
27	1.93456	1.93456	7E-13
28	1.93456	1.93456	2E-13
29	1.93456	1.93456	9E-14
30	1.93456	1.93456	3E-14

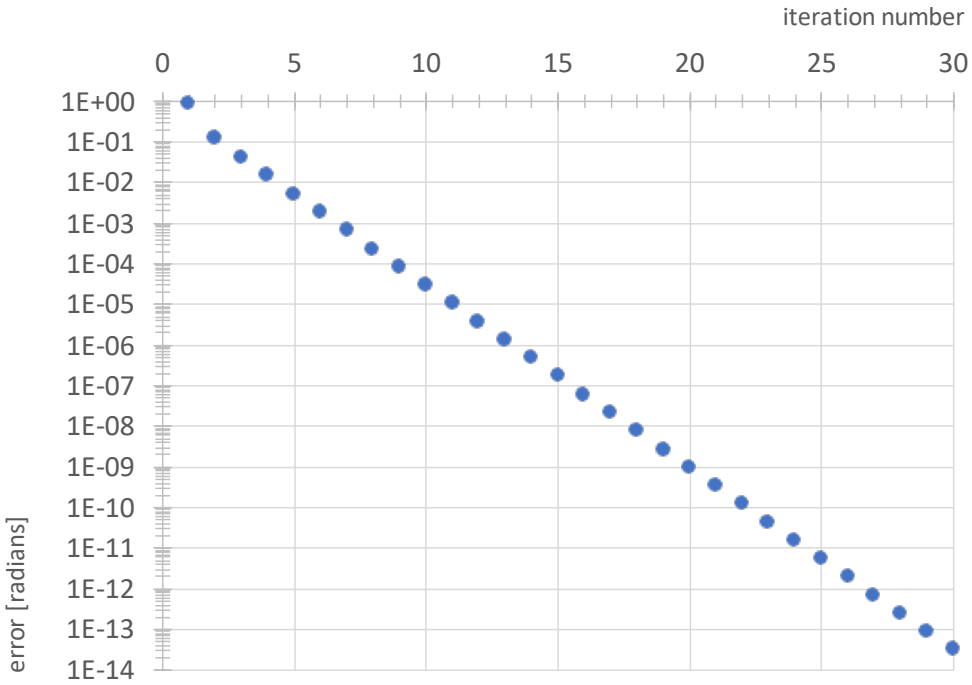
Report

1. Setup an excel file and solve a transcendental equation as shown above.

2. Plot the x value as a function of iteration number as:



3. Plot the error as a function of iteration number on a semi-log plot, as:



Marking Scheme

Solve the transcendental equation (through blackboard).

3 mark(s)

Plot the solution (x) as a function of iteration number. Marks given for curve, figure, axis and labels.

2 mark(s)

Plot the error as a function of iteration number on a semi-log plot. Marks given for curve, figure, axis and labels.

2 mark(s)

Report quality, well organized excel file, including titles and subtitles, such as the example.

3 mark(s)

Total 10 mark(s)