Assignment 1
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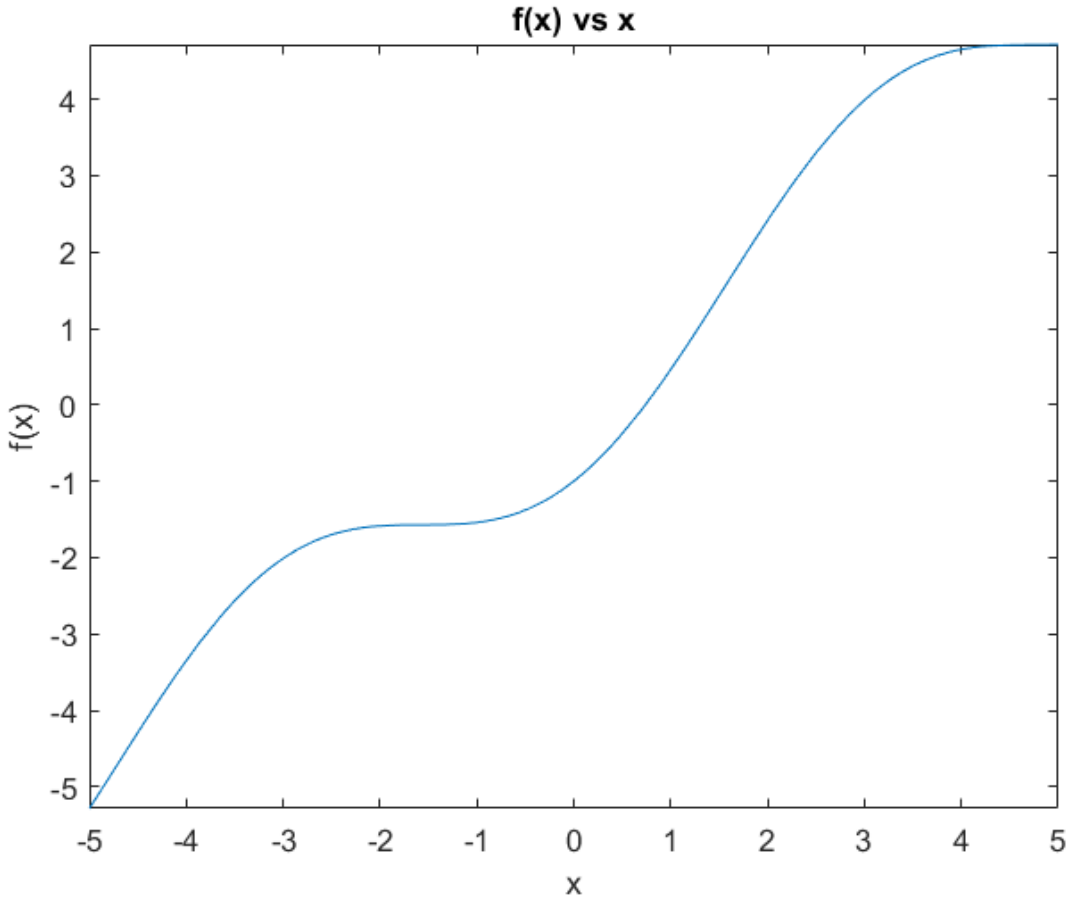
ESO208

Q1) Test Functions

(1) f(x) = x-cos(x)

Note - f(x) v/s x came same for each method thus including this image only once

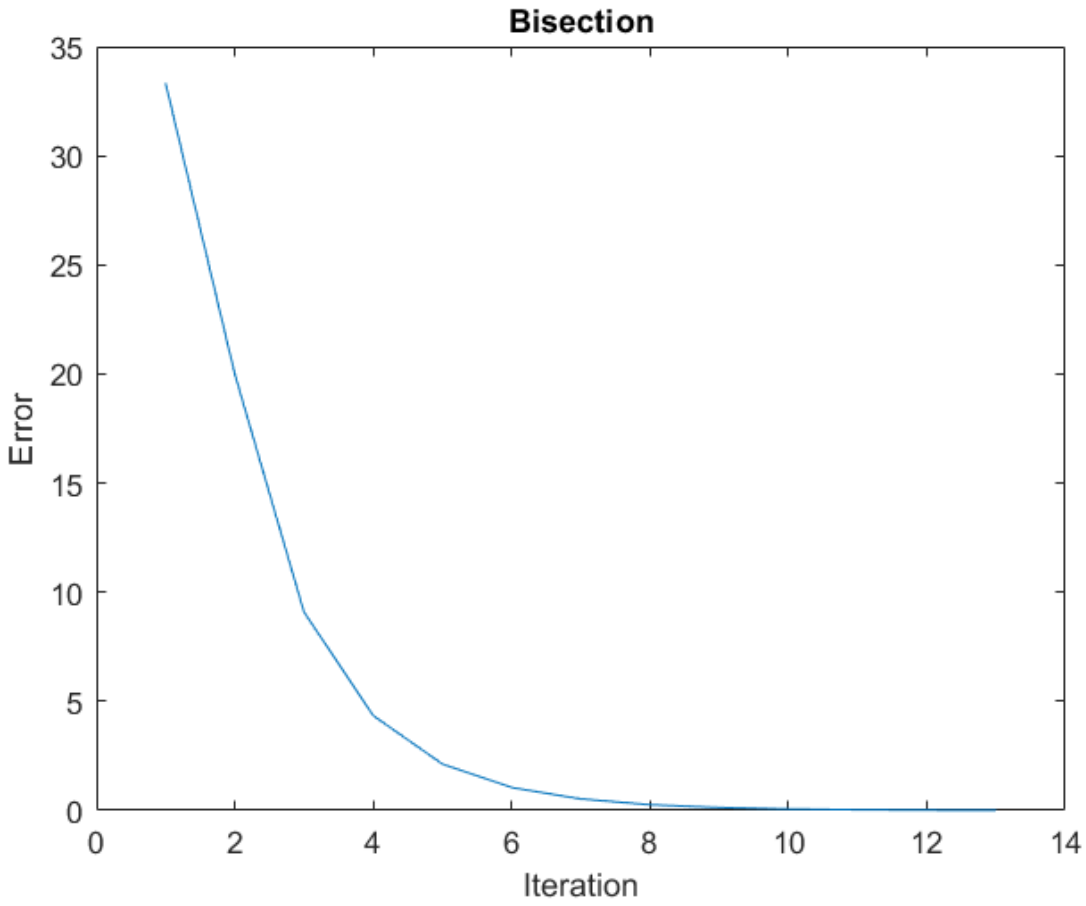


(a) Bisection method

Give an equation in x: x-cos(x)
List of methods:
1. Bisection Method
2. False-Position
3. Fixed-Point
4. Newton Raphson
5. Secant

Select the method for finding Root: 1

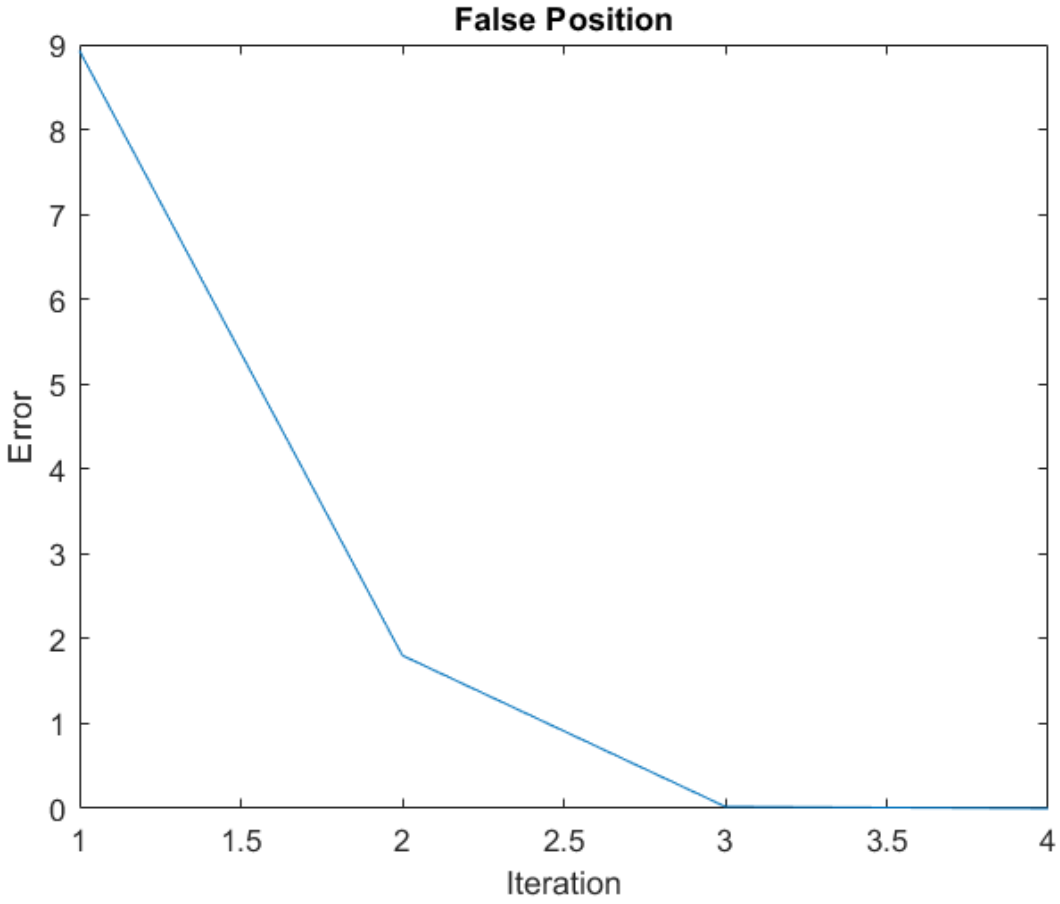
Enter x0: 0
Enter x1: 1
Enter maximum Error: 0.01
Enter maximum Iteration allowed: 50
Root is:
0.7391



(b) False-position

Give an equation in x: x-cos(x)
List of methods:
1. Bisection Method
2. False-Position
3. Fixed-Point
4. Newton Raphson
5. Secant
Select the method for finding Root: 2
Enter x0: 0
Enter x1: 1

Enter maximum Error: 0.01
Enter maximum Iteration allowed: 50
Root is:
0.7391



(c) Fixed-Point

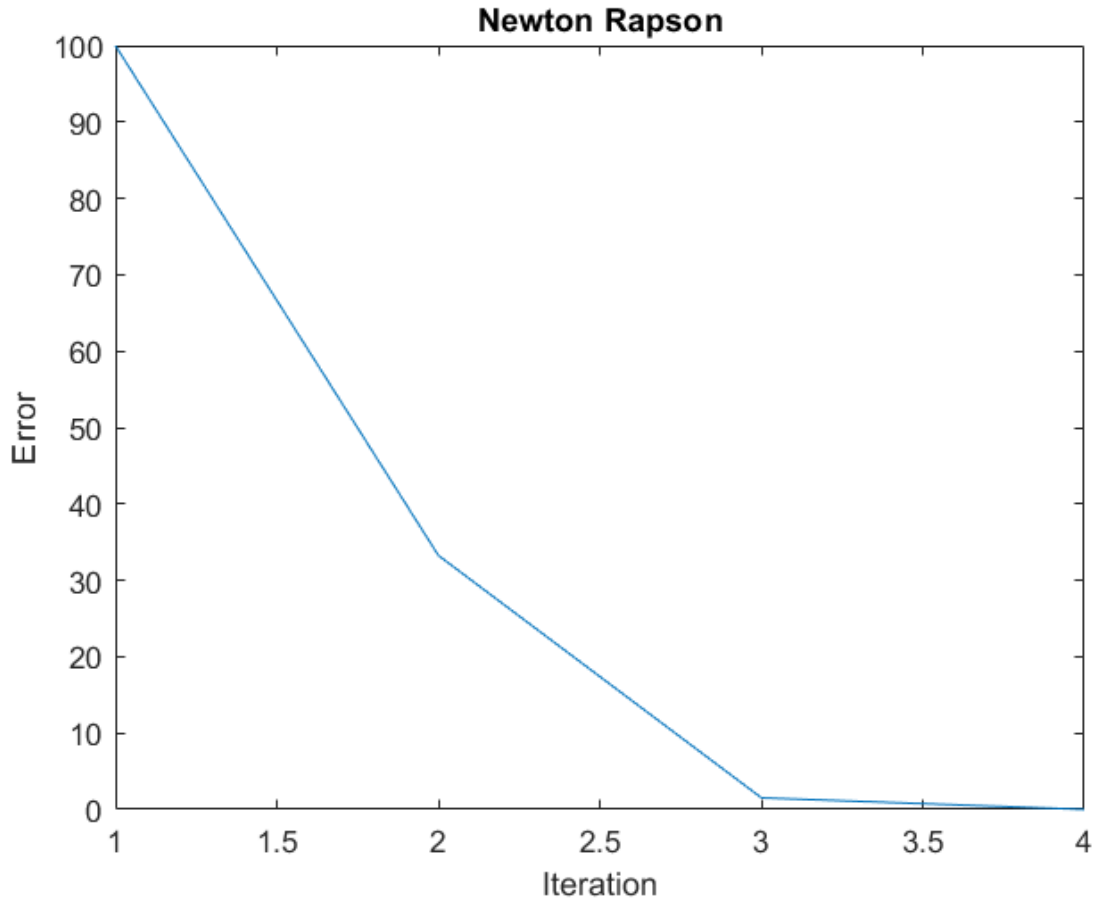
N/A (couldn't solve)

(d) Newton-Raphson

Give an equation in x: x-cos(x)
List of methods:
1. Bisection Method
2. False-Position
3. Fixed-Point
4. Newton Raphson
5. Secant
Select the method for finding Root: 4

Enter x0: 0
Enter maximum error allowed: 0.01
Enter Maximum Iterations allowed: 50
sin(x) + 1
symbolic function inputs: x

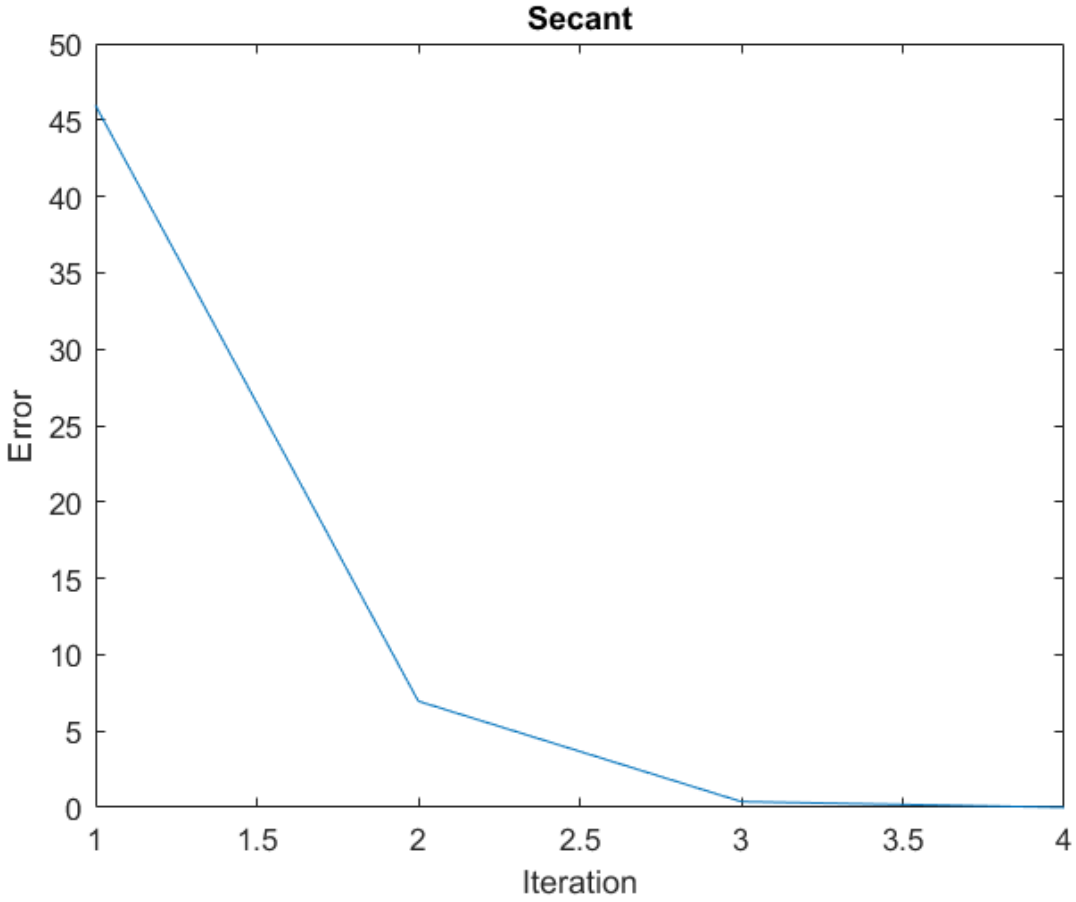
Root is:
0.7391



(e) Secant

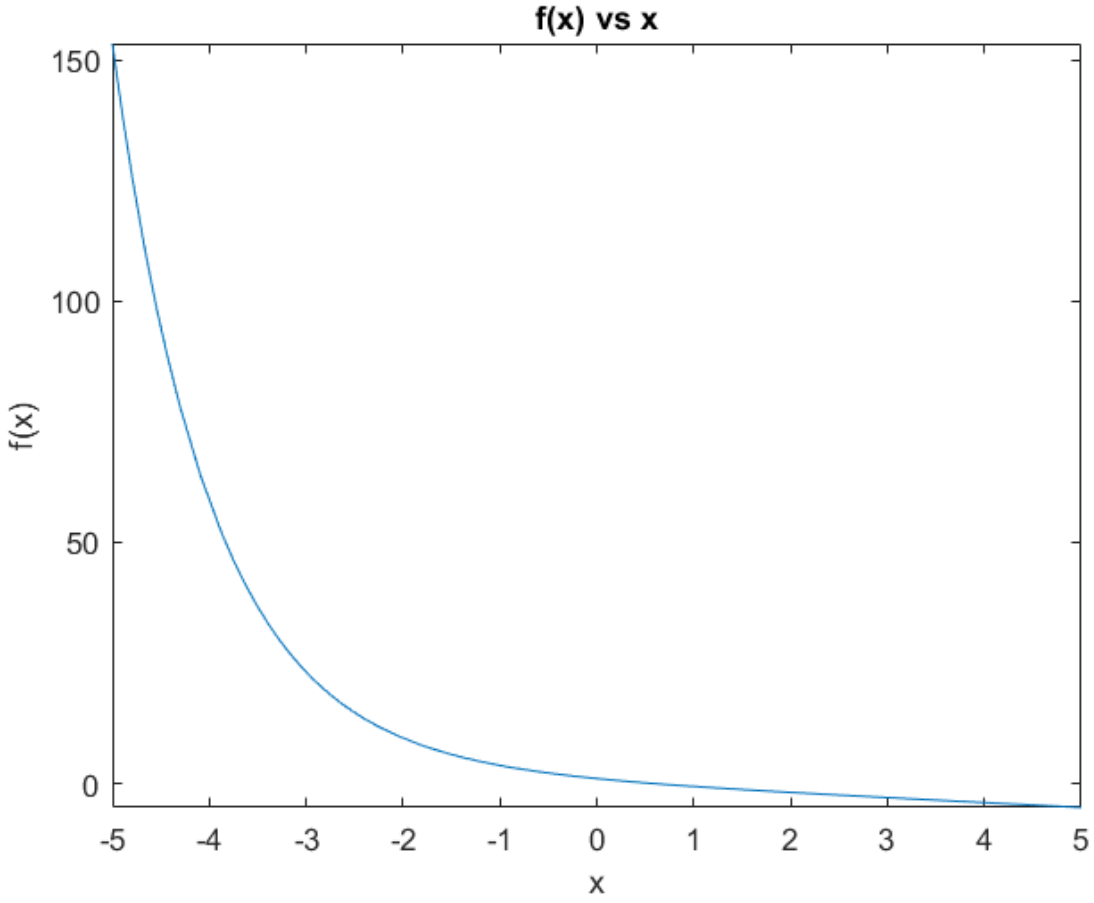
Give an equation in x: x-cos(x)
List of methods:
1. Bisection Method
2. False-Position
3. Fixed-Point
4. Newton Raphson
5. Secant
Select the method for finding Root: 5
Enter x0: 0

Enter x1: 1
Enter maximum Error: 0.01
Enter maximum Iteration allowed: 50
Root is:
0.7391



(2) f(x)=exp(-x)-x

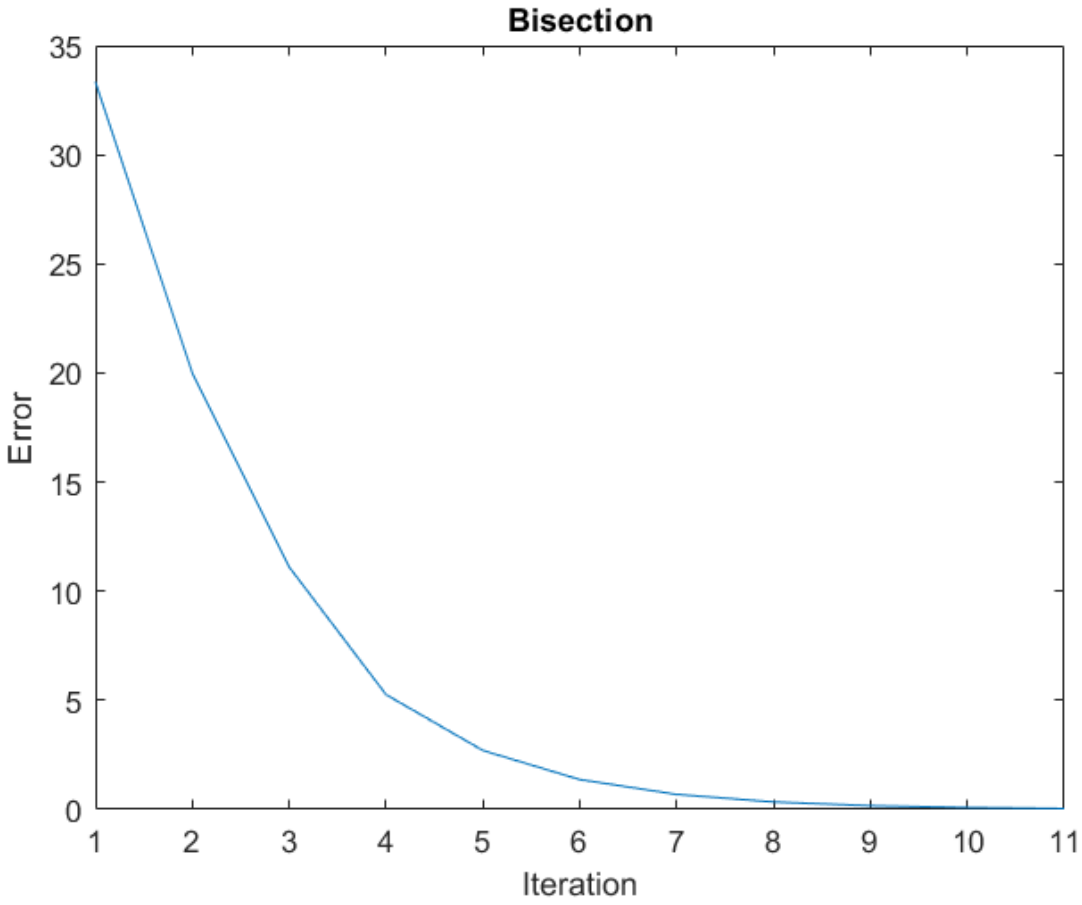
Note - f(x) v/s x came same for each method thus including this image only once



(a) Bisection Method

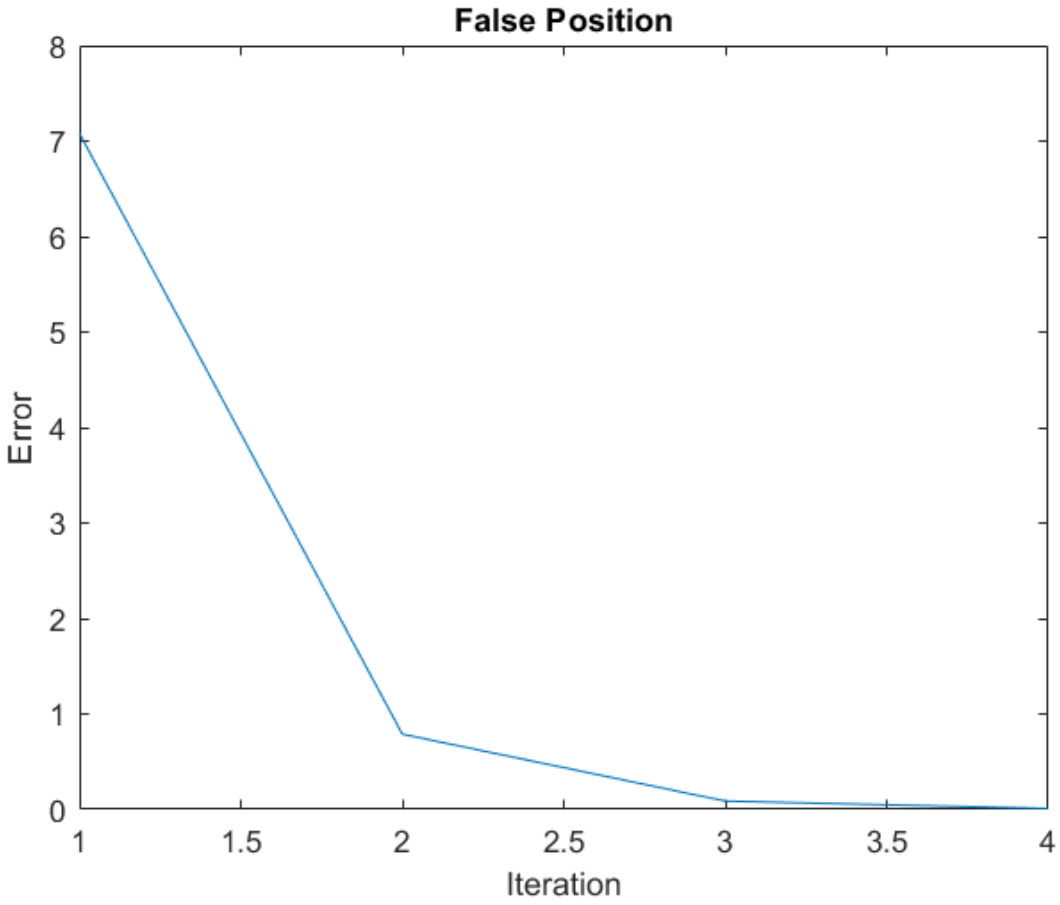
Give an equation in x: exp(-x)-x
List of methods:
1. Bisection Method
2. False-Position
3. Fixed-Point
4. Newton Raphson
5. Secant

Select the method for finding Root: 1
Enter x0: 0
Enter x1: 1
Enter maximum Error: 0.05
Enter maximum Iteration allowed: 50
Root is:
0.5671



(b) False-Position

Give an equation in x: exp(-x)-x
List of methods:
1. Bisection Method
2. False-Position
3. Fixed-Point
4. Newton Raphson
5. Secant
Select the method for finding Root: 2
Enter x0: 0
Enter x1: 1
Enter maximum Error: 0.05
Enter maximum Iteration allowed: 50
Root is:
0.5672



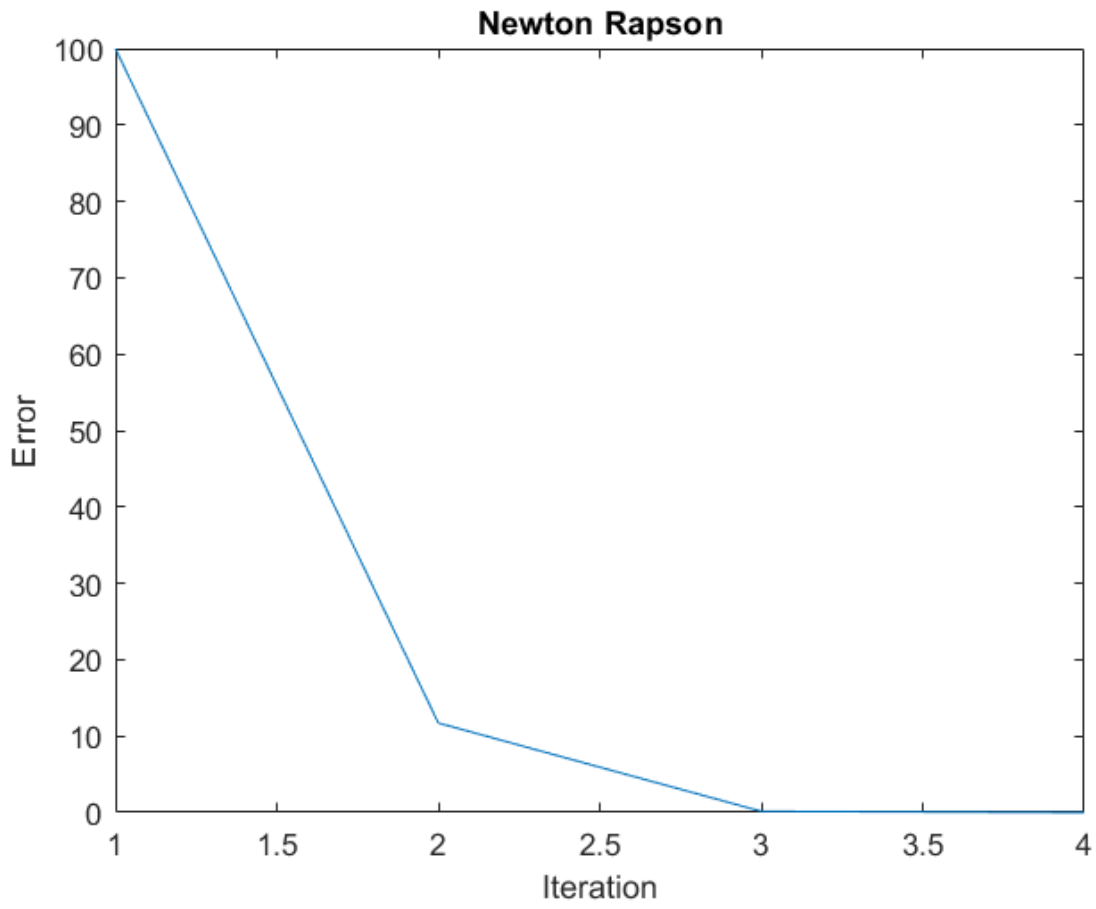
(c) Fixed-Position

N/A (couldn't solve)

(d) Newton-Raphson

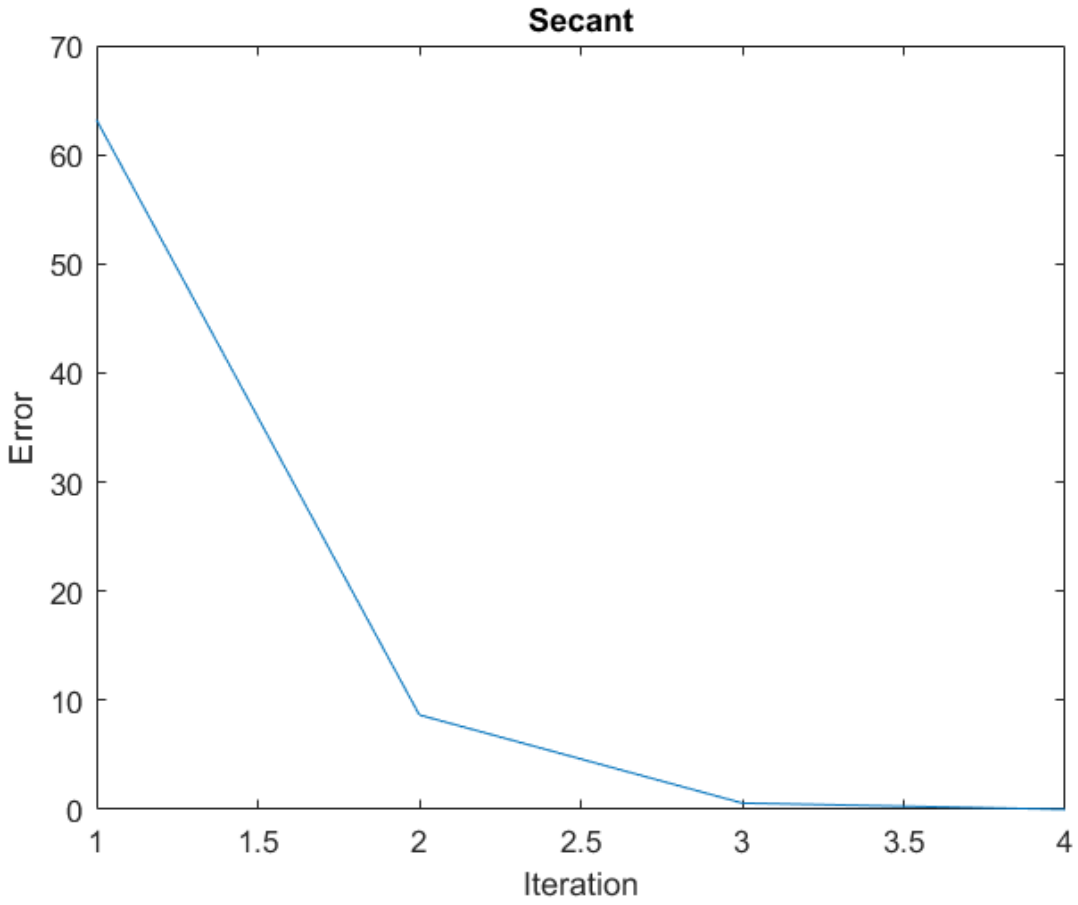
Give an equation in x: exp(-x)-x
List of methods:
1. Bisection Method
2. False-Position
3. Fixed-Point
4. Newton Raphson
5. Secant
Select the method for finding Root: 4
Enter x0: 0
Enter maximum error allowed: 0.05
Enter Maximum Iterations allowed: 50
- exp(-x) - 1
symbolic function inputs: x

Root is:
0.5671



(e) Secant

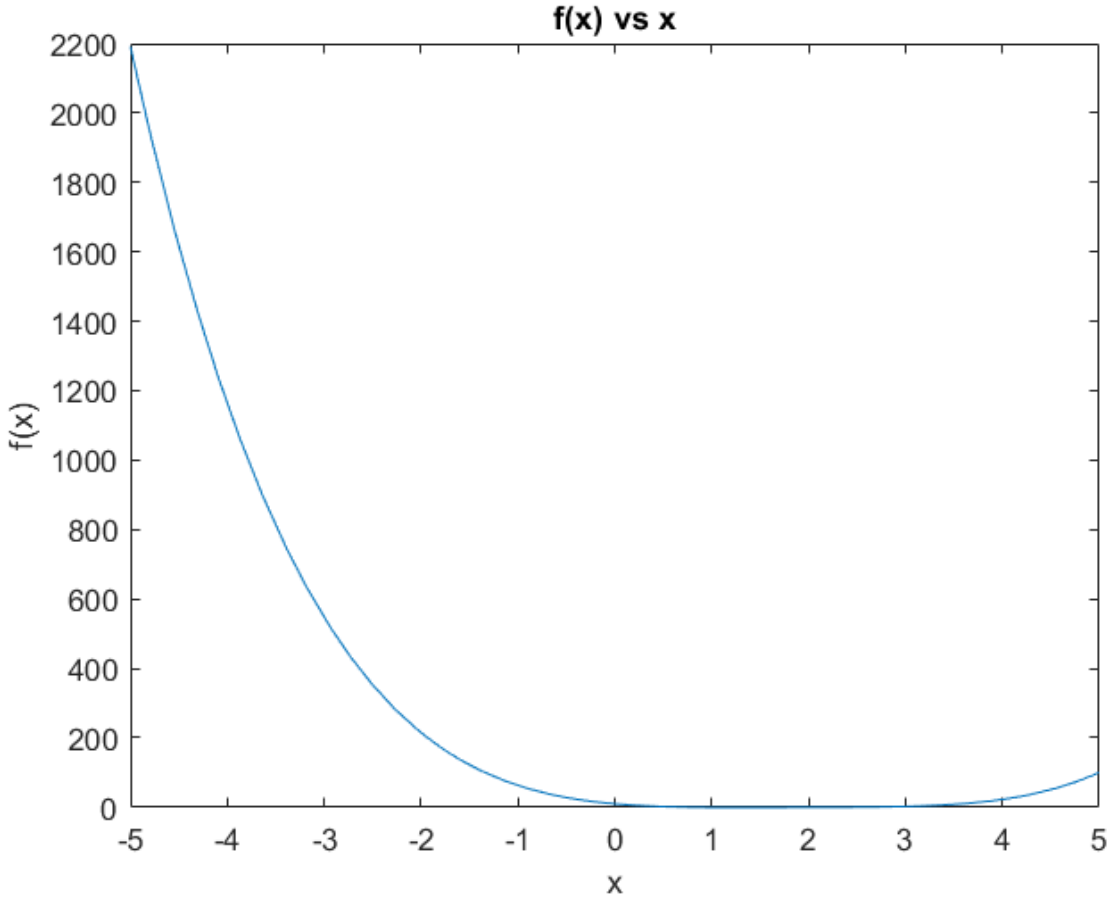
Give an equation in x: exp(-x)-x
List of methods:
1. Bisection Method
2. False-Position
3. Fixed-Point
4. Newton Raphson
5. Secant
Select the method for finding Root: 5
Enter x0: 0
Enter x1: 1
Enter maximum Error: 0.05
Enter maximum Iteration allowed: 50
Root is:
0.5671



Q2 Test function

f(x)= x^4 - 7.4x^3 + 20.44x^2 - 24.184x + 9.6448

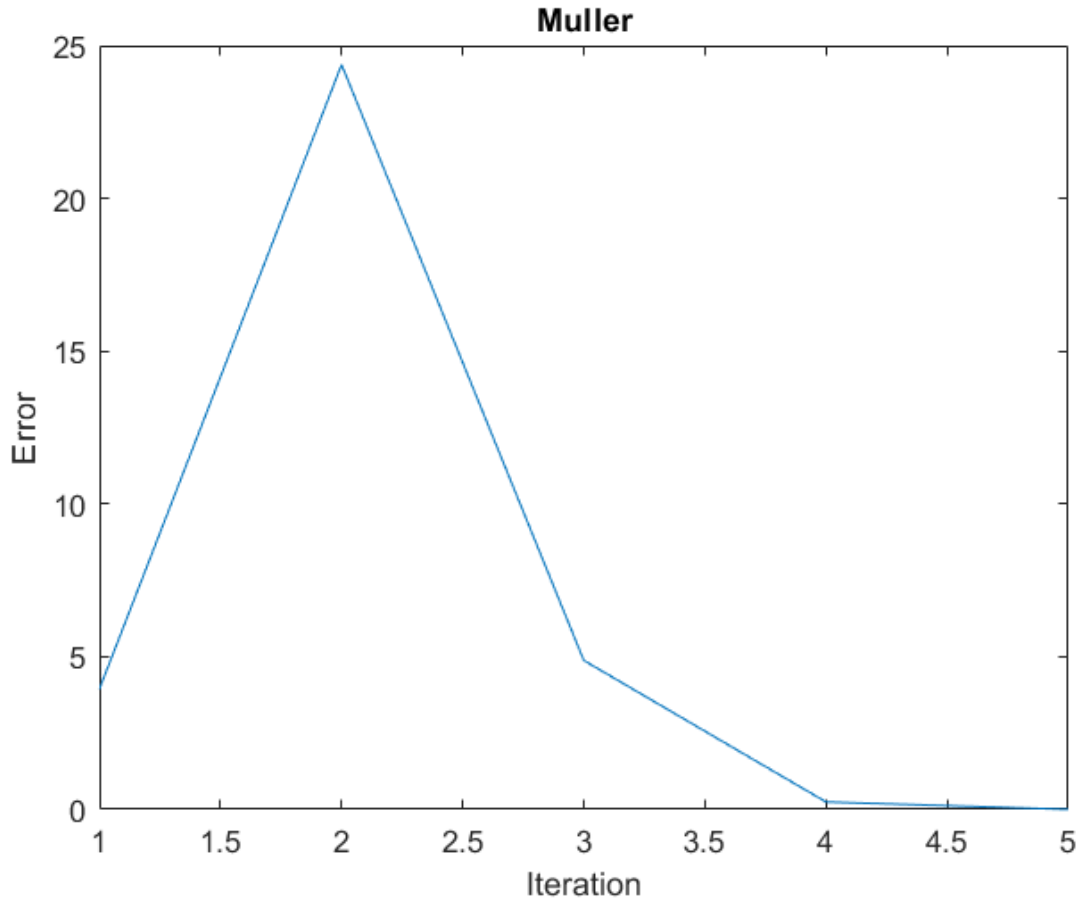
Note - f(x) v/s x came same for each method thus including this image only once



(a) Muller

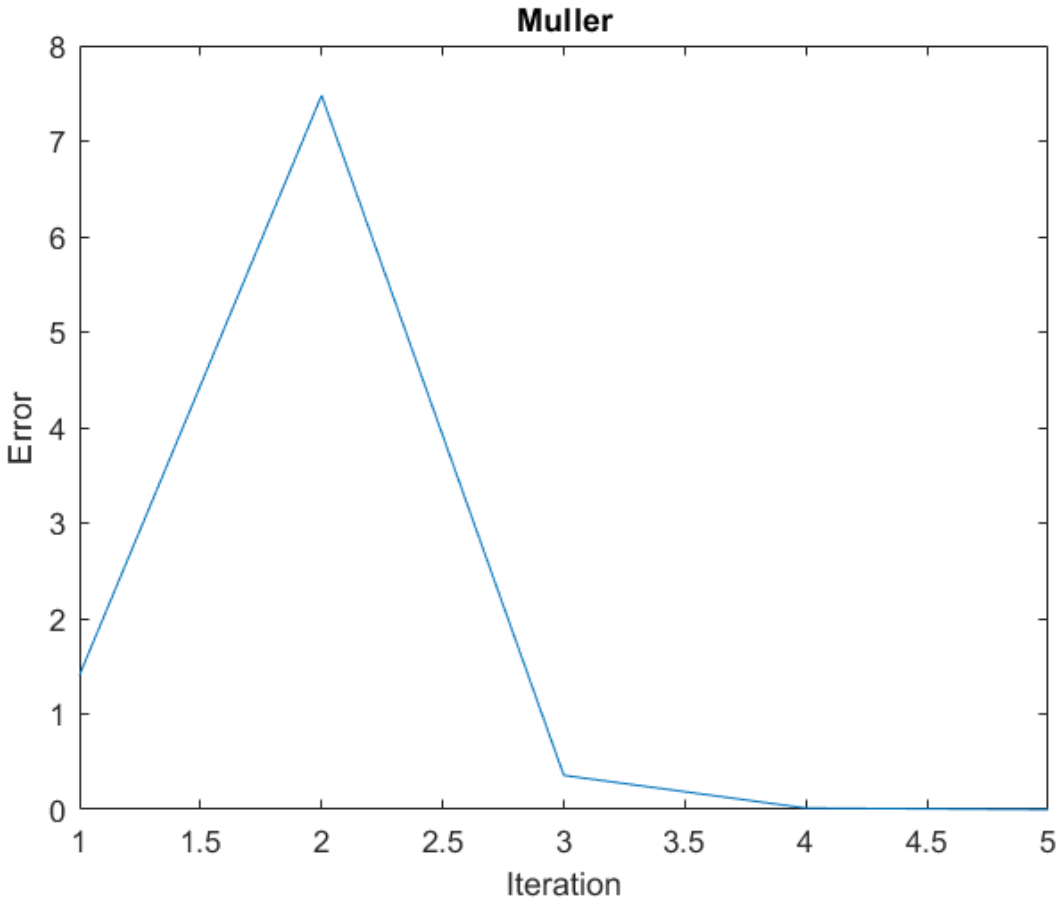
(i) (-1,0,1)

Give an equation in x: (x).^4 - 7.4*(x).^3 + 20.44*(x).^2 - 24.184*(x) + 9.6448
List of methods:
1. Muller Method
2. Bairstow Method
Select the method for finding Roots: 1
Enter the x0 : -1
Enter the x1 : 0
Enter the x2 : 1
Enter maximum Error: 0.01
Enter maximum Iteration allowed: 50
Root is :
0.8000



(ii) (0,1,2)

Give an equation in x: (x).^4 - 7.4*(x).^3 + 20.44*(x).^2 - 24.184*(x) + 9.6448
List of methods:
1. Muller Method
2. Bairstow Method
Select the method for finding Roots: 1
Enter the x0 : 0
Enter the x1 : 1
Enter the x2 : 2
Enter maximum Error: 0.01
Enter maximum Iteration allowed: 50
Root is :
2.2000



(b) Bairstow

N/A (couldn't solve)

Comment on the convergence and stability of different methods

The order of convergence of Newton Raphson method is 2 or the convergence is quadratic. It converges if |f(x). f''(x)| < |f'(x)|2. Also, this method fails if f'(x) = 0.

The Convergence in the Bisection method is linear. This method narrows the gap by taking the average of the positive and negative intervals. It is a simple method and it is relatively slow.

The order of convergence of Regula Falsi method is 1.618. The Regula Falsi, also known as the method of false position or the false position method, is a very old and still-used approach to solving equations with a single unknown in mathematics.

Muller Method is faster than Bisection, Regula – Falsi and Secant method. Although, it is slower than Newton – Raphson's Method, which has a rate of convergence of 2, but it overcomes one of the biggest drawbacks of Newton-Raphson Method, i.e., computation of derivative at each step.

In bairstows method, farther the starting values from the roots, the longer it takes to converge.