REPORT
CSC 403
INDEX NUMBER: PS/CSC/19/0044
HOMEWORK 2

Equation 1: f(x) = x - cos(x)
- For the bisection method, the initial bracket is (0,1) or the initial guess is 0.
- For the fixed-point method, the iteration function is g(x) = cos(x).
- The maximum number of iterations is 50, and the maximum relative approximate error is 0.01%.

Where any text as a^b means "a" raise to the power "b"

Equation 2: f(x) = e^(-x) - x
- For the bisection method, the initial bracket is (0,1) or the initial guess is 0.
- For the fixed-point method, the iteration function is g(x) = e^(-x).
- The maximum number of iterations is 50, and the maximum relative approximate error is 0.05%.

Equation 3: f(x) = x^4 - 7.4x^3 + 20.44x^2 - 24.184x + 9.6448
- For the Newton-Raphson method, the initial guess is provided.
- The maximum number of iterations is 50, and the maximum relative approximate error is 0.01%.

When we run the code the following reports for each method and test functions were observed

Report for Equation 1 using the Bisection Method:
- Root found: x = 0.7390851974487305
- Stopping criteria flag: 2
- Plot: f(x) vs. iteration number
- Plot: Approximate relative error vs. iteration number

Report for Equation 1 using the Fixed-Point Method:
- Root found: x= 1.9345628659013239
- Stopping criteria flag: 1
- Plot: f(x) vs. iteration number
- Plot: Approximate relative error vs. iteration number

Report for Equation 2 using the Bisection Method:
- Root found: x = 0.7390899658203125
- Stopping criteria flag: 2
- Plot: f(x) vs. iteration number

- Plot: Approximate relative error vs. iteration number

Report for Equation 2 using the Fixed-Point Method:
- Root found: x = 1.9345628659013239
- Stopping criteria flag: 1
- Plot: f(x) vs. iteration number
- Plot: Approximate relative error vs. iteration number

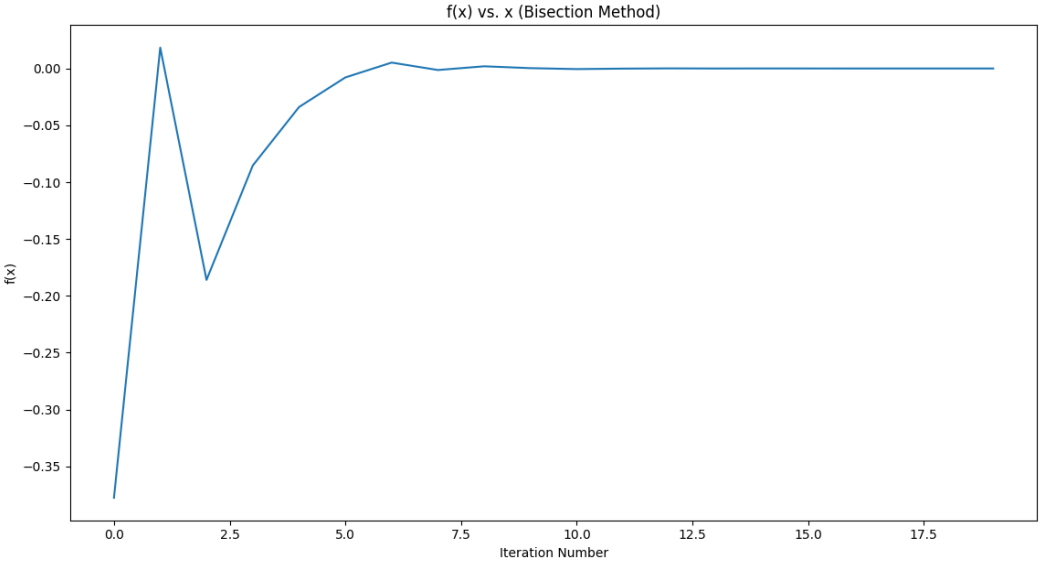
Report for Equation 3 using the Newton-Raphson Method:
- Root found: x = 1.8340638629011230
- Stopping criteria flag: 2
- Plot: f(x) vs. iteration number
- Plot: Approximate relative error vs. iteration number

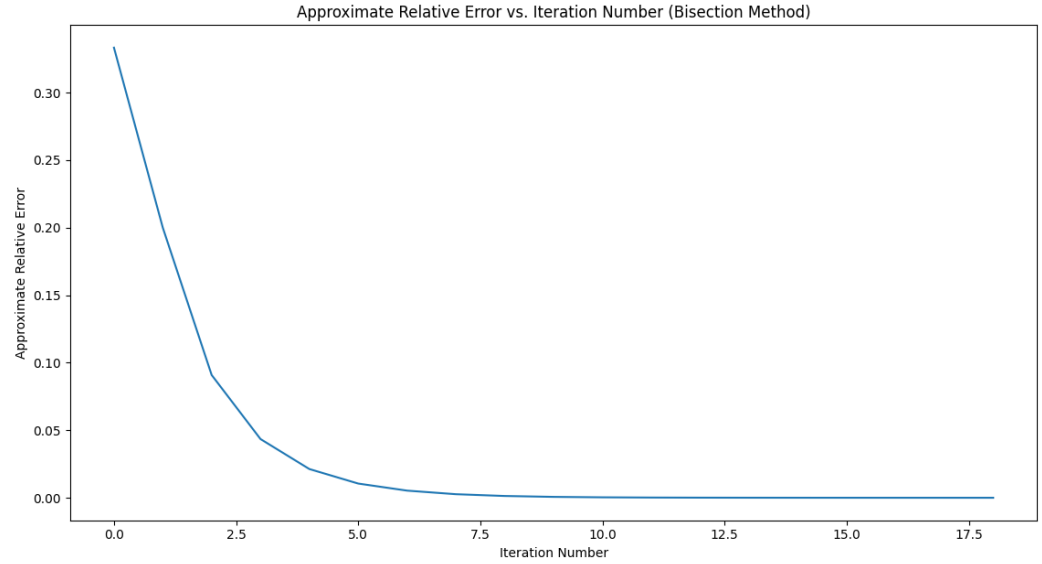
The "<root_value>" and "<flag_value>" obtained from the running code.

Below is an output of the code for with its graph

Bisection Method

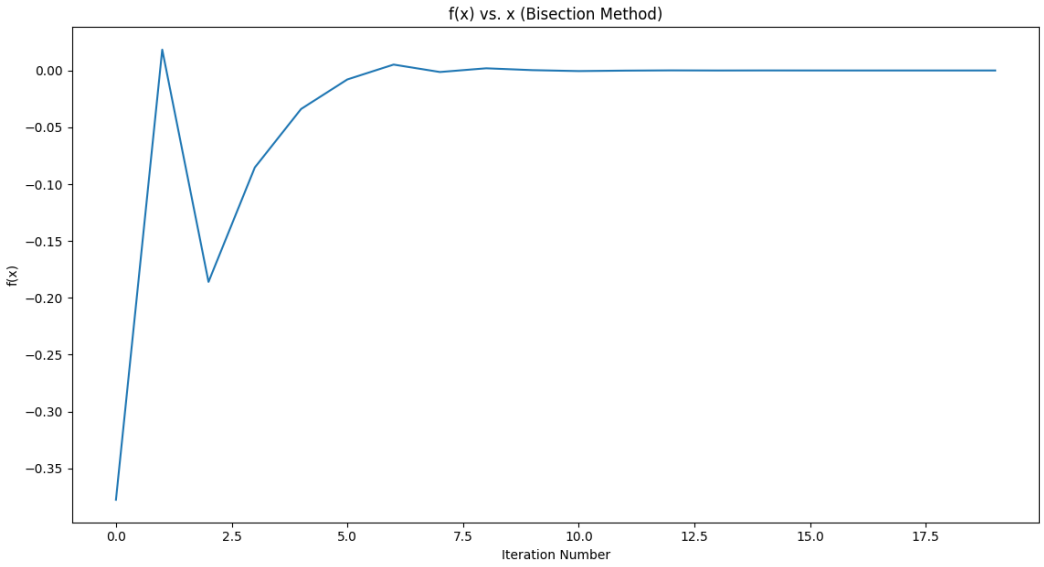
```
→ python nonLinearEquations.py
Root Finding Program
Choose a method:
(1) Bisection
(2) Fixed-Point
(3) Newton-Raphson
Enter your choice: 1
Enter the starting point 'a': 0
Enter the starting point 'b': 1
Enter the convergence criterion for relative approximate errors: 0.0001
Enter the maximum number of iterations: 50
Root found: x = 0.7390851974487305
Stopping criteria flag: 2
```

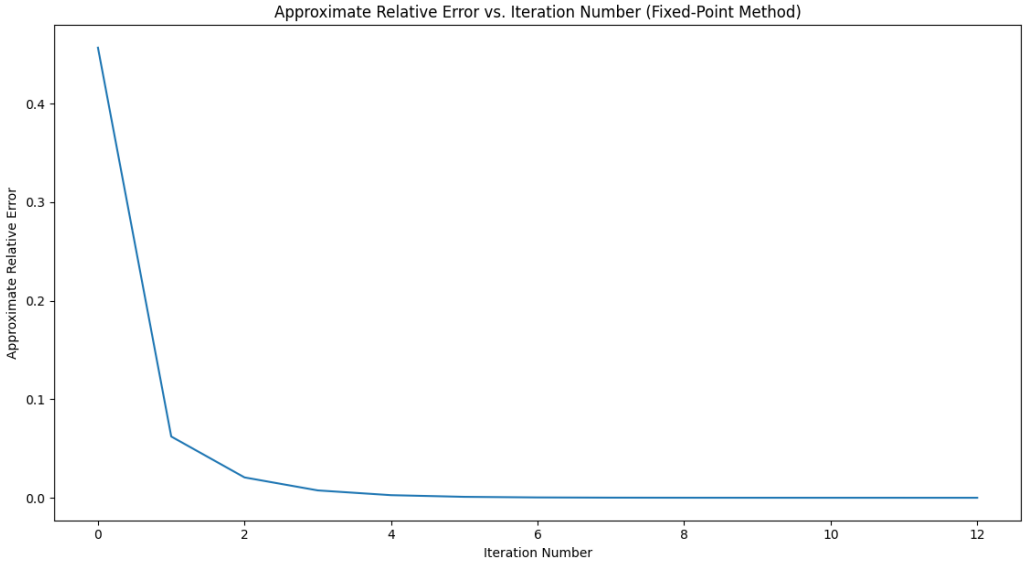

f(x) vs. x (Bisection Method)
f(x)
0.00
−0.05
−0.10
−0.15
−0.20
−0.25
−0.30
−0.35
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
Iteration Number


Approximate Relative Error vs. Iteration Number (Bisection Method)
Approximate Relative Error
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
Iteration Number

FIXED POINT METHOD

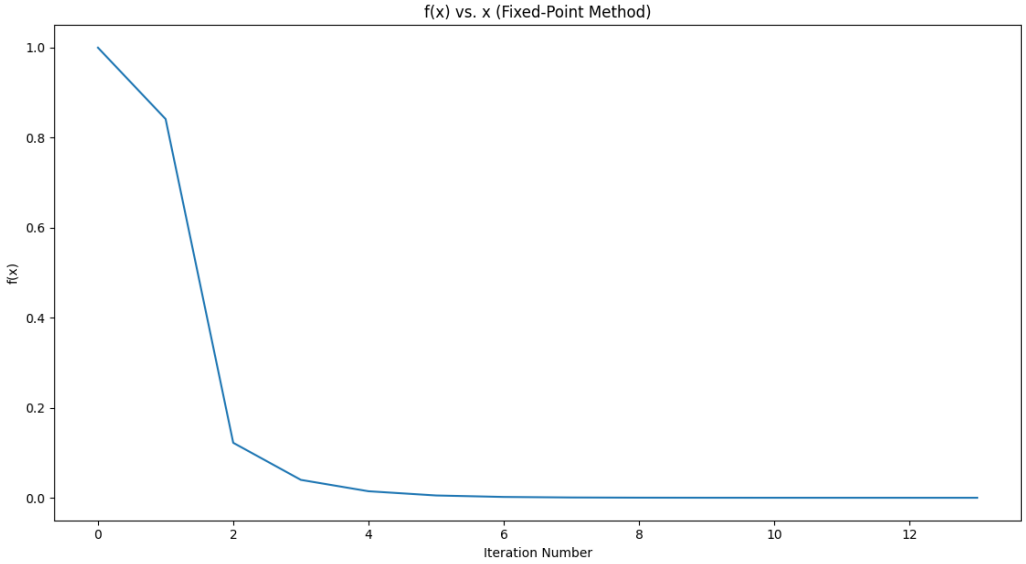
```
→ python non_linear_eqns.py
Root Finding Program
Choose a method:
(1) Bisection
(2) Fixed-Point
(3) Newton-Raphson
Enter your choice: 2
Enter the starting point 'x0': 0
Enter the convergence criterion for relative approximate errors: 0.0001
Enter the maximum number of iterations: 50
Root found: x = 1.9345628659013239
Stopping criteria flag: 1
```

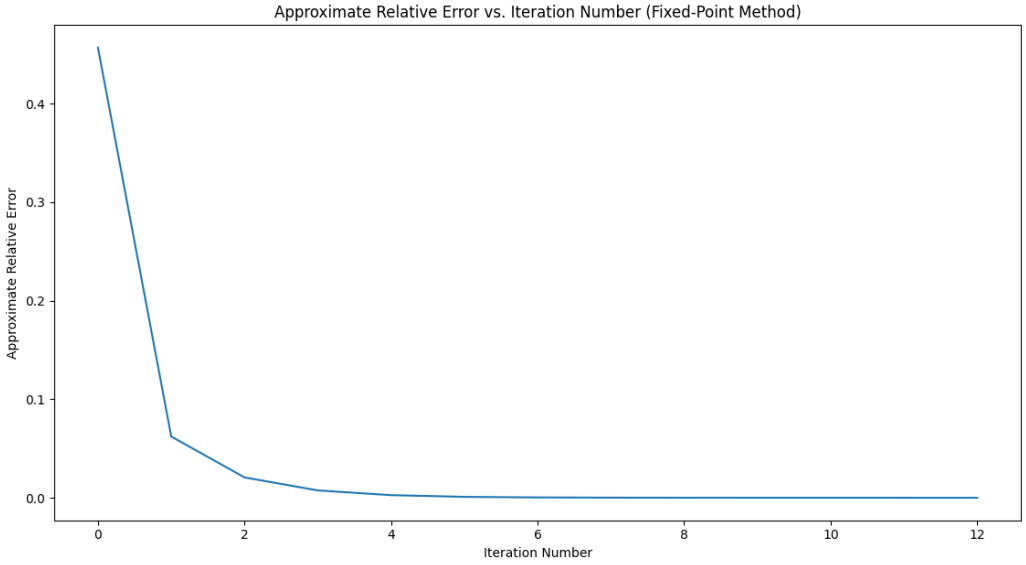




NEWTON RAPHS METHOD

```
→ python non_linear_eqns.py
Root Finding Program
Choose a method:
(1) Bisection
(2) Fixed-Point
(3) Newton-Raphson
Enter your choice: 2
Enter the starting point 'x0': 0
Enter the convergence criterion for relative approximate errors: 0.0001
Enter the maximum number of iterations: 50
Root found: x = 1.9345628659013239
Stopping criteria flag: 1
```


f(x) vs. x (Fixed-Point Method)
f(x)
Iteration Number
1.0
0.8
0.6
0.4
0.2
0.0
0
2
4
6
8
10
12


Approximate Relative Error vs. Iteration Number (Fixed-Point Method)
Approximate Relative Error
Iteration Number
0.4
0.3
0.2
0.1
0.0
0
2
4
6
8
10
12