1.(a) Solve ax^2 + bx + c = 0 for real or complex roots.

Enter a: 3

Enter b: 5

Enter c: -4

Real and distinct roots

Roots are 0.590667290886255 and -2.257333957552922

Process finished with exit code 0

(b1) Before adding tolerance 1e-14

Solve ax^2 + bx + c = 0 for real or complex roots.

Enter a: 3

Enter b: -7.8

Enter c: 5.07

Complex roots

Roots are (1.3+1.4048949503631345e-08j) and (1.3-1.4048949503631345e-08j)

Process finished with exit code 0

(b2) After adding tolerance 1e-14

Solve ax^2 + bx + c = 0 for real or complex roots.

Enter a: 3

Enter b: -7.8

Enter c: 5.07

Real and equal roots

Roots are 1.3 and 1.3

Process finished with exit code 0

(c) Solve ax^2 + bx + c = 0 for real or complex roots.

Enter a: 2

Enter b: -3

Enter c: 4

Complex roots

Roots are (0.75+1.1989578808281798j) and (0.75-1.1989578808281798j)

Process finished with exit code 0

(d) Solve ax^2 + bx + c = 0 for real or complex roots.

Enter a: 0

Enter b: -3

Enter c: 8

ERROR:Invalid inputs for a quadratic equation, such as a=0

Process finished with exit code 0\

Additional problem2&3:

(1) Solve the problem g(x)=x using fixed point iteration

Enter guess at root: -1

Enter tolerance: 1e-6

Enter maxIteration: 100

Monitor iterations? (1/0): 1

Iter 0: x= -1.000000, error = 0.116676

Iter 1: x= -0.883324, error = 0.116676, error ratio = inf

Iter 2: x= -0.842457, error = 0.040866, error ratio = 0.350255

Iter 3: x= -0.827332, error = 0.015125, error ratio = 0.370108

Iter 4: x= -0.821617, error = 0.005715, error ratio = 0.377863

Iter 5: x= -0.819440, error = 0.002177, error ratio = 0.380854

Iter 6: x= -0.818609, error = 0.000831, error ratio = 0.382002

Iter 7: x= -0.818291, error = 0.000318, error ratio = 0.382442

Iter 8: x= -0.818169, error = 0.000122, error ratio = 0.382610

Iter 9: x= -0.818123, error = 0.000047, error ratio = 0.382674

Iter 10: x= -0.818105, error = 0.000018, error ratio = 0.382699

Iter 11: x= -0.818098, error = 0.000007, error ratio = 0.382709

Iter 12: x= -0.818095, error = 0.000003, error ratio = 0.382712

Iter 13: x= -0.818094, error = 0.000001, error ratio = 0.382714

The root is -0.8180943537281646

The number of iterations is 13

errors = [1.16676417e-01 1.16676417e-01 4.08664478e-02 1.51250129e-02

5.71517626e-03 2.17664503e-03 8.31481989e-04 3.17993267e-04

1.21667401e-04 4.65590078e-05 1.78180923e-05 6.81913690e-06

2.60976689e-06 9.98793237e-07]

error ratios = [ inf 0.35025457 0.37010833 0.37786257 0.38085353 0.38200165

0.38244156 0.38260999 0.38267447 0.38269914 0.38270859 0.3827122

0.38271358]

slopes = [-inf, 0.9474446721125698, 0.9791391897341561, 0.9918987946762178, 0.9968818542200617, 0.9988040199447701, 0.9995418957005836, 0.9998246203166842, 0.9999328713754053, 0.9999743076973548, 0.9999901670578712, 0.9999962366568056]

Process finished with exit code 0

(2) Solve the problem g(x)=x using fixed point iteration

Enter guess at root: 0.5

Enter tolerance: 1e-6

Enter maxIteration: 100

Monitor iterations? (1/0): 1

Iter 0: x= 0.500000, error = 0.006951

Iter 1: x= 0.506951, error = 0.006951, error ratio = inf

Iter 2: x= 0.506237, error = 0.000714, error ratio = 0.102724

Iter 3: x= 0.506316, error = 0.000079, error ratio = 0.110268

Iter 4: x= 0.506307, error = 0.000009, error ratio = 0.109494

Iter 5: x= 0.506308, error = 0.000001, error ratio = 0.109579

The root is 0.506308379638491

The number of iterations is 5

errors = [6.95139102e-03 6.95139102e-03 7.14073829e-04 7.87391789e-05

8.62146349e-06 9.44733640e-07]

error ratios = [ inf 0.10272388 0.11026756 0.10949395 0.10957927]

slopes = [-inf, 0.968860187765297, 1.0031931973559853, 0.999647853740039]

Process finished with exit code 0

(3) Solve the problem g(x)=x using fixed point iteration

Enter guess at root: 0.1

Enter tolerance: 1e-6

Enter maxIteration: 100

Monitor iterations? (1/0): 1

Iter 0: x= 0.100000, error = 0.054519

Iter 1: x= 0.045481, error = 0.054519, error ratio = inf

Iter 2: x= 0.019158, error = 0.026322, error ratio = 0.482807

Iter 3: x= 0.007820, error = 0.011338, error ratio = 0.430727

Iter 4: x= 0.003153, error = 0.004667, error ratio = 0.411641

Iter 5: x= 0.001265, error = 0.001888, error ratio = 0.404530

Iter 6: x= 0.000507, error = 0.000759, error ratio = 0.401790

Iter 7: x= 0.000203, error = 0.000304, error ratio = 0.400713

Iter 8: x= 0.000081, error = 0.000122, error ratio = 0.400284

Iter 9: x= 0.000032, error = 0.000049, error ratio = 0.400114

Iter 10: x= 0.000013, error = 0.000019, error ratio = 0.400045

Iter 11: x= 0.000005, error = 0.000008, error ratio = 0.400018

Iter 12: x= 0.000002, error = 0.000003, error ratio = 0.400007

Iter 13: x= 0.000001, error = 0.000001, error ratio = 0.400003

Iter 14: x= 0.000000, error = 0.000000, error ratio = 0.400001

The root is 3.324079763451729e-07

The number of iterations is 14

errors = [5.45194484e-02 5.45194484e-02 2.63223801e-02 1.13377574e-02

4.66708293e-03 1.88797531e-03 7.58570103e-04 3.03968540e-04

1.21673873e-04 4.86833810e-05 1.94755654e-05 7.79058022e-06

3.11628874e-06 1.24652456e-06 4.98611274e-07]

error ratios = [ inf 0.48280716 0.43072691 0.41164075 0.40453005 0.40179027

0.40071252 0.40028443 0.40011368 0.40004546 0.40001818 0.40000727

0.40000291 0.40000116]

slopes = [-inf, 1.1567602107312414, 1.0538101466686016, 1.0196314560348703, 1.007508937791567, 1.0029456931069607, 1.0011688236625746, 1.000466004403507, 1.000186156950749, 1.0000744235516281, 1.0000297631485222, 1.0000119042550049, 1.0000047616094374]

Process finished with exit code 0