Numerical Analysis

False Position Method

Lab 09

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Functions used in False Position

- Write a program to approximate root of equation f(x)=0 in the interval a,b using false position method

Input

- f is the function
- a and b are the left and right endpoints
- delta is the tolerance for the zero
- epsilon is the tolerance for the value of f at the zero (root)
- max1 is the maximum number of iterations

Output

- c is the zero
- yc=f(c)
- err is the error estimate for c

False Position

False position function prototype

function [c,err,yc]=regula(f,a,b,delta,epsilon,max1)

Formula to calculate the value of C

C= (a*f(b)-b*f(a))/(f(b)-f(a))

Condition with dalta

abs(min((b-c),(a-c)))<delta

Condition with epsilon

(abs(yc)<epsilon)

Formula to calculate the error

abs(min((b-c),(a-c)))

Example 1

- Define a function in cosmx.m file

```
function y=cosmx(x)
    y=cos(x)-x;
```

- Draw the graph of $f(x)=\cos(x)-x$ in command window.

```
>> fplot('cosmx', [-pi pi])
>>grid on
```

- The root is lying in the interval [0   1]

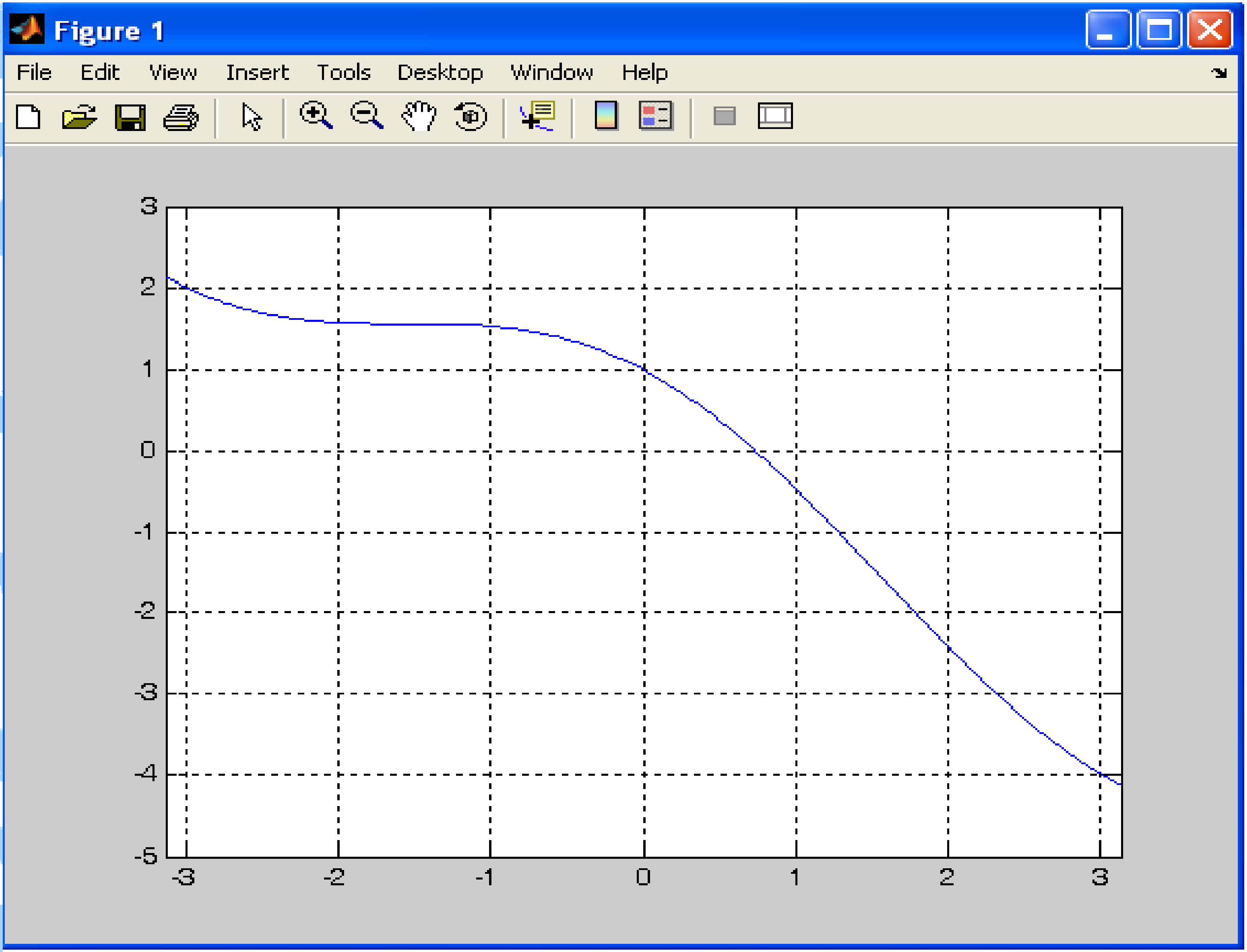
Figure 1
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3
2
1
0
-1
-2
-3
-4
-5
-3 -2 -1 0 1 2 3

Example 1 using Bisection

>> [k, c,err,yc]=bisect('cosmx',0,1,1e-4)

k	Left endpoint	Midpoint	Right endpoint	Fun Value f(c)
1	0.000000	0.50000000	1.00000000	0.37758256
2	0.500000	0.75000000	1.00000000	-0.01831113
3	0.500000	0.62500000	0.75000000	0.18596312
4	0.625000	0.68750000	0.75000000	0.08533495
5	0.687500	0.71875000	0.75000000	0.03387937
6	0.718750	0.73437500	0.75000000	0.00787473
7	0.734375	0.74218750	0.75000000	-0.00519571
8	0.734375	0.73828125	0.74218750	0.00134515
9	0.738281	0.74023438	0.74218750	-0.00192387
10	0.738281	0.73925781	0.74023438	-0.00028901
11	0.738281	0.73876953	0.73925781	0.00052816
12	0.738770	0.73901367	0.73925781	0.00011960
13	0.739014	0.73913574	0.73925781	-0.00008470
14	0.739014	0.73907471	0.73913574	0.00001745

k = 14

c = 0.7391

err = 6.1035e-005

yc = -3.3625e-005

Example 1 using False Position

>> [k,c,err,yc]=regula('cosmx',0,1,1e-4,1e-4,50)

k	Left endpoint	Midpoint	Right endpoint	Fun Value f(c)
1	0.000000	0.68507336	1.00000000	0.08929928
2	0.685073	0.73629900	1.00000000	0.00466004
3	0.736299	0.73894536	1.00000000	0.00023393
4	0.738945	0.73907813	1.00000000	0.00001172
5	0.739078	0.73908478	1.00000000	0.00000059

Breaking condition is met

k = 5
c = 0.7391
err = 6.6516e-006
yc = 5.8705e-007

Example 2

- Define a function

```
function y=xsinm1(x)
    y=(x*sin(x))-1;
```

- Draw the graph of f(x)=cos(x)-x in command window.

```
>> fplot(‘xsinm1', [0  2])
>>grid on
```

- The root is lying in the interval[1   1.2]

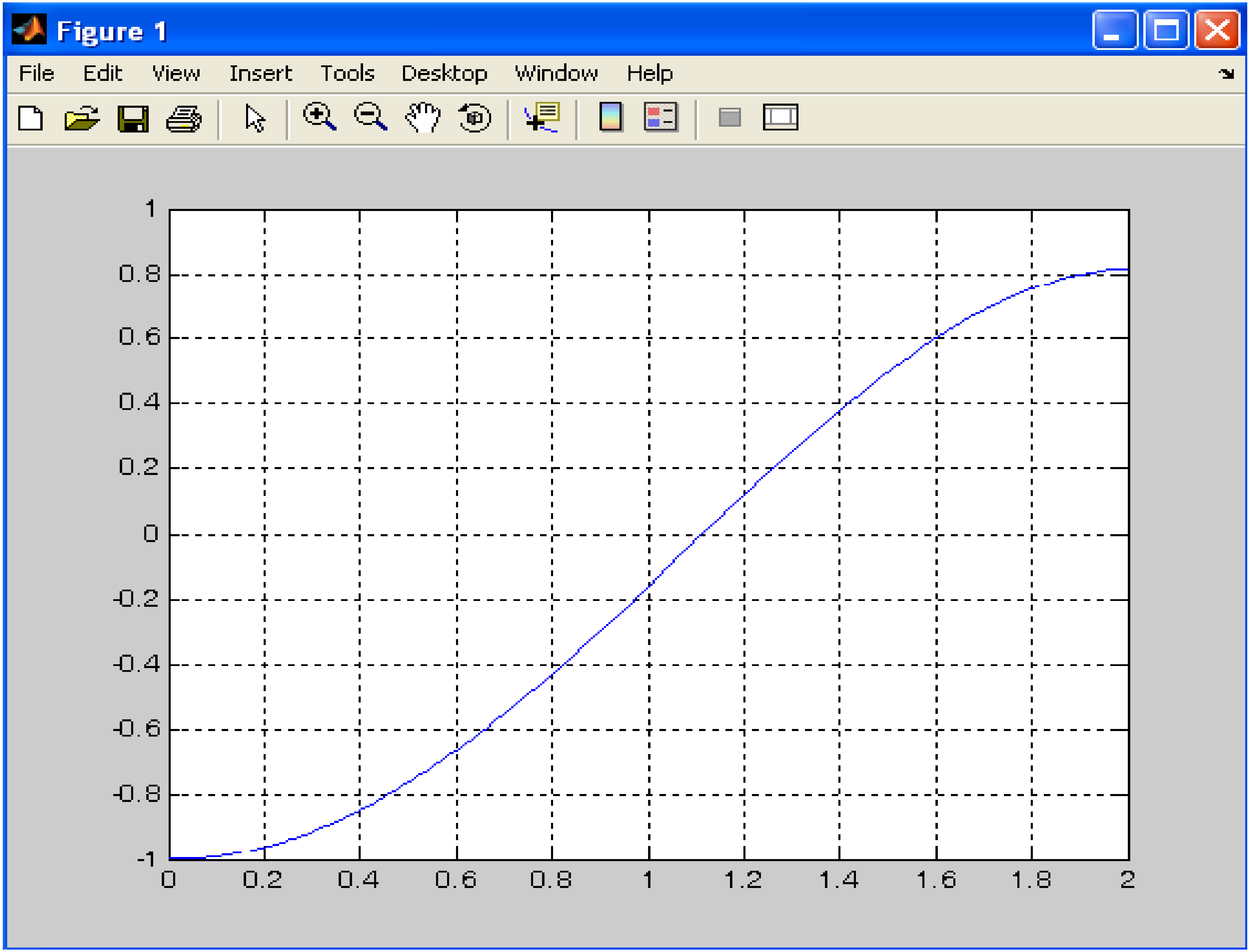
Figure 1
File Edit View Insert Tools Desktop Window Help
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
0 0.2 0.4 0.6 0.8 1 1.2 1.4 1.6 1.8 2

Example 2 using Bisection

>> [k,c,err,yc]=bisect('xsinm1',1,1.2,1e-5)

k	Left endpoint	Midpoint	Right endpoint	Fun Value f(c)
1	1.000000	1.10000000	1.20000000	-0.01967190
2	1.100000	1.15000000	1.20000000	0.04967853
3	1.100000	1.12500000	1.15000000	0.01505104
4	1.100000	1.11250000	1.12500000	-0.00230161
5	1.112500	1.11875000	1.12500000	0.00637731
6	1.112500	1.11562500	1.11875000	0.00203845
7	1.112500	1.11406250	1.11562500	-0.00013144
8	1.114063	1.11484375	1.11562500	0.00095354
9	1.114063	1.11445313	1.11484375	0.00041106
10	1.114063	1.11425781	1.11445313	0.00013981
11	1.114063	1.11416016	1.11425781	0.00000419
12	1.114063	1.11411133	1.11416016	-0.00006363
13	1.114111	1.11413574	1.11416016	-0.00002972
14	1.114136	1.11414795	1.11416016	-0.00001277
15	1.114148	1.11415405	1.11416016	-0.00000429

k = 15
c = 1.1142
err = 6.1035e-006
yc = -5.0525e-008

Example 2 using False Position

>> [k,c,err,yc]=regula('xsinm1',1,1.2,1e-5,1e-5,50)

k	Left endpoint	Midpoint	Right endpoint	Fun Value f(c)
1	1.000000	1.11447133	1.20000000	0.00043635
2	1.000000	1.11415712	1.11447133	-0.00000003
3	1.114157	1.11415714	1.11447133	0.00000000

Breaking condition is met

k = 3
c = 1.1142
err = 2.2470e-008
yc = 4.1789e-013

Exercise 1

1. Analyze the result of bisection and false position methods in example 2 when we change the interval [0 2]
2. Apply the false position and bisection methods on following and analyze

   1. $2x^3-2.5x-5=0$ for the root in the interval [1,2]
   2. $(x-2)^2-\ln(x)=0$ for the root in the interval [1,2] accurate to within 10^{-4}
   3. $5\sin^2(x)x-8\cos^5(x)=0$ for the root in the interval [0.5,1.5]

Exercise 2

Use the false position method to compute C_0, C_1, C_2 and C_3.

1. $\exp(x)-2-x=0$ $[-2.4, -1.6]$
2. $\cos(x)+1-x=0$ $[0.8, 1.6]$
3. $\ln(x)-5+x=0$ $[3.2, 4.0]$
4. $x^2-10x+23=0$ $[6.0, 6.8]$