REGULA FALSI METHOD

(PRACTICAL 2)

Que 1 Find the root of following using Regula falsi method :

In[1]:=
```
z = FindRoot[Cos[x], {x, 1, 2}]
```

Out[1]=
```
{x → 1.5708}
```

In[2]:=
```
f[x_] := Cos[x]
```

In[3]:=
```
a = 0;
```

In[4]:=
```
b = 2;
```

In[5]:=
```
ξ=0.0005;
```

In[6]:=
```
Nmax = 15;
```

In[7]:=
```
If[f[a] * f[b] > 0,
Print["THESE VALUES DO NOT SATISFY THE IVP SO CHANGE THE INITIAL VALUE"],
For[i = 1, i ≤ Nmax, i++,
c = N[(a * f[b] - b * f[a]) / (f[b] - f[a])];
If[f[c] * f[b] > 0, b = c, a = c];
If[Abs[(b - a)] < ξ, Return[c]];
Print[i, "th ITERATION VALUE IS :", N[c]];
Print["ESTIMATED ERROR IS ", N[b - a], " EXACT ERROR IS: ", 1.57079 - c]];
Print["THE APPROXIMATE ROOT IS : ", N[c]];
Print["ESTIMATED ERROR IS  : ", N[b - a]];
Plot[f[x], {x, -1, 3}]
```

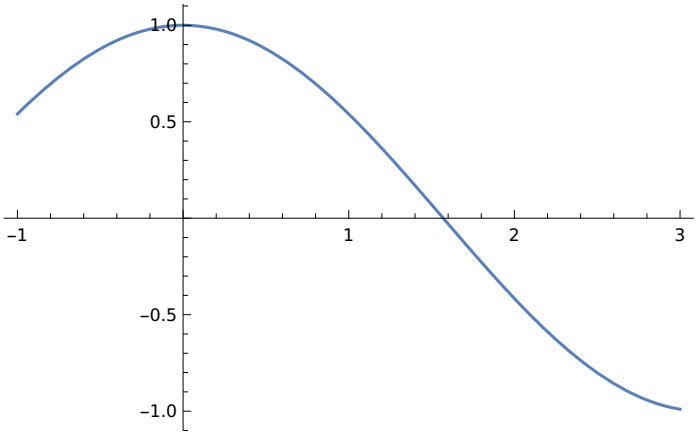
```
1th ITERATION VALUE IS :1.41228
ESTIMATED ERROR IS 0.587717 EXACT ERROR IS: 0.158507
2th ITERATION VALUE IS :1.57391
ESTIMATED ERROR IS 0.161623 EXACT ERROR IS: -0.00311632
3th ITERATION VALUE IS :1.57078
ESTIMATED ERROR IS 0.0031228 EXACT ERROR IS: 6.47806 × 10^-6
```

Out[7]=
```
1.5708
```

```
THE APPROXIMATE ROOT IS : 1.5708

ESTIMATED ERROR IS  : 0.0000128049
```

Out[10]=



In[66]:=
```
Quit
```

In[11]:=
```
z1 = FindRoot[Exp[-x] - x, {x, 1, 2}]
```

Out[11]=
```
{x → 0.567143}
```

In[12]:=
```
f[x_] := Exp[-x] - x
```

In[13]:=
```
a = 0;
```

In[14]:=
```
b = 0.8;
```

In[15]:=
```
ξ = 0.0005;
```

In[16]:=
```
Nmax = 20;
```

In[17]:=
```
If[f[a] * f[b] > 0,
Print["THESE VALUES DO NOT SATISFY THE IVP SO CHANGE THE INITIAL VALUE"],
For[i = 1, i ≤ Nmax, i++,
c = N[(a * f[b] - b * f[a]) / (f[b] - f[a])];
If[f[c] * f[b] > 0, b = c, a = c];
If[Abs[(b - a)] < ξ, Return[c]];
Print[i, "th ITERATION VALUE IS :", N[c]];
Print["ESTIMATED ERROR IS ", N[b - a], " EXACT ERROR IS: ", 0.567143 - c]];
Print["THE APPROXIMATE ROOT IS : ", N[c]];
Print["ESTIMATED ERROR IS  : ", N[b - a]];
Plot[f[x], {x, -1, 3}]
```

```
1th ITERATION VALUE IS :0.592298

ESTIMATED ERROR IS 0.592298 EXACT ERROR IS: -0.0251552

2th ITERATION VALUE IS :0.569932

ESTIMATED ERROR IS 0.569932 EXACT ERROR IS: -0.00278912

3th ITERATION VALUE IS :0.567453

ESTIMATED ERROR IS 0.567453 EXACT ERROR IS: -0.000310318
```

4th ITERATION VALUE IS :0.567178

ESTIMATED ERROR IS 0.567178 EXACT ERROR IS: -0.0000347658

5th ITERATION VALUE IS :0.567147

ESTIMATED ERROR IS 0.567147 EXACT ERROR IS: -4.12424×10^{-6}

6th ITERATION VALUE IS :0.567144

ESTIMATED ERROR IS 0.567144 EXACT ERROR IS: -7.16751×10^{-7}

7th ITERATION VALUE IS :0.567143

ESTIMATED ERROR IS 0.567143 EXACT ERROR IS: -3.37821×10^{-7}

8th ITERATION VALUE IS :0.567143

ESTIMATED ERROR IS 0.567143 EXACT ERROR IS: -2.95682×10^{-7}

9th ITERATION VALUE IS :0.567143

ESTIMATED ERROR IS 0.567143 EXACT ERROR IS: -2.90996×10^{-7}

10th ITERATION VALUE IS :0.567143

ESTIMATED ERROR IS 0.567143 EXACT ERROR IS: -2.90475×10^{-7}

11th ITERATION VALUE IS :0.567143

ESTIMATED ERROR IS 0.567143 EXACT ERROR IS: -2.90417×10^{-7}

12th ITERATION VALUE IS :0.567143

ESTIMATED ERROR IS 0.567143 EXACT ERROR IS: -2.90411×10^{-7}

13th ITERATION VALUE IS :0.567143

ESTIMATED ERROR IS 0.567143 EXACT ERROR IS: -2.9041×10^{-7}

14th ITERATION VALUE IS :0.567143

ESTIMATED ERROR IS 0.567143 EXACT ERROR IS: -2.9041×10^{-7}

15th ITERATION VALUE IS :0.567143

ESTIMATED ERROR IS 0.567143 EXACT ERROR IS: -2.9041×10^{-7}

16th ITERATION VALUE IS :0.567143

ESTIMATED ERROR IS 0.567143 EXACT ERROR IS: -2.9041×10^{-7}

17th ITERATION VALUE IS :0.567143

ESTIMATED ERROR IS 2.22045×10^{-16} EXACT ERROR IS: -2.9041×10^{-7}

18th ITERATION VALUE IS :0.567143

ESTIMATED ERROR IS 3.33067×10^{-16} EXACT ERROR IS: -2.9041×10^{-7}

19th ITERATION VALUE IS :0.567143

ESTIMATED ERROR IS 2.22045×10^{-16} EXACT ERROR IS: -2.9041×10^{-7}

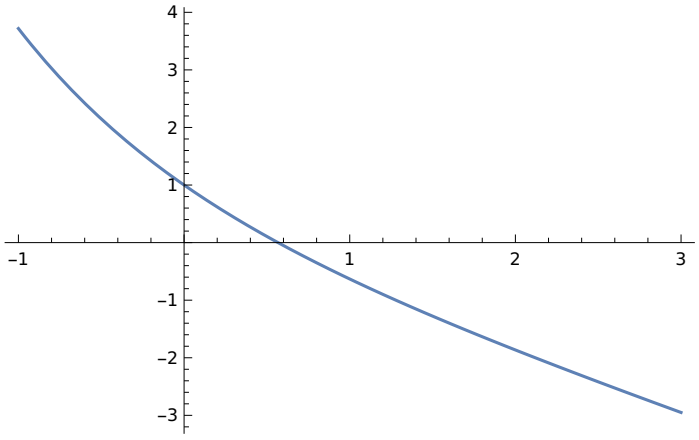
20th ITERATION VALUE IS :0.567143

ESTIMATED ERROR IS 3.33067×10^{-16} EXACT ERROR IS: -2.9041×10^{-7}

THE APPROXIMATE ROOT IS : 0.567143

ESTIMATED ERROR IS : 3.33067×10^{-16}

Out[20]=



In[51]:=
```
Quit
```

In[21]:=
```
z2 = FindRoot[x^5 + 2 x - 1, {x, 1, 2}]
```

Out[21]= {x → 0.486389}

In[22]:=
```
f[x_] := x^5 + 2 x - 1
```

In[23]:=
```
a = 0;
```

In[24]:=
```
b = 1;
```

In[25]:=
```
ξ = 0.0000001;
```

In[26]:=
```
Nmax = 10;
```

In[31]:=
```
If[f[a] * f[b] > 0,
Print["THESE VALUES DO NOT SATISFY THE IVP SO CHANGE THE INITIAL VALUE"],
For[i = 1, i ≤ Nmax, i++,
c = N[(a * f[b] - b * f[a]) / (f[b] - f[a])];
If[f[c] * f[b] > 0, b = c, a = c];
If[Abs[(b - a)] < ξ, Return[c]];
Print[i, "th ITERATION VALUE IS :", N[c]];
Print["ESTIMATED ERROR IS ", N[b - a], " EXACT ERROR IS: ", 0.486389 - c]];
Print["THE APPROXIMATE ROOT IS : ", N[c]];
Print["ESTIMATED ERROR IS  : ", N[b - a]];
Plot[f[x], {x, -1, 3}]
```

1th ITERATION VALUE IS :0.486369

ESTIMATED ERROR IS 0.513631 EXACT ERROR IS: 0.0000203015

2th ITERATION VALUE IS :0.486381

ESTIMATED ERROR IS 0.513619 EXACT ERROR IS: 8.39438×10^{-6}

3th ITERATION VALUE IS :0.486386

ESTIMATED ERROR IS 0.513614 EXACT ERROR IS: 3.45863×10^{-6}

4th ITERATION VALUE IS :0.486388

ESTIMATED ERROR IS 0.513612 EXACT ERROR IS: 1.41265×10^{-6}

5th ITERATION VALUE IS :0.486388

ESTIMATED ERROR IS 0.513612 EXACT ERROR IS: 5.6454×10^{-7}

6th ITERATION VALUE IS :0.486389

ESTIMATED ERROR IS 0.513611 EXACT ERROR IS: 2.12977×10^{-7}

7th ITERATION VALUE IS :0.486389

ESTIMATED ERROR IS 0.513611 EXACT ERROR IS: 6.72458×10^{-8}

8th ITERATION VALUE IS :0.486389

ESTIMATED ERROR IS 0.513611 EXACT ERROR IS: 6.83631×10^{-9}

9th ITERATION VALUE IS :0.486389

ESTIMATED ERROR IS 0.513611 EXACT ERROR IS: -1.82049×10^{-8}

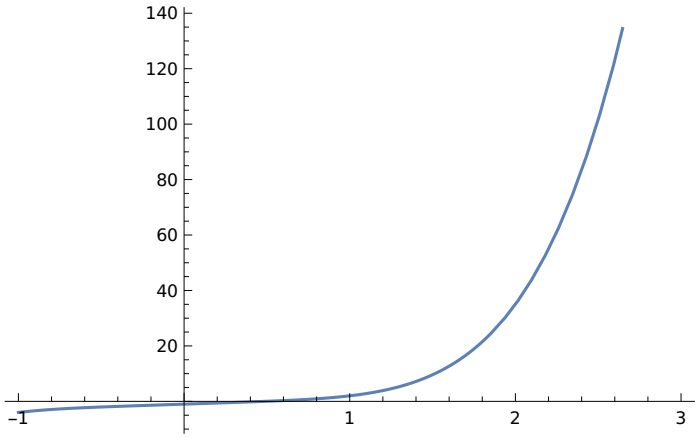
10th ITERATION VALUE IS :0.486389

ESTIMATED ERROR IS 0.513611 EXACT ERROR IS: -2.85852×10^{-8}

THE APPROXIMATE ROOT IS : 0.486389

ESTIMATED ERROR IS : 0.513611

Out[34]=



In[35]:=
```
z3 = FindRoot[(x^3) + 2 * x^2 - 3 x - 1, {x, 1, 2}]
```

Out[35]= {x → 1.19869}

In[36]:=
```
f[x_] := x^3 + 2 x^2 - 3 x - 1
```

In[37]:=
```
a = 0;
```

In[38]:=
```
b = -1;
```

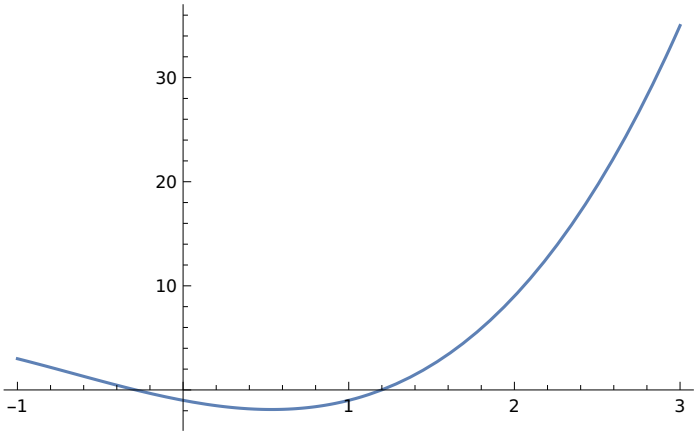
In[39]:=
```
ϵ=0.0005;
```

In[45]:=
```
Nmax = 10;
```

In[46]:=
```
If[f[a] * f[b] > 0,
Print["THESE VALUES DO NOT SATISFY THE IVP SO CHANGE THE INITIAL VALUE"],
For[i = 1, i ≤ Nmax, i++,
c = N[(a * f[b] - b * f[a]) / (f[b] - f[a])];
If[f[c] * f[b] > 0, b = c, a = c];
If[Abs[(b - a)] < ϵ, Return[c]];
Print[i, "th ITERATION VALUE IS :", N[c]];
Print["ESTIMATED ERROR IS ", N[b - a], " EXACT ERROR IS: ", 1.19869 - c]];
Print["THE APPROXIMATE ROOT IS : ", N[c];
Print["ESTIMATED ERROR IS  : ", N[b - a];
Plot[f[x], {x, -1, 3}]
```

```
1th ITERATION VALUE IS :-0.286462
ESTIMATED ERROR IS -0.713538 EXACT ERROR IS: 1.48515
2th ITERATION VALUE IS :-0.286462
ESTIMATED ERROR IS -0.713538 EXACT ERROR IS: 1.48515
3th ITERATION VALUE IS :-0.286462
ESTIMATED ERROR IS -0.713538 EXACT ERROR IS: 1.48515
4th ITERATION VALUE IS :-0.286462
ESTIMATED ERROR IS -0.713538 EXACT ERROR IS: 1.48515
5th ITERATION VALUE IS :-0.286462
ESTIMATED ERROR IS -0.713538 EXACT ERROR IS: 1.48515
6th ITERATION VALUE IS :-0.286462
ESTIMATED ERROR IS -0.713538 EXACT ERROR IS: 1.48515
7th ITERATION VALUE IS :-0.286462
ESTIMATED ERROR IS -0.713538 EXACT ERROR IS: 1.48515
8th ITERATION VALUE IS :-0.286462
ESTIMATED ERROR IS -0.713538 EXACT ERROR IS: 1.48515
9th ITERATION VALUE IS :-0.286462
ESTIMATED ERROR IS -0.713538 EXACT ERROR IS: 1.48515
10th ITERATION VALUE IS :-0.286462
ESTIMATED ERROR IS -0.713538 EXACT ERROR IS: 1.48515
THE APPROXIMATE ROOT IS : -0.286462
ESTIMATED ERROR IS  : -0.713538
```

Out[49]=



Que 4 **Find the root of the following using Regula falsi method : Cos[x]-x*Exp[x]**

In[50]:=
```
z = FindRoot[Cos[x] - x * Exp[x], {x, 1, 2}]
```

Out[50]=
```
{x → 0.517757}
```

In[51]:=
```
f[x_] := Cos[x] - x * Exp[x];
```

In[52]:=
```
a = 1;
```

In[60]:=
```
b = 0;
```

In[54]:=
```
ϵ=0.0005;
```

In[55]:=
```
Nmax = 15;
```

In[61]:=
```
If[f[a] * f[b] > 0,
Print["THESE VALUES DO NOT SATISFY THE IVP SO CHANGE THE INITIAL VALUE"],
For[i = 1, i ≤ Nmax, i++,
c = N[(a * f[b] - b * f[a]) / (f[b] - f[a])];
If[f[c] * f[b] > 0, b = c, a = c];
If[Abs[(b - a)] < ϵ, Return[c]];
Print[i, "th ITERATION VALUE IS :", N[c]];
Print["ESTIMATED ERROR IS ", N[b - a], "EXACT ERROR IS: ", 0.517757 - c]];
Print["THE APPROXIMATE ROOT IS : ", N[c]];
Print["ESTIMATED ERROR IS  : ", N[b - a]];
Plot[f[x], {x, -1, 3}]
```

1th ITERATION VALUE IS :0.314665

ESTIMATED ERROR IS −0.685335EXACT ERROR IS: 0.203092

2th ITERATION VALUE IS :0.446728

ESTIMATED ERROR IS −0.553272EXACT ERROR IS: 0.0710289

3th ITERATION VALUE IS :0.494015

ESTIMATED ERROR IS −0.505985EXACT ERROR IS: 0.0237417

4th ITERATION VALUE IS :0.509946

ESTIMATED ERROR IS −0.490054EXACT ERROR IS: 0.00781086

5th ITERATION VALUE IS :0.515201

ESTIMATED ERROR IS −0.484799EXACT ERROR IS: 0.00255599

6th ITERATION VALUE IS :0.516922

ESTIMATED ERROR IS −0.483078EXACT ERROR IS: 0.00083479

7th ITERATION VALUE IS :0.517485

ESTIMATED ERROR IS −0.482515EXACT ERROR IS: 0.000272323

8th ITERATION VALUE IS :0.517668

ESTIMATED ERROR IS −0.482332EXACT ERROR IS: 0.000088655

9th ITERATION VALUE IS :0.517728

ESTIMATED ERROR IS −0.482272EXACT ERROR IS: 0.0000286947

10th ITERATION VALUE IS :0.517748

ESTIMATED ERROR IS −0.482252EXACT ERROR IS: 9.12168×10^{-6}

11th ITERATION VALUE IS :0.517754

ESTIMATED ERROR IS −0.482246EXACT ERROR IS: 2.73255×10^{-6}

12th ITERATION VALUE IS :0.517756

ESTIMATED ERROR IS −0.482244EXACT ERROR IS: 6.46992×10^{-7}

13th ITERATION VALUE IS :0.517757

ESTIMATED ERROR IS −0.482243EXACT ERROR IS: -3.37773×10^{-8}

14th ITERATION VALUE IS :0.517757

ESTIMATED ERROR IS −0.482243EXACT ERROR IS: -2.55995×10^{-7}

15th ITERATION VALUE IS :0.517757

ESTIMATED ERROR IS −0.482243EXACT ERROR IS: -3.28531×10^{-7}

THE APPROXIMATE ROOT IS : 0.517757

ESTIMATED ERROR IS : −0.482243

Out[64]=