PRACTICAL-1

Bisection Method

Prachi Mittal

ROLL NO:-20211061

B.Sc. (H) Mathematics

Bisection Method: For Given Parameters

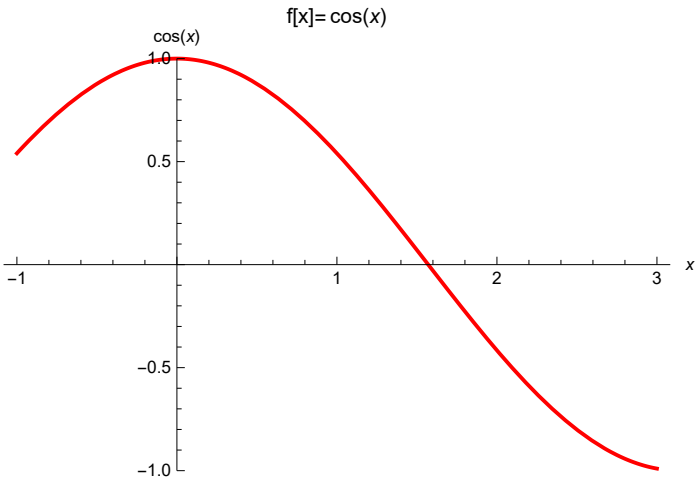
Ques-1

In[1]:=
```
x0 = 0;
x1 = 2.0;
Nmax = 20;
eps = 0.0001;
f[x_] := Cos[x];
If[N[f[x0] * f[x1]] > 0,
 Print["Your values do not satisfy the IVP,so change the values."],
 For[i = 1, i ≤ Nmax, i++, m = (x0 + x1) / 2;
  If[Abs[(x1 - x0) / 2] < eps, Return[m],
   Print[i, "th iteration value is : ", m];
   Print["Estimated error in ", i, "th iteration is : ", (x1 - x0) / 2];
   If[f[m] * f[x1] > 0, x1 = m, x0 = m]]];
 Print["Root is : ", m] ×
  Print["Estimated error in ", i, "th iteration is : ", (x1 - x0) / 2]]
Plot[f[x], {x, -1, 3}, PlotRange → {-1, 1},
 PlotStyle → {Red, Thick}, PlotLabel → "f[x]=" f[x], AxesLabel → {x, f[x]}]
```

```
1th iteration value is : 1.
Estimated error in 1th iteration is : 1.
2th iteration value is : 1.5
Estimated error in 2th iteration is : 0.5
3th iteration value is : 1.75
Estimated error in 3th iteration is : 0.25
4th iteration value is : 1.625
Estimated error in 4th iteration is : 0.125
5th iteration value is : 1.5625
Estimated error in 5th iteration is : 0.0625
6th iteration value is : 1.59375
Estimated error in 6th iteration is : 0.03125
7th iteration value is : 1.57813
Estimated error in 7th iteration is : 0.015625
8th iteration value is : 1.57031
Estimated error in 8th iteration is : 0.0078125
9th iteration value is : 1.57422
Estimated error in 9th iteration is : 0.00390625
10th iteration value is : 1.57227
Estimated error in 10th iteration is : 0.00195313
11th iteration value is : 1.57129
Estimated error in 11th iteration is : 0.000976563
12th iteration value is : 1.5708
Estimated error in 12th iteration is : 0.000488281
13th iteration value is : 1.57056
Estimated error in 13th iteration is : 0.000244141
14th iteration value is : 1.57068
Estimated error in 14th iteration is : 0.00012207
```

Out[6]= `Return[1.57074]`

Out[7]=



Ques-2

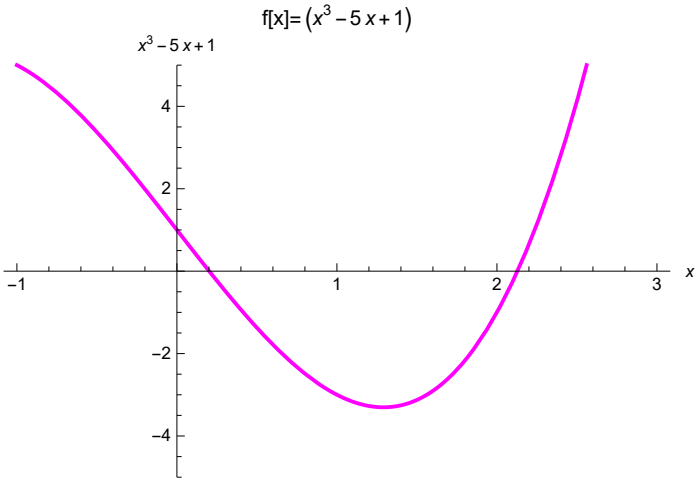
In[22]:=

```
x0 = 0;
x1 = 2.0;
Nmax = 20;
eps = 0.0001;
f[x_] := x^3 - 5 x + 1;
If[N[f[x0] * f[x1]] > 0,
 Print["Your values do not satisfy the IVP,so change the values."],
 For[i = 1, i ≤ Nmax, i++, m = (x0 + x1) / 2;
  If[Abs[(x1 - x0) / 2] < eps, Return[m],
   Print[i, "th iteration value is : ", m];
   Print["Estimated error in ", i, "th iteration is : ", (x1 - x0) / 2];
   If[f[m] * f[x1] > 0, x1 = m, x0 = m]]];
 Print["Root is : ", m] ×
  Print["Estimated error in ", i, "th iteration is : ", (x1 - x0) / 2]]
Plot[f[x], {x, -1, 3}, PlotRange → {-5, 5},
 PlotStyle → {Magenta, Thick}, PlotLabel → "f[x]=" f[x], AxesLabel → {x, f[x]}]
```

```
1th iteration value is : 1.
Estimated error in 1th iteration is : 1.
2th iteration value is : 0.5
Estimated error in 2th iteration is : 0.5
3th iteration value is : 0.25
Estimated error in 3th iteration is : 0.25
4th iteration value is : 0.125
Estimated error in 4th iteration is : 0.125
5th iteration value is : 0.1875
Estimated error in 5th iteration is : 0.0625
6th iteration value is : 0.21875
Estimated error in 6th iteration is : 0.03125
7th iteration value is : 0.203125
Estimated error in 7th iteration is : 0.015625
8th iteration value is : 0.195313
Estimated error in 8th iteration is : 0.0078125
9th iteration value is : 0.199219
Estimated error in 9th iteration is : 0.00390625
10th iteration value is : 0.201172
Estimated error in 10th iteration is : 0.00195313
11th iteration value is : 0.202148
Estimated error in 11th iteration is : 0.000976563
12th iteration value is : 0.20166
Estimated error in 12th iteration is : 0.000488281
13th iteration value is : 0.201416
Estimated error in 13th iteration is : 0.000244141
14th iteration value is : 0.201538
Estimated error in 14th iteration is : 0.00012207
```

Out[27]= `Return[0.201599]`

Out[28]=



Ques-3

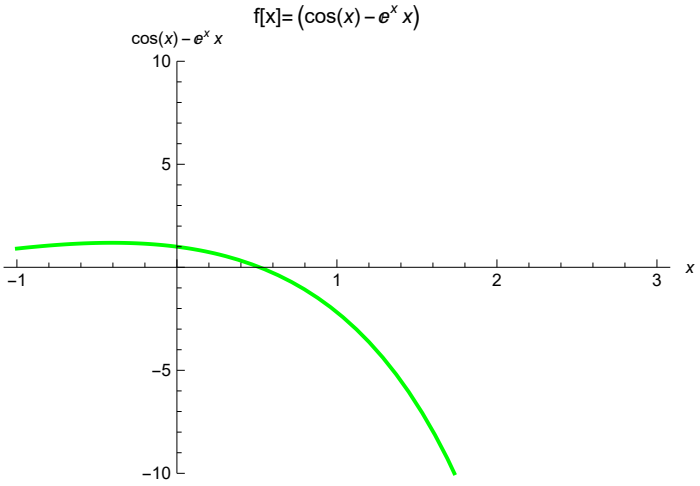
In[29]:=

```
x0 = 0;
x1 = 2.0;
Nmax = 20;
eps = 0.0001;
f[x_] := Cos[x] - x Exp[x];
If[N[f[x0] * f[x1]] > 0,
 Print["Your values do not satisfy the IVP,so change the values."],
 For[i = 1, i ≤ Nmax, i++, m = (x0 + x1) / 2;
  If[Abs[(x1 - x0) / 2] < eps, Return[m],
   Print[i, "th iteration value is : ", m];
   Print["Estimated error in ", i, "th iteration is : ", (x1 - x0) / 2];
   If[f[m] * f[x1] > 0, x1 = m, x0 = m]]];
 Print["Root is : ", m] ×
  Print["Estimated error in ", i, "th iteration is : ", (x1 - x0) / 2]]
Plot[f[x], {x, -1, 3}, PlotRange → {-10, 10},
 PlotStyle → {Green, Thick}, PlotLabel → "f[x]=" f[x], AxesLabel → {x, f[x]}]
```

```
1th iteration value is : 1.
Estimated error in 1th iteration is : 1.
2th iteration value is : 0.5
Estimated error in 2th iteration is : 0.5
3th iteration value is : 0.75
Estimated error in 3th iteration is : 0.25
4th iteration value is : 0.625
Estimated error in 4th iteration is : 0.125
5th iteration value is : 0.5625
Estimated error in 5th iteration is : 0.0625
6th iteration value is : 0.53125
Estimated error in 6th iteration is : 0.03125
7th iteration value is : 0.515625
Estimated error in 7th iteration is : 0.015625
8th iteration value is : 0.523438
Estimated error in 8th iteration is : 0.0078125
9th iteration value is : 0.519531
Estimated error in 9th iteration is : 0.00390625
10th iteration value is : 0.517578
Estimated error in 10th iteration is : 0.00195313
11th iteration value is : 0.518555
Estimated error in 11th iteration is : 0.000976563
12th iteration value is : 0.518066
Estimated error in 12th iteration is : 0.000488281
13th iteration value is : 0.517822
Estimated error in 13th iteration is : 0.000244141
14th iteration value is : 0.5177
Estimated error in 14th iteration is : 0.00012207
```

Out[34]= `Return[0.517761]`

Out[35]=



Bisection Method For Parameters Taken From Users

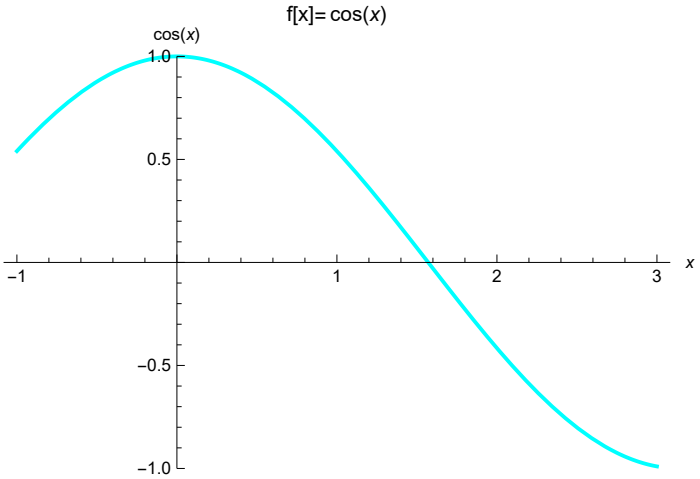
Ques-4

In[113]:=

```
x0 = Input["Enter first guess : "];
x1 = Input["Enter second guess : "];
Nmax = Input["Enter maximum number of iterations : "];
eps = Input["Enter the value of convergence parameter : "];
Print["x0 = ", x0];
Print["x1 = ", x1];
Print["Nmax = ", Nmax];
Print["Epsilon = ", eps];
f[x_] := Cos[x];
If[N[f[x0] * f[x1]] > 0,
 Print["Your values do not satisfy the IVP,so change the values."],
 For[i = 1, i ≤ Nmax, i++, m = (x0 + x1) / 2;
  If[Abs[(x1 - x0) / 2] < eps, Return[N[[m]]],
   Print[i, "th iteration value is : ", N[m]];
   Print["Estimated error in ", i, "th iteration is : ", N[(x1 - x0) / 2]];
   If[f[m] * f[x1] > 0, x1 = m, x0 = m]]];
 Print["Root is : ", N[m]] ×
  Print["Estimated error in ", i, "th iteration is : ", N[(x1 - x0) / 2]]]
Plot[f[x], {x, -1, 3}, PlotRange → {-1, 1},
 PlotStyle → {Cyan, Thick}, PlotLabel → "f[x]=" f[x], AxesLabel → {x, f[x]}]
```

```
x0 = 0

x1 = 1

Nmax = 15

Epsilon = 1.×10^-6

Your values do not satisfy the IVP,so change the values.
```

Out[123]=



Ques-5

In[91]:=

```
x0 = Input["Enter first guess : "];
x1 = Input["Enter second guess : "];
Nmax = Input["Enter maximum number of iterations : "];
eps = Input["Enter the value of convergence parameter : "];
Print["x0 = ", x0];
Print["x1 = ", x1];
Print["Nmax = ", Nmax];
Print["Epsilon = ", eps];
f[x_] := x^3 - 5 x + 1;
If[N[f[x0] * f[x1]] > 0,
 Print["Your values do not satisfy the IVP,so change the values."],
 For[i = 1, i ≤ Nmax, i++, m = (x0 + x1) / 2;
  If[Abs[(x1 - x0) / 2] < eps, Return[N[[m]]],
   Print[i, "th iteration value is : ", N[m]];
   Print["Estimated error in ", i, "th iteration is : ", N[(x1 - x0) / 2]];
   If[f[m] * f[x1] > 0, x1 = m, x0 = m]]];
 Print["Root is : ", N[m]] ×
  Print["Estimated error in ", i, "th iteration is : ", N[(x1 - x0) / 2]]]
Plot[f[x], {x, -1, 3}, PlotRange → {-5, 5},
 PlotStyle → {Red, Thick}, PlotLabel → "f[x]=" f[x], AxesLabel → {x, f[x]}]
```

x0 = 0

x1 = 1

Nmax = 15

Epsilon = $1.\times10^{-6}$

1th iteration value is : 0.5

Estimated error in 1th iteration is : 0.5

2th iteration value is : 0.25

Estimated error in 2th iteration is : 0.25

3th iteration value is : 0.125

Estimated error in 3th iteration is : 0.125

4th iteration value is : 0.1875

Estimated error in 4th iteration is : 0.0625

5th iteration value is : 0.21875

Estimated error in 5th iteration is : 0.03125

6th iteration value is : 0.203125

Estimated error in 6th iteration is : 0.015625

7th iteration value is : 0.195313

Estimated error in 7th iteration is : 0.0078125

8th iteration value is : 0.199219

Estimated error in 8th iteration is : 0.00390625

9th iteration value is : 0.201172

Estimated error in 9th iteration is : 0.00195313

10th iteration value is : 0.202148

Estimated error in 10th iteration is : 0.000976563

11th iteration value is : 0.20166

Estimated error in 11th iteration is : 0.000488281

12th iteration value is : 0.201416

Estimated error in 12th iteration is : 0.000244141

13th iteration value is : 0.201538

Estimated error in 13th iteration is : 0.00012207

14th iteration value is : 0.201599

Estimated error in 14th iteration is : 0.0000610352

15th iteration value is : 0.20163

Estimated error in 15th iteration is : 0.0000305176

Root is : 0.20163

Estimated error in 16th iteration is : 0.0000152588

Out[100]= $\texttt{Null}^2$

Out[101]=