

PRACTICAL-I: BISECTION METHOD

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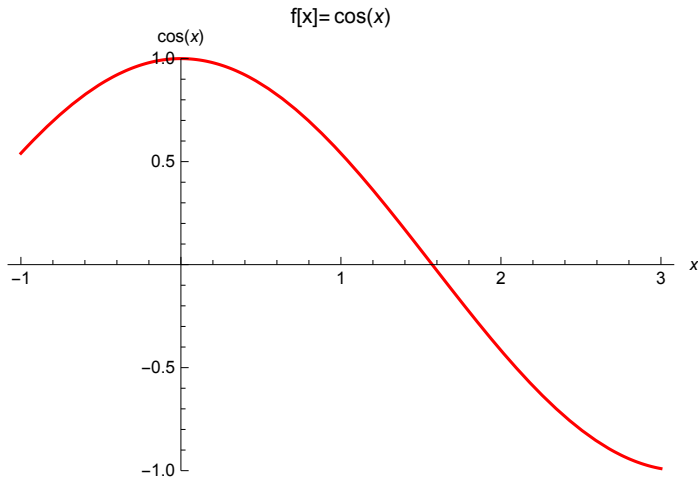
COURSE:- BSC(H) COMPUTER SCIENCE

```
x0 = 0;
x1 = 2.0;
Nmax = 20;
eps = 0.0001;
f[x_] := Cos[x];
If[N[f[x0] 8 f[x1]] > 0,
  Print["Yours values do not satisfy the IVP so change the value."],
  For[i = 1, i ≤ Nmax, i++, m =  $\frac{(x0 + x1)}{2}$  ;

    If[Abs[ $\frac{(x1 - x0)}{2}$ ] < eps, Return[m],
      Print[i, "th iteration value is :", m];
      Print["Estimated error in ", i, "th iteration is:",  $\frac{(x1 - x0)}{2}$  ];
      If[f[m] * f[x1] > 0, x1 = m, x0 = m] ]];
  Print["Root is:", m]

  Print["Estimated error in", i, "th iteration is:",  $\frac{(x1 - x0)}{2}$  ] ]
Plot[f[x], {x, -1, 3}, PlotRange → {-1, 1},
  PlotStyle → Red, 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
Return[1.57074]
```

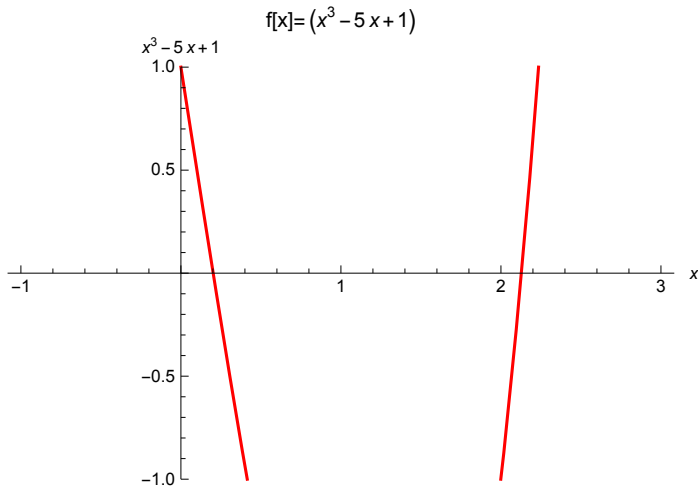


```

x0 = 0;
x1 = 2.0;
Nmax = 20;
eps = 0.0001;
f[x_] := x * x * x - 5 * x + 1;
If[N[f[x0] * f[x1]] > 0,
  Print["Yours values do not satisfy the IVP so change the value."],
  For[i = 1, i ≤ Nmax, i++, m =  $\frac{(x0 + x1)}{2}$ ;
    If[Abs[ $\frac{(x1 - x0)}{2}$ ] < eps, Return[m],
      Print[i, "th iteration value is :", m];
      Print["Estimated error in ", i, "th iteration is:",  $\frac{(x1 - x0)}{2}$ ];
      If[f[m] * f[x1] > 0, x1 = m, x0 = m]]];
  Print["Root is:", m]
  Print["Estimated error in", i, "th iteration is:",  $\frac{(x1 - x0)}{2}$ ]]
Plot[f[x], {x, -1, 3}, PlotRange → {-1, 1},
  PlotStyle → Red, 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
Return[0.201599]
```

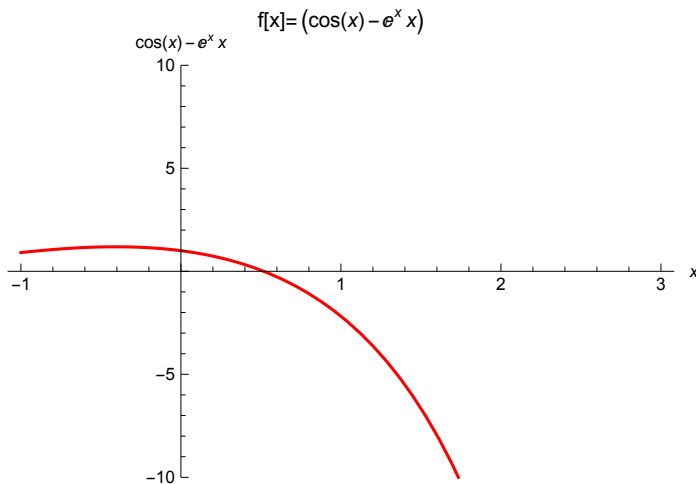


```

x0 = 0;
x1 = 1.0;
Nmax = 20;
eps = 0.0001;
f[x_] := Cos[x] - x * Exp[x];
If[N[f[x0] * f[x1]] > 0,
  Print["Yours values do not satisfy the IVP so change the value."],
  For[i = 1, i ≤ Nmax, i++, m =  $\frac{(x0 + x1)}{2}$ ;
    If[Abs[ $\frac{(x1 - x0)}{2}$ ] < eps, Return[m],
      Print[i, "th iteration value is :", m];
      Print["Estimated error in ", i, "th iteration is:",  $\frac{(x1 - x0)}{2}$ ];
      If[f[m] * f[x1] > 0, x1 = m, x0 = m]]];
  Print["Root is:", m]
  Print["Estimated error in", i, "th iteration is:",  $\frac{(x1 - x0)}{2}$ ]]
Plot[f[x], {x, -1, 3}, PlotRange → {-10, 10},
  PlotStyle → Red, PlotLabel → "f[x] = " f[x], AxesLabel → {x, f[x]}]

```

```
1th iteration value is :0.5
Estimated error in 1th iteration is:0.5
2th iteration value is :0.75
Estimated error in 2th iteration is:0.25
3th iteration value is :0.625
Estimated error in 3th iteration is:0.125
4th iteration value is :0.5625
Estimated error in 4th iteration is:0.0625
5th iteration value is :0.53125
Estimated error in 5th iteration is:0.03125
6th iteration value is :0.515625
Estimated error in 6th iteration is:0.015625
7th iteration value is :0.523438
Estimated error in 7th iteration is:0.0078125
8th iteration value is :0.519531
Estimated error in 8th iteration is:0.00390625
9th iteration value is :0.517578
Estimated error in 9th iteration is:0.00195313
10th iteration value is :0.518555
Estimated error in 10th iteration is:0.000976563
11th iteration value is :0.518066
Estimated error in 11th iteration is:0.000488281
12th iteration value is :0.517822
Estimated error in 12th iteration is:0.000244141
13th iteration value is :0.5177
Estimated error in 13th iteration is:0.00012207
Return[0.517761]
```



Bisection Method : For Parameters Taken from user

```

x0 = Input["Enter first number:"];
x1 = Input["Enter Second number:"];
Nmax = Input["Enter maximum number of iterations:"];
eps = Input["Enter a value of convergence parameter:"];
Print["x0=", x0];
Print["x1=", x1];
Print["Nmax=", Nmax];
Print["epsilon=", eps];
f[x_] := Cos[x];
If[N[f[x0] 8 f[x1]] > 0,
  Print["Yours values do not satisfy the IVP so change the value."],
  For[i = 1, i ≤ Nmax, i++, m =  $\frac{(x0 + x1)}{2}$  ;
    If[Abs[ $\frac{(x1 - x0)}{2}$ ] < eps, Return[m],
      Print[i, "th iteration value is :", m];
      Print["Estimated error in ", i, "th iteration is:",  $\frac{(x1 - x0)}{2}$  ];
      If[f[m] * f[x1] > 0, x1 = m, x0 = m] ]];
  Print["Root is:", m]
  Print["Estimated error in", i, "th iteration is:",  $\frac{(x1 - x0)}{2}$  ]]
Plot[f[x], {x, -1, 3}, PlotRange → {-1, 1},
  PlotStyle → Red, PlotLabel → "f[x]=" f[x], AxesLabel → {x, f[x]}]
x0=0
x1=2
Nmax=20
epsilon=1.×10-6
1th iteration value is :1

```

Estimated error in 1th iteration is:1

2th iteration value is : $\frac{3}{2}$

Estimated error in 2th iteration is: $\frac{1}{2}$

3th iteration value is : $\frac{7}{4}$

Estimated error in 3th iteration is: $\frac{1}{4}$

4th iteration value is : $\frac{13}{8}$

Estimated error in 4th iteration is: $\frac{1}{8}$

5th iteration value is : $\frac{25}{16}$

Estimated error in 5th iteration is: $\frac{1}{16}$

6th iteration value is : $\frac{51}{32}$

Estimated error in 6th iteration is: $\frac{1}{32}$

7th iteration value is : $\frac{101}{64}$

Estimated error in 7th iteration is: $\frac{1}{64}$

8th iteration value is : $\frac{201}{128}$

Estimated error in 8th iteration is: $\frac{1}{128}$

9th iteration value is : $\frac{403}{256}$

Estimated error in 9th iteration is: $\frac{1}{256}$

10th iteration value is : $\frac{805}{512}$

Estimated error in 10th iteration is: $\frac{1}{512}$

11th iteration value is : $\frac{1609}{1024}$

Estimated error in 11th iteration is: $\frac{1}{1024}$

12th iteration value is : $\frac{3217}{2048}$

Estimated error in 12th iteration is: $\frac{1}{2048}$

13th iteration value is : $\frac{6433}{4096}$

Estimated error in 13th iteration is: $\frac{1}{4096}$

14th iteration value is : $\frac{12867}{8192}$

Estimated error in 14th iteration is: $\frac{1}{8192}$

15th iteration value is : $\frac{25735}{16384}$

Estimated error in 15th iteration is: $\frac{1}{16384}$

16th iteration value is : $\frac{51471}{32768}$

Estimated error in 16th iteration is: $\frac{1}{32768}$

17th iteration value is : $\frac{102943}{65536}$

Estimated error in 17th iteration is: $\frac{1}{65536}$

18th iteration value is : $\frac{205887}{131072}$

Estimated error in 18th iteration is: $\frac{1}{131072}$

19th iteration value is : $\frac{411775}{262144}$

Estimated error in 19th iteration is: $\frac{1}{262144}$

20th iteration value is : $\frac{823549}{524288}$

Estimated error in 20th iteration is: $\frac{1}{524288}$

Root is: $\frac{823549}{524288}$

Estimated error in 21th iteration is: $\frac{1}{1048576}$

Null²

