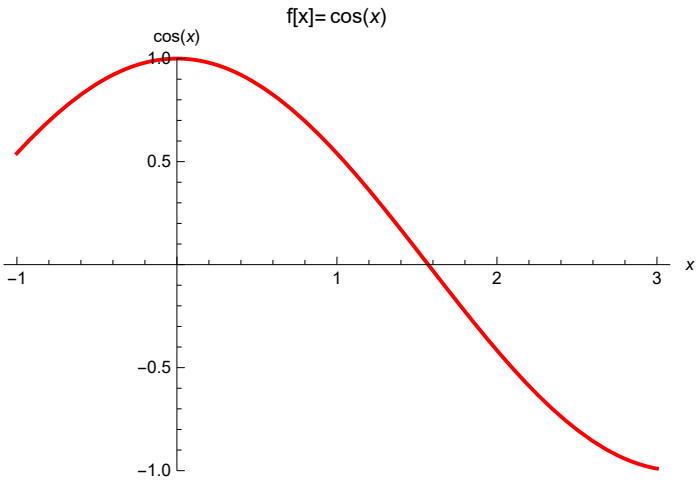
PRACTICAL-1
Bisection method
Riya Tomar

BISECTION METHOD :FOR THE GIVEN PARAMETERS

Question: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]}]
```

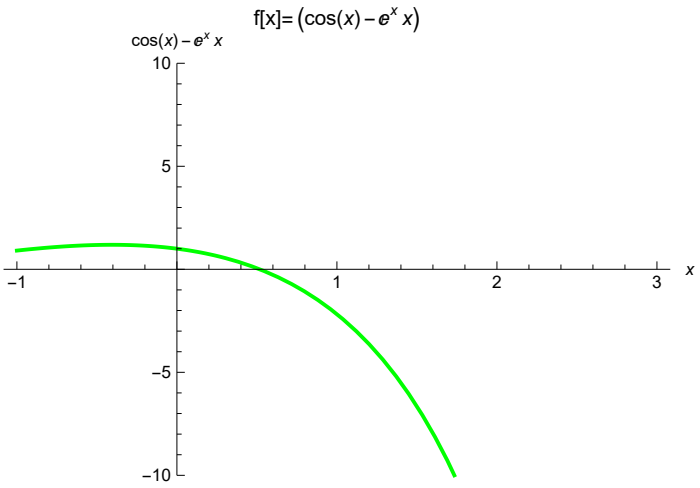
```
1th iteration value is :1.
Estimated error in 1th iteration is :1.
2th iteration value is :1.5
Estimated error in 2th iteration is :0.5
3th iteration value is :1.75
Estimated error in 3th iteration is :0.25
4th iteration value is :1.625
Estimated error in 4th iteration is :0.125
5th iteration value 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
Return[1.57074]
```



Question:2

```
x0 = 0;
x1 = 2.0;
Nmax = 20;
eps = 0.00001;
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
15th iteration value is :0.517761
Estimated error in 15th iteration is :0.0000610352
16th iteration value is :0.517731
Estimated error in 16th iteration is :0.0000305176
17th iteration value is :0.517746
Estimated error in 17th iteration is :0.0000152588
Return[0.517754]
```



Question:3

In[8]:=
```
x0 = Input["Enter the guess"];
x1 = Input["Enter Second guess"];
Nmax = Input["Enter Nmax guess"];
eps = Input["Enter approx error"];
f[x_] = Input["Enter Function"];
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 : $\frac{1}{2}$

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

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

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

4th iteration value is : $\frac{5}{8}$

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

5th iteration value is : $\frac{9}{16}$

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

6th iteration value is : $\frac{17}{32}$

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

7th iteration value is : $\frac{33}{64}$

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

8th iteration value is : $\frac{67}{128}$

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

9th iteration value is : $\frac{133}{256}$

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

10th iteration value is : $\frac{265}{512}$

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

11th iteration value is : $\frac{531}{1024}$

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

12th iteration value is : $\frac{1061}{2048}$

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

13th iteration value is : $\frac{2121}{4096}$

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

14th iteration value is : $\frac{4241}{8192}$

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

15th iteration value is : $\frac{8483}{16\,384}$

Estimated error in 15th iteration is : $\frac{1}{16\,384}$

16th iteration value is : $\frac{16\,965}{32\,768}$

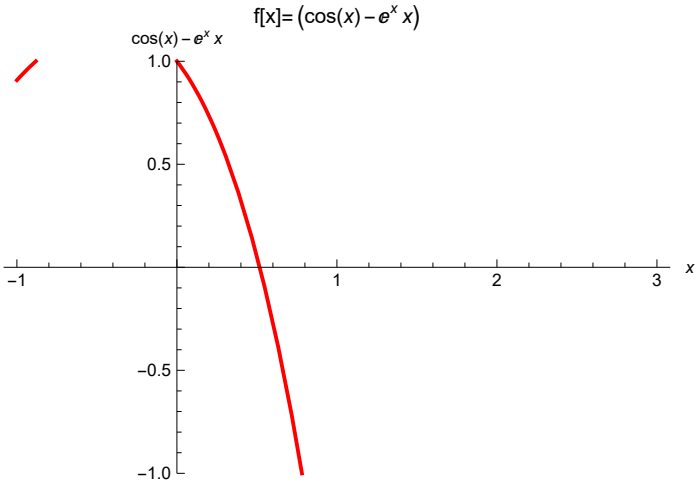
Estimated error in 16th iteration is : $\frac{1}{32\,768}$

17th iteration value is : $\frac{33\,931}{65\,536}$

Estimated error in 17th iteration is : $\frac{1}{65\,536}$

Out[13]= Return $\left[\frac{67\,863}{131\,072}\right]$

Out[14]=



Secant method

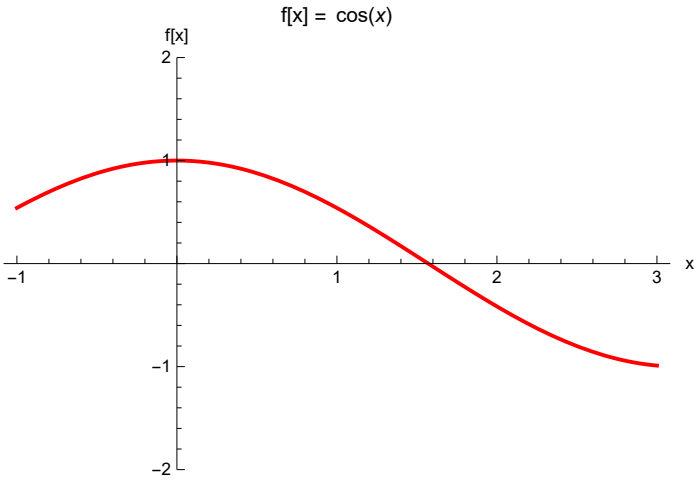
Question 1:

In[85]:=

```
x0 = 0;
x1 = 1.0;
Nmax = 20;
eps = 0.00001;
f[x_] := Cos[x];
If[N[f[x1] - f[x0]] == 0, Print["Division by zero encountered"],
  For[i = 1, i ≤ Nmax, i++, x2 = x1 - ((x1 - x0) * f[x1]) / (f[x1] - f[x0]);
   Print[i, "th iteration value is: ", x2];
   Print["Estimated error in ", i, "th iteration is: ", Abs[x1 - x0]];
   If[Abs[(x1 - x2) / 2] < eps,
    Print["Converged to root at x = ", x2, " in ", i, " iterations."];
    root = x2;
    Break[];];
   x0 = x1;
   x1 = x2;]];
Plot[f[x], {x, -1, 3}, PlotRange → {-2, 2}, PlotStyle → {Red, Thick},
 PlotLabel → "f[x] = " f[x], AxesLabel → {"x", "f[x]"}]
```

```
1th iteration value is: 2.17534

Estimated error in 1th iteration is: 1.

2th iteration value is: 1.57278

Estimated error in 2th iteration is: 1.17534

3th iteration value is: 1.57067

Estimated error in 3th iteration is: 0.602559

4th iteration value is: 1.5708

Estimated error in 4th iteration is: 0.00211435

5th iteration value is: 1.5708

Estimated error in 5th iteration is: 0.000126873

Converged to root at x = 1.5708 in 5 iterations.
```

Out[91]=

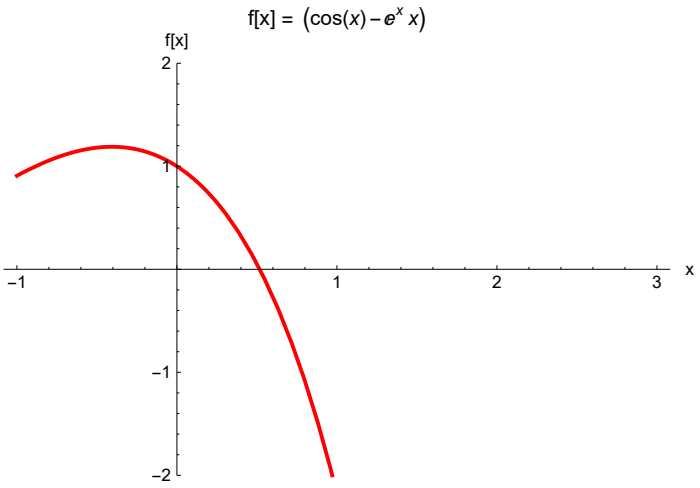


Question 2:

In[78]:=
```
x0 = 0;
x1 = 1.0;
Nmax = 20;
eps = 0.00001;
f[x_] := Cos[x] - x * Exp[x];
If[N[f[x1] - f[x0]] == 0, Print["Division by zero encountered"],
  For[i = 1, i ≤ Nmax, i++, x2 = x1 - ((x1 - x0) * f[x1]) / (f[x1] - f[x0]);
   Print[i, "th iteration value is: ", x2];
   Print["Estimated error in ", i, "th iteration is: ", Abs[x1 - x0]];
   If[Abs[(x1 - x2) / 2] < eps,
    Print["Converged to root at x = ", x2, " in ", i, " iterations."];
    root = x2;
    Break[];];
   x0 = x1;
   x1 = x2;]];
Plot[f[x], {x, -1, 3}, PlotRange → {-2, 2}, PlotStyle → {Red, Thick},
 PlotLabel → "f[x] = " f[x], AxesLabel → {"x", "f[x]"}]
```

```
1th iteration value is: 0.314665

Estimated error in 1th iteration is: 1.

2th iteration value is: 0.446728

Estimated error in 2th iteration is: 0.685335

3th iteration value is: 0.531706

Estimated error in 3th iteration is: 0.132063

4th iteration value is: 0.516904

Estimated error in 4th iteration is: 0.0849777

5th iteration value is: 0.517747

Estimated error in 5th iteration is: 0.0148014

6th iteration value is: 0.517757

Estimated error in 6th iteration is: 0.000842998

Converged to root at x = 0.517757 in 6 iterations.
```

Out[84]=



Regular Falsi

Question1:

In[92]:=

```
x0 = 0;
x1 = 2.0;
Nmax = 20;
eps = 0.0001;
f[x_] := Cos[x];
If[f[x0] * f[x1] > 0, Print["Function does not change sign in [",
   x0, ",", x1, "]. Choose different initial points."],
  For[i = 1, i ≤ Nmax, i++, x2 = x1 - (f[x1] * (x1 - x0)) / (f[x1] - f[x0]);
   Print[i, "th iteration value is: ", x2];
   Print["Estimated error in ", i, "th iteration is: ", Abs[x1 - x0]];
   If[Abs[f[x2]] < eps || Abs[x1 - x0] < eps,
    Print["Converged to root at x = ", x2, " in ", i, " iterations."];
    root = x2;
    Break[];];
   If[f[x0] * f[x2] < 0, x1 = x2, x0 = x2];]];
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: 1.41228

Estimated error in 1th iteration is: 2.

2th iteration value is: 1.57391

Estimated error in 2th iteration is: 0.587717

3th iteration value is: 1.57078

Estimated error in 3th iteration is: 0.161623

Converged to root at x = 1.57078 in 3 iterations.
```

Out[98]=