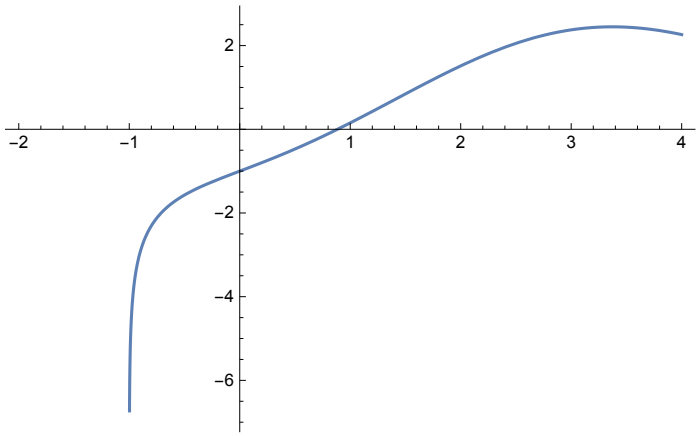
Practical 1
Bisection Method

(1) Find a real root of the equation f(x)=log(1+x)-cos(x)=0 using bisection method in 10 iterations

In[ ]:=
```
Bisection[a0_, b0_, n_, f_] :=
 Module [{a = N[a0], b = N[b0]},
  c = (a + b) / 2;
  i = 0
    If[f[a] * f[b] > 0, Print[
      "we cannot continue with the bisection method as ",
      f, "(a).", f, "(b)>=0"];
     Return[]];
  output = {{i, a, c, b, f[c]}};
  While[i < n, If[Sign[f[b]] == Sign[f[c]], b = c, a = c;];
   c = (a + b) / 2;
   i = i + 1; output = Append[output, {i, a, c, b, f[c]}];];
  Print[NumberForm[TableForm[output, TableHeadings →
     {None, {"i", "aᵢ", "cᵢ", "bᵢ", "f[cᵢ]"}}], 16]];
  Print["Approximate root after ", i,
   " iterations is ", NumberForm[c, 16]];
  Print["Function value at approximated root,f[c]=",
   NumberForm[f[c], 16]];]
f[x_] := Log[1 + x] - Cos[x];
Plot[f[x], {x, -2, 4}]
Bisection[0, 1, 10, f];
```

Out[ ]=



i	a_i	c_i	b_i	$f[c_i]$
0	0.	0.5	1.	-0.4721174537822083
1	0.5	0.75	1.	-0.1720730809383982
2	0.75	0.875	1.	-0.0123881987409511
3	0.875	0.9375	1.	0.06959340715288754
4	0.875	0.90625	0.9375	0.02843589519467271
5	0.875	0.890625	0.90625	0.007981228405989915
6	0.875	0.8828125	0.890625	-0.00221425440755807
7	0.8828125	0.88671875	0.890625	0.002880808814339719
8	0.8828125	0.884765625	0.88671875	0.000332605881430581
9	0.8828125	0.8837890625	0.884765625	-0.000940992314640399
10	0.8837890625	0.88427734375	0.884765625	-0.0003042352019027028

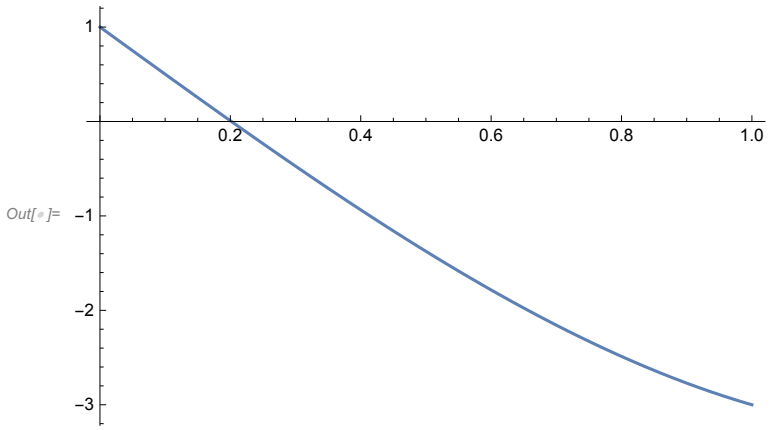
Approximate root after 10 iterations is 0.88427734375

Function value at approximated root,f[c]=-0.0003042352019027028

(2) Find one root of the function $g(x) = x^3 - 5x + 1$,using Bisection Method Perform 12 iterations

In[•]:=
```
g[x_] := x^3 - 5 x + 1;
Plot[g[x], {x, 0, 1}]
```

Out[•]=



The root lies in the interval [0,1] now apply Bisection Method on the interval [3,4]

In[•]:=
```
Bisection[0, 1, 5, g];
```

i	a_i	c_i	b_i	$f[c_i]$
0	0.	0.5	1.	-1.375
1	0.	0.25	0.5	-0.234375
2	0.	0.125	0.25	0.376953125
3	0.125	0.1875	0.25	0.069091796875
4	0.1875	0.21875	0.25	-0.083282470703125
5	0.1875	0.203125	0.21875	-0.007244110107421875

Approximate root after 5 iterations is 0.203125

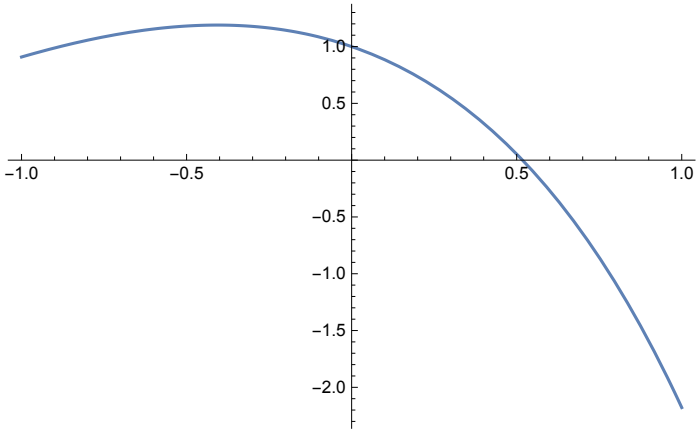
Function value at approximated root,f[c]=-0.007244110107421875

(3) Find root of the function $f(x) = \cos[x] - xe^x$,using Bisection

Method Perform 5 iterations

In[•]:=
```
f[x_] := Cos[x] - x Exp[x];
Plot[f[x], {x, -1, 1}]
Bisection[0, 1, 5, f];
```

Out[•]=



i	a_i	c_i	b_i	$f[c_i]$
0	0.	0.5	1.	0.05322192654030866
1	0.5	0.75	1.	−0.856061143585685
2	0.5	0.625	0.75	−0.356690603889921
3	0.5	0.5625	0.625	−0.1412937453091
4	0.5	0.53125	0.5625	−0.04151221167208242
5	0.5	0.515625	0.53125	0.006475340827341247

Approximate root after 5 iterations is 0.515625

Function value at approximated root,f[c]=0.006475340827341247