BISECTION METHOD

(PRACTICAL-1 BISECTION METHOD)

Que 1 Find the root of equation using bisection method: x^3+4 x^2-10.

In[191]:=
```
z1 = FindRoot[x^3 + 4 x^2 - 10, {x, 1, 2}]
```

Out[191]=
```
{x → 1.36523}
```

In[202]:=
```
f[x_] := x^3 + 4 x^2 - 10
```

In[203]:=
```
a = 1;
```

In[204]:=
```
b = 2;
```

In[205]:=
```
e=0.01;
```

In[206]:=
```
Nmax = 10;              "MAXIMUM NO OF ITERATIONS";
```

In[207]:=
```
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 = (a + b) / 2;
If[Abs[(b - a) / 2] < e, Return[c],
Print[i, "th ITERATION VALUE IS :", c];
Print["ESTIMATED ERROR IN ", i, "th ITERATION IS: ", (b - a) / 2];
Print["EXACT ERROR IN ", i, "th ITERATION IS: ", 1.36523 - c];

If[f[a] * f[c] < 0, b = c, a = c]]]];
Print["THE APPROXIMATE ROOT IS : ", N[c]];
Plot[f[x], {x, 1, 2}]
```

1th ITERATION VALUE IS :$\frac{3}{2}$

ESTIMATED ERROR IN 1th ITERATION IS: $\frac{1}{2}$

EXACT ERROR IN 1th ITERATION IS: -0.13477

2th ITERATION VALUE IS :$\frac{5}{4}$

ESTIMATED ERROR IN 2th ITERATION IS: $\frac{1}{4}$

EXACT ERROR IN 2th ITERATION IS: 0.11523

3th ITERATION VALUE IS :$\frac{11}{8}$

ESTIMATED ERROR IN 3th ITERATION IS: $\frac{1}{8}$

EXACT ERROR IN 3th ITERATION IS: -0.00977

4th ITERATION VALUE IS :$\frac{21}{16}$

ESTIMATED ERROR IN 4th ITERATION IS: $\frac{1}{16}$

EXACT ERROR IN 4th ITERATION IS: 0.05273

5th ITERATION VALUE IS :$\frac{43}{32}$

ESTIMATED ERROR IN 5th ITERATION IS: $\frac{1}{32}$

EXACT ERROR IN 5th ITERATION IS: 0.02148

6th ITERATION VALUE IS :$\frac{87}{64}$

ESTIMATED ERROR IN 6th ITERATION IS: $\frac{1}{64}$

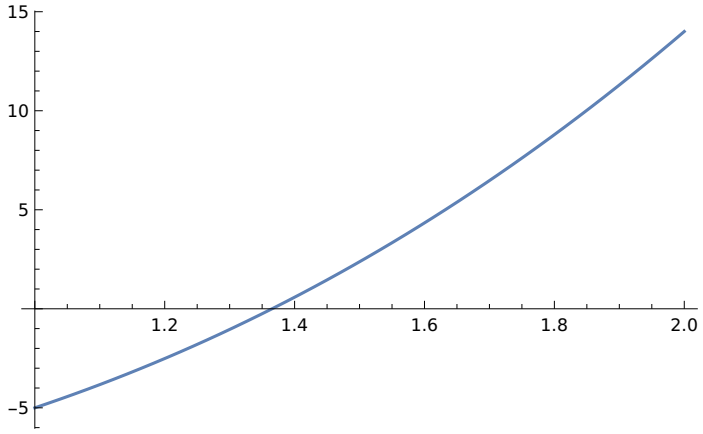
EXACT ERROR IN 6th ITERATION IS: 0.005855

Out[207]=

$\frac{175}{128}$

THE APPROXIMATE ROOT IS : 1.36719

Out[209]=



Que 2 Find the root of equation using bisection method: Cos[x].

In[119]:=
```
f[x_] := Cos[x]
```

In[141]:=
```
a2 = 0;
```

In[142]:=
```
b2 = 2;
```

In[143]:=
```
ξ=0.0005;
```

In[137]:=
```
Nmax2 = 20;
```

In[144]:=
```
If[f[a2] * f[b2] > 0,
Print["THESE VALUES DO NOT SATISFY THE IVP SO CHANGE THE INITIAL VALUE"],
For[i = 1, i ≤ Nmax2, i++, c = (a2 + b2) / 2;
If[Abs[(b2 - a2) / 2] < ξ, Return[c],
Print[i, "th ITERATION VALUE IS :", c];
Print["ESTIMATED ERROR IN ", i, "th ITERATION IS: ", (b2 - a2) / 2];
If[f[a2] * f[c] < 0, b2 = c, a2 = c]]]];
Print["THE APPROXIMATE ROOT IS : ", N[c]];
Plot[f[x], {x, 0, 2}]
```

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 :$\frac{1609}{1024}$

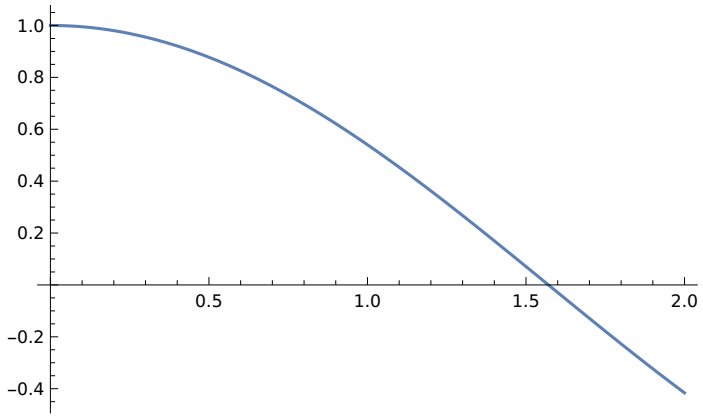
ESTIMATED ERROR IN 11th ITERATION IS: $\frac{1}{1024}$

Out[144]=

$$\frac{3217}{2048}$$

```
THE APPROXIMATE ROOT IS : 1.5708
```

Out[146]=



Que 3 Find the root of equation using bisection method: Exp[-x]-x.

In[147]:=
```
f[x_] := (E^-x) - x
```

In[148]:=
```
a = 0;
```

In[149]:=
```
b = 0.6;
```

In[150]:=
```
ξ = 0.0005;
```

In[151]:=
```
Nmax3 = 15;
```

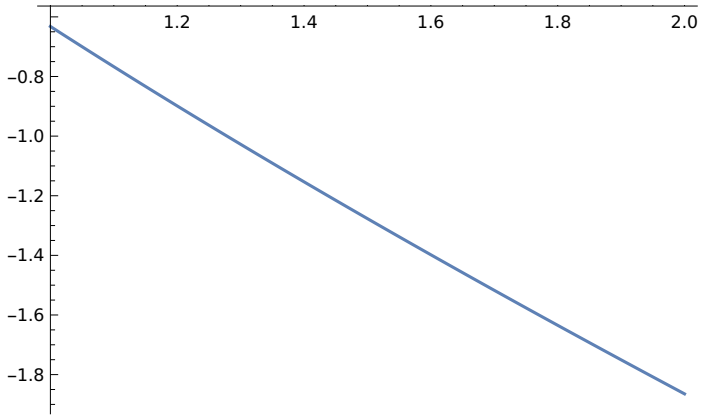
In[152]:=
```
If[f[a] * f[b] > 0,
Print["THESE VALUES DO NOT SATISFY THE IVP SO CHANGE THE INITIAL VALUE"],
For[i = 1, i ≤ Nmax3, i++, c = (a + b) / 2;
If[Abs[(b - a) / 2] < e, Return[c],
Print[i, "th ITERATION VALUE IS :", c];
Print["ESTIMATED ERROR IN ", i, "th ITERATION IS: ", (b - a) / 2];
If[f[a] * f[c] < 0, b = c, a = c]]];
Print["THE APPROXIMATE ROOT IS : ", N[c]];
Plot[f[x], {x, 1, 2}]
```

```
1th ITERATION VALUE IS :0.3
ESTIMATED ERROR IN 1th ITERATION IS: 0.3
2th ITERATION VALUE IS :0.45
ESTIMATED ERROR IN 2th ITERATION IS: 0.15
3th ITERATION VALUE IS :0.525
ESTIMATED ERROR IN 3th ITERATION IS: 0.075
4th ITERATION VALUE IS :0.5625
ESTIMATED ERROR IN 4th ITERATION IS: 0.0375
5th ITERATION VALUE IS :0.58125
ESTIMATED ERROR IN 5th ITERATION IS: 0.01875
```

Out[152]=

```
0.571875
THE APPROXIMATE ROOT IS : 0.571875
```

Out[154]=



Que 4 Find the root of equation using bisection method: x^5-2 x-1.

In[155]:=
```
f[x_] := x^5 - 2 x - 1
```

In[165]:=
```
a = -1;
```

In[166]:=
```
b = 0;
```

In[159]:=
```
ξ = 0.0005;
```

In[161]:=
```
Nmax4 = 10;
```

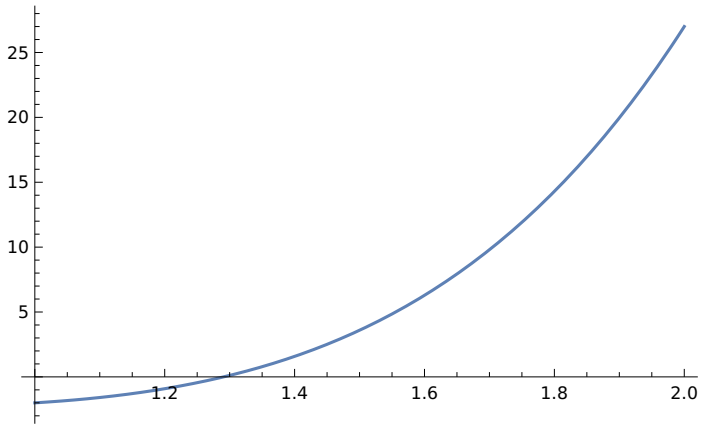
In[167]:=
```
If[f[a] * f[b] > 0,
Print["THESE VALUES DO NOT SATISFY THE IVP SO CHANGE THE INITIAL VALUE"],
For[i = 1, i ≤ Nmax4, i++, c = (a + b) / 2;
If[Abs[(b - a) / 2] < e, Return[c],
Print[i, "th ITERATION VALUE IS :", c];
Print["ESTIMATED ERROR IN ", i, "th ITERATION IS: ", (b - a) / 2];
If[f[a] * f[c] < 0, b = c, a = c]]];
Print["THE APPROXIMATE ROOT IS : ", N[c]];
Plot[f[x], {x, 1, 2}]
```

```
1th ITERATION VALUE IS :-1/2

ESTIMATED ERROR IN 1th ITERATION IS: 1/2

2th ITERATION VALUE IS :-1/4

ESTIMATED ERROR IN 2th ITERATION IS: 1/4

3th ITERATION VALUE IS :-1/8

ESTIMATED ERROR IN 3th ITERATION IS: 1/8

4th ITERATION VALUE IS :-1/16

ESTIMATED ERROR IN 4th ITERATION IS: 1/16

5th ITERATION VALUE IS :-1/32

ESTIMATED ERROR IN 5th ITERATION IS: 1/32

6th ITERATION VALUE IS :-1/64

ESTIMATED ERROR IN 6th ITERATION IS: 1/64
```

Out[167]=
$$-\frac{1}{128}$$

```
THE APPROXIMATE ROOT IS : -0.0078125
```

Out[169]=



Que 5 Find the root of equation using bisection method: x^3-5 x+1.

In[170]:=
```
f[x_] := x ^ 3 - 5 x + 1
```

In[171]:=
```
a = 0;
```

In[172]:=
```
b = 1;
```

In[173]:=
```
ξ = 0.0005;
```

In[174]:=
```
Nmax5 = 10;
```

In[175]:=
```
If[f[a] * f[b] > 0,
Print["THESE VALUES DO NOT SATISFY THE IVP SO CHANGE THE INITIAL VALUE"],
For[i = 1, i ≤ Nmax4, i++, c = (a + b) / 2;
If[Abs[(b - a) / 2] < e, Return[c],
Print[i, "th ITERATION VALUE IS :", c];
Print["ESTIMATED ERROR IN ", i, "th ITERATION IS: ", (b - a) / 2];
If[f[a] * f[c] < 0, b = c, a = c]]]];
Print["THE APPROXIMATE ROOT IS : ", N[c]];
Plot[f[x], {x, 0, 1}]
```

1th ITERATION VALUE IS :$\frac{1}{2}$

ESTIMATED ERROR IN 1th ITERATION IS: $\frac{1}{2}$

2th ITERATION VALUE IS :$\frac{1}{4}$

ESTIMATED ERROR IN 2th ITERATION IS: $\frac{1}{4}$

3th ITERATION VALUE IS :$\frac{1}{8}$

ESTIMATED ERROR IN 3th ITERATION IS: $\frac{1}{8}$

4th ITERATION VALUE IS :$\frac{3}{16}$

ESTIMATED ERROR IN 4th ITERATION IS: $\frac{1}{16}$

5th ITERATION VALUE IS :$\frac{7}{32}$

ESTIMATED ERROR IN 5th ITERATION IS: $\frac{1}{32}$

6th ITERATION VALUE IS :$\frac{13}{64}$

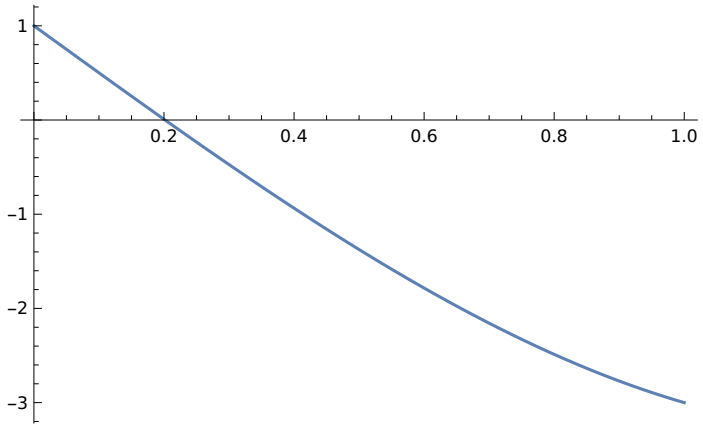
ESTIMATED ERROR IN 6th ITERATION IS: $\frac{1}{64}$

Out[175]=

$$\frac{25}{128}$$

THE APPROXIMATE ROOT IS : 0.195313

Out[177]=



NSolve[x^3+4x^2-10, x]