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Roll No. - 20222756
Practical- 4
Newton- Raphson Method

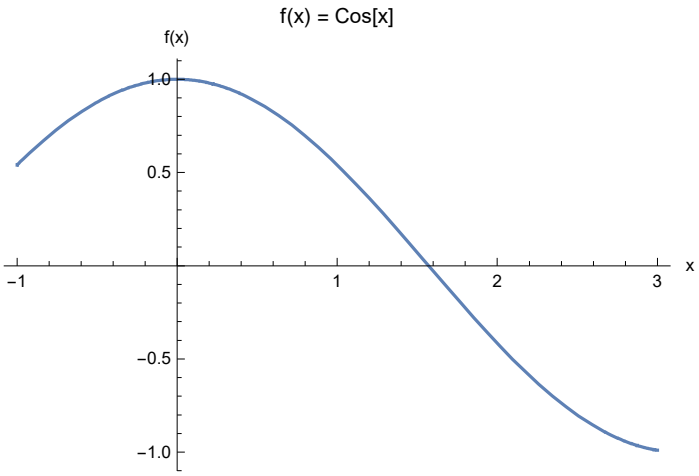
In[267]:=
```
x0 = Input["Enter first guess: "];
Nmax = Input["Enter maximum number of iterations: "];
eps = Input["Enter the value of convergence parameter: "];
Print["First guess x0 = ", x0];
Print["Nmax = ", Nmax];
Print["Epsilon = ", eps];
f[x_] := Cos[x];
Print["f[x] := ", f[x]];
Print["f'[x]:", f'[x]];
For[i = 1, i ≤ Nmax, i++,
  derivative = D[f[x], x] /. x → x0;
  If[derivative == 0, Print["Derivative is zero. No solution found."];
   Return[$Failed];];
  x1 = N[x0 - (f[x0] / f'[x0])];
  If[Abs[x1 - x0] < eps, Print["Root found: ", x1];
   Return[x1];];
  Print[i, "th iteration, the root is: ", x1];
  Print["Estimated error is: ", Abs[x1 - x0]];
  x0 = x1;];
Print["Root is: ", x1];
Print["Estimated error is: ", Abs[x1 - x0]];
Plot[f[x], {x, -1, 3}, PlotLabel → "f(x) = Cos[x]", AxesLabel → {"x", "f(x)"}]
```

```
First guess x0 = 2

Nmax = 5

Epsilon = 0.00001

f[x] := Cos[x]

f'[x]:=-Sin[x]

1th iteration, the root is: 1.54234

Estimated error is: 0.457658

2th iteration, the root is: 1.5708

Estimated error is: 0.0284616

Root found: 1.5708
```

Out[276]= `Return[1.5708]`

```
Root is: 1.5708

Estimated error is: 7.68146×10^-6
```

Out[279]=



In[187]:=
```
x0 = Input["Enter initial guess: "];
Nmax = Input["Enter maximum number of iterations: "];
eps = Input["Enter the value of convergence parameter: "];

Print["Initial guess x0 = ", x0];
Print["Nmax = ", Nmax];
Print["Epsilon = ", eps];
f[x_] := x^3 - 2 * x - 5;
fPrime[x_] := 3 * x^2 - 2;
Print["f[x] := ", f[x]];
Print["f'[x] := ", fPrime[x]];
For[i = 1, i ≤ Nmax, i++,
  If[fPrime[x0] == 0, Print["Derivative is zero. No solution found."];
   Return[$Failed];];
  x1 = x0 - (f[x0] / fPrime[x0]);
  If[Abs[x1 - x0] < eps, Print["Root found: ", x1];
   Return[x1];];
  Print[i, "th iteration, the root is: ", x1];
  Print["Estimated error is: ", Abs[x1 - x0]];
  x0 = x1;
];

Print["Root is: ", x1];
Print["Estimated error is: ", Abs[x1 - x0]];
Plot[f[x], {x, -2, 2}, PlotLabel → "f(x) = x^2 - 2", AxesLabel → {"x", "f(x)"}]
```

Initial guess x0 = 2

Nmax = 6

Epsilon = 0.00001

$f[x] := -5 - 2x + x^3$

$f'[x] := -2 + 3x^2$

1th iteration, the root is: $\frac{21}{10}$

Estimated error is: $\frac{1}{10}$

2th iteration, the root is: $\frac{11\,761}{5615}$

Estimated error is: $\frac{61}{11\,230}$

3th iteration, the root is: $\frac{4\,138\,744\,325\,037}{1\,975\,957\,316\,495}$

Estimated error is: $\frac{32\,878\,756}{1\,975\,957\,316\,495}$

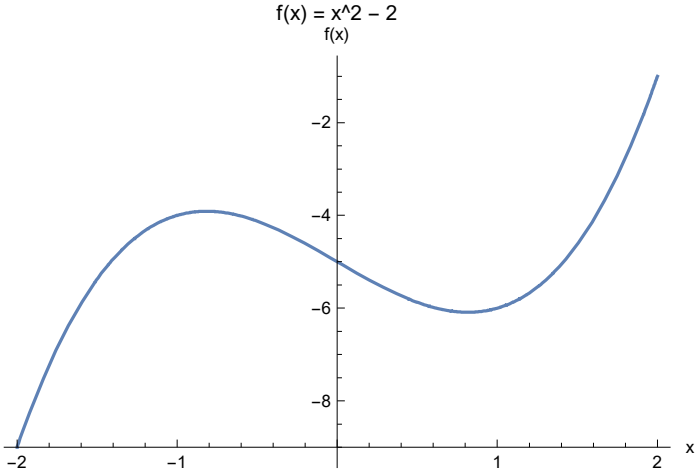
Root found: $\frac{180\,361\,507\,581\,342\,374\,686\,204\,847\,776\,335\,588\,181}{86\,109\,846\,986\,684\,169\,676\,738\,889\,168\,418\,120\,215}$

Out[197]= Return $\left[\frac{180\,361\,507\,581\,342\,374\,686\,204\,847\,776\,335\,588\,181}{86\,109\,846\,986\,684\,169\,676\,738\,889\,168\,418\,120\,215}\right]$

Root is: $\frac{180\,361\,507\,581\,342\,374\,686\,204\,847\,776\,335\,588\,181}{86\,109\,846\,986\,684\,169\,676\,738\,889\,168\,418\,120\,215}$

Estimated error is: $\frac{13\,422\,175\,326\,999\,498\,219\,819\,346\,928}{86\,109\,846\,986\,684\,169\,676\,738\,889\,168\,418\,120\,215}$

Out[200]=



Ques – 3