

Topic : Newton Raphson Method - Roots of Equations

Simulation : Pitfall - Root jumping several roots away

Language : Mathematica 4.1

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Abstract : The following example illustrates how, in the Newton-Raphson method, an initial guess close to one root can jump to a location several roots away.

■ **INPUTS: Enter the Following**

Function in $f[x]$ 0

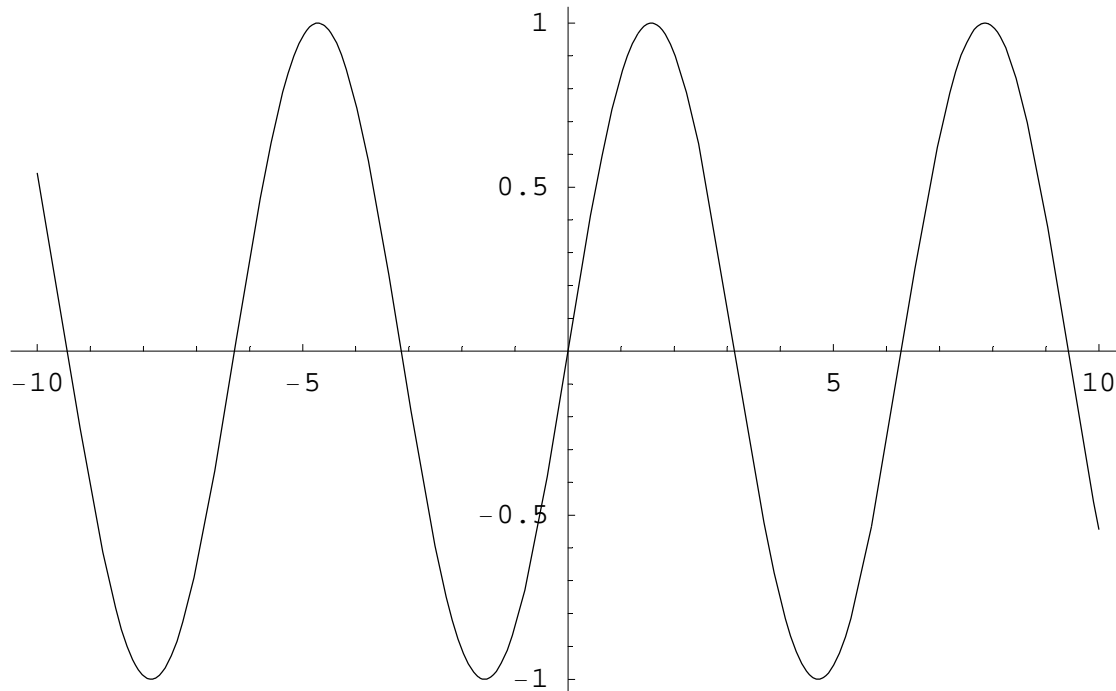
```
In[471]:= f[x_] := Sin[x]
```

Range of 'x' you want to see the function

```
In[472]:= xbegin = -10.0;  
xend = 10.0;
```

```
In[474]:= curve = Plot[f[x], {x, xbegin, xend}, PlotLabel ->  
"Entered function on given interval", TextStyle -> {FontSize -> 11}];
```

Entered function on given interval



Initial guess

```
In[475]:= x0 = 1.431;
```

Because this method uses a line tangent to the function at the initial guess, we must calculate the derivative of the function to find the slope of the line at this point. Here we will define the derivative of the function $f(x)$ as $g(x)$.

```
In[476]:= g[x_] := f'[x]
```

Iteration 1

```
In[477]:= x1 = x0 - f[x0] / g[x0]
```

```
Out[477]= -5.6756
```

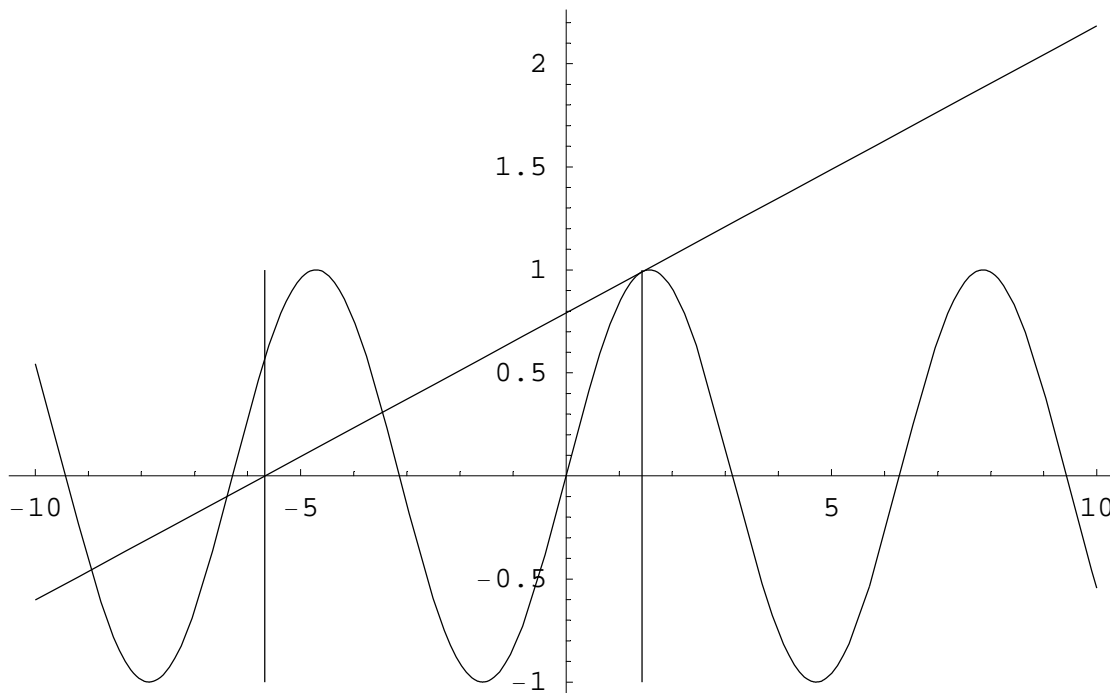
```
In[478]:= εa = Abs[(x1 - x0) / x1 * 100]
```

```
Out[478]= 125.213
```

```
In[479]:= tanline[x_] := f[x0] + ((0 - f[x0]) / (x1 - x0)) * (x - x0)
```

```
In[480]:= tline = Plot[tanline[x], {x, xbegin, xend}];
```

```
In[481]:= Show[Graphics[Line[{{x0, 1}, {x0, -1}}]], curve,
Graphics[Line[{{x1, 1}, {x1, -1}}]], tline, Axes → True,
PlotLabel → "Entered function on given interval with upper and
lower guesses and estimated root", TextStyle → {FontSize → 11}];
i function on given interval with upper and lower guesses and estimated
```



Iteration 2

```
In[482]:= x2 = x1 - f[x1] / g[x1]
```

```
Out[482]:= -6.37093
```

```
In[483]:= εa = Abs[(x2 - x1) / x2 * 100]
```

```
Out[483]:= 10.914
```

```
In[484]:= tanline[x_] := f[x1] + ((0 - f[x1]) / (x2 - x1)) * (x - x1)
```

```
In[485]:= tline = Plot[tanline[x], {x, xbegin, xend}];
```

```
In[486]:= Show[Graphics[Line[{{x1, 1}, {x1, -1}}]], curve,  
Graphics[Line[{{x2, 1}, {x2, -1}}]], tline, Axes → True,  
PlotLabel → "Entered function on given interval with upper and  
lower guesses and estimated root", TextStyle → {FontSize → 11}];
```

d function on given interval with upper and lower guesses and estimated

