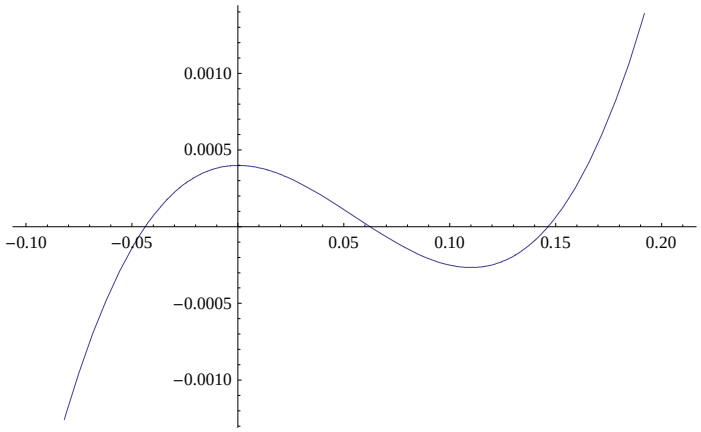
Bisection Method
Example 1

$$x^3 - 0.165x^2 + 3.993\times10^{-4} = 0$$

```
eq = x^3 - 0.165 x^2 + 3.993 × 10^-4
```

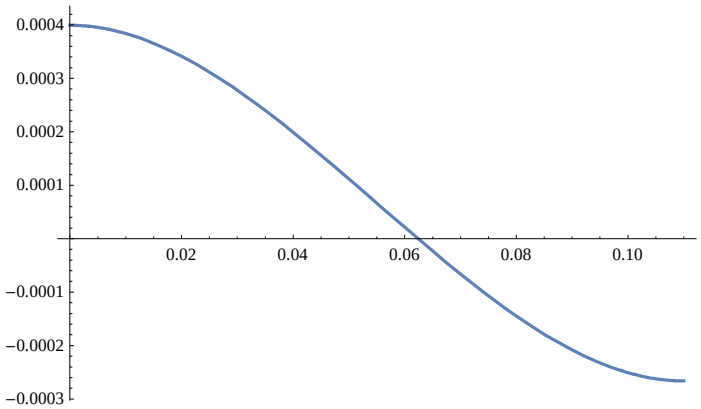
```
0.0003993 - 0.165 x^2 + x^3
```

```
Plot[eq, {x, -0.10, 0.21}]
```




```
Solve[eq == 0, x]
```

```
{{x → -0.0437371}, {x → 0.0623776}, {x → 0.14636}}
```



```
(***Program for BSC method***
 step 1**)

f[x_] := x^3 - 0.165 x^2 + 3.993 × 10^-4
xl = 0; xu = 0.11;
xm = (xl + xu) / 2;
f[xm]
f[xm] f[xl]
f[xm] f[xu]
```

```
0.00006655
```

```
2.65734 × 10^-8
```

```
-1.77156 × 10^-8
```

```
(**********step2**********)
xl = xm;
xm = (xl + xu) / 2;
f[xm];
f[xm] f[xl]
f[xm] f[xu]
```

```
-1.07954 × 10^-8
```

```
4.31818 × 10^-8
```

```
(**********step3**********)
xu = xm;
xm = (xl + xu) / 2;
f[xm]
f[xm] f[xl]
f[xm] f[xu]
```

```
-0.0000556316
```

```
-3.70229 × 10^-9
```

```
9.02432 × 10^-9
```

```
(**********step3**********)
xu = xm;
xm = (xl + xu) / 2;
f[xm]
f[xm] f[xl]
f[xm] f[xu]
```

```
0.0000353953
```

```
2.35556 × 10^-9
```

```
1.58724 × 10^-10
```

```
xu = xm;
xm = (xl + xu) / 2;
f[xm];
f[xm] f[xl]
f[xm] f[xu]
```

0.0567188

0.0000509574

3.39122×10^{-9}

1.80365×10^{-9}

```
xu = xm;
xm = (xl + xu) / 2
f[xm]
f[xm] f[xl]
f[xm] f[xu]
```

0.0627344

-3.17678×10^{-6}

-1.42457×10^{-11}

3.43207×10^{-11}

```
xu = xm;
xm = (xl + xu) / 2
f[xm]
f[xm] f[xl]
f[xm] f[xu]
```

0.0623047

6.49728×10^{-7}

2.91359×10^{-12}

-2.06404×10^{-12}

```
xl = xm;
xm = (xl + xu) / 2
f[xm]
f[xm] f[xl]
f[xm] f[xu]
```

0.0625195

-1.26457×10^{-6}

-8.21624×10^{-13}

4.01725×10^{-12}

```
?? Do
```

Do[*expr*, *n*] evaluates *expr* *n* times.
Do[*expr*, {*i*, i_{max}}] evaluates *expr* with the variable *i* successively taking on the values 1 through i_{max} (in steps of 1).
Do[*expr*, {*i*, i_{min}, i_{max}}] starts with $i = i_{min}$.
Do[*expr*, {*i*, i_{min}, i_{max}, *di*}] uses steps *di*.
Do[*expr*, {*i*, {i_1, i_2, …}}] uses the successive values i_1, i_2, ….
Do[*expr*, {*i*, i_{min}, i_{max}}, {*j*, j_{min}, j_{max}}, …] evaluates *expr* looping over different values of *j* etc. for each *i*. ≫

```
Attributes[Do] = {HoldAll, Protected}
```

```
?? If
```

If[*condition*, *t*, *f*] gives *t* if *condition* evaluates to True, and *f* if it evaluates to False.
If[*condition*, *t*, *f*, *u*] gives *u* if *condition* evaluates to neither True nor False. ≫

```
Attributes[If] = {HoldRest, Protected}
```

```
f[x_] := x^3 - 0.165 x^2 + 3.993 × 10^-4
xl = 0; xu = 0.11;

Do[{xn = xm; xm = (xl + xu) / 2;
  If[f[xm] f[xl] < 0, xu = xm, xl = xm], Print[{xm, Abs[(xn - xm) / xn]}]}, {100}]
```

```
{0.055, 0.118761}
{0.0825, 0.5}
{0.06875, 0.166667}
{0.061875, 0.1}
{0.0653125, 0.0555556}
{0.0635938, 0.0263158}
{0.0627344, 0.0135135}
{0.0623047, 0.00684932}
{0.0625195, 0.00344828}
{0.0624121, 0.00171821}
{0.0623584, 0.000860585}
{0.0623853, 0.000430663}
{0.0623718, 0.000215239}
{0.0623785, 0.000107643}
{0.0623752, 0.0000538155}
{0.0623769, 0.0000269092}
{0.0623777, 0.0000134542}
{0.0623773, 6.72703 × 10^-6}
{0.0623775, 3.36354 × 10^-6}
{0.0623776, 1.68176 × 10^-6}
{0.0623775, 8.4088 × 10^-7}
{0.0623776, 4.2044 × 10^-7}
{0.0623776, 2.1022 × 10^-7}
{0.0623776, 1.0511 × 10^-7}
```

$\{0.0623776, 5.2555 \times 10^{-8}\}$

$\{0.0623776, 2.62775 \times 10^{-8}\}$

$\{0.0623776, 1.31388 \times 10^{-8}\}$

$\{0.0623776, 6.56938 \times 10^{-9}\}$

$\{0.0623776, 3.28469 \times 10^{-9}\}$

$\{0.0623776, 1.64234 \times 10^{-9}\}$

$\{0.0623776, 8.21172 \times 10^{-10}\}$

$\{0.0623776, 4.10586 \times 10^{-10}\}$

$\{0.0623776, 2.05293 \times 10^{-10}\}$

$\{0.0623776, 1.02646 \times 10^{-10}\}$

$\{0.0623776, 5.13233 \times 10^{-11}\}$

$\{0.0623776, 2.56617 \times 10^{-11}\}$

$\{0.0623776, 1.28308 \times 10^{-11}\}$

$\{0.0623776, 6.41544 \times 10^{-12}\}$

$\{0.0623776, 3.20772 \times 10^{-12}\}$

$\{0.0623776, 1.60386 \times 10^{-12}\}$

$\{0.0623776, 8.01931 \times 10^{-13}\}$

$\{0.0623776, 4.01021 \times 10^{-13}\}$

$\{0.0623776, 2.00455 \times 10^{-13}\}$

$\{0.0623776, 1.00339 \times 10^{-13}\}$

$\{0.0623776, 5.00581 \times 10^{-14}\}$

$\{0.0623776, 2.51403 \times 10^{-14}\}$

$\{0.0623776, 1.25701 \times 10^{-14}\}$

$\{0.0623776, 6.34069 \times 10^{-15}\}$

$\{0.0623776, 3.11473 \times 10^{-15}\}$

$\{0.0623776, 1.55736 \times 10^{-15}\}$

$\{0.0623776, 7.78681 \times 10^{-16}\}$

$\{0.0623776, 3.33721 \times 10^{-16}\}$

$\{0.0623776, 2.2248 \times 10^{-16}\}$

$\{0.0623776, 1.1124 \times 10^{-16}\}$

$\{0.0623776, 1.1124 \times 10^{-16}\}$

$\{0.0623776, 0.\}$

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{0.0623776, 0.}
{0.0623776, 0.}
```

```
Do[{xm = (xl + xu) / 2;
  While[f[xm] f[xl] < 0, xu = xm], xl = xm, Print[xm]}, {15}]
```

```
0.0623776
```

```
?? Do
```

Do[*expr*, {i_{max}}] evaluates *expr* i_{max} times.
Do[*expr*, {i, i_{max}}] evaluates *expr* with the variable i successively taking on the values 1 through i_{max} (in steps of 1).
Do[*expr*, {i, i_{min}, i_{max}}] starts with $i = i_{min}$.
Do[*expr*, {i, i_{min}, i_{max}, di}] uses steps di.
Do[*expr*, {i, {i_1, i_2, …}}] uses the successive values i_1, i_2, ...
Do[*expr*, {i, i_{min}, i_{max}}, {j, j_{min}, j_{max}}, …] evaluates *expr* looping over different values of j, etc. for each i. ≫

```
Attributes[Do] = {HoldAll, Protected}
```