1) Calcular pelo menos uma raiz real das equações abaixo, com $\epsilon \leq 10^{-2}$, usando o método da Bisseção.

a. $x^3 - 6x^2 - x + 30 = 0$

b. $x + log(x) = 0$

c. $3x - cos(x) = 0$

d. $x + 2cos(x) = 0$

e. $x^2 - 10ln\, x - 5 = 0$

f. $x^3 - e^{2x} + 3 = 0$

g. $2x^3 + x^2 - 2 = 0$

h. $sen\, x - ln\, x = 0$

Obs. Itens a-d pág. 110 e-f pág. 117 **Barroso**

2) Calcular pelo menos uma raiz real das equações abaixo, com $\epsilon \leq 10^{-3}$, usando o método de Newton.

a. $2x - sen\, x + 4 = 0$

b. $e^x - tg\, x = 0$

c. $10^x + x^3 + 2 = 0$

d. $x^3 - x^2 - 12x = 0$

e. $e^{cos\, x} + x^3 - x = 0$

f. $0.1x^3 - e^{2x} + 2 = 0$

g. $2ln(3 - cos\, x) - 3x^x + 5sen\, x = 0$

h. $x^3 - 5x^2 + x + 3 = 0$

Obs. Itens a-d pág. 131 e-f pág. 122 **Barroso**

3) Calcular pelo menos uma raiz real das equações abaixo, com $\epsilon \leq 10^{-3}$, usando o método da ~~Iteração Linear.~~ `Regula Falsi.`

a. $x^3 - cos\, x = 0$

b. $x^2 + e^{3x} - 3 = 0$

c. $3x^4 - x - 3 = 0$

d. $e^x + cos\ x - 5 = 0$

e. $cos\ x + ln\ x + x = 0$

f. $e^x + cos\ x - 3 = 0$

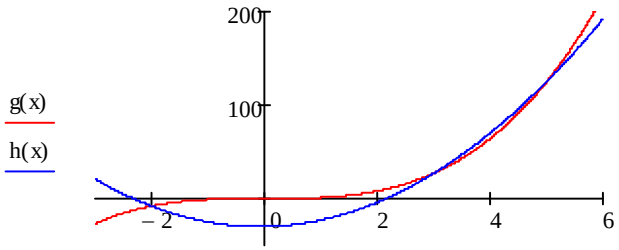
g. $x^3 - x - 1 = 0$

Obs. Itens a-e pág. 138 f-g pág. 137 **Barroso** e-g são exemplos

4) Recomendo os Exercícios Propostos no (**Barroso**, págs 147-149) seguintes: 3.12.9, 3.12.10, 3.12.11, 3.12.12, 3.12.13, 3.12.14, 3.12.19, 3.12.20.

a) $g(x) := x^3$ $h(x) := 6x^2 + x - 30$

$f(x) := g(x) - h(x)$ $f(x) \rightarrow x^3 - 6 \cdot x^2 - x + 30$



3 raízes localizadas:

$f(-2.5) = -20.625$ $f(-1.5) = 14.625$

$f(2) = 12$ $f(4) = -6$

$f(4) = -6$ $f(6) = 24$

iterações para raiz entre [2, 4]

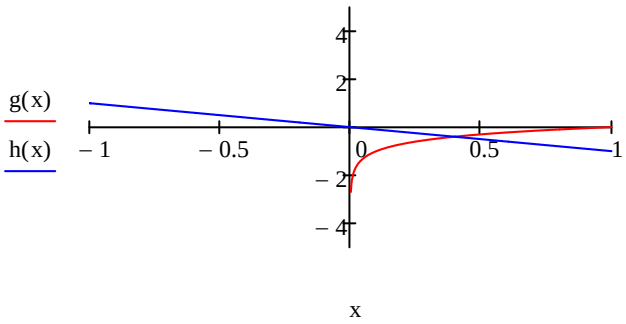
$\varepsilon \in \begin{matrix} + & - \\ [2, & 4] \end{matrix}$

$x_0 := \frac{2 + 4}{2}$ $x_0 = 3$

$f(3) = 0$ raiz = 3

b) $g(x) := \log(x)$ $h(x) := -x$

$f(x) := g(x) - h(x)$ $f(x) \to x + \frac{\ln(x)}{\ln(10)}$



raiz localizada:

$f(0.1) = -0.9$ $f(1) = 1$

iterações para raiz entre [0.1, 1]

k = 0 $\varepsilon \in$ [0.1, 1] (- +)

$x_0 := \frac{0.1 + 1}{2}$ $x_0 = 0.55$

$f(0.55) = 0.29$

k = 1 $\varepsilon \in$ [0.1, 0.55] (- +)

$x_1 := \frac{0.1 + 0.55}{2}$ $x_1 = 0.325$

$f(0.325) = -0.163$

k = 2 $\varepsilon \in$ [0.325, 0.55] (- +)

$x_2 := \frac{0.325 + 0.55}{2}$ $x_2 = 0.438$

$f(0.438) = 0.079$

k = 3

$$\varepsilon \in [0.325, 0.438]^{-\ +}$$

$$x_3 := \frac{0.325 + 0.438}{2} \qquad x_3 = 0.381$$

$$f(0.381) = -0.038$$

k = 4

$$\varepsilon \in [0.381, 0.438]^{-\ +}$$

$$x_4 := \frac{0.381 + 0.438}{2} \qquad x_4 = 0.409$$

$$f(0.409) = 0.021$$

k = 5

$$\varepsilon \in [0.381, 0.409]^{-\ +}$$

$$x_5 := \frac{0.381 + 0.409}{2} \qquad x_5 = 0.395$$

$$f(0.395) = -8.403 \times 10^{-3}$$

k = 6

$$\varepsilon \in [0.381, 0.395]^{-\ +}$$

$$x_6 := \frac{0.381 + 0.395}{2} \qquad x_6 = 0.388$$

$$f(0.388) = -0.023$$

k = 7

$$\varepsilon \in [0.388, 0.395]^{-\ +}$$

$$x_7 := \frac{0.388 + 0.395}{2} \qquad x_7 = 0.392$$

$$f(0.395) = -8.403 \times 10^{-3}$$

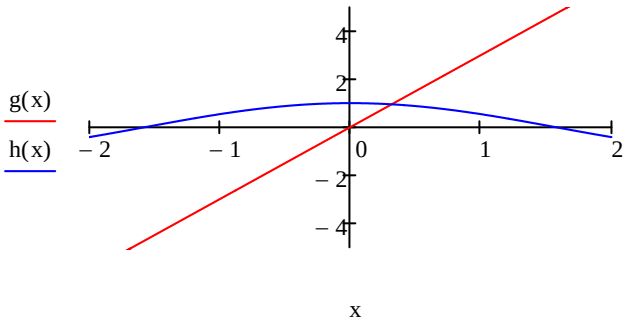
$i := 0 .. 7$ $j := 1 .. 7$ $Err_j := \left| x_j - x_{j-1} \right|$ $Err_0 := \text{"xxx"}$

$i =$	$x_i =$	$f(x_i) =$
0	0.55	0.29
1	0.325	-0.163
2	0.438	0.078
3	0.381	-0.037
4	0.409	0.022
5	0.395	$-8.403 \cdot 10^{-3}$
6	0.388	-0.023
7	0.392	-0.016

$$Err_i = \begin{pmatrix} \text{"xxx"} \\ 0.225 \\ 0.113 \\ 0.056 \\ 0.028 \\ 0.014 \\ 7 \times 10^{-3} \\ 3.5 \times 10^{-3} \end{pmatrix}$$

c) $g(x) := 3x$ $h(x) := \cos(x)$

$f(x) := g(x) - h(x)$ $f(x) \rightarrow 3 \cdot x - \cos(x)$



raiz localizada:

$f(0) = -1$ $f(1) = 2.46$

iterações para raiz entre [0, 1]

- +

k = 0 $\varepsilon \in [0, 1]$

$x_0 := \frac{0 + 1}{2}$ $x_0 = 0.5$

$f(0.5) = 0.622$

- +

k = 1 $\varepsilon \in [0, 0.5]$

$x_1 := \frac{0.0 + 0.5}{2}$ $x_1 = 0.25$

$f(0.25) = -0.219$

k = 2 - +

$\varepsilon \in [0.25, 0.5]$

$x_2 := \frac{0.25 + 0.5}{2}$ $x_2 = 0.375$

$f(0.375) = 0.194$

k = 3 - +

$\varepsilon \in [0.25, 0.375]$

$$x_3 := \frac{0.25 + 0.375}{2} \qquad x_3 = 0.313$$

$$f(0.313) = -0.012$$

k = 4 - +

$\varepsilon \in [0.313, 0.375]$

$$x_4 := \frac{0.313 + 0.375}{2} \qquad x_4 = 0.344$$

$$f(0.344) = 0.091$$

k = 5 - +

$\varepsilon \in [0.313, 0.344]$

$$x_5 := \frac{0.313 + 0.344}{2} \qquad x_5 = 0.329$$

$$f(0.329) = 0.041$$

k = 6 - +

$\varepsilon \in [0.313, 0.329]$

$$x_6 := \frac{0.313 + 0.329}{2} \qquad x_6 = 0.321$$

$$f(0.321) = 0.014$$

k = 7 - +

$\varepsilon \in [0.313, 0.321]$

$$x_7 := \frac{0.313 + 0.321}{2} \qquad x_7 = 0.317$$

$$f(0.317) = 8.252 \times 10^{-4}$$

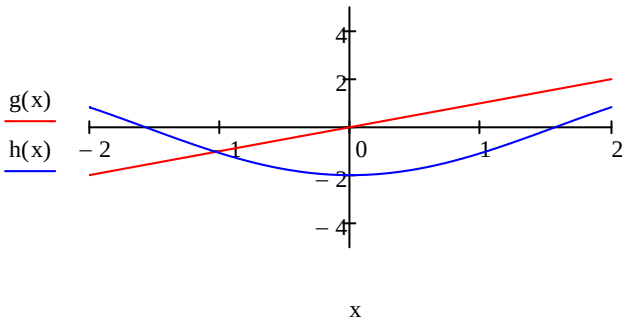
$i := 0 .. 7$ $j := 1 .. 7$ $Err_j := \left| x_j - x_{j-1} \right|$ $Err_0 := \text{"xxx"}$

$i =$	$x_i =$	$f(x_i) =$
0	0.5	0.622
1	0.25	-0.219
2	0.375	0.194
3	0.313	-0.014
4	0.344	0.091
5	0.329	0.039
6	0.321	0.014
7	0.317	$8.252 \cdot 10^{-4}$

$$Err_i = \begin{pmatrix} \text{"xxx"} \\ 0.25 \\ 0.125 \\ 0.063 \\ 0.031 \\ 0.015 \\ 7.5 \times 10^{-3} \\ 4 \times 10^{-3} \end{pmatrix}$$

d) $g(x) := x$ $h(x) := -2\cos(x)$

$f(x) := g(x) - h(x)$ $f(x) \to x + 2\cdot\cos(x)$



raiz localizada:

$f(-1.5) = -1.359$ $f(-0.5) = 1.255$

iterações para raiz entre [-1.5, -0.5]

\- +

k = 0 $\varepsilon \in$ [-1.5, -0.5]

$x_0 := \frac{-1.5 + -0.5}{2}$ $x_0 = -1$

$f(-1) = 0.081$

\- +

k = 1 $\varepsilon \in$ [-1.5, -1]

$x_1 := \frac{-1.5 + -1}{2}$ $x_1 = -1.25$

$f(-1.25) = -0.619$

k = 2 \- +

$\varepsilon \in$ [-1.25, -1]

$x_2 := \frac{-1.25 + -1}{2}$ $x_2 = -1.125$

$f(-1.125) = -0.263$

k = 3 - +

$\varepsilon \in$ [-1.125, -1]

$$x_3 := \frac{-1.125 + -1}{2} \qquad x_3 = -1.063$$

$$f(-1.063) = -0.09$$

k = 4 - +

$\varepsilon \in$ [-1.063, -1]

$$x_4 := \frac{-1.063 + -1}{2} \qquad x_4 = -1.031$$

$$f(-1.031) = -3.077 \times 10^{-3}$$

k = 5 - +

$\varepsilon \in$ [-1.031, -1]

$$x_5 := \frac{-1.031 + -1}{2} \qquad x_5 = -1.015$$

$$f(-1.015) = 0.04$$

k = 6 - +

$\varepsilon \in$ [-1.031, -1.015]

$$x_6 := \frac{-1.031 + -1.015}{2} \quad x_6 = -1.023$$

$$f(-1.023) = 0.019$$

k = 7 - +

$\varepsilon \in$ [-1.031, -1.023]

$$x_7 := \frac{-1.031 + -1.023}{2} \quad x_7 = -1.027$$

$$f(-1.027) = 7.777 \times 10^{-3}$$

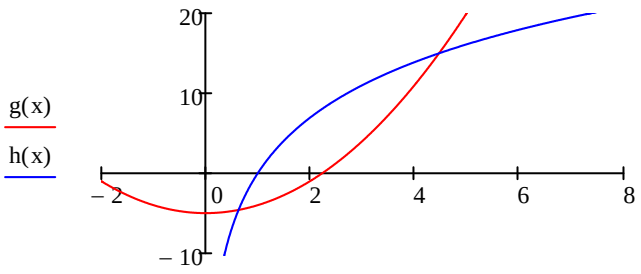
$i := 0 .. 7$ $j := 1 .. 7$ $Err_j := \left| x_j - x_{j-1} \right|$ $Err_0 := \text{"xxx"}$

$i =$	$x_i =$	$f(x_i) =$
0	-1	0.081
1	-1.25	-0.619
2	-1.125	-0.263
3	-1.063	-0.089
4	-1.031	$-4.435 \cdot 10^{-3}$
5	-1.015	0.039
6	-1.023	0.019
7	-1.027	$7.777 \cdot 10^{-3}$

$$Err_i = \begin{pmatrix} \text{"xxx"} \\ 0.25 \\ 0.125 \\ 0.063 \\ 0.031 \\ 0.016 \\ 7.5 \times 10^{-3} \\ 4 \times 10^{-3} \end{pmatrix}$$

e) $g(x) := x^2 - 5$ $h(x) := 10 \cdot \ln(x)$

$f(x) := g(x) - h(x)$ $f(x) \rightarrow x^2 - 10 \cdot \ln(x) - 5$



raizes localizadas:

$f(0.5) = 2.181$ $f(1) = -4$

$f(4) = -2.863$ $f(5) = 3.906$

iterações para raiz entre [0.5, 1]

\+ -

k = 0 $\varepsilon \in [0.5, 1]$

$x_0 := \frac{0.5 + 1}{2}$ $x_0 = 0.75$

$f(0.75) = -1.561$

\+ -

k = 1 $\varepsilon \in [0.5, 0.75]$

$x_1 := \frac{0.5 + 0.75}{2}$ $x_1 = 0.625$ $f(0.625) = 0.091$

\+ -

k = 2 $\varepsilon \in [0.625, 0.75]$

$x_2 := \frac{0.625 + 0.75}{2}$ $x_2 = 0.688$ $f(0.688) = -0.787$

\+ -

k = 3 $\varepsilon \in [0.625, 0.688]$

$x_3 := \frac{0.625 + 0.688}{2}$ $x_3 = 0.656$ $f(0.656) = -0.354$

\+

k = 4 $\varepsilon \in [0.625, 0.656]$ $f(0.641) = -0.142$

$x_4 := \frac{0.625 + 0.656}{2}$ $x_4 = 0.641$

k = 5 $\varepsilon \in [0.625, 0.641]^{+\ -}$

$$x_5 := \frac{0.625 + 0.641}{2} \qquad x_5 = 0.633 \qquad f(0.633) = -0.026$$

k = 6 $\varepsilon \in [0.625, 0.633]^{+\ -}$

$$x_6 := \frac{0.625 + 0.633}{2} \qquad x_6 = 0.629 \qquad f(0.629) = 0.032$$

k = 7 $\varepsilon \in [0.629, 0.633]^{+\ -}$

$$x_7 := \frac{0.629 + 0.633}{2} \qquad x_7 = 0.631 \qquad f(0.631) = 2.655 \times 10^{-3}$$

$i := 0 .. 7$ $\quad j := 1 .. 7$ $\quad Err_j := |x_j - x_{j-1}|$ $\quad Err_0 := \text{"xxx"}$

$i =$

0
1
2
3
4
5
6
7

$x_i =$

0.75
0.625
0.688
0.656
0.641
0.633
0.629
0.631

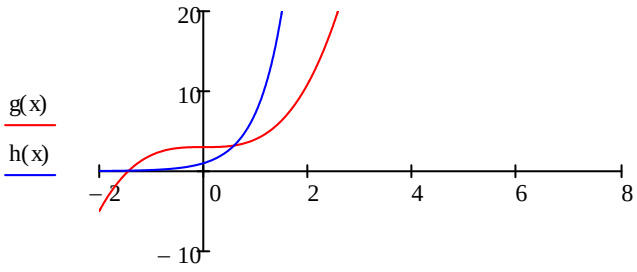
$f(x_i) =$

-1.561
0.091
-0.78
-0.361
-0.135
-0.026
0.032
$2.655 \cdot 10^{-3}$

$$Err_i = \begin{pmatrix} \text{"xxx"} \\ 0.125 \\ 0.063 \\ 0.031 \\ 0.016 \\ 7.5 \times 10^{-3} \\ 4 \times 10^{-3} \\ 2 \times 10^{-3} \end{pmatrix}$$

f) $g(x) := x^3 + 3$ $h(x) := e^{2x}$

$f(x) := g(x) - h(x)$ $f(x) \rightarrow x^3 - e^{2\cdot x} + 3$



raizes localizadas:

$f(-2) = -5.018$ $f(-1) = 1.865$

$f(0.5) = 0.407$ $f(1) = -3.389$

iterações para raiz entre [0.5, 1]

\+ -

k = 0 $\varepsilon \in [0.5, 1]$

$x_0 := \frac{0.5 + 1}{2}$ $x_0 = 0.75$

$f(0.75) = -1.06$

\+ -

k = 1 $\varepsilon \in [0.5, 0.75]$

$x_1 := \frac{0.5 + 0.75}{2}$ $x_1 = 0.625$ $f(0.625) = -0.246$

\+ -

k = 2 $\varepsilon \in [0.5, 0.625]$

$x_2 := \frac{0.5 + 0.625}{2}$ $x_2 = 0.563$ $f(0.563) = 0.095$

\+ -

k = 3 $\varepsilon \in [0.563, 0.625]$

$x_3 := \frac{0.563 + 0.625}{2}$ $x_3 = 0.594$ $f(0.594) = -0.071$

\+ -

k = 4 $\varepsilon \in [0.563, 0.594]$

$x_4 := \frac{0.563 + 0.594}{2}$ $x_4 = 0.579$ $f(0.579) = 0.011$

k = 5 $\varepsilon \in$ [0.579, 0.594]

$$x_5 := \frac{0.579 + 0.594}{2} \quad x_5 = 0.587 \quad f(0.587) = -0.033$$

k = 6 $\varepsilon \in$ [0.579, 0.587]

$$x_6 := \frac{0.579 + 0.587}{2} \quad x_6 = 0.583 \quad f(0.583) = -0.011$$

k = 7 $\varepsilon \in$ [0.579, 0.583]

$$x_7 := \frac{0.579 + 0.583}{2} \quad x_7 = 0.581 \quad f(0.581) = -1.966 \times 10^{-4}$$

$i := 0 .. 7$ $j := 1 .. 7$ $Err_j := |x_j - x_{j-1}|$ $Err_0 := "xxx"$

$i =$

0
1
2
3
4
5
6
7

$x_i =$

0.75
0.625
0.563
0.594
0.579
0.587
0.583
0.581

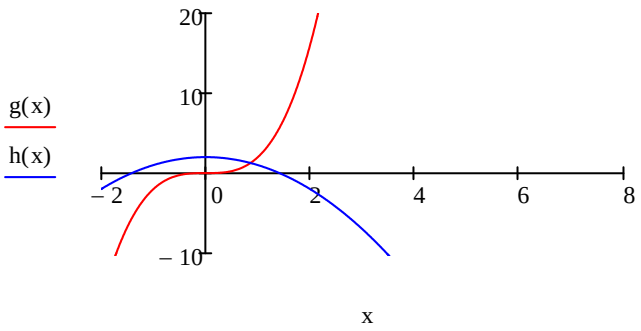
$f(x_i) =$

-1.06
-0.246
0.098
-0.071
0.013
-0.03
-0.011
-1.966·10-4

$$Err_i = \begin{pmatrix} "xxx" \\ 0.125 \\ 0.063 \\ 0.031 \\ 0.015 \\ 8 \times 10^{-3} \\ 3.5 \times 10^{-3} \\ 2 \times 10^{-3} \end{pmatrix}$$

g) $g(x) := 2x^3$ $h(x) := 2 - x^2$

$f(x) := g(x) - h(x)$ $f(x) \rightarrow 2\cdot x^3 + x^2 - 2$



raizes localizadas:

$f(0.5) = -1.5$ $f(1) = 1$

iterações para raiz entre [0.5, 1]

k = 0 $\varepsilon \in$ [0.5, 1]

$x_0 := \frac{0.5 + 1}{2}$ $x_0 = 0.75$ $f(0.75) = -0.594$

k = 1 $\varepsilon \in$ [0.75, 1]

$x_1 := \frac{0.75 + 1}{2}$ $x_1 = 0.875$ $f(0.875) = 0.105$

k = 2 $\varepsilon \in$ [0.75, 0.875]

$x_2 := \frac{0.75 + 0.875}{2}$ $x_2 = 0.813$ $f(0.813) = -0.264$

k = 3 $\varepsilon \in$ [0.813, 0.875]

$x_3 := \frac{0.813 + 0.875}{2}$ $x_3 = 0.844$ $f(0.844) = -0.085$

k = 4 $\varepsilon \in$ [0.844, 0.875]

$x_4 := \frac{0.844 + 0.875}{2}$ $x_4 = 0.859$ $f(0.859) = 5.561 \times 10^{-3}$

k = 5 $\varepsilon \in$ [0.844, 0.859]

$$x_5 := \frac{0.844 + 0.859}{2} \qquad x_5 = 0.851 \qquad f(0.851) = -0.043$$

\- +

k = 6 $\varepsilon \in [0.851, 0.859]$

$$x_6 := \frac{0.851 + 0.859}{2} \qquad x_6 = 0.855 \qquad f(0.855) = -0.019$$

\- +

k = 7 $\varepsilon \in [0.855, 0.859]$

$$x_7 := \frac{0.855 + 0.859}{2} \qquad x_7 = 0.857 \qquad f(0.857) = -6.705 \times 10^{-3}$$

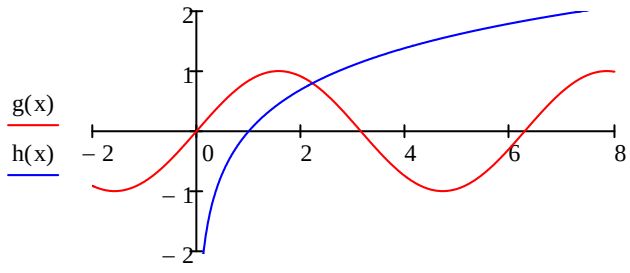
$i := 0 .. 7$ $j := 1 .. 7$ $Err_j := |x_j - x_{j-1}|$ $Err_0 := "xxx"$

$i =$	$x_i =$	$f(x_i) =$
0	0.75	-0.594
1	0.875	0.105
2	0.813	-0.267
3	0.844	-0.085
4	0.859	$8.635 \cdot 10^{-3}$
5	0.851	-0.04
6	0.855	-0.019
7	0.857	$-6.705 \cdot 10^{-3}$

$$Err_i = \begin{pmatrix} "xxx" \\ 0.125 \\ 0.063 \\ 0.031 \\ 0.015 \\ 8 \times 10^{-3} \\ 3.5 \times 10^{-3} \\ 2 \times 10^{-3} \end{pmatrix}$$

h) $g(x) := \sin(x)$ $h(x) := \ln(x)$

$f(x) := g(x) - h(x)$ $f(x) \rightarrow \sin(x) - \ln(x)$



raizes localizadas:

$f(2) = 0.216$ $f(3) = -0.957$

iterações para raiz entre [0.5, 1]

\+ -

k = 0 $\varepsilon \in [2, 3]$

$x_0 := \frac{2+3}{2}$ $x_0 = 2.5$ $f(2.5) = -0.318$

\+ -

k = 1 $\varepsilon \in [2, 2.5]$

$x_1 := \frac{2+2.5}{2}$ $x_1 = 2.25$ $f(2.25) = -0.033$

\+ -

k = 2 $\varepsilon \in [2, 2.25]$

$x_2 := \frac{2+2.25}{2}$ $x_2 = 2.125$ $f(2.125) = 0.097$

\+ -

k = 3 $\varepsilon \in [2.125, 2.25]$

$x_3 := \frac{2.125+2.25}{2}$ $x_3 = 2.188$ $f(2.188) = 0.033$

\+ -

k = 4 $\varepsilon \in [2.188, 2.25]$

$x_4 := \frac{2.188+2.25}{2}$ $x_4 = 2.219$ $f(2.219) = 1.13 \times 10^{-4}$

k = 5 $\varepsilon \in$ [2.219, 2.25] (+ -)

$x_5 := \frac{2.219 + 2.25}{2}$ $x_5 = 2.234$ $f(2.234) = -0.016$

k = 6 $\varepsilon \in$ [2.219, 2.234] (+ -)

$x_6 := \frac{2.219 + 2.234}{2}$ $x_6 = 2.226$ $f(2.226) = -7.282 \times 10^{-3}$

k = 7 $\varepsilon \in$ [2.219, 2.226] (+ -)

$x_7 := \frac{2.219 + 2.226}{2}$ $x_7 = 2.223$ $f(2.223) = -4.109 \times 10^{-3}$

$i := 0 .. 7$ $j := 1 .. 7$ $Err_j := |x_j - x_{j-1}|$ $Err_0 := "xxx"$

$i =$

0
1
2
3
4
5
6
7

$x_i =$

2.5
2.25
2.125
2.188
2.219
2.234
2.226
2.223

$f(x_i) =$

-0.318
-0.033
0.097
0.033
$1.13 \cdot 10^{-4}$
-0.016
$-7.812 \cdot 10^{-3}$
$-3.581 \cdot 10^{-3}$

$Err_i =$

"xxx"
0.25
0.125
0.063
0.032
0.015
8×10^{-3}
4×10^{-3}

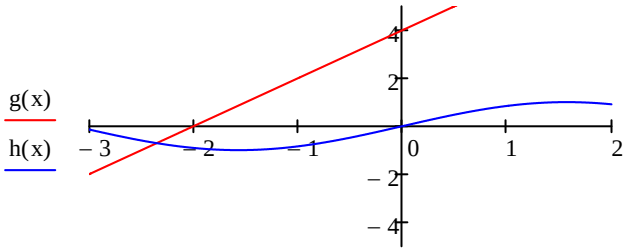
a)

$g(x) := 2x + 4$

$h(x) := \sin(x)$

$f(x) := g(x) - h(x)$

$f(x) \rightarrow 2 \cdot x - \sin(x) + 4$



raizes localizada:

$f(-3) = -1.859$ $f(-2) = 0.909$

$D(x) := \frac{d}{dx} f(x)$

$D(x) \rightarrow 2 - \cos(x)$

$x_0 := -2.5$ $N := 3$

$i := 0 .. N$

$x_{i+1} := x_i - \frac{f(x_i)}{D(x_i)}$

$i := 0 .. N$ $j := 1 .. N + 1$ $Err_j := |x_j - x_{j-1}|$ $Err_0 := "xxx"$

$x_i =$

-2.5
-2.357
-2.354
-2.354

$f(x_i) =$

-0.402
$-6.531 \cdot 10^{-3}$
$-2.058 \cdot 10^{-6}$
$-2.049 \cdot 10^{-13}$

$Err_i = \begin{pmatrix} "xxx" \\ 0.143 \\ 2.412 \times 10^{-3} \\ 7.606 \times 10^{-7} \end{pmatrix}$

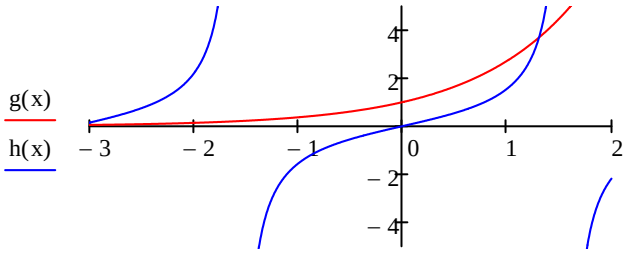
b)

$g(x) := e^{x}$

$h(x) := \tan(x)$

$f(x) := g(x) - h(x)$

$f(x) \rightarrow e^{x} - \tan(x)$



raizes localizada:

$f(1) = 1.161$ $f(1.5) = -9.62$

$D(x) := \frac{d}{dx} f(x)$

$D(x) \rightarrow e^{x} - \tan(x)^{2} - 1$

$x_0 := 1$

$N := 7$

$i := 0 .. N$

$$x_{i+1} := x_i - \frac{f(x_i)}{D(x_i)}$$

$i := 0 .. N$ $j := 1 .. N + 1$ $Err_j := |x_j - x_{j-1}|$ $Err_0 := "xxx"$

$x_i =$

1
2.641
1.497
1.446
1.384
1.332
1.309
1.306

$f(x_i) =$

1.161
14.58
-8.973
-3.717
-1.302
-0.32
-0.034
$-4.755 \cdot 10^{-4}$

$Err_i =$

"xxx"
1.641
1.145
0.051
0.062
0.052
0.023
2.982×10^{-3}

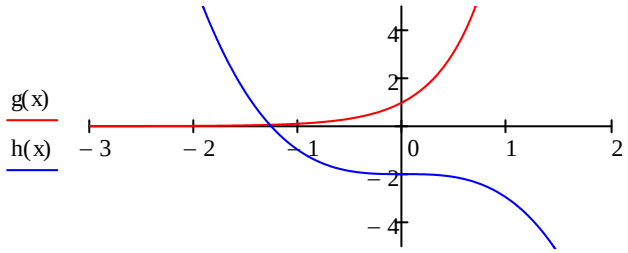
c)

$g(x) := 10^{x}$

$h(x) := -x^{3} - 2$

$f(x) := g(x) - h(x)$

$f(x) \rightarrow x^{3} + 10^{x} + 2$



raizes localizada:

$f(-2) = -5.99$ $f(-1) = 1.1$

$D(x) := \frac{d}{dx} f(x)$

$D(x) \rightarrow 3 \cdot x^{2} + 10^{x} \cdot \ln(10)$

$x_0 := -1$

$N := 3$

$i := 0 .. N$

$$x_{i+1} := x_i - \frac{f(x_i)}{D(x_i)}$$

$i := 0 .. N$ $j := 1 .. N + 1$ $Err_j := |x_j - x_{j-1}|$ $Err_0 := "xxx"$

$x_i =$

-1
-1.341
-1.274
-1.271

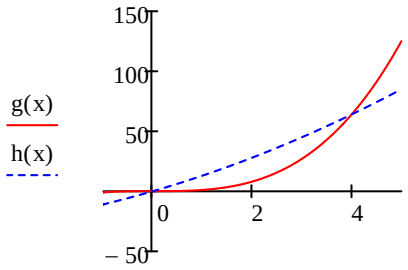
$f(x_i) =$

1.1
-0.363
-0.017
$-4.125 \cdot 10^{-5}$

$$Err_i = \begin{pmatrix} "xxx" \\ 0.341 \\ 0.066 \\ 3.349 \times 10^{-3} \end{pmatrix}$$

d) $g(x) := x^3$ $h(x) := x^2 + 12x$

$f(x) := g(x) - h(x)$ $f(x) \rightarrow x^3 - x^2 - 12 \cdot x$



raizes localizadas:

$f(3) = -18$ $f(5) = 40$

$D(x) := \frac{d}{dx} f(x)$

$D(x) \rightarrow 3 \cdot x^2 - 2 \cdot x - 12$

$x_0 := 5$ $N := 3$

$i := 0 .. N$

$x_{i+1} := x_i - \frac{f(x_i)}{D(x_i)}$

$i := 0 .. N$ $j := 1 .. N + 1$ $Err_j := |x_j - x_{j-1}|$ $Err_0 := "xxx"$

$x_i =$

5
4.245
4.021
4

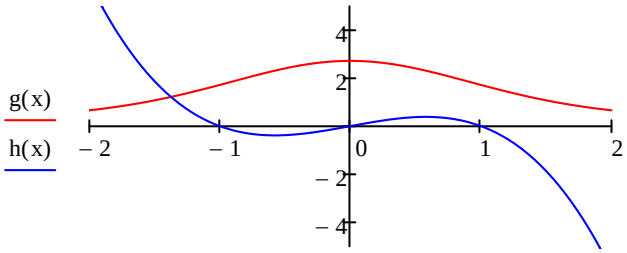
$f(x_i) =$

40
7.544
0.581
$4.606 \cdot 10^{-3}$

$Err_i = \begin{pmatrix} "xxx" \\ 0.755 \\ 0.225 \\ 0.02 \end{pmatrix}$

e) $g(x) := e^{\cos(x)}$ $h(x) := x - x^3$

$f(x) := g(x) - h(x)$ $f(x) \to e^{\cos(x)} - x + x^3$



raiz localizada:

$f(-1.5) = -0.802$ $f(-1) = 1.717$

$D(x) := \frac{d}{dx} f(x)$

$D(x) \to 3 \cdot x^2 - e^{\cos(x)} \cdot \sin(x) - 1$

$x_0 := -2$ $N := 3$

$i := 0 .. N$

$x_{i+1} := x_i - \frac{f(x_i)}{D(x_i)}$

$i := 0 .. N$ $j := 1 .. N + 1$ $Err_j := |x_j - x_{j-1}|$ $Err_0 := "xxx"$

$$x = \begin{pmatrix} -2 \\ -1.54 \\ -1.389 \\ -1.373 \\ -1.373 \end{pmatrix} \qquad f(x) = \begin{pmatrix} -5.34 \\ -1.078 \\ -0.091 \\ -8.491 \times 10^{-4} \\ -7.693 \times 10^{-8} \end{pmatrix} \qquad Err = \begin{pmatrix} "xxx" \\ 0.46 \\ 0.151 \\ 0.015 \\ 1.451 \times 10^{-4} \end{pmatrix}$$

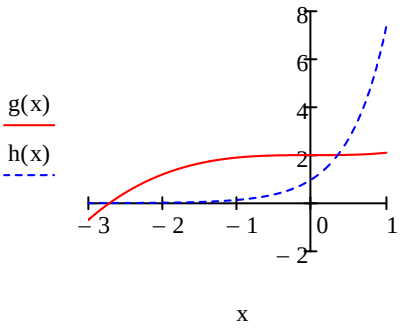
f)

$g(x) := 0.1x^3 + 2$

$h(x) := e^{2x}$

$f(x) := g(x) - h(x)$

$f(x) \rightarrow 0.1\cdot x^3 - e^{2\cdot x} + 2$



raizes localizadas:

$f(0) = 1$ $f(1) = -5.289$

$f(-3) = -0.702$ $f(-2) = 1.182$

$D(x) := \frac{d}{dx} f(x)$

$D(x) \rightarrow 0.3\cdot x^2 - 2\cdot e^{2\cdot x}$

$x_0 := 0.5$

$N := 3$

$i := 0 .. N$

$x_{i+1} := x_i - \frac{f(x_i)}{D(x_i)}$

$i := 0 .. N$ $j := 1 .. N + 1$ $Err_j := |x_j - x_{j-1}|$ $Err_0 := "xxx"$

$x_i =$

0.5
0.368
0.348
0.348

$f(x_i) =$

-0.706
-0.084
$-1.658\cdot10^{-3}$
$-6.792\cdot10^{-7}$

$Err_i = \begin{pmatrix} "xxx" \\ 0.132 \\ 0.02 \\ 4.17 \times 10^{-4} \end{pmatrix}$

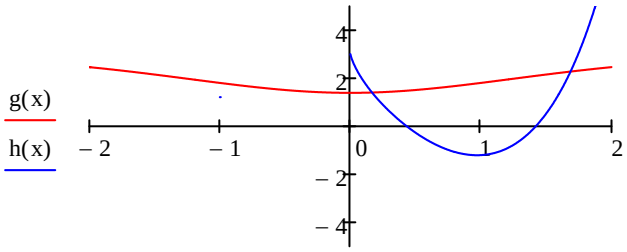
g)

$g(x) := 2\ln(3 - \cos(x))$

$h(x) := 3 \cdot x^{x} - 5\sin(x)$

$f(x) := g(x) - h(x)$

$f(x) \rightarrow 2 \cdot \ln(3 - \cos(x)) + 5 \cdot \sin(x) - 3 \cdot x^{x}$



raizes localizada:

$f(0) = -1.614$

$f(1) = 3.007$

$f(1.5) = 1.626$

$f(2) = -4.996$

$D(x) := \frac{d}{dx} f(x)$

$D(x) \rightarrow 5 \cdot \cos(x) - 3 \cdot x \cdot x^{x-1} - \frac{2 \cdot \sin(x)}{\cos(x) - 3} - 3 \cdot x^{x} \cdot \ln(x)$

$x_0 := 0.5$

$N := 3$

$i := 0 .. N$

$x_{i+1} := x_i - \frac{f(x_i)}{D(x_i)}$

$i := 0 .. N$ $\quad j := 1 .. N + 1$ $\quad Err_j := |x_j - x_{j-1}|$ $\quad Err_0 := \text{"xxx"}$

$x_i =$

0.5
0.075
0.154
0.166

$f(x_i) =$

1.781
-0.708
-0.087
$-1.195 \cdot 10^{-3}$

$$Err_i = \begin{pmatrix} \text{"xxx"} \\ 0.425 \\ 0.079 \\ 0.012 \end{pmatrix}$$

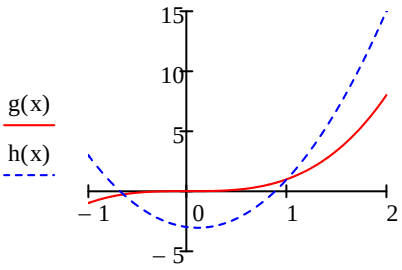
h)

$g(x) := x^3$

$h(x) := 5x^2 - x - 3$

$f(x) := g(x) - h(x)$

$f(x) \rightarrow x^3 - 5 \cdot x^2 + x + 3$



raizes localizadas:

$f(-1) = -4$ $f(0) = 3$

$f(0) = 3$ $f(1) = 0$

$D(x) := \frac{d}{dx} f(x)$

$D(x) \rightarrow 3 \cdot x^2 - 10 \cdot x + 1$

$x_0 := -0.5$

$N := 4$

$i := 0 .. N$

$$x_{i+1} := x_i - \frac{f(x_i)}{D(x_i)}$$

$i := 0 .. N$ $j := 1 .. N + 1$ $Err_j := |x_j - x_{j-1}|$ $Err_0 := "xxx"$

$x_i =$

-0.5
-0.667
-0.646
-0.646
-0.646

$f(x_i) =$

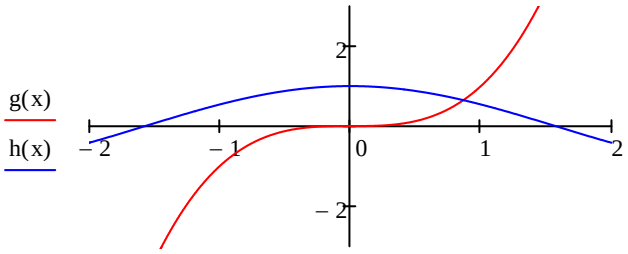
1.125
-0.185
$-2.955 \cdot 10^{-3}$
$-7.979 \cdot 10^{-7}$
$-5.79 \cdot 10^{-14}$

$Err_i =$

"xxx"
0.167
0.021
3.391×10^{-4}
9.163×10^{-8}

a) $g(x) := x^3$ $h(x) := \cos(x)$

$f(x) := g(x) - h(x)$ $f(x) \rightarrow x^3 - \cos(x)$



raizes localizadas:

$f(0.5) = -0.753$ $f(1) = 0.46$

iterações para raiz entre [0.5, 1]

k = 0 $\varepsilon \in [0.5, 1]$ $a := 0.5$ $b := 1$

$x_0 := \frac{a \cdot f(b) - b \cdot f(a)}{f(b) - f(a)}$ $x_0 = 0.81$

$f(0.81) = -0.158$

k = 1 $\varepsilon \in [0.81, 1]$ $a := 0.81$ $b := 1$

$x_1 := \frac{a \cdot f(b) - b \cdot f(a)}{f(b) - f(a)}$ $x_1 = 0.859$ $f(0.859) = -0.019$

k = 2 $\varepsilon \in [0.859, 1]$ $a := 0.859$ $b := 1$

$x_2 := \frac{a \cdot f(b) - b \cdot f(a)}{f(b) - f(a)}$ $x_2 = 0.865$ $f(0.865) = -1.425 \times 10^{-3}$

k = 3 $\varepsilon \in [0.865, 1]$ $a := 0.865$ $b := 1$

$x_3 := \frac{a \cdot f(b) - b \cdot f(a)}{f(b) - f(a)}$ $x_3 = 0.865$ $f(0.865) = -1.425 \times 10^{-3}$

$\text{root}(f(x), x, 0, 1) = 0.865$

$i := 0 .. 3$ $j := 1 .. 3$ $Err_j := \left| x_j - x_{j-1} \right|$ $Err_0 := \text{"xxx"}$

$i =$

0
1
2
3

$x_i =$

0.81
0.859
0.865
0.865

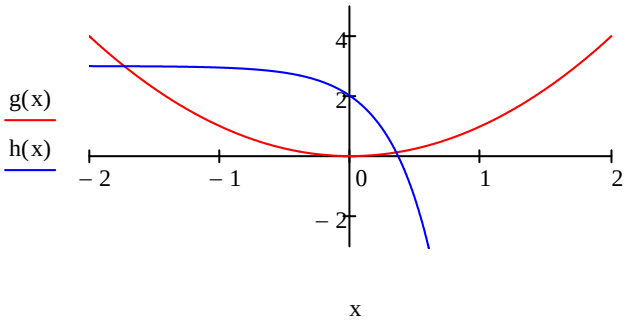
$f(x_i) =$

-0.157
-0.021
$-2.336 \cdot 10^{-3}$
$-1.706 \cdot 10^{-4}$

$$Err_i = \begin{pmatrix} \text{"xxx"} \\ 0.048 \\ 6.084 \times 10^{-3} \\ 7.205 \times 10^{-4} \end{pmatrix}$$

b) $g(x) := x^2$ $h(x) := 3 - e^{3x}$

$f(x) := g(x) - h(x)$ $f(x) \rightarrow e^{3\cdot x} + x^2 - 3$



raizes localizadas:

$f(0) = -2$ $f(0.5) = 1.732$

$f(-2) = 1.002$ $f(-1) = -1.95$

iterações para raiz entre [0, 0.5]

k = 0 $\varepsilon \in [0, 0.5]$ $a := 0$ $b := 0.5$

$x_0 := \frac{a\cdot f(b) - b\cdot f(a)}{f(b) - f(a)}$ $x_0 = 0.268$ $f(0.268) = -0.694$

k = 1 $\varepsilon \in [0.268, 0.5]$ $a := 0.268$ $b := 0.5$

$x_1 := \frac{a\cdot f(b) - b\cdot f(a)}{f(b) - f(a)}$ $x_1 = 0.334$ $f(0.334) = -0.165$

k = 2 $\varepsilon \in [0.334, 0.5]$ $a := 0.334$ $b := 0.5$

$x_2 := \frac{a\cdot f(b) - b\cdot f(a)}{f(b) - f(a)}$ $x_2 = 0.348$ $f(0.348) = -0.038$

k = 3 $\varepsilon \in [0.348, 0.5]$ $a := 0.348$ $b := 0.5$

$x_3 := \frac{a\cdot f(b) - b\cdot f(a)}{f(b) - f(a)}$ $x_3 = 0.351$ $f(0.351) = -0.011$

k = 4 $\varepsilon \in [0.351, 0.5]$ $a := 0.351$ $b := 0.5$

$x_4 := \frac{a\cdot f(b) - b\cdot f(a)}{f(b) - f(a)}$ $x_4 = 0.352$ $f(0.351) = -0.011$

$i := 0 .. 4$ $j := 1 .. 4$ $Err_j := \left| x_j - x_{j-1} \right|$ $Err_0 := \text{"xxx"}$

$i =$

0
1
2
3
4

$x_i =$

0.268
0.334
0.348
0.351
0.352

$f(x_i) =$

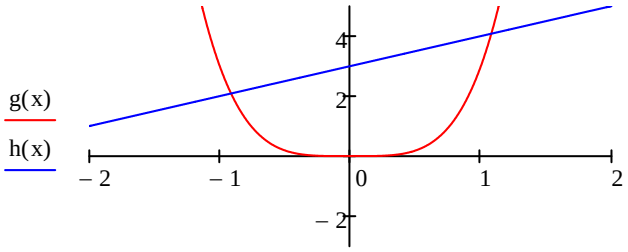
-0.694
-0.162
-0.034
$-7.842 \cdot 10^{-3}$
$-2.15 \cdot 10^{-3}$

$Err_i = \begin{pmatrix} \text{"xxx"} \\ 0.066 \\ 0.014 \\ 2.874 \times 10^{-3} \\ 6.109 \times 10^{-4} \end{pmatrix}$

$root(f(x), x, 0, 1) = 0.352$

c) $g(x) := 3x^4$ $h(x) := x + 3$

$f(x) := g(x) - h(x)$ $f(x) \rightarrow 3\cdot x^4 - x - 3$



raizes localizadas:

$f(-1) = 1$ $f(0) = -3$

$f(1) = -1$ $f(1.5) = 10.688$

iterações para raiz entre [1, 1.5]

k = 0 $\varepsilon \in [1, 1.5]$ $a := 1$ $b := 1.5$

$x_0 := \frac{a\cdot f(b) - b\cdot f(a)}{f(b) - f(a)}$ $x_0 = 1.043$ $f(1.043) = -0.493$

k = 1 $\varepsilon \in [1.043, 1.5]$ $a := 1.043$ $b := 1.5$

$x_1 := \frac{a\cdot f(b) - b\cdot f(a)}{f(b) - f(a)}$ $x_1 = 1.063$ $f(1.063) = -0.233$

k = 2 $\varepsilon \in [1.063, 1.5]$ $a := 1.063$ $b := 1.5$

$x_2 := \frac{a\cdot f(b) - b\cdot f(a)}{f(b) - f(a)}$ $x_2 = 1.072$ $f(1.072) = -0.11$

k = 3 $\varepsilon \in [1.072, 1.5]$ $a := 1.072$ $b := 1.5$

$x_3 := \frac{a\cdot f(b) - b\cdot f(a)}{f(b) - f(a)}$ $x_3 = 1.076$ $f(1.076) = -0.055$

k = 4 $\varepsilon \in [1.076, 1.5]$ $a := 1.076$ $b := 1.5$

$x_4 := \frac{a\cdot f(b) - b\cdot f(a)}{f(b) - f(a)}$ $x_4 = 1.078$ $f(1.078) = -0.027$

k = 5

$\varepsilon \in [1.078, 1.5]^{-}_{+}$ $\quad a := 1.078 \quad b := 1.5$

$$x_5 := \frac{a \cdot f(b) - b \cdot f(a)}{f(b) - f(a)} \qquad x_5 = 1.079 \qquad f(1.078) = -0.027$$

$i := 0 .. 5 \quad j := 1 .. 5 \quad Err_j := |x_j - x_{j-1}| \quad Err_0 := "xxx"$

$i =$
0
1
2
3
4
5

$x_i =$
1.043
1.063
1.072
1.076
1.078
1.079

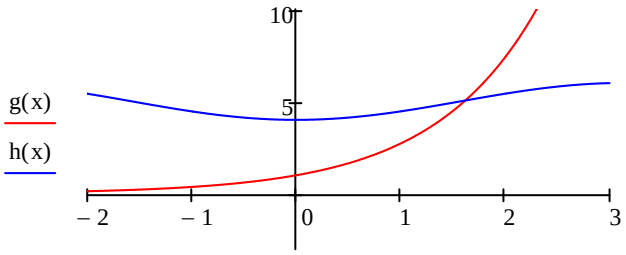
$f(x_i) =$
-0.496
-0.231
-0.106
-0.05
-0.024
-0.012

$$Err_i = \begin{pmatrix} "xxx" \\ 0.02 \\ 9.163 \times 10^{-3} \\ 4.061 \times 10^{-3} \\ 1.792 \times 10^{-3} \\ 8.933 \times 10^{-4} \end{pmatrix}$$

$root(f(x), x, 1, 1.5) = 1.08$

d) $g(x) := e^{x}$ $h(x) := 5 - \cos(x)$

$f(x) := g(x) - h(x)$ $f(x) \rightarrow \cos(x) + e^{x} - 5$



raizes localizadas:

$f(1) = -1.741$ $f(2) = 1.973$

iterações para raiz entre [1, 2]

k = 0 $\varepsilon \in [1, 2]$ $a := 1$ $b := 2$

$x_0 := \frac{a \cdot f(b) - b \cdot f(a)}{f(b) - f(a)}$ $x_0 = 1.469$ $f(1.469) = -0.553$

k = 1 $\varepsilon \in [1.469, 2]$ $a := 1.469$ $b := 2$

$x_1 := \frac{a \cdot f(b) - b \cdot f(a)}{f(b) - f(a)}$ $x_1 = 1.585$ $f(1.585) = -0.135$

k = 2 $\varepsilon \in [1.585, 2]$ $a := 1.585$ $b := 2$

$x_2 := \frac{a \cdot f(b) - b \cdot f(a)}{f(b) - f(a)}$ $x_2 = 1.612$ $f(1.612) = -0.028$

k = 3 $\varepsilon \in [1.612, 2]$ $a := 1.612$ $b := 2$

$x_3 := \frac{a \cdot f(b) - b \cdot f(a)}{f(b) - f(a)}$ $x_3 = 1.617$ $f(1.617) = -8.233 \times 10^{-3}$

k = 4 $\varepsilon \in [1.617, 2]$ $a := 1.617$ $b := 2$

$x_4 := \frac{a \cdot f(b) - b \cdot f(a)}{f(b) - f(a)}$ $x_4 = 1.619$ $f(1.619) = -1.453 \times 10^{-4}$

k = 5

$\varepsilon \in [1.619, 2]^{-+}$ $\quad a := 1.619 \quad b := 2$

$$x_5 := \frac{a \cdot f(b) - b \cdot f(a)}{f(b) - f(a)} \qquad x_5 = 1.619 \qquad f(1.619) = -1.453 \times 10^{-4}$$

$i := 0 .. 5 \qquad j := 1 .. 5 \qquad Err_j := |x_j - x_{j-1}| \qquad Err_0 := "xxx"$

$i =$

0
1
2
3
4
5

$x_i =$

1.469
1.585
1.612
1.617
1.619
1.619

$f(x_i) =$

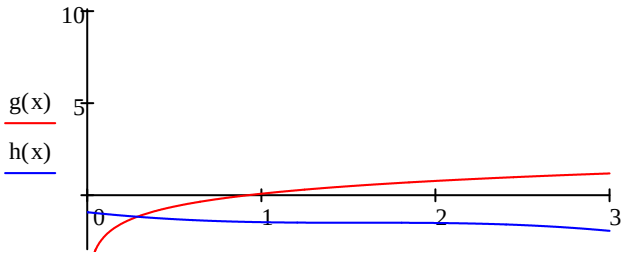
-0.554
-0.134
-0.03
$-6.216 \cdot 10^{-3}$
$-1.798 \cdot 10^{-3}$
$-3.168 \cdot 10^{-5}$

$$Err_i = \begin{pmatrix} "xxx" \\ 0.116 \\ 0.026 \\ 5.937 \times 10^{-3} \\ 1.092 \times 10^{-3} \\ 4.363 \times 10^{-4} \end{pmatrix}$$

$root(f(x), x, 1, 2) = 1.619$

e) $g(x) := \ln(x)$ $h(x) := -x - \cos(x)$

$f(x) := g(x) - h(x)$ $f(x) \rightarrow x + \cos(x) + \ln(x)$



raizes localizadas:

$f(0.1) = -1.208$ $f(1) = 1.54$

iterações para raiz entre [0.1, 1]

k = 0 $\varepsilon \in [0.1, 1]$ $a := 0.1$ $b := 1$

$x_0 := \frac{a \cdot f(b) - b \cdot f(a)}{f(b) - f(a)}$ $x_0 = 0.496$ $f(0.496) = 0.674$

k = 1 $\varepsilon \in [0.1, 0.496]$ $a := 0.1$ $b := 0.496$

$x_1 := \frac{a \cdot f(b) - b \cdot f(a)}{f(b) - f(a)}$ $x_1 = 0.354$ $f(0.354) = 0.254$

k = 2 $\varepsilon \in [0.1, 0.354]$ $a := 0.1$ $b := 0.354$

$x_2 := \frac{a \cdot f(b) - b \cdot f(a)}{f(b) - f(a)}$ $x_2 = 0.31$ $f(0.31) = 0.091$

k = 3 $\varepsilon \in [0.1, 0.31]$ $a := 0.1$ $b := 0.31$

$x_3 := \frac{a \cdot f(b) - b \cdot f(a)}{f(b) - f(a)}$ $x_3 = 0.295$ $f(0.295) = 0.031$

k = 4 $\varepsilon \in [0.1, 0.295]$ $a := 0.1$ $b := 0.295$

$x_4 := \frac{a \cdot f(b) - b \cdot f(a)}{f(b) - f(a)}$ $x_4 = 0.29$ $f(0.29) = 0.01$

k = 5

$\varepsilon \in [0.1, 0.29]^{-}_{+}$ $\quad a := 0.1 \quad b := 0.29$

$$x_5 := \frac{a \cdot f(b) - b \cdot f(a)}{f(b) - f(a)} \qquad x_5 = 0.288 \qquad f(0.288) = 2.019 \times 10^{-3}$$

k = 6

$\varepsilon \in [0.1, 0.288]^{-}_{+}$ $\quad a := 0.1 \quad b := 0.288$

$$x_5 := \frac{a \cdot f(b) - b \cdot f(a)}{f(b) - f(a)} \qquad x_5 = 0.288 \qquad f(0.288) = 2.019 \times 10^{-3}$$

$i := 0 .. 5 \qquad j := 1 .. 5 \qquad Err_j := \left| x_j - x_{j-1} \right| \qquad Err_0 := \text{"xxx"}$

$i =$
0
1
2
3
4
5

$x_i =$
0.496
0.354
0.31
0.295
0.29
0.288

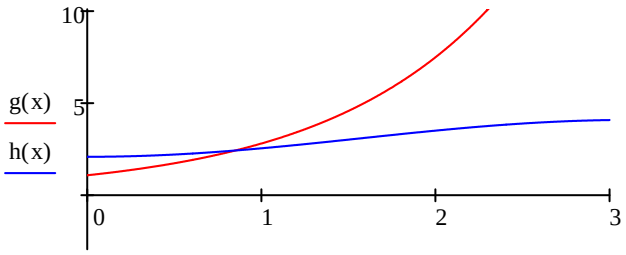
$f(x_i) =$
0.673
0.254
0.091
0.032
0.011
$7.041 \cdot 10^{-4}$

$$Err_i = \begin{pmatrix} \text{"xxx"} \\ 0.141 \\ 0.044 \\ 0.015 \\ 5.145 \times 10^{-3} \\ 2.43 \times 10^{-3} \end{pmatrix}$$

$root(f(x), x, 0.1, 1) = 0.288$

f) $g(x) := e^{x}$ $h(x) := 3 - \cos(x)$

$f(x) := g(x) - h(x)$ $f(x) \rightarrow \cos(x) + e^{x} - 3$



raizes localizadas:

$f(0.5) = -0.474$ $f(1) = 0.259$

iterações para raiz entre [0.5, 1]

k = 0 $\varepsilon \in [0.5, 1]$ $a := 0.5$ $b := 1$

$x_0 := \frac{a \cdot f(b) - b \cdot f(a)}{f(b) - f(a)}$ $x_0 = 0.823$ $f(0.823) = -0.043$

k = 1 $\varepsilon \in [0.823, 1]$ $a := 0.823$ $b := 1$

$x_1 := \frac{a \cdot f(b) - b \cdot f(a)}{f(b) - f(a)}$ $x_1 = 0.848$ $f(0.848) = -3.543 \times 10^{-3}$

k = 2 $\varepsilon \in [0.848, 1]$ $a := 0.848$ $b := 1$

$x_2 := \frac{a \cdot f(b) - b \cdot f(a)}{f(b) - f(a)}$ $x_2 = 0.85$ $f(0.85) = -3.7 \times 10^{-4}$

k = 3 $\varepsilon \in [0.85, 1]$ $a := 0.85$ $b := 1$

$x_3 := \frac{a \cdot f(b) - b \cdot f(a)}{f(b) - f(a)}$ $x_3 = 0.85$ $f(0.85) = -3.7 \times 10^{-4}$

$i := 0 .. 3$ $j := 1 .. 3$ $Err_j := \left| x_j - x_{j-1} \right|$ $Err_0 := \text{"xxx"}$

$i =$

0
1
2
3

$x_i =$

0.823
0.848
0.85
0.85

$f(x_i) =$

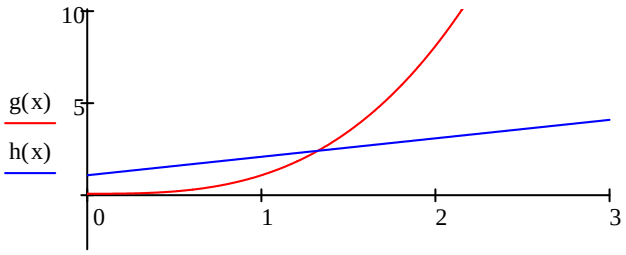
-0.042
$-3.445 \cdot 10^{-3}$
$-2.831 \cdot 10^{-4}$
$-2.954 \cdot 10^{-5}$

$$Err_i = \begin{pmatrix} \text{"xxx"} \\ 0.025 \\ 1.992 \times 10^{-3} \\ 1.596 \times 10^{-4} \end{pmatrix}$$

$root(f(x), x, 0.1, 1) = 0.85$

g) $g(x) := x^3$ $h(x) := x + 1$

$f(x) := g(x) - h(x)$ $f(x) \rightarrow x^3 - x - 1$



raizes localizadas:

$f(1) = -1$ $f(2) = 5$

iterações para raiz entre [1, 2]

k = 0 $\varepsilon \in [1, 2]$ $a := 1$ $b := 2$

$x_0 := \frac{a \cdot f(b) - b \cdot f(a)}{f(b) - f(a)}$ $x_0 = 1.167$ $f(1.167) = -0.578$

k = 1 $\varepsilon \in [1.167, 2]$ $a := 1.167$ $b := 2$

$x_1 := \frac{a \cdot f(b) - b \cdot f(a)}{f(b) - f(a)}$ $x_1 = 1.253$ $f(1.253) = -0.286$

k = 2 $\varepsilon \in [1.253, 2]$ $a := 1.253$ $b := 2$

$x_2 := \frac{a \cdot f(b) - b \cdot f(a)}{f(b) - f(a)}$ $x_2 = 1.293$ $f(1.293) = -0.131$

k = 3 $\varepsilon \in [1.293, 2]$ $a := 1.293$ $b := 2$

$x_3 := \frac{a \cdot f(b) - b \cdot f(a)}{f(b) - f(a)}$ $x_3 = 1.311$ $f(1.311) = -0.058$

k = 4 $\varepsilon \in [1.311, 2]$ $a := 1.311$ $b := 2$

$x_4 := \frac{a \cdot f(b) - b \cdot f(a)}{f(b) - f(a)}$ $x_4 = 1.319$ $f(1.319) = -0.024$

k = 5 $\varepsilon \in [1.319, 2]$ (- +) $a := 1.319$ $b := 2$

$$x_5 := \frac{a \cdot f(b) - b \cdot f(a)}{f(b) - f(a)} \quad x_5 = 1.322 \quad f(1.322) = -0.012$$

k = 6 $\varepsilon \in [1.322, 2]$ (- +) $a := 1.322$ $b := 2$

$$x_6 := \frac{a \cdot f(b) - b \cdot f(a)}{f(b) - f(a)} \quad x_6 = 1.324 \quad f(1.324) = -3.06 \times 10^{-3}$$

k = 7 $\varepsilon \in [1.324, 2]$ (- +) $a := 1.324$ $b := 2$

$$x_7 := \frac{a \cdot f(b) - b \cdot f(a)}{f(b) - f(a)} \quad x_7 = 1.324 \quad f(1.324) = -3.06 \times 10^{-3}$$

$i := 0 .. 7$ $j := 1 .. 7$ $Err_j := |x_j - x_{j-1}|$ $Err_0 := "xxx"$

$i =$

0
1
2
3
4
5
6
7

$x_i =$

1.167
1.253
1.293
1.311
1.319
1.322
1.324
1.324

$f(x_i) =$

-0.579
-0.285
-0.13
-0.057
-0.025
-0.01
$-4.915 \cdot 10^{-3}$
$-1.298 \cdot 10^{-3}$

$$Err_i = \begin{pmatrix} "xxx" \\ 0.087 \\ 0.04 \\ 0.018 \\ 7.777 \times 10^{-3} \\ 3.42 \times 10^{-3} \\ 1.277 \times 10^{-3} \\ 8.493 \times 10^{-4} \end{pmatrix}$$

$root(f(x), x, 1, 2) = 1.325$