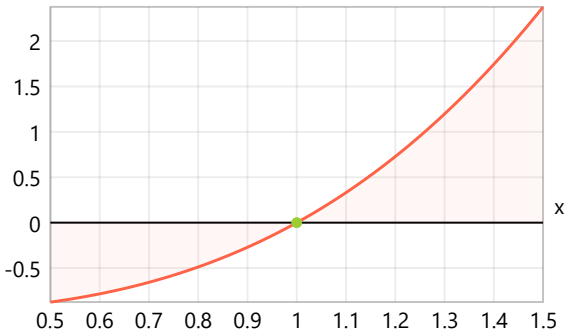
Root-finding Test Functions

Sérgio Galdino. *A family of regula falsi root-finding methods*. Proceedings of 2011 World Congress on Engineering and Technology. Shanghai, China. IEEE Press. ISBN 978-1-61284-365-0. p. 514-517
http://sergiogaldino.pbworks.com/w/file/fetch/66011429/0130-1943543

$$f_{01}(x) = x^3 - 1$$

[1.5; 2.38]

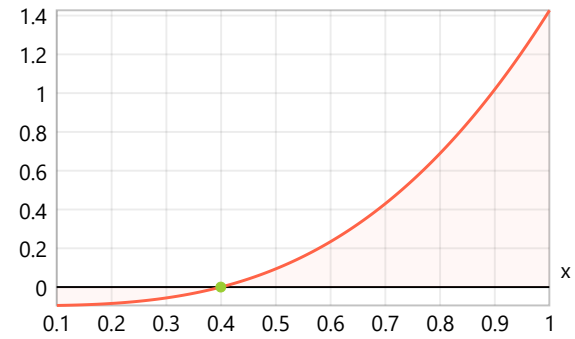


[0.5; -0.875]

$$x_{01} = \$\text{Root}\{f_{01}(x) = 0;\ x \in [0.5;\ 1.5]\} = 1$$

$$f_{02}(x) = x^2 \cdot \left(\frac{x^2}{3} + \sqrt{2} \cdot \sin(x)\right) - \frac{\sqrt{3}}{18}$$

[1; 1.43]

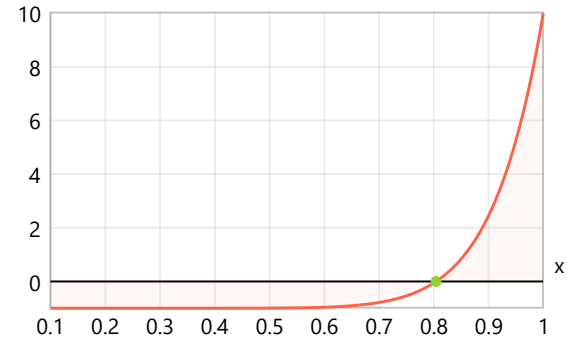


[0.1; -0.0948]

$$x_{02} = \$\text{Root}\{f_{02}(x) = 0;\ x \in [0.1;\ 1]\} = 0.399$$

$$f_{03}(x) = 11 \cdot x^{11} - 1$$

[1; 10]

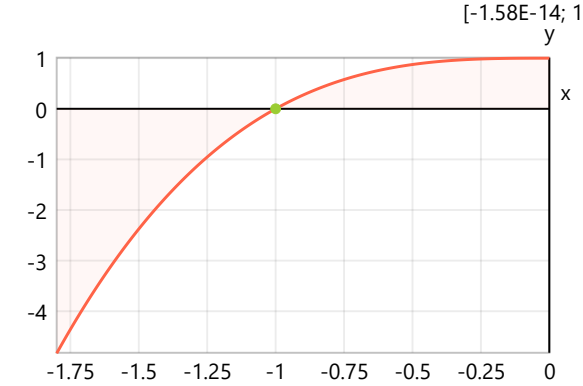


[0.1; -1]

$$x_{03} = \$\text{Root}\{f_{03}(x) = 0;\ x \in [0.1;\ 1]\} = 0.804$$

$$f_{04}(x) = x^3 + 1$$

[-1.58E-14; 1]

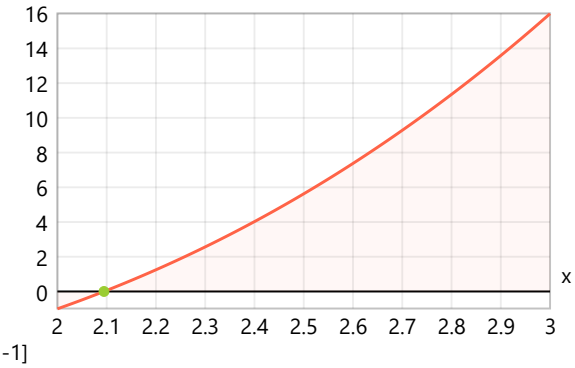


[-1.8; -4.83]

$$x_{04} = \$\text{Root}\{f_{04}(x) = 0;\ x \in [-1.8;\ 0]\} = -1$$

$$f_{05}(x) = x^3 - 2 \cdot x - 5$$

[3; 16]

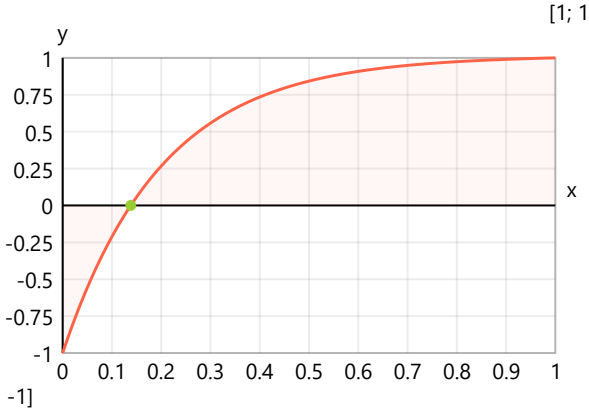


[2; -1]

$$x_{05} = \$\text{Root}\{f_{05}(x) = 0;\ x \in [2;\ 3]\} = 2.09$$

$$f_{06}(x) = 2 \cdot x \cdot e^{-5} + 1 - 2 \cdot e^{-5 \cdot x}$$

[1; 1]

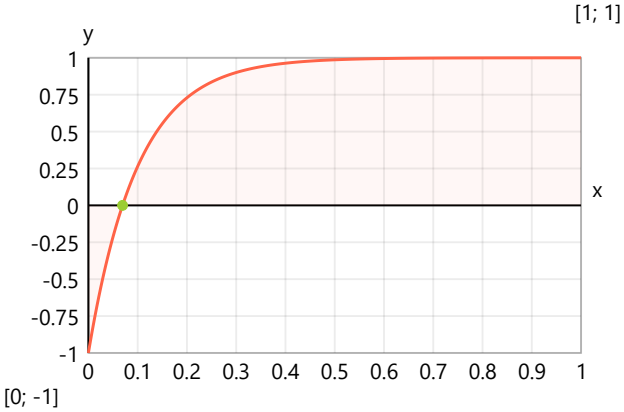


[0; -1]

$$x_{06} = \$\text{Root}\{f_{06}(x) = 0;\ x \in [0;\ 1]\} = 0.138$$

$f_{07}(x) = 2 \cdot x \cdot e^{-10} + 1 - 2 \cdot e^{-10 \cdot x}$

[1; 1]

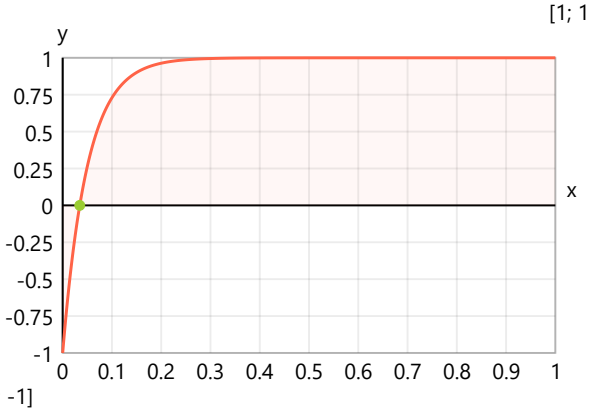


[0; -1]

$x_{07} = \$\text{Root}\{f_{07}(x) = 0; x \in [0; 1]\} = 0.0693$

$f_{08}(x) = 2 \cdot x \cdot e^{-20} + 1 - 2 \cdot e^{-20 \cdot x}$

[1; 1]

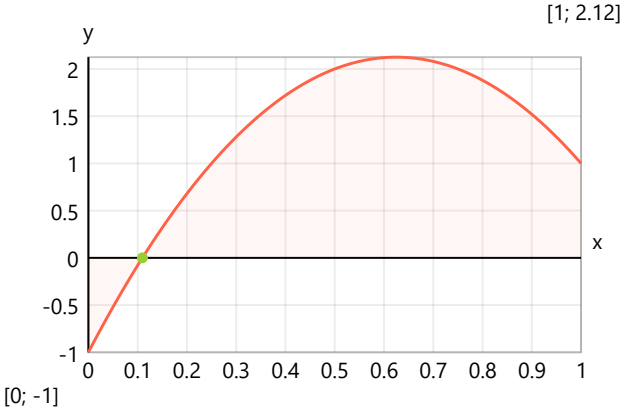


[0; -1]

$x_{08} = \$\text{Root}\{f_{08}(x) = 0; x \in [0; 1]\} = 0.0347$

$f_{09}(x) = (1 + (1 - 5)^2) \cdot x^2 - (1 - 5 \cdot x)^2$

[1; 2.12]

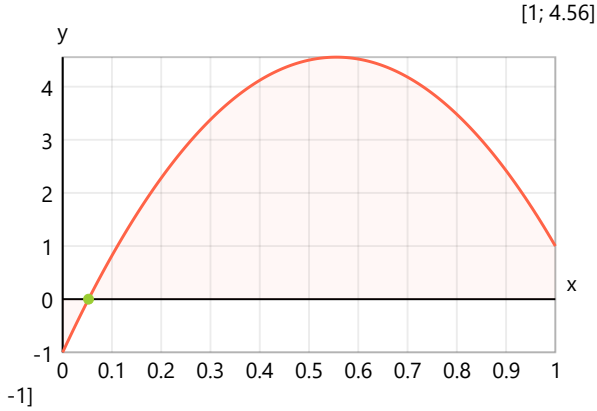


[0; -1]

$x_{09} = \$\text{Root}\{f_{09}(x) = 0; x \in [0; 1]\} = 0.11$

$f_{10}(x) = (1 + (1 - 10)^2) \cdot x^2 - (1 - 10 \cdot x)^2$

[1; 4.56]

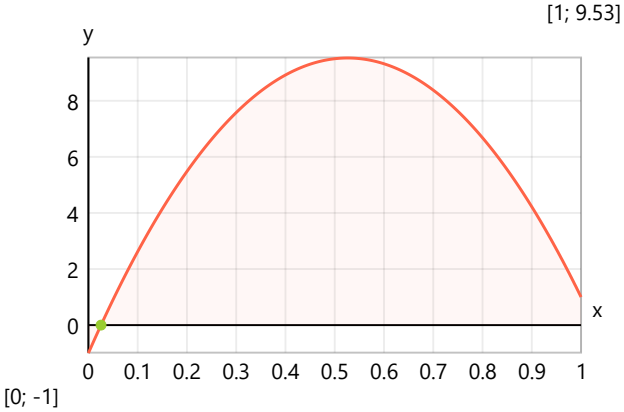


[0; -1]

$x_{10} = \$\text{Root}\{f_{10}(x) = 0; x \in [0; 1]\} = 0.0525$

$f_{11}(x) = (1 + (1 - 20)^2) \cdot x^2 - (1 - 20 \cdot x)^2$

[1; 9.53]

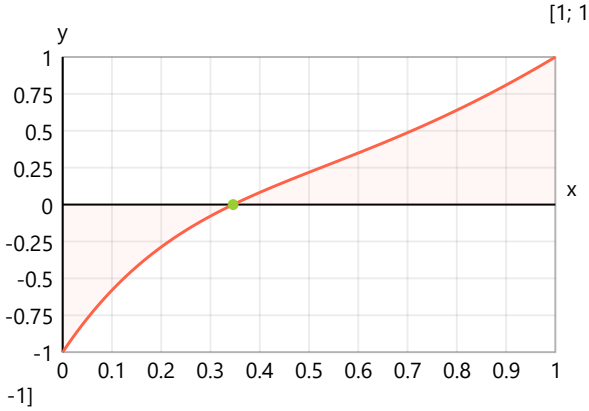


[0; -1]

$x_{11} = \$\text{Root}\{f_{11}(x) = 0; x \in [0; 1]\} = 0.0256$

$f_{12}(x) = x^2 - (1 - x)^5$

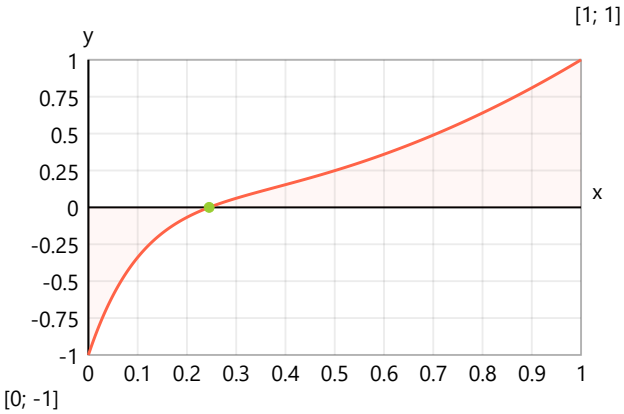
[1; 1]



[0; -1]

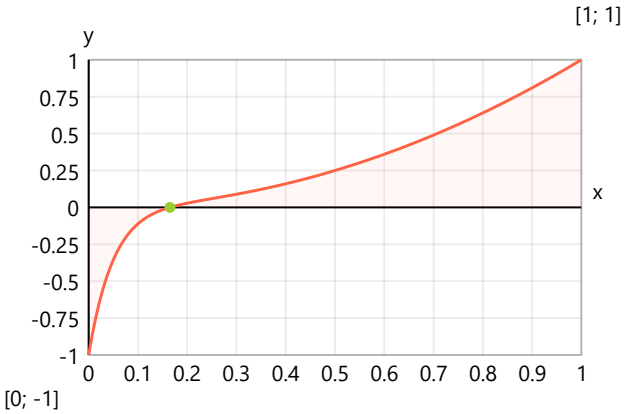
$x_{12} = \$\text{Root}\{f_{12}(x) = 0; x \in [0; 1]\} = 0.346$

$f_{13}(x) = x^2 - (1-x)^{10}$



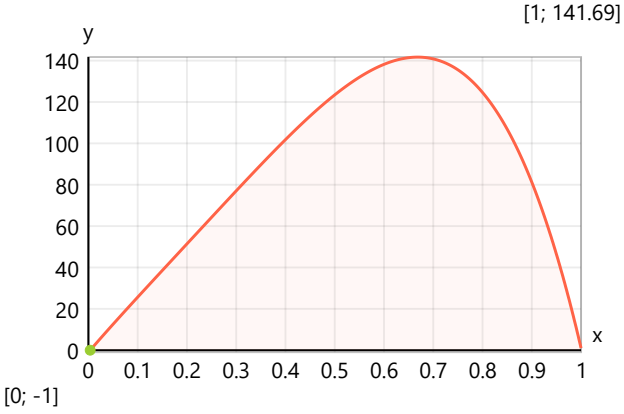
$x_{13} = \$\text{Root}\{f_{13}(x) = 0; x \in [0; 1]\} = 0.245$

$f_{14}(x) = x^2 - (1-x)^{20}$



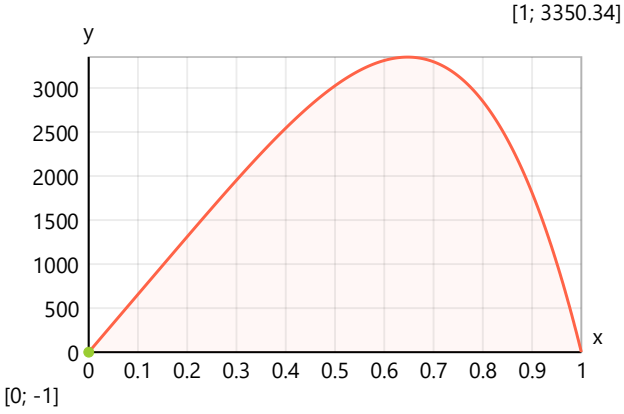
$x_{14} = \$\text{Root}\{f_{14}(x) = 0; x \in [0; 1]\} = 0.165$

$f_{15}(x) = (1 + (1-5)^4) \cdot x - (1 - 5 \cdot x)^4$



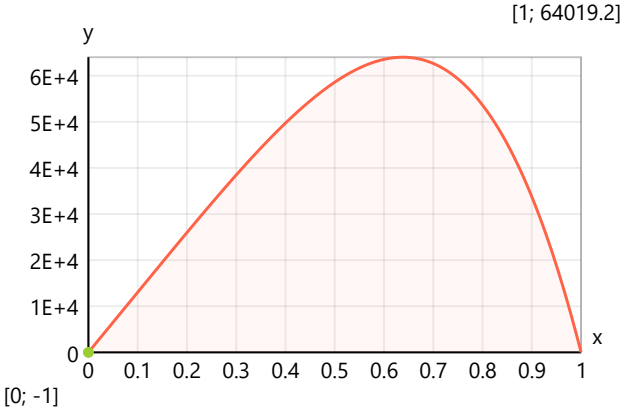
$x_{15} = \$\text{Root}\{f_{15}(x) = 0; x \in [0; 1]\} = 0.00362$

$f_{16}(x) = (1 + (1-10)^4) \cdot x - (1 - 10 \cdot x)^4$



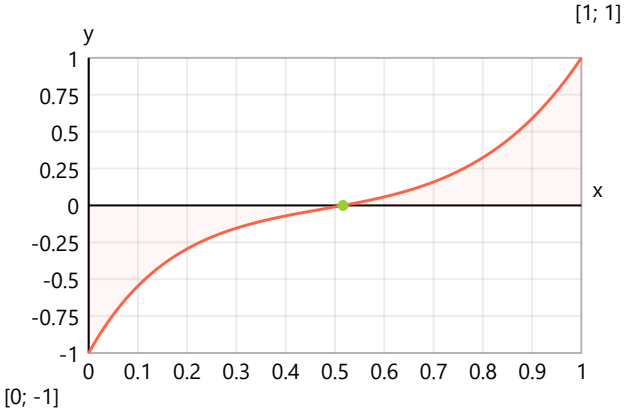
$x_{16} = \$\text{Root}\{f_{16}(x) = 0; x \in [0; 1]\} = 0.000151$

$f_{17}(x) = (1 + (1-20)^4) \cdot x - (1 - 20 \cdot x)^4$



$x_{17} = \$\text{Root}\{f_{17}(x) = 0; x \in [0; 1]\} = 7.67 \times 10^{-6}$

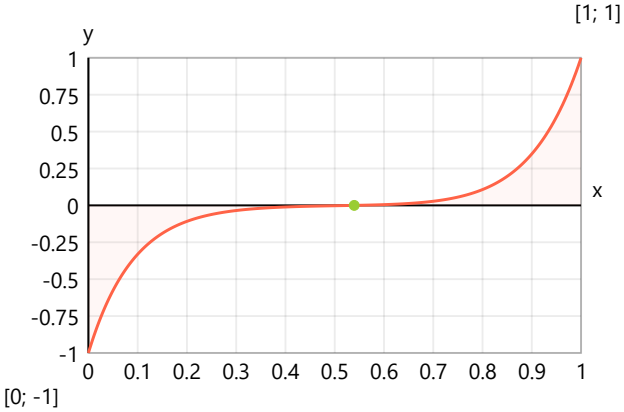
$f_{18}(x) = e^{-5 \cdot x} \cdot (x-1) + x^5$



$x_{18} = \$\text{Root}\{f_{18}(x) = 0; x \in [0; 1]\} = 0.516$

$f_{19}(x) = e^{-10 \cdot x} \cdot (x - 1) + x^{10}$

[1; 1]

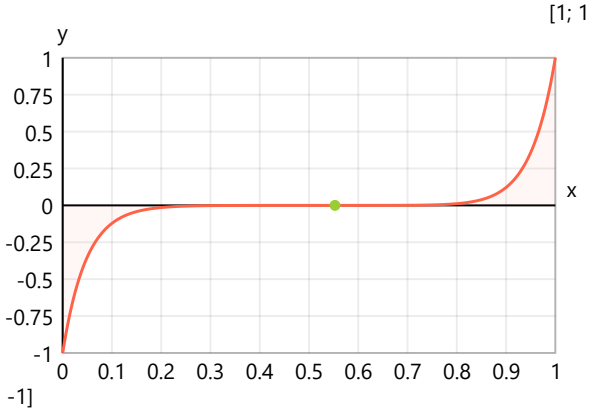


[0; -1]

$x_{19} = \$\text{Root}\{f_{19}(x) = 0; x \in [0; 1]\} = 0.54$

$f_{20}(x) = e^{-20 \cdot x} \cdot (x - 1) + x^{20}$

[1; 1]

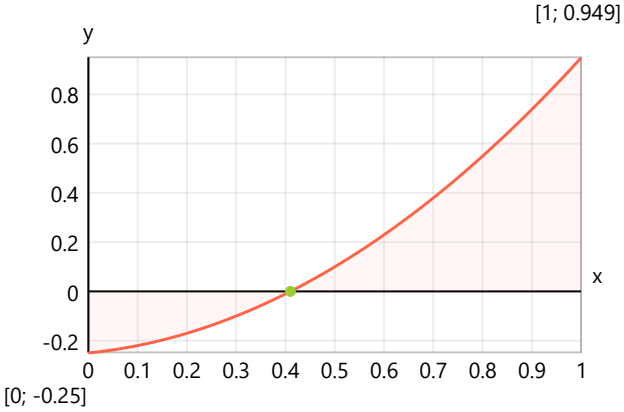


[0; -1]

$x_{20} = \$\text{Root}\{f_{20}(x) = 0; x \in [0; 1]\} = 0.553$

$f_{21}(x) = x^2 + \sin\left(\frac{x}{5}\right) - \frac{1}{4}$

[1; 0.949]

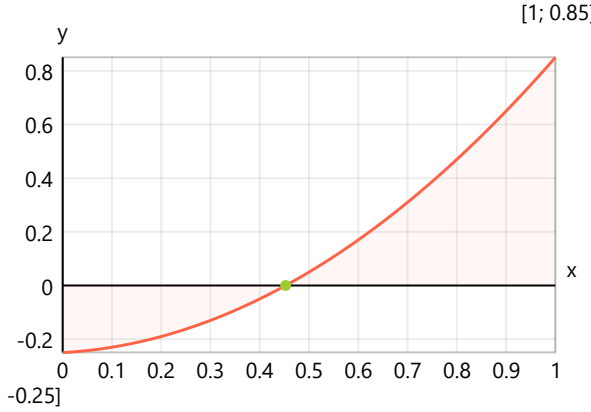


[0; -0.25]

$x_{21} = \$\text{Root}\{f_{21}(x) = 0; x \in [0; 1]\} = 0.41$

$f_{22}(x) = x^2 + \sin\left(\frac{x}{10}\right) - \frac{1}{4}$

[1; 0.85]

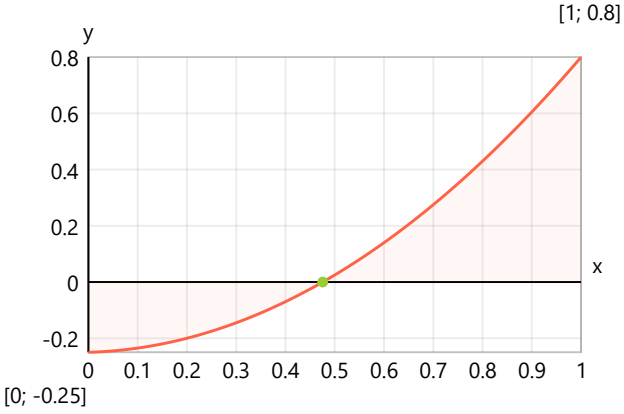


[0; -0.25]

$x_{22} = \$\text{Root}\{f_{22}(x) = 0; x \in [0; 1]\} = 0.453$

$f_{23}(x) = x^2 + \sin\left(\frac{x}{20}\right) - \frac{1}{4}$

[1; 0.8]

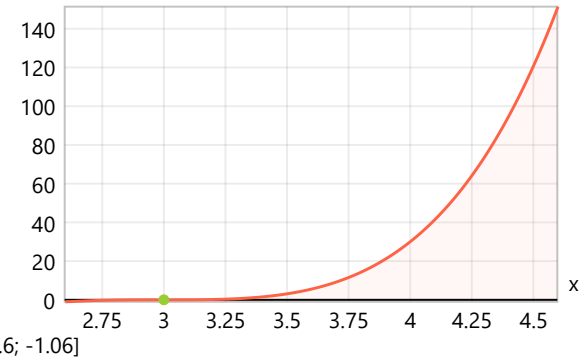


[0; -0.25]

$x_{23} = \$\text{Root}\{f_{23}(x) = 0; x \in [0; 1]\} = 0.476$

$f_{24}(x) = (x + 2) \cdot (x + 1) \cdot (x - 3)^3$

[4.6; 151.39]

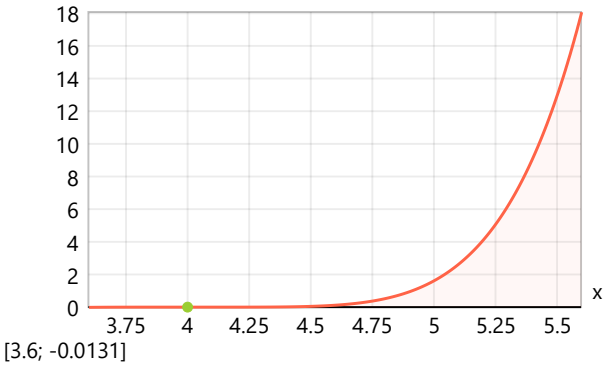


[2.6; -1.06]

$x_{24} = \$\text{Root}\{f_{24}(x) = 0; x \in [2.6; 4.6]\} = 3$

$$f_{25}(x) = (x-4)^5 \cdot \ln(x)$$

[5.6; 18.06]

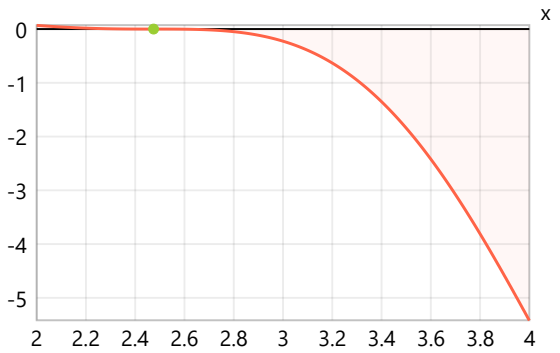


[3.6; -0.0131]

$$x_{25} = \$\text{Root}\{f_{25}(x) = 0;\ x \in [3.6;\ 5.6]\} = 4$$

$$f_{26}(x) = \left(\sin(x) - \frac{x}{4}\right)^3$$

[4; 0.0686]

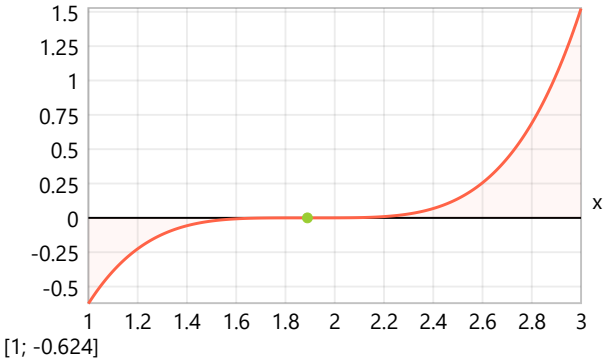


[2; -5.42]

$$x_{26} = \$\text{Root}\{f_{26}(x) = 0;\ x \in [2;\ 4]\} = 2.47$$

$$f_{27}(x) = \Big(81 - p(x) \cdot \Big(108 - p(x) \cdot \Big(54 - p(x) \cdot \big(12 - p(x)\big)\Big)\Big)\Big) \cdot \Big(\text{sign}(p(x) - 3)\Big),\ p(x) = x + 1.11$$

[3; 1.52]

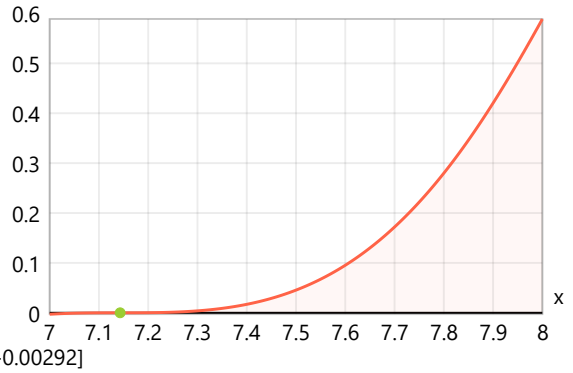


[1; -0.624]

$$x_{27} = \$\text{Root}\{f_{27}(x) = 0;\ x \in [1;\ 3]\} = 1.89$$

$$f_{28}(x) = \sin((x-7.14)^3)$$

[8; 0.589]

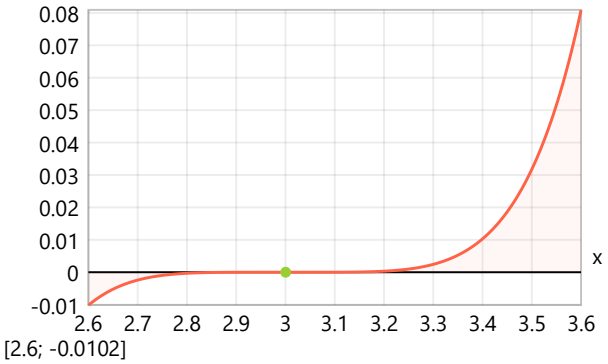


[7; -0.00292]

$$x_{28} = \$\text{Root}\{f_{28}(x) = 0;\ x \in [7;\ 8]\} = 7.14$$

$$f_{29}(x) = e^{(x-3)^5} - 1$$

[3.6; 0.0809]

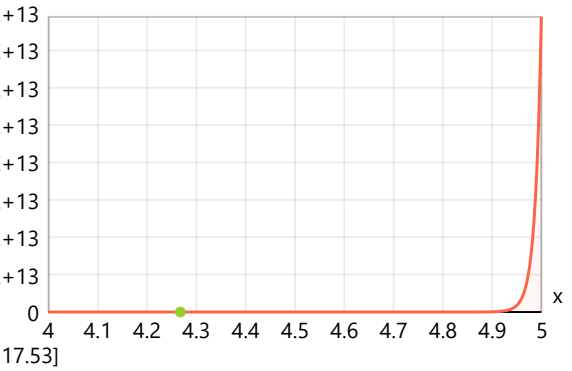


[2.6; -0.0102]

$$x_{29} = \$\text{Root}\{f_{29}(x) = 0;\ x \in [2.6;\ 3.6]\} = 3$$

$$f_{30}(x) = e^{(x-3)^5} - e^{x-1}$$

[5; 78962960182626]



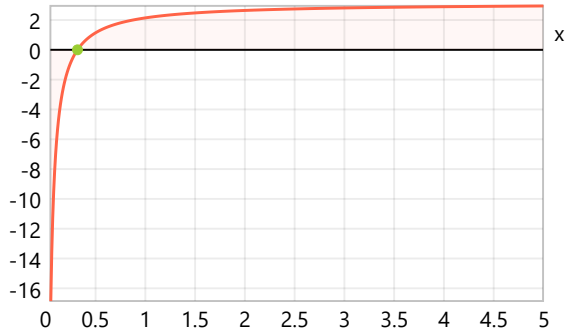
[4; -17.53]

$$x_{30} = \$\text{Root}\{f_{30}(x) = 0;\ x \in [4;\ 5]\} = 4.27$$

My functions

$$f_{31}(x) = \pi - \frac{1}{x}$$

[5; 2.94]

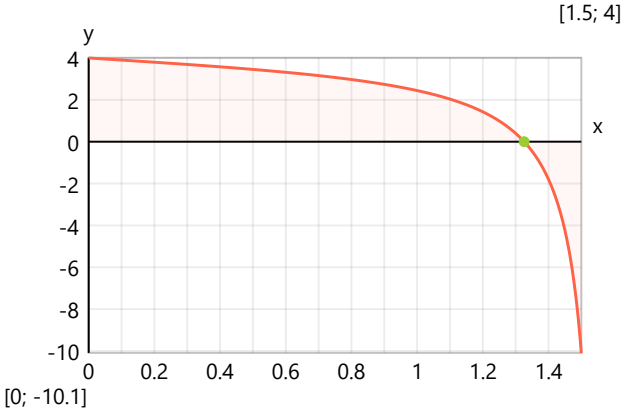


[0.05; -16.86]

$$x_{31} = \$\text{Root}\{f_{31}(x) = 0;\ x \in [0.05v5]\} = 0.318$$

$$f_{32}(x) = 4 - \tan(x)$$

[1.5; 4]



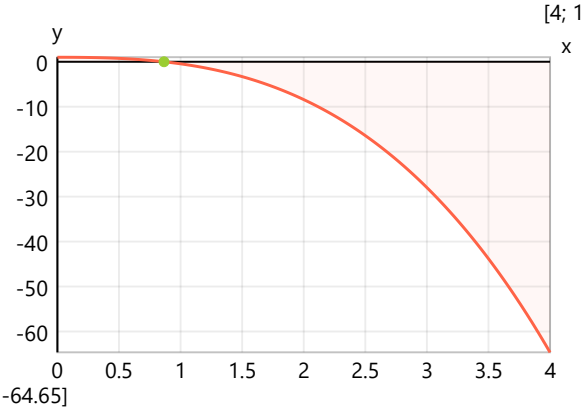
[0; -10.1]

$$x_{32} = \$\text{Root}\{f_{32}(x) = 0;\ x \in [0; 1.5]\} = 1.33$$

Steven A. Stage. *Comments on An Improvement to the Brent's Method*. International Journal of Experimental Algorithms (IJEA), Volume (4) : Issue (1) : 2013

$$f_{33}(x) = \cos(x) - x^3$$

[4; 1]

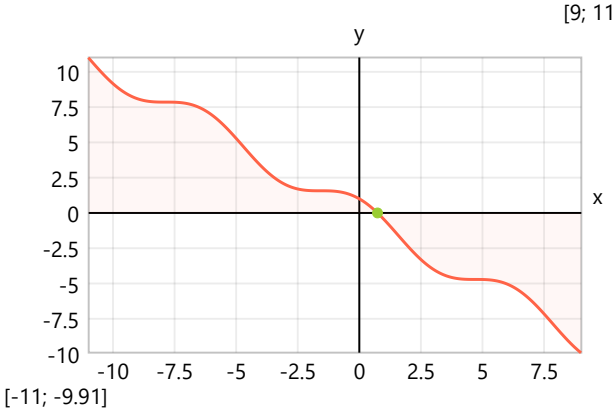


[0; -64.65]

$$x_{33} = \$\text{Root}\{f_{33}(x) = 0;\ x \in [0; 4]\} = 0.865$$

$$f_{34}(x) = \cos(x) - x$$

[9; 11]

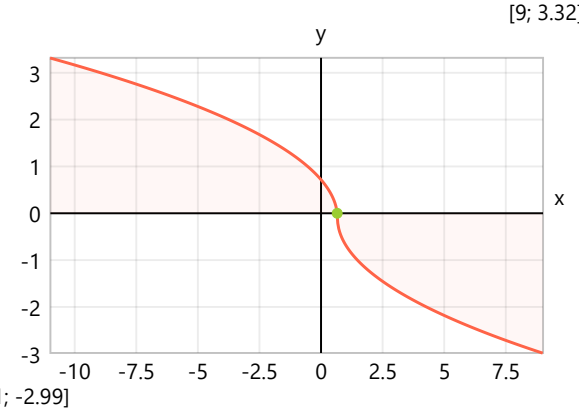


[-11; -9.91]

$$x_{34} = \$\text{Root}\{f_{34}(x) = 0;\ x \in [-11; 9]\} = 0.739$$

$$f_{35}(x) = \sqrt{\left|x - \frac{2}{3}\right|} \cdot \begin{cases} \text{if } x \le \frac{2}{3}: & 1 \\ \text{else:} & -1 \end{cases} - 0.1$$

[9; 3.32]

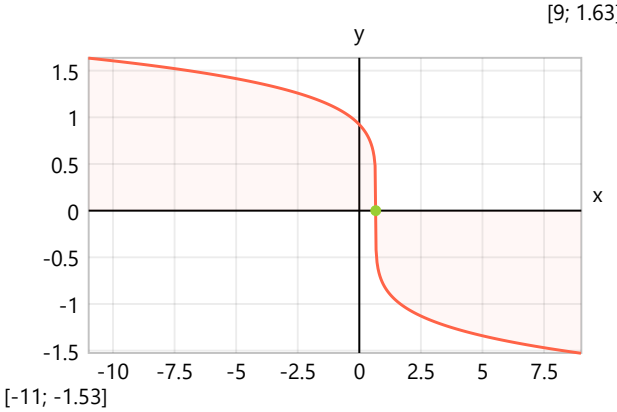


[-11; -2.99]

$$x_{35} = \$\text{Root}\{f_{35}(x) = 0;\ x \in [-11; 9]\} = 0.657$$

$$f_{36}(x) = \left(\left|x - \frac{2}{3}\right|\right)^{0.2} \cdot \begin{cases} \text{if } x \le \frac{2}{3}: & 1 \\ \text{else:} & -1 \end{cases}$$

[9; 1.63]

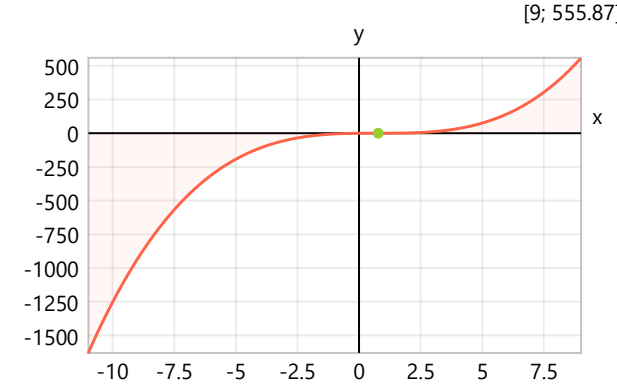


[-11; -1.53]

$$x_{36} = \$\text{Find}\{f_{36}(x);\ x \in [-11; 9]\} = 0.667$$

$$f_{37}(x) = \left(x - \frac{7}{9}\right)^3 + \left(x - \frac{7}{9}\right) \cdot 10^{-3}$$

[9; 555.87]

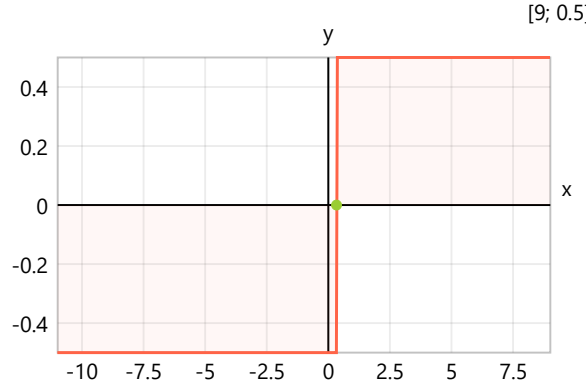


[-11; -1633.78]

$x_{37} = \$\text{Root}\{f_{37}(x) = 0;\ x \in [-11; 9]\} = 0.778$

$$f_{38}(x) = \begin{cases} \text{if } x \le \frac{1}{3}: & -0.5 \\ \text{else:} & 0.5 \end{cases}$$

[9; 0.5]

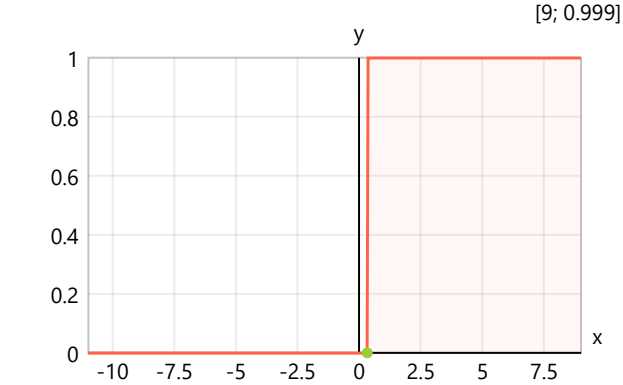


[-11; -0.5]

$x_{38} = \$\text{Find}\{f_{38}(x);\ x \in [-11; 9]\} = 0.333$

$$f_{39}(x) = \begin{cases} \text{if } x \le \frac{1}{3}: & -10^{-3} \\ \text{else:} & 1 - 10^{-3} \end{cases}$$

[9; 0.999]

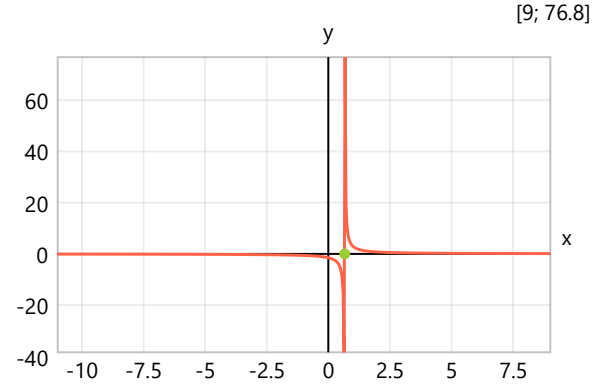


[-11; -0.001]

$x_{39} = \$\text{Find}\{f_{39}(x);\ x \in [-11; 9]\} = 0.333$

$$f_{40}(x) = \begin{cases} \text{if } x \equiv 0: & 0 \\ \text{else:} & \dfrac{1}{x - 2/3} \end{cases}$$

[9; 76.8]



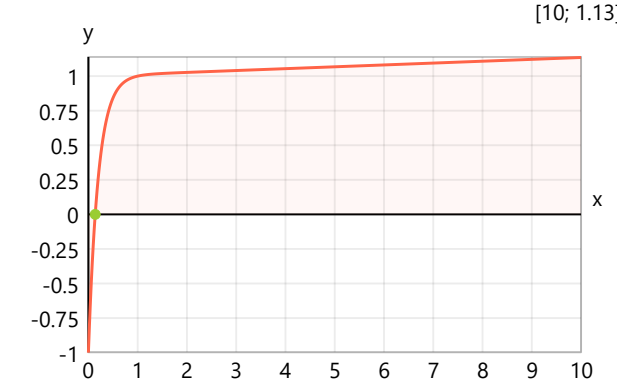
[-11; -38.4]

$x_{40} = \$\text{Find}\{f_{40}(x);\ x \in [-11; 9]\} = 0.667$

A. Swift, G. R. Lindfield, *Comparison of a continuation method with Brent's method for the numerical solution of a single nonlinear equation*, The Computer Journal, Volume 21, Issue 4, 1978, p. 359–362
https://doi.org/10.1093/comjnl/21.4.359

$$f_{41}(x) = 2 \cdot x \cdot e^{-5} - 2 \cdot e^{-5 \cdot x} + 1$$

[10; 1.13]

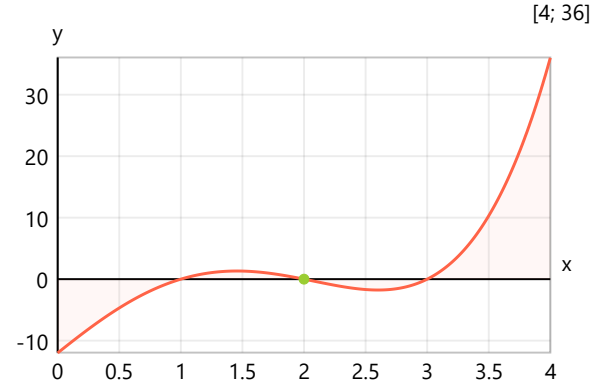


[0; -1]

$x_{41} = \$\text{Root}\{f_{41}(x) = 0;\ x \in [0; 10]\} = 0.138$

$$f_{42}(x) = (x^2 - x - 6) \cdot (x^2 - 3 \cdot x + 2)$$

[4; 36]

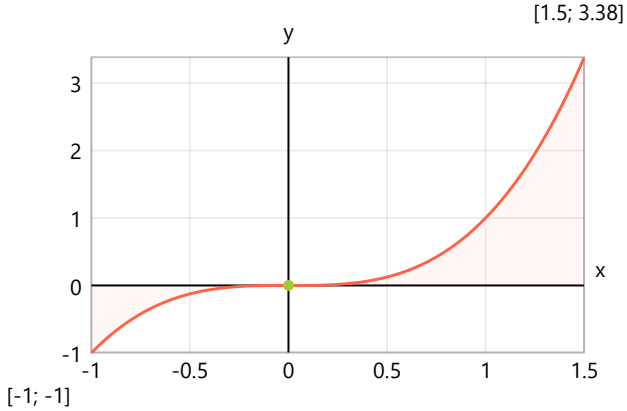


[0; -12]

$x_{42} = \$\text{Root}\{f_{42}(x) = 0;\ x \in [0; 4]\} = 2$

$f_{43}(x) = x^3$

[1.5; 3.38]

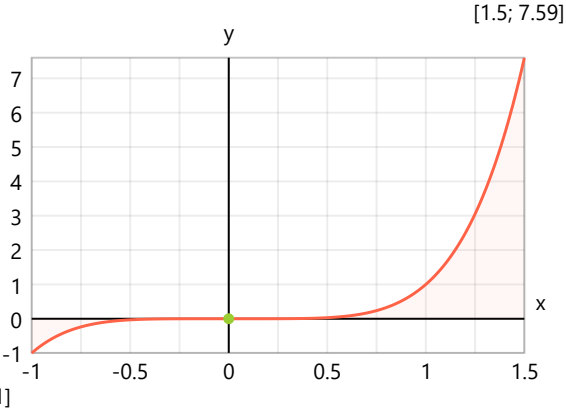


[-1; -1]

$x_{43} = \$Root\{f_{43}(x) = 0;\ x \in [-1;\ 1.5]\} = -1.46 \times 10^{-11}$

$f_{44}(x) = x^5$

[1.5; 7.59]

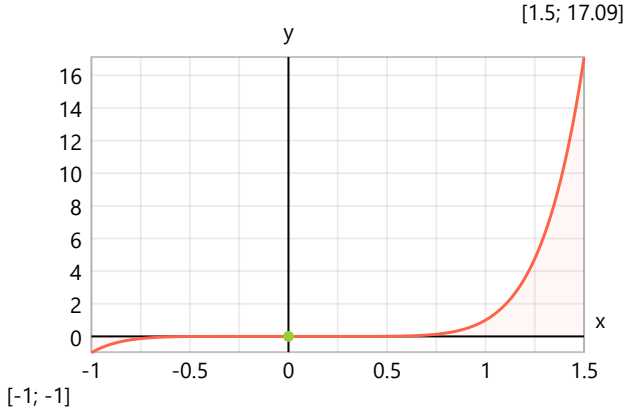


[-1; -1]

$x_{44} = \$Root\{f_{44}(x) = 0;\ x \in [-1;\ 1.5]\} = 2.38 \times 10^{-7}$

$f_{45}(x) = x^7$

[1.5; 17.09]

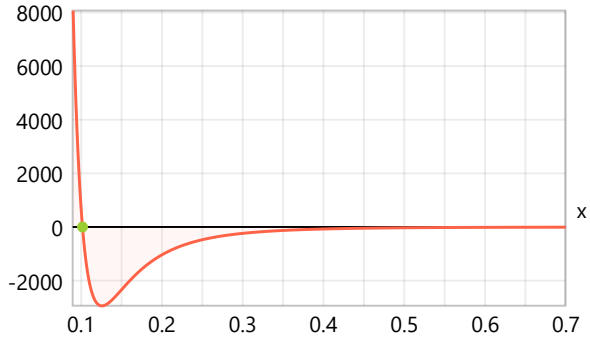


[-1; -1]

$x_{45} = \$Root\{f_{45}(x) = 0;\ x \in [-1;\ 1.5]\} = -1.53 \times 10^{-5}$

$f_{46}(x) = \dfrac{e^{-5 \cdot x} - x - 0.5}{x^5}$

[0.7; 8065.87]

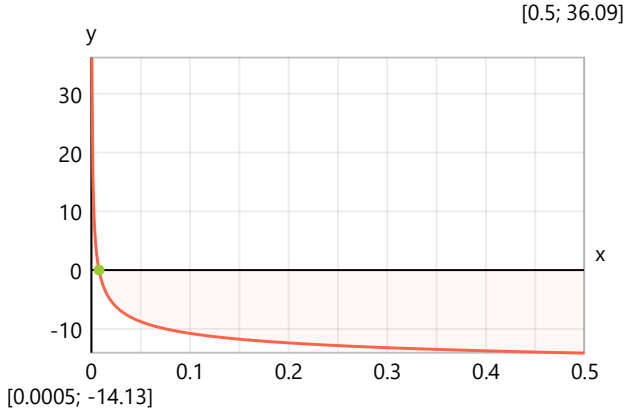


[0.09; -2941.47]

$x_{46} = \$Root\{f_{46}(x) = 0;\ x \in [0.09;\ 0.7]\} = 0.102$

$f_{47}(x) = \dfrac{1}{\sqrt{x}} - 2 \cdot \ln\left(5 \cdot 10^3 \cdot \sqrt{x}\right) + 0.8$

[0.5; 36.09]

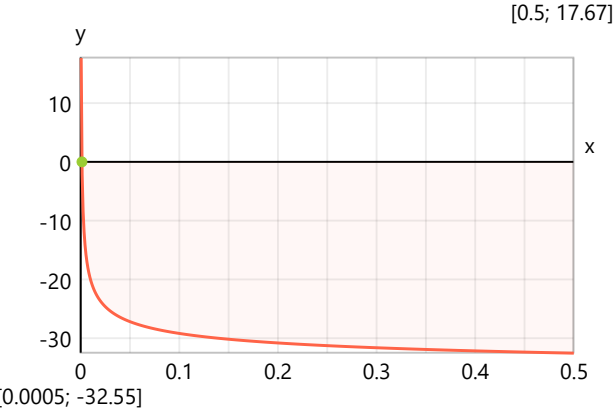


[0.0005; -14.13]

$x_{47} = \$Root\{f_{47}(x) = 0; x \in [0.0005; 0.5]\} = 0.00773$

$f_{48}(x) = \dfrac{1}{\sqrt{x}} - 2 \cdot \ln\left(5 \cdot 10^7 \cdot \sqrt{x}\right) + 0.8$

[0.5; 17.67]

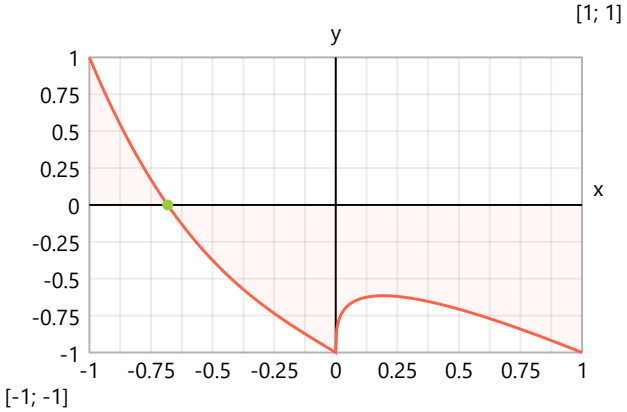


[0.0005; -32.55]

$x_{48} = \$Root\{f_{48}(x) = 0; x \in [0.0005; 0.5]\} = 0.00128$

$$f_{49}(x) = \begin{cases} \text{if } x \le 0: & -x^3 - x - 1 \\ \text{else:} & x^{\frac{1}{3}} - x - 1 \end{cases}$$

[1; 1]

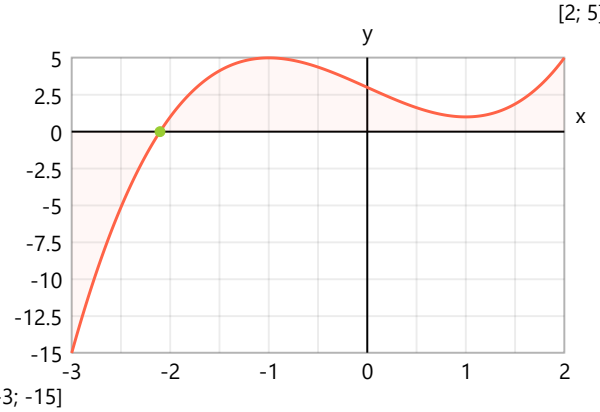


[-1; -1]

$x_{49} = \$\text{Root}\{f_{49}(x) = 0; x \in [-1; 1]\} = -0.682$

$$f_{50}(x) = x^3 - 2 \cdot x - x + 3$$

[2; 5]



[-3; -15]

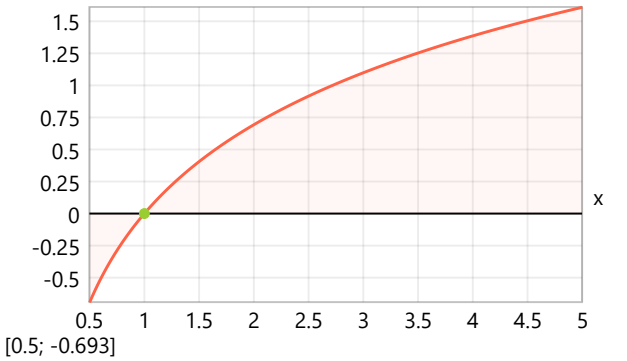
$x_{50} = \$\text{Root}\{f_{50}(x) = 0; x \in [-3; 2]\} = -2.1$

Alojz Suhadolnik, Combined bracketing methods for solving nonlinear equations, Applied Mathematics Letters, Volume 25, Issue 11, 2012, Pages 1755-1760, ISSN 0893-9659

https://doi.org/10.1016/j.aml.2012.02.006

$$f_{51}(x) = \ln(x)$$

[5; 1.61]

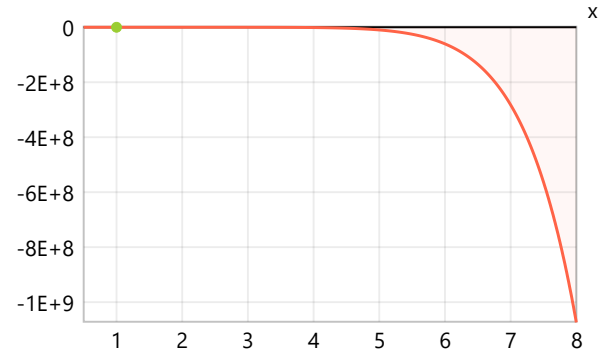


[0.5; -0.693]

$x_{51} = \$\text{Root}\{f_{51}(x) = 0; x \in [0.5; 5]\} = 1$

$$f_{52}(x) = (10 - x) \cdot e^{-10 \cdot x} - x^{10} + 1$$

[8; 1.06]

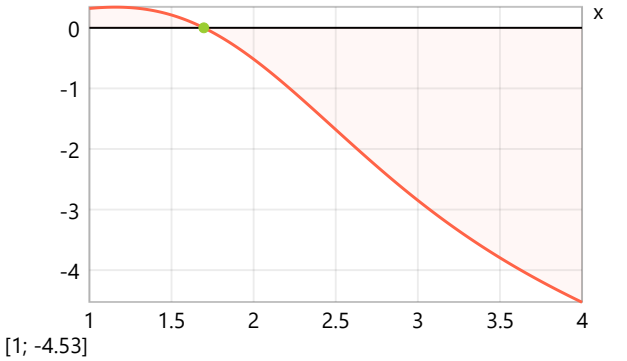


[0.5; -1073741823]

$x_{52} = \$\text{Root}\{f_{52}(x) = 0; x \in [0.5; 8]\} = 1$

$$f_{53}(x) = e^{\sin(x)} - x - 1$$

[4; 0.341]

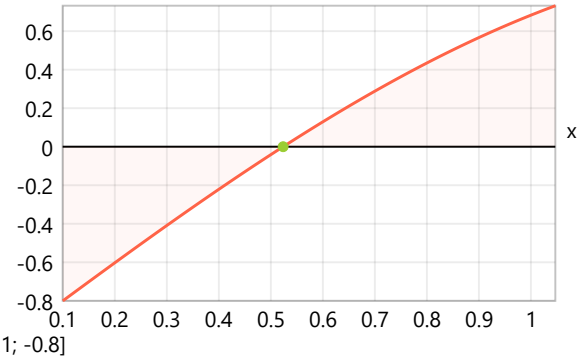


[1; -4.53]

$x_{53} = \$\text{Root}\{f_{53}(x) = 0; x \in [1; 4]\} = 1.7$

$$f_{54}(x) = 2 \cdot \sin(x) - 1$$

[1.05; 0.732]

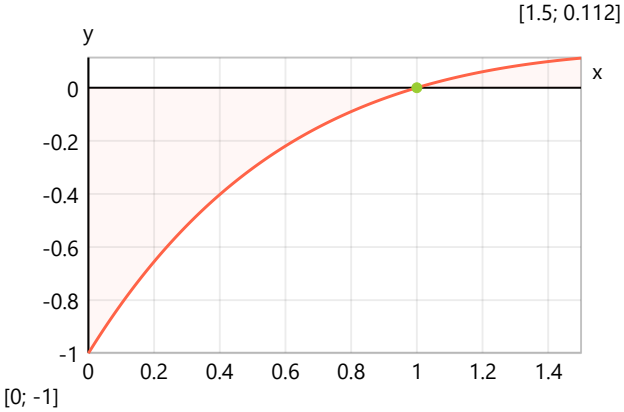


[0.1; -0.8]

$x_{54} = \$\text{Root}\left\{f_{54}(x) = 0; x \in \left[0.1; \frac{\pi}{3}\right]\right\} = 0.524$

$f_{55}(x) = (x-1)\cdot e^{-x}$

[1.5; 0.112]

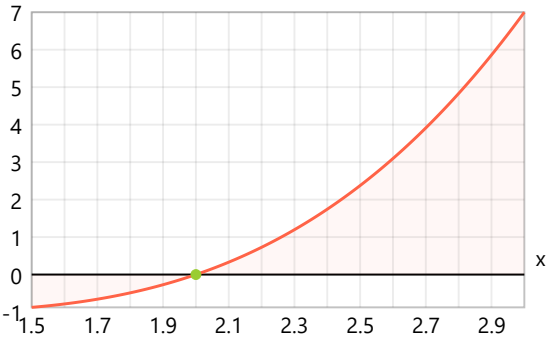


[0; -1]

$x_{55} = \$\text{Root}\{f_{55}(x) = 0;\ x \in [0;\ 1.5]\} = 1$

$f_{56}(x) = (x-1)^3 - 1$

[3; 7]

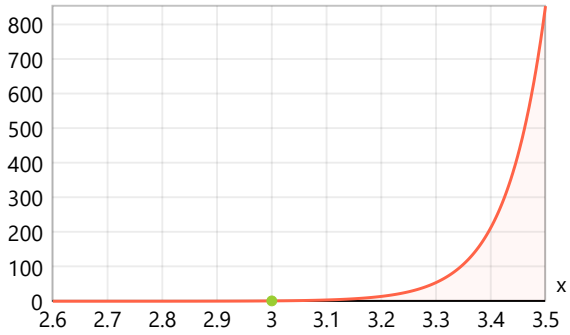


[1.5; -0.875]

$x_{56} = \$\text{Root}\{f_{56}(x) = 0;\ x \in [1.5;\ 3]\} = 2$

$f_{57}(x) = e^{x^2+7\cdot x-30} - 1$

[3.5; 853.06]

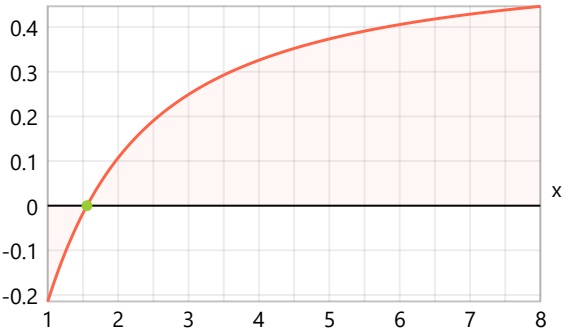


[2.6; -0.994]

$x_{57} = \$\text{Root}\{f_{57}(x) = 0;\ x \in [2.6; 3.5]\} = 3$

$f_{58}(x) = \text{atan}(x) - 1$

[8; 0.446]

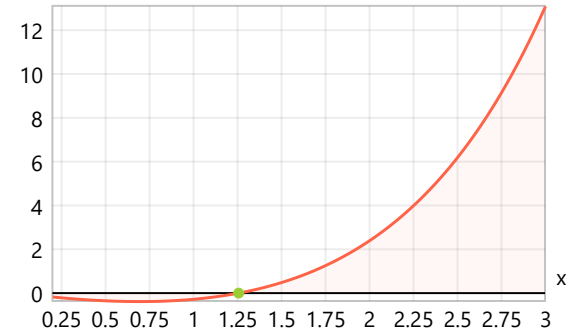


[1; -0.215]

$x_{58} = \$\text{Root}\{f_{58}(x) = 0;\ x \in [1; 8]\} = 1.56$

$f_{59}(x) = e^x - 2\cdot x - 1$

[3; 13.09]

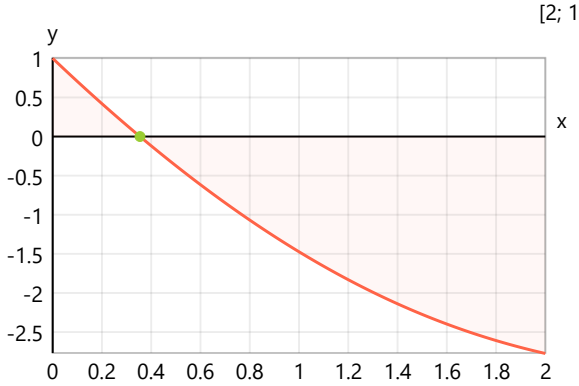


[0.2; -0.386]

$x_{59} = \$\text{Root}\{f_{59}(x) = 0;\ x \in [0.2;\ 3]\} = 1.26$

$f_{60}(x) = e^{-x} - x - \sin(x)$

[2; 1]

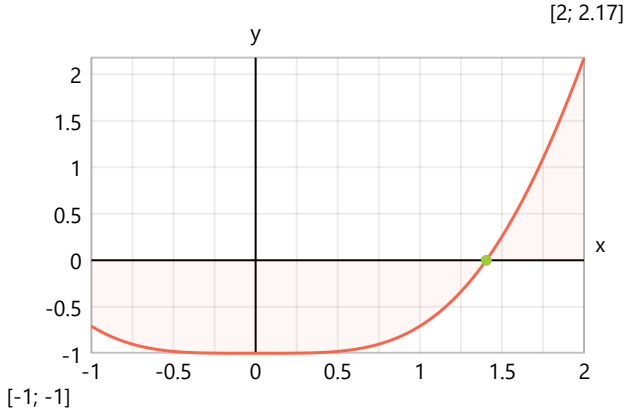


[0; -2.77]

$x_{60} = \$\text{Root}\{f_{60}(x) = 0;\ x \in [0;\ 2]\} = 0.354$

$f_{61}(x) = x^2 - \sin(x)^2 - 1$

[2; 2.17]

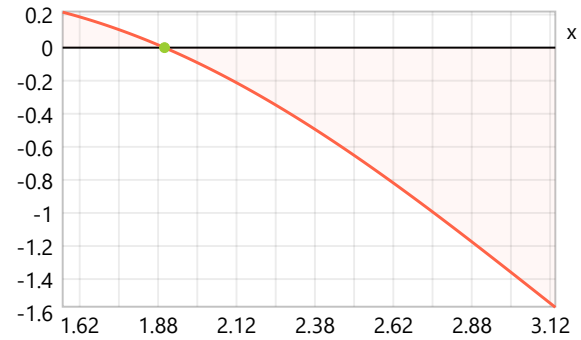


[-1; -1]

$x_{61} = \$\text{Root}\{f_{61}(x) = 0; x \in [-1; 2]\} = 1.4$

$f_{62}(x) = \sin(x) - x/2$

[3.14; 0.215]



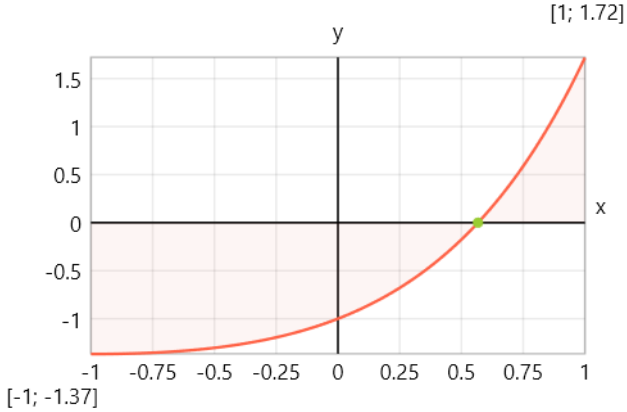
[1.57; -1.57]

$x_{62} = \$\text{Root}\{f_{62}(x) = 0; x \in [\pi/2\,; \pi]\} = 1.9$

Oliveira I. F. D., Takahashi R. H. C. An Enhancement of the Bisection Method Average Performance Preserving Minmax Optimality

Lambert - $f_{63}(x) = x \cdot \exp(x) - 1$

[1; 1.72]

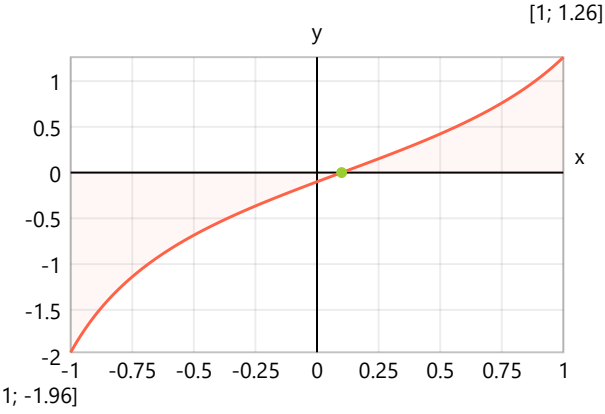


[-1; -1.37]

$x_{63} = \$\text{Root}\{f_{63}(x) = 0; x \in [-1; 1]\} = 0.567$

Trigonometric 1 - $f_{64}(x) = \tan\left(x - \frac{1}{10}\right)$

[1; 1.26]

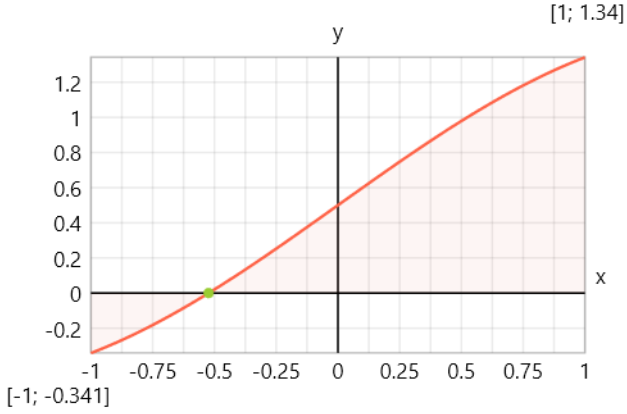


[-1; -1.96]

$x_{64} = \$\text{Root}\{f_{64}(x) = 0; x \in [-1; 1]\} = 0.1$

Trigonometric 2 - $f_{65}(x) = \sin(x) + 0.5$

[1; 1.34]

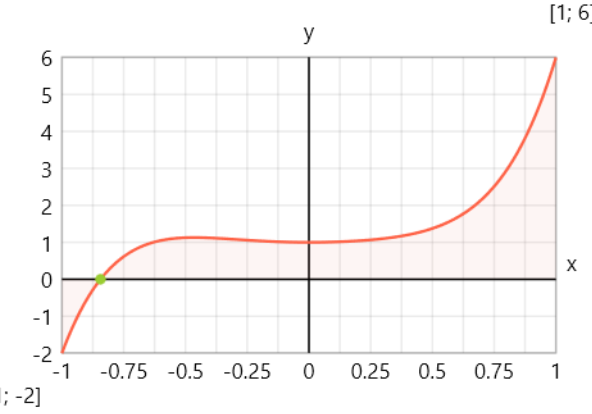


[-1; -0.341]

$x_{65} = \$\text{Root}\{f_{65}(x) = 0; x \in [-1; 1]\} = -0.524$

Polynomial 1 - $f_{66}(x) = 4 \cdot x^5 + x \cdot x + 1$

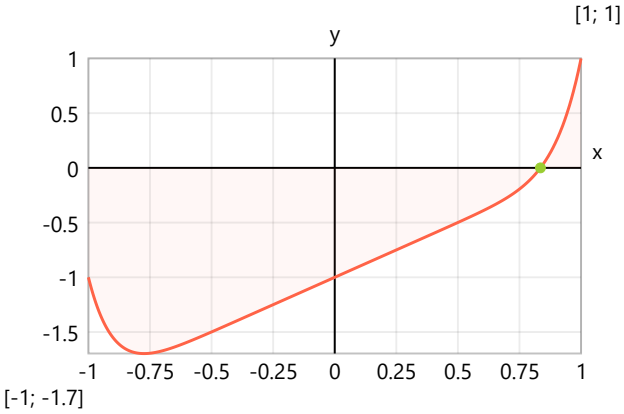
[1; 6]



[-1; -2]

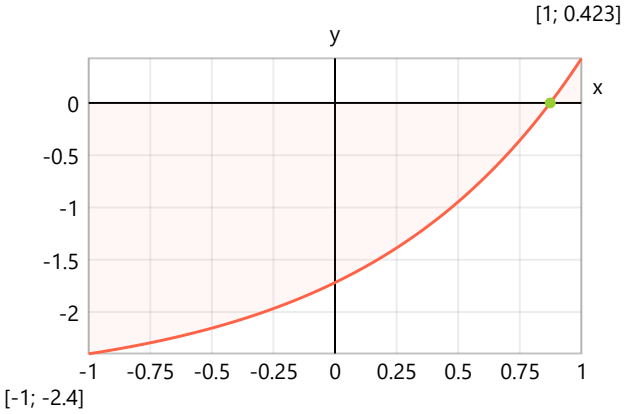
$x_{66} = \$\text{Root}\{f_{66}(x) = 0; x \in [-1; 1]\} = -0.844$

Polynomial 2 - $f_{67}(x) = x + x^{10} - 1$



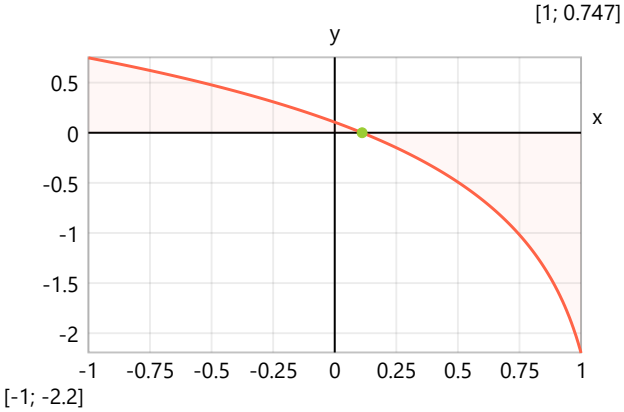
$x_{67} = \$\text{Root}\{f_{67}(x) = 0; x \in [-1; 1]\} = 0.835$

Exponential - $f_{68}(x) = \pi^x - e$



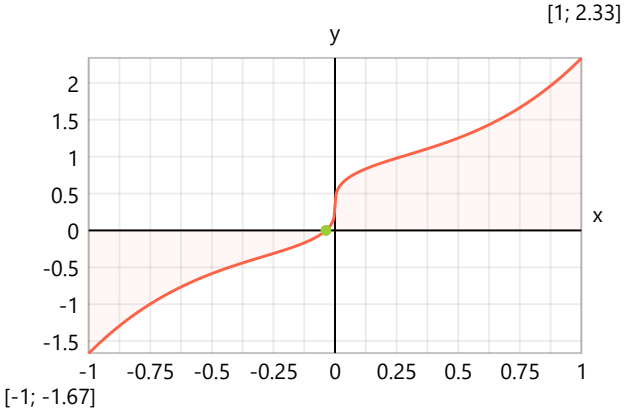
$x_{68} = \$\text{Root}\{f_{68}(x) = 0; x \in [-1; 1]\} = 0.874$

Logarithmic - $f_{69}(x) = \ln\left(\left|x - \frac{10}{9}\right|\right)$



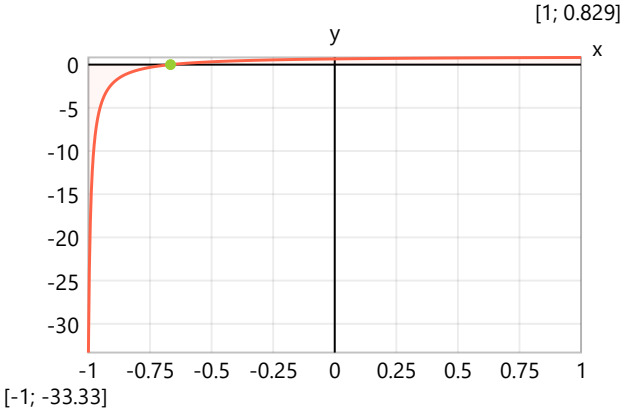
$x_{69} = \$\text{Root}\{f_{69}(x) = 0; x \in [-1; 1]\} = 0.111$

Polynomial - $f_{70}(x) = \frac{1}{3} + \text{sign}(x) \cdot \sqrt[3]{|x|} + x^3$



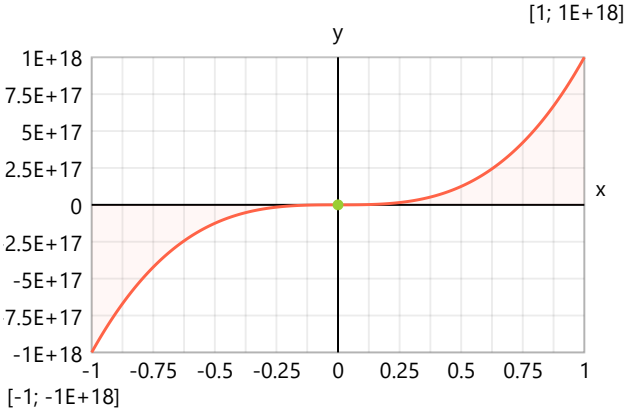
$x_{70} = \$\text{Root}\{f_{70}(x) = 0; x \in [-1; 1]\} = -0.037$

Poly. Frac. - $f_{71}(x) = \dfrac{x + 2/3}{x + 101/100}$



$x_{71} = \$\text{Root}\{f_{71}(x) = 0; x \in [-1; 1]\} = -0.667$

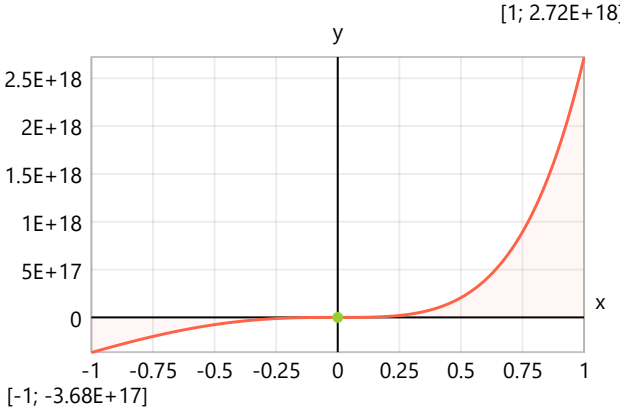
Polynomial 3 - $f_{72}(x) = (x \cdot 10^6 - 1)^3$



$x_{72} = \$\text{Root}\{f_{72}(x) = 0; x \in [-1; 1]\} = 10^{-6}$

Exp. Poly. - $f_{73}(x) = \exp(x) \cdot (x \cdot 10^6 - 1)^3$

[1; 2.72E+18]

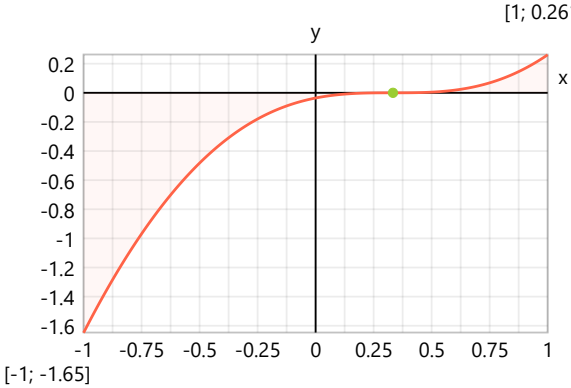


[-1; -3.68E+17]

$x_{73} = \$\text{Root}\{f_{73}(x) = 0;\ x \in [-1;\ 1]\} = 10^{-6}$

Tan. Poly. - $f_{74}(x) = \left(x - \frac{1}{3}\right)^2 \cdot \left(\operatorname{atan}\left(x - \frac{1}{3}\right)\right)$

[1; 0.261]



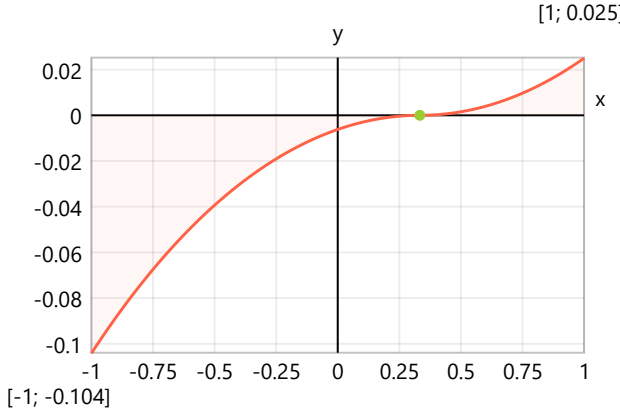
[-1; -1.65]

$x_{74} = \$\text{Root}\{f_{74}(x) = 0;\ x \in [-1;\ 1]\} = 0.333$

Circles

$$f_{75}(x) = \operatorname{sign}(3 \cdot x - 1) \cdot \left(1 - \sqrt{1 - \frac{(3 \cdot x - 1)^2}{81}}\right)$$

[1; 0.025]



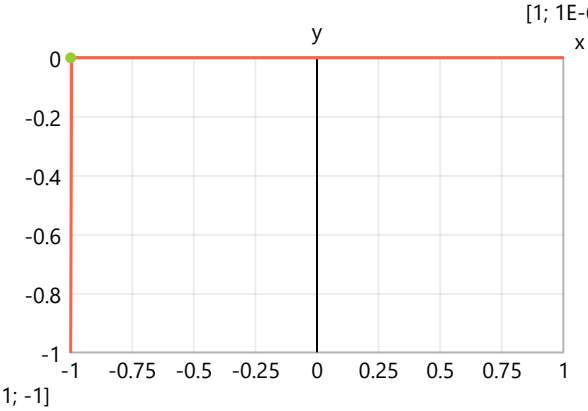
[-1; -0.104]

$x_{75} = \$\text{Root}\{f_{75}(x) = 0;\ x \in [-1;\ 1]\} = 0.333$

Step Function

$$f_{76}(x) = \left\{\begin{matrix}\text{if } x > \dfrac{1 - 10^6}{10^6}: & \dfrac{1 + 10^6}{10^6} \\ \text{else:} & 0\end{matrix}\right\} - 1$$

[1; 1E-6]

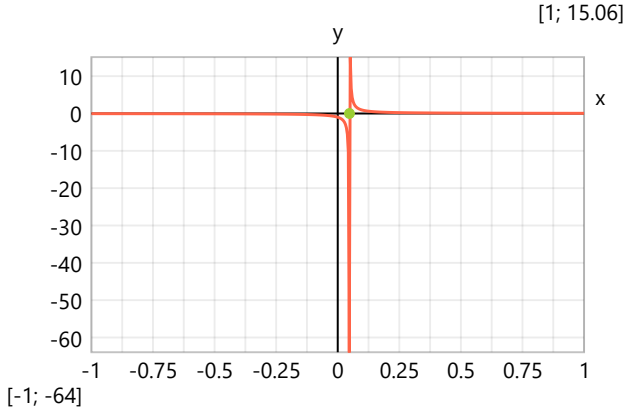


[-1; -1]

$x_{76} = \$\text{Find}\{f_{76}(x);\ x \in [-1;\ 1]\} = -1$

Geometric $-f_{77}(x) = \left\{\begin{matrix}\text{if } x \neq \dfrac{1}{21}: & \dfrac{1}{21 \cdot x - 1} \\ \text{else:} & 0\end{matrix}\right\}$

[1; 15.06]



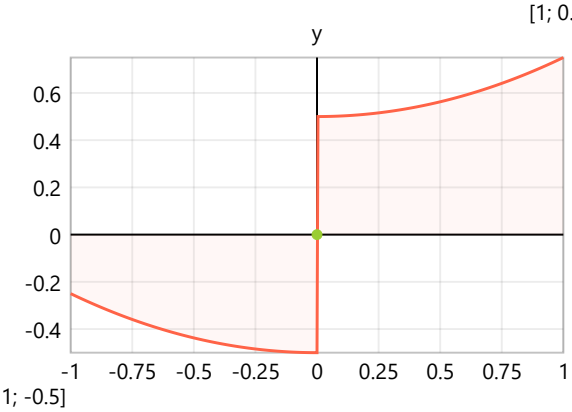
[-1; -64]

$x_{77} = \$\text{Find}\{f_{77}(x);\ x \in [-1;\ 1]\} = 0.0476$

Trunc. Poly.

$$f_{78}(x) = \frac{x \cdot x}{4} + \operatorname{ceiling}\left(\frac{x}{2}\right) - 0.5$$

[1; 0.75]

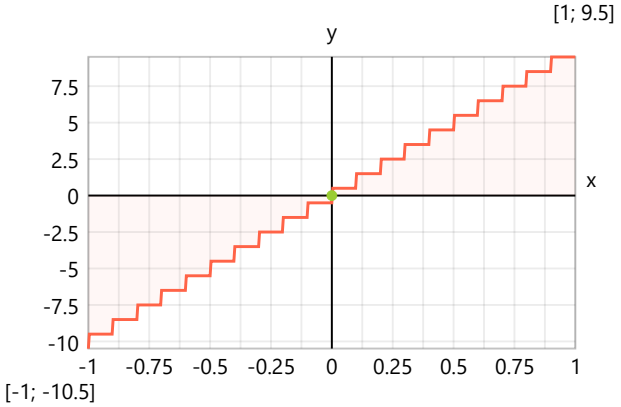


[-1; -0.5]

$x_{78} = \$\text{Find}\{f_{78}(x);\ x \in [-1;\ 1]\} = 7.11 \times 10^{-15}$

Staircase

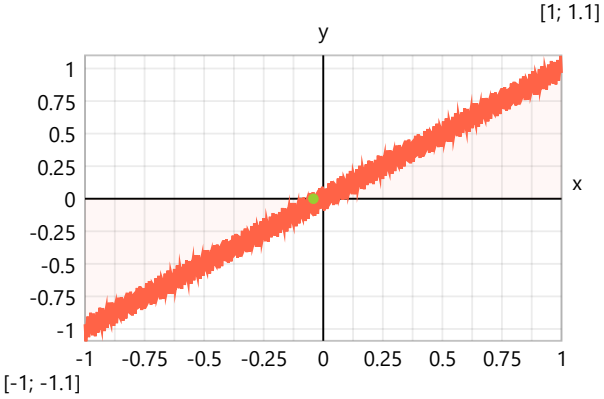
$$f_{79}(x) = \text{ceiling}(10 \cdot x - 1) + 0.5$$



$$x_{79} = \$\text{Find}\{f_{79}(x);\ x \in [-1;\ 1]\} = 2.91 \times 10^{-19}$$

Noisy Line

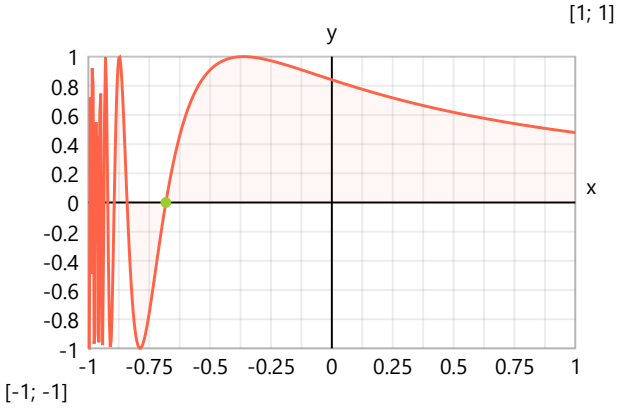
$$f_{80}(x) = x + \frac{\sin(x \cdot 10^6)}{10} + 10^{-3}$$



$$x_{80} = \$\text{Root}\{f_{80}(x) = 0;\ x \in [-1;\ 1]\} = -0.0415$$

Warsaw

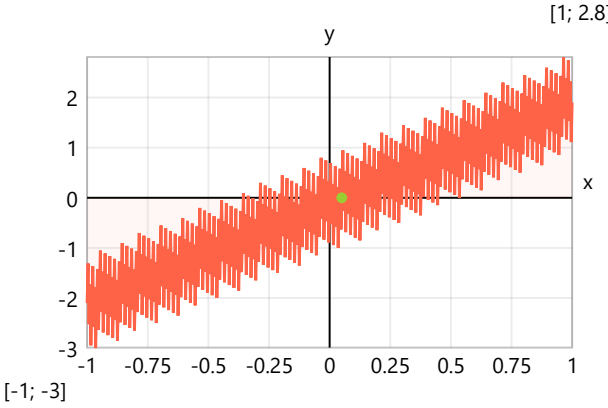
$$f_{81}(x) = \begin{cases} \text{if } x > (-1): & 1 + \sin\left(\dfrac{1}{x+1}\right) - 1 \\ \text{else:} & 0 \end{cases}$$



$$x_{81} = \$\text{Root}\{f_{81}(x) = 0;\ x \in [-1;\ 1]\} = -0.682$$

Sawtooth

$$f_{82}(x) = 202 \cdot x - 2 \cdot \text{floor}\left(\frac{2 \cdot x + 10^{-2}}{2} \cdot 10^{-2}\right) - 0.1$$

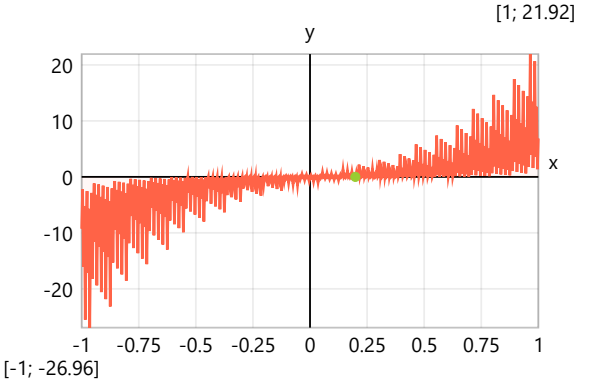


$$x_{82} = \$\text{Root}\{f_{82}(x) = 0;\ x \in [-1;\ 1]\} = 0.000495$$

SciML Benchmarks test suite

Sawtooth Cube

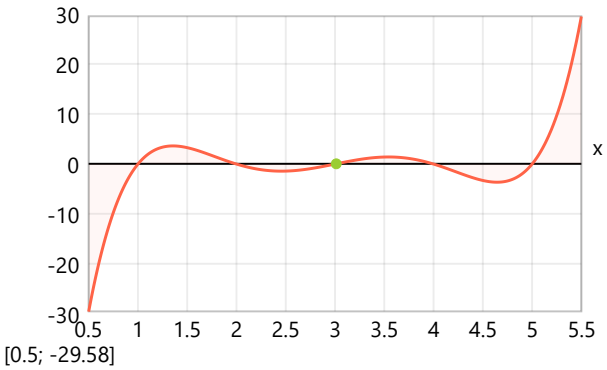
$$f_{83}(x) = \left(202 \cdot x - 2 \cdot \text{floor}\left(\frac{2 \cdot x + 10^{-2}}{2} \cdot 10^{-2}\right) - 0.1\right)^3$$



$$x_{83} = \$\text{Root}\{f_{83}(x) = 0;\ x \in [-1;\ 1]\} = 0.000495$$

Polynomial with multiple roots

$$f_{84}(x) = (x-1)\,(x-2)\,(x-3)\,(x-4)\,(x-5) - 0.05$$

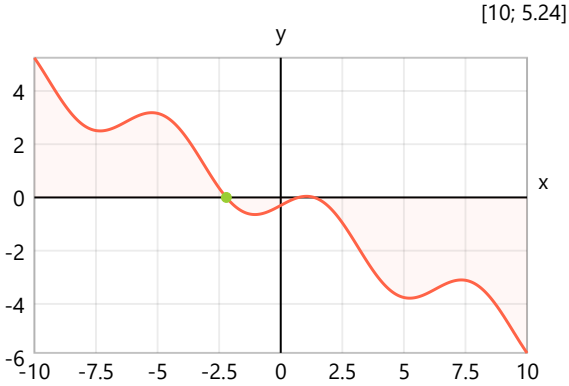


$$x_{84} = \$\text{Root}\{f_{84}(x) = 0;\ x \in [0.5;\ 5.5]\} = 3.01$$

Trigonometric with multiple roots

$$f_{85}(x) = \sin(x) - 0.5 \cdot x - 0.3$$

[10; 5.24]



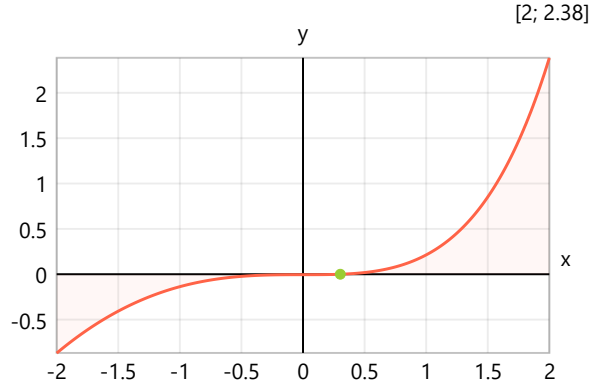
[-10; -5.84]

$$x_{85} = \$\text{Root}\{f_{85}(x) = 0; x \in [-10; 10]\} = -2.21$$

Exponential function (sensitive near zero)

$$f_{86}(x) = \exp(x) - 1 - x - \frac{x \cdot x}{2} - 0.005$$

[2; 2.38]



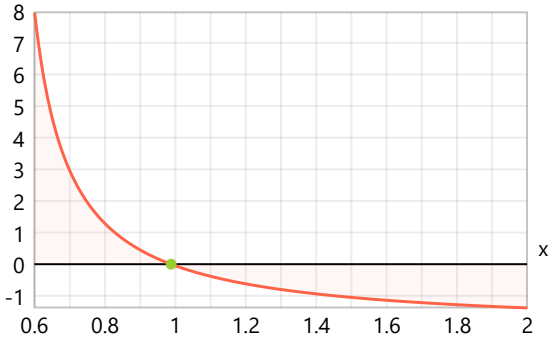
[-2; -0.87]

$$x_{86} = \$\text{Root}\{f_{86}(x) = 0; x \in [-2; 2]\} = 0.303$$

Rational function with pole

$$f_{87}(x) = \frac{1}{x-0.5} - 2 - 0.05$$

[2; 7.95]



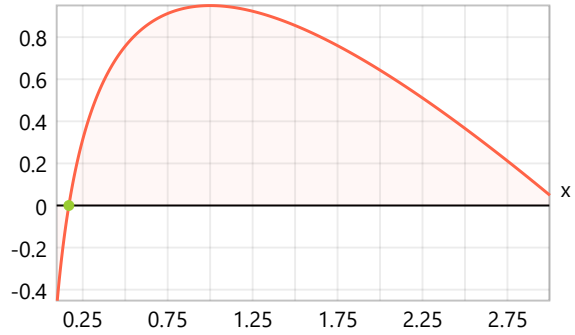
[0.6; -1.38]

$$x_{87} = \$\text{Root}\{f_{87}(x) = 0; x \in [0.6; 2]\} = 0.988$$

Logarithmic function

$$f_{88}(x) = \ln(x) - x + 2 - 0.05$$

[3; 0.95]



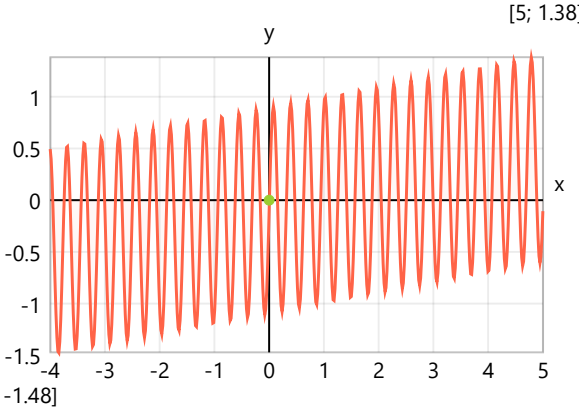
[0.1; -0.453]

$$x_{88} = \$\text{Root}\{f_{88}(x) = 0; x \in [0.1; 3]\} = 0.168$$

High oscillation function

$$f_{89}(x) = \sin(20 \cdot x) + 0.1 \cdot x - 0.1$$

[5; 1.38]



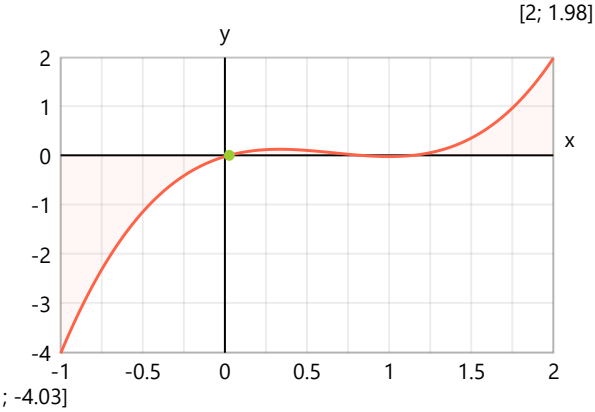
[-4; -1.48]

$$x_{89} = \$\text{Root}\{f_{89}(x) = 0; x \in [-4; 5]\} = -1.742$$

Function with very flat region

$$f_{90}(x) = x \cdot x \cdot x - 2 \cdot x \cdot x + x - 0.025$$

[2; 1.98]

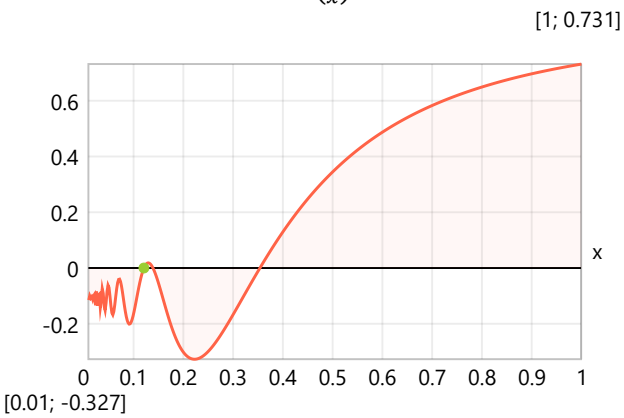


[-1; -4.03]

$$x_{90} = \$\text{Root}\{f_{90}(x) = 0; x \in [-1; 2]\} = 0.0264$$

Bessel-like function

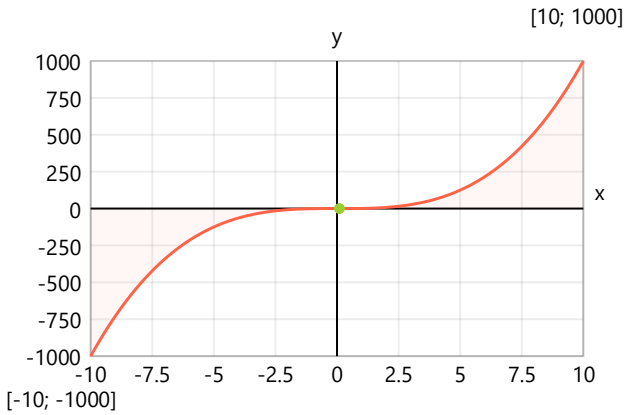
$$f_{91}(x) = x \cdot \sin\left(\frac{1}{x}\right) - 0.1 - 0.01$$



$$x_{91} = \$\text{Root}\{f_{91}(x) = 0;\ x \in [0.01;\ 1]\} = 0.121$$

Nearly asymmetric function

$$f_{92}(x) = x^3 - 0.001$$



$$x_{92} = \$\text{Root}\{f_{92}(x) = 0;\ x \in [-0;10]\} = 0.1$$