Demo Math 113 23 May 2007

Defining and plotting functions

Example f(x)=x^2 + 1

> $f := x \to x^2$

$$f := x \to x^2$$

> $f(2)$

$$4$$

> $f\left(\frac{1}{2}\right)$

$$\frac{1}{4}$$

> $f(.5)$

0
.25

> $evalf\left(f\left(\frac{1}{2}\right)\right)$

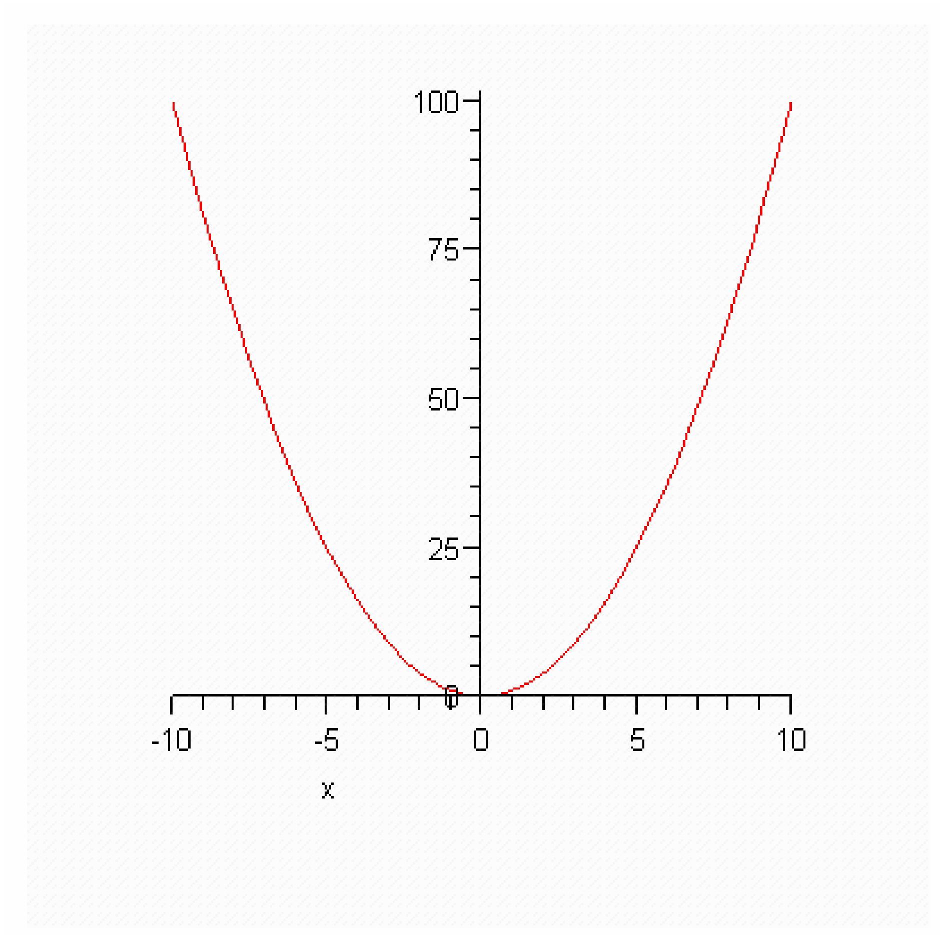
0
.2500000000

> $f(2.)$

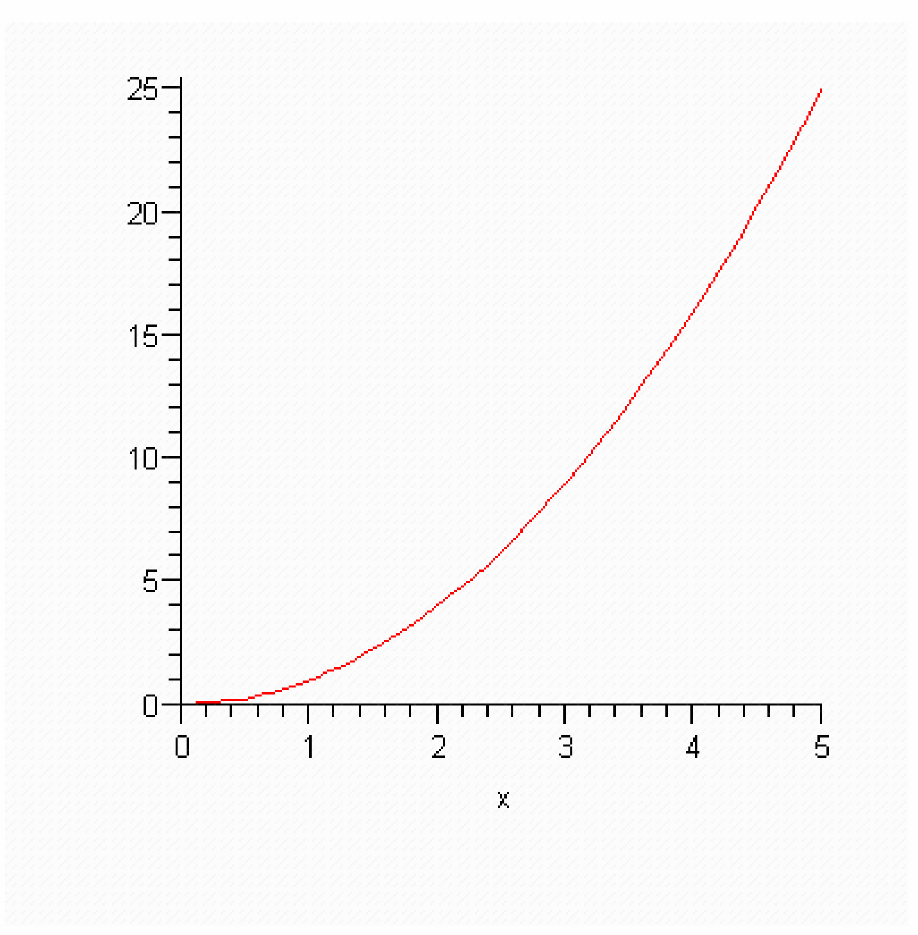
4

.

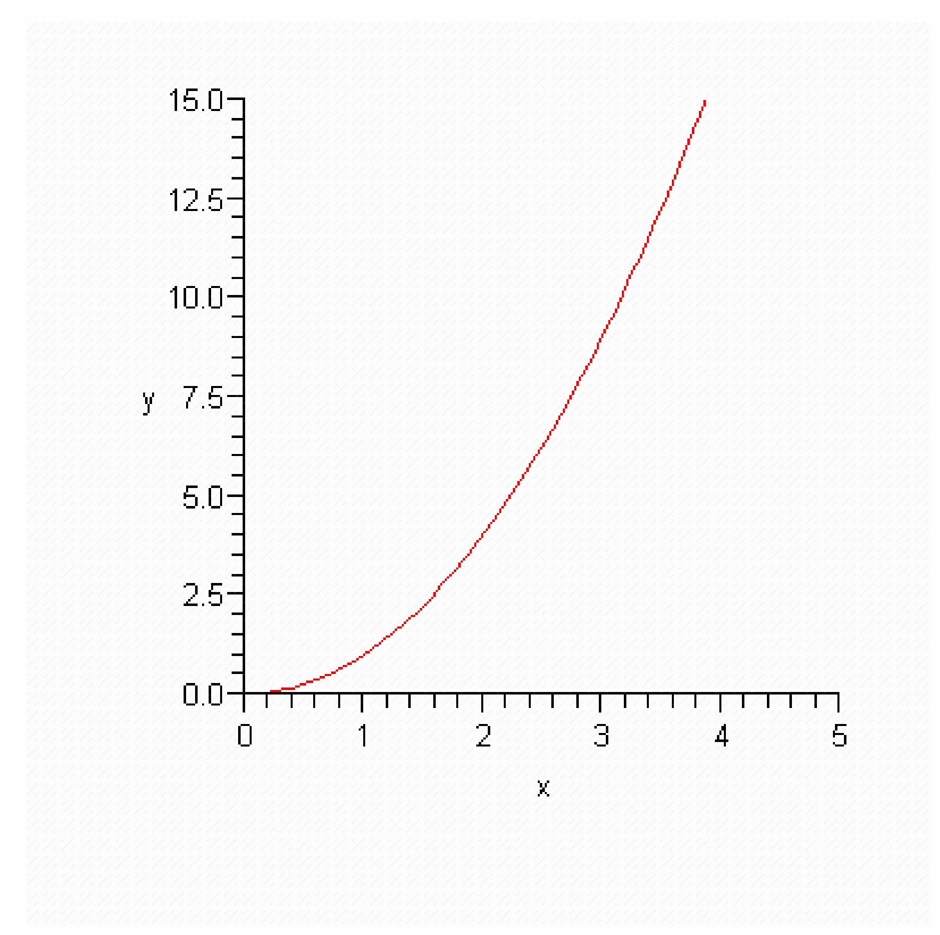
> $plot(f(x), x)$



> $plot(f(x), x = 0 ..5)$



> $plot(f(x), x = 0..5, y = 0..15)$



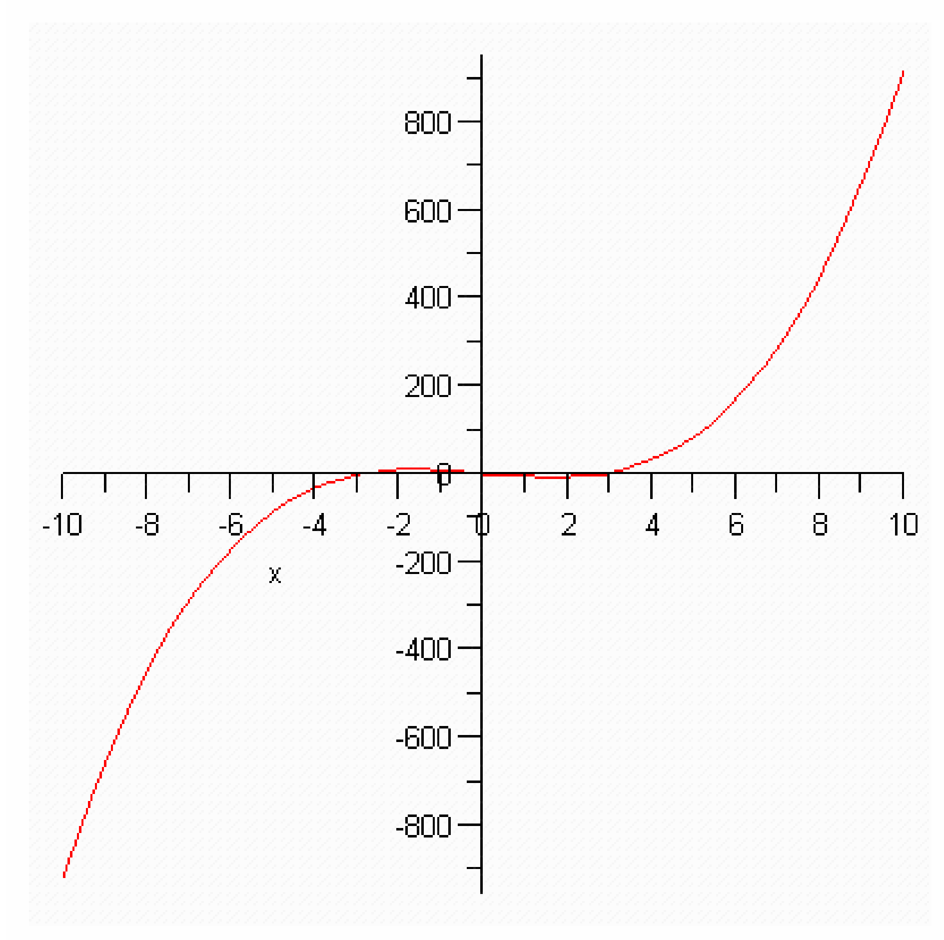
> $help(plot)$

> $help(plot)$

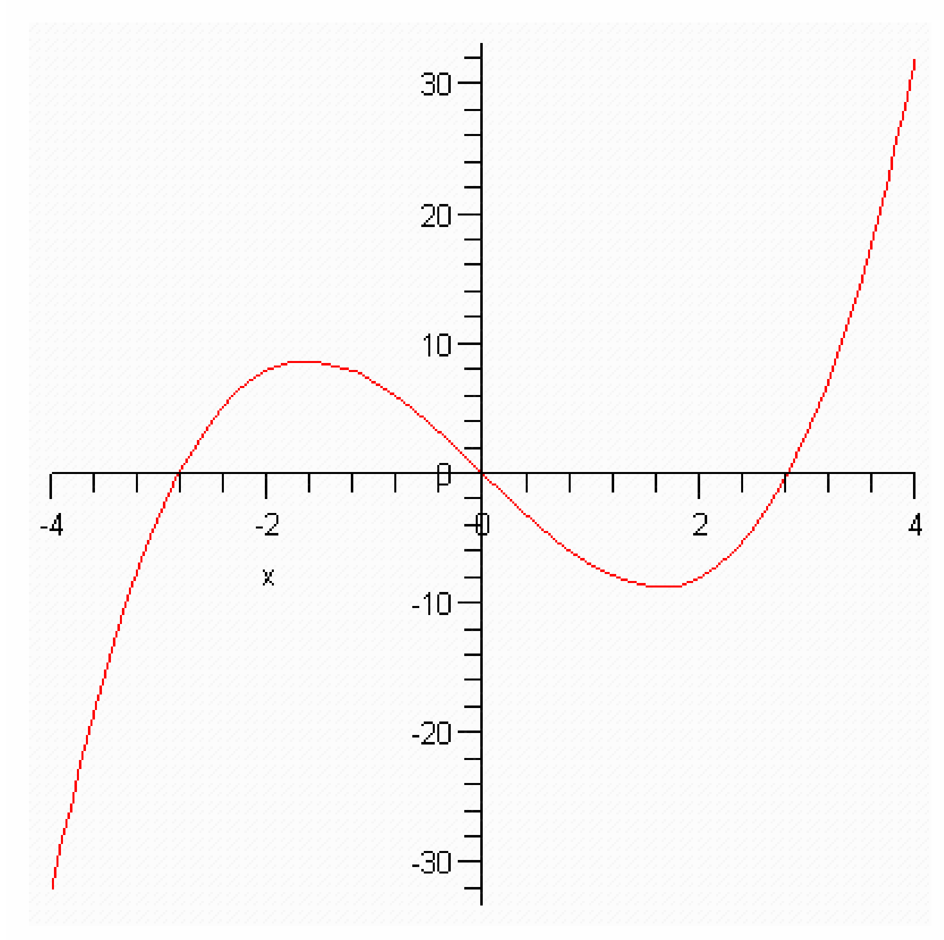
> $g := x \rightarrow x^3 - 8 \cdot x$

$$g := x \rightarrow x^3 - 8\,x$$

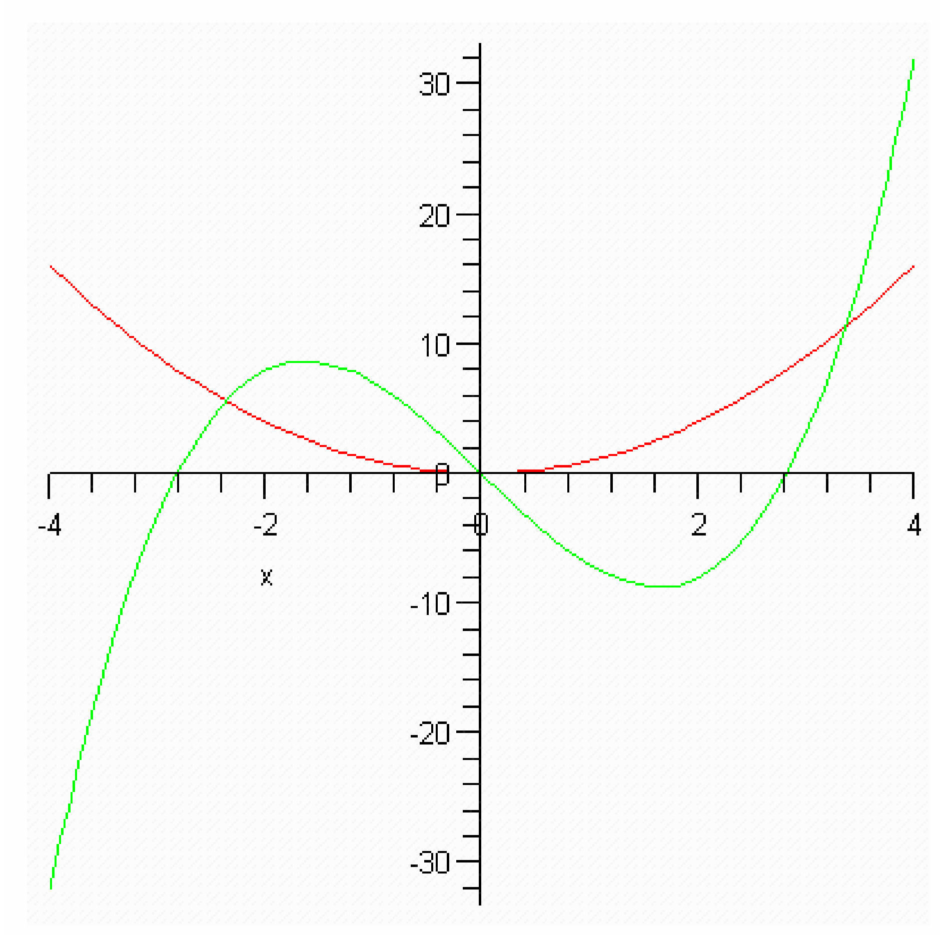
> $plot(g(x), x)$



> $plot(g(x), x = -4..4)$



> $plot([f(x), g(x)], x = -4..4)$



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Doing limits in MAPLE

Example #34, p. 83

> $f := x \rightarrow \dfrac{(x+2)}{sqrt(x^2+5)-3}$

$$f := x \rightarrow \frac{x+2}{\sqrt{x^2+5}-3}$$

> $f(2.)$

$$Float(\infty)$$

> $f(3.6)$

$$4$$
$$.523702513$$

> $f(6)$

$$\frac{8}{\sqrt{41}-3}$$

> $f(-2.)$

$$\mathit{Float}(\mathit{undefined})$$

>

Want to find limit of f(x) as x-> -2

> $f(-1.)$

$$-1.816496582$$

> $f(-1.5)$

$$-1.626452118$$

> $f(-1.9)$

$$-1.521610290$$

> $f(-1)$

$$\frac{1}{\sqrt{6}-3}$$

> $f(-1.95)$

$$-1.510607790$$

> $f(-1.99)$

$$-1.502090835$$

> $f(-1.995)$

$$-1.501043525$$

> $f(-3.)$

$$-1.348331477$$

> $f(-2.5)$

$$-1.412022660$$

> $f(-2.1)$

$$-1.479895691$$

> $f(-2.05)$

$$-1.489768479$$

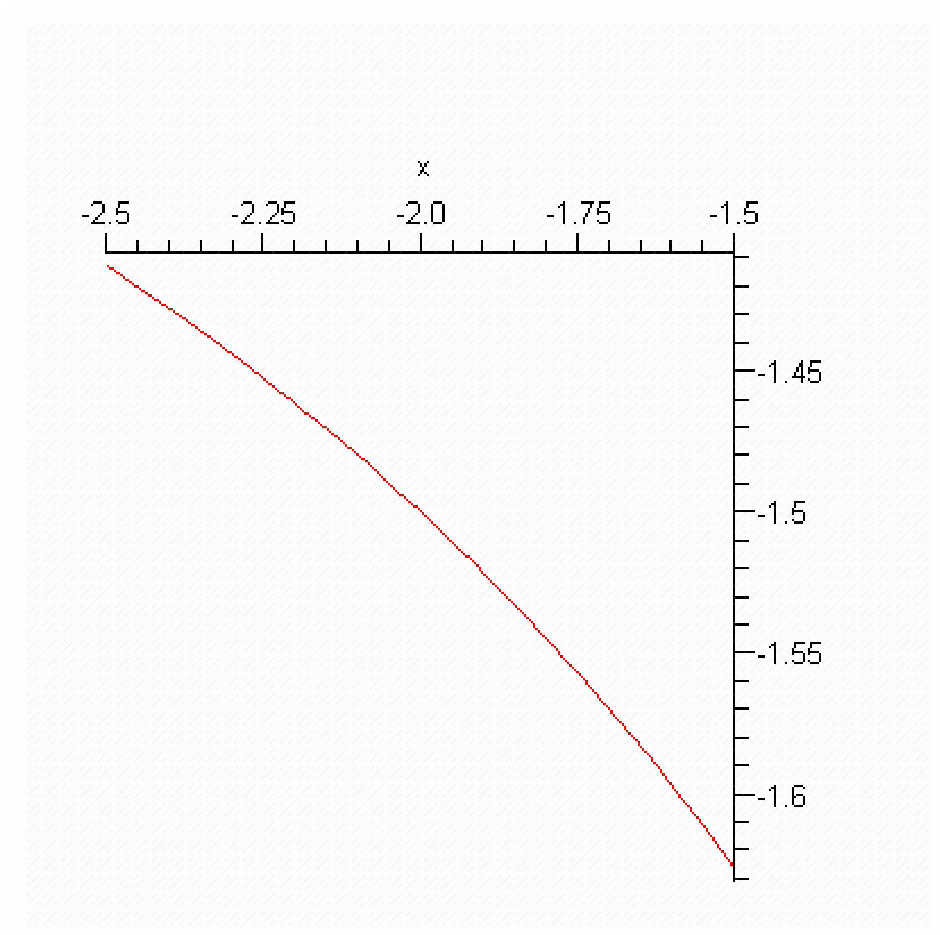
> $f(-2.01)$

$$-1.497924251$$

> $f(-2.005)$

$$-1.498960022$$

> $plot(f(x), x = -2.5..-1.5)$



> $limit(f(x), x = -2.)$

$$-1.500000000$$

> $limit(f(x), x = -2)$

$$\frac{-3}{2}$$

>

Using MAPLE for limits at infinity.

Example #60, p. 108

> $h := x \rightarrow \frac{(-x^4)}{x^4 - 7 \cdot x^3 + 7 \cdot x^2 + 9}$

$$h := x \rightarrow -\frac{x^4}{x^4 - 7\,x^3 + 7\,x^2 + 9}$$

> $h(100)$

$$\frac{-100000000}{93070009}$$

> $h(200)$

$$\frac{-1600000000}{1544280009}$$

> $h(500)$

$$\frac{-62500000000}{61626750009}$$

> $h(1000)$

$$\frac{-1000000000000}{993007000009}$$

> $h(10000)$

$$\frac{-10000000000000000}{9993000700000009}$$

> $h(500.)$

$$-1.014169983$$

> $h(1000.)$

$$-1.007042246$$

> $h(10000.)$

$$-1.000700420$$

> $limit(h(x), x = \infty)$

$$-1$$

>

>

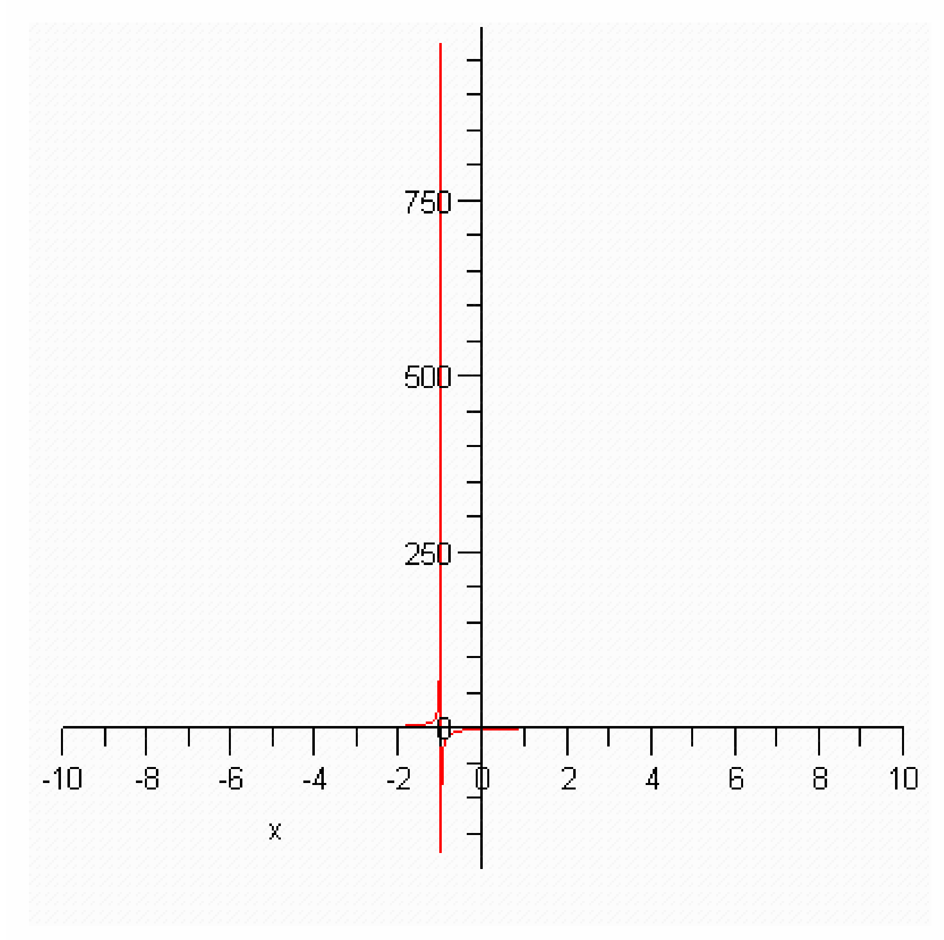
Tangent lines and secant lines.

Example just done in class: f(x)=(x-1)/(x+1) at the point x=0.

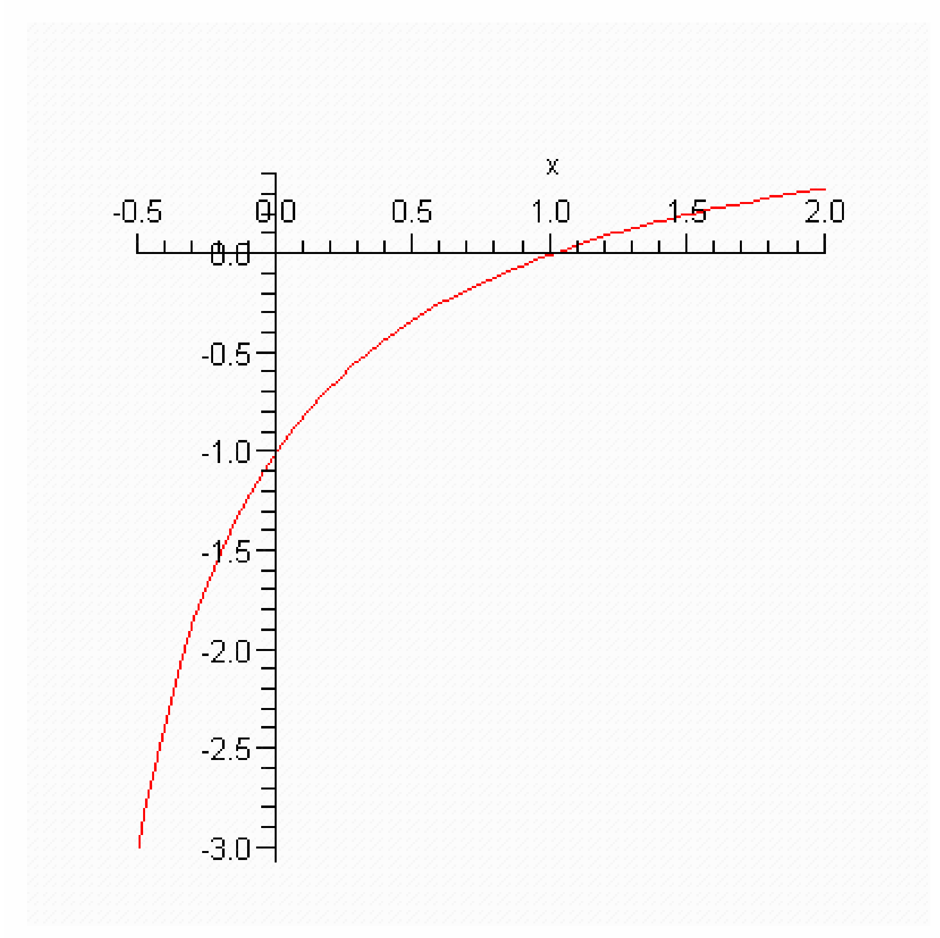
> $f := x \rightarrow \frac{(x-1)}{(x+1)}$

$$f := x \rightarrow \frac{x-1}{x+1}$$

> $plot(f(x), x)$



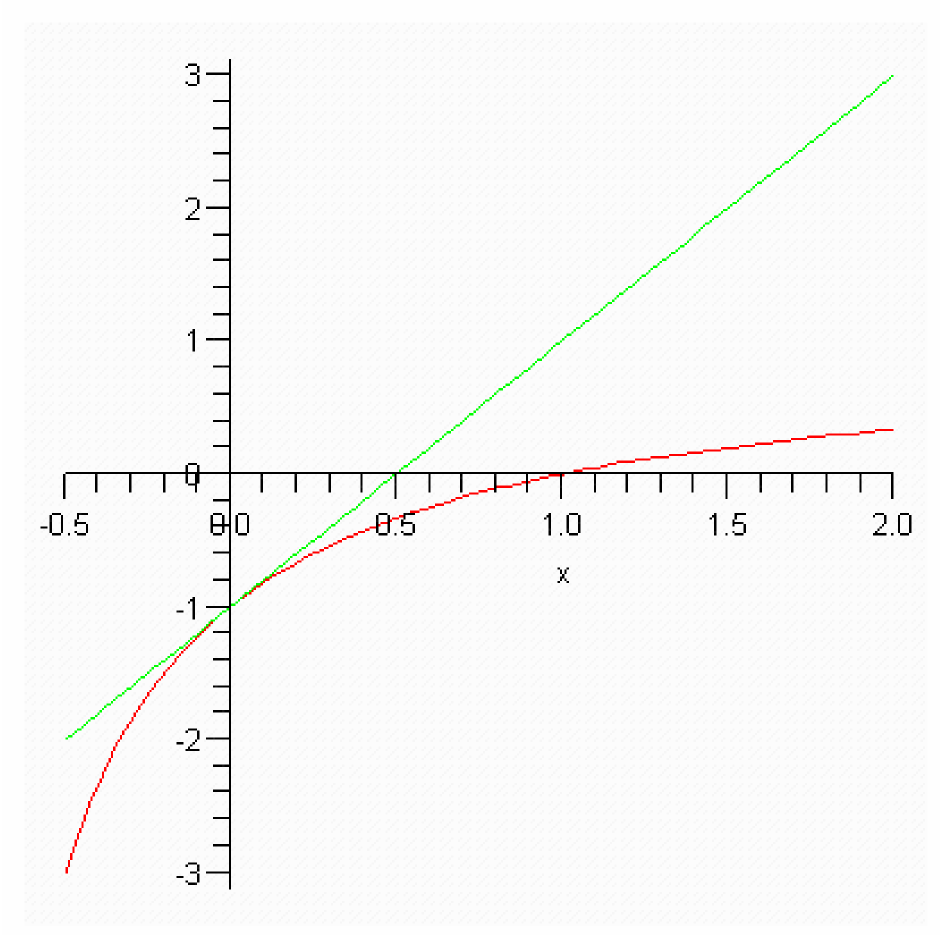
> $plot(f(x), x = -.5 ..2.0)$



> $T := x \to 2 \cdot x$
$- 1$

$$T := x \to 2\, x - 1$$

> $plot([f(x), T(x)], x = -.5 ..2.0)$



>

Example: g(x)=sqrt(x^2-2x) at x=3

> $g := x \rightarrow sqrt(x^2 - 2 \cdot x)$

$$g := x \rightarrow \sqrt{x^2 - 2\,x}$$

>

We need to set up the difference quotient: (g(3+h)-g(3))/h.

We can define a function of h that gives this difference quotient. Call it Q(h).

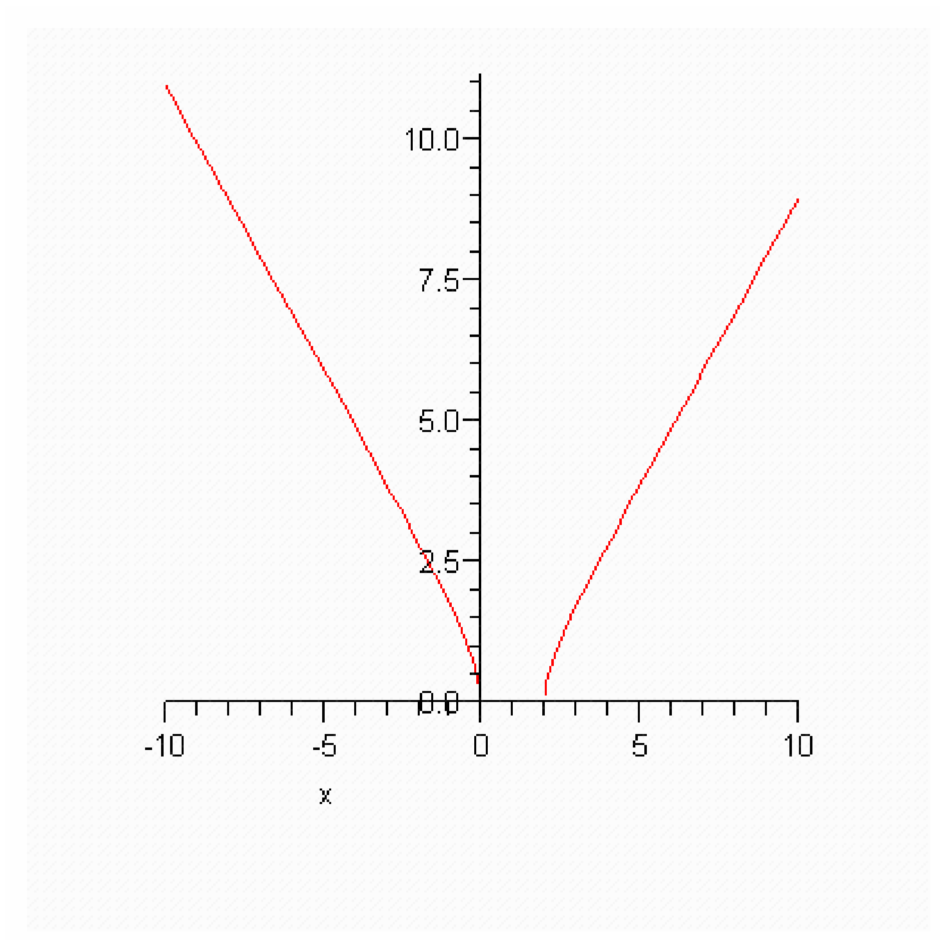
> $Q := h \rightarrow \frac{(g(3. + h) - g(3.))}{h}$

$$Q := h \rightarrow \frac{g(3. + h) - g(3.)}{h}$$

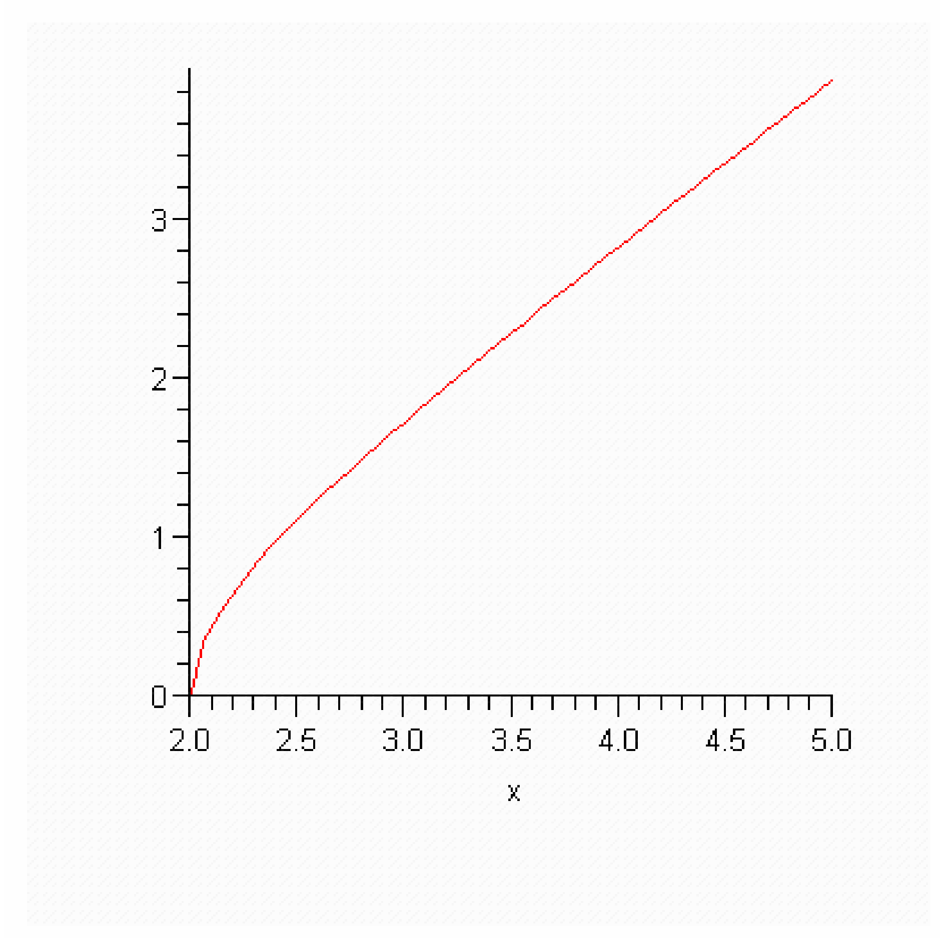
> $Q(1.)$

1
.096376317

> $plot(g(x), x)$



> $plot(g(x), x = 2 ..5)$



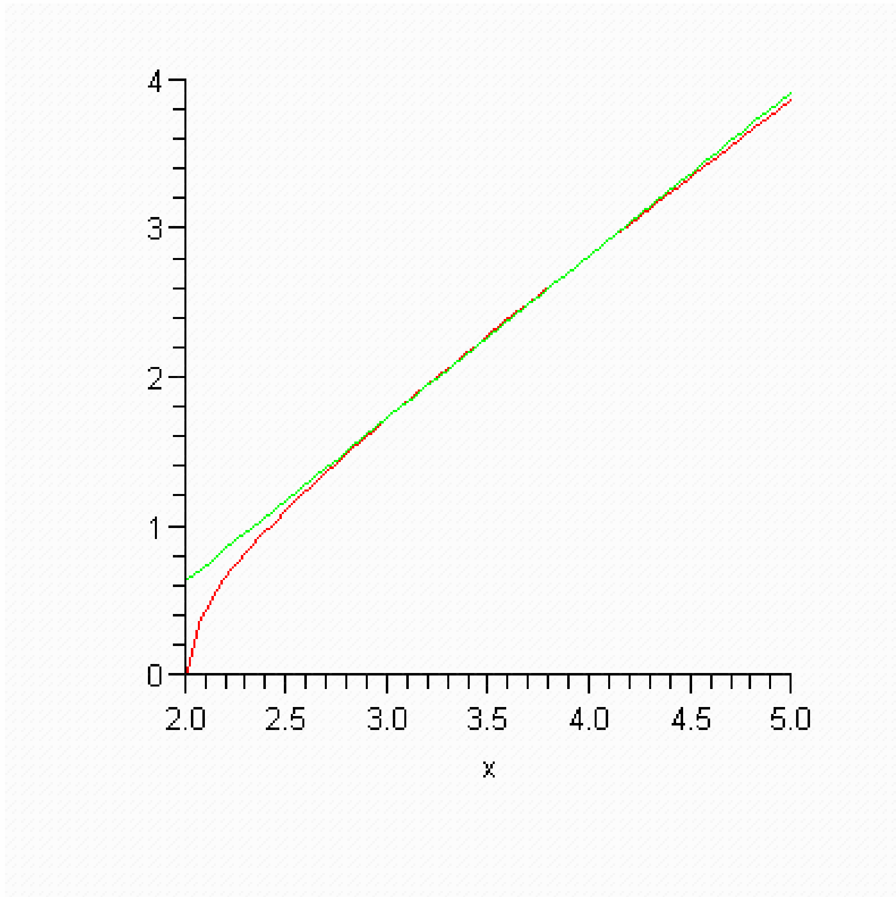
> $S1 := x \rightarrow g(3.) + Q(1.) \cdot (x - 3.)$

$$S1 := x \rightarrow g(3.) + Q(1.)\ (x - 3.)$$

> $S1(4.)$

2
.828427125

> $plot([g(x), S1(x)], x = 2..5)$



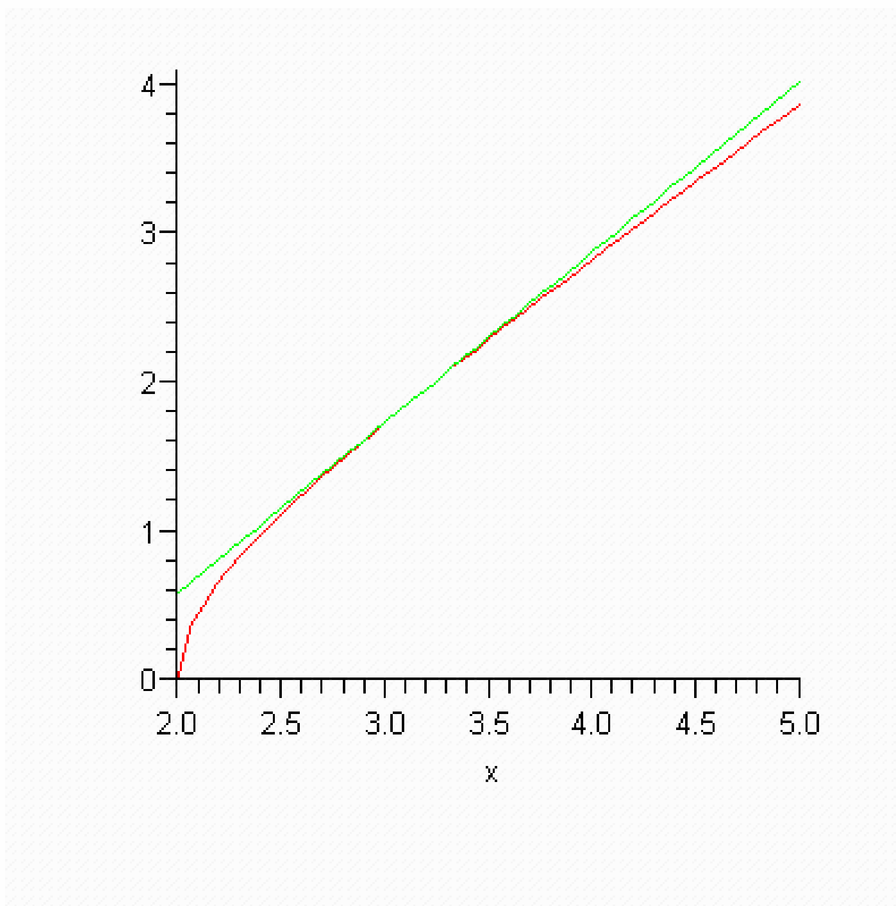
> $Q(.1)$

$$1$$
$$.145677230$$

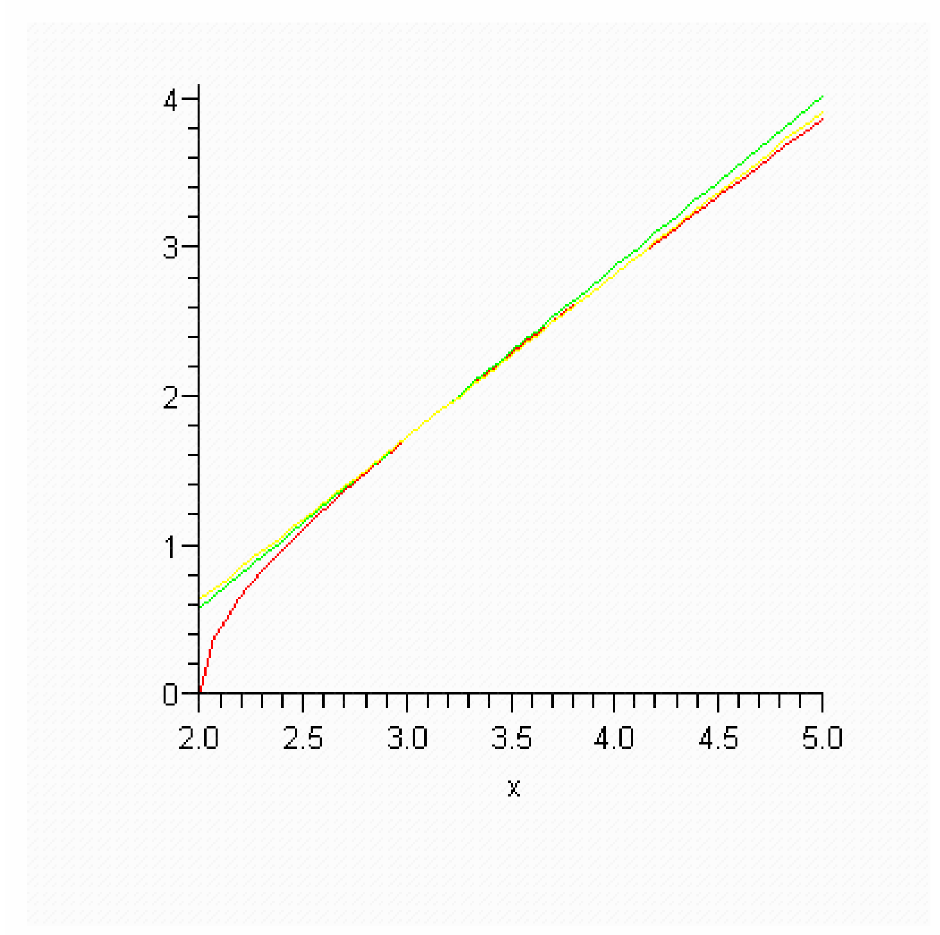
> $S2 := x \rightarrow g(3.) + Q(.1) \cdot (x - 3.)$

$$S2 := x \rightarrow g(3.) + Q(0.1)\ (x - 3.)$$

> $plot([g(x), S2(x)], x = 2\,..5)$



> $plot([g(x), S2(x), S1(x)], x = 2..5)$



> $Q(1.)$

1
.096376317

> $Q(.1)$

1
.145677230

> $Q(.05)$

1
.150044180

> $limit(Q(h), h = 0)$

$$Float(undefined)$$

> $Q(.001)$

$$1.154604000$$

> $Q(.0001)$

$$1.154690000$$

> $limit(Q(x), x = 0)$

$$Float(undefined)$$

> $Q1 := h \rightarrow \frac{(g(3+h) - g(3))}{h}$

$$Q1 := h \rightarrow \frac{g(3+h) - g(3)}{h}$$

> $limit(Q1(h), h = 0)$

$$\frac{2}{3}\sqrt{3}$$

> $evalf(\%)$

$$1.154700539$$

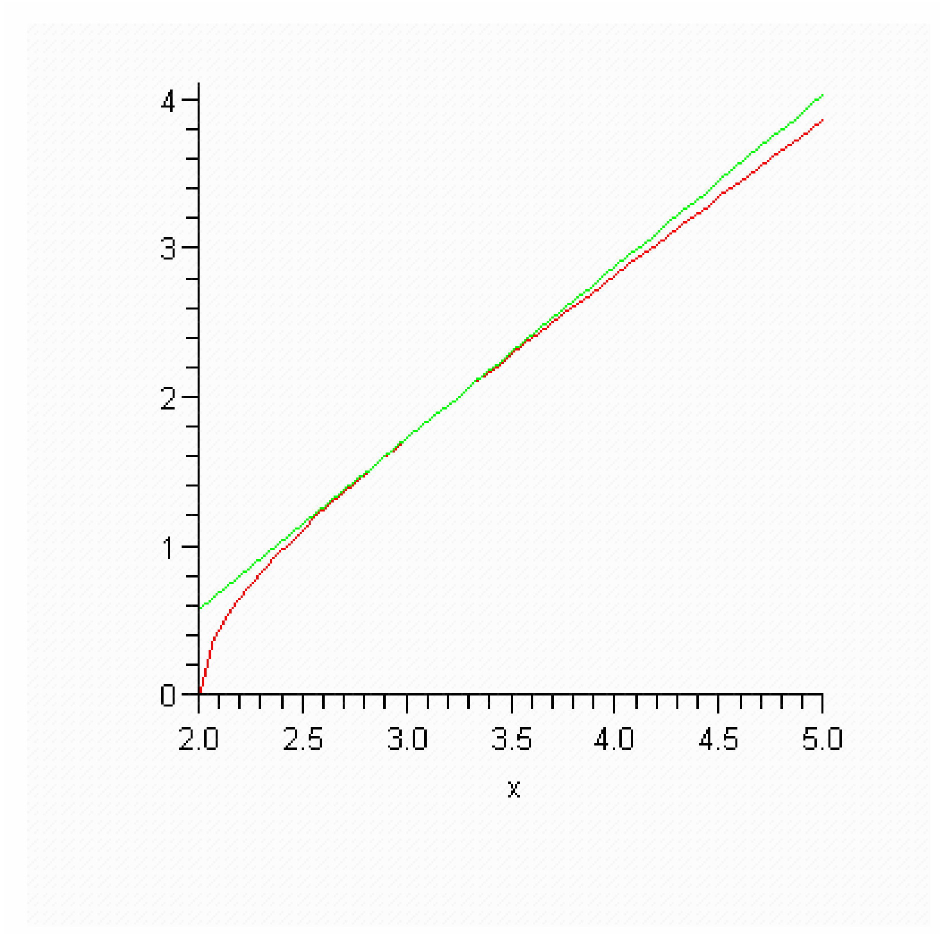
> $T := x \rightarrow g(3.) + 1.154700539 \cdot (x - 3.)$

$$T := x \rightarrow g(3.) + 1.154700539\ (x - 3.)$$

> $T(2.)$

$$0$$
$$.577350269$$

> $plot([g(x), T(x)], x = 2..5)$



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