MAPLE demo 2-13-07

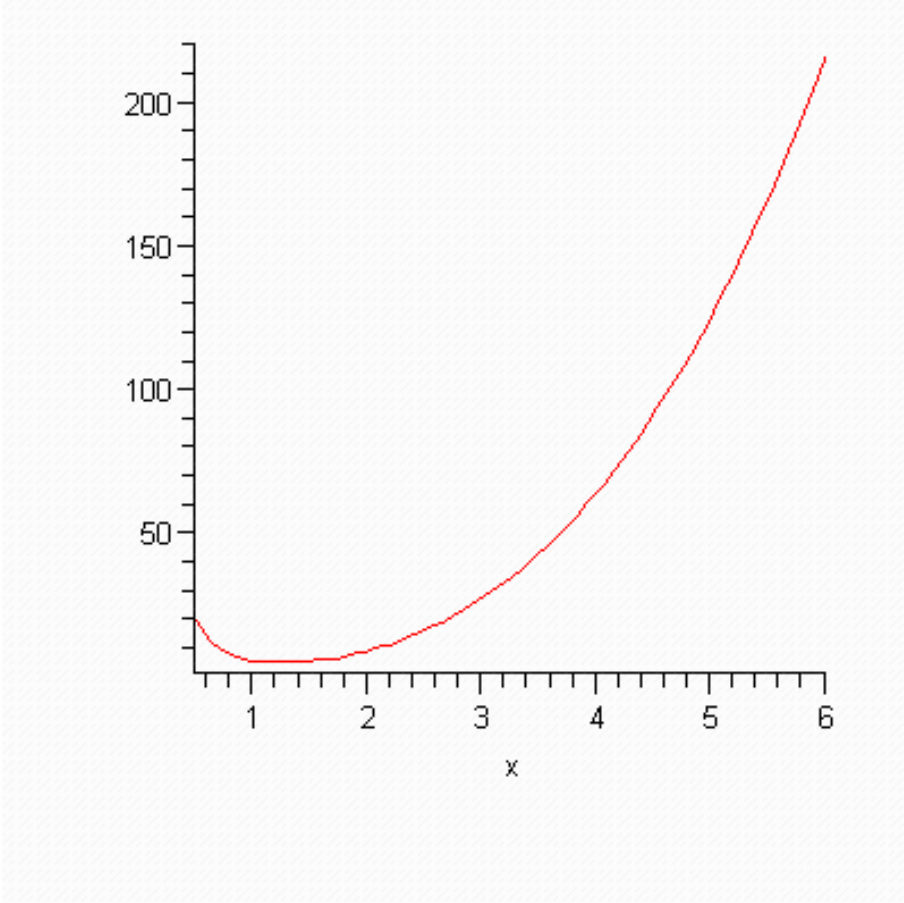
Look at tangent and secant lines.

Example f(x)=x^3+5/x^2 at x_0=2.

> $f := x \to x^3 + \frac{5}{x^2}$

$$f := x \to x^3 + \frac{5}{x^2}$$

> $plot(f(x), x = .5 ..6)$



>

Define the difference quotient for f(x) at x=2.

> $q := h \to \dfrac{(f(2+h) - f(2))}{h}$

$$q := h \to \frac{f(2+h) - f(2)}{h}$$

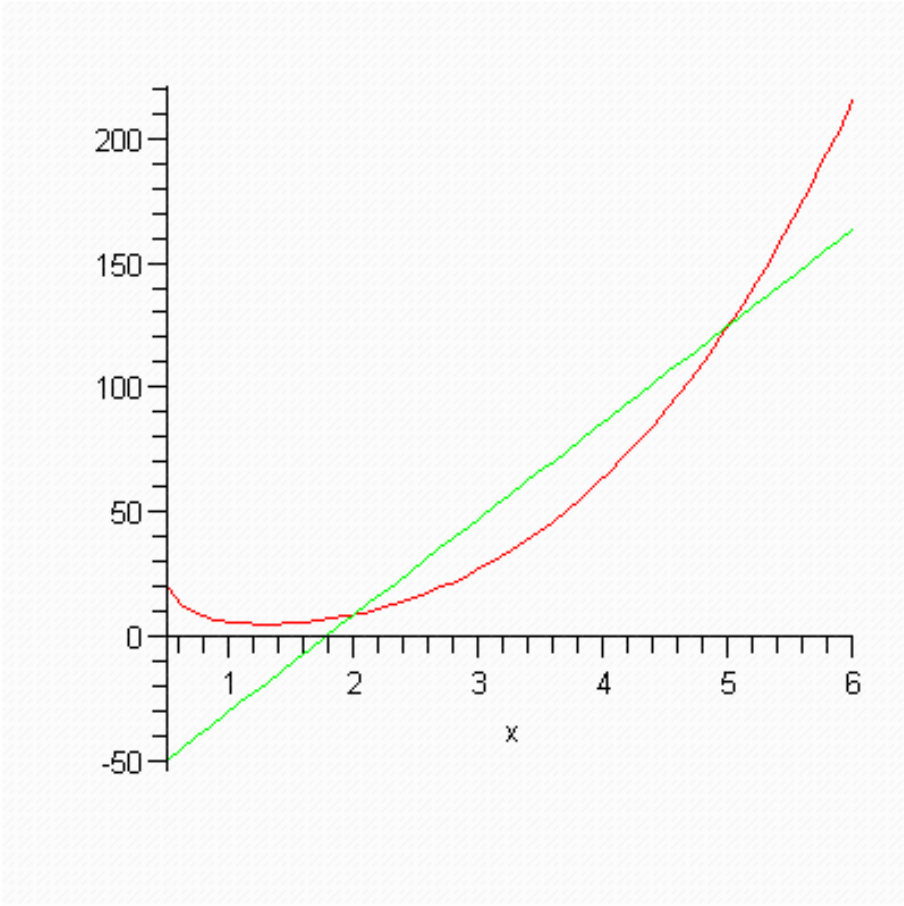
> $q(3.)$

$$3$$
$$8.65000000$$

> $s1 := x \to f(2) + q(3.) \cdot (x - 2)$

$$s1 := x \to f(2) + q(3.)\ (x - 2)$$

> $plot([f(x), s1(x)], x = .5..6)$



> $q(.1)$

$$1$$
$$1.44786850$$

> $q(-.1)$

$$1$$
$$0.05958449$$

> $q(.05)$

$$1$$
$$1.09785990$$

> $q(-.05)$

$$1$$
$$0.40401216$$

> $q(.01)$

$$1$$
$$0.81941290$$

> $q(-.01)$

$$1$$
$$0.68066210$$

> $q(.005)$

$$1$$
$$0.78469700$$

> $q(-.005)$

$$1$$
$$0.71532180$$

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

$$\frac{43}{4}$$

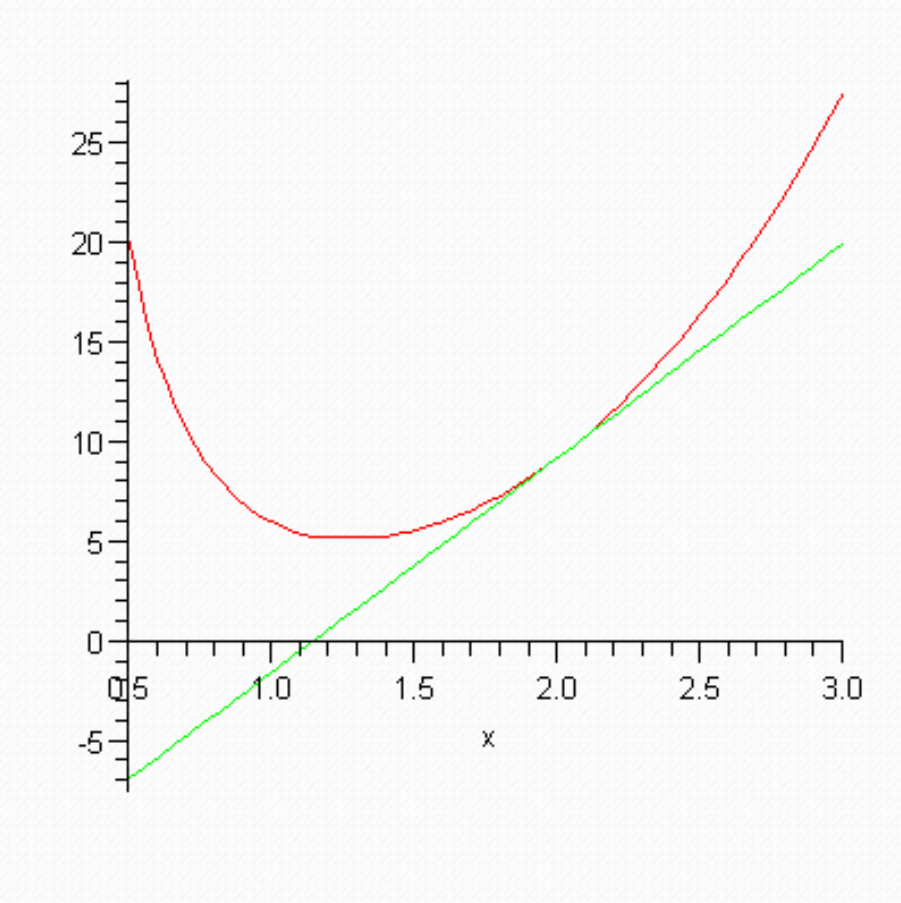
>

Plot the tangent line.

> $t := x \rightarrow f(2) + \left(\frac{43}{4}\right) \cdot (x - 2)$

$$t := x \rightarrow f(2) + \frac{43}{4} x - \frac{43}{2}$$

> $plot([f(x), t(x)], x = .5 ..3)$



>

Define some graphs of secant lines.

> $s2 := x \to f(2) + q(.5) \cdot (x - 2)$

$$s2 := x \to f(2) + q(0.5)\ (x - 2)$$

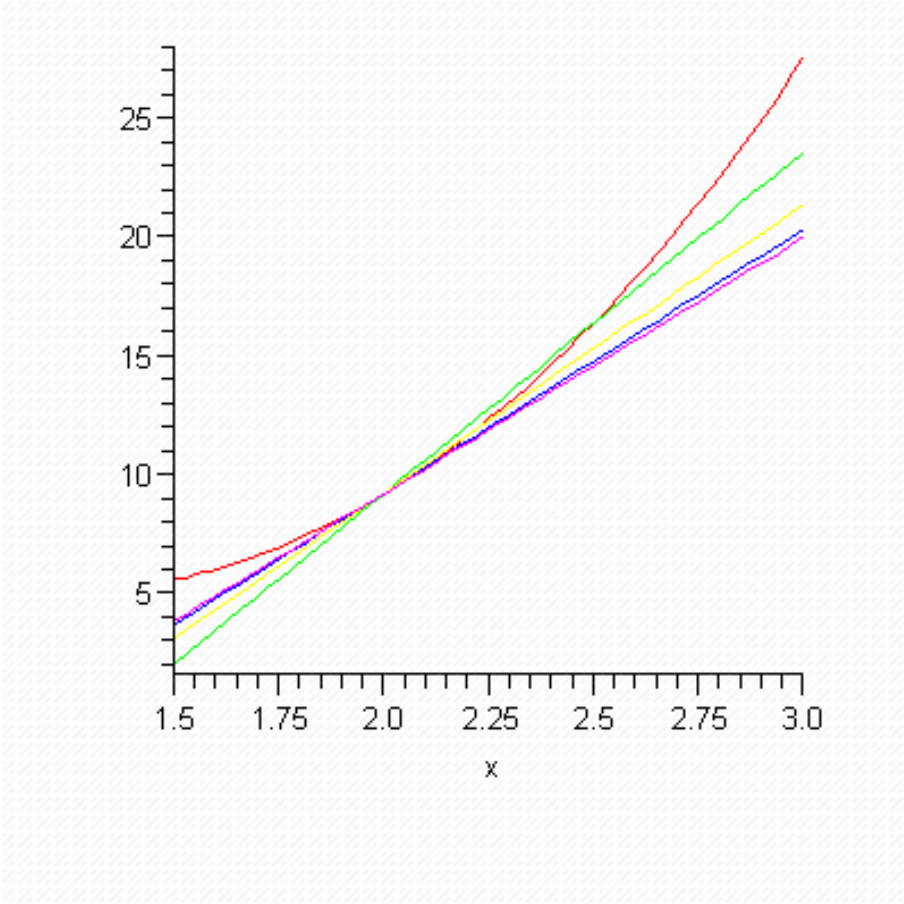
> $s3 := x \to f(2) + q(.2) \cdot (x - 2)$

$$s3 := x \to f(2) + q(0.2)\ (x - 2)$$

> $s4 := x \to f(2) + q(.05) \cdot (x - 2)$

$$s4 := x \to f(2) + q(0.05)\ (x - 2)$$

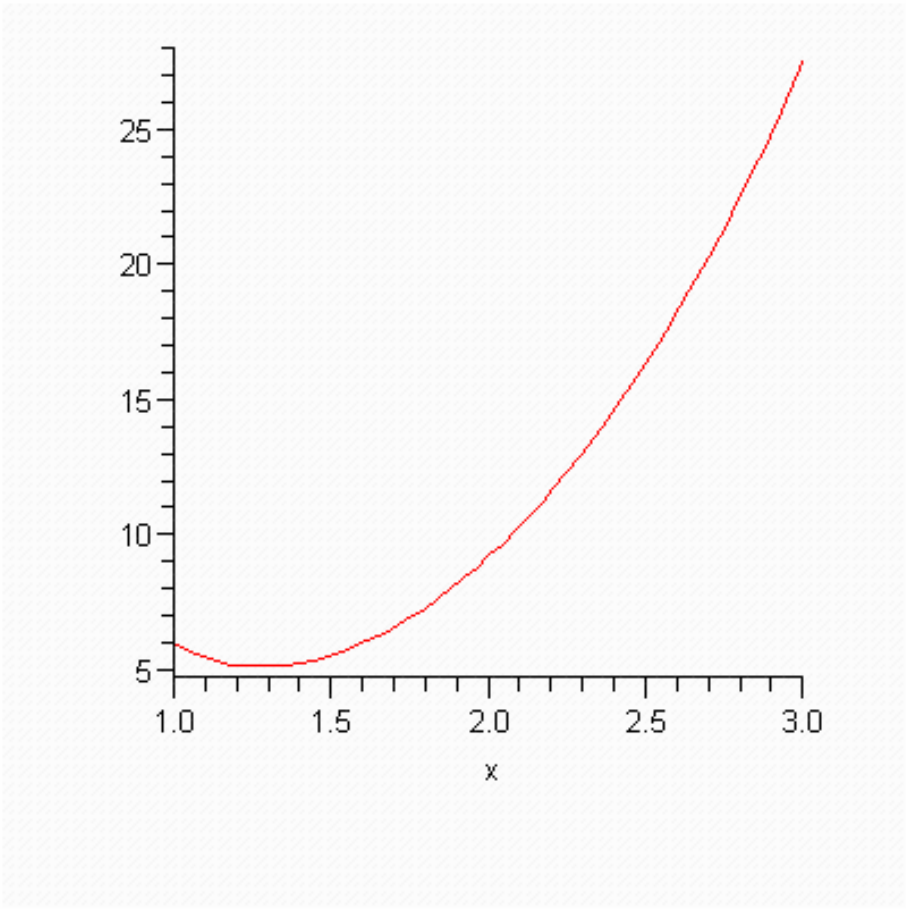
> $plot([f(x), s2(x), s3(x), s4(x), t(x)], x = 1.5..3)$



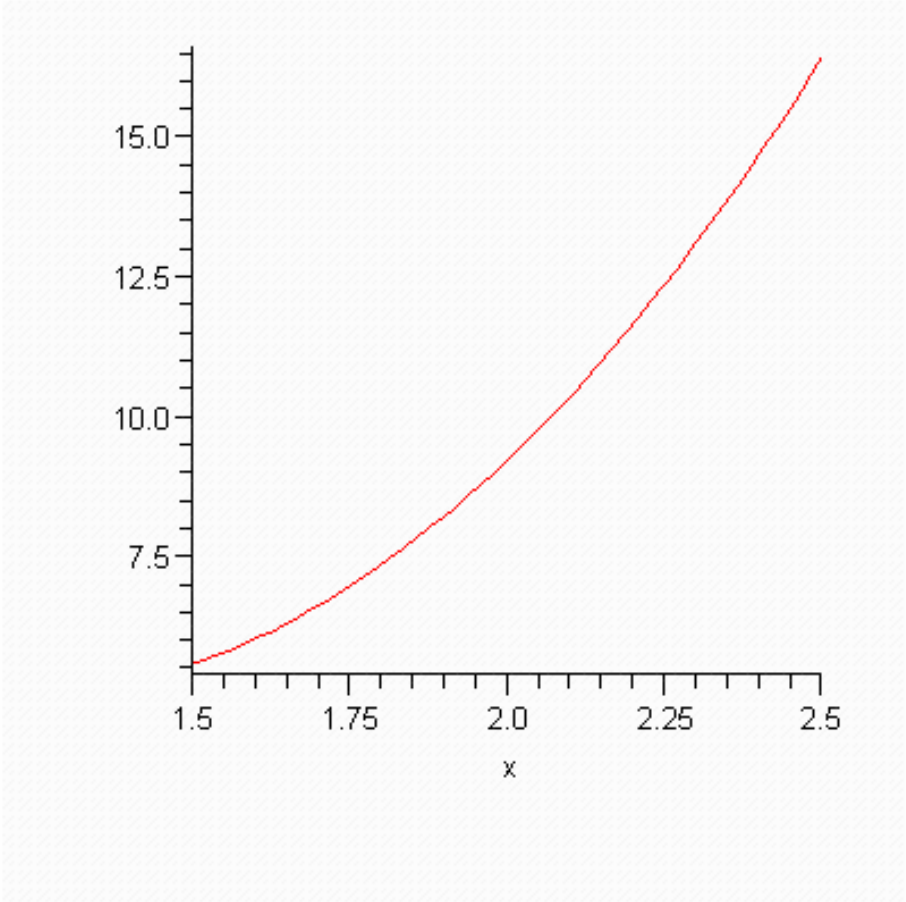
>

Look at tangent line as best linear approximation.

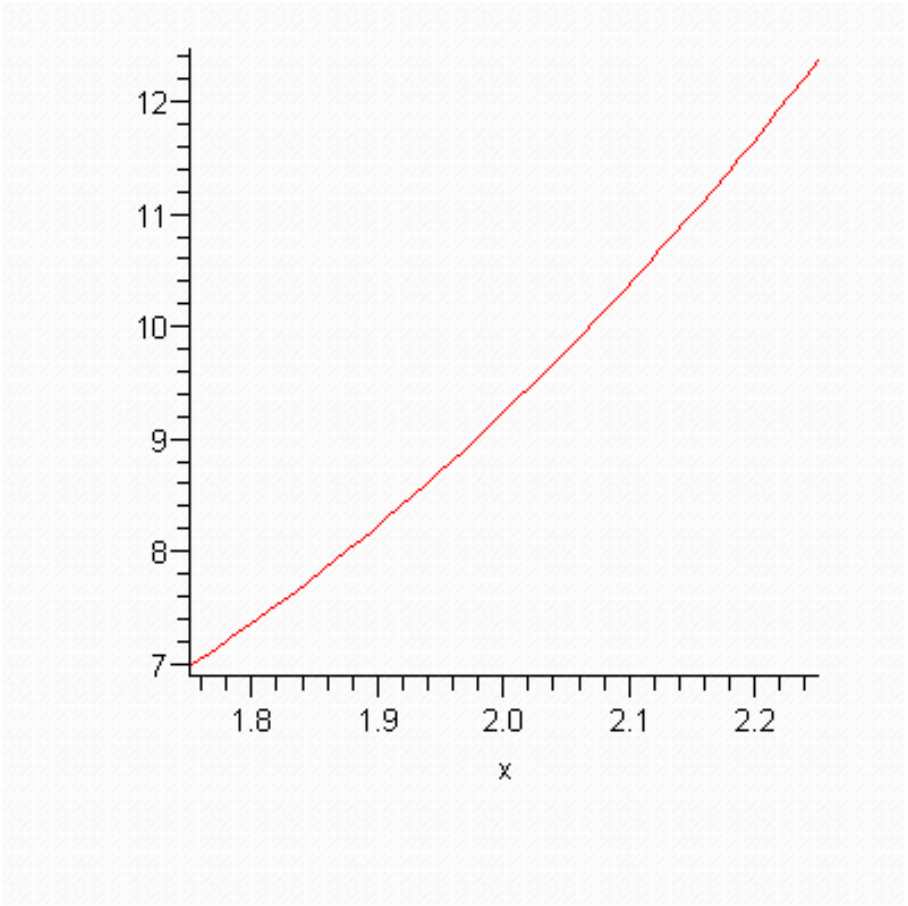
> $plot(f(x), x = 1..3)$



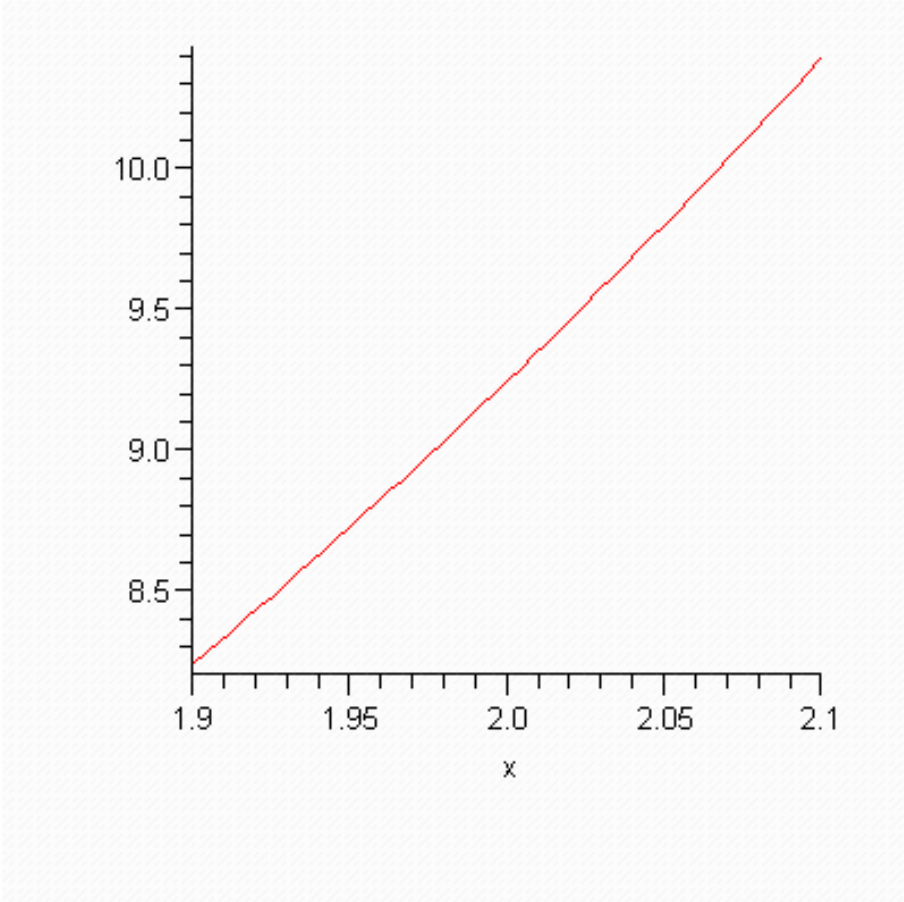
> $plot(f(x), x = 1.5..2.5)$



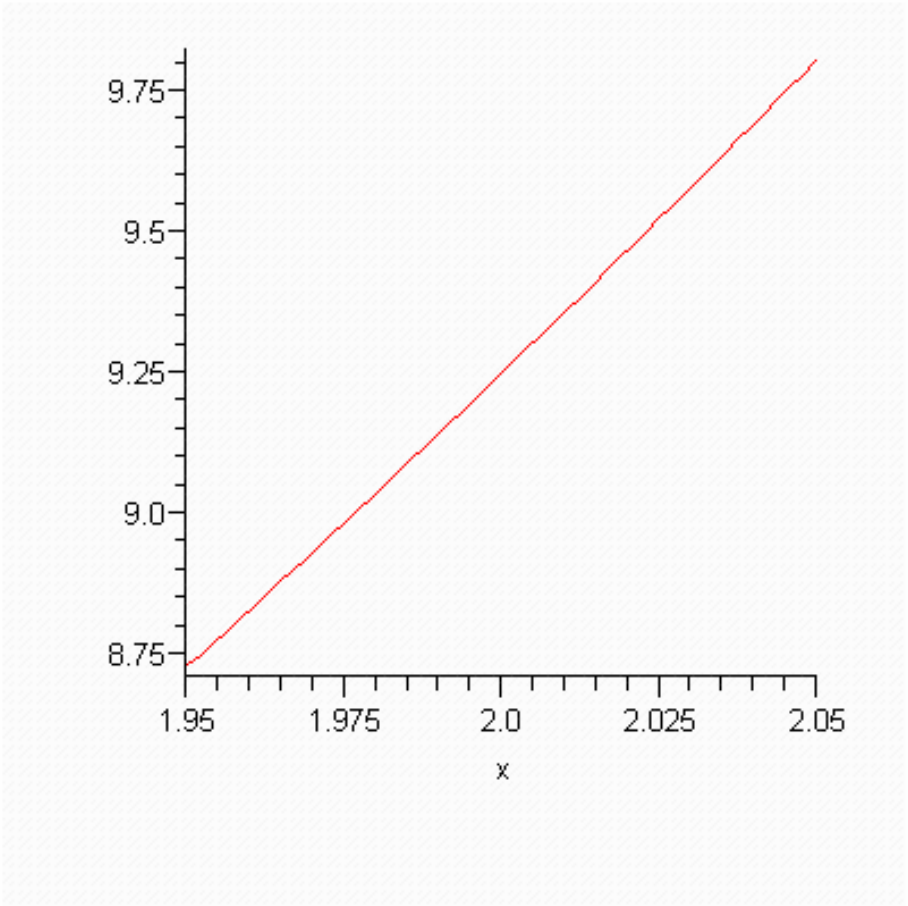
> $plot(f(x), x = 1.75 ..2.25)$



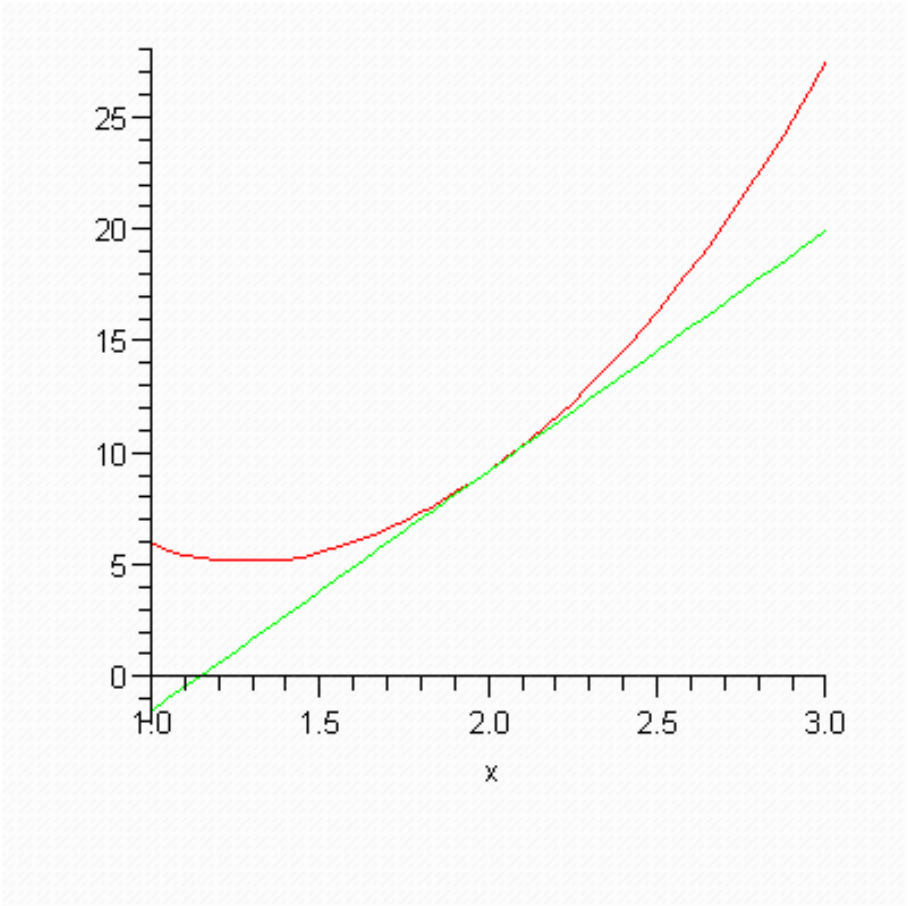
> $plot(f(x), x = 1.9..2.1)$



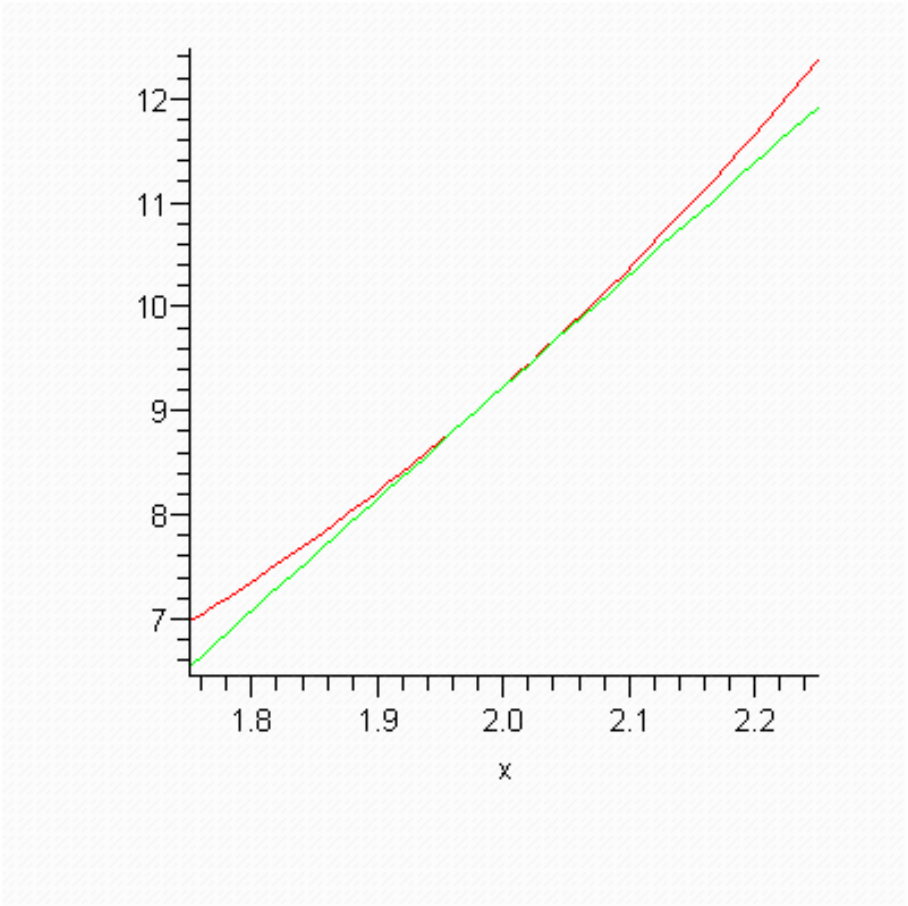
> $plot(f(x), x = 1.95 ..2.05)$



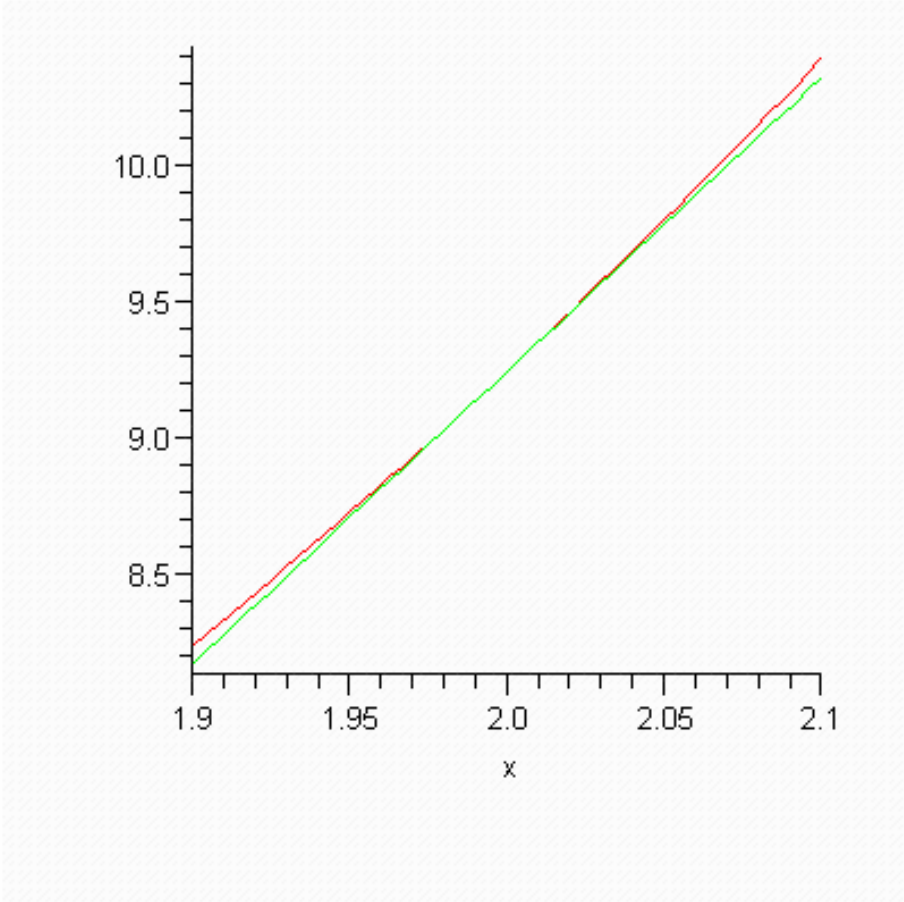
> $plot([f(x), t(x)], x = 1..3)$



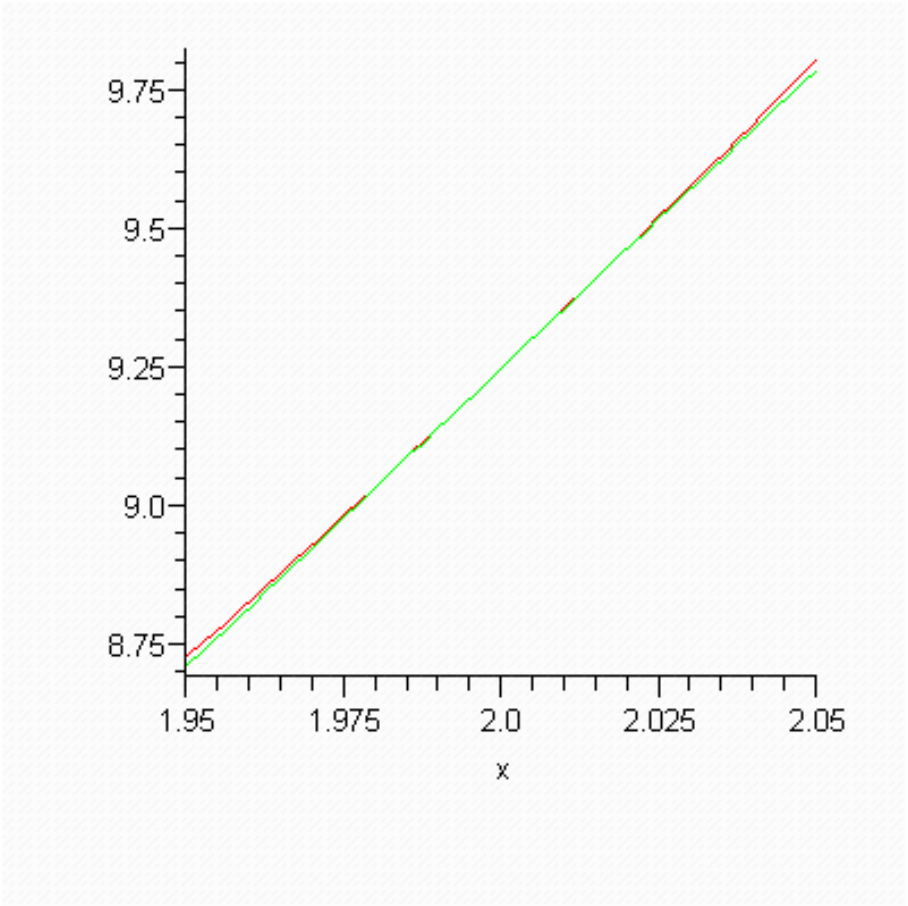
> $plot([f(x), t(x)], x = 1.75..2.25)$



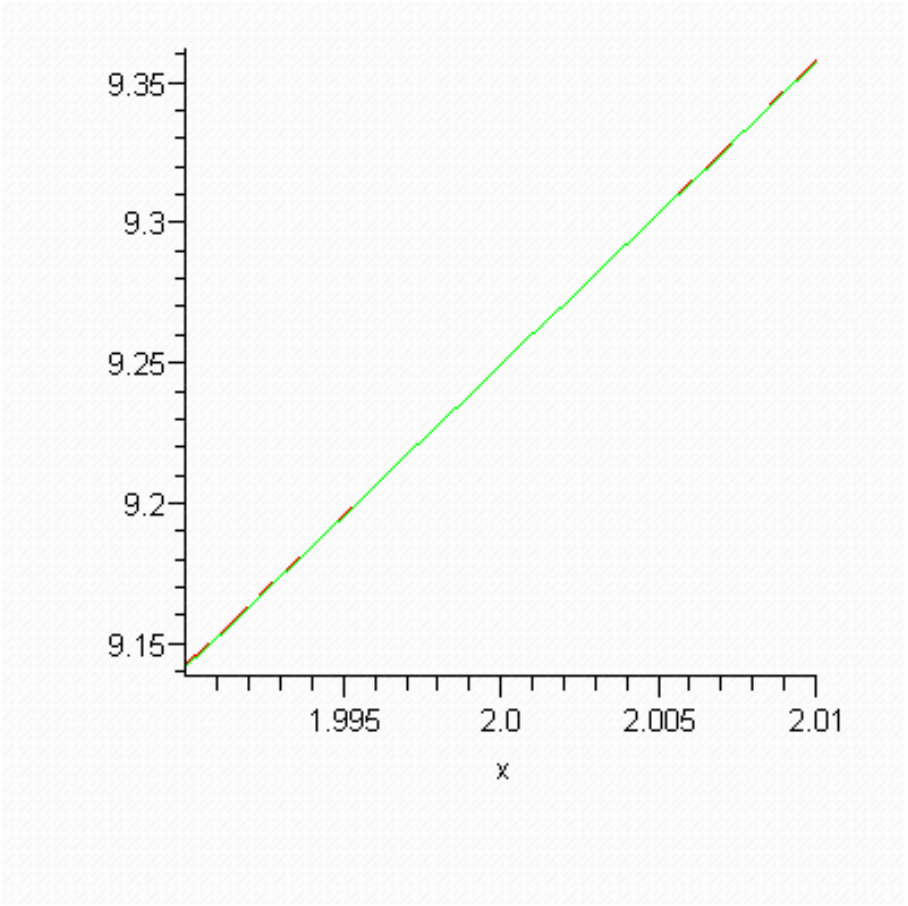
> $plot([f(x), t(x)], x = 1.9..2.1)$



> $plot([f(x), t(x)], x = 1.95..2.05)$



> $plot([f(x), t(x)], x = 1.99..2.01)$


9.35
9.3
9.25
9.2
9.15
1.995
2.0
2.005
2.01
x

>