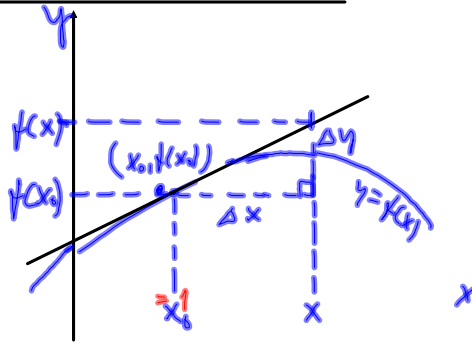


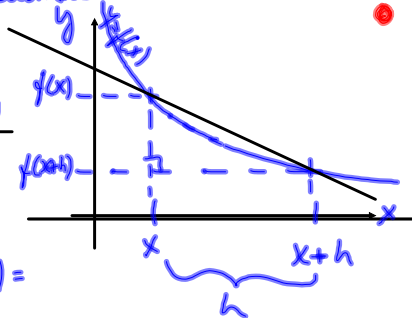
DERIVAATAN MÄÄRITELMÄ

$$\begin{aligned}
 f'(x_0) &= \lim_{x \rightarrow x_0} \frac{\Delta y}{\Delta x} \\
 &= \lim_{x \rightarrow x_0} \frac{f(x) - f(x_0)}{x - x_0}
 \end{aligned}$$



Derivaatan geometrinen merkitys on funktion f kuvaajan pisteestä $(x_0, f(x_0))$ piirretyn tangentin kulmakerto!

$$\begin{aligned}
 f'(x) &= \lim_{h \rightarrow 0} \frac{\Delta y}{\Delta x} \\
 &= \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}
 \end{aligned}$$



esim 1
160a $f(x) = x^3$ $f(1) =$
 $x_0 = 1$

$$f'(1) = ?$$

$$f'(x) = \lim_{x \rightarrow x_0} \frac{f(x) - f(x_0)}{x - x_0}$$

MAA2

$$f'(1) = \lim_{x \rightarrow 1} \frac{x^3 - 1^3}{x - 1} \quad \begin{matrix} \text{m: } x-1 \neq 0 \\ x \neq 1 \end{matrix}$$

$$= \lim_{x \rightarrow 1} \frac{x^3 - 1}{x - 1}$$

(0/0)

$$= \lim_{x \rightarrow 1} \frac{(x-1)(x^2+x+1)}{(x-1)}$$

$$= \lim_{x \rightarrow 1} (x^2 + x + 1)$$

$$= 1^2 + 1 + 1 = \underline{\underline{3}} = \underline{\underline{k}}$$

II tyyppi

↑
tarkista tangentin kulmakerto

$$x^2 + x + 1$$

$$\begin{array}{r}
 \textcircled{x} - 1 \overline{) x^3 - 1} \\
 \underline{(+)\ x^3 \quad (-)\ x^2} \\
 x \\
 \underline{(-)\ x^2 \quad (+)\ x} \\
 \\
 \textcircled{x} - 1 \\
 \underline{(-)\ x \quad (+)\ 1} \\
 \textcircled{0}
 \end{array}$$

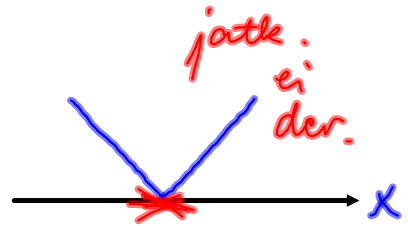
The diagram shows the long division of $x^2 + x + 1$ by $x - 1$. The dividend is written as $x^3 + x^2 + x - 1$ with a red 'x' below the constant term. The divisor is $x - 1$. The quotient is $x^2 + x + 1$. Red circles highlight the leading terms x in the divisor and x^3 , x^2 , and x in the dividend. Blue arrows indicate the flow of terms from the dividend to the quotient and the subtraction of the product of the divisor and the current quotient term.

Huom!

Derivoituva funktio on aina jatkuva.
Jatkuva funktio ei ole välttämättä
derivoituva.

ort. itseisarvo-funktio

kts. esim 1/s. 68



II tyyppi

$$\lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$$

$$k = f'(x_0) = \lim_{h \rightarrow 0} \frac{f(x_0+h) - f(x_0)}{h}$$

s. 62

kts. s. 66

$$f'(1) = \lim_{h \rightarrow 0} \frac{f(1+h) - f(1)}{h}$$

$$= \lim_{h \rightarrow 0} \frac{(1+h)^3 - 1^3}{h}$$

kt

I tyyppi

$$(1+h)(1+h)^2$$

II Pascalin

MAA1

kolmi.