

## Average to Instantaneous

We define the function to be graphed

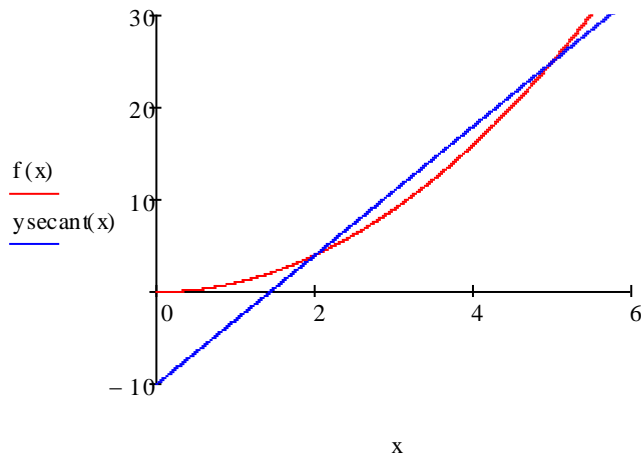
$$f(x) := x^2$$

We define the secant line. We start by defining  $h$  which will be the variable we animate and allow to decrease so that the secant line becomes the tangent line at  $x = 2$ . I'm going to define  $a = 2$  even though I don't have to but I want to create a template that could be used at any point.

$$h := 3 - \frac{\text{FRAME}}{10} \quad a := 2$$

$$y_{\text{secant}}(x) := \frac{f(a+h) - f(a)}{h} \cdot (x - a) + f(a)$$

In the  $x$  direction I used a range  $[0,6]$  and on the vertical  $[-10,30]$

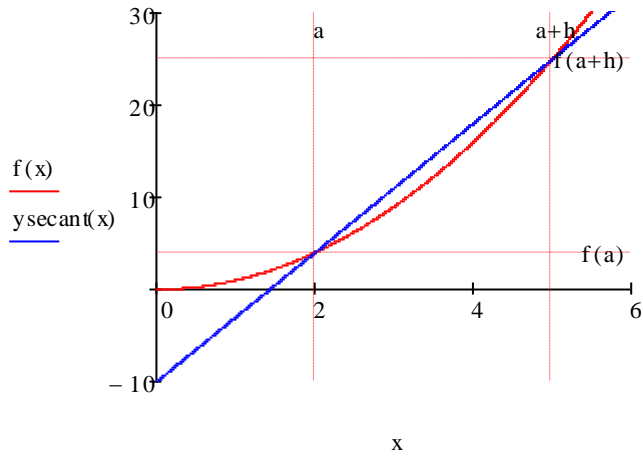


Now we turn on show markers and put  $a$  and  $a+h$  on the horizontal and  $f(a)$  and  $f(a+h)$  on the vertical.

Also type  $\frac{f(a+h) - f(a)}{h} =$  and  $h =$  above the graph to show the approximation to the derivative as  $h$  decreases.

$$h = 3$$

$$\frac{f(a+h) - f(a)}{h} = 7$$



Now Animate using 29 frames since  $h = 3 - \frac{\text{FRAME}}{10}$  and  $\frac{f(a+h) - f(a)}{h}$  is undefined at  $h=0$ .

Make sure you include

$$\frac{f(a+h) - f(a)}{h} = \text{ and } h = \text{ when you highlight to animate}$$