https://colab.research.google.com/github/ageron/handson-ml3/blob/main/math_differential_calculus.ipynb#scrollTo=Vev7qaj1ZLBB

Differential Calculus:

As you probably know, the slope of a (non-vertical) straight line can be calculated by taking any two points A and B on the line, and computing the "rise over run":

$$slope = rise \ / \ run = \Delta y \ / \ \Delta x = (y_B - y_A) \ / \ (x_B - x_A)$$

In this example, the rise is 3, and the run is 6, so the slope is 3/6 = 0.5.

Defining the slope of a curve

But what if you want to know the slope of something other than a straight line? For example, let's consider the curve defined by $y = f(x) = x^2$:

Differentiation rules

One very important rule is that **the derivative of a sum is the sum of the derivatives**. More precisely, if we define $f(x) = g(x) + h(x)$, then $f'(x) = g'(x) + h'(x)$. This is quite easy to prove:

Similarly, it is possible to show the following important rules (I've included the proofs at the end of this notebook, in case you're curious):

	Function f	**Derivative f'**
Constant	$f(x)=c$	$f'(x)=0$
Sum	$f(x)=g(x)+h(x)$	$f'(x)=g'(x)+h'(x)$
Product	$f(x)=g(x)h(x)$	$f'(x)=g(x)h'(x)+g'(x)h(x)$

	Function f	**Derivative f'**
Quotient	$f(x)=g(x)h(x)$	$f'(x)=g'(x)h(x)-g(x)h'(x)h^2(x)$
Power	$f(x)=x^r$ with $r\neq 0$	$f'(x)=rx^{r-1}$
Exponential	$f(x)=\exp(x)$	$f'(x)=\exp(x)$
Logarithm	$f(x)=\ln(x)$	$f'(x)=1x$
Sin	$f(x)=\sin(x)$	$f'(x)=\cos(x)$
Cos	$f(x)=\cos(x)$	$f'(x)=-\sin(x)$
Tan	$f(x)=\tan(x)$	$f'(x)=1\cos^2(x)$
Chain Rule	$f(x)=g(h(x))$	$f'(x)=g'(h(x))h'(x)$