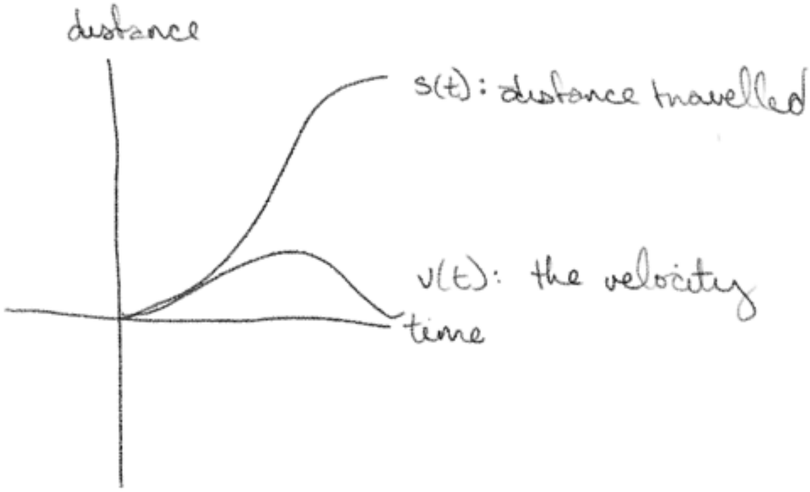

Velocity at a single moment doesn't make sense — you need <u>two</u> points of time

↳ in order to have change.

Can approximate rate of change by observing the change in distance compared to the change in time.

Change in time is <u>ds</u>.
Change in distance is <u>dt</u>.

$$\text{velocity} \Rightarrow \frac{ds}{dt}(t) = \frac{s(t+dt) - s(t)}{dt}$$

The derivative is very similar to this, however it takes sampling to an extreme, where analysis is performed on the function as the delta approaches insignificance.

THAT IS.

derivative $\Rightarrow \dfrac{ds}{dt}(t) = \dfrac{s(t+dt)-s(t)}{dt}$,

as dt approaches zero.

- Similar to a tangent.— this is the best constant approximation around a point.

An Example of a Derivative

if $s(t)=t^3$, then

$$\frac{ds}{dt}(2) = \frac{s(2+dt)-s(2)}{2+dt-2}$$

$$\Leftrightarrow \frac{(2+dt)^3-(2)^3}{dt}$$

$$\Leftrightarrow \frac{\cancel{2^3}+3(2)^2\cancel{dt}+3(2)(dt)^{\cancel{2}}+(dt)^{\cancel{3}}-\cancel{(2)^3}}{\cancel{dt}}$$

$$\Leftrightarrow 3(2)^2+3(2)\,dt+(dt)^2, \text{ as } dt\to 0.$$

$$\Leftrightarrow 3(2)^2,$$

$3(2)dt$ as $dt\to 0$ is ≈ 0.

$(dt)^2$ as $dt\to 0$ is ≈ 0.

□

This generalizes to $\underline{3(t)}^2$ is the derivative.

In considering the derivative, equations describe the change in output due to slight changes in input.

Accounting for comparison involves many terms forming precise but convoluted sums.

By interpreting these same equations in the certain circumstances they can be simplified, that is when the change between input approaches zero.

This simplification under certain conditions — is the ♡ of Calculus.