The average velocity, if S(t) denotes the position at time t, from t=t0 to t=t1 is

$$V_{ave} = \frac{S(t_1) - S(t_0)}{t_1 - t_0}$$

The instantaneous velocity at t=t0 is

$$S'(t_0) = \lim_{t \to t_0} \frac{S(t) - S(t_0)}{t - t_0}$$

$$= \lim_{h \to 0} \frac{S(t_0 + h) - S(t_0)}{h}$$

Ex. Find instantaneous velocity at $t = 1$ if $S(t) = t^2 + 3t$

$$S'(1) = \lim_{h \to 0} \frac{S(1 + h) - S(1)}{h}$$

$$= \lim_{h \to 0} \frac{(1 + h)^2 + 3(1 + h) - 4}{h}$$

Ex. 2. Find $S'(t_0)$ for any $t_0 \in \mathbb{R}$

$$S'(t_0) = \lim_{h \to 0} \frac{S(t_0 + h) - S(t_0)}{h}$$

$$= \lim_{h \to 0} \frac{(t_0 + h)^2 + 3(t_0 + h) - t_0^2 + 3t_0}{h}$$