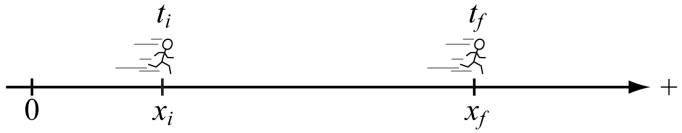
Derivatives and integrals in kinematics

$$x(t_f) = x(t_i) + \int_{t=t_i}^{t=t_f} v(t)\,\mathrm{d}t$$ Position $x(t)$



$$v(t_f) = v(t_i) + \int_{t=t_i}^{t=t_f} a(t)\,\mathrm{d}t$$ Velocity $v(t)$ $= \dfrac{\mathrm{d}x}{\mathrm{d}t}$

Acceleration $a(t)$ $= \dfrac{\mathrm{d}v}{\mathrm{d}t} = \dfrac{\mathrm{d}^2x}{\mathrm{d}t^2}$

Jerk $= \dfrac{\mathrm{d}^3x}{\mathrm{d}t^3}$

Snap $= \dfrac{\mathrm{d}^4x}{\mathrm{d}t^4}$

Crackle $= \dfrac{\mathrm{d}^5x}{\mathrm{d}t^5}$

Pop $= \dfrac{\mathrm{d}^6x}{\mathrm{d}t^6}$

Speed:

$$|v(t)|$$

Distance:

$$d = \int_{t=t_i}^{t=t_f} |v(t)|\,\mathrm{d}t$$

can be analyzed by identifying times where v changes sign and, thus, identifying time interals in which v has uniform sign $(+/-)$.

v	a	Motion
$+$	$+$	speeding up
$-$	$-$	
$+$	$-$	slowing down
$-$	$+$	
$+$ or $-$	constantly 0	constant velocity
0	$+$ or $-$	speeding up from rest
0	constantly 0	remaining at rest