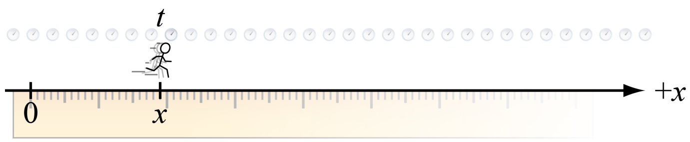
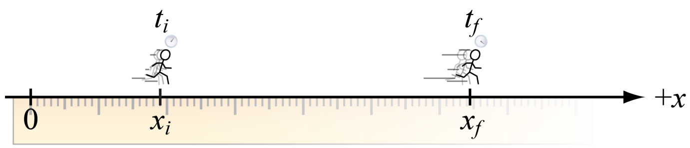
Derivatives and integrals in 1-d kinematics



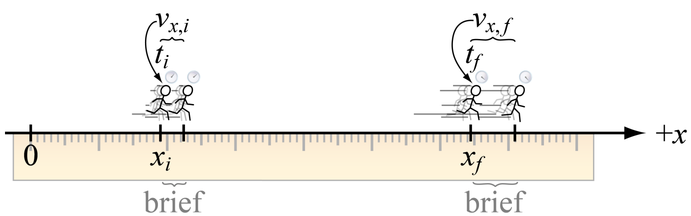
$$x(t_f) = x(t_i) + \int_{t=t_i}^{t=t_f} v_x(t)\,\mathrm{d}t$$

x-**position** $x(t)$



$$v_x(t_f) = v_x(t_i) + \int_{t=t_i}^{t=t_f} a_x(t)\,\mathrm{d}t$$

x-**velocity** $v_x(t)$ $= \dfrac{\mathrm{d}x}{\mathrm{d}t}$



x-**acceleration** $a_x(t)$ $= \dfrac{\mathrm{d}v_x}{\mathrm{d}t} = \dfrac{\mathrm{d}^2x}{\mathrm{d}t^2}$

x-**jerk** $= \dfrac{\mathrm{d}^3x}{\mathrm{d}t^3}$

x-**snap** $= \dfrac{\mathrm{d}^4x}{\mathrm{d}t^4}$

x-**crackle** $= \dfrac{\mathrm{d}^5x}{\mathrm{d}t^5}$

x-**pop** $= \dfrac{\mathrm{d}^6x}{\mathrm{d}t^6}$

Speed:

$$|v_x(t)|$$

Total **path length** traveled (distance traveled):

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

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

v_x	a_x	Motion
+	+	speeding up
−	−	
+	−	slowing down
−	+	
+ or −	constantly 0	constant velocity
0	+ or −	speeding up from rest
0	constantly 0	remaining at rest