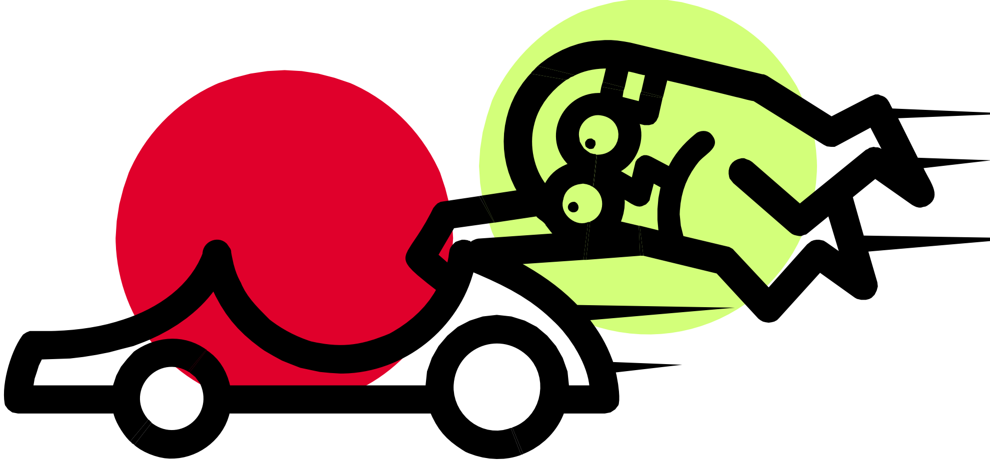
DERIVATIVES OF
VECTOR VALUED FUNCTIONS



Let $\vec{r}(t) = x(t)\hat{i} + y(t)\hat{j} + z(t)\hat{k} = position$

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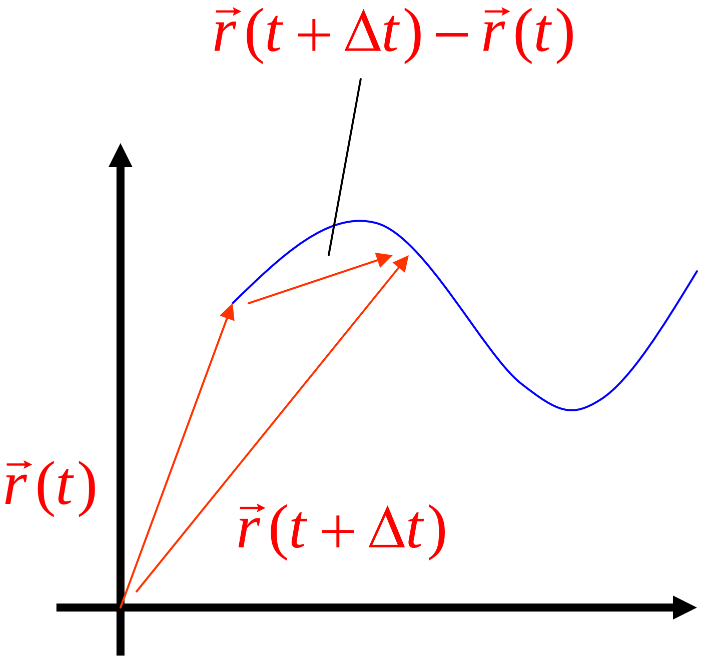
$$= \lim_{\Delta t \to 0} \frac{\left(x(t+\Delta t)\hat{i} + y(t+\Delta t)\hat{j} + z(t+\Delta t)\hat{k}\right) - \left(x(t)\hat{i} + y(t)\hat{j} + z(t)\hat{k}\right)}{\Delta t}$$

$$= \lim_{\Delta t \to 0} \frac{\left[x(t+\Delta t) - x(t)\right]\hat{i} + \left[y(t+\Delta t) - y(t)\right]\hat{j} + \left[z(t+\Delta t) - z(t)\right]\hat{k}}{\Delta t}$$

$$= \lim_{\Delta t \to 0} \left[\frac{x(t+\Delta t) - x(t)}{\Delta t}\hat{i} + \frac{y(t+\Delta t) - y(t)}{\Delta t}\hat{j} + \frac{z(t+\Delta t) - z(t)}{\Delta t}\hat{k} \right]$$

$$= \frac{dx}{dt}\hat{i} + \frac{dy}{dt}\hat{j} + \frac{dz}{dt}\hat{k} = \frac{d\vec{r}}{dt} = \vec{r}\,'(t) = \vec{v}(t) = velocity$$

Notice that *r´(t)* will be tangent to our curve.



$$\vec{r}'(t)=\frac{d\vec{r}}{dt}=\lim_{\Delta t\to 0}\frac{\vec{r}(t+\Delta t)-\vec{r}(t)}{\Delta t}$$

Also,

$$\vec{r}''(t) = \frac{d\vec{v}}{dt} = \vec{a}(t) = acceleration$$

And,

$$\vec{r}'''(t) = \frac{d\vec{a}}{dt} = the\ jerk\ (why?)$$