

**Cheat Sheet for homework Number 16**  
**Bring to Final**

This cheat sheets give you the things to find for cars on roads in Texas (2 dimensions) in roughly the order you want to find them.

Position vector

$$\vec{r}(t)$$

Velocity vector, Speed and Unit Tangent Vector

$$\vec{v}(t) = \frac{d\vec{r}}{dt} \quad \frac{ds}{dt} = \|\vec{v}\| \quad \hat{T} = \frac{\vec{v}}{\|\vec{v}\|}$$

Unit Normal Vector

$$\hat{T} = \langle t_1, t_2 \rangle \longrightarrow \hat{N} = \langle -t_2, t_1 \rangle$$

Acceleration vector

$$\vec{a}(t) = \frac{d\vec{v}}{dt} = \frac{d^2\vec{r}}{dt^2}$$

Tangential component of Acceleration

$$a_T = \frac{d}{dt} \frac{ds}{dt} = \frac{d^2s}{dt^2}$$

Normal component of Acceleration

$$a_N = \vec{a} \cdot \hat{N}$$

Kurvature

$$\kappa = \frac{a_N}{\left(\frac{ds}{dt}\right)^2}$$

You can check your work by checking to see if

$$\vec{a} = a_T \hat{T} + a_N \hat{N}$$