Differentiation Rules For Vector Calculus

• Are exact analogs to differentiation rules for regular functions.

• A nice illustration of the strength of these rules is what we are calling "Bucky’s Theorem:" \( | \mathbf{r}(t) | \) is constant exactly when \( \mathbf{r}(t) \cdot \mathbf{r}'(t) = 0 \).

Curvature

• Formally equal to \( \left| \frac{dT}{ds} \right| \)

• Is also equal by chain rule to \( \left| \frac{dT'}{dr'} \right| \) and by product rule to \( \left| \frac{\mathbf{r}' \times \mathbf{r}''}{r'} \right| \).
This last equation is particularly useful, as it gives the curvature in terms of only $r(t)$ and its derivatives.

The curvature is the reciprocal of the radius of the circle that approximates the curve locally.