

in the cases f is not diff

$$TV(f) = \int_0^1 |f'(x)| dx$$

$$\text{Length (path)} = \int_0^1 \sqrt{1 + (f'(x))^2} dx$$

one is finite $\Leftrightarrow$ other is

$$|f'(x)| \leq \sqrt{1 + f'(x)^2} \leq 1 + |f'(x)|$$

$TV(f)$ measures the "change in the vertical direction"