• What is the derivative of a Fourier transform of f?

$$\frac{d}{ds}\mathcal{F}f(s) = \frac{d}{ds}\int_{-\infty}^{\infty} f(t)\, e^{-2\pi i s t}\, dt$$

$$= \int_{-\infty}^{\infty} f(t)\, \frac{d}{ds} e^{-2\pi i s t}\, dt$$

$$= \int_{-\infty}^{\infty} f(t)\, (-2\pi i t)\, e^{-2\pi i s t}\, dt$$

$$= \int_{-\infty}^{\infty} [-2\pi i t f(t)]\, e^{-2\pi i s t}\, dt$$

$$\frac{d}{ds}\mathcal{F}f(s) = \mathcal{F}[-2\pi i t f(t)]$$

$$-2\pi i t f(t) \rightleftharpoons \frac{d}{ds}\mathcal{F}f(s)$$