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$$\begin{aligned} 1. \quad \frac{d}{dt} [f_1(t) * f_2(t)] &= \frac{d}{dt} \int_{-\infty}^{\infty} f_1(\tau) f_2(t-\tau) d\tau \\ &= \int_{-\infty}^{\infty} f_1(\tau) \frac{d}{dt} f_2(t-\tau) \cdot d\tau \\ &= f_1(t) * \left[\frac{d}{dt} f_2(t) \right] \end{aligned}$$

$$\begin{aligned} \text{又.} \quad \frac{d}{dt} [f_1(t) * f_2(t)] &= \frac{d}{dt} \int_{-\infty}^{\infty} f_2(\tau) f_1(t-\tau) d\tau \\ &= \int_{-\infty}^{\infty} f_2(\tau) \frac{d}{dt} f_1(t-\tau) d\tau \\ &= f_2(t) * \left[\frac{d}{dt} f_1(t) \right] \end{aligned}$$

$$\text{故.} \quad \frac{d}{dt} [f_1(t) * f_2(t)] = f_1(t) * \left[\frac{d}{dt} f_2(t) \right] = \left[\frac{d}{dt} f_1(t) \right] * f_2(t)$$

$$\begin{aligned} 3. \quad f(t) * u(t) &= \int_{-\infty}^{\infty} f(\tau) u(t-\tau) d\tau \\ &= \int_{-\infty}^t f(\tau) \cdot 1 d\tau \\ &= \int_{-\infty}^t f(\tau) d\tau. \end{aligned}$$