If the function $f(t)=\sin t$, then try to draw that

$f(t)\left[u(t-0)-u(t-p)\right] * f(t)\left[u(t-0)-u(t-p)\right]$

$$\begin{aligned}
\int \sin(t-u)\sin u\,du &= \int (\sin t\cos u-\cos t\sin u)\sin u\,du \\
&= \frac{1}{2}\int\left[\sin t\sin(2u)-\cos t\left(1-\cos(2u)\right)\right]du \\
&= \frac{1}{2}\int\left[\left(\sin t\sin(2u)+\cos t\cos(2u)\right)-\cos t\right]du \\
&= \frac{1}{2}\int\left(\cos(t-2u)-\cos t\right)du \\
&= \frac{1}{2}\left(-\frac{1}{2}\sin(t-2u)-u\cos t\right) \\
&= -\frac{1}{4}\sin(t-2u)-\frac{1}{2}u\cos t
\end{aligned}$$

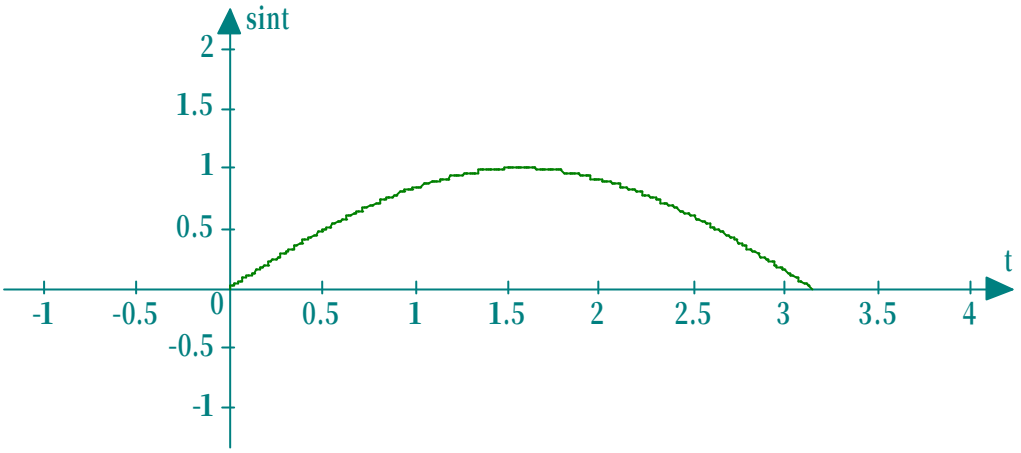
If $0\le t\le p$, then $\int \sin(t-u)\sin u\,du = \left(-\frac{1}{4}\sin(t-2u)-\frac{1}{2}u\cos t\right)\Big|_0^t$

$$= \frac{1}{2}\sin t-\frac{1}{2}t\cos t$$

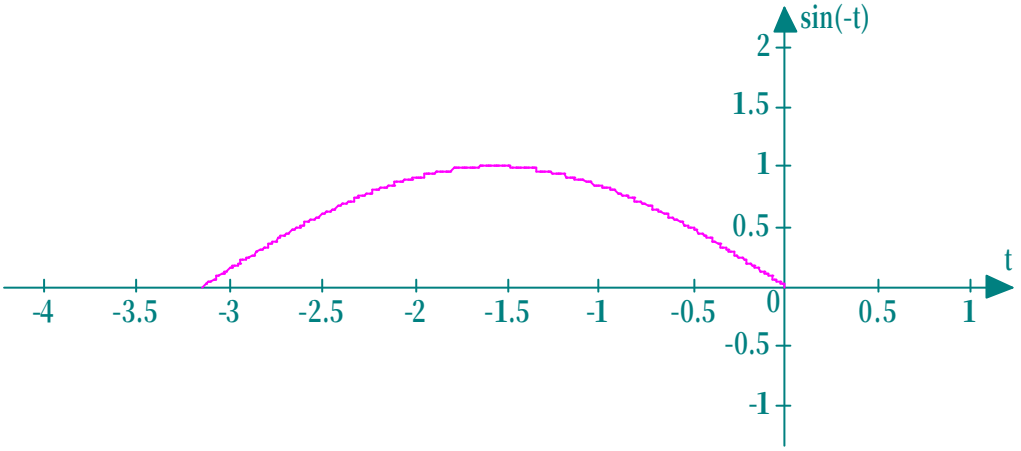
If $p\le t\le 2p$, then $\int \sin(t-u)\sin u\,du = \left(-\frac{1}{4}\sin(t-2u)-\frac{1}{2}u\cos t\right)\Big|_{t-p}^{p}$

$$= -\frac{1}{2}\sin t-\frac{1}{2}(2p-t)\cos t$$

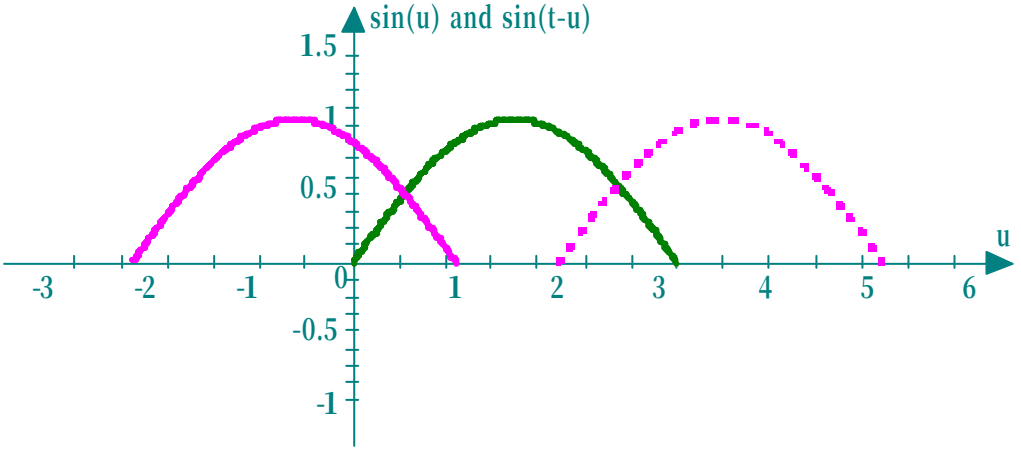
sint



sin(-t)



sin(u) and sin(t-u)



$$f(t)\left[u(t-0)-u(t-p)\right]*f(t)\left[u(t-0)-u(t-p)\right]$$