Steps in Computing Continuous-Time Convolution

\[ y(t) = x(t) * h(t) = \int_{-\infty}^{\infty} x(\lambda) h(t - \lambda) \, d\lambda \quad (1) \]
\[ = \int_{-\infty}^{\infty} x(t - \lambda) h(\lambda) \, d\lambda \quad (2) \]

You can use either (1) or (2), whichever is more convenient. The following steps are used for (1). If you use (2), then “flip and shift” \( x \) rather than \( h \).

1. Plot \( x(\lambda) \) and \( h(\lambda) \).
2. Plot \( h(-\lambda) \) [time-reverse] and \( h(t - \lambda) \) [add \( t \) to all ordinates] versus \( \lambda \).
3. **Do not skip this step:** Plot \( x(\lambda) \) and \( h(t - \lambda) \) on the same graph, versus \( \lambda \).

The location of \( h(t - \lambda) \) on the \( \lambda \)-axis will be a function of \( t \).
(Note that these functions appear inside the integral in (1).)

4. Repeat the following steps for every value of \( t \in (-\infty, \infty) \):
   (a) Form the product \( x(\lambda) \cdot h(t - \lambda) \) at all \( \lambda \) values.

   (You may want to plot this product on a graph versus \( \lambda \). This product will often "look different" when \( t \) takes on values in different intervals.)
   (b) Find the area under this product, i.e., evaluate \( \int_{-\infty}^{\infty} x(\lambda) h(t - \lambda) \, d\lambda \).

   (In many problems, the integration limits will depend on \( t \).)
   (c) The area you computed in step 4(b) is the value of \( y(t) \) for a particular value of \( t \) (or, more often, the result is valid for an interval of \( t \) values.)

5. It is usually best to write the equation for \( y(t) \) and to sketch a plot of \( y(t) \) versus \( t \).