

## Tune-Up Tuesday #8 Continuous-Time Convolution

Homework problem 8.2(a)iv. Convolve  $x(t)$  and  $h(t)$  where

- $x(t)$  is a rectangular pulse that lasts from 0 seconds to 9 seconds
- $h(t)$  is a rectangular pulse that lasts from 0 seconds to 4 seconds

Perform the convolution in continuous time using `cconvdemo` from *Signal Processing First*.

Install the code from <https://dspfirst.gatech.edu/matlab/ZipFiles/cconvdemo-v218.zip>.

Please copy and paste the link into your browser, and unzip the contents in your local Matlab directory. Change directories to `cconvdemo` and run the command `cconvdemo`.

Describe the output  $y(t)$ .

**Answer:** Trapezoid has duration  $T_y = T_h + T_x = 4 + 9 = 13$  seconds. Let  $T_{min} = \min(4,9) = 4$  seconds and  $T_{max} = \max(4,9) = 9$  seconds. As we flip and slide one rectangular pulse against the other, partial overlap occurs from 0 to  $T_{min}$  seconds, complete overlap from  $T_{min}$  to  $T_{max}$  seconds, and partial overlap from  $T_{max}$  to  $T_y$  seconds.

$$y(t) = \begin{cases} 0 & \text{for } t < 0 \\ t & \text{for } 0 \leq t < 4 \\ 4 & \text{for } 4 \leq t < 9 \\ 13 - t & \text{for } 9 \leq t < 13 \\ 0 & \text{for } t > 13 \end{cases}$$

We can check the points at the boundaries between intervals for a sanity check. For example, when  $t = 4$ , partial overlap gives an amplitude of 4 and so does complete overlap.

