

# Convolution (1A)

---

-

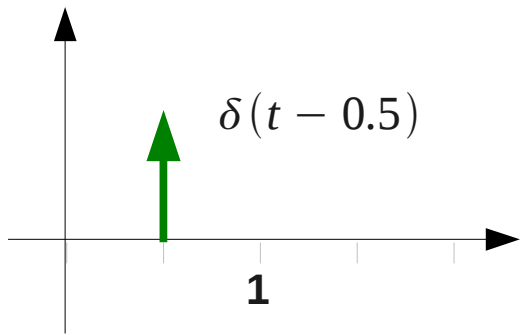
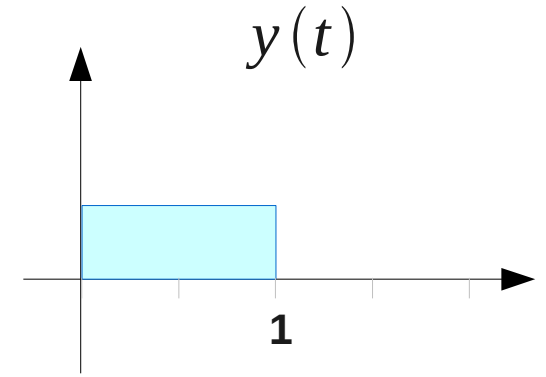
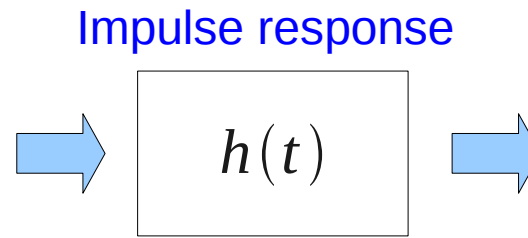
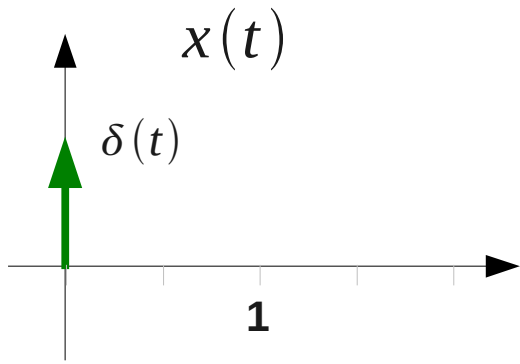
Copyright (c) 2010 Young W. Lim.

Permission is granted to copy, distribute and/or modify this document under the terms of the GNU Free Documentation License, Version 1.2 or any later version published by the Free Software Foundation; with no Invariant Sections, no Front-Cover Texts, and no Back-Cover Texts. A copy of the license is included in the section entitled "GNU Free Documentation License".

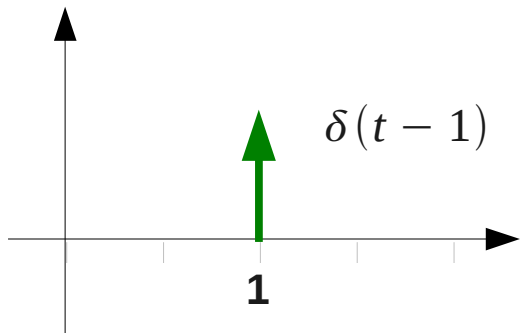
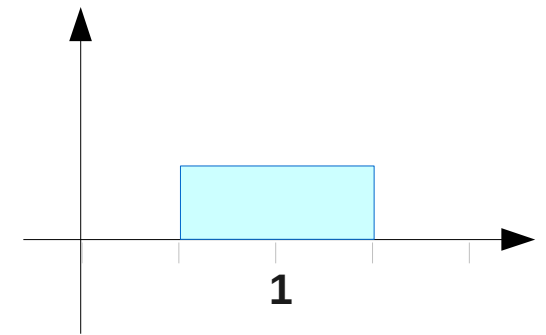
Please send corrections (or suggestions) to [youngwlim@hotmail.com](mailto:youngwlim@hotmail.com).

This document was produced by using OpenOffice and Octave.

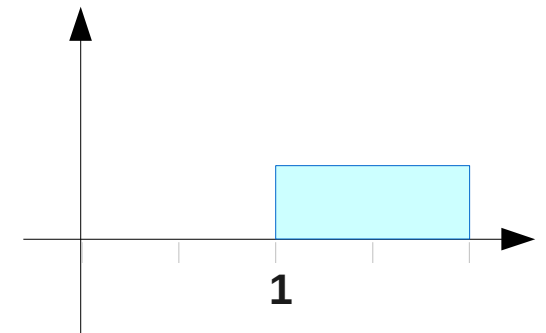
# Impulse Response



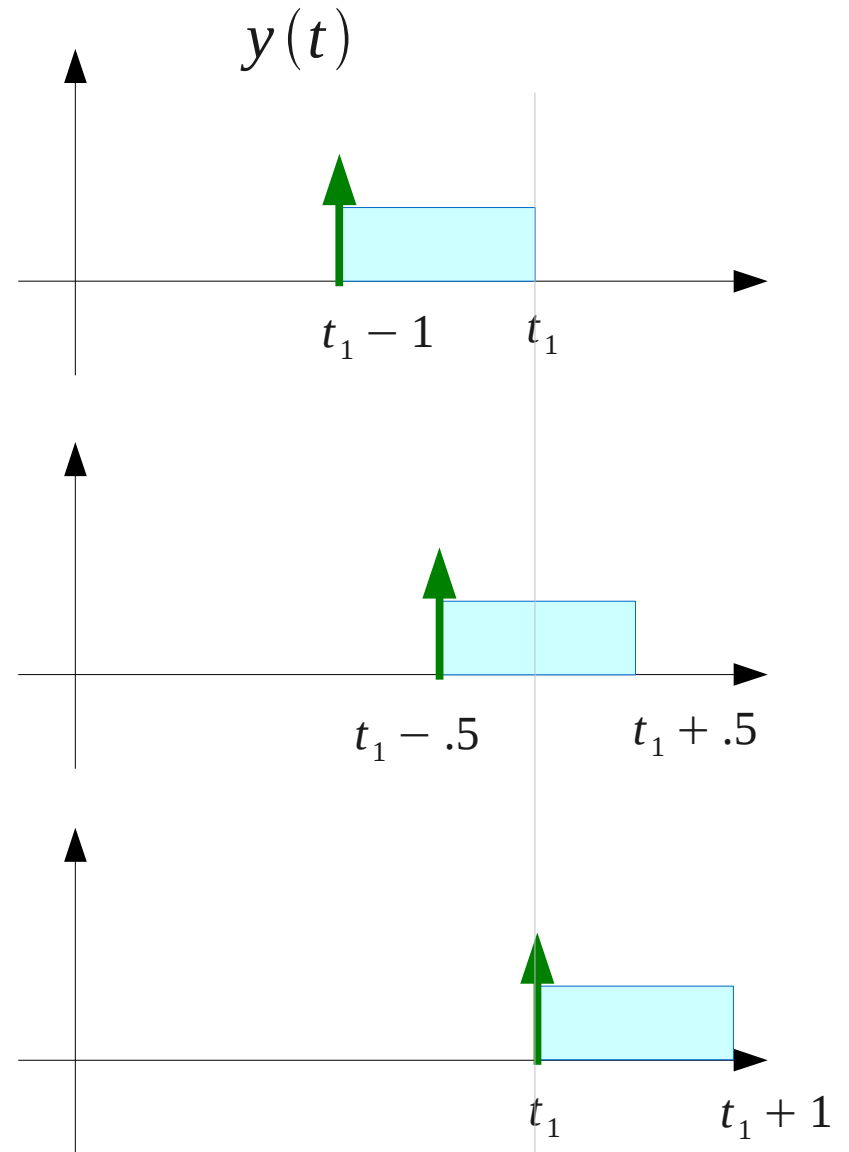
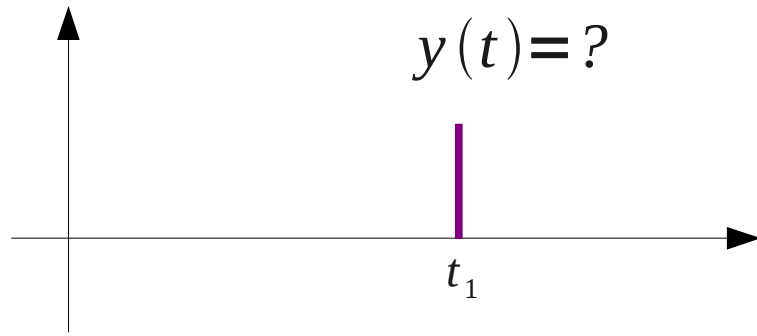
delayed response  
by 0.5



delayed response  
By 1



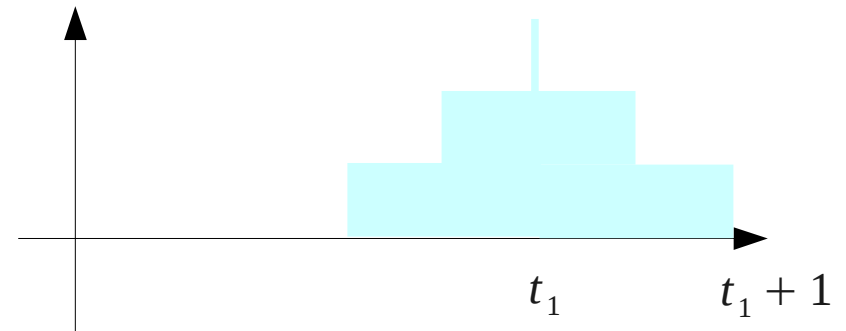
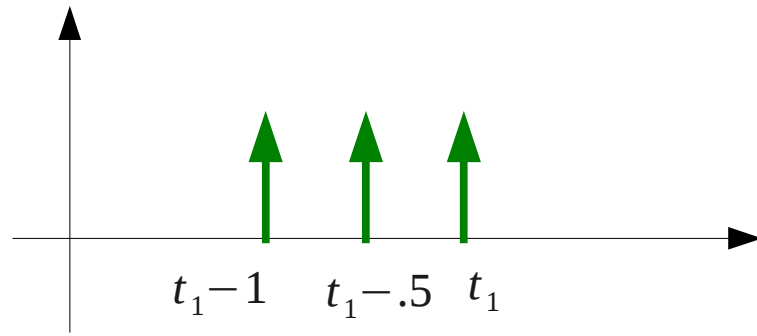
# Output at $t_1$



# N=8 DFT

$$x(t) = \delta(t-t_1+1) + \delta(t-t_1+.5) + \delta(t-t_1)$$

$$y(t) = h(t-t_1+1) + h(t-t_1+.5) + h(t-t_1)$$



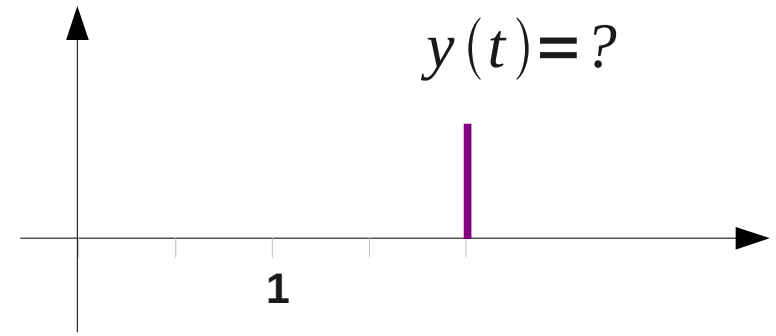
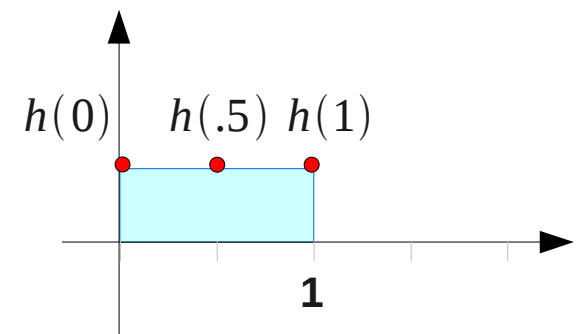
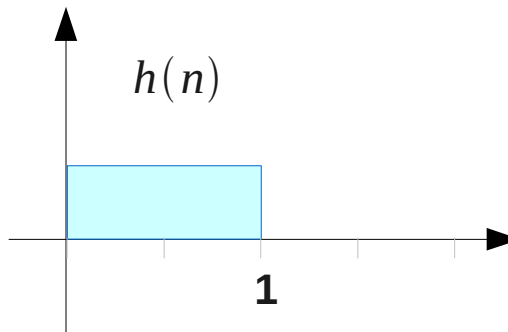
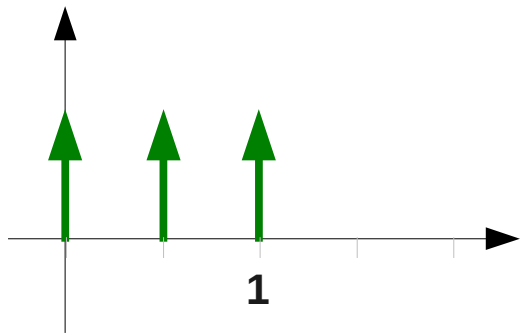
$$\begin{aligned} y(t) &= \int x(v)h(t-v) dv \\ &= \int \delta(v-t_1+1)h(t-v) dv && \rightarrow h(t-t_1+1) \\ &+ \int \delta(v-t_1+.5)h(t-v) dv && \rightarrow h(t-t_1+.5) \\ &+ \int \delta(v-t_1)h(t-v) dv && \rightarrow h(t-t_1) \end{aligned}$$

$$\begin{aligned} y(t_1) &= h(t_1-t_1+1) + h(t_1-t_1+.5) + h(t_1-t_1) \\ &= h(1) + h(.5) + h(0) \end{aligned}$$

# N=8 DFT

$$x(t) = \delta(t-t_1+1) + \delta(t-t_1+.5) + \delta(t-t_1)$$

$$\delta(t) + \delta(t-.5) + \delta(t-1)$$



$$y(t) = h(t-t_1+1) + h(t-t_1+.5) + h(t-t_1)$$

$$y(t_1) = h(1) + h(.5) + h(0)$$

# N=8 DFT

$$x(t) = \delta(t-t_1+1) + \delta(t-t_1+.5) + \delta(t-t_1)$$

$$x(v) = \delta(v-t_1+1) + \delta(v-t_1+.5) + \delta(v-t_1)$$

$$x(t-v) = \delta(t-v-t_1+1) + \delta(t-v-t_1+.5) + \delta(t-v-t_1)$$

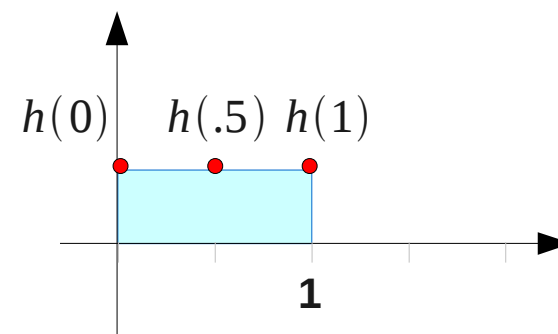
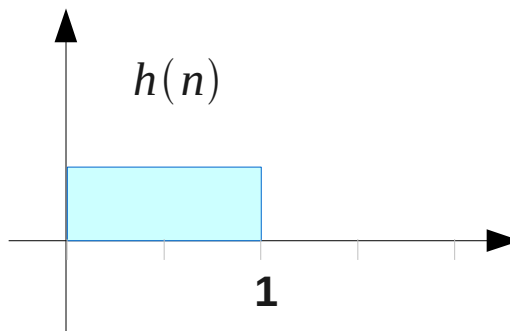
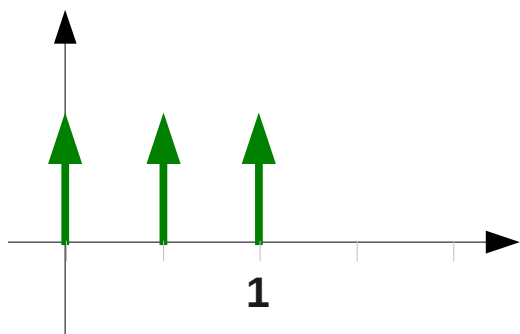
$$y(t) = \int x(t-v)h(v) dv$$

$$= \int \delta(t-v-t_1+1)h(v) dv \quad \rightarrow h(t-t_1+1)$$

$$+ \int \delta(t-v-t_1+.5)h(v) dv \quad \rightarrow h(t-t_1+.5)$$

$$+ \int \delta(t-v-t_1)h(v) dv \quad \rightarrow h(t-t_1)$$

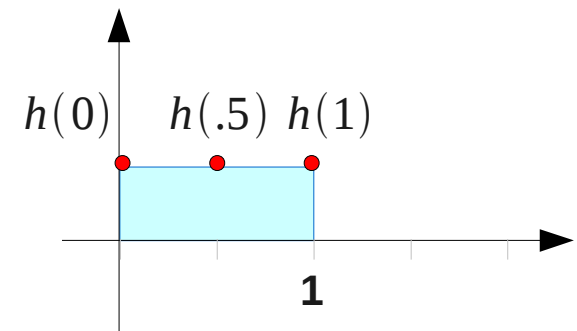
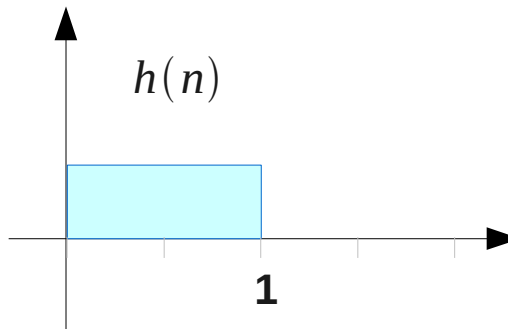
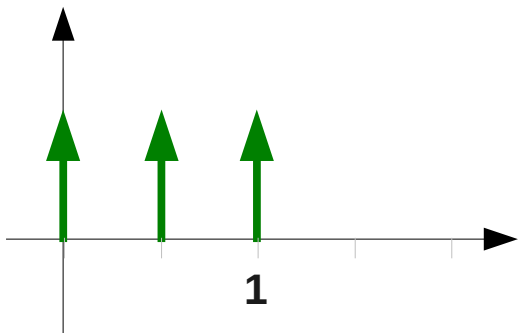
$$\delta(t) + \delta(t-.5) + \delta(t-1)$$



# N=8 DFT

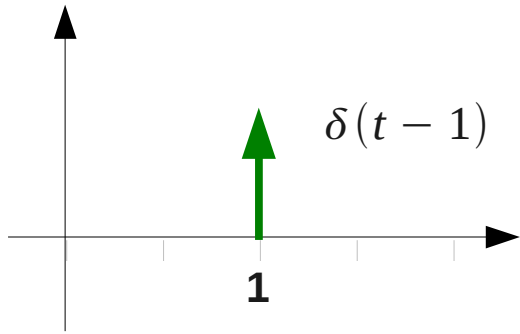
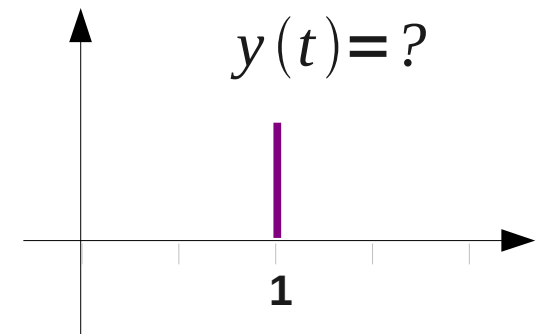
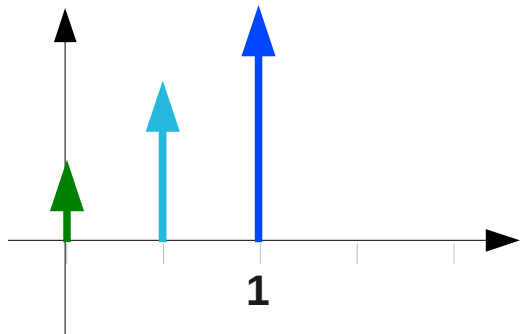
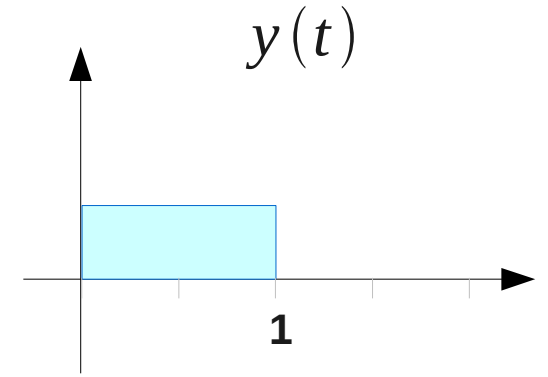
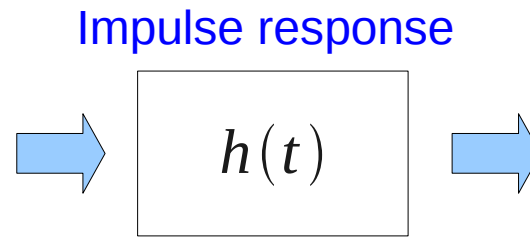
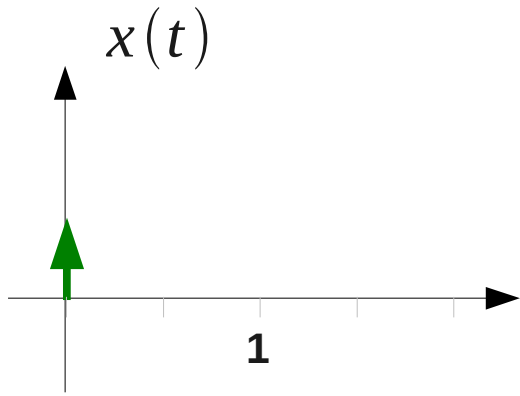
$$\begin{aligned}
 y(t) &= \int x(v)h(t-v) dv \\
 &= \int \delta(v-t_1+1)h(t-v) dv && \rightarrow h(t-t_1+1) \\
 &+ \int \delta(v-t_1+.5)h(t-v) dv && \rightarrow h(t-t_1+.5) \\
 &+ \int \delta(v-t_1)h(t-v) dv && \rightarrow h(t-t_1)
 \end{aligned}$$

$$\begin{aligned}
 y(t) &= \int x(t-v)h(v) dv \\
 &= \int \delta(t-v-t_1+1)h(v) dv && \rightarrow h(t-t_1+1) \\
 &+ \int \delta(t-v-t_1+.5)h(v) dv && \rightarrow h(t-t_1+.5) \\
 &+ \int \delta(t-v-t_1)h(v) dv && \rightarrow h(t-t_1)
 \end{aligned}$$

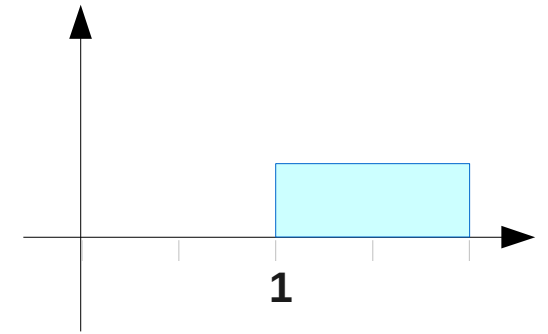




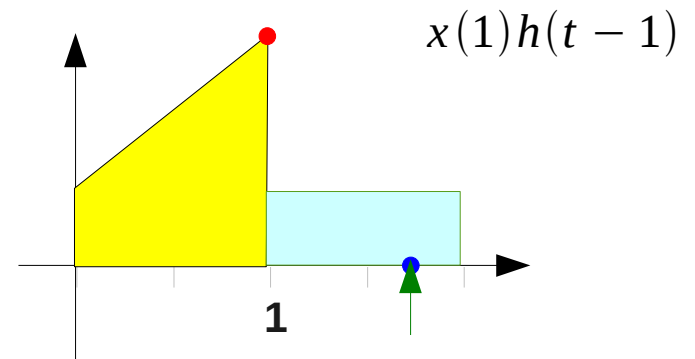
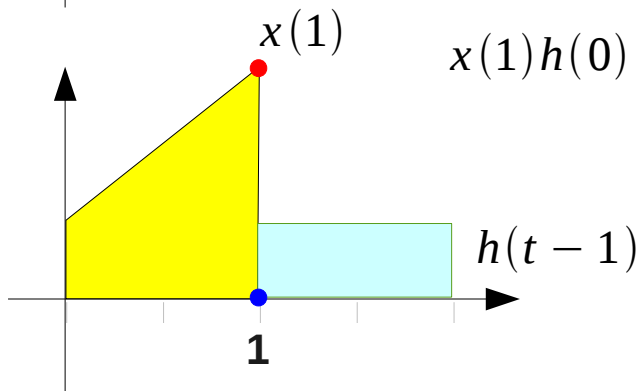
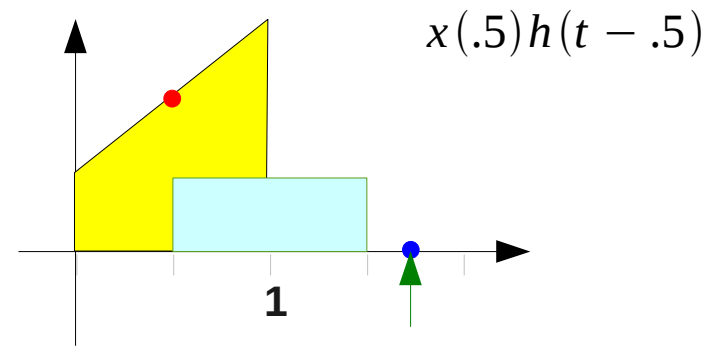
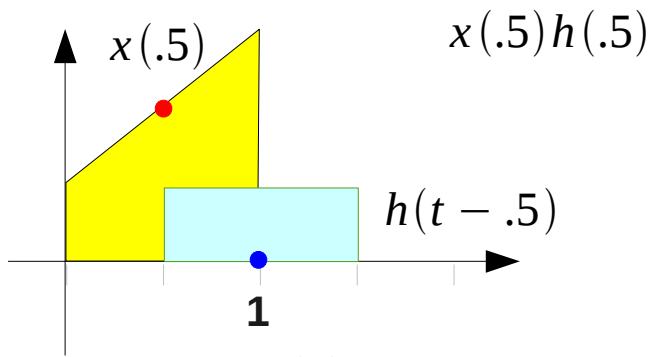
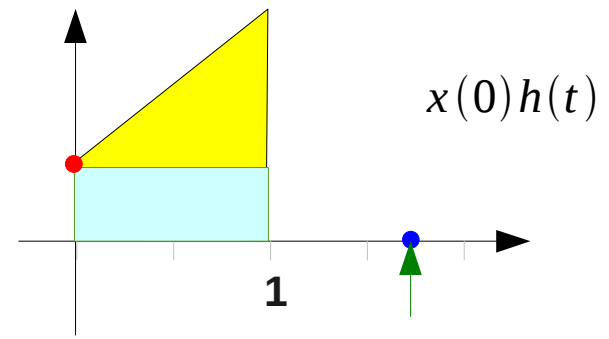
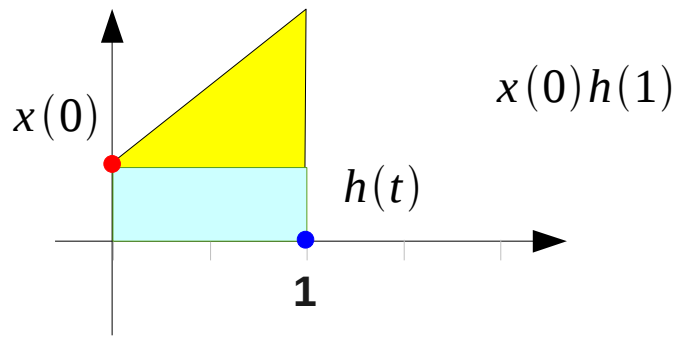
# Impulse Response



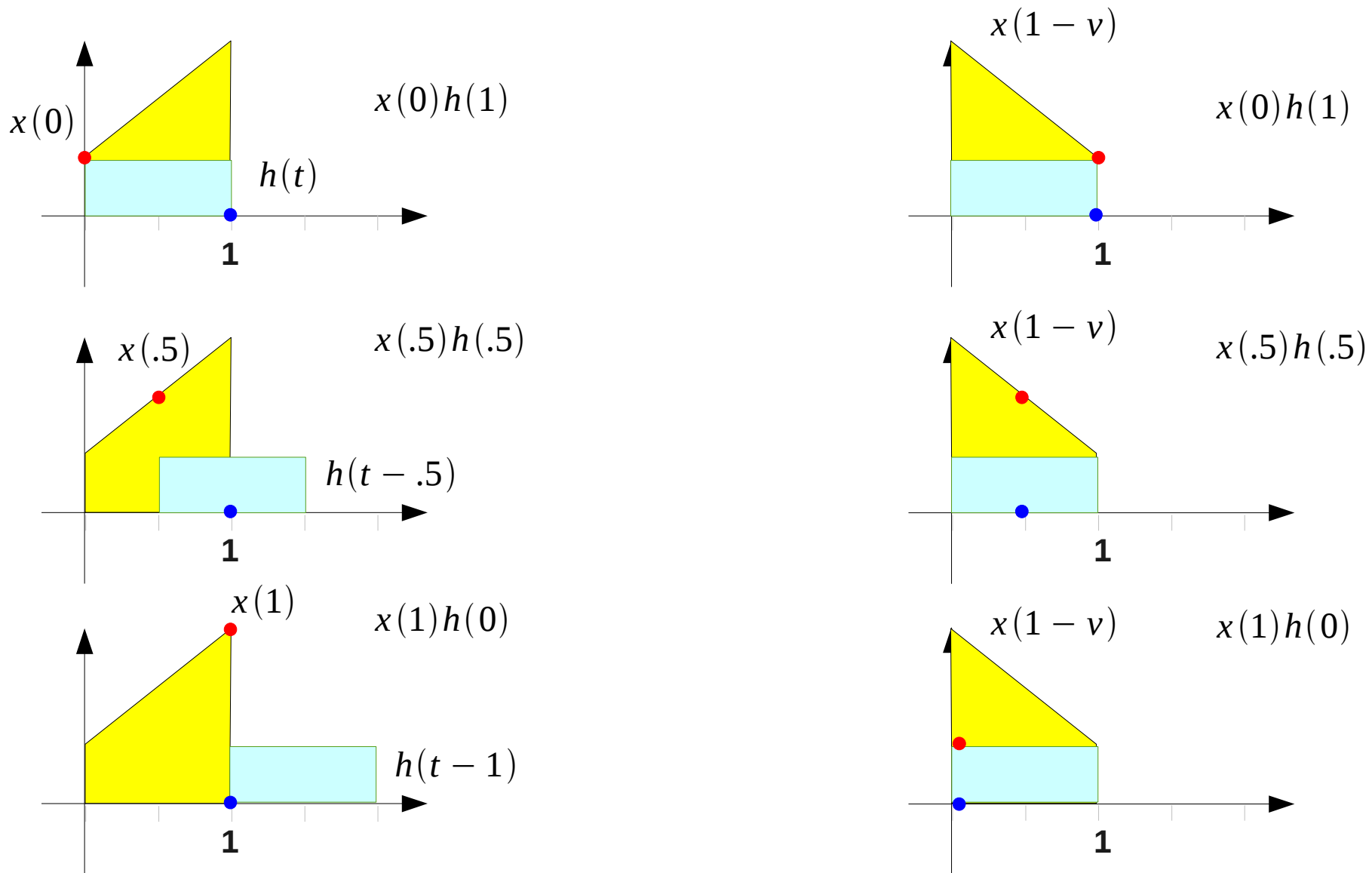
delayed response  
By 1



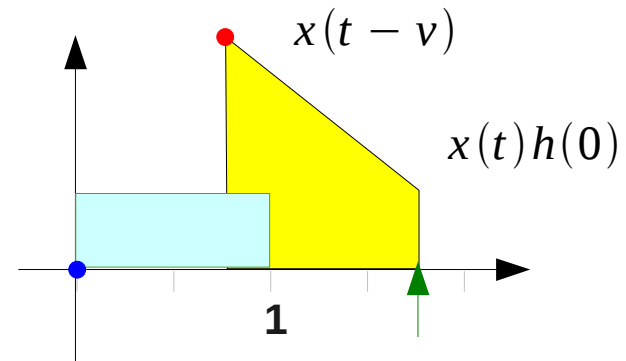
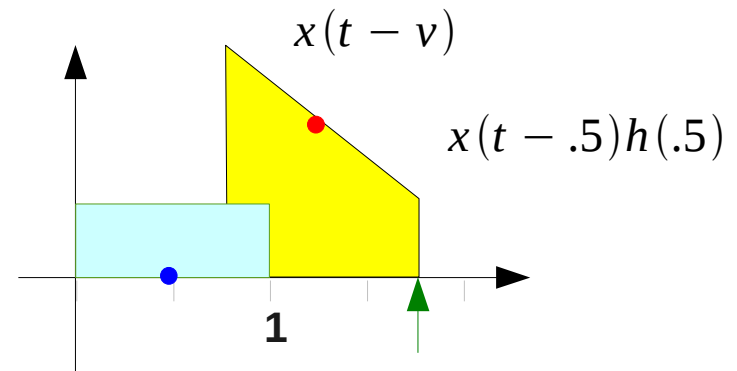
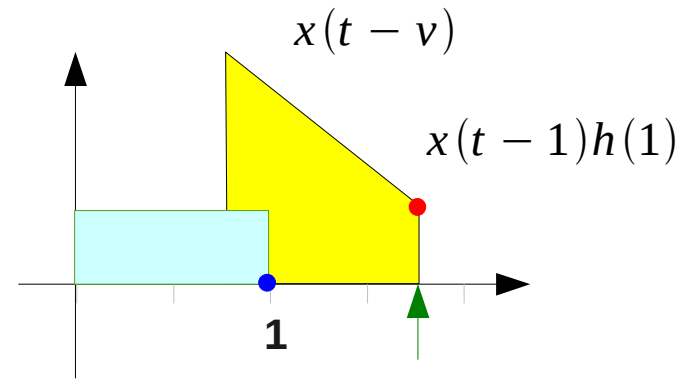
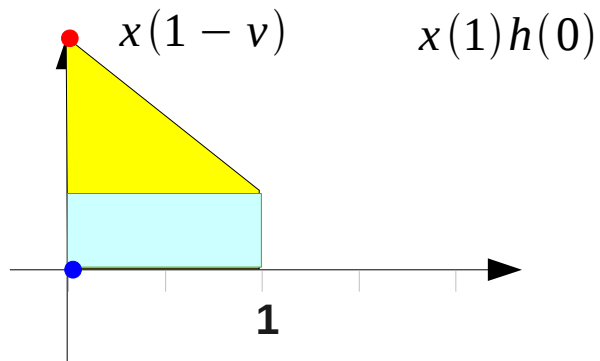
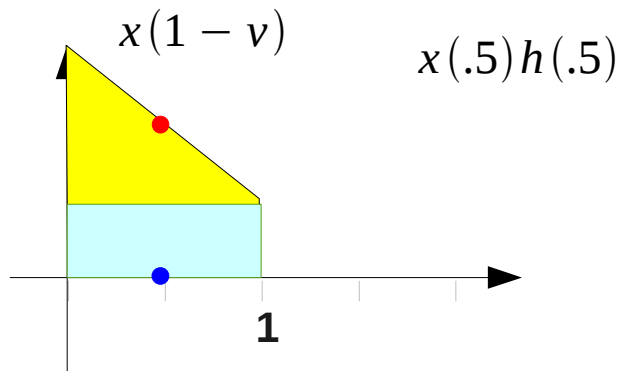
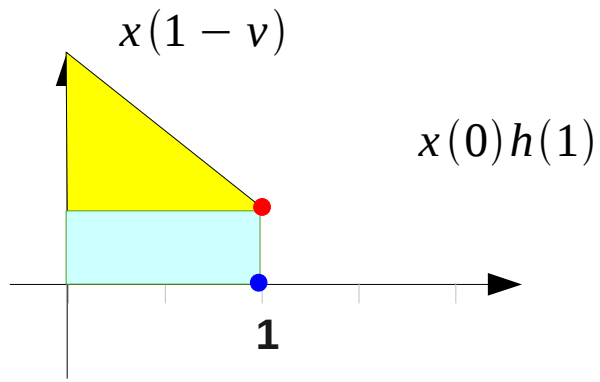
# Impulse Response



# Impulse Response



# Impulse Response



## References

[1] <http://en.wikipedia.org/>

[2] J.H. McClellan, et al., Signal Processing First, Pearson Prentice Hall, 2003