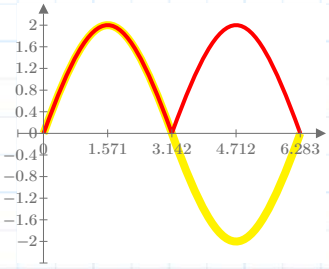
I want to know the reasons of my Mathcad sheet errors. Answer: They are Bugs.

Q1. Average value of a signal. $y(t) := 2 \cdot \sin(t) + a1.5$

$a := 0$ $y(t) := 2 \cdot \sin(t) + a$



$y(t)$

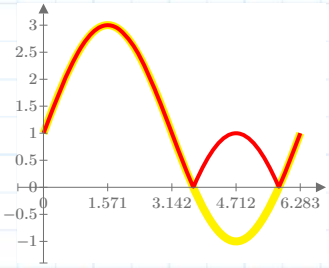
$|y(t)|$ Correct

t

$$E_a := \frac{1}{2 \cdot \pi} \cdot \left(\int_0^{2 \cdot \pi} \sqrt{(y(t))^2}\, dt \right) \rightarrow \frac{\int_0^{2 \cdot \pi} 2 \cdot \sqrt{\sin(t)^2}\, dt}{2 \cdot \pi} = 1.273$$ Correct

$$E_a := \frac{1}{2 \cdot \pi} \cdot \left(\int_0^{2 \cdot \pi} |y(t)|\, dt \right) \rightarrow \frac{4}{\pi} = 1.273$$ Correct

$a := 1$ $y(t) := 2 \cdot \sin(t) + a$



$y(t)$

$|y(t)|$ Correct

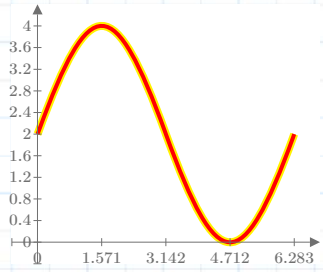
t

$$E_a := \frac{1}{2 \cdot \pi} \cdot \left(\int_0^{2 \cdot \pi} \sqrt{(y(t))^2}\, dt \right) \rightarrow \frac{\int_0^{2 \cdot \pi} \sqrt{(2 \cdot \sin(t) + 1)^2}\, dt}{2 \cdot \pi} = 1.436$$ Correct

$$E_a := \frac{1}{2 \cdot \pi} \cdot \left(\int_0^{2 \cdot \pi} |y(t)|\, dt \right) \rightarrow \frac{2 \cdot \sqrt{3} - \frac{5 \cdot \pi}{3}}{2 \cdot \pi} = -0.282$$ Not correct

Bug

$a := 2$ $\quad y(t) := 2 \cdot \sin(t) + a$



t

$y(t)$

$|y(t)|$

Correct

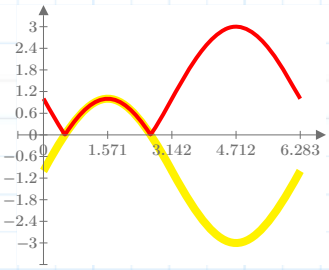
$$E_a := \frac{1}{2 \cdot \pi} \cdot \left(\int_0^{2 \cdot \pi} \sqrt{(y(t))^2}\, dt \right) \rightarrow \frac{\int_0^{2 \cdot \pi} \sqrt{(2 \cdot \sin(t) + 2)^2}\, dt}{2 \cdot \pi} = 2$$

Correct

$$E_a := \frac{1}{2 \cdot \pi} \cdot \left(\int_0^{2 \cdot \pi} |y(t)|\, dt \right) \rightarrow 2 = 2$$

Correct

$a := -1$ $\quad y(t) := 2 \cdot \sin(t) + a$



t

$y(t)$

$|y(t)|$

Correct

$$E_a := \frac{1}{2 \cdot \pi} \cdot \left(\int_0^{2 \cdot \pi} \sqrt{(y(t))^2}\, dt \right) \rightarrow \frac{\int_0^{2 \cdot \pi} \sqrt{(2 \cdot \sin(t) - 1)^2}\, dt}{2 \cdot \pi} = 1.436$$

Correct

$$E_a := \frac{1}{2 \cdot \pi} \cdot \left(\int_0^{2 \cdot \pi} |y(t)|\, dt \right) \rightarrow \frac{\frac{7 \cdot \pi}{3} + 2 \cdot \sqrt{3}}{2 \cdot \pi} = 1.718$$

Not correct

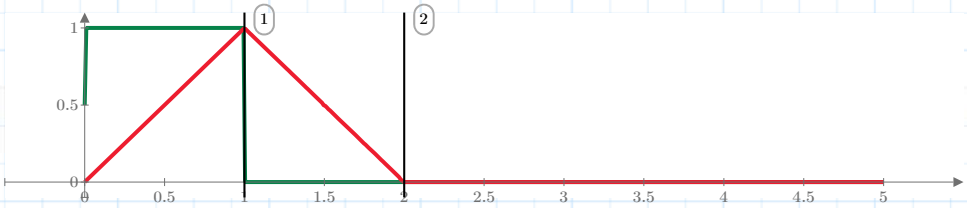
Bug

Q2. Convolution of signals. $\mathbf{clear}(t)$

$\mathbf{clear}(t,a)$ $a:=1$ $x(t):=\Phi(t)-\Phi(t-a)$ $h(t):=\Phi(t)-\Phi(t-1)$

$$y(t):=\int_0^t h(\tau)\cdot x(t-\tau)\,d\tau \qquad Y:=\int_0^{a+1} y(t)\,dt=1$$

Correct



$x(t)$

$h(t)$

$y(t)$

t

Correct

$\mathbf{clear}(t,a)$ $a:=2$ $x(t):=\Phi(t)-\Phi(t-a)$ $h(t):=\Phi(t)-\Phi(t-1)$

$$y(t):=\int_0^t h(\tau)\cdot x(t-\tau)\,d\tau \qquad Y:=\int_0^{a+1} y(t)\,dt=1.986$$

Not correct
Bug

$x(t)$

$h(t)$

$y(t)$

t

Not correct
Bug

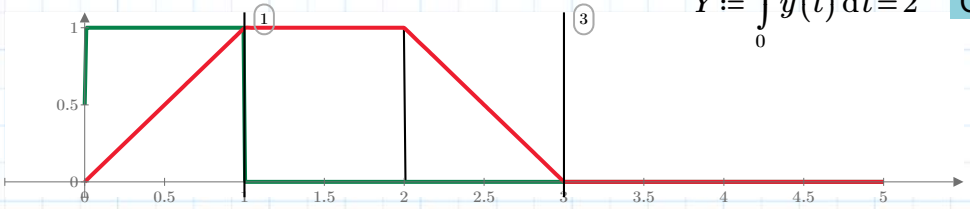
$$x(t):=\Phi(t)-\Phi(t-a)\xrightarrow{laplace}-\frac{e^{-2\cdot s}-1}{s} \qquad x(t):=\Phi(t)-\Phi(t-a)$$

$$h(t):=\Phi(t)-\Phi(t-1)\xrightarrow{laplace}-\frac{e^{-s}-1}{s} \qquad h(t):=\Phi(t)-\Phi(t-1)$$

$$y(t):=\left(-\frac{e^{-2\cdot s}-1}{s}\right)\cdot\left(-\frac{e^{-s}-1}{s}\right)\xrightarrow{invlaplace}t+\Phi(t-1)+2\cdot\Phi(t-2)-3\cdot\Phi(t-3)-t\cdot\Phi(t-1)$$

$$Y:=\int_0^{a+1} y(t)\,dt=2$$

Correct



$x(t)$

$h(t)$

$y(t)$

t

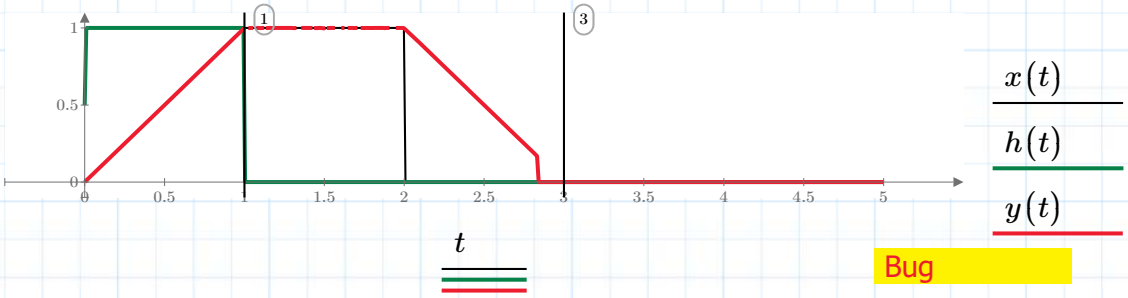
Correct

$$y(t):=t+\Phi(t-1)+2\cdot\Phi(t-2)-3\cdot\Phi(t-3)-t\cdot\Phi(t-1)-t\cdot\Phi(t-2)+t\cdot\Phi(t-3)$$

$\mathbf{clear}(t,a)$ $a := 2$ $x(t) := \Phi(t) - \Phi(t-a)$ $h(t) := \Phi(t) - \Phi(t-1)$

$$y(t) := \int_0^t h(\tau) \cdot x(t-\tau)\,d\tau \qquad Y := \int_0^{a+1} y(t)\,dt = 1.986$$

Bug



$x(t)$

$h(t)$

$y(t)$

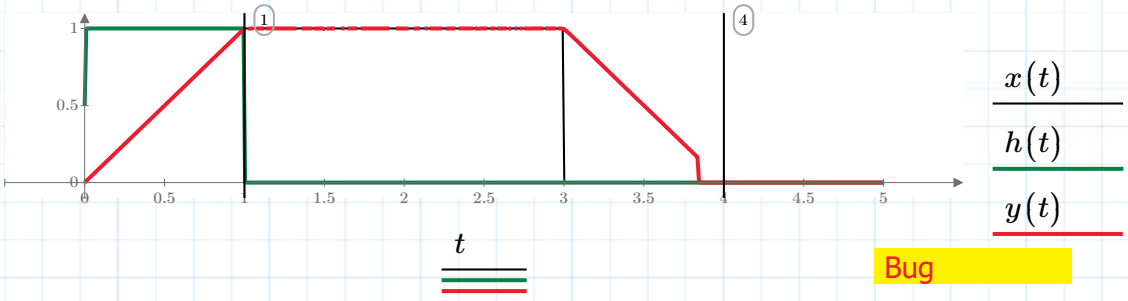
t

Bug

$\mathbf{clear}(t,a)$ $a := 3$ $x(t) := \Phi(t) - \Phi(t-a)$ $h(t) := \Phi(t) - \Phi(t-1)$

$$y(t) := \int_0^t h(\tau) \cdot x(t-\tau)\,d\tau \qquad Y := \int_0^{a+1} y(t)\,dt = 2.987$$

Bug



$x(t)$

$h(t)$

$y(t)$

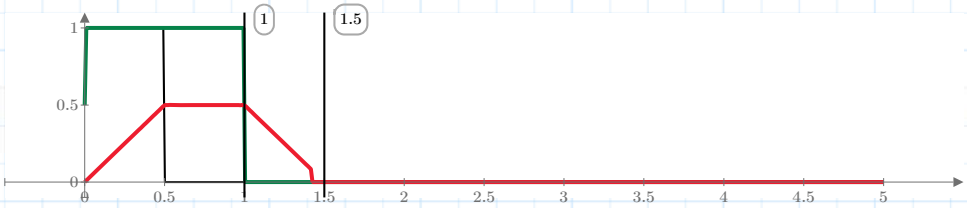
t

Bug

$\mathbf{clear}(t,a)$ $a := 0.5$ $x(t) := \Phi(t) - \Phi(t-a)$ $h(t) := \Phi(t) - \Phi(t-1)$

$$y(t) := \int_0^t h(\tau)\cdot x(t-\tau)\,d\tau \qquad Y := \int_0^{a+1} y(t)\,dt = 0.497$$

Bug



$x(t)$

$h(t)$

$y(t)$

t

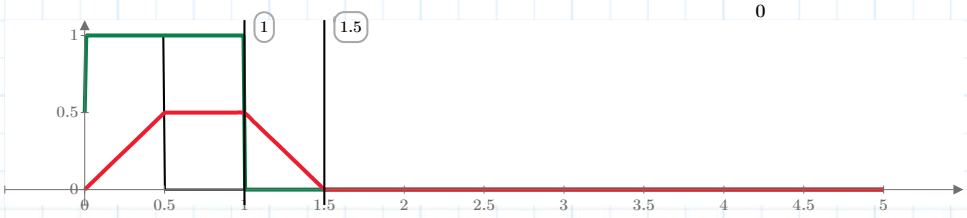
Bug

$$x(t) := \Phi(t) - \Phi(t-a) \xrightarrow{laplace} -\frac{e^{-0.5\cdot s}-1}{s} \qquad x(t) := \Phi(t) - \Phi(t-a)$$

$$h(t) := \Phi(t) - \Phi(t-1) \xrightarrow{laplace} -\frac{e^{-s}-1}{s} \qquad h(t) := \Phi(t) - \Phi(t-1)$$

$$y(t) := \left(-\frac{e^{-0.5\cdot s}-1}{s}\right)\cdot\left(-\frac{e^{-s}-1}{s}\right) \xrightarrow{invlaplace} t + 0.5\cdot\Phi(t-0.5) - 1.5\cdot\Phi(t-1.5) + \Phi(t-1) - 1.$$

$$Y := \int_0^{a+1} y(t)\,dt = 0.5$$ Correct



$x(t)$

$h(t)$

$y(t)$

t

Correct

$$y(t) := t + 0.5\cdot\Phi(t-0.5) - 1.5\cdot\Phi(t-1.5) + \Phi(t-1) - 1.0\cdot t\cdot\Phi(t-0.5) + t\cdot\Phi(t-1.5) - t\cdot\Phi(t-1)$$