

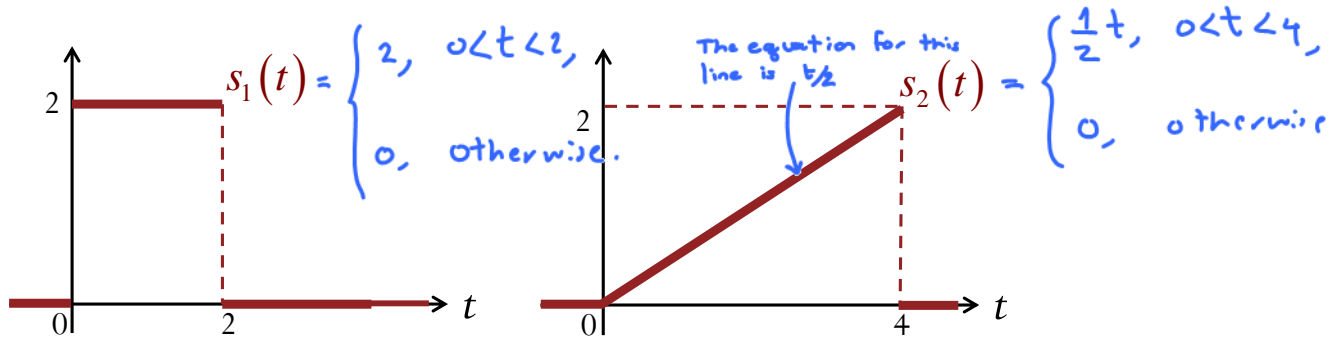
# ECS 452: In-Class Exercise #18

## Instructions

1. Separate into groups of no more than three persons. **The group cannot be the same as any of your former groups after the midterm.**
2. **Write down all the steps** that you have done to obtain your answers. You may not get full credit even when your answer is correct without showing how you get your answer.
3. **Do not panic.**

Date: <u>01</u> / <u>05</u> / 2018			
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Consider the two signals  $s_1(t)$  and  $s_2(t)$  shown below.



a. Find the energy of each signal.

$$E_1 = \int_{-\infty}^{\infty} s_1^2(t) dt = \int_0^2 2^2 dt = \int_0^2 4 dt = 4t \Big|_0^2 = 4 \times 2 = 8$$

$$E_2 = \int_{-\infty}^{\infty} s_2^2(t) dt = \int_0^4 \left(\frac{t}{2}\right)^2 dt = \int_0^4 \frac{t^2}{4} dt = \frac{t^3}{12} \Big|_0^4 = \frac{4 \times 4 \times 4}{12} = \frac{16}{3}$$

b. Find their inner product  $\langle s_1(t), s_2(t) \rangle$ .

note that this is 2 (not 4) because  $s_1(t) = 0$  when  $2 < t < 4$ .

$$\langle s_1(t), s_2(t) \rangle = \int_{-\infty}^{\infty} s_1(t) s_2(t) dt = \int_0^2 2 \times \frac{t}{2} dt = \int_0^2 t dt = \frac{t^2}{2} \Big|_0^2 = \frac{4}{2} = 2$$

c. Find and plot  $\text{proj}_{s_1(t)} s_2(t)$ .

$$\text{proj}_{s_1} s_2 = \frac{\langle s_2, s_1 \rangle}{\langle s_1, s_1 \rangle} s_1 = \frac{2}{8} = \frac{1}{4} s_1 = \begin{cases} 1/2, & 0 < t < 2, \\ 0, & \text{otherwise.} \end{cases}$$

