# MAE 143 A - Fall 2019

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### Homework 1

1. Exercise 1.6 from Boulet FSS
2. Exercise 1.8 from Boulet FSS
3. Exercise 1.11 from Boulet FSS
4. Let

$$f(t) = \begin{cases} 0, & t < 0, \\ 1, & 0 \leq t < 1, \\ e^{-t+1}, & t \geq 1 \end{cases}$$

   and answer the following questions:

   a. Sketch the signal $f(t)$;
   b. Skecth the signals
      1. $g_1(t) = f(-t)$
      2. $g_2(t) = -f(t-1)$
      3. $g_3(t) = 2f(2t)$
      4. $g_4[n] = f(0.5n)$, $n \in \mathbb{Z}$
      5. $g_5(t) = \int_{-\infty}^{t} f(\tau)\, d\tau$
      6. $g_6(t) = \dot{f}(t)$
   c. Calculate:
      1. $\int_{-\infty}^{\infty} f(t)$
      2. $\lim_{T\to\infty} \frac{1}{2T} \int_{-T}^{T} f(t)$

5. Let $f(t)$ from question 4 be the impulse response of a time-invariant linear system and answer the following questions:

   a. Is the system causal?
   b. Is the system memoryless?
   c. Use the convolution formula

$$y(t) = \int_{-\infty}^{\infty} f(t-\tau)\, u(\tau)\, d\tau$$

      to calculate the response of the system to a unit step input.
   d. Is the response you calculated in c. bounded?

6. When working with time series, a commonly used filter is a *moving average* filter, as in

$$y[k] = \frac{1}{N} \sum_{i=0}^{N-1} u[k-i].$$

   Such a filter is a linear time-invariant filter. Calculate and sketch its impulse response and interpret the above formula in terms of a convolution.