EC401 HW01 Spring 2020

Due Date: Wednesday Jan 29, 2020

You must submit your homework on paper (all pages of your submission stapled together) during the first 10 minutes of lecture on the due date. Please be sure to write your name on the first page of the homework you submit. Additionally, if you have collaborated on the homework with other individuals enrolled in EC401 this semester, please identify them as your collaborators on the first page of the submitted homework.

HW01.1

a) What is the *domain* of functions used to represent continuous-time signals?

b) What is the *domain* of functions used to represent discrete-time signals?

c) Suppose we are given that $x(t) = 2$. Is this a valid mathematical function (i.e., it maps every element of the *domain* to just one element of the *range*)? If your answer is yes, sketch a continuous-time signal that can be represented by this function. If your answer is no, explain your reasoning.

d) Suppose we are given that $x[n] = 2$. Is this a valid mathematical function (i.e., it maps every element of the *domain* to just one element of the *range*)? If your answer is yes, sketch a discrete-time signal that can be represented by this function. If your answer is no, explain your reasoning.

HW01.2

a) Sketch by hand the discrete-time signal specified as $x[n] = \begin{cases} 1 \text{ for } 0 \le n \le 5 \\ 0 \quad \text{otherwise} \end{cases}$

b) Sketch by hand the discrete-time signal specified as $y[n] = \begin{cases} 1 \text{ for } 0 \le |n| \le 5, \\ 0 \quad \text{otherwise} \end{cases}$

where $|n|$ denotes the absolute value of n.

HW01.3

Consider a discrete-time signal given as $x[n] = n.^2$

a) Determine the numerical values of $x[0], x[2], x[4], (x[4]),^2 x[2^4]$, and $x[-2^4]$

b) Is it true that $x[1.5]$ has a value between 1 and 4? Justify your answer.

HW01.4

Consider the discrete-time unit step $u[n]$ and the discrete-time unit impulse $\delta[n]$ as described in lecture. Sketch each of the following discrete-time signals:

a) $x[n] = u[n] + \delta[n]$. Please note that when we sum two functions, we have to sum their values for each *n* in the *domain.*

b) $x[n] = u[n] - \delta[n]$. Please note that when we take the difference of two functions, we have to take the difference of their values for each *n* in the *domain*.

c) $x[n] = u[n] \times \delta[n]$, where $\times$ denotes multiplication. Please note that when we multiply two functions, we have to multiply their values for each *n* in the *domain.*

HW01.5

In this problem we consider the following discrete-time signal:

$$x[n] = (0.5)^n u[n]$$

Note that this function is the product of $(0.5)^n$ with the unit step $u[n]$.

(a) Determine the numerical values of $x[2]$ and $x[-2]$. Justify your answers.

(b) Let $\alpha = x[0] + x[1] + x[2] + x[3] + \cdots + x[99]$. Show that $(1 - 0.5)\alpha = 1 - (0.5)^{100}$

(c) Using the result of the previous parts, argue that the sum of all the heights of the lollipops in the signal $x[n]$ is 2.