ECE 130A Computer Assignment #4

Due Date: March 4, 2021

Submit your homework as a zipped folder with the .m function files.

For this assignment, you will need create the function files with the right filenames and parameters/outputs.

Problem 1.

Function Name: hw41

Inputs:

- *(double, 1 × M)* first - first signal.
- *(double, 1 × N)* second - second signal.

Outputs:

- *(double, 1 × (N + M - 1))* convolved - output signal from the convolution.

Function Description:
You want to define a convolution function, but you're adamant on not using the predefined function from MATLAB, since you don't trust their code.

Examples:

- hw31([0, 1, 0], [0, 1, 1, 0]) should output [0, 0, 1, 1, 0, 0]
- hw31([0, 1, 2, 0], [2, 1]) should output [0, 2, 5, 2, 0]

Notes:

- You are not allowed to use the `conv()` function or any other predefined convolve functions in MATLAB (just for this problem).

Tests Understanding Of:

- convolution
- for loops

Problem 2

Function Name: hw42

Inputs:

- *(double, 2 × M)* h - [time points; impulse response at corresponding time points]
- *(double), 2 × N* x - [time points; input value at corresponding time points]

Outputs:

- *(double, 2 × K)* y - [time points; output value at corresponding time points]

Function Description:
Given a system's impulse response and and input, you would like to characterize the output of the system. Unlike in previous problem, you now have to keep track of the time points when performing the convolution. You can assume that for each signal, if it is not explicitly defined for a time point, then the value of the signal at that time point is 0.

Notes:

- When returning the y variable, remove all time points with a corresponding output value of 0.
- You can use the `conv()` function to perform the convolution for this problem

Tests Understanding Of:

- convolutions

Problem 3

Function Name: hw43

Inputs:

- *(double, 1 × M)* numtf - coefficients for the numerator of the transfer function
- *(double, 1 × N)* dentf - coefficients for the denominator of the transfer function
- *(double, 1 × K)* coeffExp - list of scalings for each exponential
- *(double, 1 × K)* powExp - list of exponents for the exponential function
- *(double, 1 × D)* T - list of time points in which to define the input for

Outputs:

- *(double, 1 × D)* y - output from the system with an exponential input

Function Description:
You would like to characterize the output of a given transfer function and a linear combination of exponential inputs. The input is

$$x(t) = \sum_{i=0}^{K} \text{coeffExp(i)} \cdot e^{\text{powExp(i)}t} \quad \text{for } t \in T$$

Notes:

- Helpful functions include `tf()`, `lsim()`

Tests Understanding Of:

- Control system toolbox functions

Problem 4.

Function Name: hw44

Inputs:

- *(cell array)* tree - nested cell array.

Outputs:

- *(double)* diam - number of nestings in the given tree.

Function Description:
You are given a cell array with a tree structure. Each element in the cell array will either be a string or another cell array (which contains either strings or further cell arrays, and so on). You would like to determine the maximum number of nesting of cell arrays there are in a given tree.

Examples:

- hw33({'a'}) should output 1
- hw33({{'a'}, {'b', {'c', 'd'}}}) should output 3

Tests Understanding Of:

- cell arrays
- recursion