PROJECT 1 | MCT4338/MCTE4314

Part 1: DISCRETE SYSTEM – MOVING AVERAGE FILTER

Load bostemp into your matlab and you should be able to see tempC on your workspace. The data was gathered for 31 days. Plot the x-axis in number of days [Hint: days=(1:31*24)/24;].

a) Using Matlab build in function called 'filter', **obtain** a 24-point moving average filter on tempC. **Plot** the original data and the filtered data in one plot

b) **Perform** a 50-point moving average filter using convolution. **Plot** both graph of tempC and yfilter in one plot. **Analyse** and **explain** why the length of yfilter is 793. **Provide** a solution on how to modify the results of yfilter to fit the original data tempC

[Hint: The impulse response of the length 50-point MAF is given as $h(n) = \frac{1}{50}\ (u(n) - u(n\ -\ 50))$

Part 2: DISCRETE TIME SYSTEM

A discrete time system, $y(n)$ is given below,

$$y(n)\ =\ x(2n)\ =\ cos\ (\frac{2\pi n}{7})$$

Plot using MATLAB (or other language you prefer),

(a) $y(n)$
(b) $y1(n)\ =\ x(2n)$
(c) $y2(n)\ =\ x(n/2)$

Analyse the respective plots and determine what is system $y1(n)$ and $y2(n)$.

Part 3: DISCRETE TIME SYSTEM RESPONSE

A first order difference equation of an autoregressive system is given as

$$y(n) = 0.5y(n-1) + x(n)$$

Determine the system's impulse response $h(n)$ and compute the response of the system to an input of $x(n) = u(n) - u(n-3)$ using the method of convolution. Plot and verify the result using MATLAB.

Part 4: CONVOLUTION IN 1D

Using MATLAB's conv function, multiply the following terms together to determine the resulting polynomial.
Turn in your code used to compute these.
a. $(x\ +\ 3)(x\ +\ 12)$
b. $(x\ +\ 2)(x2\ +\ 3x\ -\ 6)$

Part 5: CORRELATION VS CONVOLUTION IN 2D

i) Download the image 'bby.png'. Using the kernels listed below, plot the resulting images (side by side with the original image) and analyse the resulting images that are produced by the respective kernels.

(a) $K_1 = \begin{bmatrix} 0 & -1 & 0 \\ -1 & 5 & -1 \\ 0 & -1 & 0 \end{bmatrix}$

(b) $K_2 = \begin{bmatrix} 1 & 0 & -1 \\ 0 & 0 & 0 \\ -1 & 0 & 1 \end{bmatrix}$

(c) $K_3 = \begin{bmatrix} 1 & 2 & 1 \\ 2 & 4 & 2 \\ 1 & 2 & 1 \end{bmatrix} \frac{1}{16}$

ii) Using image 'bby.png', plot the convolution and correlation of the image with the kernel $\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 0 \\ 1 & 0 & 0 \end{bmatrix}$