Convolution Calculator v1.00

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Introduction:

In introductory digital signal processing courses, the convolution is a rather important concept and is an operation involving two functions. The word "convolve" means to wrap around. In essence, the convolution of two functions is "sweeping" a function across another function and multiplying their overlapping regions. One function is kept stationary while one function is flipped across the y axis and is then shifted left or right. The amount of shifting depends on the value of n. Since we are dealing with discrete values, we multiply the functions and sum the products to compute the convolution at that point of n. The purpose of this program is to take a set of values for x[n] and a set of values for h[n] and compute their convolution, x[n]*h[n], which results in the output, y[n]. The values of x[n] and y[n] must be discrete and cannot rely upon a formula. In example, the program cannot take an equation in terms of n and compute the convolution that way. You must enter individual values. It is also assumed that the system is LTI/LSI (Linear Time/Shift Invariant).

Remember that the formula for a convolution is:

$$y[n] = \sum_{k=\infty}^{\infty} x[n]h[n-k]$$

x[n] is our input to the LTI/LSI system and h[n] is our unit pulse response. y[n] is the output to our system.

How to use:

To use the program:

1) Send the file named "CONVCALC.8xg" to your TI-83 Plus/TI-84 Plus.
2) Ungroup this file from the Memory->Group->Ungroup Menu.
3) Once the files have been ungrouped, they will show in Programs. Run the file named "CONVCALC."

Once you have run the program, you have four options:

a) ENTER DATA – This allows you to enter the data. The program will ask for a range. This range indicates what values of n are being used for your data. For a more detailed explanation, refer to the example later in this file.

b) COMPUTE – This will draw the graph of x[n] and draw the shiftable graph of h[n-k]. Using the arrow keys, you can move the graph left and right and compute the convolution at specific points of your choice. Despite the fact that a convolution is commutative (x[n]*h[n]=h[n]*x[n]), please note that you are only able to shift the h[n-k] values.
c) CREDITS – Lists credits information.
d) EXIT – This will quit the program.

An Example Run-Through:

Suppose we have the following system:

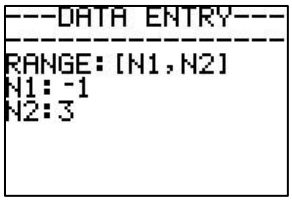
x[n] = [0,1,2,3,4]
↑

h[n] = [1,1,0,-1,-1]
↑

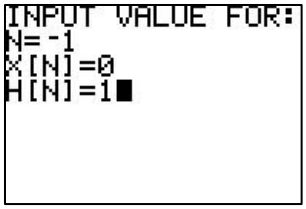
*(Firstly, remember that the values being pointed at by an arrow refer to the **n=0 value**.)*

To compute the convolution, let's enter this data into the program:

Run the program and select ENTER DATA.



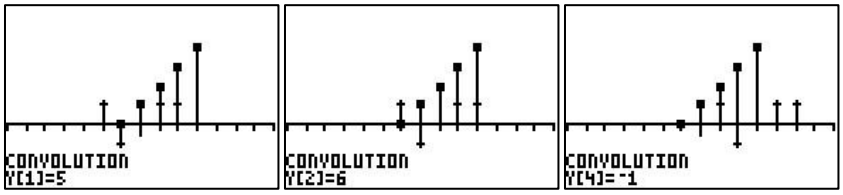
For the range, we need to enter [-1,3] since we know our values lie only within this range. Press enter.



Now, the program will cycle through the values of n=-1 to n=3. For each value of n, we must enter the appropriate value of x[n] and h[n] at those values of n. In this example, we know that x[-1] = 0 and h[-1] = 1. Once the values have been entered, we continue to n=0 to n=1 and so on.

Once all the data in our range has been entered, a short confirmation message is shown and you are returned to the main screen.

Now, we will compute the convolution:



As you can see, the x[n] graph remains put while the h[n-k] is shiftable by using the arrow keys (left and right). The bottom of the screen shows the value of y[n]. Remember that the convolution may cover values that are outside of the given range.

Pressing clear will return you to the main menu.

<u>An Important Note:</u>

If your sequence lies within a range that excludes one or more values of n within that range, please enter 0 for x[n] and for h[n] for the undefined values of n.

Thank you for choosing to use this program. I hope it is helpful in understanding the convolution – a topic that many students including myself can find tricky to learn. Be on the lookout for more DSP programs, including full tutorials and lessons!

Please email any questions or comments to:
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