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| Activity No. 4 | |
| Fundamental Convolution Application | |
| **Course Code:** CPE 027 | **Program:** |
| **Course Title:** Digital Signal Processing and Applications | **Date Performed:** |
| **Section:** | **Date Submitted:** |
| **Name/s:** | **Instructor:** |
| **1. Objective:** | |
| This activity aims to introduce the convolutional process by demonstrating with the programmatic processing of both arbitrarily generated signals and collected data using simple convolution techniques, | |
| **2. Intended Learning Outcomes (ILOs):** | |
| After completion of this activity the students should be able to:  Develop a program that manipulates signals with convolutional processing with simple response signals. | |
| **3. Discussion :** | |
| In mathematics (in particular, functional analysis), convolution is a mathematical operation on two functions (f and g) that produces a third function (f\*g) that expresses how the shape of one is modified by the other. The term convolution refers to both the result function and to the process of computing it. It is defined as the integral of the product of the two functions after one is reversed and shifted. The integral is evaluated for all values of shift, producing the convolution function.  Convolution has applications that include probability, statistics, acoustics, spectroscopy, signal processing and image processing, engineering, physics, computer vision and differential equations.  The convolution can be defined for functions on Euclidean space and other groups.For example, periodic functions, such as the discrete-time Fourier transform, can be defined on a circle and convolved by periodic convolution. A discrete convolution can be defined for functions on the set of integers.  Generalizations of convolution have applications in the field of numerical analysis and numerical linear algebra, and in the design and implementation of finite impulse response filters in signal processing. Computing the inverse of the convolution operation is known as deconvolution. | |
| **4. Resources:** | |
| The activity will require the following software, tools and equipment: | |
| **5. Directions:** | |
| 1. Programmatically generate a sinusoidal wave, running at 500hz, an amplitude of 5 volts, with a sampling rate of 100, starting at time 0 with 0 offset. Store the sine wave in an array.  3. Plot and save the sine wave as an image.  4. Create an 10-element array containing the following kernel function with values:  A=[0 0 0 0 0 1 1 1 1 1]. Also, Plot and save the image.  5. Perform a convolution of both the sine wave and the generated array. Use the convolve function provided by NumPy. This will generate a new array for you to plot.  6. Repeat he same process of the following kernels:  B = [1 1 1 1 1 0 0 0 0 0]  C = [-1 -1 -1 -1 -1 0 0 0 0 0]  D = [0 0 0 0 0 -1 -1 -1 -1 -1]  E = [-1 -1 -1 -1 -1 0 0 0 0 0]  F = [ 0 0 .5 .5 1 1 .5 .5 0 0]  G = [ 0 0 -.5 -.5 -1 -1 -.5 -.5 0 0]  7. Compare and analyses the different effects of the kernels to the original signal and each other.  8. Generate another kernel arrays using the scipy wavelet library and convolve with the sine wave. This time use the following:   * Daubechie wavelet   signal.wavelets.daub(8)   * Morlet wavelet   signal.wavelets.morlet2(20,4,2)   * Ricker wavelet   signal.wavelets.ricker(20,1)  8. Compare and analyses the different effects of the kernels to the original signal and each other.  9. Apply the kernels A-G and the three(3) wavelets to the mean and standard deviation summaries from activity 1.  10. Cite and record observations. | |
| **6. Procedures** | |
| *\*Document EVERYTHING you did to accomplish this. Discuss why you did those.* | |
| **7. Results(sample)** | |
| *\*Don’t forget to add a link of your ipynb file, csv, and image results.* | |
| **8. Data Analysis** | |
| ***\*****what did you observe in the data?* | |
| **9. Summary and Conclusions** | |
| *\*summarize what you did. What did you find out?* | |
| **10. Learnings and Contributions of each member** | |
| *\*what did you do to contribute to this activity? What new learnings, methods and techniques did you pick up? Describe in detail.* | |