SECOND YEAR B. TECH THIRD SEMESTER

COMPUTER SCIENCE AND ENGINEERING DEPARTMENT

MINI PROJECT REPORT(ITW-1)

ON

Convolution of 2 Signals using Python

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(An Institution of National Importance by Act of Parliament)

Background of Project

In this project, we aim to calculate the convolution of 2 signals using simple operations on arrays.

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.

A common engineering notational convention is:

$$f(t) * g(t) := \underbrace{\int_{-\infty}^{\infty} f(\tau)g(t-\tau)\,d\tau}_{(f*g)(t)},$$

Applications of convolution:

1. Convolution of a signal with the response of a system to a Linear-Time Invariant system gives the output of the system when the signal is inputted to it. This property proves to be extremely useful in electrical engineering applications.
2. In digital image processing, convolutional filtering plays an important role in many important algorithms in edge detection and related processes
3. In probability theory, the probability distribution of the sum of two independent random variables is the convolution of their individual distributions.
4. Convolutional neural networks apply multiple cascaded convolution kernels with applications in machine vision and artificial intelligence

Methodology

In this project, we use the convolution sum rather than the convolution integral.

$$(f * g)[n] = \sum_{m=-\infty}^{\infty} f[m]g[n-m],$$

We use the following Python libraries in this project:

1. **NumPy:**
    a. NumPy is a library for the Python programming language, that adds support for large, multi-dimensional arrays and matrices, along with a large collection of high-level mathematical functions to operate on these arrays.

b. In this project, we use a NumPy array and some basic array operations for the calculation of convolution.

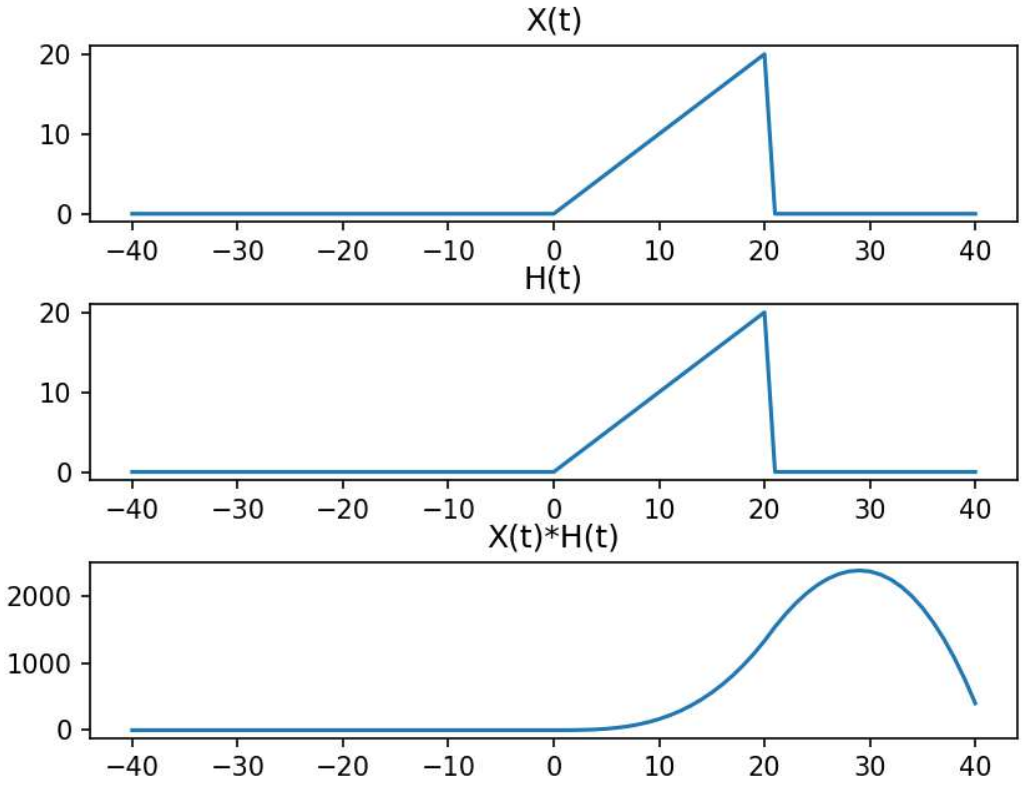
2. **Matplotlib.pyplot:**
   a. Matplotlib is a plotting library for the Python programming language and its numerical mathematics extension NumPy.
   b. We use this library to plot the functions as output.
3. **SymPy:**
   a. SymPy is an open-source Python library for symbolic computation.
   b. We use this for user input of symbolic functions as signals

Refer to the diagrams for an explanation of the Code.

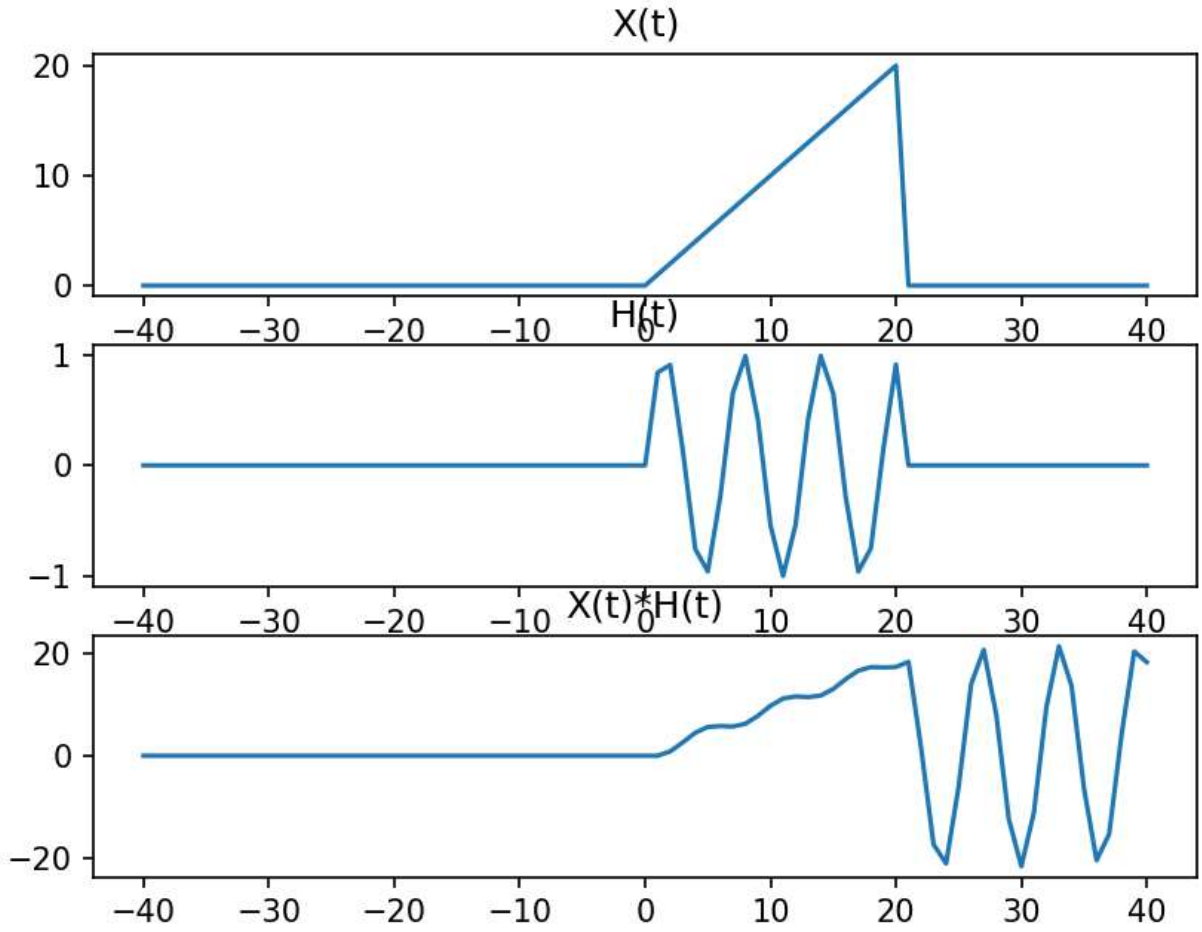
Results

Following are the screenshots of the output of the program

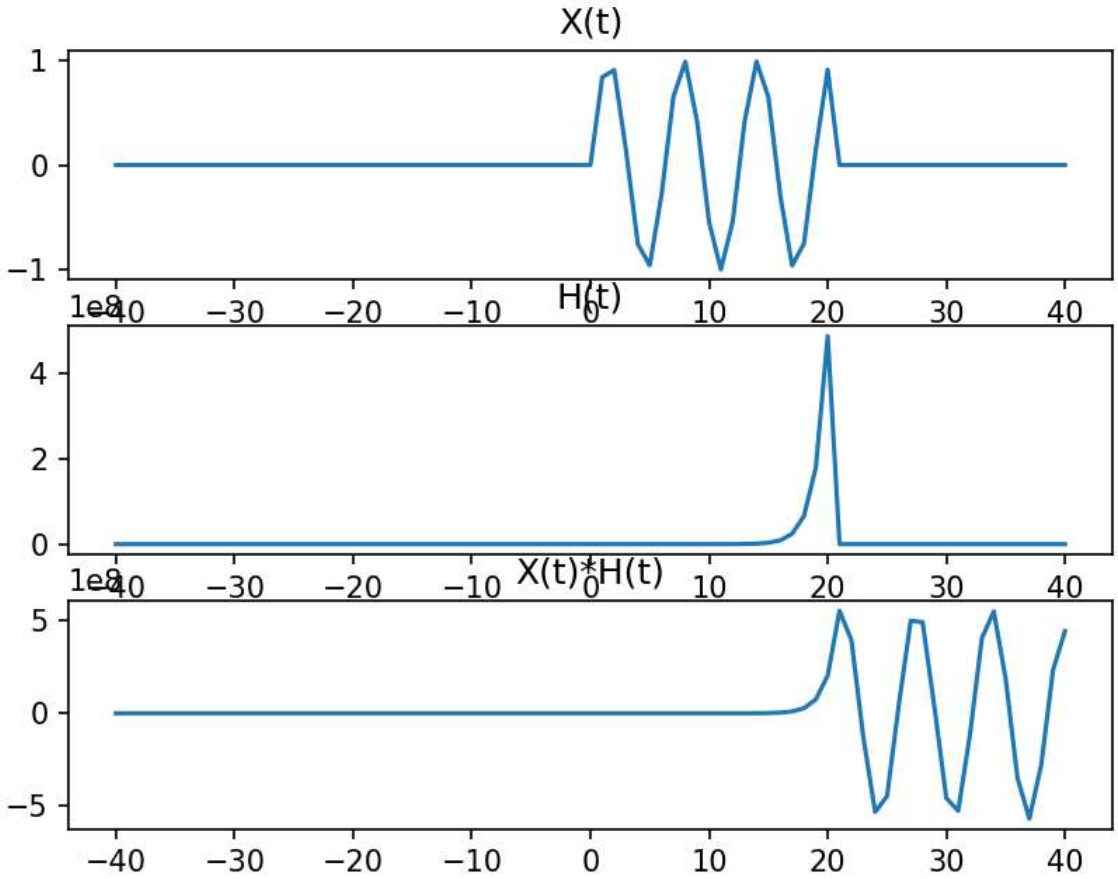
```
PS C:\Users\anshu\Convolution> & C:/Users/anshu/AppData/Local/Programs/Python/Python310/python.exe
 c:/Users/anshu/Convolution/convolution.py
Enter the first signal :t
Enter the second signal :t
```



```
PS C:\Users\anshu\Convolution> & C:/Users/anshu/AppData/Local/Programs/Python/Python310/python.exe
 c:/Users/anshu/Convolution/convolution.py
Enter the first signal :t
Enter the second signal :sin( t )
```



```
PS C:\Users\anshu\Convolution> & C:/Users/anshu/AppData/Local/Programs/Python/Python310/python.exe
 c:/Users/anshu/Convolution/convolution.py
Enter the first signal :sin( t )
Enter the second signal :exp( t )
```



GitHub link for the project: https://github.com/AnshumatDinesh/Convolution-using-Python