WIGGLES

EXPERIMENT #03

AUGUST 2022

EXPERIMENT NAME

Implementation of some basic operations using user defined functions in python.

1. SIGNAL SHIFTING

Theory

1. **Shifting** means movement of the signal, either **in the time domain** or **in the amplitude domain**. Accordingly, we can classify the shifting into two categories named as Time shifting and Amplitude shifting.
2. Here, **Time shifting means,** shifting of signals in the **time domain.**
3. *In the expression given below,* This K value may be positive or it may be negative. According to the sign of k value, we have two types of shifting named as **Right shifting and Left shifting.**
4. *In the expression given below, When **K is greater than zero,** the shifting of the signal takes place towards **"left"** in the time domain. Therefore, this type of shifting is known as **Left Shifting** of the signal.*
5. *In the expression given below, When **K is less than zero** the shifting of signal takes place towards the **right** in the time domain. Therefore, this type of shifting is known as **Right shifting.***

Expression

$$x(t) \; -> \; y(t + k)$$

Getting the environment ready

- **Python 3.10** is installed in the system and added to the system variables.
- The library is installed through pip i.e. through the command **“pip install wiggles.”**

- Here, **vs code** is used to code and test out the results.
- The code is written to best find the solution of the given problem and then is evaluated and displayed using the inbuilt **'show()'** or the **'compare()'** function in wiggles.

PROBLEM

- Time shifting a test signal by a specific value and displaying it in a subplot in order to study the change and compare.

PROGRAM CODE

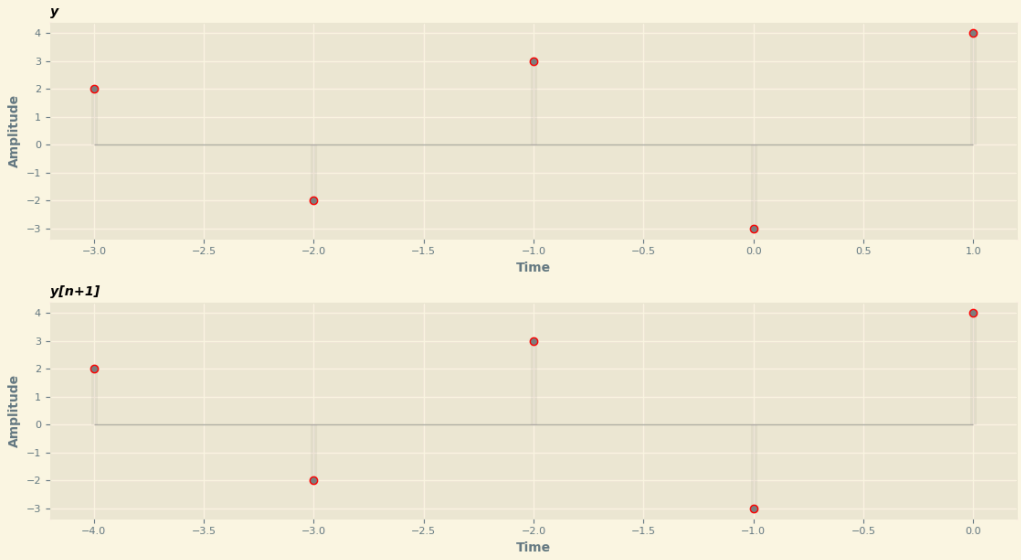
```
#from wiggles import signals as sp

#Test signal y; Making Discrete signal using wiggles
y = sp.discrete([2,-2,3,-3,4],-3)
y.name="y"

#shifting the signal 'y' by 1
y1 = y.TimeShift(1)

#comparing two signals
y.compare(y1)
```

OUTPUT

Printed notation for the shift operation

```
y
[       2       -2      3       -3      4       ]
                        ↑
y[n+1]
[       2       -2      3       -3      4       ]
                                ↑
```

Plotted graph for the shift operation



The comparison for the shift operation plotted in the discrete time domain using a user defined function. Represented through a stem graph.

2. SIGNAL SCALING

Theory

1. The process of **multiplying a constant** to the **time axis** of a signal is known as **time scaling** of the signal. Here, **Time shifting means,** shifting of signals in the **time domain.**
2. The **time scaling** of a signal may be **time compression or time expansion** depending upon the value of the constant or scaling factor. The time scaling operation of signals is very useful when data is to be fed at some rate and is to be taken out at a different rate.
3. *In the expression given below, We can see that the time scaling of a continuous time signal* ***x(t)*** *can be accomplished by replacing* ***'t' by 'αt'*** *in the function.*

4. *If **α > 1**, then the signal is **compressed in time** by **a** factor α and the time scaling of the signal is called the time compression. Whereas, if **α < 1,** then the signal is **expanded in time** by the factor **α** and the time scaling is said to be time expansion.*

Expression

$$x(t) \; -> \; y(t) = \; x(at)$$

Getting the environment ready

- **Python 3.10** is installed in the system and added to the system variables.
- The library is installed through pip i.e. through the command **“pip install wiggles.”**
- Here, **vs code** is used to code and test out the results.
- The code is written to best find the solution of the given problem and then is evaluated and displayed using the inbuilt **‘show()’** or the **‘compare()’** function in wiggles.

PROBLEM

- Time scaling a test signal by a specific value and displaying it in a subplot in order to study the change and compare.

PROGRAM CODE

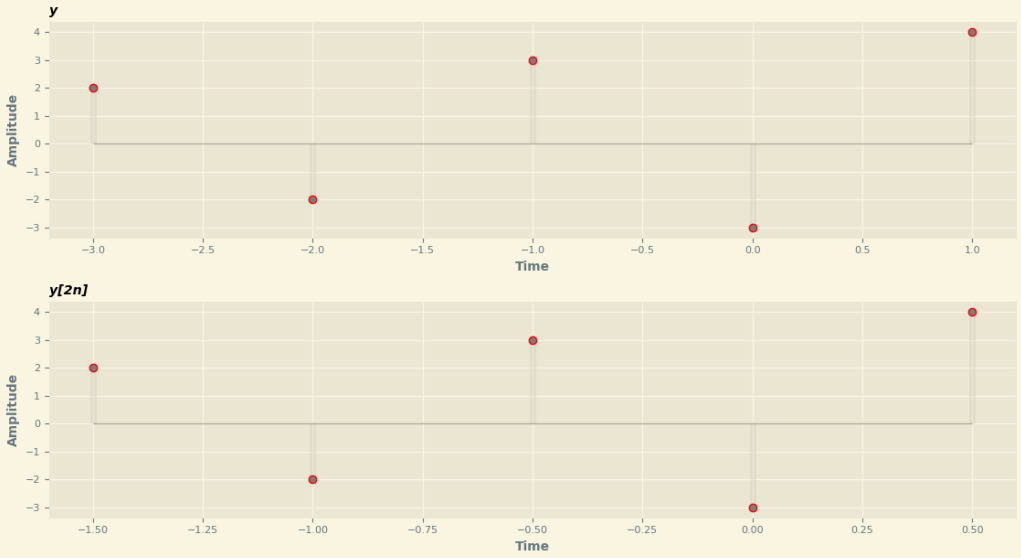
```
#from wiggles import signals as sp

#Test signal y; Making Discrete signal using wiggles
y = sp.discrete([2,-2,3,-3,4],-3)
y.name="y"

#scaling the signal 'y' by 2
y1 = y.TimeScale(2)

#comparing two signals
y.compare(y1)
```

OUTPUT

Printed notation for the scaling operation

```
y
[       2       -2       3       -3       4       ]
                          ↑
y[2n]
[       2       -2       3       -3       4       ]
                          ↑
```

Plotted graph for the scaling operation



The comparison for the scaling operation plotted in the discrete time domain using a user defined function. Represented through a stem graph.

3. SIGNAL REVERSERSAL

Theory

1. Whenever the time in a signal gets **multiplied by -1,** the signal gets reversed. It produces its mirror image about the Y or X-axis. This is known as **Reversal of the signal.**
2. In **time reversal**, whenever a signal's **time** is multiplied by **-1,** it is known as time reversal of the signal. In this case, the signal produces its **mirror image about the Y-axis.** Mathematically, this can be written as,

Expression

$$x(t) \; -> \; y(t) = \; x(- \; t)$$

Getting the environment ready

- **Python 3.10** is installed in the system and added to the system variables.
- The library is installed through pip i.e. through the command **“pip install wiggles.”**
- Here, **vs code** is used to code and test out the results.
- The code is written to best find the solution of the given problem and then is evaluated and displayed using the inbuilt **‘show()’** or the **‘compare()’** function in wiggles.

PROBLEM

- Time reversal of a test signal by a specific value and displaying it in a subplot in order to study the change and compare.

PROGRAM CODE

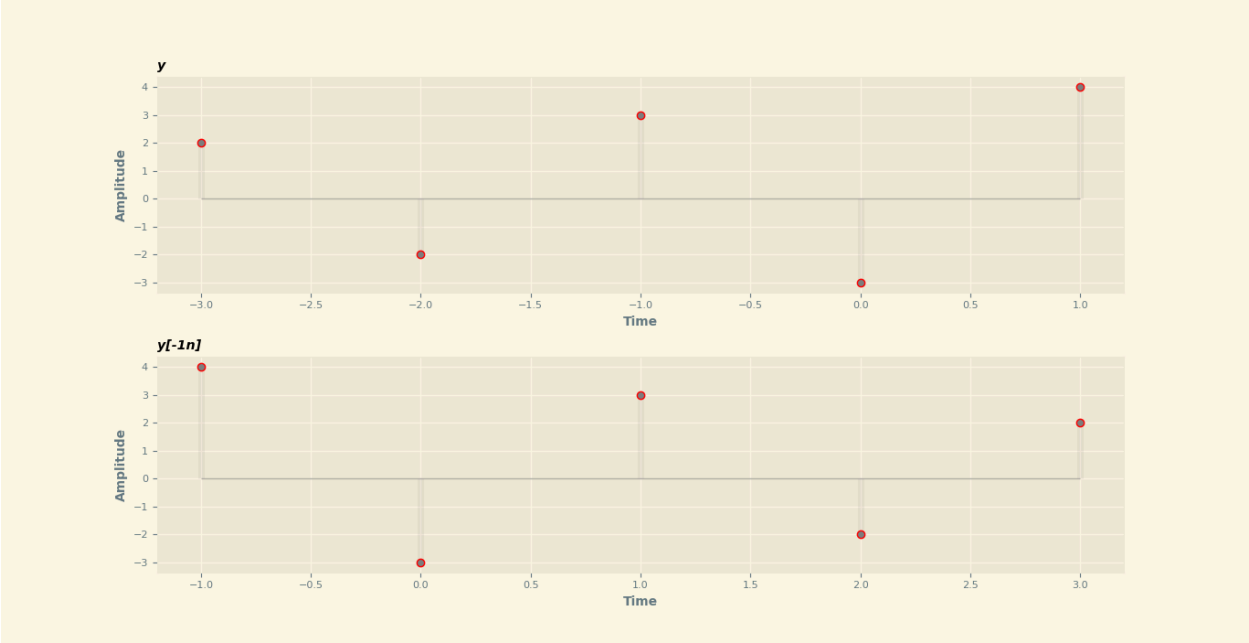
```
#from wiggles import signals as sp

#Test signal y; Making Discrete signal using wiggles
y = sp.discrete([2,-2,3,-3,4],-3)
y.name="y"

#scaling the signal 'y' by 2
y1 = y.reverse()

#comparing two signals
y.compare(y1)
```

OUTPUT

Printed notation for reversal operation

```
y
[      2      -2      3      -3      4      ]
                              ↑
y[-1n]
[      4      -3      3      -2      2      ]
              ↑
```

Plotted graph for the reversal operation



The comparison for the reversal operation plotted in the discrete time domain using a user defined function. Represented through a stem graph.

CONCLUSION

The above experiments show us how to perform some basic operations on signals, i.e. shifting, scaling and reversal in time domain and how to display, plot and subplot the same.