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March 10, 2020

This script presents an example of how to use python signal processing toolbox to calculate the inverse Z-transform of a discrete time signal by using power series expansion method. The code executes a long division (or polynomial division) algorithm to calculate the power series.

In this example, the same expression as the previous example is given:

$$X(z) = \frac{1}{(1 - \frac{1}{4}z^{-1})(1 - \frac{1}{2}z^{-1})}, |z| > 0.5$$

and we will calculate its inverse Z-transform by power series expansion

[1]:
```
# import the necessary libraries
import numpy as np               # for using basic array functions
import matplotlib.pyplot as plt # for this example, it may not be necessary

# the main package for signal processing is called "scipy" and we will use␣
 ↪"signal" sub-package
import scipy.signal as sgnl
# alternative syntax: from scipy import signal as sgnl
%matplotlib notebook
```

[3]:
```
num = np.array([1,0,0])                 # we add zeros to match the size of num␣
 ↪and denum
denum = np.array([1, -3.0/4, 1.0/8])      # coeffs of denum

n, x = sgnl.dimpulse((num, denum, 1), x0=0, n=10)
print(np.squeeze(x))
```

```
[1.         0.75       0.4375     0.234375   0.12109375 0.06152344
 0.03100586 0.01556396 0.00779724 0.00390244]
```

This result is interpreted as follows: the output of the *dimpulse* function is an array of coefficients, starting with the constant term:

$$X(z) = x[0] + x[1]z^{-1} + x[2]z^{-2} + ...$$

then the inverse transform of a polynomial series is

$$x[n] = [x[0], x[1], x[2], ...]$$

Observe that; * The first argument of the dimpulse function is the system coeffs (with a constant gain 1) as a *tuple* which means it must be passed in parantheses (). * The second argument $x0$ is initial state (usually zero) * The third argument k is the number of points we want to calculate the inverse transform.

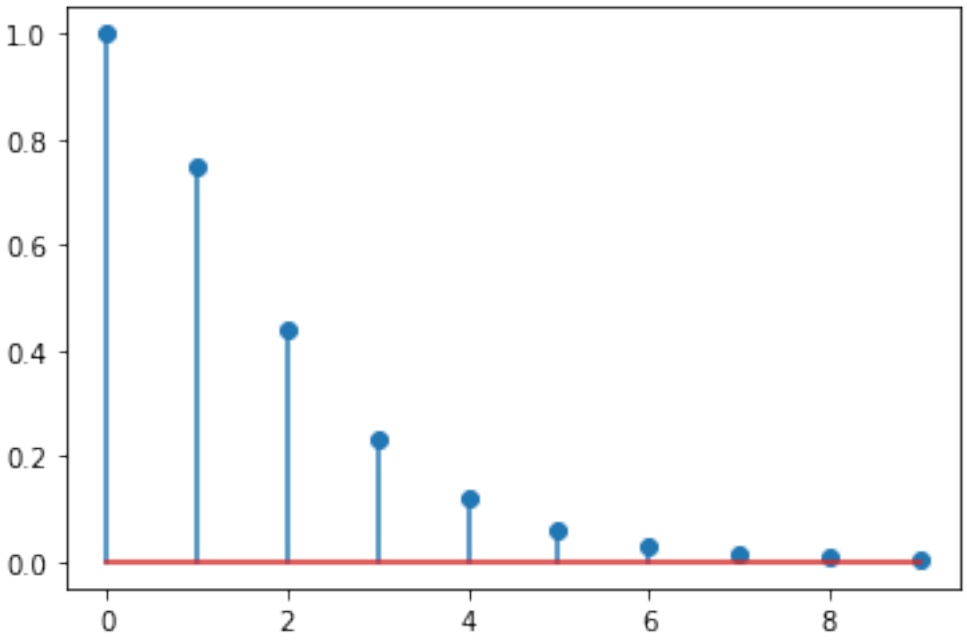
The outputs; * n is the sample index vector from 0 to 10 for this example * x is the inverse transform as an n-dimensional array, so we use the *np.squeeze*() function to reduce the redundant dimensions.

Note: if we do not reduce the dimensions of the output, the plotting function throws error.

[4]:
```
plt.stem(n, np.squeeze(x))
```

```
C:\ProgramData\Anaconda3\lib\site-packages\ipykernel_launcher.py:1: UserWarning:
In Matplotlib 3.3 individual lines on a stem plot will be added as a
LineCollection instead of individual lines. This significantly improves the
performance of a stem plot. To remove this warning and switch to the new
behaviour, set the "use_line_collection" keyword argument to True.
  """Entry point for launching an IPython kernel.
```

[4]:
```
<StemContainer object of 3 artists>
```



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