



Digital Filtering

preparing for the exam - part 2, IIR filters

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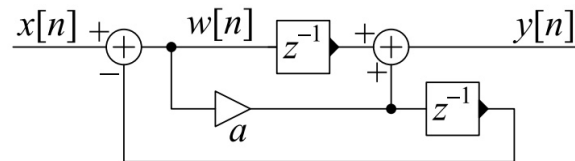
Theoretical Examples

1. A digital filter is described by difference equation

$$y[n] = 0.1 x[n] + 0.7 x[n - 1] - 0.6 x[n - 2] + 0.3 y[n - 1] - 0.19 y[n - 2].$$

- a Find the transfer function $H(z)$ of the filter.
- b Write the filter coefficients in a Sigma Studio format [b0, b1, b2, a1, a2].

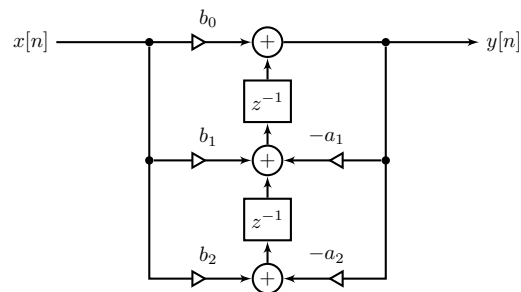
2. In the following block diagram, all elements are drawn with their outputs on the right. The input and output signals are $x[n]$ and $y[n]$ respective



- a Determine the transfer function of the system $H(z) = \frac{Y(z)}{X(z)}$.
- b Draw the transposed form of the block diagram.

Practical Examples

3. Complete a Python-like code that implements the following digital filter structure (sample by sample) without using `lfilter` function.



```
import numpy as np
import imdea

b, a = ... # filter coefficients b, a
x = ...    # input signal

y = np.zeros_like(x) # an empty array for the output signal

# complete the code here to get the output signal y
```

4. A 2nd order IIR filter has following parameters

$$b = [1, -2, 1]$$

$$a = [1, -1.9, 0.9]$$

Implement this filter in Sigma Studio without using **Filter** block. You can use **Multiply**, **Add**, **Gain**, **Delay**, **Feedback**, and **T-connection**.